Auckland Council
Te Kaunihera o Tāmaki Makaurau

I hereby give notice that a hearing by commissioners will be held on:

Date:	**Wednesday 2 & Thursday 3 April 2025** **(with Friday 4 April 2025 if required)**
Time:	**9:30am**
Meeting Room:	**Council Chambers**
Venue:	**Level 1, Manukau Civic Centre,** **33 Manukau Station Road, Manukau City Centre, Auckland**

APPLICATION MATERIAL AND SUBMISSIONS

VOLUME I

100 OKARORO DRIVE, BEACHLANDS

WATERCARE SERVICES LIMITED

COMMISSIONERS

Chairperson	**Karyn Sinclair**
Commissioners	**Martin Neale**
	Juliane Chetham

PATRICE BAILLARGEON
KAITOHUTOHU MATAAMUA WHAKAWĀ /
SENIOR HEARINGS ADVISOR

Telephone: 09 890 4692 or 027 338 5383
Email: patrice.baillargeon@aucklandcouncil.govt.nz
Website: www.aucklandcouncil.govt.nz

Note: The reports contained within this document are for consideration and should not be construed as a decision of Council. Should commissioners require further information relating to any reports, please contact the hearings advisor.

VOLUME I	TABLE OF CONTENTS	PAGE NO.
Attachment 1	Executive Summary	5 - 8
Attachment 2	Application Form - Updated 31 Oct 24	9 - 18
Attachment 3	Assessment of Environmental Effects - 6 Jun 24	19 - 122
Attachment 4	Alternatives Assessment Report - Jun 24	123 - 366
Attachment 5	Preliminary Assessment of Land Area for Overland Flow System Memo 1 - 2 Apr 24	367 - 376
Attachment 6	Assessment of Overland Flow System Treatment Performance - Memo 2 - 2 Apr 24	377 - 388
Attachment 7	Assessment of Overland Flow System Treatment Performance - Memo 3-Interim - 17 May 24	389 - 422
Attachment 8	Overland Flow System Land Impacts - Memo 4 - 2 Apr 24	423 - 448
Attachment 9	Stream Hydraulic Assessment	449 - 484
Attachment 10	Assessment of Microbiological Effects & Health Risk - Apr 24	485 - 546
Attachment 11	Assessment of Effects on Te Puru Stream Discharge - 28 March 24	547 - 580

SUBMITTERS:	
Page 537-540	JWB Group [1]
Page 541-544	JWB Group [2]
Page 545-548	Shane Stewart
Page 549-552	Catherine Bryant
Page 553-556	Dick Bavelaar
Page 557-560	Robin Miller
Page 561-564	Ngāi Tai ki Tāmaki
Page 565-568	Zaelene Maxwell-Butler
Page 569-574	Russell Property Group
Page 575-582	National Public Health Service - Northern Region
Page 583-588	Knight Investments Limited

LATE SUBMITTERS:	
Page 589-590	Impress Company Limited

ATTACHMENT 1

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Application number:	DIS60433803 (Section 14 discharge permit)
Applicant:	Watercare Services Limited
Address:	100 Okaroro Drive, Beachlands

Proposal

Watercare Services Limited have submitted to Auckland Council an application for a discharge permit associated with the discharge of treated wastewater to groundwater and an overland flow system, which will then flow into an unnamed tributary of Te Puru Stream, from the continued and expanded operation of the Beachlands Wastewater Treatment Plant (**BWWTP**).

The application seeks to replace existing consent discharge permit DIS60263339 with a new permit for a term of 35 years, which will be implemented in four stages, as summarised below:

<u>Stage 1</u>

The discharge of treated wastewater from the existing BWWTP without any upgrade works, allowing for a maximum discharge volume limit of 4,500m³/day, and an average daily flow of 2,200m³. This will cater for a design population of up to 11,000 people.

<u>Stage 2</u>

The undertaking of short-term upgrade works to cater for a population of up to 18,000 people and a maximum discharge volume limit of 8,700m³/day, and an average daily flow of 3,600m³. The upgrade works will include:

- replacement of the existing inlet screen;
- increasing the aeration capacity of the lagoon and the pipework from the ultra violet (**UV**) treatment area to the overland flow area, including an expansion of the overland flow area;
- installation of a new recycle (A) pumps and pipework, an additional tertiary filter and UV lamps;
- construction of additional sludge drying beds; and
- upgrading to mains power supply and distribution boards.

<u>Stages 3 and 4</u>

The undertaking of long-term upgrades in two stages (stages 3 and 4). The stage 3 works will cater for a population of up to 24,000 people and a maximum discharge volume limit of 28,900m³/day, and an average daily flow of 4,800m³. The stage 4 works will cater for a population of up to 30,000 people and a maximum discharge volume limit of 36,200m³/day, and an average daily flow of 6,000m³.

These upgrade works will result in the current lagoon being replaced by concrete tanks known as activated sludge reactors, while the current filtration system will be replaced by new ultrafiltration and membrane bioreactors. This will allow for removal of 100% of suspended solids and most micro-organisms (bacteria, viruses etc.), with UV disinfection to be retained and expanded to provide an additional level of treatment. Water will still be discharged into the unnamed tributary of Te Puru Stream via the groundwater and an overland flow system

<u>Implementation</u>

The short-term upgrade works will be implemented as soon as possible, with December 2026 considered a potentially achievable target, but with the latest date for completion proposed as being December 2031 in order to allow for all necessary contingencies. The long-term upgrades are population dependent and will only be implemented once the referenced population numbers are reached.

<u>Auckland Unitary Plan (Operative in Part)</u>

The discharge of wastewater onto land and then into surface water and groundwater associated with the operation of the Beachlands Wastewater Treatment Plant, is a **discretionary activity** under Rule E6.4.1(A6).

ATTACHMENT 2

APPLICATION FORM - UPDATED 31 OCT 24

Auckland Council
Te Kaunihera o Tāmaki Makaurau

Property search

Date received: 17 Jun 2024 14:25:52 PM

Property address

100 Okaroro Drive Beachlands 2571
478416, NA95C/569 - LOT 1 DP 157365, LOT 8 DP 153965

DIS60433803

Application details

What type of application is this for? Select all the options necessary to cover your proposal.

- ☐ Coastal permit
- ☑ Discharge permit
- ☐ Land use
- ☐ Streamworks
- ☐ Subdivision
- ☐ Water permit

Provide sub-type for discharge permit

- ☐ Contaminated site
- ☐ Landfills
- ☐ To air
- ☑ Other

The application will be assessed under the Auckland Unitary Plan (operative in part). If there are any other relevant regional plan provisions, please indicate.

- ☐ Air, land, water
- ☐ Coastal
- ☐ Farm dairy discharges
- ☑ Not applicable

Are you a Qualified Partner Customer or are you lodging on behalf of a Qualified Partner Customer?

- ◉ Yes
- ○ No

Please enter your/their Qualified Partner BP Number

2650022927

Is consent required under a National Environmental Standard (NES)?

- ○ Yes
- ◉ No

Are any additional resource consent(s) required for this proposal but not being applied for under this application?

- ○ Yes
- ◉ No

Do you have any existing consent(s) relevant to this application?

- ○ Yes
- ◉ No

discharge permit renewal

Have you had a pre-application meeting with us regarding your proposal?

- (●) Yes
- ( ) No

Pre-application meeting details [1]

Reference number

PRR00041671

Date of the meeting (optional)

Name of the staff member (optional)

Attach meeting records/minutes related to the pre-application meeting (optional)

You can upload this document to myAUCKLAND files when you get to the attachments section of this form

Was it identified at the pre-application meeting that this is a premium project?

- (●) Yes
- ( ) No

Who is applying?

In relation to this application, are you:

- ( ) The agent
- (●) The applicant

Applicant details

Is the applicant an individual, registered company or other organisation?

- ( ) Individual
- (●) Registered company
- ( ) Organisation

Company details

Company name

WATERCARE SERVICES LIMITED

Registration number

9429039071552

Trading name (optional)
Provide trading name if different from company name.

Contact person details

Legal first and middle name
Tanvir

Legal last name
Bhmaji

Email address
Tanvir.Bhamji@water.co.nz

Mailing address

What is the address type?
- ○ Street address
- ○ Rural address
- ○ PO Box
- ◉ Private Bag
- ○ Counter delivery
- ○ International

Private Bag number
92521

Area
Victoria St West

City
Auckland

Postcode
1142

Physical address (if different from mailing address)

Contact number - day time
095397494

Contact number - after hours (optional)
0220597768

Fax number (optional)

Mobile (optional)

Website address (optional)

Do you want us to remember these details for future use?

- (●) Yes
- ( ) No

Owner information

Is the applicant the owner of the site?

- (●) Yes
- ( ) No

Are there any other owners or occupiers of the site?

- ( ) Yes
- (●) No

Contact information

Who is the first point of contact for communication with council or consent authority?

(●) Company name : WATERCARE SERVICES LIMITED
Trading name : Not applicable
Name : Tanvir Bhmaji
Contact number : 095397494
Email address : Tanvir.Bhamji@water.co.nz
( ) Other

Who should invoices be billed to?

(●) Company name : WATERCARE SERVICES LIMITED
Trading name : Not applicable
Name : Tanvir Bhmaji
Contact number : 095397494
Email address : Tanvir.Bhamji@water.co.nz
( ) Other

Customer reference (optional)

Are you an Approved Credit Account customer?

- (●) Yes
- ( ) No

What is your preferred method of billing?

- (●) By email
- ( ) By post

Activity details

What type of activity will you carry out for your discharge permit?

- ☐ Animal waste
- ☐ Contaminated site
- ☐ Comprehensive stormwater
- ☐ Dairy
- ☐ Industrial or trade activity
- ☐ Landfill discharge
- ☐ Other
- ☐ Rural
- ☐ Stormwater
- ☐ To air
- ☑ Wastewater

Describe the proposed activity in detail

Provide a summary of your proposed activity. Keep the description concise but ensure that it describes the nature of the activity. (250 character maximum)

For example: The construction of a new dwelling and associated earthworks on a residential zoned vacant site.

The discharge of treated wastewater from the Beachlands Wastewater Treatment Plant, via an overland flow system, to a tributary of the Te Puru Stream, and to groundwater

Are there any other activities that are part of the proposal to which this application relates to?

- ○ Yes
- ◉ No

What is the map reference of proposed works?

1780829.60 5912665.11

Are you providing any discharge point(s)?

- ◉ Yes
- ○ No

What is the map reference of proposed discharge or take?

1780829.60 5912665.11

Is the discharge/take location on the same property as the application site?

- ◉ Yes
- ○ No

Does the application involve any stream, river or lake?

- ◉ Yes
- ○ No

Is the stream, river or lake named?

- ◉ Yes
- ○ No

What is the name of the stream, river or lake?

Te Puru Stream

Indicate the duration for which you are requesting a permit (optional)

Site visit requirements

Is there a locked gate, security system, or dog(s) restricting access to the site by council staff?

- (●) Yes
- ( ) No

Details

Contact Chloe Jacobs at Watercare - chloe.jacobs@water.co.nz 0223102291

Are there any other hazard or entry restrictions that council staff should be aware of, e.g. health and safety, organic farm, measures to inhibit transfer of PSA-V etc?

- (●) Yes
- ( ) No

Details

bush, steep, must wear appropriate PPE

Contributions

When granting certain consents, the council may levy a monetary contribution. Development contributions are levied under the Local Government Act 2002 in accordance with the council's Development Contribution Policy. Financial or reserve contributions are levied under the RMA under the relevant District Plan. When such contributions are due, the consent holder is responsible for their payment. Unless otherwise advised, the name and contact address of the person responsible for payment will be taken as the applicant.

Who should contributions be billed to?

- (●) Company name : WATERCARE SERVICES LIMITED
  Trading name : Not applicable
  Name : Tanvir Bhmaji
  Contact number : 095397494
  Email address : Tanvir.Bhamji@water.co.nz
- ( ) Other

Notification

Are you requesting the application to be publicly notified?

- (●) Yes
- ( ) No

Mana Whenua details

Is your proposal located within a "site and place of significance to Mana Whenua" as identified in the Auckland Unitary Plan (operative in part)?

○ Yes
◉ No

Is your proposal an activity that has the potential to generate effects on Mana Whenua and their relationship with their ancestral land, water, site, waahi tapu and other taonga?

○ Yes
◉ No

Attachments

Application plans
Appendix A Site Plan.pdf

Record of title (less than 3 months old)
Title NA95C-569 (1).pdf
Title 478416 (1).pdf

Assessment of Environmental Effects (AEE)
Assessment of Environmental Effects.pdf
Beachlands - Alternatives Assessment Report.pdf
Beachlands WWTP - NIWA QMRA Assessment.pdf
Beachlands WWTP - Ecology Assessment.pdf
Beachlands WWTP - QMRA Assessment.pdf
DHI Te Puru Discharge Dilution Assessment.pdf
PDP - OFS Land Impacts - Memo 4.pdf
PDP Land Area Assessment Memo 1.pdf
PDP OFC Performance Interim - Memo 3.pdf
PDP OFS Treatment Performance Memo 2.pdf
Te Puru Stream Discharge Assessment.pdf
Water Quality and Biological Assessment.pdf
WSL Beachlands - Stakeholder Engagement Report.pdf

Completed checklist
Apendix C - Quarry WO Naturalisation Table.pdf
Appendix C - Additional Flow Curve.pdf
Appendix C - Additional Flow Table.pdf
Appendix C - Bridge Additional Flow Table.pdf
Appendix C - Bridge Additional Flow.pdf
Appendix C - Bridge W Naturalisation Curve.pdf
Appendix C - Bridge W Naturalisation Table.pdf
Appendix C - bridge WO Naturalisation Curve.pdf
Appendix C - Bridge WO Naturalisation Table.pdf
Appendix C - C WO Naturalisation Curve.pdf
Appendix C - C WO Naturalisation Table.pdf
Appendix C - Quarry Additional Flow Curve.pdf
Appendix C - Quarry Additional Flow Table.pdf
Appendix C - Quarry W Naturalisation Table.pdf
Appendix C - Quarry W Naturalisation.pdf
Appendix C - Quarry WO Naturalisation Curve.pdf
Appendix C - W Naturalisation Curve.pdf
Appendix C - W Naturalisation Table.pdf
Appendix A-combined.pdf

Terms and conditions

Once I submit my application, I accept that:

- a deposit will be charged upon receipt of the application
- I may have to pay additional charges for processing, administration and inspections
- I may receive a refund if the actual costs are lower than the deposit paid
- I can object to and appeal costs relating to the processing, as set out in sections 357B and 358 of the Resource Management Act 1991, up to 15 days after receiving the decision or invoice/debit note
- if any steps, including the use of debt collectors and/or lawyers, are necessary to recover unpaid processing costs, the applicant agrees to pay all collection costs
- if this application is made on behalf of a trust (private or family), a society (incorporated or unincorporated) or a company, the applicant binds the trust, society or company to pay all the costs and guarantee to pay all the costs in their personal capacity
- I understand that, when granting consent to certain activities, the council may levy a development contribution under the Local Government Act 2002. When these are due, the consent holder is responsible for the payment, unless otherwise advised
- by submitting this form, I confirm that the council may undertake a site inspection
- the application may be returned if all information under Section 88 of the RMA is not supplied.

I agree to Auckland Council''s terms and conditions and privacy policy.

Deposit: $7,000.00

ATTACHMENT 3

ASSESSMENT OF ENVIRONMENTAL EFFECTS
6 JUN 24

Beachlands Wastewater Scheme Discharge

Resource Consent Application and Assessment of Environmental Effects

June 2024 **Ref: 310104130**

PREPARED FOR:

Watercare

PREPARED BY:

Stantec

Revision Schedule

Revision No.	Date	Description	Project Manager Final Approval
1	6 June 2024	Final	Mark Wollina

Disclaimer

The conclusions in the report are Stantec's professional opinion, as of the time of the report, and concerning the scope described in the report. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. The report relates solely to the specific project for which Stantec was retained and the stated purpose for which the report was prepared. The report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorised use or reliance is at the recipient's own risk.

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Application Form

APPLICATION FOR RESOURCE CONSENT UNDER SECTION 88

OF THE RESOURCE MANAGEMENT ACT 1991

To: Auckland Council

1. Watercare Services Ltd., 73 Remuera Road, Remuera, Auckland 1050 applies for the following type of resource consent:

   Discharge permit.

2. The activity to which the application relates (the **proposed activity**) is as follows:

   The discharge of treated wastewater from the Beachlands Wastewater Treatment Plant, via an overland flow system, to a tributary of the Te Puru Stream, and to groundwater.

3. The site at which the proposed activity is to occur is the Beachlands Wastewater Treatment Plant (owned by Watercare Services Limited) at 100 Okaroro Drive, Beachlands and legally described as Lot 8, DP 153965 and Lot 1, 157365.

4. The full name and address of each owner or occupier (other than the applicant) of the sites to which the application relates are as follows:

5. Watercare owns the application site including the proposed discharge location (tributary of the Te Puru Stream).

6. The other activities that are part of the proposal to which the application relates, including any permitted activities, are described in section 4, Beachlands Wastewater Scheme Resource Consent Application and Assessment of Environmental Effects, June 2024.

7. The following additional resource consents are potentially needed for the proposal to which this application relates and have not been applied for:

   a) Regional land use consent for activities associated with the construction of the upgraded and new wastewater treatment plant and extended overland flow system.

   b) Land use consent required under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.

   c) Any consents required under the National Environmental Standard for Freshwater.

8. Attached are:

   Beachlands Wastewater Scheme Discharge - Resource Consent Application and Assessment of Environmental Effects, June 2024

   Stantec - Beachlands Wastewater Scheme Resource Consent Project - Alternatives Assessment Report, June 2024

   Streamlined Environmental - Beachlands Wastewater Treatment Plant – water quality, ecological and human health effects assessment

   Pattle Delamore Partners (PDP) – Beachlands WWTP: Preliminary assessment of land area requirements for overland flow system explanation – Memorandum 1

   PDP – Beachlands WWTP: Assessment of Overland Flow System Treatment Performance – Memorandum 2.

   PDP – Beachlands WWTP: Assessment of Overland Flow System Treatment Performance – Memorandum 3 (interim)

   PDP – Assessment of Potential Effects on Soils and Ecology from Beachlands WWTP Overland Flow System (Memorandum 4)

   PDP – Beachlands Maraetai WWTP Resource Consent Renewal: Stream Hydraulic Assessment

   NIWA – Beachlands WWTP Discharge: Assessment of microbiological effects and health risk

   DHI Water & Environment Ltd (DHI) – Assessment of Proposed Te Puru Stream Discharge

   Bioresearches – Water Quality and Biological Assessment, Te Puru Stream Tributary, Beachlands

   Bioresearches – Te Puru Stream WWTP Discharge Assessment of Effects on Stream Habitat

Beachlands WWTP – Wastewater Discharge Consent Project – Stakeholder Engagement Report, May 2024

which contain assessments of the proposed activity's effect on the environment that:

a) includes the information required by clause 6 of Schedule 4 of the Resource Management Act 1991; and

b) addresses the matters specified in clause 7 of Schedule 4 of the Resource Management Act 1991; and

c) includes such detail as corresponds with the scale and significance of the effects that the activity may have on the environment.

9. Beachlands Wastewater Scheme Discharge - Resource Consent Application and Assessment of Environmental Effects, June 2024 referred to in 8. above which contains an assessment of the proposed activity against the matters set out in Part 2 of the Resource Management Act 1991.

10. Beachlands Wastewater Scheme Discharge - Resource Consent Application and Assessment of Environmental Effects, June 2024 referred to in 8. above which contain assessments of the proposed activity against any relevant provisions of a document referred to in section 104(1)(b) of the Resource Management Act 1991, including the information required by clause 2(2) of Schedule 4 of that Act.

11. No further information is required to be included in this application by the district plan, the regional plan, the Resource Management Act 1991, or any regulations made under that Act.

12. A term of 35 years is sought for the resource consent.

Date: 07 June 2024

Tanvir Bhamji

Resource Consenting Manager

Signed on behalf of Watercare Services Ltd

Electronic Address for Service: Tanvir.Bhamji@water.co.nz

Telephone: +64 22 059 7768

Postal Address: Private Bag 92521, Wellesley Street, Auckland 1141

Contact Person: Tanvir Bhamji

Executive Summary

Watercare Services Limited (Watercare) is a lifeline utility providing water and wastewater services to 1.7 million Aucklanders every day. Its services are vital for life, keeping people safe and helping communities to flourish. Watercare's activities and programmes are funded through user charges and borrowings. Watercare is required by the Local Government (Auckland Council) Act 2010 to be a minimum-cost, cost-efficient service provider.

Watercare is seeking to replace the current resource consent it holds for the discharge of treated wastewater from the Beachlands Wastewater Treatment Plant (**WWTP**). The current discharge consent has a maximum daily discharge volume limit of 2,800m³/day and expires on 31 December 2025.

Like much of Auckland, the service area of the WWTP is subject to significant growth which is beyond the current capacity of the existing WWTP. In addition, the existing WWTP is coming to the end of its design life and several components need to be upgraded or replaced.

The proposal will enable the servicing of future growth including under a recently allowed plan change and a proposed business park. Both these developments originally included individual wastewater treatment and discharge solutions. This application will enable the reticulation of the wastewater from these new developments to the WWTP for treatment and discharge. It will result in only one discharge to the environment, rather than three, and ensure the consistent and effective management of the community's wastewater by a highly competent and experienced operator.

The proposal is to discharge treated wastewater from the WWTP, via an overland flow system, to a tributary of the Te Puru Stream and to groundwater for a term of 35 years. There are 4 stages to the proposed discharge: first, a short-term continuation of the discharge from the current WWTP; second, discharge following a Short-term upgrade to the WWTP; and discharge following the replacement of the WWTP with a new MBR WWTP (Long-term Stages 1 and 2). The timing of the replacement of the WWTP will be triggered by discharge flow rate, based on a population equivalent (PE). The new MBR WWTP will raise the level of treatment of wastewater from the Beachlands and Maraetai communities to the very high standard that Watercare provides elsewhere in Auckland. A term of 35 years is being sought, covering the 4 stages noted above.

Under the proposal, during all 4 stages treated wastewater will continue to be discharged, via an overland flow system, to groundwater and the current farm pond which is located within a tributary of the Te Puru Stream. During the term of the proposed consent, the overland flow system would be expanded to accommodate the forecasted increase in discharge volumes. The current farm pond may also need to be upgraded to accommodate increased flows.

A comprehensive suite of technical investigations and assessments have been undertaken to support the resource consent application.

An assessment of environmental effects (AEE) has been prepared and takes into account these technical assessments. This document identifies the potential for adverse effects in relation to the discharge of treated wastewater to land, on Te Puru Stream and on the coastal marine area.

With respect to the discharge to land, the AEE identifies that adverse effects may potentially arise in relation to terrestrial ecological values and groundwater quality. The AEE concludes that any such adverse effects will be very low given proposed design and operational measures.

With respect to effects on Te Puru Stream, the AEE evaluates potential hydrological impacts, potential effects on the water quality of the stream and potential effects on stream ecology. It identifies that the level of these adverse effects will range from negligible to potentially moderate (when considered in the combination with other catchment stressors). Further, relative to the current state, the proposed improvements in the treated wastewater quality will result in material improvement to several stream attributes.

Finally with respect to potential adverse effects on the coastal marine area, the AEE evaluates potential effects that may arise due to salinity, nutrients and microbiological contaminants. The AEE identifies that due to dilution and the proposed treatment improvements such effects will be negligible to low.

Ongoing engagement is occurring with Ngāi Tai ki Tāmaki on the proposal and its effects on their values. Their input to date has helped to guide the development of the preferred option.

The proposal will also result in a range of positive effects These include the provision of a safe and reliable public health sanitation system for the community and the facilitation of future development within the community.

The detailed statutory assessment completed for this application concludes that the proposal is generally consistent with the relevant planning instruments and Part 2 of the RMA. It further concludes that the potential adverse effects identified in section 107 (1) (c) to (g) of the RMA are unlikely to occur as a result of the proposed discharge.

Watercare has proposed a range of management, mitigation and monitoring measures that it considers will ensure the proposal remains appropriate over the 35 year consent term being sought. These include:

- Short-term and Long-term WWTP upgrades to ensure high quality treated wastewater.
- Progressively stricter compliance limits for discharge volumes and treated wastewater quality that reflect staged upgrades to the WWTP.
- Wastewater and receiving environment water quality and ecology monitoring.
- An Environmental Management Plan to integrate operational management and maintenance, treated wastewater and environmental monitoring and reporting.
- The preparation and implementation of an Overland Flow Design and Operational Management Plan.
- Riparian planting within the Watercare site boundary.
- Ongoing community consultation through the establishment of a Community Liaison Group.
- Regular monitoring and technology reviews.

In addition, Watercare is continuing to work with Ngāi Tai ki Tāmaki to understand the effects of the treated wastewater discharge on Te Taiao, Te Puru Stream and its tributaries, and Ngāi Tai ki Tāmaki's special connection to these, and to develop additional mitigations and remedies to assist in addressing these effects. Watercare is continuing to engage with Ngāi Tai ki Tāmaki throughout the project and Watercare has committed to support them in the development of a Cultural Impact Assessment.

For these reasons Watercare considers that the discharge permit should be granted for period of 35 years and subject to conditions reflecting the measures proposed in Section 10 of this application.

Contents

List of tables

List of figures

Abbreviations

Abbreviations	Full Name
ADF	Average Daily Flow
AEE	Assessment of Environmental Effects
AMP	Watercare's Asset Management Plan 2021-2041
ASR	Activated Sludge Reactors
AUP	Auckland Unitary Plan Operative in part (Updated 16 February 2024)
BNR	Biological Nitrogen Removal
BOD	Carbonaceous Biochemical Oxygen Demand – 5 day test
BPO	Best Practicable Option
CMA	Coastal Management Area
DIN	Dissolved Inorganic Nitrogen (same as SIN)
DO	Dissolved Oxygen
DRP	Dissolved Reactive Phosphorus
E-Coli	*Escherichia coli*
EMP	Environmental Management Plan
EOC's	Emerging Organic Contaminants
EPT	Percentage of Sensitive Species
FC	Faecal Coliform
HGMPA	Hauraki Gulf Marine Park Act 2000
IBI	Fish Index of Biotic Integrity
I&I	Inflow and Infiltration
MBR	Membrane Bioreactors
MCI	Macroinvertebrate Community Index
MDRS	Medium Density Residential Standards
N	Nitrogen
NBL	National Bottom Line
NES-F	National Environmental Standard Freshwater 2020
NH4-N	Ammoniacal nitrogen
NOx-N	Nitrate plus nitrite nitrogen
NPS-FM	National Policy Statement for Freshwater Management 2020

Abbreviations	Full Name
NPS-IB	National Policy Statement on Indigenous Biodiversity
NTU	Turbidity
NZCPS	New Zealand Coastal Policy Statement 2010
PC78	Plan Change 78 to the AUP
PDP	Pattle Delamore Partners Ltd.
PE	Population Equivalent
pH	Measure of acid or base nature of liquid
PNEC	Predicted no effect concentrations
PPC88	Private Plan Change 88 Beachlands South
ppt	Parts per trillion
OFDOMP	Overland Flow Design and Operational Management Plan
O & M Manual	Operation and Maintenance Manual
QMRA	Quantitative Microbial Risk Assessment
RAS	Return Activated Sludge
RMA	Resource Management Act 1991
RPS	Regional Policy Statement
RQ	Risk Quotients
SEA	Significant Ecological Area
SIN	Soluble Inorganic Nitrogen (same as DIN)
SOI	Statement of Intent 2023 to 2026 Watercare Services
TKN	Total Kjeldhl Nitrogen
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
UF	Ultrafiltration
UV	Ultraviolet Light
WAS	Waste Activated Sludge
Watercare	Watercare Service Ltd
WWTP	Beachlands Wastewater Treatment Plant

1. Introduction

1.1 Watercare’s Role in Relation to Auckland’s Wastewater

Watercare is a lifeline utility responsible for the planning, maintenance, and operation of wastewater services to communities in Auckland. Watercare’s activities and programmes are funded through user charges and borrowings. It is required by the Local Government (Auckland Council) Act 2009 to be a minimum-cost, cost-efficient service provider.

Watercare collects wastewater from 1.7 million people’s homes including trade waste from industry, through approximately 8,700 Km of pipelines. Pumps through 534 pump stations, treats approximately 410 million litres of wastewater daily through 18 treatment plants and disposes in environmentally responsible ways to protect the public health, the local environment and coasts and harbours (refer to Figure 1-1).

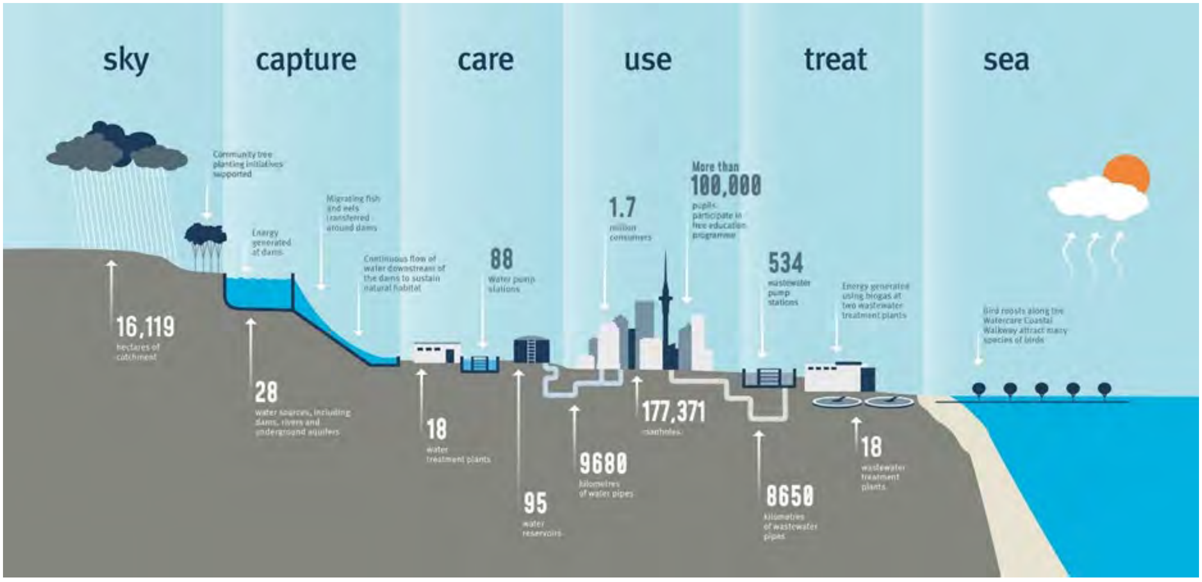


Figure 1-1: Overview of Watercare Assets and Operations

Watercare carries out significant work to upgrade and build infrastructure, to maintain levels of service and provide capacity for a fast-growing population. Watercare ensures Auckland and its people continue to enjoy dependable services by upgrading its assets, planning, building, and delivering new infrastructure in cost-efficient ways.

1.2 Background

The Beachlands and Maraetai communities are currently serviced by a wastewater network that connects to Watercare’s Beachlands Wastewater Treatment Plant (**WWTP**). There are around 3,400 existing wastewater-only connections (there is no reticulated water supply) in Beachlands and Maraetai; around 2,500 connections are in Beachlands, with the remainder in Maraetai.

Wastewater from the Beachlands Maraetai community is treated at and discharged from the WWTP located at 100 Okaroro Drive, approximately 5 km south of the Beachlands urban area. The WWTP and discharge location is situated on Watercare land in a rural area (see Figure 1-2 and Figure 1-3).

Figure 1-2: WWTP Location

Figure 1-3: Beachlands and Maraetai Wastewater Scheme

(Source: Beachlands, Maraetai and Whitford Village Servicing Strategy)

The Beachlands and Maraetai communities were originally serviced by onsite septic tanks before the Beachlands WWTP was constructed in 1995 by the Manukau City Council. The original treatment process was an aerated lagoon followed by a series of partially mixed aerated lagoons and wetlands, with the treated wastewater discharged into a tributary of the Te Puru Stream via an overland flow system. The WWTP was upgraded in 2009 to convert the aerated lagoon into an activated sludge biological nitrogen removal (**BNR**) process incorporating chemical phosphorus removal, tertiary filtration and UV disinfection.

The current resource consent that applies to the discharge of treated wastewater from the WWTP is for the 'discharge of treated domestic wastewater to the Te Puru Stream via ground soakage' (Consent Number 26875). The consent was initially granted by Auckland Regional Council in November 2004 with a consent order issued by the Environment Court in August 2005. The current consent has a maximum daily discharge volume limit of 2,800 m³/day and expires on 31 December 2025.

Like much of Auckland, the service area of the WWTP is subject to significant growth (see Section 2 for details), which is placing pressure on the treatment and flow capacity of the current WWTP. In addition, the existing WWTP is coming to the end of its design life and several components need to be upgraded or replaced.

For these reasons, Watercare is seeking to replace the existing resource consent with an approach which provides for phased increases in the discharge volumes and a corresponding staged upgrade of the WWTP.

1.3 Overview of the Current Wastewater Scheme

Wastewater from the Beachlands Maraetai community is pumped to the WWTP from the Te Puru pump station in Beachlands via a 5 km rising main. The current WWTP comprises a step screen and vortex grit removal chamber which removes gross solids and particles, a bioreactor which removes organic pollutants, nitrogen and phosphorus, a clarifier which separates the fine solids from the wastewater, a disc filter which further removes residual suspended solids and Ultraviolet Light (**UV**) disinfection which further treats the microorganisms in the wastewater.

Following the UV disinfection, the treated wastewater is discharged to land via an overland flow system. The treated wastewater from this system then enters groundwater and a pond (known as the farm pond), located on a tributary of the Te Puru Stream. The existing WWTP is described in detail in Section 2.4.

The WWTP site is owned by Watercare and comprises an area of approximately159 ha as shown on Figure 1-4 below. The land on which the WWTP and overland flow system is located is designated 'Wastewater purposes – wastewater treatment plant' (Designation 9537) under the Auckland Unitary Plan Operative in part (Updated 16 February 2024) (AUP) (refer to Figure 1-4). The designation does not contain any conditions. The underlying zoning of the designated land is Mixed Rural Zone. The balance of the site is zoned a combination of Rural Coastal Zone and Mixed Rural Zone.

The site includes two Significant Ecological Areas Terrestrial (SEA_T) which are shown on Figure 1-4 below. SEA_T428 applies to the farm pond, tributaries of the Te Puru Stream and associated riparian areas. SEA_T_5259 applies to an area on the southern portion of the WWTP site which will is current occupied by pine forest. The Watercare owned land is shown within the yellow outline, and the SEAs as green x shading. The designation is shown as a brown outline and the Watercare property boundary with the yellow line.

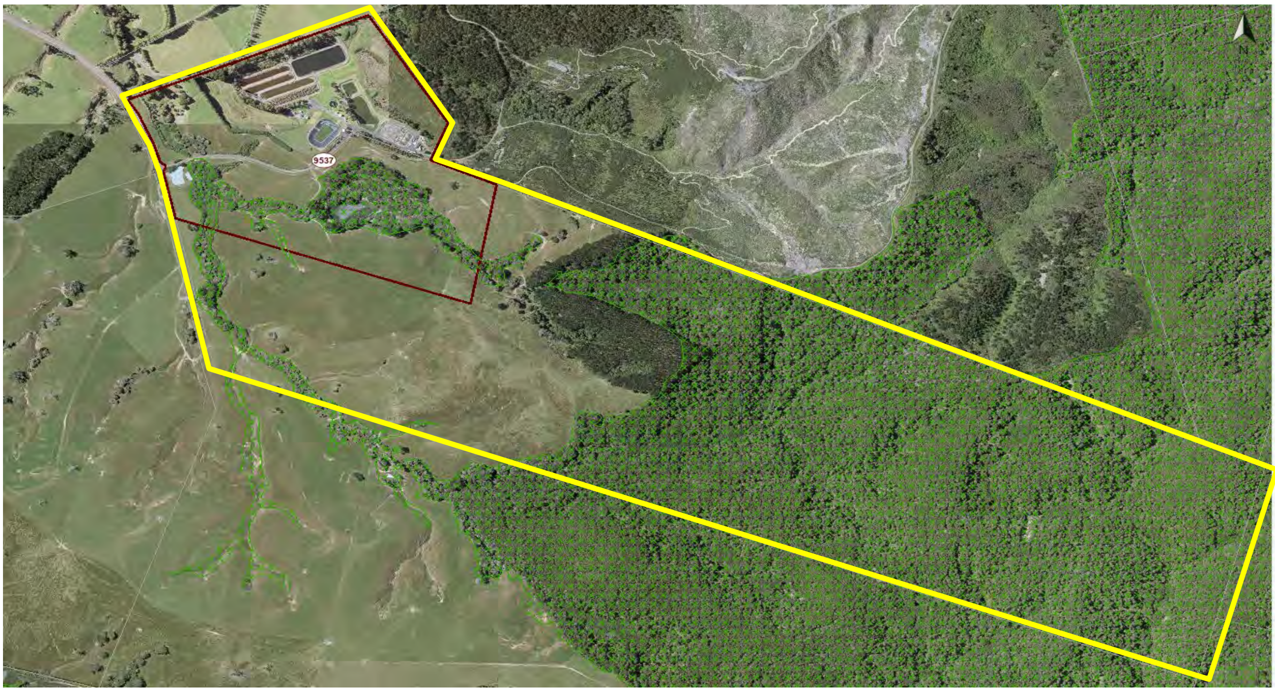


Figure 1-4: WWTP Site, Designation and SEA Overlays

1.4 Overview of the Proposal

The proposal is to discharge treated wastewater from the WWTP, via an overland flow system, to a tributary of the Te Puru Stream and to groundwater for a term of 35 years. This involves the short-term continuation of the discharge from the current WWTP; discharge following a Short-term upgrade to the WWTP; and discharge following the replacement of the WWTP with a new MBR WWTP (Long-term Stages 1 and 2). The timing of the replacement of the WWTP will be triggered by discharge flow rate, based on a population equivalent (PE).

Throughout the consent term the treated wastewater will be discharged via an overland flow system to groundwater and the farm pond located on a tributary of the Te Puru Stream. The expansion of the overland flow system to accommodate increases in treated wastewater flows will be undertaken when the Short-term upgrade to the existing WWTP is undertaken. The upgrade stages are described in detail in Section 2.7.

The proposal will enable the servicing of future growth in the Beachlands Maraetai area and in particular the Beachlands South area which is subject to a recently allowed plan change and a proposed business park which is subject to a fast-track consenting process. Both these proposed developments originally included individual wastewater treatment and discharge solutions. The proposed upgrades and new MBR WWTP will enable the reticulation of the wastewater from these new developments to the WWTP for treatment and discharge. This is a positive outcome as the centralisation of the area's wastewater treatment and discharge at the WWTP will result in only one discharge to the environment rather than three separate discharges. It will also ensure the consistent and effective management of the community's wastewater by a highly competent and experienced operator.

1.5 Summary of Consent Sought

This application only seeks consent for the discharge of treated wastewater from the WWTP, via an overland flow system, to a tributary of the Te Puru Stream, and to groundwater. A more detailed description of the consent sought is contained in Section 4.

No other consents (e.g. replacement of the existing air discharge permit or consents under national environmental standards) or other approvals (e.g. alteration to the Beachlands WWTP designation under s181 of the Resource Management Act (RMA)) are being sought as part of this application.

It is noted that the existing air discharge consent (permit # 26876) has a later expiry date than the wastewater discharge consent. Watercare intends to lodge the air discharge consent application in accordance with the timeframes set under s124 of the RMA.

In the event they are required, Watercare would apply for any additional consents once detailed design phase of the project has been completed.

1.6 Project Objectives

Project Objectives have been developed for this Project and are as follows:

Work in partnership with the Mana Whenua and engage with the community to identify the best practicable option (BPO) to provide wastewater services for the Beachlands and Maraetai community. The BPO must:

- *Recognise the significance of the Hauraki Gulf and the historic, traditional, cultural, and spiritual relationship of the tangata whenua with the Hauraki Gulf and its islands.*
- *Give effect to Te Mana o te Wai.*
- *Keep our communities healthy.*
- *Protect the health of our environment, particularly the life supporting capacity of land, air, and water.*
- *Provide a solution that caters for planned growth that keeps the overall costs of service to customers (collectively) at sustainable levels.*
- *Be sustainable and resilient and minimise whole-of-life carbon emissions and optimise resource recovery.*

The Project Objectives have been used to inform the Best Practicable Option assessment of alternatives for the WWTP and discharge.

1.7 Structure of Application Documentation

The resource consent application comprises the following documents:

- Application and Assessment of Environmental Effects (this document).
- Stantec - Beachlands Wastewater Scheme Resource Consent Project - Alternatives Assessment Report, April 2024;
- Streamlined Environmental - Beachlands Wastewater Treatment Plant – water quality, ecological and human health effects assessment;
- Pattle Delamore Partners (PDP) – Beachlands WWTP: Preliminary assessment of land area requirements for overland flow system explanation – Memorandum 1;
- PDP – Beachlands WWTP: Assessment of Overland Flow System Treatment Performance – Memorandum 2;
- PDP – Beachlands WWTP: Assessment of Overland Flow System Treatment Performance – Memorandum 3 (interim);
- PDP – Assessment of Potential Effects on Soils and Ecology from Beachlands WWTP Overland Flow System (Memorandum 4);
- PDP – Beachlands Maraetai WWTP Resource Consent Renewal: Stream Hydraulic Assessment;
- NIWA – Beachlands WWTP Discharge: Assessment of microbiological effects and health risk;
- DHI Water & Environment Ltd (DHI) – Assessment of Proposed Te Puru Stream Discharge;
- Bioresearches – Water Quality and Biological Assessment, Te Puru Stream Tributary, Beachlands;
- Bioresearches – Te Puru Stream WWTP Discharge Assessment of Effects on Stream Habitat; and
- Beachlands WWTP – Wastewater Discharge Consent Project – Stakeholder Engagement Report, May 2024.

1.7.1 RMA Schedule 4 Requirements

The table below sets out the RMA Schedule 4 requirements for resource consents and which section of this document addresses each of the requirements.

Table 1-1: RMA Schedule 4 Requirements

Schedule 4 Information	Relevant Section
Description of the activity	Section 2
Description of the site at which the activity is to occur	Section 3
Full name and address of each owner or occupier of the site	Application forms
Description of any other activities that are part of the proposal to which the application relates	Section 4
Description of any other resource consents required for the proposal to which the application relates	Section 4
An assessment of the activity against the matters set out in Part 2	Section 12
An assessment of the activity against any relevant provisions of the relevant national environmental standards, other regulations, policy and planning documents referred to in section 104(1)(b) including: (a) any relevant objectives, policies, or rules in a document; and (b) any relevant requirements, conditions, or permissions in any rules in a document; and (c) any other relevant requirements in a document (for example, in a national environmental standard or other regulations).	Section 12
If it is likely that the activity will result in any significant adverse effect on the environment, a description of any possible alternative locations or methods for undertaking the activity	Section 2
An assessment of the actual or potential effect on the environment of the activity	Sections 5 - 9
If the activity includes the use of hazardous installations, an assessment of any risks to the environment that are likely to arise from such use	N/A
If the activity involves the discharge of any contaminant, a description of: (i) the nature of the discharge and the sensitivity of the receiving environment to adverse effects; and (ii) any possible alternative methods of discharge, including discharge into any other receiving environment	Sections 2 and 3
A description of the mitigation measures (including safeguards and contingency plans where relevant) to be undertaken to help prevent or reduce the actual or potential effect	Section 10
Identification of the persons affected by the activity, any consultation undertaken, and any response to the views of any person consulted	Section 13

Schedule 4 Information	Relevant Section
If the scale and significance of the activity’s effects are such that monitoring is required, a description of how and by whom the effects will be monitored if the activity is approved	Section 11
If the activity will, or is likely to, have adverse effects that are more than minor on the exercise of a protected customary right, a description of possible alternative locations or methods for the exercise of the activity (unless written approval for the activity is given by the protected customary rights group)	NA
An assessment of the activity’s actual or potential effects on the environment that addresses: (a) any effect on those in the neighbourhood and, where relevant, the wider community, including any social, economic, or cultural effects: (b) any physical effect on the locality, including any landscape and visual effects: (c) any effect on ecosystems, including effects on plants or animals and any physical disturbance of habitats in the vicinity: (d) any effect on natural and physical resources having aesthetic, recreational, scientific, historical, spiritual, or cultural value, or other special value, for present or future generations: (e) any discharge of contaminants into the environment, including any unreasonable emission of noise, and options for the treatment and disposal of contaminants: (f) any risk to the neighbourhood, the wider community, or the environment through natural hazards or hazardous installations.	Sections 5 - 9

2. Description of the Activity

2.1 Current Serviced Area

The area serviced by the Beachlands WWTP includes the communities of Beachlands and Maraetai. There are around 3,400 existing wastewater-only connections (there is no reticulated water supply) in Beachlands and Maraetai; around 2,500 connections are in Beachlands, with the remainder in Maraetai.

The red lines show the current extent of the area serviced by the WWTP as shown in Figure 2-1.

Figure 2-1: Beachlands-Maraetai WWTP Serviced Area (Auckland Council GIS Map Viewer)

2.2 Future Serviced Areas

The catchment population for the Beachlands WWTP is expected grow substantially over the life of the consent sought in this application. Growth is expected to occur as result of both infill and greenfield development.

Initial growth will be generated by a significant private plan change (Private Plan Change 88 – Beachlands South (**PPC88**)) and a resource consent application for a business park provided these applications are approved.

PPC88 was publicly notified on 26 January 2023. PPC88 seeks to rezone 307 hectares of land south of the Beachlands township from Rural – Countryside Living to a combination of live residential, business, and open space zones, with a new precinct and Future Urban Zone (southern portion of land, 147.58 hectares). (see Figure 2-2 below). The developer anticipates building approximately 3,000 new homes of varying typologies in the Beachlands area in stages until 2038, with a further 1,500 at a later date through a Future Urban Zone. Implementation of the Future Urban Zone will require additional plan changes in the future.

The development is also expected to include a Village Centre, Community and Employment sub-precincts, primary and secondary schools, visitor accommodation, and a golf course.

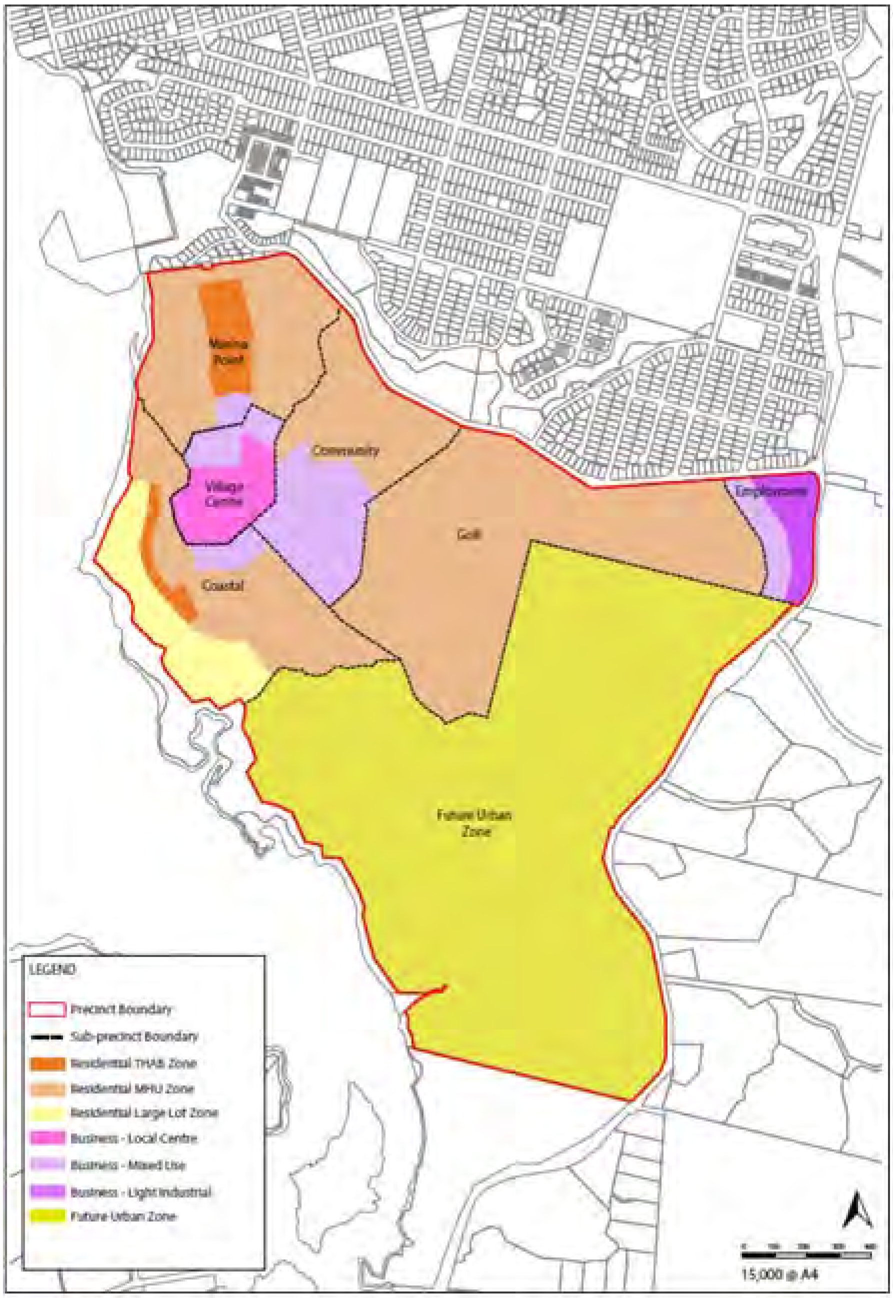


Figure 2-2: PPC88 Proposed Beachlands South Zoning and Sub-precincts Plan

(Source: Reply Legal Submissions on behalf of Beachlands South Partnership)

While PPC88 proposes a private pressure sewer system with a separate wastewater treatment facility, Watercare's preference is that if the development proceeds it should connect to the existing Beachlands WWTP.

On 2 April 2024 Independent Commissioners of behalf of Auckland Council approved PPC88. The reasons for the decision are that PPC88:

a. is supported by necessary evaluation in accordance with s 32 and s 32AA of the RMA;

b. will give effect to the National Policy Statement Urban Development and the Regional Policy Statement;

c. satisfies the provisions of Part 2 of the RMA; and

d. will assist the Council in achieving the purpose of the RMA.

The decision is the subject of appeals to the Environment Court, which had not been resolved as at the date this AEE was finalised.

Resource consent has been applied for under the COVID 19 Fast Track process to subdivide approximately 12 hectares of land for a business park for light industrial and business uses adjacent to a former quarry site on the Whitford Maraetai Road at Beachlands. Land use consent has also been sought to construct 5,200m^2 of industrial warehousing with associated hard stand and parking areas and 17,000m^2 of yard-based light industrial activities. An on-site wastewater treatment facility with a discharge to the Ruangaiagai Stream (which is a tributary of the Te Puru stream) is proposed. However, Watercare has been working with the developer to enable the wastewater generated by the proposal to be conveyed to the Beachlands WWTP for treatment.

Future wastewater servicing for the PPC88 proposal and the proposed Business Park have been taken into account in the development of this application.

Plan Change 78 to the AUP (**PC78**) responds to the previous government's National Policy Statement on Urban Development 2020 (amended in 2022) and Medium Density Residential Standards (**MDRS**) of the RMA. Through the use of MDRS the government requires the Council to enable medium-density housing across most of Auckland's residential suburbs. Three dwellings of up to three storeys, including terrace housing and low-rise apartments, are to be permitted on most residential properties unless a 'qualifying matter' applies. Qualifying matters are characteristics about some properties or within some areas that may allow the council to modify, or reduce, required building heights or density.

The Beachlands Maraetai urban area is subject to two qualifying matters: the water and wastewater for residential sites with existing significant capacity constraints, and transport constraints. The water and wastewater constraint requires that a restricted discretionary activity resource consent application has to be made for more than one dwelling per site and for subdivision. The granting of this application and the commissioning of the proposed upgrades / new WWTP would remove the need for wastewater constraint qualifying matter introduced by PC78.

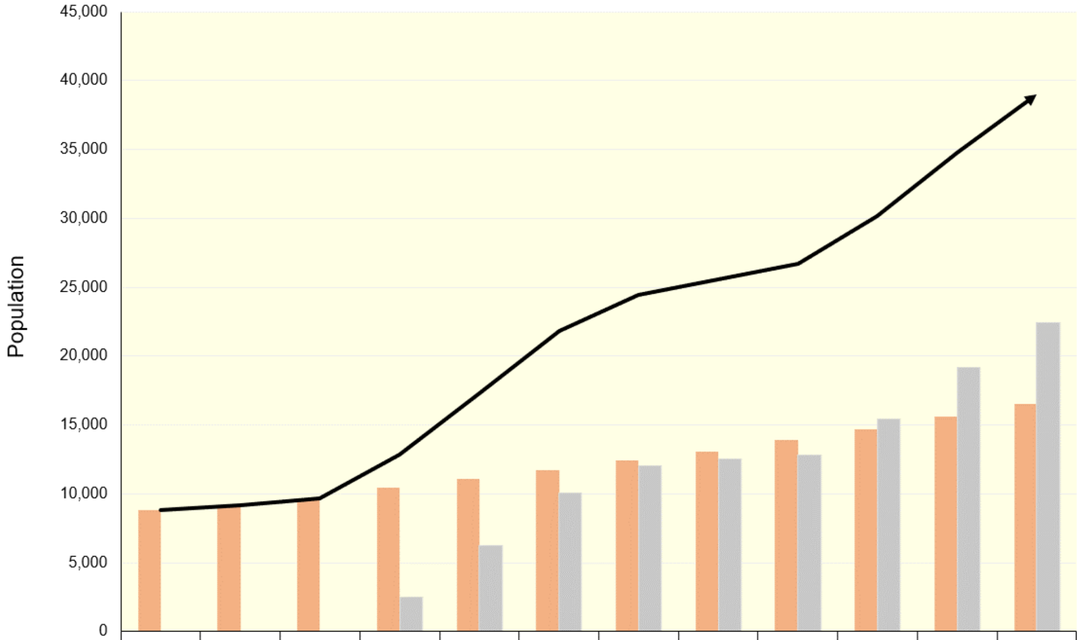
There is some uncertainty over the future of PC78 given that the coalition government has signalled its intention to amend the RMA to make the MDRS optional for councils. The government has also granted the Council a further one-year extension of time to notify its decisions on PC78 from 31 March 2025 to 31 March 2026.

2.3 Projected Future Connected Population

Factors influencing future population growth and resulting population forecasts for the WWTP are discussed and presented in Watercare's Servicing Strategy for Beachlands, Maraetai and Whitford (Watercare, May 2023).

Infill and greenfield development are expected to result in substantial population growth in the catchment for the WWTP. Figure 2-3 illustrates the projected population growth for the catchment. By the end of the 35-year consent duration sought in this application (approximately 2059-60) the projections estimate that the population serviced by the WWTP will be 30,000 PE1. This population estimate has been used as the design basis for the New WWTP (MBR) Stages 1 and 2 proposed in this application.

[1] PE is the population equivalent in units of domestic residents using standard per capita flow and loads. This approach allows for commercial and industrial wastewater (trade waste).



	2018	2020	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068
Average Beachlands Population Growth	8835	9181	9704	10412	11086	11727	12399	13061	13892	14720	15602	16543
Total Population from Proposed Developments	0	0	0	2470	6240	10067	12017	12537	12810	15410	19180	22430
Average Growth, plus proposed Development	8835	9181	9704	12882	17326	21794	24417	25599	26702	30130	34782	38974

Figure 2-3: Population projections for the Beachlands WWTP catchment (Watercare, May 2023)

2.4 Current Wastewater Treatment Plant

Wastewater from Beachlands and Maraetai is pumped to the WWTP from the Te Puru pump station in Beachlands via a 5 km rising main. At the WWTP, the wastewater initially passes through a step screen which removes gross solids and particles greater than 3mm followed by a vortex grit removal chamber. The wastewater then enters the bioreactor lagoon. The bioreactor lagoon is divided into zones known as a 4-stage Bardenpho process. The core function of the bioreactor is to remove organic pollutants, nitrogen and phosphorus. At separate locations within the bioreactor, acetic acid and aluminium sulphate (alum) are dosed into the wastewater to assist in the removal of nitrogen and phosphorus respectively.

Following the bioreactor lagoon, mixed liquor (treated wastewater and biological solids) passes through a clarifier which separates the suspended solids from the wastewater. The suspended solids are returned to the bioreactor lagoon as return activated sludge (**RAS**), to trap the solids within the process and maintain the required concentration of microorganisms to consume the incoming wastewater as “food”. Excess solids, or waste activated sludge (**WAS**) is wasted to two sludge lagoons where the solids digest before transfer to sand drying beds and then disposal to Hampton Downs landfill. The disposal of the dried sludge is not subject of this resource consent application as it is managed via landfill disposal at a consented landfill.

Treated wastewater then passes through a disc filter which further removes residual suspended solids which are carried over the clarifier weir. The remaining filtered wastewater then enters the UV disinfection facility which further treats the microorganisms in the wastewater.

From the UV facility, the treated wastewater is discharged to land via the overland flow system consisting of an approximately 1.5 ha vegetated discharge field and riparian plantings as shown in Figure 2-6. Following dispersal through the overland flow system, the discharge enters a tributary to the Te Puru Stream which has been dammed to form a pond (known as the farm pond).

The WWTP contains a 6,000 m^3 storm buffer pond and a 9,700 m^3 post treatment buffer pond to manage high flow storm events. A process flow diagram and aerial photograph of the current treatment plant is presented in Figure 2-4 and Figure 2-5.

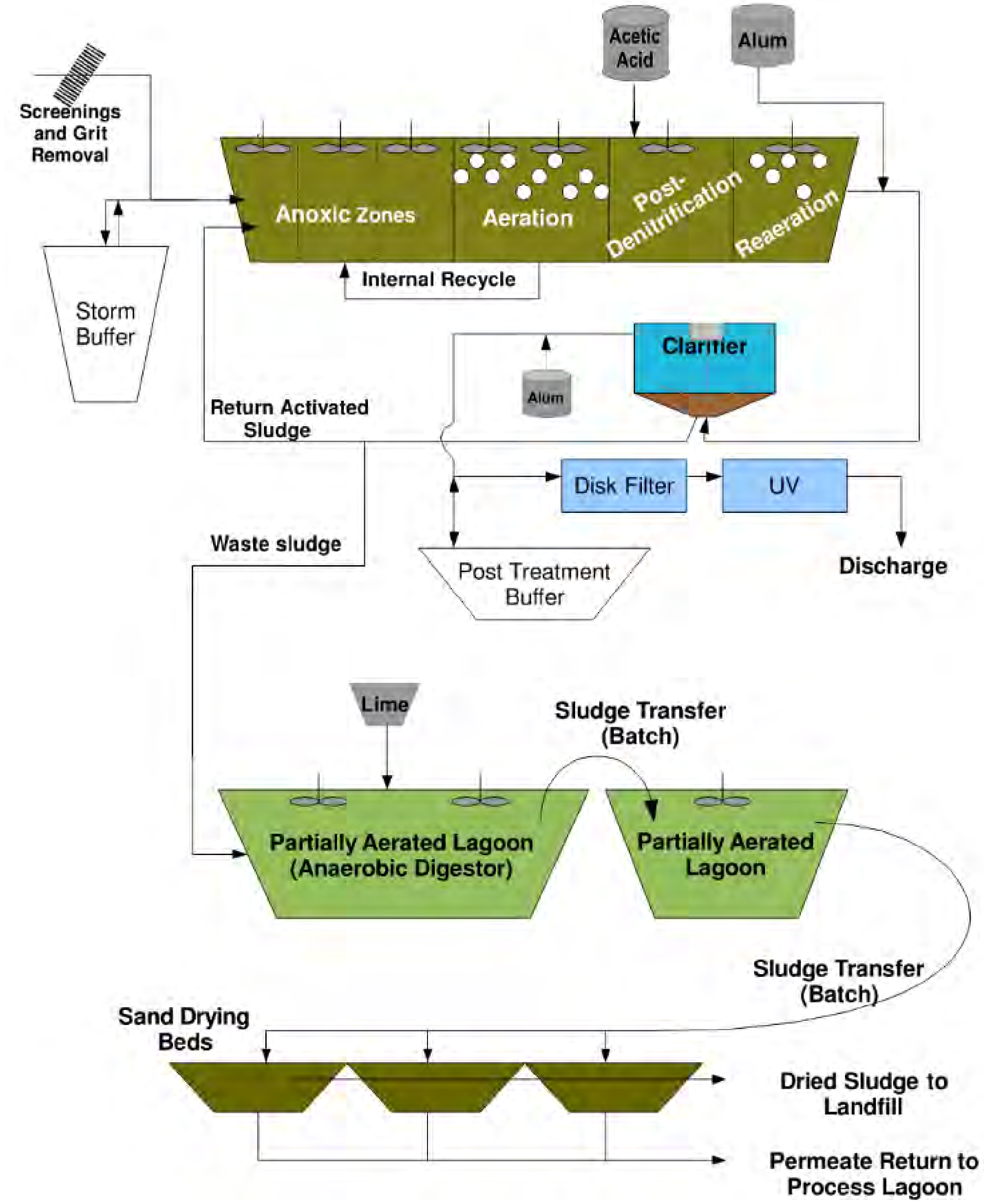


Figure 2-4: Beachlands Current WWTP Process Flow Diagram

Figure 2-5: Beachlands WWTP Aerial Photograph – Current Layout

Figure 2-6: Beachlands WWTP Overland Flow Area Aerial Photograph

2.4.1 Wastewater Flows

Influent (untreated wastewater entering the WWTP) and treated wastewater flow data from the past five years is presented in Figure 2-7 and Figure 2-8.

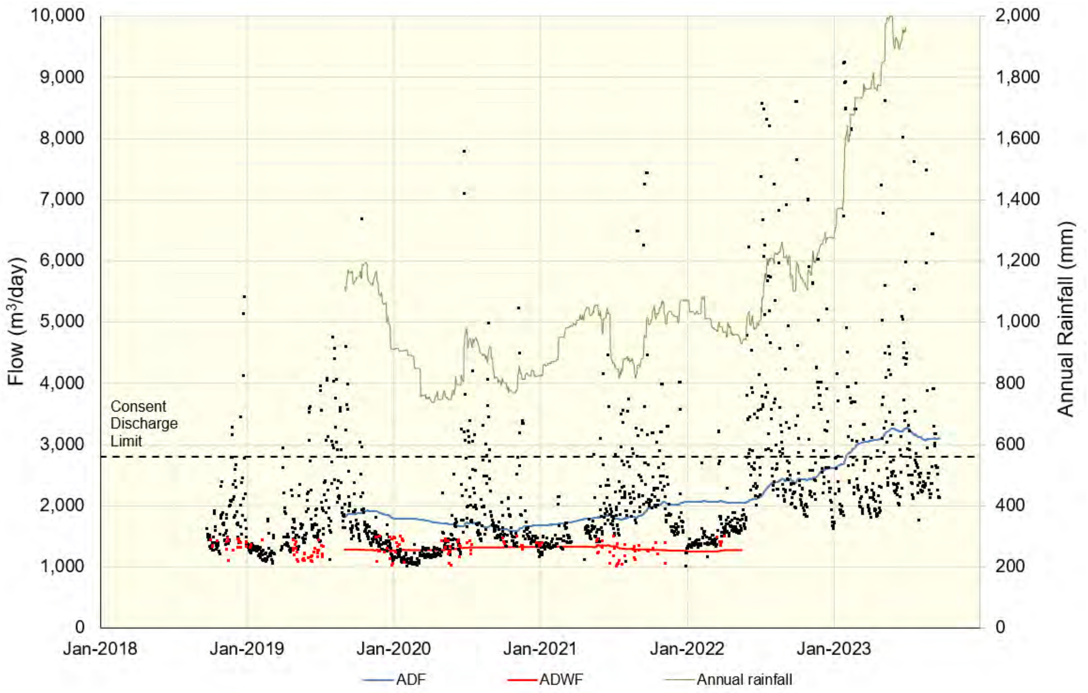


Figure 2-7: Beachlands WWTP Influent Flow and Rainfall Data 2018-2023

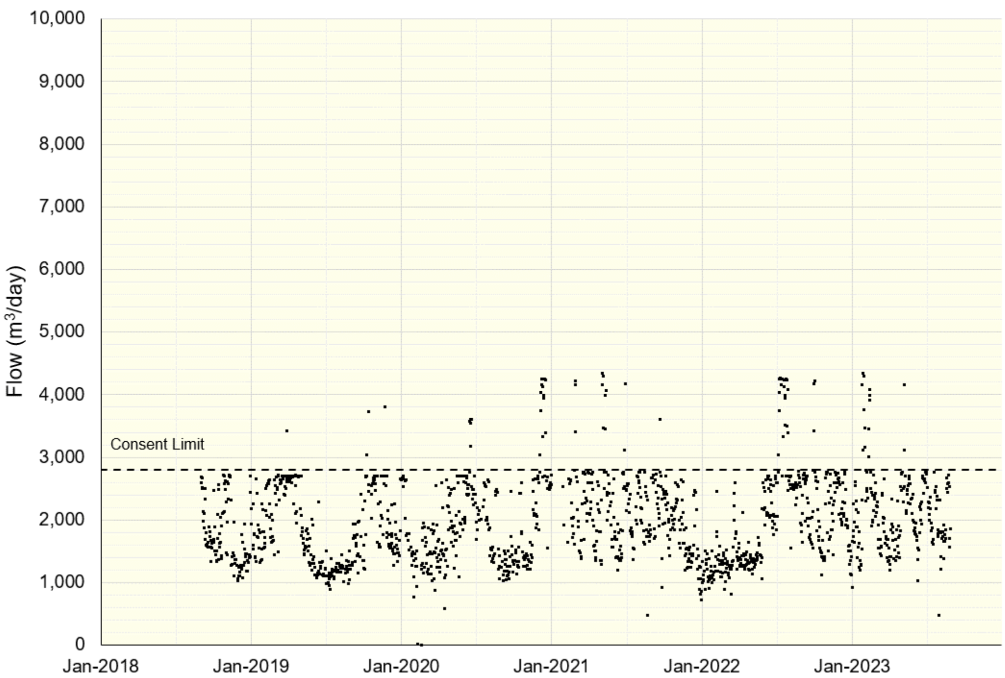


Figure 2-8: Beachlands WWTP Treated Wastewater Flow Data 2018-2023

Figure 2-7 illustrates the effect of rainfall on inflows to the WWTP. In late 2022 and early 2023, inflow to the WWTP increased markedly which, as illustrated in Figure 2-7, reflects the unusually high rainfall over this period. Prior to 2021 there was an issue with seawater ingress into the system, however the main source of the ingress was identified and rectified in 2021. Any remaining salinity in the influent from seawater ingress is expected to be diluted over time with population growth as new pipes are unlikely to have this issue.

High inflows are largely offset by storage within the WWTP site (i.e. the storm buffer pond and post treatment buffer pond), as shown in Figure 2-8. The storage system has performed well in limiting the daily discharge volume to within the current consent limit of 2,800m^3 on most occasions. However, the system is vulnerable to prolonged rainfall and resulting high inflows which exceed the storage system. To address the non-compliances it is proposed to raise the maximum daily discharge limit from 2,800m^3 to 4,500 m^3 immediately (ie. as soon as the new consent commences)).

2.4.2 Compliance with current consents

The Beachlands WWTP has largely been compliant with the conditions of its existing resource consents. The 2022-2023 Annual report[2] for the WWTP states that:

> *In 2022, daily discharges from the Beachlands WWTP were above the consented maximum volume limit on 20 days in July and 3 days in October 2022. High rainfall increased the inflow and infiltration in the wastewater network significantly and subsequently the flow into the plant. It was not possible to store all the incoming flows in the storm buffer and post-treatment ponds, the discharge was increased to treat as much of the raw wastewater as the process allowed. The discharge volume limits were breached again for 13 days across January and February 2023 due to the Auckland Anniversary storm event and Cyclone Gabrielle. Another extreme rainfall event in May 2023 resulted in three days where the plant exceeded the discharge limits. The alternative to breaching the discharge consent limit would be to force overflows in the wastewater network, particularly at pump stations.*

During the above-mentioned period, the highest flows were recorded at 4,331 m^3 per day. While flows were above the consented limit, the treated wastewater quality was compliant with the discharge limits.

In the 2019/20 and 2020/21 consent years, the WWTP was fully compliant with all treated wastewater quality conditions of its existing consent.

As already noted, on occasions the WWTP operations are non-compliant with the maximum daily discharge volume. These non-compliances arose during extreme and prolonged wet weather events which resulted in significantly high inflow and infiltration into the wastewater network connected to the WWTP. However, as discussed below, the treated wastewater quality was nearly always compliant with the consent standards.

2.4.3 Current Treated Wastewater Quality

Treated wastewater quality over the past five years has been excellent and is summarised in Table 2-1 and in Figures 2-8 to 2-13. These are the parameters included in the current consent that apply at the point of discharge from the UV system of the WWTP.

Table 2-1: Beachlands WWTP Treated Wastewater Quality 2018 – 2023

Parameter	Units	Median		90th percentile		95th percentile	
		Plant Results	Consent Limit	Plant Results	Consent Limit	Plant Results	Consent Limit
BOD	mg/L	1.2	-	4.0	**15**	-	-
TSS	mg/L	7.0	-	12	**15**	-	-
NO_3-N[3]	mg/L	0.8	-	5.3	**15**	-	-
NH_4-N (Nov– Apr)	mg/L	0.4	-	-	-	1.7	**4.0**

[2] Beachlands Wastewater Treatment Plant 2022- 2023 Annual Report, Final September 2023
[3] NO_3-N data excludes 2022-2023 data due to steady increase in concentrations compared to previous 4 years (see Figure 2-11).

Parameter	Units	Median		90th percentile		95th percentile	
		Plant Results	Consent Limit	Plant Results	Consent Limit	Plant Results	Consent Limit
NH_4-N (May–Oct)	mg/L	0.4	-	-	-	1.9	**5.0**
DRP	mg/L	0.3	-	0.7	**5**	-	-
Faecal coliforms	cfu/100mL	1.6	**14**	-	-	-	-

As shown in Table 2-3 and the figures below, treated wastewater quality is generally well below consent limits. The increases in NO_3-N and DRP observed over the last two to three years are the result of Watercare optimising their chemical dosing strategies. As shown, the WWTP was performing well below consented limits so there was scope to adjust chemical dosing rates and reduce operating costs.

There were two instances where the rolling 95th percentile ammoniacal nitrogen concentration exceeded the summer consent limit; in October 2018 – February 2019 and September 2019 to January 2020 (see Figure 2-12). In both instances these exceedances were due to a single high result (the rolling consent standard of using the previous 10 consecutive samples means a single high result takes several months to drop out of the compliance sample set). The reasons for the two high ammoniacal nitrogen results is not clear but could be due to mechanical issues with the aerator in the final aerobic zone of the bioreactor lagoon.

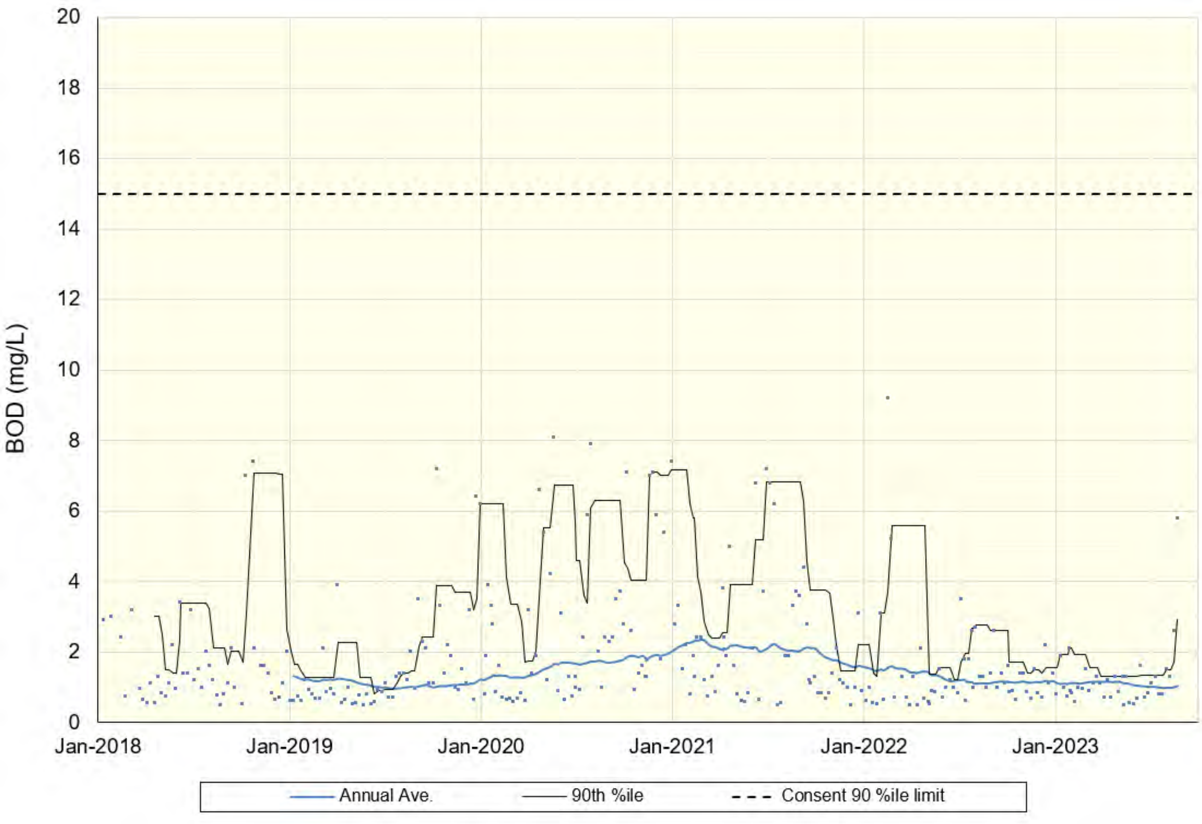


Figure 2-9: Beachlands WWTP Treated Wastewater BOD Concentrations 2018 – 2023

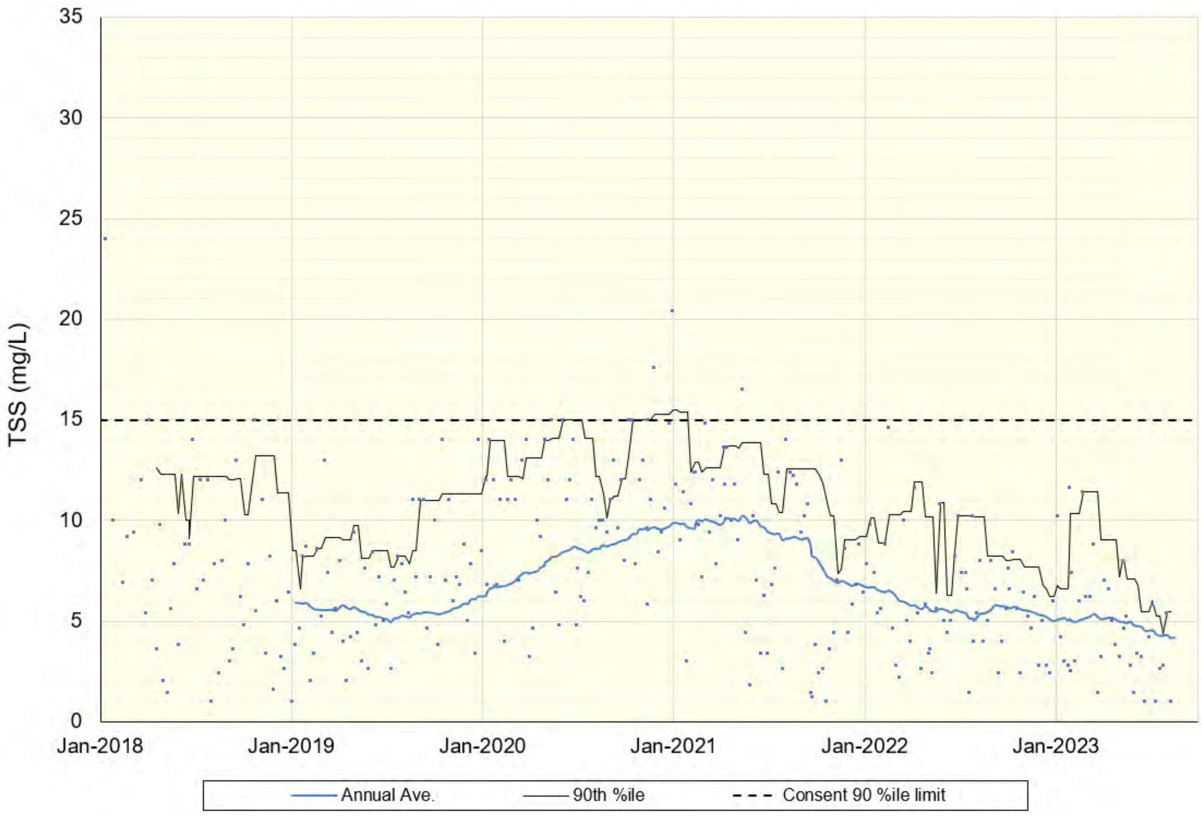


Figure 2-10: Beachlands WWTP Treated Wastewater TSS Concentrations 2018 – 2023

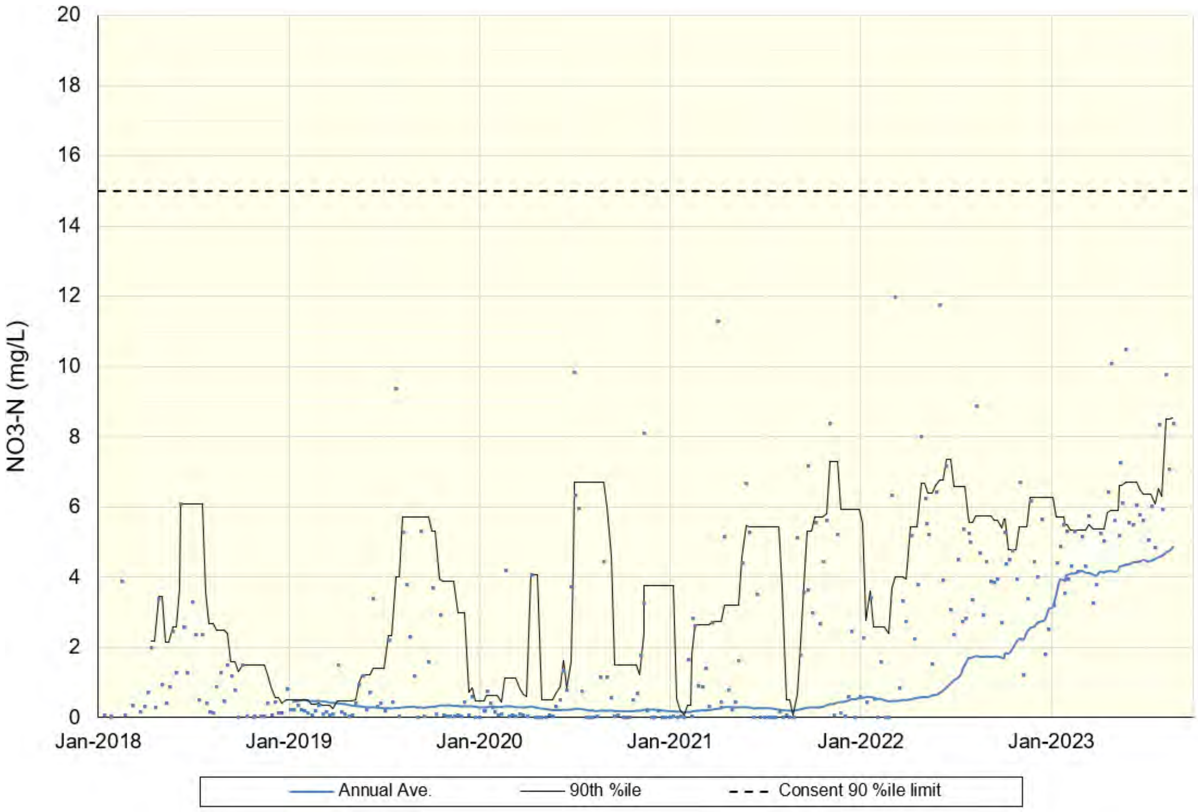


Figure 2-11: Beachlands WWTP Treated Wastewater NO_3-N Concentrations 2018 – 2023

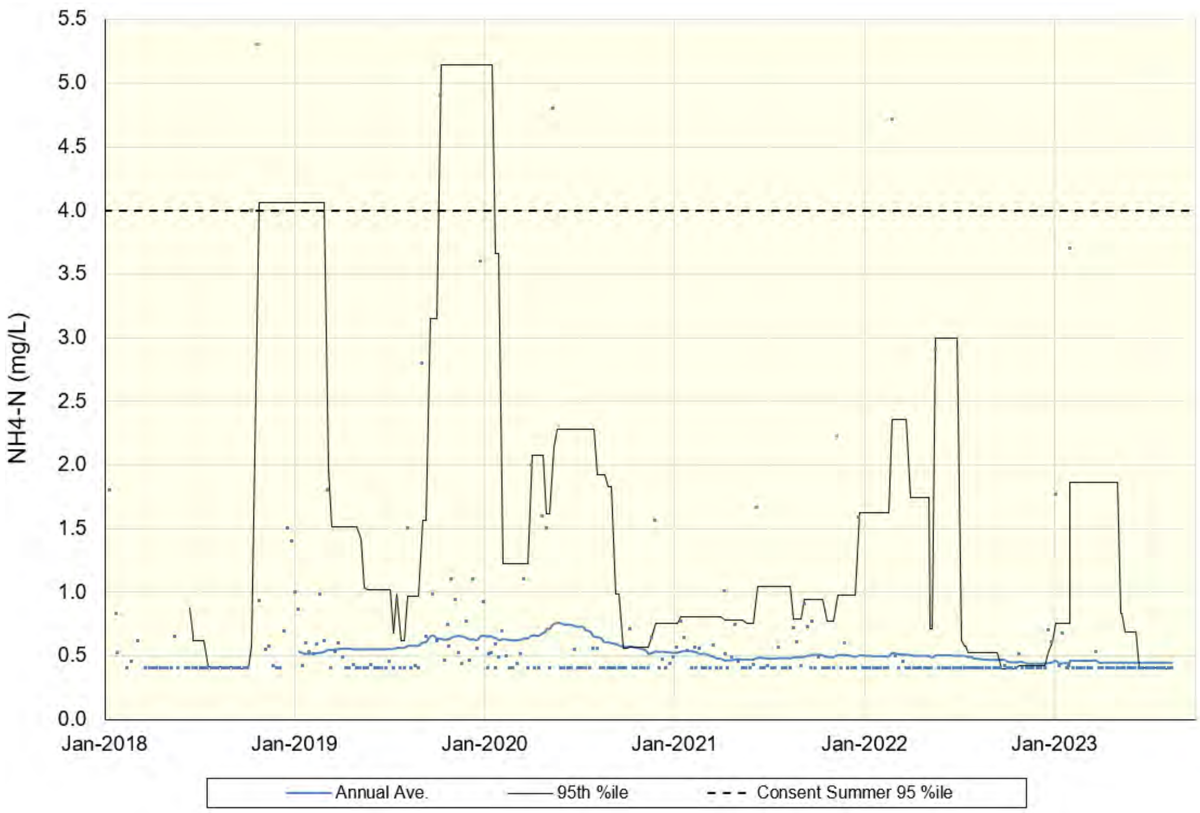


Figure 2-12: Beachlands WWTP Treated Wastewater NH_4-N Concentrations 2018 – 2023

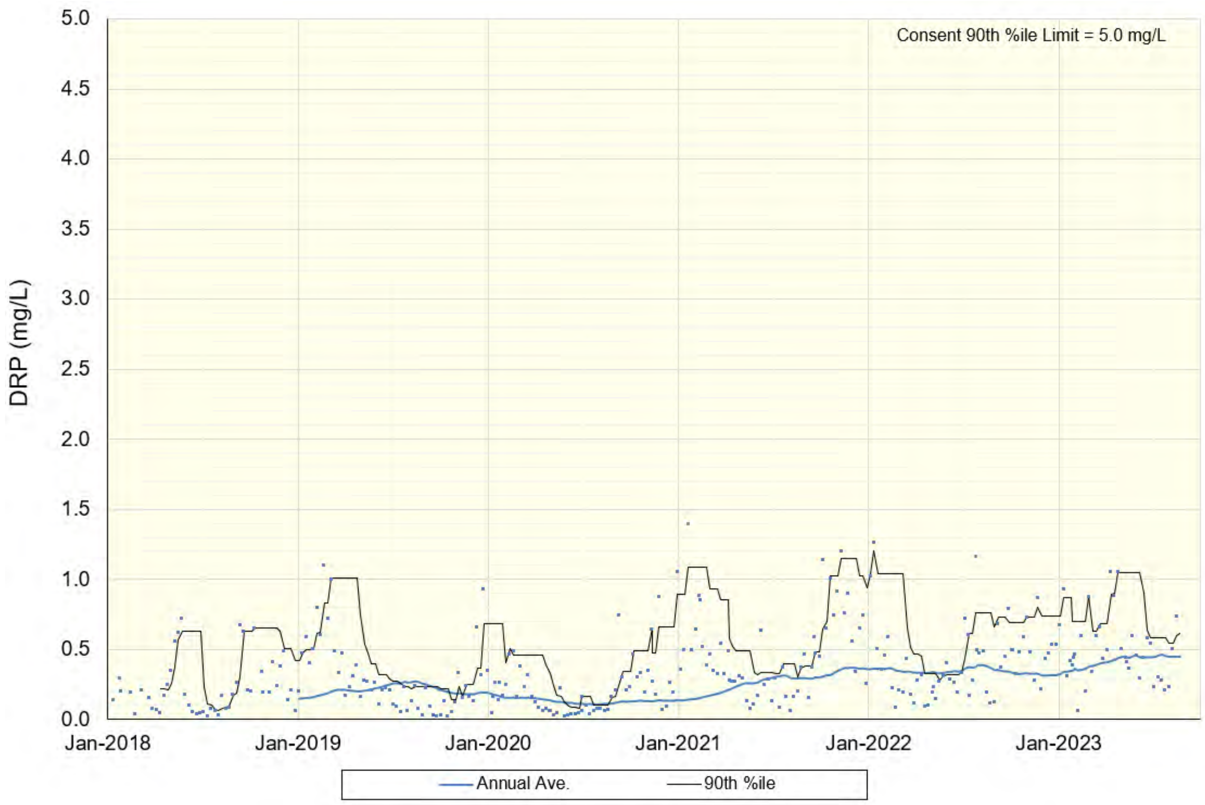


Figure 2-13: Beachlands WWTP Treated Wastewater DRP Concentrations 2018 – 2023

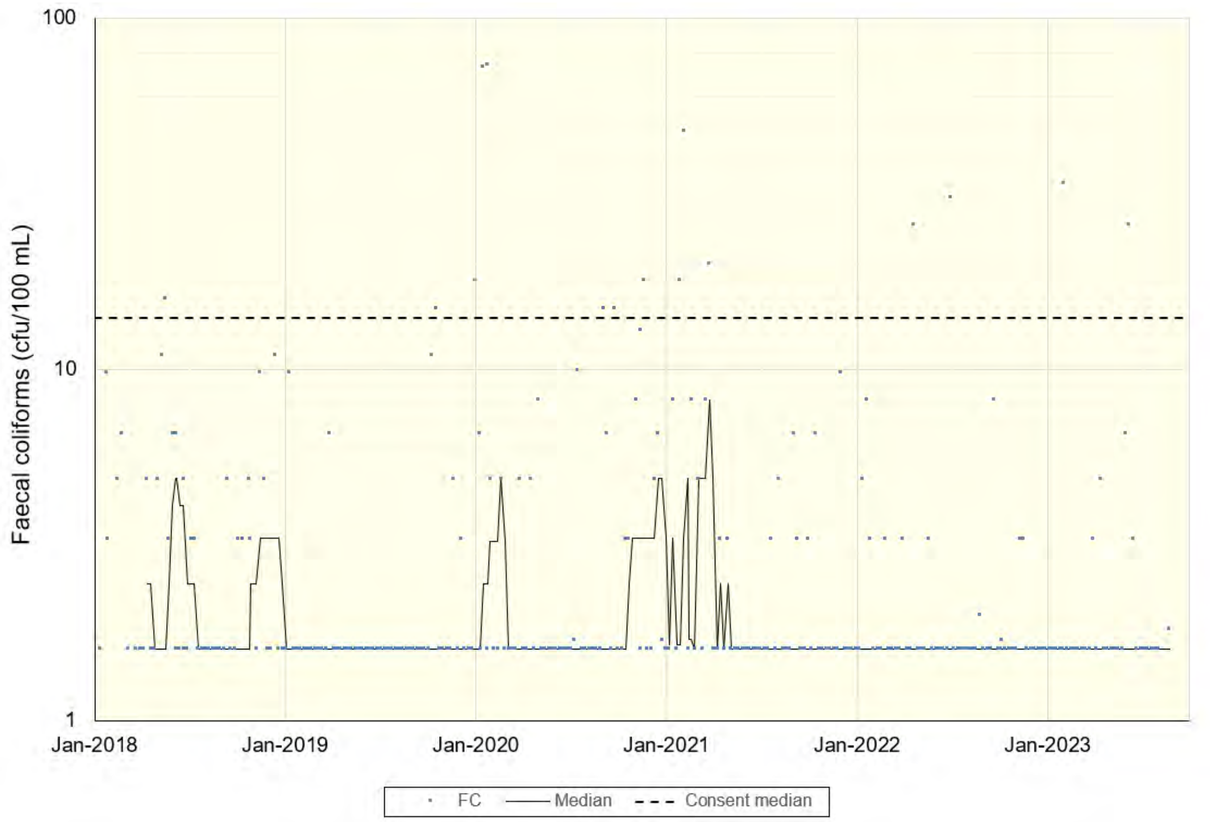


Figure 2-14 Beachlands WWTP Treated Wastewater Faecal Coliforms Concentrations 2018 – 2023

2.5 Existing Overland Flow System

The existing overland flow system consists of four dispersion zones each with three parallel series of PVC pipes elevated above the ground in the upslope section of the overland flow area covering an area of approximately 1.5 hectares. Treated wastewater from the UV disinfection system flows through the pipes via gravity and is dispersed through holes drilled in the pipes.

The length of overland flow slope between the distribution pipes and the farm pond edge ranges from approximately 50 – 100m dependent on the location within the dispersal area and if the individual distribution pipe is at the top or the bottom of the array. The system does not utilise all zones or pipes within zones consistently.

Most of the treated wastewater is discharged from the lower two sets of pipelines and the first three zones. Only at higher flows do all of the zones and pipelines provide discharge. Dependent on the position within the dispersal area, the average slope varies between approximately 10-14% with an average fall over the length of the dispersal area of approximately 10m. Following dispersal over land and through the vegetated discharge field and riparian plantings with some seepage, the discharge enters a reach of the tributary which has previously been dammed to create a pond (farm pond). This has created a gentle slope to the water's edge compared to the more steeply incised reaches of the stream both upstream and downstream of the pond. The overland flow system operates continuously/on demand without any controlled rest periods.

Figure 2-15: Beachlands WWTP Overland Flow Distribution Pipe

Figure 2-16: Beachlands WWTP Overland Flow Distribution Pipe

2.6 Alternatives Assessment Process

2.6.1 Background

Watercare proposed that the process to identify the preferred option for the future treatment and discharge needs to determine that the preferred option is the Best Practicable Option (**BPO**) as defined under the Resource Management Act 1991 (**RMA**).

The alternatives assessment that is summarised in this section is a technical assessment. The assessment is recorded in more detail in the Alternatives Assessment Report.

Watercare has undertaken separate consultation processes with Ngāi Tai ki Tāmaki and the Beachlands Maraetai community regarding options for the future treatment and discharge of the wastewater from Beachlands Maraetai. Feedback from these consultation processes has been integrated with this technical BPO assessment processes for Watercare to determine the preferred option for the future treatment and discharge of the wastewater.

The BPO assessment has responded to direction on alternatives assessment in the RMA, and in particular Section 105 and Schedule 4. The process also took into account the extensive body of case law that exists regarding the consideration of alternatives under the RMA, and the relevance of identifying the BPO noting the relevance of section 108(2)(e) of the RMA. In this respect, as an initial step in the BPO assessment process was the identification of key principles and best practice guidance for the assessment of alternatives. In the present context these include that assessment must be undertaken of:

a. any possible alternative locations or methods for undertaking the activity.

b. any possible alternative methods of discharge, including discharge into any other receiving environment.

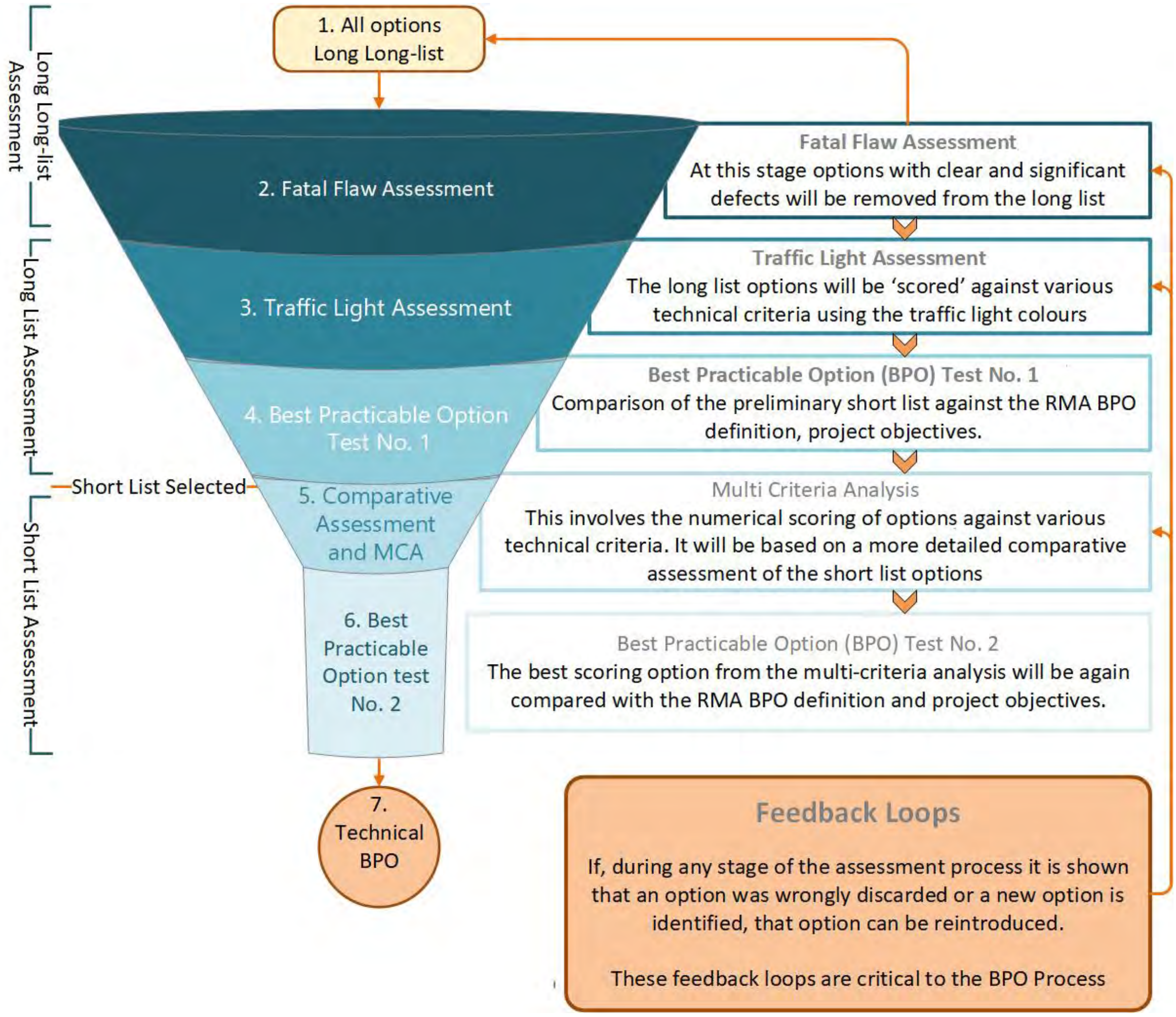
2.6.2 Methodology

The methodology designed for the technical BPO assessment is set out in the diagram below. It involves:

1. The development of a Long Long list of options.
2. Fatal Flaw assessment that removed options with significant defects from the Long Long list to identify a Long List of options.
3. Traffic Light assessment of the Long List of options to identify a preliminary Short List of options.
4. BPO Test No 1 to confirm the Short List of options.

5. Short List assessment to identify a preliminary technical preferred option / BPO.

6. BPO Test No 2 to confirm a technical preferred option / BPO.



2.6.3 Fatal Flaw Assessment

This involved assessing the Long Long List of 32 options against seven fatal flaw criteria. An option only had to meet one of the criteria to be fatally flawed. A total of 13 options were fatally flawed resulting in a Long List of 19 options. The options that were fatally flawed primarily involved the conveyance of raw, partially treated and fully treated wastewater to other Watercare wastewater treatment plants.

2.6.4 Traffic Light Assessment

The 19 Long List options taken forward for the traffic light assessment comprised options involving discharge to the tributary of the Te Puru Stream, options involving discharge to other freshwater bodies, options involving discharge to the Coastal Marine Area (**CMA**), options involving discharge to land and groundwater and options involving discharge to a combination of these receiving environments. The options also included a range of potable and non-potable reuse combinations including a supplementary supply for the Hunua Dams.

This stage of the assessment involved the development of assessment criteria (eight in total), technical expert assessment and traffic light scoring of each option against the criteria the experts were responsible for, and a Long List workshop that used the Traffic Light assessment to identify a preliminary Short List of options (five in total).

2.6.5 BPO Test No 1

This involved assessing the preliminary Short List of options against BPO criteria based on the RMA BPO definition and against the Project Objectives developed for the project. The BPO and objectives assessments were reasonably well aligned with the Short List Traffic Light assessment and did not identify any additional red traffic light scores which would direct an option to not be progressed for further consideration.

All five of the preliminary technical Short List of options passed the Best Practicable Option Test No. 1 and were taken forward to the Short List assessment stage.

2.6.6 Short List Assessment

The five options taken forward for the Short List assessment were:

- Diffuse discharge to the tributary of the Te Puru Stream.
- Direct discharge to the tributary of the Te Puru Stream.
- Discharge of 100% of the treated wastewater to land (approximately 750ha) in the vicinity of the WWTP.
- Combination of discharging the treated wastewater to land (approximately 300ha) in the vicinity of the WWTP during dry weather and a discharge to the tributary of the Te Puru Stream at other times.
- Discharge to the Hauraki Gulf north of Beachlands in the Tāmaki Strait via a 2.9km offshore ocean. outfall.

This stage of the assessment involved the technical expert assessment and 1 to 5 scoring (1 best 5 worst) of each option against the criteria they were responsible for, and multi-criteria assessment (**MCA**) workshops to identify a preliminary technical BPO.

2.6.7 BPO Test No. 2

This stage followed a similar process to the BPO Test No 1 and involved the BPO and Project Objectives assessment of the preliminary technical BPO in comparison with the other Short List Options. The BPO Test No 2 confirmed that the option involving the diffuse discharge to the tributary of the Te Puru Stream should be recommended to Watercare as the technical BPO.

2.7 Staging of Proposed Wastewater Treatment Plant

The proposed discharge will be undertaken in 4 stages over the 35-year consent term sought as shown in Table 2-2 and described below.

Table 2-2 Beachlands WWTP Design Discharge Flows

Parameter	Units	Existing WWTP		New WWTP	
		Current	Short-term Upgrade	Long Term Upgrade Stage 1	Long Term Upgrade Stage 2
Design population	P.E.	11,000	18,000	24,000	30,000
Annual average daily discharge flow	m^3/day	2,200	3,600	4,800	6,000
Maximum daily discharge flow	m^3/day	4,500*	8,700	28,900	36,200

* The current consent maximum daily discharge limit is 2,800 m^3.

2.7.1 Existing WWTP (Current)

This involves a treated wastewater discharge from the existing WWTP in its current form as described in section 2.4, prior to completion of the proposed Short-term upgrade.

The WWTP is currently operating at its design capacity and has limited ability to accept any additional growth. An upgrade is needed to alleviate this constraint, allowing housing developments and population growth to occur in the short term. The main elements of the Short-term upgrade are:

- Replacement of the existing inlet screen (which has reached the end of its useful life).
- Increasing the aeration capacity of the bioreactor lagoon.
- Installation of a new A recycle pumps and pipework.
- Installation of an additional tertiary filter.
- Installation of additional UV lamps.
- Increased pipework capacity from UV to extended overland flow area.
- Construction of additional sludge drying beds.
- Upgrade of mains power supply and distribution boards.
- Expansion of the existing overland flow area.

An aerial photograph showing the elements of the Short-term upgrade is presented in Figure 2-20.

This application seeks consent to increase the maximum daily discharge volume from 2,800 m^3 to 4,500 m^3 for the existing WWTP in its current form. This increased discharge volume is required to remedy the current ongoing non-compliances with the existing consent maximum discharge volume condition and reflects the level of inflow and infiltration in the network. Non-compliant flow volumes have occurred after sustained periods of heavy rain.

2.7.2 Existing WWTP (following Short-Term Upgrade)

This covers the WWTP discharge following the commissioning of the short-term upgrade described in the previous section, through to the commissioning of Stage 1 of the Long-term upgrade described in the following section. The treatment process for the Short-Term upgrade is identical to the current WWTP, but with increased capacity.

The Short-Term upgrade is based on a design of 18,000 PE which provides for projected population growth within the existing urban areas and for the initial development phase of PPC88, should this development be connected to the WWTP. This application seeks that the maximum daily discharge volume during this stage is set at 8,700 m^3.

Prior to reaching a catchment 18,000 PE, Watercare will construct the Stage 1 of the Long-term upgrade (new MBR treatment plant). Should development and population growth not occur at the projected rate, the construction of the new MBR treatment plant will be delayed.

2.7.3 New WWTP (following Long-term Upgrade Stages 1 and 2)

This is the discharge from the new WWTP following the commissioning of Stage 1 of the Long-term upgrade. The Long-term upgrade will be constructed in two stages (first stage capacity of 24,000 PE followed by a second stage taking the capacity to 30,000 PE) which Watercare expects will provide sufficient capacity out to approximately 2060 (see Section 2.7.6). The application seeks that the maximum daily discharge volume for Long-term stage 1 is set at 28,900 m^3 and for Long-term Stage 2 is set at 36,200 m^3. In addition, Watercare proposes to set treated wastewater concentration limits as described in Section 2.7.7 below.

The Long-term upgrade will involve construction of a new WWTP replacing the existing one, albeit using the same biological treatment process. The current bioreactor lagoon will be replaced with new concrete tanks termed activated sludge reactors (**ASR's**). The secondary clarifier and disc filters will be replaced by new ultrafiltration (**UF**) membrane bioreactors (**MBR's**). UF membranes have a nominal pore size of 0.04 microns (compared with the current cloth disc filter nominal pore size of 10 microns, i.e. 250 x smaller pore size). UF membranes remove 100% of suspended solids and most micro-organisms (bacteria, viruses and protozoa) from the treated wastewater, thereby providing disinfection as well as solids removal. Notwithstanding this, the UV disinfection system will be retained and expanded to provide an additional public health protection barrier. The main elements of the new WWTP are:

- New inlet works
- New ASR's
- New MBR's

- UV disinfection system (existing system expanded)
- New sludge handling facilities (thickening and dewatering)
- Expansion of the overland flow area

As noted in the previous section, transition to the Long-term upgrade will be based on an average daily flow trigger rather than a fixed timeframe. To ensure that this is met Watercare proposes to monitor and model average daily flows within the WWTP catchment and to annually report on it to Auckland Council. Once Watercare’s monitoring and modelling indicates that population within the WWTP catchment will exceed the Short-term upgrade capacity within 6 years, it will initiate design and construction of the Long-term upgrade.

2.7.4 Site Layouts

Aerial photographs of the Beachlands WWTP showing the Short-term and Long-term stages are presented in Figure 2-17 and Figure 2-18:. Figure 2-18: presents a possible Long-term layout; this may change, or a completely new layout may be developed as the design progresses. However, those changes will not impact on the treated wastewater discharge quality for which consent is sought.

2.7.5 Long-term Stages 1 and 2 - Process Flow Diagram

A process flow diagram for the new MBR WWTP Long-term (Stages 1 and 2) is presented in Figure 2-19. As noted in section 2.7.2 above, the treatment process for the Short-term upgrade is the same as the existing process, so the process flow diagram is identical to the current WWTP (Figure 2-4).

Figure 2-17: Beachlands WWTP Short-Term Upgrade Indicative Site Layout

Figure 2-18: Beachlands WWTP Long-term Stage 1 & 2 Indicative Concept Site Layout

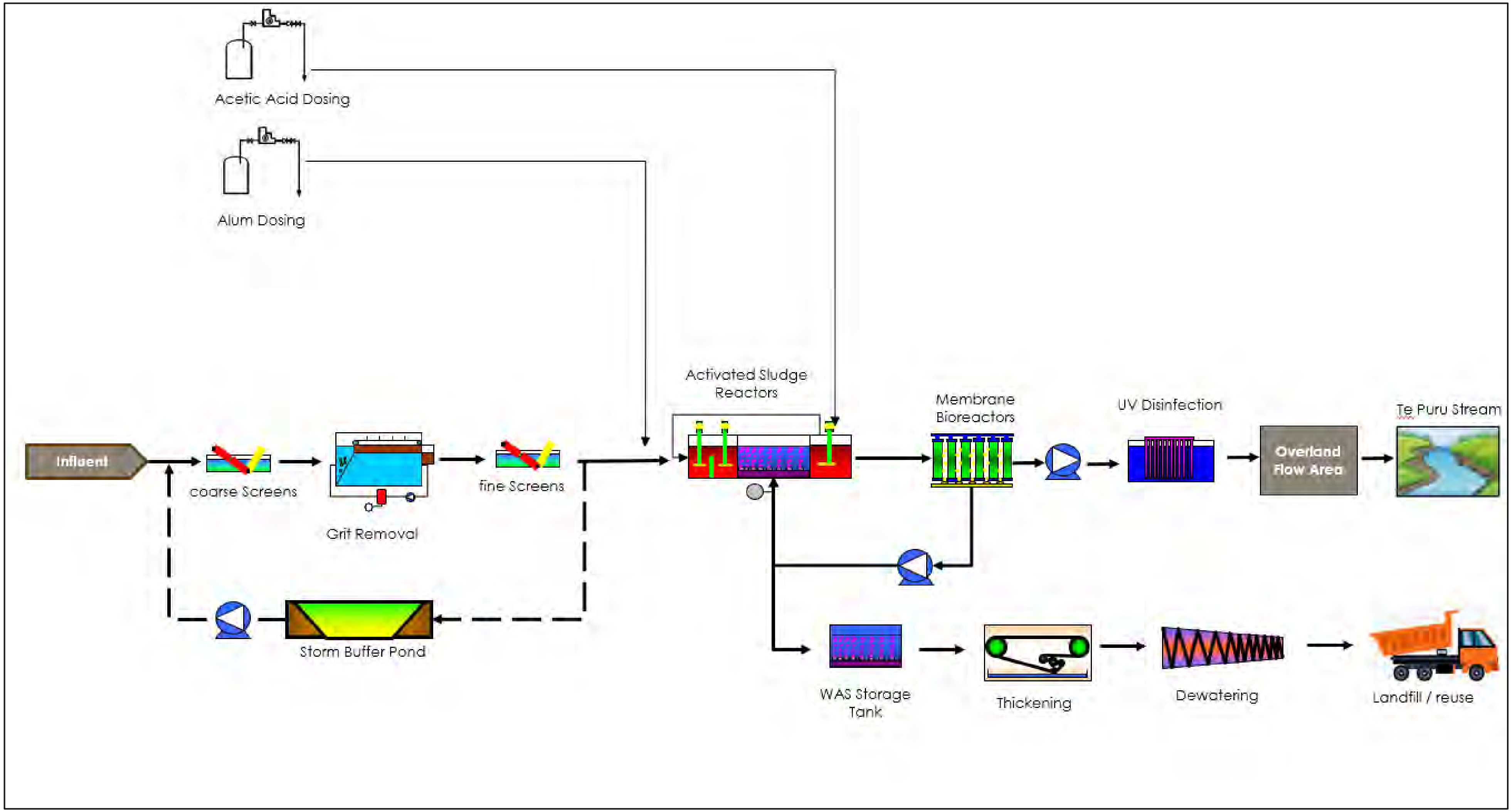


Figure 2-19: Beachlands WWTP Long-term Stage 1 and 2 Indicative Process Flow Diagram

2.7.6 WWTP Upgrade Staging

The timing of the upgrades based on the Servicing Strategy[4] population growth forecast is presented in Figure 2-20.

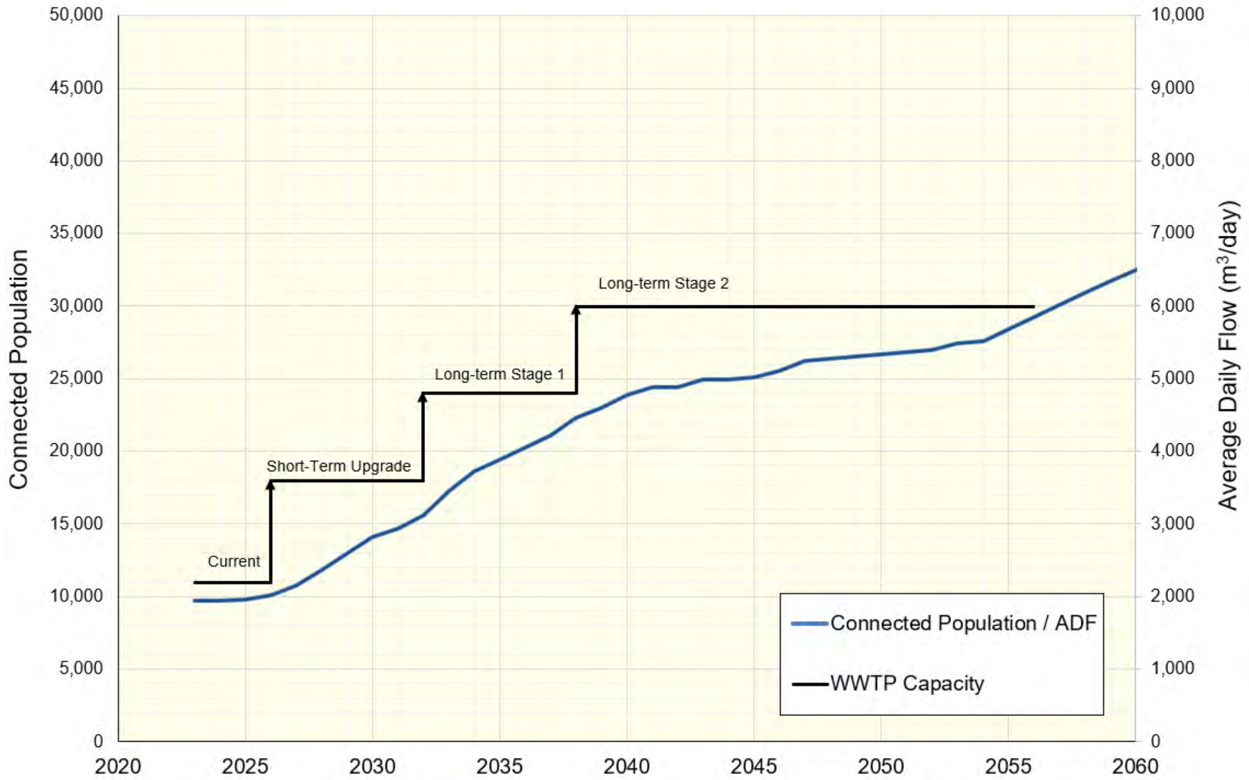


Figure 2-20: Beachlands WWTP Upgrade Staging and Forecast Population from Servicing Strategy

The following points should be noted regarding the WWTP staging: Figure 2-20: Beachlands WWTP Upgrade Staging and Forecast Population from Servicing Strategy

- As the WWTP is currently at its design capacity, the Short-term upgrade is required as soon as possible to avoid the WWTP restricting growth and housing developments within Beachlands-Maraetai. A commissioning date of December 2026 is considered a stretch but achievable target for this upgrade however to allow some contingency a latest date for completion of the Short-term upgrade is December 2031.
- As noted previously, the timing of the new WWTP Long-term Stage 1 upgrade will depend on future population growth. The timing shown in Figure 2-20 is the earliest date based on the population growth and assumes that the Private Plan Change 88 (PPC88) application is successful. If growth of Beachlands-Maraetai does not occur at the rate presented in Figure 2-20 then the Short-term upgrade operation will be extended and the new MBR WWTP design will be delayed until such time as the connected population approaches the Short-term design capacity.

2.7.7 Treated Wastewater Quality

Treated wastewater quality consent limits for the WWTP upgrades are presented in Table 2-3.

[4] Servicing Strategy for Beachlands, Maraetai and Whitford (Watercare, May 2023)

Table 2-3: Beachlands WWTP Treated Wastewater Quality Consent Limit Summary

Parameter	Units	Existing WWTP		New WWTP	
		Current and Short-term Upgrade		Long-term Stages 1 and 2	
		Median	95th %ile	Median	95th %ile
BOD	mg/L	7.0	15	5.0	9.0
TSS	mg/L	7.0	15	5.0	9.0
NH_4-N	mg/L	0.6	3.0	0.5	3.0
NO_x-N	mg/L	3.5	11	2.0	4.5
SIN	mg/L	4.1	14	2.5	7.5
DRP	mg/L	1.0	3.0	0.5	1.0
Faecal coliforms	cfu/100 mL	<10	100	<10	100

2.8 Wastewater Scheme Management

2.8.1 General Management Policies and Plans

The upgraded and new WWTP will be based on modern design and construction techniques. These will be integrated into Watercare's wastewater management and operation procedures, policies and plans. The following presents a summary of a number of these procedures, policies and plans.

2.8.1.1 Watercare's Statement of Intent

Watercare's Statement of Intent (**SOI**) sets the overall strategic direction and objectives for Watercare, to be achieved through the delivery of major projects such as the Beachlands WWTP. A key activity identified in the SOI for 2023 – 2026 is delivering safe and reliable water and wastewater services to Aucklanders 24 hours, seven days a week.

2.8.1.2 Strategic Planning

This project is part of Watercare's strategic planning approach, not only in terms of securing effective and efficient resource consents but also in providing wastewater servicing capacity to meet the current and future planned residential, business and industrial (trade waste) requirements.

2.8.1.3 Consent Compliance

Ensuring a high level of compliance with their resource consents is a key objective of Watercare. Watercare's annual report contains a number of performance measures related to compliance with wastewater discharge permit conditions. The current SOI sets a performance target of 100% of wastewater discharged from treatment plants complying with consent conditions. A high level of importance is attached to effective communication with officers of Auckland Council in respect of resource consent matters. Associated with consent compliance is the management of trade wastes in accordance with the Trade Waste Bylaw 2013 and individual trade waste agreements.

Section 2.4.2 of this AEE traverses the WWTP's resource consent compliance.

2.8.1.4 Asset Management

Watercare has a well-developed asset management planning approach and practice as set out in the Asset Management Plan 2021 - 2041 (**AMP**). The AMP is Watercare's tactical plan for managing the company's infrastructure cost-effectively to achieve long-term strategic goals. The plans outline 20-year forecasts of asset strategies and 10-year capital expenditure to achieve defined levels of service and performance standards.

Watercare is committed to best-practice asset management across the business. The aim is to align the asset management systems with the international standard ISO 55000:2018 - Asset Management System and follow the guidelines of the International Infrastructure Management Manual.

The Asset Management Policy outlines how Watercare plans, designs, constructs, acquires, maintains, operates, rehabilitates and disposes of their assets. Watercare keeps in mind both present and future customers by considering the assets in a manner that:

- Protects the public health of the community and provides a defined level of service to customers.
- Takes an asset life-cycle approach.
- Develops cost-effective management strategies for the long term, including optimising the cost of maintaining and operating networks.
- Manages risks associated with asset failure.
- Uses physical resources sustainably and cares for the natural environment.
- Continuously monitors and improves asset performance and management practices.

Watercare's high-level asset management objectives are as follows:

- To operate and maintain the water and wastewater systems in an efficient manner.
- To ensure there is sufficient infrastructural capacity to meet growth in demand.
- To meet regulatory requirements and levels of service.
- To replace assets as they reach the end of their economic lives.
- To respond and adapt to climate change.

Watercare's Wastewater-specific principles are as follows:

- Wastewater treatment plant capacity will be augmented to match growth in demand and to maintain compliance with the facilities' discharge consents.
- Augmentation of the wastewater transmission and local networks will be carried out prior to the peak dry-weather flow exceeding the capacity of the network and in accordance with discharge consent conditions.
- It is recognised that the network discharge consent sets the performance standard for the wastewater network and the investment required.
- Cross-connections from the stormwater system to the separated wastewater network are not permitted.
- The wastewater system is for the conveyance of wastewater only; therefore, as much as practical, stormwater and groundwater will be diverted from the system.
- An inflow and infiltration (I&I) reduction programme will be progressed and enhanced to maximise the use of existing assets.
- As the transmission system reaches capacity, Watercare will augment the interceptors by truncating the catchment or diverting flow to an adjacent interceptor.
- High-risk rising mains and inverted siphons will be duplicated to provide redundancy.
- Wastewater treatment plants will be regarded as 'resource recovery plants'. This means that, where possible and practicable, energy, biosolids and other resources will be beneficially reused.

In support of infrastructure delivery, Watercare has dedicated resources tasked with the development and maintenance of a dedicated organizational technical standards framework; known as the Engineering Standards Framework. This contains design guidelines to ensure adequate levels of design and construction quality to achieve the asset management principles in the plan.

Key components are:

- Appropriate materials of construction.
- Approved equipment vendors.
- Construction standards.

- Equipment redundancy policies:
  - Spare (n-1) treatment units in-site to continue operation in the case of failure.
  - Stand-by power generation in the case of electricity grid interruptions.
  - Spares held in Mangere Watercare Stores common to all sites to quickly supply common spares when required.

2.8.2 Trade Waste Management

Trade waste is regulated by the Trade Waste Bylaw 2013 which puts in place procedures to manage the risk of trade wastes discharges to the wastewater network. Watercare has delegated authority from Auckland Council to administer and enforce this Bylaw and any related trade waste controls. Any potential wet industries producing significant industrial/trade waste wastewater wishing to connect to the Beachlands WWTP would need to enter into a Trade Waste Agreement (**TWA**) with Watercare to discharge into the system via Auckland Council's Trade Waste Bylaw; no such industries are anticipated at the present time.

Before entering into a TWA Watercare ensures that the network and WWTP have capacity for the volume and flow rate requested. If capacity is available, Watercare carries out risk assessments on the characteristics of the discharge to determine the necessary terms of the TWA; and to set up an appropriate monitoring programme for the site. This includes assessing the adequacy of the pre-treatment processes in place and their maintenance and requesting improvements to trade waste management as necessary.

Within the Beachlands WWTP catchment the Pine Harbour Water Treatment Plant has a TWA to discharge wastewater from the regeneration of their ion exchange cartridges. This is currently the highest risk trade waste in the catchment. Other trade waste discharges in the catchment are classified as lower risk and do not need a TWA with specific conditions. Examples of these activities include cafes, shops, hairdressers, car wash facilities etc.

2.8.3 Operation and Management Procedures

The Beachlands WWTP currently has an Operation and Maintenance Manual (**O & M Manual**). Watercare updates this manual as necessary to cover changes to operating and maintenance requirements resulting from plant upgrades. The O & M Manual will need to be updated when the WWTP is upgraded and the new WWTP developed.

2.8.4 Management of Biosolids and other Residuals

Currently biosolids produced by the WWTP are stabilised in two sludge lagoons over the winter months and dried on sand drying beds over summer prior to trucking the dried biosolids to Hampton Downs Landfill.

The current biosolids management system will be maintained following the Short-term upgrade. For the Long-term upgrade, new biosolids handling facilities will be constructed to replace the lagoons and drying beds. It is expected that the new facilities will include a waste activated storage tank, followed by mechanical thickening and dewatering of the sludge. Dewatered sludge cake will be trucked to landfill in covered bins.

2.8.5 Stormwater Management

Stormwater management on the WWTP site is subject to Discharge Permit # 33614 which authorises the diversion and discharge of stormwater from 2,900m^2 of new impervious surface that was created as part of the WWTP upgrade in 2009.

Stormwater flows from the impervious surfaces at the site are diverted and discharged to a 215m long and 2m wide grass swale which provides water quality treatment prior to discharge to a tributary of the Te Puru Stream.

Planting as required by Discharge Permit # 33614 has been carried out over 1.7ha which was put in place instead of attenuating the ten-year storm event (10 year ARI) and providing extended detention. The planting is a mix of riparian planting and native revegetation of pasture and exotic planting. Operations and Maintenance are carried out in accordance with an Operations and Maintenance Plan and compliance is reported on the WWTP Annual Report.

2.8.6 Climate Change and Natural Hazards

The extensive alternatives assessment included a resilience assessment criterion that includes natural hazards and climate change. All the options were assessed against this criterion in the determination of the technical BPO. This assessment included addressing the carbon component of Watercare's 40:20:20 policy.

The 40:20:20 goal represents Watercare's commitment to the environment, its workforce, and its customers. The numbers stand for a 40% reduction in construction carbon emissions, 20% reduction in construction costs, and 20% yearly improvement in wellbeing, health and safety.

Climate change has been factored into the design wet weather flows in this application so that the upgraded WWTP will be able to remain operational and treat wet weather flows during extreme wet weather events such as occurred in the Auckland Anniversary floods of 2023.

3. Description of Receiving Environments

3.1 Existing Environment

As the current discharge is to be re-consented it cannot be treated as forming part of the existing environment beyond the term of the existing consent. Therefore, any effects assessment cannot include effects resulting from the exercise of the current consent. The baseline against which effects must be assessed is the environment without the current consented discharge occurring. In the case of a freshwater discharge, the best guide to the existing environment without the discharge occurring is the existing environment in the freshwater body upstream of and unaffected by the current discharge. This principle has been established through case law.

While the current discharge is not part of the existing environment, it is discussed in the application because it provides crucial context to the application. The current discharge can be referenced in the effects assessment as a point of comparison with the proposed discharge.

3.2 Cultural Setting Ngāi Tai Ki Tāmaki

The Beachlands Wastewater Scheme is within the rohe of Ngāi Tai Ki Tāmaki and sits within their Statutory Acknowledgement Area which has been identified and described in Ngāi Tai Ki Tāmaki Claims Settlement Act 2018 and the AUP.

In respect to their cultural setting and aspirations, Ngāi Tai Ki Tāmaki has recently published *'Ngāi Tai Ki Tāmaki Take Taiaomaurikura – September 2022'* which sets out the expectations and actions to protect and restore the Mauri of Te Taiao in the rohe of Ngāi Tai ki Tāmaki.

Ngāi Tai Ki Tāmaki Claims Settlement Act 2018 contains statements of association which help to provide an insight into the cultural setting of the Beachlands area[5]. Locations that are described and that are relevant to the WWTP and the discharge to a tributary of the Te Puru Stream are the Coastal Marine Area, the Hauraki Gulf/Tikapa Moana and Whakakaiwhara ki Umupuia ki Maraetai ki Okokino. Noting that this needs to be confirmed by Ngāi Tai Ki Tāmaki.

Ngāi Tai ki Tāmaki and Watercare are continuing to engage and are working together to develop a cultural statement for the project.

Ngāi Tai ki Tāmaki have communicated that they wish to formally respond the application by way of a cultural statement however, this will occur following lodgement of the application.

3.3 Overland Flow Area

While the current WWTP is in operation, the proposal will involve the continued discharge of treated wastewater to a tributary of Te Puru Stream via the existing overland flow area. Following the short-term and Long-term upgrades, the discharge will occur via an expanded overland flow area. The expansion of the overland flow system will commence as part of the Short-term upgrade, and the area will be further expanded as part of each of the Long-term upgrades.

The existing overland flow area (shown in Figure 3-1 and location identified in Figure 3-2) is located to the south of the WWTP, immediately adjoining the farm pond within the tributary of Te Puru Stream. The existing overland flow area is approximately 1.5 hectares and has an average slope of approximately 10-14% with an average fall over the length of the dispersal area of approximately 10 m. The upper portion of the overland flow area contains the treated wastewater dispersion infrastructure and the length of the overland flow area below the dispersion infrastructure ranges from approximately 50 to 100 m.

As shown in Figure 3-2, the existing overland flow area is part of a significant ecological area (SEA) identified in the AUP. This is SEA_T_428 which has been identified as being significant because of its threat status, rarity and diversity. The area is fenced and contains a mix of exotic and indigenous vegetation. The SEA connects to SEA_T_5259 (a larger contiguous area of complex native vegetation, including regenerating and semi-mature native forest). Despite the AUP SEA

[5] Appendix 21 to the Auckland Unitary Plan, Treaty Settlement Legislation – Statutory Acknowledgements

classification, PDP has identified[6] that the existing overland flow area and farm pond, are not natural ecosystems and do not meet the SEA or natural wetland criteria.

In an ‘Assessment of Overland Flow System Treatment Performance – Memorandum 3 (Interim)’ PDP identifies characteristics of the existing overland flow area that impact its performance. These include higher flow rate to some zones within the overland flow area, uneven distribution of the wastewater across the slope and associated channelisation of the flow. These limitations with the existing overland flow area will be addressed under the conditions of the consent being sought in this application (see section 10.5 below).

In a ‘Preliminary assessment of land area requirements for overland flow system expansion’ PDP has identified three feasible additional overland flow areas within the land owned by Watercare. These are areas A, B1 and B2 on Figure 3-2. Of these three areas PDP has identified area B2 as preferred and Watercare proposes to adopt this recommendation. While the topography within area B2 varies, PDP has identified that it contains sufficient land with a slope ranging from 2-12% to make it feasible for the WWTP’s expanded overland flow system.

Area B2 is covered with exotic grassland, and the riparian margin of the adjoining stream is dominated by indigenous shrubland, but also includes regional pest plant species such as crack willow and grey willow. Wetlands have also been identified in gullies and the riparian margins adjoining area B2. The riparian margins adjoining B2, although not area itself, are identified as part of SEA_T_428 in the AUP.

It is proposed that the final area, location and design of the additional overland flow areas will be determined under conditions of the resource consent. Further details on this proposal are provided in Section 10.5 below.

[6] See ‘Assessment of Potential Effects on Soils and Ecology from Beachlands WWTP Overland Flow System (Memorandum 4)’

Figure 3-1: Overland Flow Area feed pipes (top) and farm pond (bottom)

(Source: Stewart, M., James, M., and Sim-Smith, C. (2024) Beachlands Wastewater Treatment Plant – ecological and human health effects assessment. Report WSL2303–D1, Streamlined Environmental)

Figure 3-2: Location of existing and potential overland flow areas

(Source: Beachlands WWTP: Preliminary assessment of land area requirements for overland flow system expansion – Memorandum 1, PDP, 22 March 2024)

3.4 Te Puru Stream and Tributaries

3.4.1 Catchment Overview

The WWTP is located in the headwaters of the Te Puru Stream which flows to Te Maraetai / Kellys Beach on the eastern side of Te Puru Park and the inter-tidal flats of Te Maraetai / Kellys Beach (see Figure 3-3). The stream catchment contains low relief, mainly in dairy and sheep pasture, with areas of exotic forestry on open land and regenerating native bush in stream gullies and some open slopes. The lower reaches of the stream have a wide range of saline habitats including mangroves, raupō and Scirpus sedgeland. The stream reach within the WWTP site has a grade of approximately 2–4%.

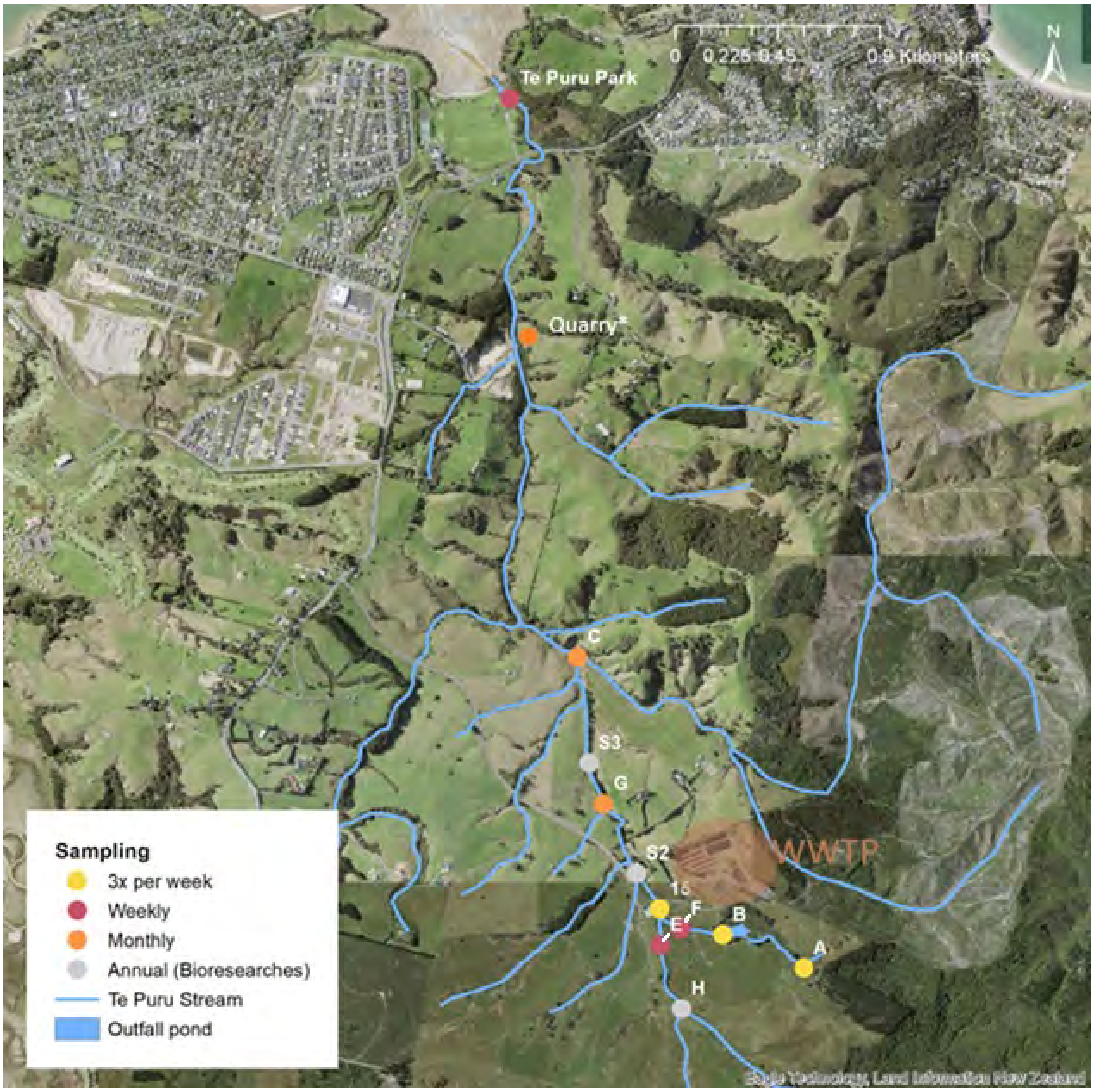


Figure 3-3: Location of the Beachlands WWTP (brown oval) within the Te Puru catchment, showing water quality and annual ecology monitoring sites[7]

[7] Stewart, M., James, M., and Sim-Smith, C. (2024). Beachlands Wastewater Treatment Plant – water quality, ecological and human health effects assessment. Report WSL2303–F2, Streamlined Environmental (hereafter 'Stewart et al')

3.4.2 Hydrology and Hydrodynamics

Te Puru Stream involves a series of tributaries joining the main stem at various locations above and below the wastewater discharge. The entrance of Te Puru Stream to the estuary is over a riffle section of steeply inclined stream bed at all tidal stages, clearly defining the upper limit of saline influence to below the Quarry site.

Between 2019 and 2023 annual rainfall within the catchment ranged from 867 mm to 1803 mm, with an average of 1272 mm. 2023 was the wettest year with 1803mm of rain (average of 150mm per month). In comparison, October 2023 (66mm), January 2024 (57mm), and February 2024 (6mm) were particularly dry months.

Flow in Te Puru Stream is highly dependent on rainfall. However, once effects of rainfall runoff have cleared, it is estimated that the farm pond, into which the WWTP discharges from the overland flow area, contributes around 20% of the total flow at the downstream Quarry site[8].

The hydrodynamics of Te Maraetai / Kellys Beach change significantly depending on the tides due to the large area of inter-tidal flat. At low tide the lowest levels of dilution occur along the sub-tidal channel but will be along the waterline on the incoming tide. At high tide the dilution is lowest at the eastern end of the beach and highest at the western end.

3.4.3 Water and Sediment Quality State

Table 3-1 compares the results from water quality monitoring within Te Puru Stream with relevant guideline values[9]. The locations of the monitoring sites are shown on Figure 3-3 above. As noted in Section 3.1, the monitoring sites upstream of the WWTP discharge (sites A and E in Exceedances of Auckland Council (AC) and ANZG (2018) guidelines and NPS-FM national bottom line (NBL) are bolded red. Results from sites indicative of the existing environment are shaded grey.

Table 3-1) are indicative of the 'existing environment', while data from the downstream monitoring sites provides important context for consideration of the proposed discharges. The data shows that:

- Water in Te Puru Stream is generally well oxygenated, with dissolved oxygen (**DO**) similar upstream and downstream of the WWTP.
- Water temperature is above guideline levels at all sites and slightly elevated at downstream sites relative to upstream sites.
- Low pH appears to be more an issue than high pH in the receiving environment and appears to be driven by the upstream farm pond, not the WWTP discharge.
- Biochemical oxygen demand (**$cBOD_5$**) is at low concentrations and similar upstream and downstream of the WWTP discharge.
- Conductivity at all sites is above Australian and New Zealand Guidelines (**ANZG**) 95% default guideline values (**DGV**) and there is a clear influence of the WWTP discharge on conductivity in sites downstream.
- There was no evidence of any significant salinity ingress into the WWTP (influent maximum 2.4 parts per thousand (**ppt**) and discharge maximum 1.4 ppt), or any receiving environment site upstream of Te Puru Park.
- Total suspended solids (**TSS**) and turbidity are low and at similar concentrations in receiving environment sites upstream of the Quarry site and unrelated to the WWTP discharge.
- Nitrogen concentrations are elevated at sites downstream of the WWTP discharge relative to concentrations observed upstream. Ammoniacal-N and nitrate-N concentrations upstream of the WWTP discharge place them in National Policy Statement for Freshwater Management (**NPS-FM**) attribute band A for toxicity. Whereas downstream, after the potential mixing zone for the WWTP discharge (at Bridge site (15)) Ammoniacal-N and nitrate-N concentrations place them in NPS-FM attribute band B for toxicity. Dissolved inorganic nitrogen (**DIN**) at the same site is above levels that would be expected to contribute to eutrophication and is higher than at the upstream sites.
- Phosphorus shows a similar pattern to nitrogen with concentrations upstream meeting guideline values, while concentrations at sites downstream are higher and do not meet guideline values.

[8] See section 4.3 of Stewart et al.

[9] See section 4.4.1 of Stewart et al for explanation of the guideline values selected.

- Chlorophyll a is not measured in the influent or discharge. Concentrations are slightly elevated at the farm pond and farm pond downstream site, but back to upstream levels by the Bridge site.
- Bacteria – *Escherichia coli (***E. coli**), Faecal Coliform (**FC**), and enterococci – concentrations are higher upstream of the WWTP discharge, suggesting catchment sources dominate. E.coli concentrations do not meet guideline values at any of the sites in the catchment.

Water and surficial sediment samples at sites A (upstream pond), B (farm pond) and 15 (bridge) have been analysed for metal concentrations. The results show that all metal concentrations measured were below the applicable ANZG 95% DGV[10]. The surficial sediment samples were also analysed for phosphorous. The results indicate that sediment phosphorous is higher at Bridge site 15, although it is noted that earlier studies indicate that sediment phosphorous is relative static over decadal timeframes which suggests the farm pond, into which the WWTP discharges via the overland flow area, has the capacity to absorb phosphorous in the water column.

Finally, pharmaceutical and personal care products (**PPCPs**) (a subset of emerging organic contaminants (**EOCs**)) were sampled at the same three sites in November 2023[11]. Upstream of the WWTP discharge, at site A, PPCPs were mostly below detection limits. However low levels of wastewater markers (e.g. caffeine) were detected indicating the presence of wastewater upstream of the WWTP discharge, most likely from septic tanks. Results for sites B and 15 showed that the farm pond concentrations were consistently higher than site 15. These results indicate that an average attenuation of PPCPs of 2.9-fold is achieved by the overland flow system and farm pond.

3.4.3.1 Temporal Trends

Table 3-2 provides results from a temporal trend analysis that was undertaken on water quality data from the upstream farm pond (A) and farm pond (B) sites from February 2020 to March 2023. The parameters included in the analysis are only those likely to be impacted by the WWTP discharge, namely water temperature, ammoniacal-N, nitrate-N, Total Phosphorous (**TP**), and DRP. For the upstream farm pond (A) site there were no significant trends for all parameters, suggesting changes to catchment land use that may affect water quality at this site are not occurring on this time scale. For the farm pond into which the WWTP discharges via the overland flow area (site B) there was a statistically significant and meaningful increase in nitrate-N. All other trends were not statistically significant. The increase in nitrate-N observed at site B is consistent with an increase in nitrate-N in the WWTP discharge since 2020 (see Figure 2-11 above).

As noted in Section 2.4.3, the increase in nitrate-N in the discharge is the result of Watercare optimising their chemical dosing strategies. Figure 2-11 illustrates that during this period the plant continued to perform well below consented limits so there was scope to adjust chemical dosing rates and reduce operating costs.

[10] See Table 10 and Figure 27 in Stewart et all, 2024.

[11] For further detail, see section 4.4.1.5 of Stewart et all, 2024

Exceedances of Auckland Council (AC) and ANZG (2018) guidelines and NPS-FM national bottom line (NBL) are bolded red[12]. Results from sites indicative of the existing environment are shaded grey.

Table 3-1: Comparison of receiving environment water quality parameters from September 2023 to January 2024 with applicable guideline

Site/Parameter		WWTP Inlet	WWTP Outlet	Upstream Farm Pond (A)	Farm Pond (B)	Farm Pond downstream (F)	Bridge (15)	Tributary upstream (E)	Quarry	Te Puru Park[1]	Statistic	Guideline Value	Source[2]
Number of data	N	57	58	57	57	19	58	19	11	19			
DO	mg/L	0.1	0.8	**1.2**	**3.6**	7.4	5.2	5.9	7.0	5.6	1-day minimum (summer)[3]	4.0	NPS-FM NBL
Temperature	°C	23.0	25.7	**22.3**	**25.4**	**25.5**	**23.2**	**21.6**	**21.9**	23.3	Maximum (summer)[3]	17.7	AC
pH	unitless	7.40	7.30	6.80	7.50	7.70	7.40	7.24	7.50	7.74	80th %ile	7.70	ANZG WWLE[13]
pH	unitless	7.10	7.04	**6.60**	**7.20**	7.56	**7.20**	**7.00**	**7.10**	7.26	20th %ile	7.26	ANZG WWLE
$cBOD_5$	mg/L	230	5.7	1.1	1.1	1.1	0.7	0.5	0.9	0.7	Median	No guideline	
Volatile Solids	mg/L	237	7.0	4.6	5.2	6.0	4.9	4.4	11.6	10.4	Median	No guideline	
Conductivity	µS/cm	2,442	2,072	**213**	**1,552**	**1,236**	**965**	**176**	**557**	18,760	80th %ile	115	ANZG WWLE
Salinity	ppt	0.9	0.7	0.1	0.6	0.6	0.3	0.1	0.2	5.6	Median	No guideline	
TSS	mg/L	395	10.2	**12.4**	**12.0**	**13.9**	**9.5**	8.3	**50.8**	66.0	80th %ile	8.8	ANZG WWLE
Turbidity	NTU	160	2.0	**15.0**	**7.0**	**6.2**	**10.4**	**13.4**	**60.0**	55.0	80th %ile	5.2	ANZG WWLE
TN	mg/L	71.0	7.3	0.23	**4.6**	**4.7**	**2.4**	**0.31**	**1.10**	1.10	80th %ile	0.292	ANZG WWLE
NH_4-N (Attribute Band)	mg/L	51.5	0.38	0.03	**0.29**	0.21	0.07	0.02	0.04	0.04	Median	0.24	NPS-FM NBL
		NA	NA	(A)	**(C)**	(B)	(B)	(A)	(B)	NA			

[12] Source: Stewart et al

[13] WWLE = warm-wet low elevation

Site/Parameter		WWTP Inlet	WWTP Outlet	Upstream Farm Pond (A)	Farm Pond (B)	Farm Pond downstream (F)	Bridge (15)	Tributary upstream (E)	Quarry	Te Puru Park[1]	Statistic	Guideline Value	Source[2]
NH_4-N (Attribute Band)	mg/L	63.1	0.04	0.05	**0.48**	0.35	0.24	0.03	0.10	0.22	95th %ile	0.40	NPS-FM NBL
		NA	NA	(A)	**(C)**	(B)	(B)	(A)	(B)	NA			
NO_3-N (Attribute Band)	mg/L	0.02	5.1	0.02	**2.8**	**3.2**	1.6	0.1	0.6	0.5	Median	2.4	NPS-FM NBL
		NA	NA	(A)	**(C)**	**(C)**	(B)	(A)	(A)	NA			
NO_3-N (Attribute Band)	mg/L	1.3	6.4	0.1	**3.8**	**3.8**	2.1	0.1	0.9	0.8	95th %ile	3.5	NPS-FM NBL
		NA	NA	(A)	**(C)**	**(C)**	(B)	(A)	(A)	NA			
NO_2-N	mg/L	0.020	0.020	0.002	0.002	0.002	0.002	0.002	0.002	0.002	Median	No guideline	
DIN (mg/L)	mg/L	52.67	5.52	0.05	**3.19**	**3.42**	**1.72**	0.14	0.47	0.54	Median	1.00	SRC[14]
TP	mg/L	9.07	1.12	**0.045**	**0.580**	**0.596**	**0.297**	**0.030**	**0.100**	0.087	80th %ile	0.024	ANZG WWLE
DRP[4] (Attribute Band)	mg/L	4.92	0.73	0.014	**0.374**	**0.370**	**0.182**	0.014	**0.034**	0.027	Median	0.018	NPS-FM
		NA	NA	(C)	**(D)**	**(D)**	**(D)**	(C)	**(D)**	NA			
DRP[4] (Attribute Band)	mg/L	6.51	1.09	0.026	**0.499**	**0.503**	**0.251**	0.026	**0.066**	0.046	95th %ile	0.054	NPS-FM NBL
		NA	NA	(B)	**(D)**	**(D)**	**(D)**	(B)	**(D)**	NA			
Chla	mg/L	ND	ND	0.0009	0.0019	0.0023	0.0007	0.0006	0.0018	0.0014	Median	No guideline	
E. Coli	cfu/100mL	4,800,000	2	**1,250**	**510**	**540**	**540**	**930**	**480**	530	Median	130	NPS-FM NBL
E. Coli	cfu/100mL	10,200,000	17	**4,815**	**2,460**	**1,530**	**3,415**	**3,780**	**2,650**	6,320	95th %ile	1200	NPS-FM NBL
FC	cfu/100mL	8,200,000	2	1,750	650	770	715	1,300	590	690	Median	No guideline	
Enterococci	cfu/100mL	1,400,000	2	97	86	130	230	480	365	110	Median	No guideline	

[14] Southland Regional Council

Table 3-2: Summary of analysis of trends for selected parameters between 2020 and 2023 for upstream farm pond and farm pond sites[15]

Site	Parameter	Unit	Method	Seasonal variation	Mean	Max	Min	Median	Kendall statistic	P	Median annual slope	Percent annual change	Likelihood	Trend direction and confidence
Upstream	Temperature	°C	Seasonal Kendall	0.000	17.3	22.7	12.9	16.9	0	1.000	0.033	0.2	0.500	No detectable trend
Upstream	NH_4-N	mg/L	Mann-Kendall	0.633	0.40	0.40	0.40	0.40	0	1.000	0.000	0.0	0.500	No detectable trend
Upstream	NO_3-N	mg/L	Seasonal Kendall	0.014	0.04	0.16	0.02	0.02	-1	1.000	0.000	0.0	0.876	Trend exceptionally unlikely
Upstream	TP	mg/L	Mann-Kendall	0.124	0.09	0.18	0.02	0.07	5	0.856	0.000	0.0	0.572	Trend unlikely
Upstream	DRP	mg/L	Mann-Kendall	0.075	0.025	0.050	0.010	0.023	-3	0.927	0.000	0.0	0.573	Trend extremely unlikely
Downstream	Temperature	°C	Seasonal Kendall	0.000	18.2	23.1	12.6	18.3	0	1.000	0.054	0.3	0.500	No detectable trend
Downstream	NH_4-N	mg/L	Seasonal Kendall	0.032	0.40	0.43	0.40	0.40	1	1.000	0.000	0.0	0.500	Trend exceptionally unlikely
Downstream	NO_3-N	mg/L	Mann-Kendall	0.918	1.57	3.12	0.02	1.68	70	0.002	0.716	42.7	0.999	Increasing trend virtually certain
Downstream	TP	mg/L	Seasonal Kendall	0.010	0.33	0.56	0.10	0.35	1	1.000	0.082	23.3	0.549	Trend exceptionally unlikely
Downstream	DRP	mg/L	Seasonal Kendall	0.006	0.201	0.330	0.030	0.228	3	0.371	0.049	21.6	0.831	Increasing trend about as likely as not

[15] Source: Appendix 2 of Stewart et al, 2024

3.4.4 Freshwater Ecology

Data on the ecology of Te Puru Stream has been collected on behalf of Watercare from stream monitoring at sites H and E (upstream / reference sites), A and F (farm pond tributary) and S2, G, S3 and C (Te Puru Stream tributary) on several occasions since 2016 (see Figure 3-3 for the location of this sampling sites)[16].

Results from the recent 2024 survey indicate that:

- Macrophyte diversity and the percentage of macrophyte and algae cover generally increased downstream of the discharge.
- With respect to macroinvertebrates:
  - There were higher numbers of species at the upstream sites, while species numbers in the downstream sites increase with distance from the WWTP discharge.
  - The percentage of sensitive species (**%EPT**) ranged from 22-30% at upstream sites, with either no EPT or virtually 0% EPT at downstream sites.
  - Upstream sites were on the border between 'good' and 'fair' in the Macroinvertebrate Community Index (**MCI**), and above the **AUP** minimum of 94 for rural areas. Downstream sites were in 'fair' and 'poor' MCI categories, and below the AUP minimum for rural areas.
  - The Semi-Quantitative Macroinvertebrate Community Index (**SQMCI**) showed similar results to MCI with upstream sites in the 'fair' or 'excellent' category, and above the NPS-FM NBL of 4.5, and downstream sites in the 'poor' or 'fair' category, but with only site F below the NPS-FM NBL of 4.5.
  - It is considered that the poor macroinvertebrate scores downstream of the discharge are likely to be due to a combination of stressors, including the existing WWTP discharge, decreased riparian vegetation and hard substrate.
- Native fish species abundance and diversity was higher at upstream than downstream sites, with upstream sites rating 'poor' or 'fair' and downstream sites 'very poor' or 'poor' under the Fish Index of Biotic Integrity (**IBI**).

Overall, the survey indicates that at present the Stream is subject to moderate adverse ecological effects. The existing WWTP discharge contributes to these adverse effects as do catchment land uses and other stressors, e.g. limited riparian planting and the nature of the stream substrate.

Analysis of temporal trends over 2016 to 2024 indicates that:

- For most sites the number of macrophyte and algae taxa appear to be stable or increasing since 2016, with generally more taxa recorded at downstream sites. A similar trend is noted for percentage macrophyte/algae cover.
- For macroinvertebrates:
  - Number of taxa appear to be stable or declining at the upstream sites and generally lower but stable or increasing at the downstream sites.
  - %EPT has remained very low and between 0% and 3% for downstream sites.
  - MCI scores for upstream sites have been relatively consistent and mostly above the AUP minimum for rural areas of 94. Whereas MCI scores for downstream sites while generally consistent have been below the AUP minimum for rural areas in almost all instances.
- With respect to native fish:
  - Numbers of species were generally low (1-5) for upstream sites and 0-4 for downstream sites with no apparent temporal trends were observed.
  - The number of native fish at upstream site H was declining from 2016 (38) to 2022 (14) but returned to near 2016 numbers in 2024 (36). Upstream sites E and A showed a general increase in the number of native fish.

[16] Information on the approach to sampling and analysis of the data is provided in section 4.6.1 of Stewart et al, 2024.

Of the downstream sites, site F had consistently very low numbers of native fish, while the numbers of native fish at other downstream sites varied.

- Fish IBI appears to be reducing at upstream site H, but stable or increasing at sites E and A. For downstream sites, site F has either no fish or a very low Fish IBI, while sites S2 and G appear to be generally improving.

3.5 Coastal Marine Area

For the purposes of this application the existing coastal and marine environment has been assessed at the following scales:

- Te Maraetai / Kellys Beach and entrance of Te Puru Stream
- Adjoining coastal area of Beachlands and Maraetai
- Adjoining offshore marine environment (Tamaki Strait)

An extract from the relevant NZ topographic map series 50 showing the general area of the assessment is included in Figure 3-4.

3.5.1 Te Maraetai / Kellys Beach & Te Puru Stream entrance

Te Puru Stream enters the marine coastal environment at Te Maraetai / Kellys Beach, which is located approximately midway between Beachlands and Maraetai. The lower, estuarine reaches of Te Puru Stream are strongly influenced by seawater inflow during high tide, with salinities of 20–35 ppt at high tide but decreasing to 5–15 ppt during low tide. The entrance to Te Puru Stream is identified as a Significant Ecological Area–Marine 1 (SEA-M1-42b) in the AUP due to the variety of saline vegetation and coastal vegetation present and the intact ecological sequence from estuarine to freshwater wetlands (see Figure 3-5). In addition, Te Maraetai / Kellys Beach and the surrounding coastal area is identified as a Significant Ecological Area–Marine 2 (SEA-M2-42a) due to the variety of intertidal habitats present that provide a habitat for a wide variety of marine organisms.

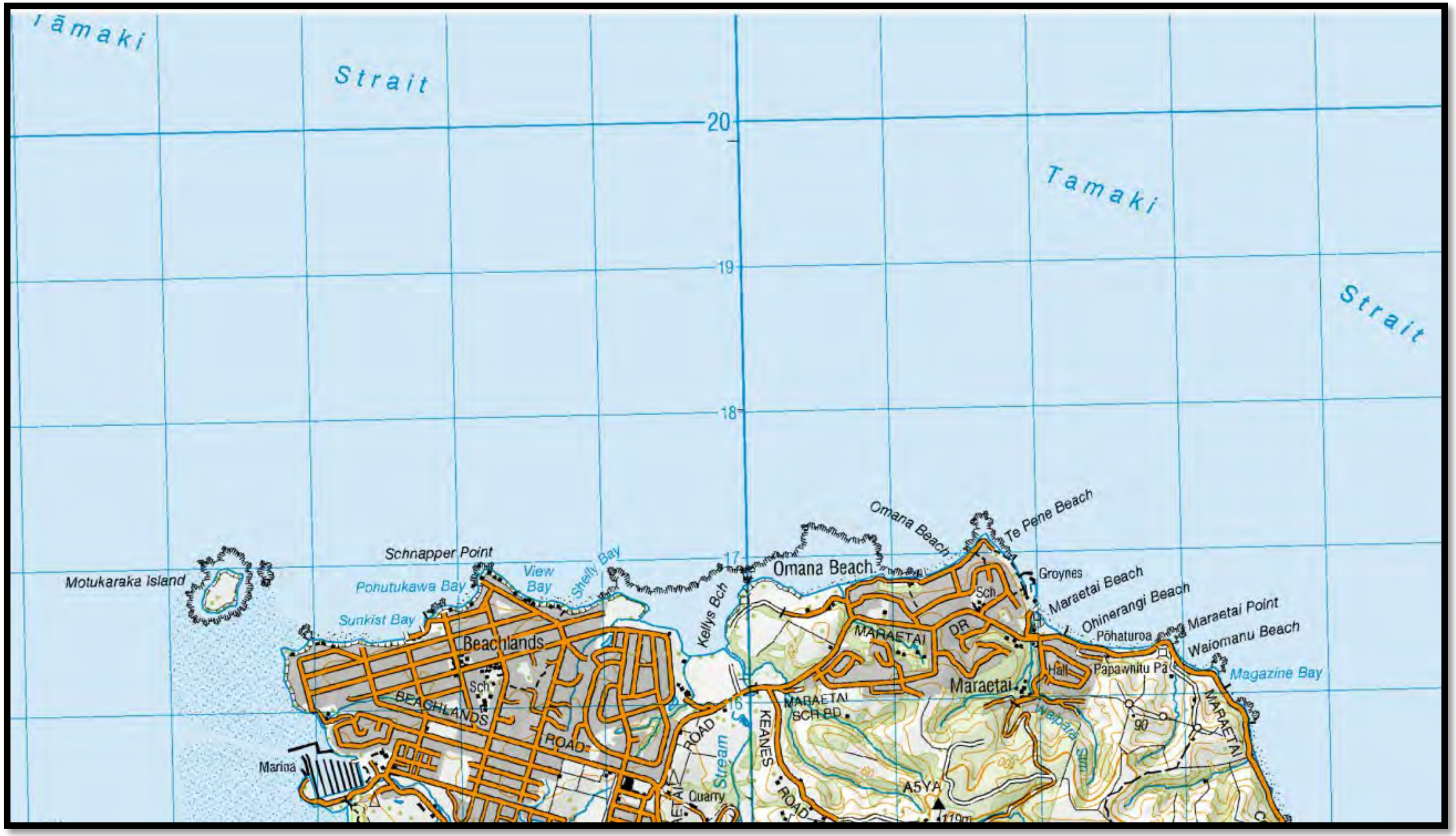


Figure 3-4 Topographical map showing Te Maraetai / Kellys Beach, the wider Beachlands and Maraetai coastal area and the Tamaki Strait offshore marine environment

(Source: NZTopo50 BA32 and BA33, Edition 1.07 Published in 2022.)

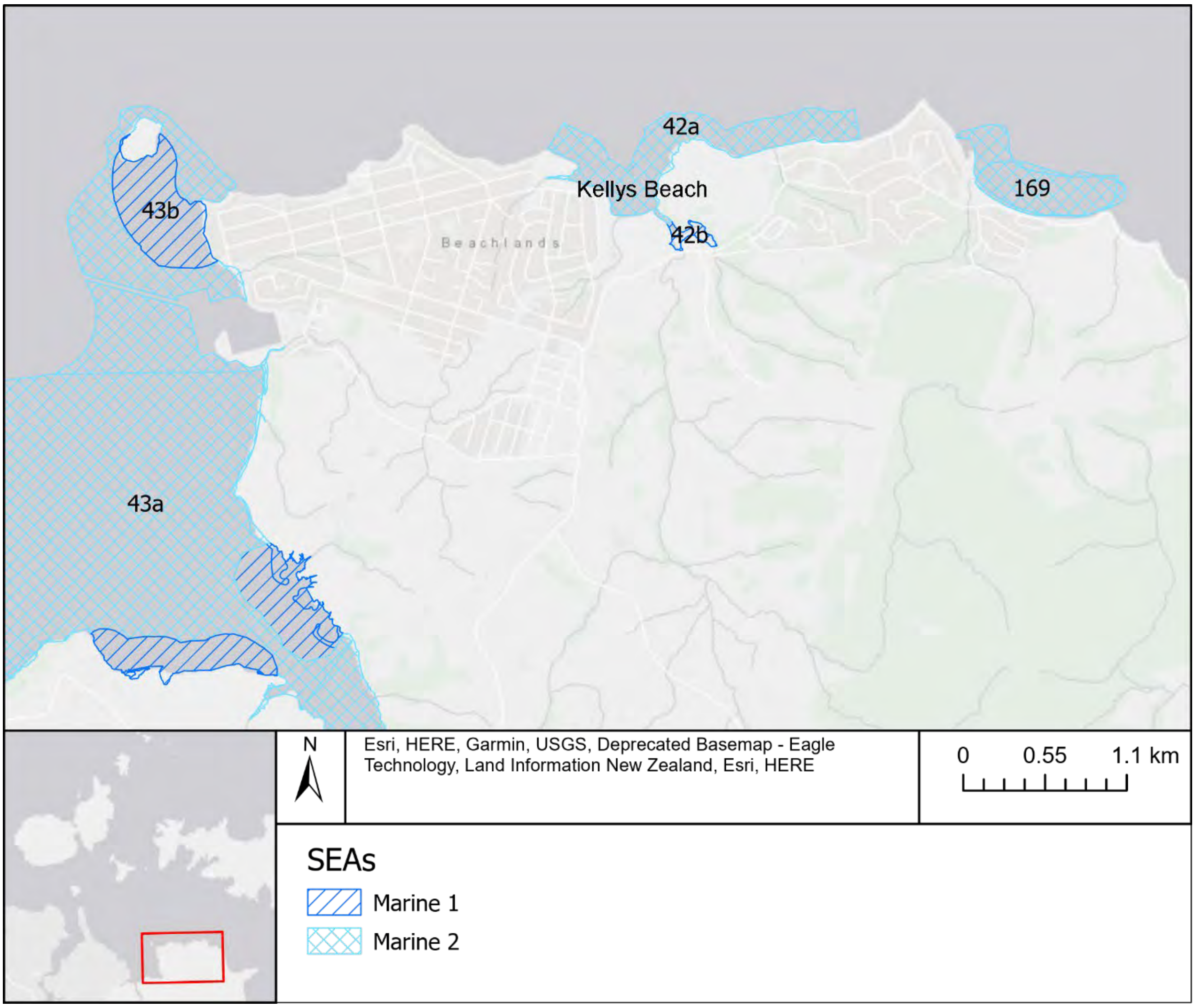


Figure 3-5: Auckland Unitary Plan 'Significant Ecological Areas – Marine' around Te Maraetai / Kellys Beach[17]

A survey of the intertidal area around Te Maraetai / Kellys Beach was conducted on 21st December 2023 around low tide to describe the intertidal marine community of the coastal receiving environment. The intertidal survey found that:

- Upper shore of Te Maraetai / Kellys Beach is very muddy with abundant crustacean burrows. Mangroves line the stream bank around the entrance to Te Puru Stream.
- Mid to lower shore is sandy with scattered shell/rock. Low lying shell banks are present in some areas.
- Juvenile cockles and pipi were present in low to high densities across the mid to lower sandflats, but no shellfish were found that were near harvestable size.
- Three small patches (each 2 m × 1 m) of moderately dense seagrass were observed near the low tide mark, which are much too small to meet the criteria of biogenic habitat.
- Intertidal sandstone reef platforms are present on either side of the bay that provide a habitat for a range of common intertidal species.
- Several coastal and seabirds were observed on the intertidal flats during the survey. These included New Zealand dotterels (Charadrius obscurus), variable oystercatchers (Haematopus unicolor), black-backed gulls (Larus

[17] Source: Stewart et al, 2024; pg 67

dominicus), and white-faced herons (Egretta novaehollandiae). A nesting area for New Zealand dotterels on the upper beach west of Te Puru Stream had been cordoned off.

In summary, the intertidal marine community at Te Maraetai / Kellys Beach is typical of sheltered beaches around the Auckland region. The only threatened marine species (excluding birds) observed during the survey was seagrass, which was present in three very small patches on the lower shore.

3.5.2 Coastal Area of Beachlands and Maraetai

To the west of Te Maraetai / Kellys Beach, Sunkist Bay grades from sand at the high tide mark to shell and bedrock on the lower intertidal area. Shellfish (cockles, pipis and wedge shells) abundances in this bay were low. Adjoining Sunkist Bay to the west, the area around Motukaraka Island is identified as a Significant Ecological Area-Marine 1 (see Figure 3-5) due to the presence of large shellbanks that are used as high tide roosts by wading and coastal birds. Extensive seagrass beds have developed over this area over the last decade. South and west, most of Whitford embayment, including the area around Motukaraka Island is identified as a Significant Ecological Area-Marine 2 due to the presence of large areas of intertidal flats that provide a habitat for a wide range of marine species. The intertidal flats also provide feeding and roosting areas for a variety of coastal and wading birds. The intertidal macrofaunal community is typical of sheltered northern estuaries.

To the east of Te Maraetai / Kellys Beach, Omana Beach is a sandy/shelly beach with no shellfish beds. Further east, Maraetai Beach is popular for recreation and is identified as a Significant Ecological Area-Marine 2 (see Figure 3-5) due to the long sandy beach that provides extensive feeding areas for wading and coasting birds.

Occasional blooms of the nuisance cyanobacteria Okeania spp. have been reported along the Beachlands-Maraetai coastline. In the late 1970s Okeania spp. were reported as seasonally dominant species around Motukaraka, and throughout the 2000's there were regular occurrences of the Okeania spp. blooms around the Beachlands and Omana area. No Okeania spp. blooms were observed in Te Maraetai / Kellys Beach during the intertidal survey. Little is known about the drivers and impacts of cyanobacterial blooms.

3.5.3 Off-shore Marine Environment – Tamaki Strait

Tidal currents directly offshore of the Beachlands-Maraetai coastline are moderate (<0.25 cm/s) and substrates are predominantly muddy sand, though large patches of shell hash occur in places.

An underwater video survey was conducted approximately 3km offshore of Te Maraetai / Kellys Beach in November 2023. The survey found that the habitat throughout the region was sandy-mud to muddy-sand interspersed with patches of dense shell. The Mediterranean fan worm, an unwanted organism, was the only common epifaunal species observed. Other species that were occasionally observed included sponges, hydroids, bryozoans, horse mussels, 11-armed starfish and sea cucumbers. No rocky reefs, living biogenic habitats, or regionally significant benthic species were observed in the survey.

4. Resource Consent Information

4.1 Current Resource Consents

Table 4-1 sets out the current resource consents that Watercare holds for the Beachlands Wastewater Scheme.

Table 4-1: Current Resource Consents

Consent # and Type	Purpose	Date Granted	Expiry Date
Discharge Permit (Treated Wastewater) Consent # 26875	To authorise the discharge of treated domestic wastewater into the Te Puru Stream via ground soakage in accordance with Section 15 (1 a) of the Resource Management Act 1991	3 August 2005	31 December 2025
Discharge Permit (Air) Consent # 26876	To authorise the discharge of contaminants to air associated with the operation of a wastewater treatment plant in accordance with Section 15 (l)(c) of the Resource Management Act 1991	17 July 2006	31 December 2026
Discharge Permit (Stormwater) Consent # 33614	To authorise the diversion and discharge of stormwater from 0. 29ha of new impervious surface to be created as part of a wastewater treatment plant upgrade in accordance with Sections 14(1)(a) and 15(1)(a) and (b) of the Resource Management Act 1991	23 March 2007	31 December 2041

4.2 Activities Subject to this Application

Watercare is seeking to replace its existing treated wastewater discharge consent (Consent # 26875) with a new consent containing different discharge limits and a higher maximum discharge volume.

The activity for which consent is sought is the discharge of treated wastewater from the WWTP, via an overland flow system, to a tributary of the Te Puru Stream, and to groundwater.

The proposed discharge volumes are set out in Section 7.

The proposed discharge is classified as a discretionary activity under the AUP. The applicable AUP rule that applies, the type of consent required, and the activity classification are set out in the table below.

Watercare request that the application be publicly notified.

Table 4-2: Unitary Plan Rule and Activity Classification

Rule	Description	Classification
E6.4. Activity table (A6)	Discharge of treated or untreated wastewater onto or into land and/or into water from a wastewater treatment plant.	Discretionary Activity

4.3 Consent Term

A term of 35 years is sought for the consent. A term of 35 years is considered appropriate because:

- Effective wastewater collection, treatment and discharge facilities are and will continue to be essential for community health and wellbeing.
- Watercare has investigated and assessed a comprehensive range of possible alternatives.
- Watercare has a substantial existing investment in the current wastewater scheme. This will become even more substantial once the upgrades to the WWTP are undertaken and the new WWTP commissioned.
- Watercare has considered population growth and servicing requirements over a 35 year term and proposes a staged approach to the discharge to reflect increases in demand for wastewater services over the term of the consent, and improvements in discharge quality through the New WWTP (MBR) Long-term Stage 1 and 2.
- The quality of the treated wastewater discharged to the overland flow system and ultimately to the Te Puru Stream will be high once the new WWTP (MBR) Long-term Stage 1 is commissioned. This quality, particularly with the membranes and the UV treatment, will be one of the highest in New Zealand for municipal WWTPs.
- The proposed wastewater treatment process is well proven both in New Zealand and internationally.
- The effects of the proposed wastewater discharge can be appropriately mitigated.
- Watercare is proposing an appropriate technology review condition in the consent.

4.4 Activities not covered by this Application

Without the certainty of the discharge consent, Watercare is unable to further the design of the new WWTP and the extended overland flow system. Should this application be granted, Watercare will then be able to confirm the following resource consents details:

- Land use consent (regional) for earthworks associated with the construction of the upgraded and new wastewater treatment plant and extended overland flow system including earthworks in an SEA.
- Land use consent required under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.
- Any consents required under the National Environmental Standard for Freshwater.
- Vegetation alteration or removal within a SEA and riparian areas.

As set out in Table 4-1, the existing air discharge consent (permit # 26876) has a later expiry date than the wastewater discharge consent. Watercare intends to lodge the air discharge consent application in accordance with the timeframes set under s124 of the RMA, should this application for consent be granted.

Once the detailed design of the extension to the overland flow system is available, and if parts of the system are to be located outside the current designation Watercare will determine whether it wishes to seek an alteration to the boundary of the designation.

5. Cultural Considerations

Watercare is continuing to work with Ngāi Tai ki Tāmaki to understand the effects of the treated wastewater discharge to their ancestral landscape, Te Taiao, and is committed to supporting Ngāi Tai ki Tāmaki as partners in the process following the lodgement of the application.

Take Taiaomaurikura is an Iwi planning document of Ngāi Tai ki Tāmaki. The vision, principles and kaupapa contained in Take Taiaomaurikura, outline what is important to Ngāi Tai and will guide the decisions they make when responding to plans and applications that affect their rohe. Take Taiaomaurikura states that Auckland Council, and other parties such as consent applicants should give effect to the vision, principles and kaupapa in Take Taiaomaurikura at the earliest possible opportunity.

The vision, principles and values provide a framework for assessing the effects of the proposal on Te Taiao and the Ngāi Tai ki Tāmaki connection to Te Taiao.

As stated in the Stakeholder Engagement Report, Ngāi Tai ki Tāmaki requested Watercare to record that Ngāi Tai ki Tāmaki are the iwi taketake (original inhabitants) of the area and Ngāi Tai ki Tāmaki do not recognise or accept any other iwi or hapū Cultural Impact Assessments / Cultural Values Assessments or registration of interest that may be submitted on this kaupapa.

Acknowledging that Ngāi Tai ki Tāmaki has stated their intention to provide a cultural statement which will be progressed following lodgement of this application, the key themes communicated by Ngāi Tai ki Tāmaki in its engagement with Watercare on proposed discharge options to date include:

- The cultural significance for Ngāi Tai ki Tāmaki of Te Puru Stream, the surrounding whenua and wider cultural landscape and Te Marae-o-Tai / Tāmaki Strait and Tikapa Moana / Hauraki Gulf
- The historical grievance caused by the lack of engagement with Ngāi Tai ki Tāmaki on the original decision to place the discharge from the WWTP into the tributary of Te Puru Stream and Te Ruangaengae / Ruangaingai Stream (pumpstation location)
- Ngāi Tai ki Tāmaki has a preference for land based discharges of treated wastewater
- Opposition to conveyance of wastewater out of the Beachlands service area for treatment and discharge in the rohe of another iwi
- Opposition to a marine discharge and construction of any new structures within the coastal marine area of the Tikapa Moana / Hauraki Gulf
- Opposition to a direct discharge to Te Puru Stream and other waterways within the Ngāi Tai ki Tāmaki rohe.

Subject to further investigation and support of the opportunities identified for co-design of the overland flow system and provision of water supply for a proposed nursery, Ngāi Tai ki Tāmaki provided a generally supportive response to the technical preferred option involving diffuse discharge (via overland flow system) to a tributary of Te Puru Stream.

Watercare has taken into account this feedback in selecting the BPO for the discharge application.

The ongoing outcomes of the continued engagement between Ngāi Tai ki Tāmaki and Watercare will be documented and, with the agreement of Ngāi Tai ki Tāmaki, will be provided to the consent authority.

6. Positive Effects

In accordance with the definition of ‘effect’ in s3(a), and s104(1)(a) of the RMA, positive effects of the proposal need to be assessed. Positive effects should be kept to the fore when weighing all effects as defined under the RMA and considering the proposal in terms of the purpose of the RMA.

The positive effects of the proposal include:

Public health: The proposal to discharge treated wastewater from the WWTP will form an integral part of the Beachlands Maraetai wastewater scheme that provides a safe and reliable public health sanitation system for the community. Currently, wastewater services cannot be provided to the Beachlands-Maraetai community without some form of discharge of the treated wastewater. Sanitation of wastewater is crucial to the well-being of people in these communities. Conveying untreated wastewater away from residential and commercial areas to treat the water enables domestic and commercial activities to occur while protecting public health.

Enabling growth: As set out in previous sections, the current WWTP is at capacity and nearing the end of its economic life. The proposal will enable future development with appropriate and affordable municipal wastewater services. Operational efficiency is crucial for infrastructure outcomes. Sanitation can become unaffordable for homeowners if the operational budget is not managed carefully.

The proposal provides Watercare with the ability to successfully service the Beachlands South area subject to PPC88 and the proposed business park for light industrial and business uses adjacent to a former quarry site which is subject to a fast-track resource consent process. The granting of this consent will mean that the developers of Beachlands South and the business park will not have to provide on-sites facilities for the treatment and discharge of wastewater and that the management of the community’s wastewater can be centralised at the WWTP.

Social and economic: The proposal will have positive social and economic effects, by providing the community with economically sustainable and affordable wastewater treatment system.

Consolidating wastewater discharges: Watercare is working with the applicants of PPC88 and for the proposed business park to enable the wastewater generated by these proposed developments to be reticulated to the WWTP for treatment and discharge. The applicants’ original proposals provided for individual wastewater treatment and discharge solutions. The centralisation of the area’s wastewater treatment and discharge at the WWTP will result in only one discharge to the environment rather than three separate discharges. It will also ensure the consistent and effective management of the community’s wastewater by a highly competent and experienced operator.

Ecological enhancement: The expansion of the overland flow system and improvements to the current system provide the opportunity to increase the extent of indigenous flora on the WWTP site. This coupled with the proposed riparian planting and improvement in the wastewater discharge quality should result in the overall enhancement of ecological values at the WWTP site.

7. Effects of the Discharge to Land (Overland Flow Area)

This section identifies the potential adverse effects that may arise from the discharge of the treated wastewater to the existing and future overland flow areas. The assessment is a summary of the PDP memo ‘Assessment of Potential Effects on Soils and Ecology from Beachlands WWTP Overland Flow System (Memorandum 4)’.

PDP has identified that the discharge of the treated wastewater to the existing and future overland flow areas has the potential to cause adverse effects in relation to:

- Terrestrial ecological values, and
- Groundwater quality.

7.1 Terrestrial Ecology

As identified in section 3.3, the WWTP site includes SEA_T_428 (see Figure 3-2). Within this SEA, PDP has identified the presence of possible wetlands in the gullies and riparian margins adjoining the proposed overland flow expansion area (B2) and downstream of the farm pond. Potential adverse effects on these areas will be managed by locating the future expansion to the overland flow area outside of these ecologically valuable areas and by designing the proposed overland flow area so that it drains to the farm pond. With respect to the ecological values of the existing overland flow area and farm pond, PDP has concluded that these specific areas are not natural ecosystems and do not meet the SEA or natural wetland criteria.

Given that:

- The future overland flow area will not drain to the ecologically valuable areas, and
- The existing overland flow area and farm pond have low ecological values.

It is considered unlikely that the discharge of treated wastewater to overland flow areas will have adverse effects on the terrestrial ecological values of the WWTP site.

Further, it is noted that there is potential for positive terrestrial ecological effects if, subject to final design, the overland flow areas are planted with native flora.

7.2 Groundwater

The soils within the WWTP site are deep with low hydraulic conductivity and high adsorptive capacity. As a result, the downward migration of contaminants from the application of treated wastewater to the overland flow areas is expected to be limited. In addition, the recharge area that feeds the groundwater flowing beneath the overland flow areas is estimated to be 4 to 6 times larger than the area of the overland flow area itself. Consequently, any contaminants that do infiltrate through the soils will be mixed with this larger upgradient flow. Any potential groundwater effect will occur over a short distance (no more than hundreds of metres) to the nearest stream discharge zone. Finally, compared to the discharge to the Stream, the influence of infiltration via groundwater on Te Puru Stream is expected to be undetectable. For these reasons it is considered that potential effects on groundwater arising from the application of treated wastewater to the overland flow areas will be very low.

7.3 Overland Flow Management

Watercare’s proposal is to manage any potential adverse effects through good practice design and operational measures. These measures will involve:

- The review of the design and operation of the existing overland flow area and pond to ensure that it aligns with good practice and seek to replicate the existing overland flow system over the new area.
- Ensuring the final location, design and operational recommendations for the proposed additional overland flow system address any potential erosion and land stability effects.

- Provision of planting of suitable species within the overland flow area which are fit for purpose and, to the extent practicable, contiguous with the species found in the SEA area.

Further details on these measures are set out in Section 10. Based on these measures it is considered that any adverse effects arising from the proposed discharge to the overland flow area will be very low.

8. Effects of the WWTP Discharge on Te Puru Stream

The section assesses the effects of the WWTP on Te Puru Stream, including the tributary of Te Puru Stream into which the WWTP discharges. It considers potential hydrological impacts, potential effects on the water quality of the stream and potential effects on stream ecology.

8.1 Hydrology

Two technical reports have been prepared to assess the potential effects of the WWTP discharge on stream hydrology. These are:

- Stream Hydraulic Assessment, March 2024, prepared by PDP
- Discharge Volume Increase Assessment on Stream Habitat, April 2024, prepared by Bioresearches

These reports identify that the potential hydrological effects on Te Puru stream from the WWTP discharge relate to:

1. Physical effects, particularly erosion of stream channels.
2. Reduction in native fish habitat arising from increased flow velocities.

8.1.1 Physical Effects

PDP's Stream Hydraulic Analysis uses modelling to identify the extent to which the current and future WWTP discharge will influence stream flow under a variety of flow conditions. The results of this modelling[18] indicate that:

- At the 90th %ile flow, the current WWTP discharge accounts for approximately between 30 and 70% of flow of the tributary of Te Puru Stream between the farm pond and bridge, whereas future WWTP discharge volumes that will occur under Long-term Stage 2 of the consent would account for approximately between 58% and 88% of the 90th%ile stream flow.
- During flood events (2-yr, 5-yr and 10-yr Average Recurrence Intervals) under both current and future scenarios, the WWTP discharge would account for only a minor portion of total stream flow of the tributary of Te Puru Stream (at most approximately 7% of the flow between the farm pond and bridge).

In addition, PDP has assessed the effect of the current and future WWTP discharges on stream flow velocities of the tributary of Te Puru Stream. The assessment indicates that the discharges have a minimal influence on velocities at the 90th %ile flow and have no influence on velocities during higher flow events.

As part its assessment, PDP also undertook site visits to assess current stream bank and bed erosion. They noted that there is currently evidence of stream bank erosion between the farm pond and bridge site, and near the confluence with Te Puru Stream, but minimal erosion at the Quarry site. PDP concluded that this erosion was likely caused by storm events and is restricted to localised areas where weak material is being undercut.

As the current and future WWTP discharges will only have a minor influence on stream flow and velocities during storm events, PDP has concluded that the effect of the proposed WWTP discharge on stream bank erosion will be no more than minor.

It is noted that Bioresearches has recommended that '*infill riparian planting with deep rooting vegetation is undertaken within these more vulnerable meandering reaches'*[19]. Even though the effects of the WWTP discharge on stream bank erosion are anticipated to be no more than minor, Watercare is proposing to adopt Bioresearches recommendation and undertake riparian planting within the Watercare site boundary as this is the reach which they can undertake works within. See section 10.7 for further information.

PDP also identified capacity issues and potential erosion risks associated with the culvert at the downstream end of the farm pond (see Figure 8-1 for location of this culvert). In the event that they are required, Watercare proposes to address

[18] See Table 2 of the PDP Stream Hydraulic Assessment

[19] See pg 5 of Discharge Volume Increase Assessment on Stream Habitat, April 2024, prepared by Bioresearchers

the capacity and erosion issues as part of the Overland Flow Design and Operation Management Plan described in Section 10.5.

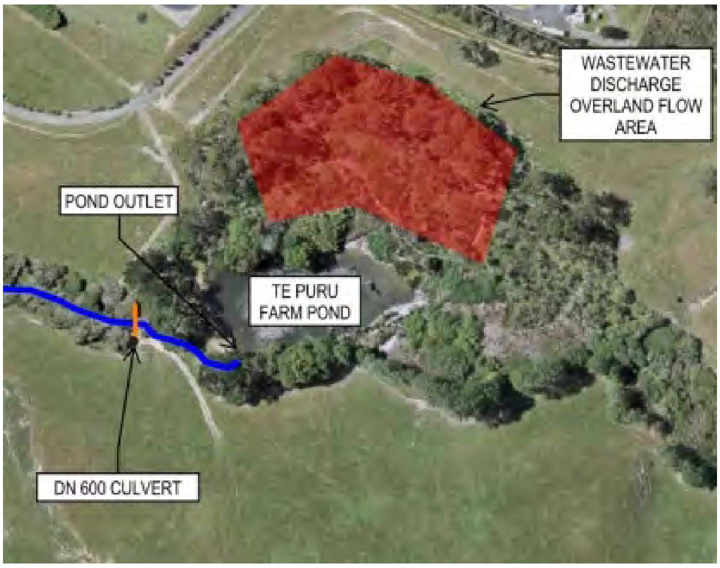


Figure 8-1: Location of Farm Pond culvert

8.1.2 Hydrological Impacts on Fish Habitat

An assessment by Bioresearches has evaluated the potential hydrological impact of the current and future WWTP discharges on fish habitat. An increase in discharge volumes may result in increases in depth and stream velocity, which in turn may result in a decrease in suitable fish habitat preferences. For the purposes of this assessment, Bullies were selected as the exemplar species as they have the lowest velocity threshold of the fish species present in the study area. For Bullies stream velocities over 0.5 ms-1 correlate to a decrease in suitable habitat.

Currently, the fastest flowing site within the tributary of Te Puru Stream was Site G (see Figure 3-3 above), with an average flow velocity of 0.066 ms-1. This indicates that the current WWTP discharge does not cause hydrological impacts on fish habitat within the stream.

Under the proposed discharge for Long-term Stage 2 of the consent (i.e. the maximum discharge scenario), Site G is estimated to have an increase in flow velocities to approximately 0.133 ms-1. This remains well below the 0.5 ms-1 threshold for adverse effects on bully habitat. Therefore, it is considered that the stream velocities arising from the proposed WWTP discharge, even under the maximum discharge volume scenario, are unlikely to result in a reduction of native fish habitat.

8.2 Freshwater Water Quality

An assessment of the potential impact on water quality in Te Puru Stream is provided in Streamlined Environmental's Water Quality, Ecological and Human Health Effects Assessment[20]. The following section summarises the findings of that assessment.

It is noted that the assessment in Streamlined Environmental's report, and summarised below, is based on the proposed operational limits for each stage of the WWTP discharge. Streamlined Environmental notes that this is a conservative approach as actual concentrations in the WWTP discharge are expected to be less than the operational limits.

8.2.1 Physical Stressors

The physical stressors on water quality that have been assessed are DO and $cBOD_5$, water temperature, pH, conductivity and salinity, and TSS and turbidity.

[20] Stewart, M., James, M., and Sim-Smith, C. (2024) Beachlands Wastewater Treatment Plant – water quality, ecological and human health effects assessment. Report WSL2303–D1, Streamlined Environmental

DO is critical to supporting healthy aquatic ecosystems. High BOD in the WWTP discharge has the potential to result in low DO concentrations in the tributary and Te Puru Stream as oxygen is consumed during organic matter decomposition.

Monitoring at receiving environment sites indicates that the occasional low DO in the existing WWTP discharge is not currently impacting DO in the pond or further downstream. The WWTP discharge is expected to continue to have a negligible effect on DO levels in the pond or further downstream following the proposed Long-term upgrades. As a result, no DO standards are proposed for the future discharges.

Monitoring of treated wastewater quality has identified recent elevated $cBOD_5$ in the discharge. However, receiving environment monitoring indicates that these elevated levels are not impacting $cBOD_5$ in the farm pond or further downstream. All receiving environment sites are well below relevant guidelines values indicating negligible effect from the discharge on this element of water quality.

Following the proposed Long-term upgrades, the improved treatment process will reduce $cBOD_5$ by approximately 1.4-fold. While there will also be an approximate 3-fold increase in discharge volume by Long-Term Stage 2, the treatment improvements that will be delivered mean that it is expected that the potential adverse effects of the proposed discharge on $cBOD_5$ will remain negligible, and further the reduction of $cBOD_5$ will contribute to an overall improvement in water quality downstream of the discharge compared with the existing situation.

Data on water temperature is available for monitoring site A and site B (see Figure 3-3) for the monitoring locations). This data indicates that stream water temperature above and below the WWTP discharge location is currently well above Auckland Council guidelines[21]. This suggests that even without the WWTP, water temperatures in the stream have the potential to cause stress on aquatic life. Recent monitoring indicates that the current WWTP discharge is having a minimal additional impact on water temperature in the farm pond. While there are no water temperature standards for the Long-term upgrades, it is considered that future discharge will have only a low impact on downstream water temperatures.

With respect to the potential impact of the WWTP discharge on pH levels, low pH appears to be more of an issue than high pH in the receiving environment. Further, it is considered that the current WWTP discharge is having negligible impacts on pH at sites downstream and that treated wastewater discharges following the Long-term upgrades will continue to have negligible effects on pH.

With respect to conductivity, all Te Puru Stream sites monitored between September 2023 and January 2024 had 80th percentile concentrations above the ANZG 80th percentile DGV (155 µS/cm), indicating a 'potential risk' of adverse effects. Sites upstream of the WWTP discharge only marginally exceeded this DGV, whereas monitoring results indicate that the WWTP discharge is having a clear additional influence on conductivity downstream.

Despite the influence on conductivity exerted by the WWTP discharge, it is noted that the NIWA Stream Health Monitoring and Assessment Kit (SHMAK) report suggests that direct effects from conductivity on stream life do not occur until conductivity reaches levels found in brackish water or seawater, well above the conductivity identified within Te Puru Stream sites. Further, while elevated conductivity may lead to reduced DO, there are no apparent effects on DO downstream attributable to the current WWTP discharge.

These factors indicate that the discharge currently has, and will continue to have, a negative influence on conductivity in the tributary and Te Puru Stream, with the potential to contribute to low / moderate adverse environmental effects. Given this potential adverse effect, Watercare has accepted Streamlined Environmental's[22] recommendation to propose a trigger for conductivity, which if exceeded during the consent term will result in investigations and potentially remedial action being undertaken (see section 10.3 for further discussion about this proposed mitigation measure). It is considered that this approach will ensure that actual adverse effects remain low.

TSS levels can have an impact on receiving environments by directly affecting physiological processes of invertebrates and fish and availability of light for photosynthesizing plants (algae, periphyton, macrophytes). There can also be impacts on aesthetics and recreation through changes in water clarity and colour. The current WWTP discharge has consistently low TSS and there appears to be little difference in TSS for the receiving environment sites upstream and downstream of the WWTP discharge. The improved treatment performance that will occur following the Long-term upgrades will result in an approximate 1.4-fold decrease in TSS from the WWTP discharge. As a result, the TSS in proposed discharge will have

[21] See section 5.3.1 of Stewart et al for details on these guidelines.

[22] Stewart et al, 2024, pg 99

a negligible effect on the tributary and Te Puru Stream and further the Long-term upgrades will contribute to improved water quality downstream of the discharge compared with the current situation.

8.2.2 Nutrients

Nutrients in discharges from WWTPs have the potential to cause significant environmental impacts on freshwater environments. This assessment considers potential toxicity effects that may arise due to ammoniacal-N and nitrate-N in the discharge, and potential eutrophication effects which may arise from DIN and DRP in the discharge.

Ammoniacal-N makes up only around 0.5% of TN being discharged from the WWTP. The current WWTP discharge is therefore unlikely to be significantly contributing to ammoniacal-N concentrations downstream. Future concentrations are not expected to increase significantly from current and will be very low in the discharge, and not contributing significantly to elevated nitrogen downstream. It is noted that processes in the pond, into which the WWTP discharges via the overland flow area, will continue to increase ammoniacal-N levels downstream. Despite these processes within the pond, levels would be expected to meet the NBL for ammoniacal-N toxicity and be unlikely to impact on species found downstream.

During the Current and Short-term stages median nitrate-N concentrations (3.5 mg/L) in the WWTP discharge are expected to result in an increase in instream nitrate-N concentrations downstream of the discharge point (1.1 mg/L at site 15 (downstream) compared with 0.02 mg/L at upstream site A). This effect equates to a shift from NPS-FM attribute band A to band B for toxicity. Based on narrative band descriptions in the NPS-FM, this indicates that the level of adverse toxicity effect from nitrate-N during these initial stages of the consent will be low.

The Long-term WWTP upgrades will result in a significant reduction in median nitrate-N concentrations in the discharge. This improvement will in turn likely result in a significant reduction in instream nitrate-N concentrations at the potential mixing zone (site 15), corresponding to an improvement in the NPS-FM attribute band from B (under the Current and Short term stages) to A (under Long-term stages) for toxicity. In other words, while the discharge will result in median instream concentrations of nitrate-N increasing downstream relative to concentrations at site A upstream, the downstream concentrations will remain within attribute band A. Based on narrative band descriptions in the NPS-FM, this indicates that any potential toxicity effects from nitrate-N in the discharge during Long-term stages will be negligible.

For DIN, the discharges during the Current and Short-term consent stages will contain a median concentration of 4.1 mg/L. This is expected to result in a DIN concentration at site 15 of 1.3mg/L. This represents an improvement relative to the existing discharge but will marginally exceed the threshold (1 mg/L) for eutrophication. Following the Long-term upgrades median DIN in the discharge will not exceed 2.5 mg/L which is anticipated to result in a DIN concentration at site 15 of around 0.8 mg/L. This is below the accepted threshold for eutrophication.

The median concentration of DRP in the WWTP discharge during the Current and Short-term consent stages of the consent will be 1.0 mg/L. This is expected to result in in-stream concentrations at site 15 being 0.251 mg/L. Following the Long-term upgrades, the median concentration of the DRP in the discharge will not exceed 0.5 mg/L. This is expected to result in in-stream concentrations at site 15 being 0.125 mg/L, which represents an improvement relative to current levels.

Under both the short and long term upgrades the concentration of DRP in the WWTP discharge will result in instream DRP concentrations being within NPS FM band D. It is expected that these elevated DRP concentrations may, in combination with other factors, result in moderate adverse effects on the Stream ecology (see section 8.3 for further discussion on this point).

8.2.3 Metals

Monitoring indicates that current metal concentrations are currently at 50% or below the ANZG DGV at the Bridge site. Zinc, copper and chromium appear to be increasing at the farm pond site (and to a lesser extent at site 15) to near ecological guideline values as a result of the influence of Beachlands WWTP discharge. Monitoring results also show that all sediment metal concentrations were below the ANZG DGV, with only zinc reported at concentrations that were increased downstream of the influence of Beachlands WWTP relative to upstream. These results indicate that the current discharge is having a minimal adverse effect on downstream metal concentrations.

No discharge standards are proposed for metals for the Long-term WWTP upgrades. Concentrations of metals in the discharge are not expected to increase, however with a 3-fold increase in discharge volume proposed, loads will increase proportionally. To mitigate any potential risk from metals in the future discharge, it is proposed to monitor metals, to ensure metals are not increasing to above DGVs downstream as a result of the WWTP (see section 10.8 for further discussion). Based on this proposed mitigation measure it is considered that potential adverse effects from metals will be less than minor.

8.2.4 Emerging Organic Contaminants

To estimate the ecological risk presented by the EOCs in the WWTP discharge, hazard risk quotients (**RQs**) were calculated. The RQ was calculated as EOC concentration/ predicted no-effect concentration (**PNEC**), with a value >1 indicating a potential ecological effect.

Based on this assessment, it is considered that the majority of EOCs will have negligible ecological effects based on measured and literature treated WWTP discharge concentrations. Most of the limited number of EOCs that are present in concentrations above ecological effects concentrations will likely be significantly attenuated and/or diluted in the freshwater environments and present a low risk of adverse effects. Overall, the effects on the environment from EOCs present in the proposed discharge during all stages covered by this consent application are likely to be between negligible and low.

Notwithstanding this conclusion, Watercare is proposing to undertake monitoring, through consent conditions to better understand the risks of EOCs from the discharge (see Section 10.8).

8.2.5 Microbiological Effects

The potential effects from the WWTP on the microbiological quality of Te Puru Stream, and therefore public health risks, have been assessed:

1. By considering indicator bacteria results.
2. Through a Quantitative Microbial Risk Assessment (QMRA) and comparison of the QMRA results with the anticipated treatment effectiveness of the WWTP during the proposed staged upgrades.

With respect to indicator bacteria, it is noted that E. coli, FC, and enterococci are at extremely low concentrations (median 2 cfu/100 mL for all three) in the WWTP discharge. For the receiving environment sites, bacteria concentrations are highly variable and higher upstream of the WWTP discharge. This suggests that catchment sources dominate FC and E. coli concentrations, which will be uninfluenced by proposed staged upgrade of the WWTP. Therefore, it is considered that risks from pathogens (as indicator bacteria) discharged by the WWTP are negligible compared to catchment sources and will remain so with the upgrades proposed in this application.

The QMRA identifies the level of treatment (log reduction) that needs to be achieved by the WWTP during the proposed upgrade stages in order to ensure that mean infection risks arising from the discharge are within acceptable limits for users of the Stream. It is noted that the QMRA looks at the added risk from the WWTP discharge, there is still existing risks from other sources, but these are not part of QMRA.

In summary, the required levels of effectiveness identified in the QMRA are:

- For watercress consumption, a Norovirus[23] log reduction of 5 is required to reduce the risk of infection to <1% at the Te Puru stream sites.
- For swimming, a Norovirus log reduction of 4 is required to reduce risks to below 1% at Te Puru stream sites, while it was noted that swimming is unlikely at these sites.

Log reductions for Norovirus that are anticipated to be achieved by the WWTP during each of the proposed stages are set out in Table 8-1. This shows that the required level of effectiveness will be met or exceeded in all of the proposed stages. Therefore, it is considered that the potential effects of the WWTP on microbiological water quality and public health risks in Te Puru Stream will be low.

[23] Norovirus is the exemplar virus used for the purposes of the QMRA

Table 8-1: Log reductions in Norovirus at each of the proposed consent stages

Stage	Existing WWTP			New WWTP
	Current	**Short-Term Upgrade**	**Long-Term Upgrade Stage 1**	**Long-Term Upgrade Stage 2**
Secondary / tertiary treatment	2.0	2.0	4.5	4.5
UV disinfection	3.0	3.0	3.0	3.0
Total	**5.0**	**5.0**	**7.5**	**7.5**

8.3 Aquatic Ecology

The effects on aquatic ecology that have been identified as arising from the existing WWTP discharge are indicative of the potential effects that may arise during the proposed 'current' and short-term consent stages. The effects include:

- Localised decreases in the presence of native fish and pollutant sensitive macroinvertebrates, which correspond with the decreases in water quality parameters, e.g. conductivity and nutrients, downstream of the WWTP discharge.
- Nuisance aquatic plant growth which coincides with increased conductivity and bioavailable nutrient concentrations (DIN and DRP) below WWTP discharge point. It is noted that these adverse effects could in part be caused by a lack of shading at downstream sites and the ongoing observed level of stock access to streams.

While some decreases in water quality parameters are predominantly limited to a short length of stream of at least 200 m downstream of the farm pond (Site F), conductivity and nutrients are affected for a greater distance. Further, macroinvertebrates, native fish communities, and filamentous algae do not appear to fully recover at the most downstream sites, which often lacked more sensitive taxa.

Overall, the aquatic ecology downstream of the existing WWTP discharge is 'degraded' compared with the existing environment and these adverse effects are expected to continue during the proposed 'Current' and Short-term consent stages.

The proposed long-term MBR WWTP will result in an improvement in water quality compared to the current water quality results and is highly likely to result in an improvement in the overall macroinvertebrate and fish community downstream compared to the most recent survey results. Other measures, such as the proposed conductivity trigger, the riparian planting and the monitoring of metals will also mitigate potential adverse effects. Overall the WWTP discharge is expected to contribute to moderate adverse effects on the Stream ecology in combination with others conditions and stressors in the catchment, such as the soft substrate, limited riparian vegetation and the influence of other land uses.

9. Effects on the Coastal Marine Area

The assessment of effects from the WWTP discharge on the CMA focusses on the potential impact of salinity, nutrients and microbiological risks to human health and recreation activities. The following sections summarise assessments included in Streamlined Environmental's Water Quality, Ecological and Human Health Effects Assessment [24].

9.1 Salinity

The proposed discharge, under all consent stages, will have negligible effects on the salinity and the marine communities of Te Maraetai / Kellys Beach. This conclusion is based on the relatively low discharge rates from the WWTP compared to other nearby streams and rivers, the rapid dilution that occurs within the stream and CMA, and the tolerance of intertidal biota to low salinities.

9.2 Effects from Nutrients

Nitrogen, and to a lesser extent, phosphorus, are the two primary limiting nutrients of concern in coastal waters. Small increases in these nutrients can lead to increased productivity, but excessive concentrations can result in nuisance phytoplankton and macroalgal booms, increased turbidity, and reduced dissolved oxygen near the seabed.

With the Long-term upgrades, median nutrient concentrations in treated wastewater that is discharged from the WWTP are proposed as follows:

- 5 mg/L TN
- 0.5 mg/L for TP
- 0.5 mg/L DRP

Stream monitoring indicates that concentrations of nitrogen (TN and nitrate-N) and phosphorus (TP and DRP) materially decrease in concentration down Te Puru Stream with the increasing distance from the WWTP due to dilution[25]. Concentrations of these nutrients will be diluted 309× (50%ile) by the time they reach the Te Puru Stream mouth, making them well below background concentrations as they enter coastal waters. Modelling by DHI[26] shows that concentrations will be further decreased by mixing with coastal waters.

Based on this level of dilution, nutrient concentrations will be below background levels of coastal waters before the influence of the WWTP discharge reaches Te Puru Stream mouth. Given the rapid dilution rate, and the reduction of nutrient concentrations in the proposed discharge, no increase in nutrient concentrations in coastal waters, or related adverse effects from increased nutrients, are likely to occur as a result of the proposed discharge. Other minor contaminants that are present in the treated wastewater at low concentrations will be diluted at a similar rate to TN and TP. Mean annual attenuated TN and TP loads from the current WWTP are estimated to be 1,799 kg/year and 212 kg/year, respectively. Following the Long-term upgrades, mean annual attenuated TN loads are estimated to increase by around 114% to 3,856 kg/year, and mean annual attenuated TP loads are estimated to increase by around 200% to 637 kg/year (DHI, 2024). While these increases in loads represent a large percentage increase, the absolute values need to be considered in context with other nutrient inputs into the inner Hauraki Gulf and Firth of Thames. TN loads for the Tamaki River, Wairoa River, Piako River, and Waihou River are around 60,000, 160,000, 1,415,000 and 2,168,000 kg/year, respectively, while TP loads for the Piako River, and Waihou River are 74,000 and 121,000 kg/year, respectively. Given that the estimated loads from the upgraded WWTP represent a very small percentage of the TN and TP loads entering the inner Hauraki Gulf and Firth of Thames, the effects of the increased loads from the upgraded WWTP are assessed to be negligible.

[24] Stewart et al, 2024
[25] See Section 4.4.1.2of Stewart et al, 2024
[26] Assessment of Proposed Te Puru Stream Discharge, March 2024, DHI

9.3 Potential ecological effects in the coastal environment

Potential effects on SEA-M1-42b Te Puru Stream estuary and SEA-M2-42a are anticipated to be low given the level of influence the treated wastewater discharge will have on nutrient concentrations and salinity in coastal waters. There will be no change from the current WWTP scenario.

9.4 Microbiological, Public Health and Recreation Effects

As for Te Puru Stream, a QMRA has been used to assess the potential microbiological, public health and recreation effects of the WWTP on coastal waters. The QMRA identifies the level of treatment (log reduction) that needs to be achieved by the WWTP during all of the proposed consent stages in order to ensure that mean infection risks arising from the discharge are within acceptable limits for users. For coastal water users the required reductions identified by the QMRA are:

- For shellfish consumption, a log reduction of 1 is sufficient to provide a risk of <1% for the current discharge scenario at all marine sites. The required log reduction increases (due to increased wastewater volumes) but is below 2 for the proposed Short-term and Long-term (new MBR WWTP) discharge scenarios.
- For swimming, required log reductions range from 2-3 at Te Maraetai / Kellys Beach transect sites (depending on the proposed consent phase), but less than 1 for those further out in the bay and for all 3 consent phases.

As identified in Table 8-1, the anticipated log reductions proposed consent the Current and Short-term stages of the consent are 5, while in the Long-term Stages 1 and 2 over 7 log reduction is expected. As a result, the potential microbiological effects and public health risk arising from the WWTP on coastal waters are considered to be very low. As these effects would be the key cause of any potential recreation effects, it is considered that potential adverse effects on recreation activities in the marine environment are also very low.

10. Management and Mitigation Framework

This section outlines proposed consent compliance mechanisms, the monitoring programme intended to support compliance with the consent, and outlines proposals for management plans that may be incorporated into consent conditions.

10.1 WWTP Stages

Watercare proposes to monitor and model population growth within the WWTP catchment and to annually report on this to Auckland Council as part of the Annual Report. Once Watercare's monitoring and modelling of average daily flows indicates that population within the WWTP catchment will exceed 18,000 PE within six years, it will initiate design and construction of the Long-term upgrade.

The staging of WWTP activities is summarised in the table below.

Table 10-1: Staging of WWTP activities

Stage	Maximum Discharge Volume	Trigger to Commence Design Work for Stage
Current WWTP	4,500 m^3/d	n/a
Short-Term Upgrade	8,700 m^3/d	Design work is currently underway.
Long-term Upgrade Stage 1	28,900 m^3/d	Six years before population is projected to reach 18,000 PE (based on average daily flow).
Long-term Upgrade Stage 2	36,200 m^3/d	Four years before population is projected to reach 24,000 PE (based on average daily flow).

10.2 Discharge Volume

Consent is sought for the discharge volumes presented in Table 10-2.

Table 10-2: Beachlands WWTP Maximum Treated Wastewater Discharge Volumes

Parameter	Units	Existing WWTP		New WWTP	
		Current	Short-Term Upgrade	Long-term Stage 1	Long-term Stage 2
Maximum treated wastewater discharge	m^3/day	4,500	8,700	28,900	36,200
Average daily flow	m^3/day	2,800	3,600	4,800	6,000

A flow meter will be provided to measure the treated wastewater discharge volume on a daily basis.

10.3 Treated Wastewater Discharge Quality

Treated wastewater quality limits for the Current, Short Term and Long-term Stages are presented in Table 10-3. The monitoring location is the same as it is for the current consent being the point of discharge from the UV disinfection system prior to discharging to the overland flow system.

Table 10-3: Beachlands WWTP Proposed Treated Wastewater Quality Summary

Parameter	Units	Existing WWTP				New WWTP	
		Current		Short-Term Upgrade		Long-Term Stages 1 and 2	
		Median	95^{th} %ile	Median	95^{th} %ile	Median	95^{th} %ile
BOD	mg/L	7.0	15	7.0	15	5.0	9.0
TSS	mg/L	7.0	15	7.0	15	5.0	9.0
NH_4-N	mg/L	0.6	3.0	0.6	3.0	0.5	3.0
NO_x-N	mg/L	3.5	11	3.5	11	2.0	4.5
SIN	mg/L	4.1	14	4.1	14	2.5	7.5
DRP	mg/L	1.0	3.0	1.0	3.0	0.5	1.0
Faecal coliforms	cfu/100 mL	<10	100	<10	100	<10	100

As noted above, because the WWTP Short-term upgrade prior is designed solely to increase plant capacity, no change in discharge limits is proposed for the Short-term upgrade. The proposed discharge limits for the existing WWTP shown above are lower than those in the current resource consent (see Table 2-1). Further improvements in discharge limits are proposed for the Long-term Stage 1 upgrade, once the new MBR WWTP is operational.

It is proposed that treated wastewater samples be taken on a weekly basis and analysed for the parameters shown in Table 10-3:. It is also proposed that a trigger level for conductivity and salinity be set for the influent to the WWTP which would require investigations to be undertaken into the sources should the trigger levels be exceeded.

10.4 Receiving Environment Water Quality Monitoring

As noted earlier in this application, water quality samples have been collected from a number of sites during the course of investigations for this application.

It is proposed that a water quality monitoring programme be implemented for the duration of the consent period to measure water quality in the receiving environment and to ascertain any changes in water quality attributable to the discharge from the WWTP. The water quality monitoring locations will be identified as part of the monitoring programme outlined in the Environmental Monitoring Plan. Suggested monitoring parameters, to be collected in monthly samples, are shown in Table 10-4.

Table 10-4: Beachlands WWTP Receiving Environment Water Quality Monitoring Parameters

Parameter	Units	Sites
Dissolved Oxygen	mg/L	All
pH		All
Temperature	°C	All
Conductivity	mS/m	All
Total Suspended Solids	mg/L	All
Faecal Coliforms	cfu/100mL	All
Carbonaceous Biochemical Oxygen Demand	mg/L	All
Ammoniacal-N (NH4-N)	mg/L	All
Nitrate plus Nitrite-N (NOx-N)	mg/L	All

Parameter	Units	Sites
Total Nitrogen (TN)	mg/L	All
Dissolved Reactive Phosphorus (DRP)	mg/L	All
Total Phosphorus (TP)	mg/L	All

10.5 Overland Flow Design and Operation Management Plan

Regarding the development of the Overland Flow System, Watercare will invite Ngāi Tai ki Tāmaki to partner in a co-design process to design and develop the expanded overland flow system for the ongoing discharges from the WWTP within the Watercare site.

Watercare propose that the final design be set out in an Overland Flow Design and Operation Management Plan (**OFDOMP**) which, as a minimum, will include:

1. A review of the design of the existing overland flow system and pond to ensure that it aligns with good practice including application rate, residence time, the periodic resting of zones within the overland flow area, and the capacity and potential erosion risk of the culvert at the downstream end of the farm pond.
2. Detailed design plans for the Overland Flow System, including any pond / wetland element that is part of the system.
3. A description of the cultural design input and how this has been incorporated into the final design of the Overland Flow System.
4. A description of how the location and design the proposed additional overland flow system:
    a. Avoids and mitigates potential adverse effects on the ecological values of riparian areas, wetlands and aquatic habitats, including application of an effects management hierarchy where appropriate.
    b. Ensures the future overland flow system has an appropriate area slope and gradient. This includes earthworks, slope length, soil conditions, vegetation cover and erosion control.
    c. Ensures that future wastewater flows, including wet weather flows, are provided for.
    d. Aligns with good practice in relation to:
        i. dispersal method.
        ii. wastewater application rate.
        iii. residence time.
        iv. periodic resting of zones within the overland flow area(s).
        v. management of vegetation, including harvesting where this will contribute to the treatment benefits of the overland flow areas.
    e. Ensures diffuse entry of the overland flow into the stream.
5. Operational management of all overland flow systems for the WWTP.

6. Description of the ongoing monitoring and maintenance requirements associated with the Overland Flow System.

The OFDOMP could be developed in phases. With the matters set out in 1. above undertaken within six months of the granting of the consent, and the matters set out in 2. and 3. above developed in conjunction with the Short-term upgrades to the existing WWTP.

10.6 Riparian Planting

To minimise potential erosion and scour of the banks of the tributary to Te Puru Stream during storm events, infill riparian planting with deep rooting vegetation will be undertaken within the more vulnerable meandering reaches of the tributary within the Watercare site boundary. A riparian planting plan should be included in the Environmental Management Plan that details the planting locations, plant species and proposed maintenance.

10.7 Benthic Habitat Monitoring

Watercare recognises that over time, mass loads of some contaminants being discharged may increase as population growth occurs, even though contaminant concentrations are reduced in comparison with the existing discharge.

To address this issue, it is proposed to undertake ecological and sediment quality monitoring in the vicinity of and downstream of the farm pond. The monitoring locations will be set out in the Environmental Management Plan.

Monitoring should include:

- Benthic ecology monitoring.
- Sediment texture, organic carbon content, and total nitrogen and total phosphorus concentrations.
- Heavy metals.
- Macroalgal cover and extent.

10.8 Emerging Organic Contaminants

Although the ecological assessment concluded that majority of EOCs will present negligible ecological effects, it is recognised that this area is subject to ongoing research. To better understand the risks associated with EOCs, Watercare proposes to:

- Undertake a EOC risk assessment within six months of commissioning the Short Term upgrade to the existing WWTP. The risk assessment should include:
  - Review changes in the state of knowledge of emerging contaminants.
  - Methods for identifying, measuring, and assessing EOCs.
  - Comparison of results from previous monitoring.
- Repeat the risk assessment at 5 yearly intervals and within six months of commissioning the new WWTP (MBR) Long-term Stage 1 and Long-term Stage 2.

10.9 Environmental Management Plan

Watercare proposes the development and implementation of an Environmental Management Plan (EMP) for the WWTP to integrate operational management and maintenance, treated wastewater and environmental monitoring and reporting.

The EMP should include the following information:

- Service area information including population growth.
- Inspection and maintenance activities.
- Monitoring and reporting (flows, treated wastewater quality, water quality monitoring, other environmental monitoring).
- Sampling methodology and sampling locations.
- Contingency and incident management procedures.

- Complaints procedures.

The EMP will be submitted to Auckland Council within six months of the resource consent commencing and within six months of any upgrades to the WWTP and the commissioning of the new WWTP.

10.10 Annual Reporting

Consistent with Watercare's standard operating procedures for WWTPs Watercare proposes to prepare an Annual Monitoring Report, covering the period from 1 July to 30 June. The report will include:

- Monitoring data collected for that year, data analysis and trends.
- Compliance reporting.
- WWTP performance reporting.
- Monitoring and modelling of population growth within the WWTP catchment.
- Record of complaints.

In the event of any non-compliance, discussion of the reasons for the non-compliance and a timetable to rectify any non-compliance will be provided.

10.11 Community Liaison Group

Watercare is committed to keeping the Beachlands Maraetai community and other stakeholders informed the WWTP and the discharge activities throughout the term of any consent granted. To this end, Watercare proposes to establish the Beachlands WWTP Community Liaison Group, which is proposed to meet once a year to:

- Discuss WWTP operation, performance, complaints, investigations and planned upgrade works, and the effects or potential effects of these on the community and receiving environment.
- Make recommendations on appropriate changes to the monitoring framework to better understand the effects of the WWTP on the receiving environment.
- Discuss updates on issues that have been resolved.
- Consider other issues raised by either the Community Liaison Group or Watercare.

The Community Liaison Group will be provided with copies of the reports required to be prepared by resource consent conditions.

10.12 Monitoring and Technology Reviews

Watercare is committed to ongoing investigations to improve the quality of the treated wastewater discharge, reduce the amount of wastewater generated by the Beachlands Maraetai community and the beneficial reuse of treated wastewater. To this end Watercare proposed development of a Monitoring and Technology Review Report and regular reviews of the report. The report should include:

- An assessment of ongoing compliance with the requirements of the resource consent particularly in relation to any reported non-compliance with consent conditions.
- An assessment of compliance/consistency with any relevant national or regional water quality policies, environmental standards or guidelines in effect at the time.
- An assessment of the results of the consent holder's monitoring undertaken in accordance with these consents, including the adequacy and scope of such monitoring.
- A summary of any residual actual or potential adverse effects of the treated wastewater discharge.
- An outline of significant technological changes and advances in relation to wastewater management, inflow reduction, treatment, discharge and beneficial reuse technologies (including potable and non-potable use) that could be of relevance for possible future use.

- An assessment of whether any newly available technology option(s) or combination of options identified represent the BPO to minimise the potential and actual adverse effects of the treated wastewater discharge and whether the consent holder intends to adopt that BPO and Incorporate such technologies.

11. Summary of Effects

Sections 5 to 9 of this application provide an assessment of the potential effects from the proposed discharge of treated wastewater, with more detailed assessments provided in the corresponding Appendices.

A range of positive effects will arise from operation of the WWTP and wider Beachlands-Maraetai wastewater treatment scheme, which could not operate without a treated wastewater discharge at the end of the treatment process. These positive effects are associated with the provision of a safe and reliable public health sanitation system for the community, treating wastewater to ensure good ecological health outcomes and the facilitation of future development within the community. They also include the consolidation of three potential wastewater discharges (the other two being from the PPC 88 area and quarry) into a single, high quality discharge.

Potential adverse effects may arise with respect to the tributary of Te Puru Stream, Te Puru Stream, the discharge to land and the coastal marine area.

With respect to the discharge to land, the AEE identifies that potential adverse effects may arise in relation to terrestrial ecological values and groundwater quality. The AEE concludes that any such adverse effects will be very low given proposed design and operational measures.

With respect to effects on Te Puru Stream, the AEE evaluates potential hydrological impacts, potential effects on the water quality of the stream and potential effects on stream ecology. It identifies that the level of these adverse effects, relative to the existing environment, will range from negligible to moderate (in combination with effects generated by other catchment stressors such as nutrient input from adjacent farmland). Further, relative to the current state, the proposed improvements in the treated wastewater quality will result in material improvement to several stream attributes.

Finally with respect to potential adverse effects on the coastal marine area, the AEE evaluates potential effects that may arise due to salinity, nutrients and microbiological contaminants. The AEE identifies that due to dilution and the proposed treatment improvements such effects will be negligible to low.

Watercare is continuing to work with Ngāi Tai ki Tāmaki to understand the effects of the treated wastewater discharge on Te Taiao, Te Puru Stream and its tributaries, and Ngāi Tai ki Tāmaki ‘s special connection to these, and to develop additional mitigations and remedies to assist in addressing these effects. Watercare is continuing to engage with Ngāi Tai ki Tāmaki throughout the project and Watercare has committed to support them in the development of a Cultural Impact Assessment.

12. Statutory Assessment

12.1 RMA Requirements

12.1.1 Section 104

Section 104 of the RMA sets out the matters that the consent authority must have regard to when considering the resource consent application. These matters provide the framework for this statutory assessment and are reproduced below.

> *(1) When considering an application for a resource consent and any submissions received, the consent authority must, subject to Part 2 and section 77M[27], have regard to–*
>
> > *(a) any actual and potential effects on the environment of allowing the activity; and*
> >
> > *(ab) any measure proposed or agreed to by the applicant for the purpose of ensuring positive effects on the environment to offset or compensate for any adverse effects on the environment that will or may result from allowing the activity; and*
> >
> > *(b)any relevant provisions of—*
> >
> > > *(i) a national environmental standard:*
> > >
> > > *(ii) other regulations:*
> > >
> > > *(iii) a national policy statement:*
> > >
> > > *(iv) a New Zealand coastal policy statement:*
> > >
> > > *(v) a regional policy statement or proposed regional policy statement:*
> > >
> > > *(vi) a plan or proposed plan; and*
> >
> > *(c) any other matter the consent authority considers relevant and reasonably necessary to determine the application.*

The actual and potential effects on the environment of allowing the activity (s104(1)(a)) are addressed in sections 5-9 and 11 above. The matters in s104(1)(b) and(c) hat are considered relevant to the consent application are identified and summarised in the following sections, as is s104(2A) relating to the value of the consent holder's investment.

12.1.2 Section 105

As the application is for a discharge permit, s105 of the RMA applies. It requires that:

> *(1) If an application is for a discharge permit or coastal permit to do something that would contravene section 15 or section 15B, the consent authority must, in addition to the matters in section 104(1), have regard to—*
>
> > *(a) the nature of the discharge and the sensitivity of the receiving environment to adverse effects; and*
> >
> > *(b) the applicant's reasons for the proposed choice; and*
> >
> > *(c) any possible alternative methods of discharge, including discharge into any other receiving environment.*

[27] Section 77M relates to the effects of the incorporation of MDRS in a district plan and is not considered relevant to this application.

In terms of paragraph (a), this application outlines the nature of the proposed discharge and the sensitivity of the receiving environment (both freshwater and marine).

Watercare's reasons for the proposal (paragraph(b)) are also outlined in this application, and in the Alternatives Assessment Report. Watercare's mission is reliable, safe, and efficient wastewater services. Watercare is responsible for collecting, treating, and disposing of the wastewater from the Beachlands Maraetai community. The discharge of treated wastewater cannot practicably be avoided as it cannot be turned off and there are currently no practicable reuse opportunities that could avoid completely a discharge of treated wastewater to the natural environment. As such, the discharge needs to go to a receiving environment.

In terms of paragraph (c), as set out in section 2 and the Alternatives Assessment Report a range of receiving environments were considered for the discharge of treated wastewater from the WWTP. These included the discharge to the CMA, the discharge to land, the discharge to range of freshwater bodies, conveyance to other Watercare wastewater treatment plants and potable and non-potable reuse.

12.1.3 RMA Section 107 Restriction on grant of certain discharge permits

Section 107 specifically applies to any discharge of contaminants into water and onto or into land in circumstances which may result in that contaminant (or any other contaminant emanating as a result of natural processes from that contaminant) entering water. Section 107(1) states that a resource consent shall not be granted if:

> ...
>
> *after reasonable mixing, the contaminant or water discharged (either by itself or in combination with the same, similar, or other contaminants or water), is likely to give rise to all or any of the following effects in the receiving waters:*
>
> *(c) the production of any conspicuous oil or grease films, scums, or foams, or floatable or suspended materials:*
>
> *(d) any conspicuous change in the colour or visual clarity:*
>
> *(e) any emission of objectionable odour:*
>
> *(f) the rendering of fresh water unsuitable for consumption by farm animals:*
>
> *(g) any significant adverse effects on aquatic life.*

The high level of treatment of the wastewater prior to discharge from all 4 stages of improvements to the WWTP and in particular the new (MBR) WWTP Long-term Stage 1 and Stage 2 which includes the very fine membranes of the MBR treatment process will ensure the production of any conspicuous oil or grease films, scums, or foams, or floatable or suspended materials does not occur in the Te Puru Stream and associated tributaries (s107(1)(c)).

The assessment of effects (see section 7.2.1) identifies that:

- The current WWTP discharge has consistently low TSS.
- There is little difference in TSS for the receiving environment sites upstream and downstream of the WWTP discharge.
- Discharge standards for the new (MBR) WWTP Long-term Stage 1 and Stage 2 are expected to result in an approximate 1.4-fold decrease in TSS and therefore contribute to improved water quality downstream of the discharge.

Based on these findings it is not expected that the discharge (under any of the 4 stages) will result in any conspicuous change in colour or visual clarity after reasonable mixing (s107(1)(d)).

There will be no emission of objectionable odour associated with the proposed discharge (s107(1)(e) due to the high level of treatment of the wastewater.

The QRMA[28] has identified that due to high levels of faecal indicator bacteria in the Te Puru Stream, the stream is an unsuitable source of stock drinking water. The high levels of faecal indicator bacteria are attributed to other activities in the Te Puru catchment and not to the discharge from the WWTP (s107(1)(f)).

The findings of the ecological assessment concludes that the level of adverse effects on stream ecology, relative to the existing environment, will range from negligible to potentially moderate (when considered in combination with other catchment stressors) and relative to the current state, the proposed improvements in the treated wastewater quality will result in material improvement to several stream attributes. Consequently, the proposed discharge should not result in significant adverse effects on aquatic life (s107(1)(g)).

Based on the above findings it is unlikely that the proposed discharge from any of the 4 stages of upgrades to the WWTP will result in any of the effects identified in s107(1)(c) to (g) downstream of the potential mixing zone – Bridge site (15) approximately 350 m below the pond discharge. Site 15 has been identified as a potential mixing zone as it is sufficiently downstream to accommodate reasonable mixing from the existing farm pond and diffuse discharge from the proposed areas identified as potentially suitable for an expansion of the Beachlands overland flow system. Between the farm pond and the Bridge site is also Watercare land[29].

12.2 Relevant National Planning Instruments

The following provides a summary of the key provisions of the national planning instruments that under s104(1)(b) of the RMA the consent authority must have regard to when considering the application.

12.2.1 National Policy Statement for Freshwater Management 2020 (Updated 2023)

The NPS-FM is relevant to the proposal as it involves a discharge to land that will enter freshwater.

The fundamental concept of Te Mana o te Wai introduced by the NPS-FM establishes the overarching framework for the consideration of the effects of the wastewater discharges on freshwater receiving environments such as the Te Puru stream and its associated tributaries.

Te Mana o te Wai incorporates the following hierarchy of obligations:

a. first, the health and well-being of water bodies and freshwater ecosystems.

b. second, the health needs of people (such as drinking water).

c. third, the ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future.

This hierarchy is reflected in the only objective of the NPS-FM.

Te Mana o te Wai encompasses six principles relating to the roles of tangata whenua and other New Zealanders in the management of freshwater, and these principles inform the NPS-FM and its implementation. The six principles are:

1) *Mana whakahaere: the power, authority, and obligations of tangata whenua to make decisions that maintain, protect, and sustain the health and well-being of, and their relationship with, freshwater.*

2) *Kaitiakitanga: the obligation of tangata whenua to preserve, restore, enhance, and sustainably use freshwater for the benefit of present and future generations.*

3) *Manaakitanga: the process by which tangata whenua show respect, generosity, and care for freshwater and for others.*

[28] Beachlands WWTP Discharge: Assessment of microbiological effects and health risk, NIWA March 2024, page 6

[29] Beachlands Wastewater Treatment Plant – water quality, ecological and human health effects assessment, Aquatic Environmental Sciences, Coast & Catchment, Streamlined Environmental. April 2024, Footnote 2.

4) *Governance: the responsibility of those with authority for making decisions about freshwater to do so in a way that prioritises the health and well-being of freshwater now and into the future.*

5) *Stewardship: the obligation of all New Zealanders to manage freshwater in a way that ensures it sustains present and future generations.*

6) *Care and respect: the responsibility of all New Zealanders to care for freshwater in providing for the health of the nation.*

Key themes from the policies in the NPS-FM include that:

- Freshwater is managed in a way that gives effect to Te Mana o te Wai (Policy 1).
- Tangata whenua are actively involved in freshwater management (including decision-making processes), and Māori freshwater values are identified and provided for (Policy 2).
- The health and wellbeing of waterbodies is maintained or, where degraded, improved (Policy 5).
- The loss of river extent and values is avoided to the extent practicable (Policy 7).
- There is no further loss of the extent of natural inland wetlands, their values are protected, and their restoration is promoted (Policy 6).
- The habitats of indigenous freshwater species are protected (Policy 9).
- The condition of freshwater is systematically monitored over time, and action is taken where freshwater is degraded, and to reverse deteriorating trends (Policy 13).
- Communities are enabled to provide for their social, economic, and cultural well-being in a way that is consistent with this National Policy Statement (Policy 15).

Based on the information available to date (noting that Ngāi Tai ki Tāmaki is preparing a CIA for the proposal), it is considered that the proposal is generally consistent with the NPS-FM because:

- From a technical perspective, the proposed new (MBR) WWTP (Stage 1 and Stage 2) will contribute to giving effect to Te Mana o te Wai because the quality of the treated wastewater discharge from the new WWTP to the tributary of Te Puru Stream and ultimately Te Puru Stream is very high, particularly with the proposed membranes and the UV treatment.
- Watercare propose a comprehensive monitoring regime to detect the occurrence of any adverse effects of the discharge on the tributary of Te Puru Stream and Te Puru Stream.
- The proposed wastewater scheme will enable the continuation of a safe and reliable public health sanitation system for both the existing and future communities of Beachlands and Maraetai, which in turn will support community well-being and growth.
- The OFDOMP will identify if any natural inland wetlands will be affected by the proposed works. The plan, which Watercare will invite Ngāi Tai ki Tāmaki to partner in the development of, will ensure the design and operation of the overland flow system avoids, mitigates or offsets potential adverse effects on the ecological values of riparian areas, wetlands and aquatic habitats.
- Key findings from the water quality and ecological assessment are that the downstream sites would be classified as degraded compared with the existing environment (reference upstream sites) for nitrate-N, DRP and macroinvertebrate indices but the proposed reduction in nitrate-N from the upgraded WWTP (significant improvements once the MBR WWTP is installed) will likely contribute to improved stream health and potentially ecological communities downstream compared to the current WWTP discharge.[30] .
- Based on the ecological assessment findings, over the longer term the treated wastewater discharge from the new (MBR) WWTP Long-term (Stage 1 and Stage 2) should potentially contribute to improving the health and well-being

[30] Beachlands Wastewater Treatment Plant – water quality, ecological and human health effects assessment, Aquatic Environmental Sciences, Coast & Catchment, Streamlined Environmental. April 2024, page 16

of the tributary to the Te Puru Stream and to the stream itself, to avoiding further loss of stream values, and to protecting habitats of indigenous freshwater species.

The assessment of the NPS-FM can be updated following the receipt of the Ngāi Tai ki Tāmaki CIA for the proposal.

12.2.2 New Zealand Coastal Policy Statement 2010

The NZCS has some relevance to the proposal as the treated wastewater is discharged to a tributary of the Te Puru Stream which ultimately discharges into the Te Puru Stream estuary / Te Maraetai / Kellys Beach some 4km downstream from the WWTP site.

Relevant key provisions in the NZCPS seek to:

- Safeguard the integrity, form, functioning and resilience of the coastal environment and sustain its ecosystems (Objective 1).
- Preserve the natural character of the coastal environment and protect natural features and landscape values (Objective 2).
- Take account of the principles of the Treaty of Waitangi, recognise the role of tangata whenua as kaitiaki and provide for tangata whenua involvement in management of the coastal environment (Objective 3).
- Protect indigenous biological diversity in the coastal environment (Policy11).
- Manage discharges of human wastewater and do not allow the discharge of treated human sewage to water in the coastal environment, unless:
  - there has been adequate consideration of alternative methods, sites and routes for undertaking the discharge; and
  - informed by an understanding of tangata whenua values and the effects on them (Policy 23).
- Maintain and enhance recreation opportunities (Objective 4).
- Enable people and communities to provide for their social, economic, and cultural wellbeing, and health and safety (Objective 6).
- Recognise that the provision of infrastructure in the coastal environment is important for the well-being of people and communities. (Policy 6).

Based on the information available to date (noting that Ngāi Tai ki Tāmaki is preparing a CIA for the proposal), it is considered that the proposal is generally consistent with the NZCPS because:

- The proposal does not involve the direct discharge of untreated human sewage to the coastal environment. The highly treated wastewater is discharged to a tributary of the Te Puru Stream, the Te Puru Stream which ultimately discharges to the Te Puru Estuary / CMA.
- The proposed wastewater scheme will enable the continuation of a safe and reliable public health sanitation system for both the existing and future communities of Beachlands and Maraetai, which in turn will support community well-being and growth.
- The findings of the ecological assessment in relation to the effects if the proposed discharge ecosystems and water quality in the CMA[31] are summarised as follows:
  - The proposed discharge rates from the new WWTP (MBR) Long-term (Stage 2) will have negligible effects on the salinity and the marine communities of Te Maraetai / Kellys Beach due to the relatively low discharge rates compared to other nearby streams and rivers, the rapid dilution, and the tolerance of intertidal biota to low salinities. There will be no change from the current WWTP scenario.
  - Nitrogen, and to a lesser extent, phosphorus, are the two primary limiting nutrients of concern in coastal waters. Concentrations of these nutrients from the new WWTP (MBR) Long-term (Stages 1 and 2) will be

[31] Beachlands Wastewater Treatment Plant – water quality, ecological and human health effects assessment, Aquatic Environmental Sciences, Coast & Catchment, Streamlined Environmental. April 2024, page 17.

significantly diluted by the time they reach the Te Puru Stream mouth, making them well below background concentrations in coastal waters. Given the rapid dilution rate, no increase in nutrient concentrations in coastal waters, or related adverse effects from increased nutrients, are likely to occur. There will be no change from the current WWTP scenario.

- Given that the estimated TN and TP loads from the new WWTP (MBR) Long-term (Stages 1 and 2) represent a very small percentage of the TN and TP loads entering the inner Hauraki Gulf and Firth of Thames, the effects of the increased loads from the new WWTP are assessed to be less than minor. Other minor contaminants that are present in the treated wastewater at low concentrations will be diluted at a similar rate to TN and TP.

- Given that the proposed treated wastewater will be discharged to a tributary of the Te Puru Stream some 4 km upstream from where Te Puru Stream ultimately discharges to the CMA (Te Puru Estuary / Te Maraetai / Kellys Beach), it is considered highly unlikely that the discharge will result in any adverse effects the natural character of the coastal environment.
- Given the findings of the water quality and ecological assessment over the longer term the treated wastewater discharge from the new WWTP (MBR) Long-term (Stages 1 and 2) should contribute to sustaining the coastal environment's ecosystems and to protecting its indigenous biological diversity.
- The log reduction to be achieved by the new WWTP will reduce risks for shellfish consumption and for swimming to below 1% at all marine sites used for the QMRA and therefore any adverse effects on public health and recreation are anticipated to be very low.

The assessment of the NZCPS can be updated following the receipt of the Ngāi Tai ki Tāmaki CIA for the proposal.

12.2.3 National Environmental Standard for Freshwater 2020 (Updated 2024)

As set out in Section 4, no consents have currently been sought under the National Environmental Standard for Freshwater (**NES-F**) for the proposed scheme. Once detailed design of the extended overland flow system has been undertaken there will be sufficient information to determine the location of any natural inland wetlands in relation to the proposed works and the extent to which any wetlands will be affected. If any consents are identified as being required under the NES-F they will be sought in conjunction with any other required consents.

12.2.4 Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011

As set out in Section 4, no consents have currently been sought under the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations (**NES Contaminated Soil**). Once detailed design of the new WWTP and the extended overland flow system has been undertaken there will be sufficient information to determine the location of any contaminated soil in relation to the proposed works. If any consents are identified as being required under the NES Contaminated Soil they will be sought in conjunction with any other required consents.

12.2.5 National Policy Statement for Indigenous Biodiversity 2023

The National Policy Statement on Indigenous Biodiversity (**NPS-IB**) applies to indigenous biodiversity in the terrestrial environment.

The NPS-IB prioritises the mauri and intrinsic value of indigenous biodiversity and recognises people's connections and relationships with indigenous biodiversity while recognising the relationship between indigenous species, ecosystems, the wider environment, and the community and in particular the bond between tangata whenua and indigenous biodiversity and obligations of care that tangata whenua have as kaitiaki of indigenous biodiversity among other principles.

To the extent that it is necessary, the NPS-IB will be taken into account as part of the detailed design process for the extended overland flow system and the for the upgrades / new WWTP. It is noted however that the expansion of the overland flow system and improvements to the current system provide the opportunity to increase the extent of indigenous flora on the WWTP site.

12.3 Auckland Unitary Plan operative in part (Updated 8 March 2024)

12.3.1 Regional Policy Statement

The following provides a summary assessment of the key objectives and policies of the Regional Policy Statement (RPS) that under s104(1)(b) of the RMA the consent authority must have regard to when considering the application.

Relevant key provisions in the RPS seek to:

- The quality of freshwater and coastal water is maintained where it is excellent or good and progressively improved over time where it is degraded (Objective B7.4.1(2).
- The adverse effects of point and non-point discharges, in particular stormwater runoff and wastewater discharges, on coastal waters and freshwater are minimised and existing adverse effects are progressively reduced (Objective B7.4.1(3).
- Ensure new development is supported by wastewater infrastructure with sufficient capacity to serve the development (Policies B7.4.2).
- Adopt the best practicable option for minimising the adverse effects of discharges from wastewater treatment plants. (Policies B7.4.2).
- Progressively improve water quality in areas identified as having degraded water quality through managing subdivision, use, development and discharges (Policies B7.4.2).
- Manage discharge of contaminants into water to avoid where practicable, and otherwise minimise significant bacterial contamination, adverse effects on the quality of freshwater and coastal water) adverse effects on Mana Whenua values including wāhi tapu, wāhi taonga and mahinga kai (Policies B7.4.2).
- Development, operation, maintenance, and upgrading of infrastructure is enabled, while managing adverse effects on the quality of the environment and the health and safety of communities and amenity values (Objective B3.2.1 (3).
- The functional and operational needs of infrastructure are recognised (Objective B3.2.1 (4).
- The mauri of, and the relationship of Mana Whenua with, natural and physical resources including freshwater, land, air and coastal resources are enhanced overall Objective B6.3.1 (2).
- Recognises the role of Mana Whenua as kaitiaki and provide for the practical expression of kaitiakitanga, recognises Mana Whenua as specialists in the tikanga of their hapū or iwi and as being best placed to convey their relationship with their ancestral lands, water, sites, wāhi tapu and other taonga (Policies B6.2.2).
- The management of the Hauraki Gulf gives effect to sections 7 and 8 of the Hauraki Gulf Marine Park Act 2000 (Objective B8.5.1 (1).
- Encourage and support the restoration and enhancement of the Hauraki Gulf's ecosystems, its islands and catchments (Policies B8.5.2).

Based on the information available to date (noting that Ngāi Tai ki Tāmaki is preparing a CIA for the proposal), it is considered that the proposal is generally consistent with the RPS because:

- There is an operational need for the proposal because the current wastewater scheme is nearing capacity and will not be able to support the future growth of the Beachlands Maraetai area particularly if PPC88 and the Business Park application are approved.
- There is a functional need for the discharge of treated wastewater to the tributary of the Te Puru Stream because Watercare is responsible for collecting, treating, and disposing of the Beachlands Maraetai community's wastewater. The discharge cannot practicably be avoided as it cannot be turned off. The discharge needs to go to a receiving environment.
- An extensive range of receiving environments were considered for the discharge of treated wastewater from the WWTP. These included the discharge to the CMA, the discharge to land, the discharge to range of freshwater

bodies, conveyance to other Watercare wastewater treatment plants and potable and non-potable reuse. A comprehensive assessment of these receiving environments was undertaken, and the proposal was determined to be the BPO from a technical perspective.

- Key findings from the water quality and ecological assessment are that the downstream sites would be classified as degraded compared with the existing environment (reference upstream sites) for nitrate-N, DRP and macroinvertebrate indices but the proposed reduction in nitrate-N from the upgraded WWTP (significant improvements once the MBR WWTP is installed) will likely contribute to improved stream health and potentially ecological communities downstream compared to the current WWTP[32]will likely contribute to improved stream health and potentially ecological communities downstream.
- Based on the ecological assessment findings, over the longer term the treated wastewater discharge from the new WWTP (MBR) Long-term (Stages 1 and 2) should potentially contribute to improving the health and well-being of the tributary to the Te Puru Stream and the stream, to minimising adverse effects of the treated wastewater discharge on the quality of freshwater and to minimising any significant bacterial contamination.
- The findings of the ecological assessment in relation to the effects if the proposed discharge ecosystems and water quality in the CMA[33] are summarised as follows:
    - The proposed discharge rates from the new WWTP (MBR) Long-term (Stage 2) will have negligible effects on the salinity and the marine communities of Te Maraetai / Kellys Beach due to the relatively low discharge rates compared to other nearby streams and rivers, the rapid dilution, and the tolerance of intertidal biota to low salinities. There will be no change from the current WWTP scenario.
    - Concentrations of these nutrients from the new WWTP (MBR) Long-term (Stages 1 and 2) will be significantly diluted by the time they reach the Te Puru Stream mouth, making them well below background concentrations in coastal waters. Given the rapid dilution rate, no increase in nutrient concentrations in coastal waters, or related adverse effects from increased nutrients, are likely to occur. There will be no change from the current WWTP scenario.
    - Given that the estimated TN and TP loads from the new WWTP (MBR) Long-term (Stages 1 and 2) represent a very small percentage of the TN and TP loads entering the inner Hauraki Gulf and Firth of Thames, the effects of the increased loads from the new WWTP are assessed to be less than minor. Other minor contaminants that are present in the treated wastewater at low concentrations will be diluted at a similar rate to TN and TP.
- Given the findings of the water quality and ecological assessment, over the longer term the treated wastewater discharge from the new WWTP (MBR) Long-term (Stages 1 and 2) should contribute to enhancing the Hauraki Gulf's ecosystems, to minimising adverse effects on the quality of coastal water and to minimising any significant bacterial contamination.

The assessment of the RPS can be updated following the receipt of the Ngāi Tai ki Tāmaki CIA for the proposal.

12.3.2 Regional Plan

The following provides a summary assessment of the key objectives and policies of the Regional Plan that under s104(1)(b) of the RMA the consent authority must have regard to when considering the application.

Relevant key provisions in the Regional Plan seek to:

- Avoid the discharge of wastewater from wastewater treatment plants to freshwater, unless:
    - alternative methods and sites for the discharge have been considered and are not the best practicable option.
    - Mana Whenua have been consulted in accordance with tikanga Māori and due consideration has been given to section 6, section 7 and section 8 of the RMA.

[32] Beachlands Wastewater Treatment Plant – water quality, ecological and human health effects assessment, Aquatic Environmental Sciences, Coast & Catchment, Streamlined Environmental. April 2024, page 16
[33] Beachlands Wastewater Treatment Plant – water quality, ecological and human health effects assessment, Aquatic Environmental Sciences, Coast & Catchment, Streamlined Environmental. April 2024, page 17.

- the affected community has been consulted regarding the suitability of the treatment and disposal system to address any environmental effects.
- the extent to which adverse effects have been avoided where practicable, or otherwise remedied or mitigated in areas of high recreational use, or areas that are used for fishing or shellfish gathering, commercial or residential development, significant ecological value (Policy E1.3 (18)).

- Freshwater and sediment quality is maintained where it is excellent or good and progressively improved over time in degraded areas (Objective E1.2 (1)).
- The mauri of freshwater is maintained or progressively improved over time to enable traditional and cultural use of this resource by Mana Whenua (Objective E1.2 (2)).
- 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 (Objective E1.2 (3)).
- Manage discharges having regard to NPS-FM national bottom lines and the Macroinvertebrate Community Index and enhance water quality, flows, stream channels and their margins and other freshwater values where the current condition is below national bottom lines or the relevant Macroinvertebrate Community Index guideline (Policy E1.3 (1)).
- Auckland's streams are restored, maintained or enhanced. Significant residual adverse effects on streams that cannot be avoided, remedied or mitigated are offset where this will promote the purpose of the RMA (Objectives E3.2).
- Avoid significant adverse effects and avoid where practicable or otherwise remedy or mitigate other adverse effects of activities in, on, under or over the beds of streams or wetlands within SEAs (Policy E3.3 (1)).
- Protect the riparian margins of streams from inappropriate use and development and promote their enhancement (Policy E3.3 (15)).
- Avoid the discharge of contaminants in the CMA where it will result in significant modification of, or damage to any areas identified as having significant values (Policy F2.11.3 (1)).

Based on the information available to date (noting that Ngāi Tai ki Tāmaki is preparing a CIA for the proposal), it is considered that the proposal is generally consistent with the Regional Plan because:

- An extensive consideration of alternative receiving environments was undertaken to determine the preferred wastewater scheme and to determine that the proposed scheme was the BPO.
- Watercare has engaged extensively with the Beachlands Maraetai community and other stakeholders through the various stages of the option selection process which included a comparison of the various effects of the options.
- The option assessment process took into account areas of high recreational use, or areas that are used for fishing or shellfish gathering and the selected option avoids these areas.
- The log reductions required by the QMRA from the WWTP Short Term and Long-term Stages can be achieved and therefore the public health effects from the treated wastewater discharge are anticipated to be low.
- The OFDOMP will identify if any natural inland wetlands will be affected by the proposed works. The plan will ensure the design and operation of the overland flow system avoids, mitigates or, if required, offsets potential adverse effects on the ecological values of riparian areas, wetlands, and aquatic habitats.
- Key findings from the water quality and ecological assessment are that the downstream sites would be classified as degraded compared with the existing environment (reference upstream sites) for nitrate-N, DRP and macroinvertebrate indices but the proposed reduction in nitrate-N from the upgraded WWTP (significant improvements once the MBR WWTP is installed) will likely contribute to improved stream health and potentially ecological communities downstream compared to the current discharge from the WWTP[34].
- Based on the ecological assessment findings, over the longer term the treated wastewater discharge from the new WWTP (MBR) Long-term (Stages 1 and 2) will result in an improvement in water quality compared to the current

[34] Beachlands Wastewater Treatment Plant – water quality, ecological and human health effects assessment, Aquatic Environmental Sciences, Coast & Catchment, Streamlined Environmental. April 2024, page 16

water quality results and is highly likely to result in an improvement in the overall macroinvertebrate and fish community downstream compared to the most recent survey results..

- OFDOMP should ensure the design and operation of the overland flow system avoids, mitigates or offsets potential adverse effects on the SEA_T_428. The implementation of the proposed wastewater scheme will avoid SEA_T_5259.
- Potential effects on SEA-M1-42b Te Puru Stream estuary and SEA-M2-42a are anticipated to be less than minor given the level of influence the treated wastewater discharge will have on nutrient concentrations and salinity in coastal waters.
- The increase in discharge volume is not expected to have significant adverse effects on stream bank conditions or native fauna habitats along the tributary of the Te Puru stream. Infill riparian planting with deep rooting vegetation is proposed along the tributary of Te Puru Stream within the Watercare site to minimise erosion and scour associated with any increase in the discharge volume[35].

The assessment of the Regional Plan can be updated following the receipt of the Ngāi Tai ki Tāmaki CIA for the proposal.

12.4 Hauraki Gulf Marine Park Act 2000

The Hauraki Gulf Marine Park Act 2000 (**HGMPA**) is relevant to the proposal as the treated wastewater is discharged to a tributary of the Te Puru Stream which ultimately discharges into the Te Puru Stream estuary and the CMA in the Hauraki Gulf and s9(4) of the HGMPA requires that a consent authority must, when considering an application for a resource consent for the Hauraki Gulf, its islands, and catchments, have regard to sections 7 and 8 in addition to the matters contained in the RMA.

Sections 7 and 8 of the HGMPA are set out below.

7 Recognition of national significance of Hauraki Gulf

(1) The interrelationship between the Hauraki Gulf, its islands, and catchments and the ability of that interrelationship to sustain the life-supporting capacity of the environment of the Hauraki Gulf and its islands are matters of national significance.

(2) The life-supporting capacity of the environment of the Gulf and its islands includes the capacity—

(a) to provide for—

(i) the historic, traditional, cultural, and spiritual relationship of the tangata whenua of the Gulf with the Gulf and its islands; and

(ii) the social, economic, recreational, and cultural well-being of people and communities:

(b) to use the resources of the Gulf by the people and communities of the Gulf and New Zealand for economic activities and recreation:

(c) to maintain the soil, air, water, and ecosystems of the Gulf.

8 Management of Hauraki Gulf

To recognise the national significance of the Hauraki Gulf, its islands, and catchments, the objectives of the management of the Hauraki Gulf, its islands, and catchments are—

[35] Te Puru Stream WWTP Discharge Volume Increase Assessment on Stream Habitat, Bioresearches, 2 April 2024, page 5.

(a) the protection and, where appropriate, the enhancement of the life-supporting capacity of the environment of the Hauraki Gulf, its islands, and catchments:

(b) the protection and, where appropriate, the enhancement of the natural, historic, and physical resources of the Hauraki Gulf, its islands, and catchments:

(c) the protection and, where appropriate, the enhancement of those natural, historic, and physical resources (including kaimoana) of the Hauraki Gulf, its islands, and catchments with which tangata whenua have an historic, traditional, cultural, and spiritual relationship:

(d) the protection of the cultural and historic associations of people and communities in and around the Hauraki Gulf with its natural, historic, and physical resources:

(e) the maintenance and, where appropriate, the enhancement of the contribution of the natural, historic, and physical resources of the Hauraki Gulf, its islands, and catchments to the social and economic well-being of the people and communities of the Hauraki Gulf and New Zealand:

(f) the maintenance and, where appropriate, the enhancement of the natural, historic, and physical resources of the Hauraki Gulf, its islands, and catchments, which contribute to the recreation and enjoyment of the Hauraki Gulf for the people and communities of the Hauraki Gulf and New Zealand.

Based on the information available to date (noting that Ngāi Tai ki Tāmaki is preparing a CIA for the proposal), it is considered that the proposal is generally consistent with section 7 and 8 of the HGMPA because:

- The proposed discharge is not a direct discharge to the CMA. The treated wastewater passes through an overland flow system before entering the tributary to the Te Puru Stream. The discharge enters the stream some 4 km upstream of the CMA.
- The findings of the ecological and water quality assessment in relation to the effects if the proposed discharge ecosystems and water quality in the CMA[36] are summarised as follows:
  - The proposed discharge rates from the new WWTP (MBR) Long-term (Stage 2) will have negligible effects on the salinity and the marine communities of Te Maraetai / Kellys Beach due to the relatively low discharge rates compared to other nearby streams and rivers, the rapid dilution, and the tolerance of intertidal biota to low salinities. There will be no change from the current WWTP scenario.
  - Nitrogen, and to a lesser extent, phosphorus, are the two primary limiting nutrients of concern in coastal waters. Concentrations of these nutrients from the New WWTP (MBR) Long-term Stages 1 and 2 will be significantly diluted by the time they reach the Te Puru Stream mouth, making them well below background concentrations in coastal waters. Given the rapid dilution rate, no increase in nutrient concentrations in coastal waters, or related adverse effects from increased nutrients, are likely to occur. There will be no change from the current WWTP scenario. Given that the estimated TN and TP loads from the new WWTP (MBR) Long-term (Stages 1 and 2) represent a very small percentage of the TN and TP loads entering the inner Hauraki Gulf and Firth of Thames, the effects of the increased loads from the new WWTP are assessed to be negligible. Other minor contaminants that are present in the treated wastewater at low concentrations will be diluted at a similar rate to TN and TP.
- Given the findings of the water quality and ecological assessment, over the longer term the treated wastewater discharge from the new WWTP (MBR) Long-term (Stages 1 and 2) should contribute to enhancing the Hauraki Gulf's ecosystems, to sustaining the life-supporting capacity of the environment of the Hauraki Gulf and to minimising adverse effects on the quality of coastal water.

[36] Beachlands Wastewater Treatment Plant – water quality, ecological and human health effects assessment, Aquatic Environmental Sciences, Coast & Catchment, Streamlined Environmental. April 2024, page 17.

- Given that the proposed treated wastewater will be discharged to a tributary of the Te Puru Stream some 4 km from where the stream ultimately discharges to the CMA (Te Puru Estuary / Te Maraetai / Kellys Beach) it is considered unlikely that the discharge will result in any adverse effects the natural character of the coastal environment.
- The log reduction to be achieved by the new WWTP will reduce risks for shellfish consumption and for swimming to below 1% at all marine sites used for the QMRA and therefore any adverse effects on public health and recreation are anticipated to be negligible.

12.5 Take Taiaomaurikura 2022

Ngāi Tai ki Tāmaki is preparing a CIA for the proposal which will assess the proposal against Take Taiaomaurikura.

12.6 Statutory Acknowledgements

A statutory acknowledgement is a formal acknowledgement by the Crown of the mana of tangata whenua over a specified area. It recognises the particular cultural, spiritual, historical, and traditional association of an iwi with the site, which is identified as a statutory area. Statements of statutory acknowledgements are set out in Treaty of Waitangi claim settlement legislation.

Consent authorities, the Environment Court, and Heritage New Zealand Pouhere Taonga are required to have regard to a statutory acknowledgement when determining whether the relevant iwi may be adversely affected by the granting of a resource consent for activities within, adjacent to or impacting directly on the statutory area.

As set out in Section 3, the proposal is within Ngāi Tai Ki Tāmaki Statutory Acknowledgement as described in the Ngāi Tai Ki Tāmaki Claims Settlement Act 2018. Auckland Council is required to provide Ngāi Tai Ki Tāmaki with summaries of all resource consent applications that may affect the areas named in their acknowledgements, prior to decisions being made on those applications.

As set out in section 5, Watercare is continuing to work with Ngāi Tai ki Tāmaki to understand the effects of the treated wastewater discharge to their ancestral landscape, Te Taiao, and is committed to support Ngāi Tai ki Tāmaki as partners in the process following the lodgement of the application.

12.7 RMA Part 2

Schedule 4, clause 2 of the RMA requires that an application for a resource consent must include an assessment of the activity against the matters set out in Part 2 of the Act. The following table provides this required assessment.

Table 12-1: RMA Part 2 Assessment

Part 2	Assessment
5 Purpose Promote the sustainable management of natural and physical resources. Managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while— (a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and (b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and	The proposed wastewater scheme will enable communities to provide for their social and economic well-being as the scheme will enable the continuation of a safe and reliable public health sanitation system for both the existing and future population of the Beachlands Maraetai community. The proposed long-term MBR WWTP will result in an improvement in water quality compared to the current water quality results and is highly likely to result in an improvement in the overall macroinvertebrate and fish community downstream compared to the most recent survey results. The level of adverse effects on stream ecology, relative to the existing environment, will range from negligible to potentially moderate (when considered in combination with other catchment stressors) and the proposed improvements in the treated wastewater

(c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.	quality will result in material improvement to several stream attributes. Adverse effects from the discharge to land on terrestrial ecological values and groundwater quality are considered to be very low given proposed design and operational measures. Based on the above findings the proposed discharge should not result in significant adverse effects on the environment and should contribute to safeguarding the life-supporting capacity of water, soil, and ecosystems. The risks to recreational users of the stream and CMA downstream of the discharge have been assessed using Quantitative Microbiological Risk Assessment. The assessment has concluded that the log reduction to be achieved by the Short-term upgrades and new WWTP Long-term WWTP (Stages 1 and 2) will reduce risks for watercress and shellfish consumption and for swimming to below 1% at the sites used for the QMRA. Therefore, any adverse effects on public health and recreation are anticipated to be low to negligible.
6 Matters of national importance Recognise and provide for the following matters of national importance: (a) the preservation of the natural character of wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development: (b) the protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development: (c) the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna: (d) the maintenance and enhancement of public access to and along rivers: (e) the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, wāhi tapu, and other taonga: (f) the protection of historic heritage from inappropriate subdivision, use, and development: (g) the protection of protected customary rights: (h) the management of significant risks from natural hazards.	The natural character of the tributary of the Te Puru Stream and its margins within the Watercare site should be enhanced as a result of proposed riparian planting. There are no outstanding natural features or landscapes, affected by the proposed treated wastewater discharge. OFDOMP should ensure the design and operation of the overland flow system avoids, mitigates or offsets potential adverse effects on the SEA_T_428. The implementation of the proposed wastewater scheme will avoid SEA_T_5259. Potential effects on SEA-M1-42b Te Puru Stream estuary and SEA-M2-42a are anticipated to be low given the level of influence the treated wastewater discharge will have on nutrient concentrations and salinity in coastal waters. The proposed treated wastewater discharge does not affect any identified archaeological sites. Ngāi Tai ki Tāmaki is preparing a CIA for the proposal which will provide information on s6(e) matters and other section 6 matters of importance to Ngāi Tai ki Tāmaki.
7 Other matters	Watercare is working with Ngāi Tai ki Tāmaki to acknowledge and recognise their kaiitiaki role through opportunities for ongoing involvement in the

Have particular regard to (a) kaitiakitanga: (aa) the ethic of stewardship: (b) the efficient use and development of natural and physical resources: (ba) the efficiency of the end use of energy: (c) the maintenance and enhancement of amenity values: (d) intrinsic values of ecosystems: (f) maintenance and enhancement of the quality of the environment: (g) any finite characteristics of natural and physical resources: (h) the protection of the habitat of trout and salmon: (i) the effects of climate change: (j) the benefits to be derived from the use and development of renewable energy.	implementation of the consent including the co-design of the overland flow system. Utilisation of the existing WWTP and site as part of the upgraded / new WWTP will result in the efficient use of current resources. The level of adverse effects on stream ecology, relative to the existing environment, will range from negligible to potentially moderate (when considered in combination with other catchment stressors). Further, relative to the current state, the proposed improvements in the treated wastewater quality will result in material improvement to several stream attributes. The expansion of the overland flow system and improvements to the current system provide the opportunity to increase the extent of indigenous flora on the WWTP site. This coupled with the proposed riparian planning and improvement in the wastewater discharge quality should result in the overall enhancement of ecological values at the WWTP site. The proposed wastewater scheme will be designed to be resilient to the effects of climate change and natural hazards.
8 Te Tiriti o Waitangi In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall take into account the principles of the Te Tiriti o Waitangi.	Watercare is continuing to work with Ngāi Tai ki Tāmaki to understand the effects of the treated wastewater discharge to their ancestral landscape, and Te Taiao and is committed to support Ngāi Tai ki Tāmaki as partners in the process following the lodgement of the application.

Based on the information available to date (noting that Ngāi Tai ki Tāmaki is preparing a CIA for the proposal), it is considered that the proposal is generally consistent with Part 2 of the RMA.

13. Engagement and Consultation

Over the past seven months (October 2023 – April 2024), an engagement exercise has taken place to inform and seek feedback from key stakeholders and members of the community including Ngāi Tai ki Tāmaki (as Mana Whenua) to help inform the determination of the BPO for the treated wastewater discharge from the WWTP. The engagement process, activities and responses are set out in the Watercare Stakeholder Engagement Report April 2024 appended to this resource consent application.

Stakeholder engagement on major projects is supported by Watercare's SOI, prepared in accordance with Section 64 and Schedule 8 of the Local Government Act 2002. The SOI outlines the company's strategic direction, activities, intentions and objectives. It reflects Watercare's commitment to engage with mana whenua and affected and interested parties in an open manner to address concerns of those parties where feasible.

13.1 Ngā Iwi Mana Whenua o Tāmaki Makaurau

Watercare regards its relationship with Ngā Iwi Mana Whenua o Tāmaki Makaurau as a collaborative partnership which recognises the local iwi or hapū as kaitiaki or guardians of the land.

Watercare established a Mana Whenua Kaitiaki Forum in 2012 to encourage discussion and guidance between mana whenua and Watercare to share views on the management of water and wastewater issues. The forum's focus has widened so that it now encompasses all Watercare projects affecting the strategic interests of mana whenua across the Auckland region. Watercare has offered each of the mana whenua entities an opportunity to be involved in all projects.

Watercare has kept iwi groups informed of this project through updates to the Kaitiaki Forum, which includes nominated representatives of all 19 mana whenua groups of the Auckland area. Watercare initially added the project to the Mana Whenua Kaitiaki Managers' List in September 2023 under the title "Beachlands Wastewater Treatment Plant Discharge Renewal". The following updates are relevant to this project:

- Ngāi Tai ki Tāmaki registered interest in the project in September 2023

  A summary of how Watercare has been working with Ngāi Tai ki Tāmaki is set out in the Watercare Stakeholder Engagement Report. Watercare is continuing to work with Ngāi Tai ki Tāmaki and this will continue beyond the lodgement of the application.

- Ngaati Te Ata Waiohua communicated with Watercare in mid-December 2023 that they wish to be updated on all projects in their rohe

  Watercare will continue to update Ngāti te Ata as the project progresses.

13.1.1 Ngāi Tai ki Tāmaki Engagement Summary

Engagement with Ngāi Tai ki Tāmaki on the project to date has been set out in the Stakeholder Engagement Report and has included engagement in multiple forms from September 2023 through to lodgement of the application in April 2024.

To date, Ngāti Tai ki Tāmaki have not provided formal input (by way of a cultural statement) on cultural values and potential impacts as they related to the project, however, the general themes of the matters covered during the engagement are set out in section 5 above. Additionally, Ngāi Tai ki Tāmaki has stated their intention to provide a cultural statement which will be progressed following lodgement of this application.

13.2 Project Stages and Engagement

The table below sets out the engagement activities undertaken through the stages of the alternatives assessment process to determine the BPO and through the preparation of the resource consent application.

Table 13-1: Project stages and engagement activities

Project Stage	Stakeholder	Communication	Timing
Long long-list assessment	Internal Watercare Staff & technical specialists		August 2023
	Ngāi Tai ki Tamaki	Meeting and email with Ngāi Tai ki Tāmaki Governance to provide overview of option selection process and timeline.	September 2023
Long list assessment	Mana Whenua	Project Options posted on the Mana Whenua Kaitiaki Forum.	October 2023
	Wider community	Direct Email to 2660 email addresses on database. Community Information Session 1. Online survey.	October 2023
Short list assessment	Ngāi Tai ki Tāmaki	Representatives present at the two Short List Workshops	November and December 2023
	Wider community	Direct Email to 2660 email addresses on database. Advertisement on Pohutukawa Coast newspaper. Social Media post on Pohutukawa Coast Grapevine and Maraetai Group. Community Information Session 2.	November 2023
	Key Stakeholders	Where offer to meet was accepted, individual meetings held with stakeholders to go through the 5 Short-List options and the options process to date.	November 2023
	Potentially Affected Landowners	Letters sent directly to affected landowners. Community Information Session 2.	November 2023
BPO Preferred Scheme	Potentially affected landowners	Email and letter sent directly to landowners.	March 2024
	Interested parties	Email sent directly to interested parties registered on the contact list.	March 2024
	Wider community	Update Watercare website for the Beachlands project .	March 2024
	Mana Whenua	Direct email to Ngāti Tai ki Tāmaki. Update Mana Whenua Kaitiaki Forum.	February 2024 February 2024
Prepare Resource Consent	Ngāi Tai ki Tāmaki	Mana Whenua preparation of a Cultural Impact/Values Assessment.	Ongoing
	Potentially affected landowners	N/A as Watercare is the landowner for the WWTP	N/A
	Wider community and stakeholders	Public notification of the consent application. Opportunity to provide a submission on the consent application.	TBC following lodgement

13.3 Stakeholders

13.3.1 Local Board

Watercare, through its dedicated Stakeholder Liaison team, has undertaken direct engagement with central government, Auckland Council, and the Franklin Local Board. A summary of this engagement is set out in the Watercare Stakeholder Engagement Report.

13.3.2 Key Stakeholders

A range of stakeholders with diverse interests and influence have been involved in the project. The level of engagement with these groups varied depending on the stakeholder and their interest. Key stakeholders engaged with by Watercare to date are:

- Environmental Defence Society
- Hauraki Gulf Forum
- Auckland Regional Public Health

Through the process, the project team communicated with local interested individuals, as they became involved during the process. People would either request to be sent information following a newsletter, respond via Watercare's website or would leave their contact details at a Community Information Session.

13.3.3 Potentially Affected Landowners

Ahead of the Community Information Session on the short-listed options (Session 2), 22 potentially affected landowners were contacted to notifying them that their land would be potentially affected if the final BPO was the land application discharge method. The notice invited parties to attend the Community Information Session 2 and provided a direct contact person for any queries on the proposed options. A number of potentially affected landowners contacted Watercare directly. A summary of the feedback from the potential affected landowners was:

- Concerns over the acquisition of land for the discharge purposes
- Questions around how landowners would be compensated if the preferred option required their land
- Requests to be updated as the BPO decision process progresses.

13.3.4 Public and Community Interests

At various stages of the project, community groups, businesses and the wider community were engaged, including the Pohutukawa Coast newspaper and the Maraetai social media Groups.

Groups were primarily kept informed through social media, email updates, the Watercare website and community letters. The main opportunity for people to provide feedback to Watercare on the option selection process was through Community Information Sessions and the online survey. The feedback channel on the Watercare Beachlands webpage was also open through a dedicated email address that was monitored by the project team.

13.4 Engagement Activities

13.4.1 Community Information Session 1

Local businesses within the area were contacted on 17 October 2023 via hand-delivered invitation posters and flyers for the Beachlands Community Information Session 1 which were delivered to local shops, kindergartens, restaurants and cafes. The wider community was also contacted on 20 October 2023, via emails sent to the database of approximately 2660 email addresses for the wider community inviting them to the Beachlands Information Session 1, with information on the long-list of options and a survey link which enabled feedback on the long-list options.

The Community Information Session 1 was held on 26 October 2023 at Te Puru Community Centre, a local well-resourced venue, to discuss the long-list options. A total of 13 community members volunteered their contact details a higher number attended the event.

13.4.2 Online Survey

As part of the initial community wide email to the database of 2660 community email addresses, an online survey link was sent for the community to fill out, to help Watercare better understand the community concerns of the suggested options. A total of 61 respondents started the survey, with 23 respondents completing the survey and 38 respondents partially completing it.

13.4.3 Community Information Session 2

On 13 November 2023 direct emails were sent to the database of 2660 community email addresses and social media posts in the Pohutukawa Coast Grapevine and Maraetai Group were made that invited the community to the Community Information Session 2. Follow-up reminder emails were sent and social media posts made on 21 November 2023. On 17 November 2023, Watercare also published an ad and public notice in the Pohutukawa Coast newspaper advertising for the Community Information Session 2.

The Community Information Session 2 was held on 22 November 2023 to discuss the five Short-List options. A total of 13 community members volunteered their contact details however, a higher number attended the event. By way of summary, a mixed response was received in terms of what parties considered the BPO to be for the discharge of treated wastewater.

13.4.4 Website

The ‘Projects around Auckland’ section on Watercare’s website houses specific web pages on current and proposed infrastructure projects that Watercare is involved in. The web page designated to the Beachlands WWTP discharge consent renewal[37] contains an overview of the project, a description of the alternatives process, maps and option description. The web page was progressively updated as the BPO process was advanced.

13.5 Responses

Feedback from the community on the various wastewater management options is summarised in the Watercare Stakeholder Engagement Report.

[37] Watercare - Beachlands WWTP discharge consent renewal

14. Conclusions

Watercare is seeking to replace the current consent it holds for the discharge of treated wastewater from the WWTP. The current discharge consent expires on 31 December 2025.

The current consent has a maximum daily discharge volume limit of 2,800m³/day. Like much of Auckland, the catchment of the Beachlands WWTP is subject to significant growth which is placing pressure on the capacity of the WWTP and the consent limits. In addition, the current WWTP is coming to the end of its design life and several components need to be upgraded or replaced.

The proposal will enable the servicing of future growth including a recently allowed plan change and a proposed business park. Both these developments originally included individual wastewater treatment and discharge solutions. This application will enable the reticulation of the wastewater from these new developments to the WWTP for treatment and discharge. It will result in only one discharge to the environment, rather than three, and ensure the consistent and effective management of the community's wastewater by a highly competent and experienced operator.

The proposal is to undertake a short term (interim) upgrade to the WWTP to manage the increased flows to the plant and then to ultimately replace the current WWTP with a new MBR plant to improve treatment levels. The timing of the new WWTP is population driven. The new plant will need to be commissioned by the time a population equivalent (PE) of 18,000 is reached. The new WWTP is designed to provide for a PE of 30,000 by the end of the consent term sought of 35 years. The new MBR WWTP will raise the level of treatment of wastewater from the Beachlands and Maraitai communities to the very high standard that Watercare provides elsewhere in Auckland.

The treated wastewater will continue to be discharged via an overland flow system to the current farm pond which is located within a tributary of the Te Puru Stream. The overland flow system will need to be expanded to accommodate the increase in flows. The current farm pond may need to be upgraded or a wetland developed to receive the increase in the discharge.

A comprehensive suite of technical investigations and assessments have been undertaken to support the resource consent application. The conclusions from these assessments are summarised in Section 11.

A range of positive effects will also arise from operation of the WWTP, of which the wastewater discharge is part, associated with the provision of a safe and reliable public health sanitation system for the community, treating wastewater to ensure good ecological health outcomes, the facilitations of future development within the community.

The assessments identify that potential adverse effects may arise with respect to the overland flow area, Te Puru Stream and the coastal marine area. It is anticipated that these adverse effects will range from negligible to potentially moderate.

The detailed statutory assessment completed for this application concludes that the proposal is generally consistent with the relevant planning instruments and Part 2 of the RMA. It further concludes that none of the adverse effects identified in section 107 (1) (c) to (g) of the RMA are likely to occur as a result of the proposed discharge.

Watercare has proposed a range of management, mitigation and monitoring measures that it considers will ensure the proposal and its effects are appropriately managed and monitored over the 35 year consent term being sought. In addition, Watercare is continuing to work with Ngāi Tai ki Tāmaki to understand the effects of the treated wastewater discharge on Te Taiao and the Ngāi Tai ki Tāmaki connection to Te Taiao, and to develop additional mitigations and remedies to assist in addressing these effects.

For these reasons Watercare considers that the discharge permit should be granted for period of 35 years and subject to conditions reflecting the measures proposed in section 10 of this application.

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ATTACHMENT 4

ALTERNATIVES ASSESSMENT REPORT
JUN 24

Beachlands Wastewater Scheme Resource Consent Project

Alternatives Assessment Report

June 2024 **Ref: 310104130**

PREPARED FOR:

Watercare

PREPARED BY:

Stantec

Stantec

Revision Schedule

Revision No.	Date	Description	Project Manager Final Approval
1	June 2024	Final	Mark Wollina

Disclaimer

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Contents

List of tables

List of figures

List of Appendices

Abbreviations

Abbreviations	Full Name
AUP	Auckland Unitary Plan Operative in part (Updated 16 February 2024)
AMP	Watercare's Asset Management Plan 2021-2024
BNR	Biological Nitrogen Removal
BPO	Best Practicable Option
CMA	Coastal Management Area
HUE	Housing Unit Equivalents
I&I	Inflow and Infiltration
MAR	Managed Aquifer Recharge
MCA Watercare	Multi-Criteria Analysis Watercare Service Ltd
NPS-FM2020	National Policy Statement for Freshwater Management 2020
PE	Population Equivalent
PPC88	Private Plan Change 88
RMA	Resource Management Act 1991
TBC	To be confirmed
WW	Wastewater
WWTP	Beachlands Wastewater Treatment Plant

Executive Summary

Background

Watercare Services Ltd (Watercare) current consent for the discharge of treated wastewater from the Beachlands Wastewater Treatment Plant (WWTP) is nearing expiry. The discharge volume is nearing the consent limit of 2,800m^3 per day and the condition that restricts the population serviced by the WWTP to 10,000 people is at this limit or potentially exceeded. There is significant growth projected for the Beachlands Maraetai area. By 2059 the population is projected to be 30,000 people.

Due to growth pressures, limitations of the current discharge consent, capacity constraints of the existing WWTP and that components of the plant are coming to the end of their design life, Watercare has initiated a process to investigate options for the future treatment and discharge of the wastewater from the Beachlands and Maraetai communities. Through the process Watercare can effectively and efficiently plan how it will continue providing wastewater services to the Beachlands and Maraetai communities.

Watercare has proposed that the process to identify the preferred option for the future treatment and discharge needs to determine that the preferred option is the Best Practicable Option (BPO) as defined under the Resource Management Act 1991 (RMA).

Purpose

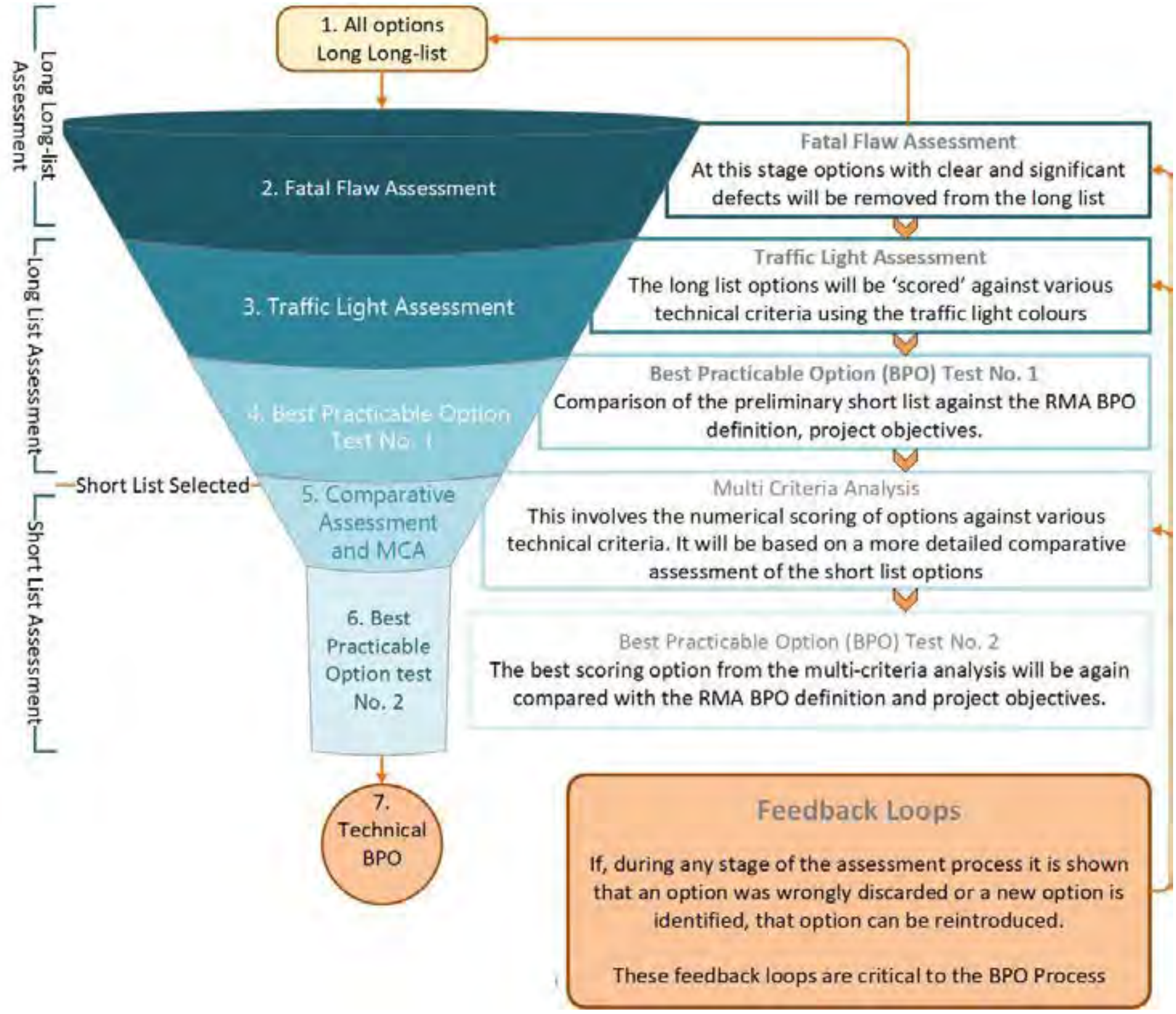
The purpose of this report is to summarise the alternatives (options) assessment process that was followed to determine the BPO for the treatment and discharge of wastewater and to demonstrate that the process has been thorough and robust.

The alternatives assessment that is described in this report is a technical assessment. Watercare has undertaken separate processes with Ngāi Tai ki Tāmaki and the Beachlands Maraetai community in considering the options for the future treatment and discharge of the wastewater. The outcomes of these processes will be integrated with this technical BPO assessment process, allowing Watercare to then determine the preferred option for the future treatment and discharge of the wastewater.

Methodology

The methodology designed for the technical BPO assessment is set out in the diagram below. It involves:

1. The development of a Long Long list of options.
2. Fatal Flaw assessment that removed options with significant defects from the Long Long list to identify a Long List of options.
3. Traffic Light assessment of the Long List of options to identify a preliminary Short List of options.
4. BPO Test No 1 to confirm the Short List of options.
5. Short List assessment to identify a preliminary technical preferred option / BPO.
6. BPO Test No 2 to confirm a technical preferred option / BPO.



Fatal Flaw Assessment

This involved assessing the Long Long List of 32 options against seven fatal flaw criteria. An option only had to meet one of the criteria to be fatally flawed. A total of 13 options were fatally flawed resulting in a Long List of 19 options. The options that were fatally flawed primarily involved the conveyance of raw, partially treated and fully treated wastewater to other Watercare wastewater treatment plants.

Traffic Light Assessment

The 19 Long List options taken forward for the traffic light assessment comprised options involving discharge to the tributary of the Te Puru Stream, options involving discharge to other freshwater bodies, options involving discharge to the Coastal Marine Area (CMA), options involving discharge to land and groundwater and options involving discharge to a combination of these receiving environments. The options also included a range of potable and non-potable reuse combinations including a supplementary supply for the Hunua Dams.

This stage of the assessment involved the development of assessment criteria (eight in total), technical expert assessment and traffic light scoring of each option against the criteria the experts were responsible for, and a Long List workshop that used the Traffic Light assessment to identify a preliminary Short List of options (5 in total).

BPO Test No 1

This involved assessing the preliminary Short List of options against BPO criteria based on the RMA BPO definition and against the Project Objectives developed for the project. The BPO and objectives assessments were reasonably well aligned with the Short List Traffic Light assessment and did not identify any additional red traffic light scores which would direct an option to not be progressed for further consideration.

All five of the preliminary technical Short List of options passed the Best Practicable Option Test No. 1 and were taken forward to the Short List assessment stage.

Short List Assessment

The five options taken forward for the short list assessment comprised a diffuse discharge to the tributary of the Te Puru Stream, a direct discharge to the tributary of the Te Puru Stream, the discharge of 100% of the treated wastewater to land (approximately 750 ha) in the vicinity of the WWTP, a combination of discharging the treated wastewater to land (approximately 300 ha) in the vicinity of the WWTP during dry weather and a discharge to the tributary of the Te Puru Stream at other times, and a discharge to the Hauraki Gulf north of Beachlands in the Tāmaki Strait via a 2.9km offshore ocean outfall.

This stage of the assessment involved the technical expert assessment and 1 to 5 scoring (1 best 5 worst) of each option against the criteria the experts were responsible, and multi-criteria assessment (MCA) workshops to identify a preliminary technical BPO.

BPO Test No 2

This stage followed a similar process to the BPO Test No 1 and involved the BPO and Project Objectives assessment of the preliminary technical BPO in comparison with the other Short List Options. The BPO Test No 2 confirmed the option involving the diffuse discharge to the tributary of the Te Puru Stream should be recommended to Watercare as the technical BPO.

1. Introduction

1.1 Watercare Background

Watercare Services Ltd (Watercare) is a council-controlled organisation that provides water and wastewater services to the Auckland region. Watercare's obligations to deliver water and wastewater services for Auckland are established under Part 5 and section 57(1) of the Local Government (Auckland Council) Act 2009. This section requires Watercare, as an Auckland water organisation, to manage its operations efficiently with a view to keeping the overall costs of water supply and wastewater services to its customers (collectively) at the minimum levels consistent with the effective conduct of its undertakings and the maintenance of the long-term integrity of its assets[1].

Watercare's Asset Management Plan (2021 – 2041) (AMP) sets out Watercare's investment plan to meet the water and wastewater needs of Auckland. The AMP gives effect to Auckland Plan outcomes and also contributes to Auckland Council's Long-Term Plan and infrastructure strategy. The purpose of the AMP is to:

- Cater for a growing Auckland;
- Develop a resilient and diverse water system for tomorrow;
- Protect the environment;
- Adapt to climate change impacts and reduce emissions; and
- Deliver value for money by running an efficient operation.

Watercare aims to cater to planned growth and participates in growth planning exercises such as the Auckland Council Future Development Strategy.

1.2 Project Background

The Beachlands and Maraetai communities are currently serviced by a wastewater network service that connects to the Beachlands Wastewater Treatment Plant (WWTP). There are around 3,400 existing wastewater-only connections (there is no reticulated water supply) in Beachlands and Maraetai; around 2,500 connections are in Beachlands, with the remainder in Maraetai. The sampling undertaken in 2023 to confirm the current connected population estimated the population of Beachlands and Maraetai to be between 10,000 and 12,000.

Wastewater from the Beachlands and Maraetai communities is processed and treated at the Beachlands WWTP located approximately 5 km south of the communities at 100 Okaroro Drive, Beachlands. Part of this site is designated in the Auckland Unitary Plan Operative in part (Updated 16 February 2024) (AUP) for Wastewater Treatment Purposes. Figure 1-1 below shows the extent of the designation.

Figure 1-1: Beachlands WWTP Designation

[1] Sourced from the Watercare website: Watercare - Who we are (https://www.watercare.co.nz/About-us/Who-we-are)

The WWTP was commissioned in 1994. The original treatment process was an aerated lagoon followed by a series of partially mixed aerated lagoons and wetlands, with the treated wastewater discharged into a tributary of the Te Puru Stream. The WWTP was upgraded in 2009 to convert the aerated lagoon into an activated sludge biological nitrogen removal (BNR) process incorporating chemical phosphorus removal, tertiary filtration, and UV disinfection. The plant's most recent upgrade was in 2020 with the installation of a diffused aeration system to boost aeration capacity in the bioreactor lagoon. Treated wastewater is discharged into a tributary of the Te Puru Stream via a marshy overland flow area and pond.

Plan Change 88 – Beachlands South (PPC88) was publicly notified on 26 January 2023. On 2 April 2024 Independent Commissioners of behalf of Auckland Council approved PPC88. PPC88 proposes to rezone 307 hectares of land from rural and countryside living zones to urban and future urban zones. PPC88 states that the area of land to be re-zoned with a "live" urban zone, has a potential residential yield of 3,000 dwellings[2]. PPC88 concept design proposes a private pressure sewer system with a separate wastewater treatment facility.

The current consents that apply to the existing WWTP at 100 Okaroro Drive, Beachlands are:

- Discharge of treated domestic wastewater to the Te Puru Stream via ground soakage, Consent Number 26875 - initially granted in November 2004 with the appeal to the permit determined by way of a consent order in August 2005. The consent has a maximum daily discharge volume limit of 2,800m³/day and restricts the population to be serviced by the WWTP to 10,000 people. It expires on 31 December 2025.
- Discharge of contaminants to air associated with the operation of a WWTP, Consent Number 26876 which expires on 31 December 2026.

Due to the above growth pressures, limitation of the existing discharge consent and the fact that the existing WWTP is coming to the end of its design life, Watercare has initiated a process to explore options for reconsenting the discharge. Through the process Watercare can effectively and efficiently plan how it will continue providing wastewater services to the Beachlands and Maraetai communities.

Watercare has proposed that resource consent application for the wastewater discharge be prepared based on the treated wastewater discharge option that is determined to be the Best Practicable Option (BPO) through an alternatives assessment process. The receiving environment for the discharge will dictate the treatment standard that must be met.

1.3 Purpose of this Report

The purpose of this report is to summarise the process that was followed to assist Watercare to determine the BPO for the treatment and discharge of wastewater from the Beachlands / Maraetai communities and to demonstrate that the process has been thorough and robust.

BPO is defined in the Resource Management Act 1991 (RMA) and in relation to a discharge of a contaminant or an emission of noise to mean:

> *"…the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to—*
>
> *(a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and*
>
> *(b) the financial implications, and the effects on the environment, of that option when compared with other options; and*
>
> *(c) the current state of technical knowledge and the likelihood that the option can be successfully applied"*

The Long List and Short List assessment processes are technical processes that have not incorporated inputs from Mana Whenua. Watercare is undertaking a separate process with Mana Whenua and in particular Ngāi Tai ki Tāmaki (Ngāi Tai). The outcomes from this process will be integrated with the outcomes from the technical assessment to enable Watercare to confirm the BPO solution for the management of the wastewater from the Beachlands / Maraetai community.

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[2] Sourced from the Auckland Council website: pc88-private-plan-change-request.pdf (aucklandcouncil.govt.nz) (https://www.aucklandcouncil.govt.nz/UnitaryPlanDocuments/pc88-private-plan-change-request.pdf)

In this report the words ‘Alternative’ and ‘Option’ are used interchangeably.

The report describes:

- The methodology for developing and assessing the options.
- The development of the options.
- The results of the assessment process being the Fatal Flaw assessment, the technical Long List / Traffic Light assessment and the technical Short List assessment.
- The BPO tests and project objectives assessments of the Short List and the Preferred Technical Option
- The integration of Mana Whenua into the process and how their feedback has been taken into account.
- The process of inputting stakeholder engagement outputs into the assessment of alternatives process.

1.4 Project Objectives

The Project Objectives have been specifically developed for this Project. The Project Objectives have been used to inform the development of the criteria for assessing the Long and Short List of options and to assist in the confirmation of the Short List of options and the preferred option (BPO).

The Project Objectives are:

Work in partnership with the Mana Whenua and engage with the community to identify the best practicable option (BPO) to provide wastewater services for the Beachlands and Maraetai community. The BPO must:

- Recognise the significance of the Hauraki Gulf and the historic, traditional, cultural, and spiritual relationship of the tangata whenua with the Hauraki Gulf and its islands[3].
- Give effect to Te Mana o te Wai[4].
- Keep our communities healthy.
- Protect the health of our environment, particularly the life supporting capacity of land, air, and water.
- Provide a solution that caters for planned growth that keeps the overall costs of service to customers (collectively) at sustainable levels.
- Be sustainable and resilient and minimise whole-of-life carbon emissions and optimise resource recovery[5].

1.5 Requirements of the RMA for the Consideration of Alternatives

1.5.1 Relevant Provisions

There are a number of circumstances when the RMA requires an assessment of alternatives (options) to be undertaken. Relevant to this application, these include:

a. Section 105(1)(c) which requires decision makers when considering applications for discharge permits or coastal permits involving discharges “to have regard to any possible alternative methods of discharge, including discharge into any other receiving environment”.

b. When preparing an assessment of environmental effects (AEE) if the proposal is likely to have a significant adverse effect on the environment, Schedule 4 of the RMA provides that the AEE must describe alternative locations and methods for undertaking the activity. Likewise, if the proposal involves the discharge of contaminants the AEE will need to address alternative methods of discharge and locations.

In the context of this project s105(1)(c) will definitely apply as the proposal will involve discharges (of treated wastewater and air) to the environment. Adopting a conservative approach, the Schedule 4 requirement noted above could apply.

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[3] Section 3 (Purpose) of the Hauraki Gulf Marine Park Act
[4] Policy 1 NPS-FM, Water Services Act
[5] Recognises the carbon component of 40/20/20

1.5.2 Case Law Guidance

There is an extensive body of case law regarding the consideration of alternatives. While this mainly relates to designations and the consideration of alternatives as required by s171(1)(b) of the RMA, the principles established by this case law can be applied in the context of resource consents.

A decision of the Environment Court[6] in respect of a designation sought by Watercare for a reservoir noted the relevant principles from earlier case law relating to the consideration of alternatives were gathered together in the final report and decision of the Board of Inquiry into the Upper North Island Grid Upgrade Project. The Court adopted these principles, and they are set out below.

a. The focus is on the process, not the outcome: whether the requiring authority (applicant) has made sufficient investigations of alternatives to satisfy itself of the alternative proposed, rather than acting arbitrarily, or giving only cursory consideration to alternatives. Adequate consideration does not mean exhaustive or meticulous consideration.

b. The question is not whether the best route, site or method has been chosen, nor whether there are more appropriate routes, sites or methods.

c. That there may be routes, sites or methods which may be considered by some (including submitters) to be more suitable is irrelevant.

d. The Act does not entrust to the decision-maker the policy function of deciding the most suitable site; the executive responsibility for selecting the site remains with the requiring authority.

e. The Act does not require every alternative, however speculative, to have been fully considered.

f. The requiring authority is not required to eliminate speculative alternatives or suppositious options[7].

In terms of undertaking multi criteria assessments (MCAs) the High Court in the Basin Bridge decision[8] provides useful guidance on using a MCA to evaluate alternatives. In summary the High Court decision states:

a. An MCA analysis of alternatives should be transparent and replicable.

b. If any weightings are applied to the "raw" MCA scores, it may be necessary for those weightings to be available to the decision maker in order to be satisfied that adequate consideration has been given to alternatives.

c. If weightings are used in an alternatives assessment (such as an MCA) they should be "*infused*" with Part 2 matters and decisions to allocate weight to different evaluative criteria is subject to Part 2.

The High Court Basin Bridge decision confirms that a more careful consideration of alternatives may be required where there are more significant adverse effects.

1.6 Best Practice Approaches

The following provides general guidance based on the findings of the Courts and previous project experience on best practice approaches for assessing options:

a. Any assessment of options needs to be robust, defensible, transparent, genuine, undertaken with an open mind and well documented from the outset.

b. Any option evaluation process should be “fit for purpose” i.e. of a detail that corresponds with the scale and significance of the options including the adverse effects that the options may have on the environment.

c. The process must have a clear RMA focus in order to meet the requirements of the Act and principles established through case law.

d. The assessment of options needs to be undertaken in a structured and methodical manner.

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[6] Pukekohe East Community Society Inc v Auckland Council Decision No. [2017] NZEnvC 027
[7] Pukekohe East Community Society Inc v Auckland Council [2017] NZEnvC 027 at [21 and 22]
[8] NZ Transport Agency v Architectural Centre [2015] NZHC 1991. Also known as the Basin Bridge decision, at [175] – [198]

e. The process should use a consistent methodology as far as possible. If changes to the approach are required, the reasons for these must be well documented to avoid accusations of “engineering a desired outcome”.

f. Comprehensive documentation of the assessment process and decision making is essential, particularly to ensure transparency.

g. The right experts (i.e. ideally those who may later be witnesses) must be involved in providing information on the options being assessed and the assessment and decision-making processes to ensure the process is evidence based and robust.

h. Where weightings are applied to criteria these need to be agreed through a consultative process, infused with Part 2 of the RMA, and recorded in the final presentation of results.

i. When undertaking an alternatives assessment process, it is important to be clear on who owns and is responsible for the process. Preferably whoever that is should be involved from the beginning to the end and preferably an expert in options assessment processes and the requirements of the RMA.

j. Key principles from RMA case law state:

- The focus is on the process not the outcome.
- The applicant does not have to choose the best option.
- The Act does not require every alternative, however speculative, to have been fully considered.
- It is the responsibility of the applicant to select the option not the decision maker.

These best practice approaches have been adopted in developing the process to determine the BPO to manage the wastewater from Beachlands and Maraetai.

In order to determine the BPO to manage the wastewater from Beachlands and Maraetai options have been developed and assessed which entail alternative discharges (such as re-use), discharge locations and treatment plant locations. Alternative treatment processes will be assessed once the BPO for the discharge has been developed.

1.7 Project Technical Team

The project technical team is made up of Watercare staff and other technical experts. The current members of the project team are set out below:

Table 1-1: Project Technical Team

Name	Organisation	Expertise
Tanvir Bhamji	Watercare	Project Manager
Luke Faithfull	Mitchell Daysh	Project Manager
Jim Bradley	Stantec	Public Health / Wastewater Schemes
Andrew Slaney	Stantec	Wastewater Treatment Specialist
Paula Hunter	Stantec	Planning
Katja Huls	Stantec	Planning
Mark James	Aquatic Environmental Sciences Ltd	Overall Environmental Lead
Shane Kelly	Coast and Catchment Environmental Consultants	Marine waters
Alan Pattle	PDP	Land, Groundwater
Rebecca Stott	NIWA	QMRA
John Oldman	DHI	Oceanographic Modelling

Name	Organisation	Expertise
Gary Teear	OCEL	Ocean Outfalls
Padraig McNamara Warren Bangma	Simpson Grierson	Legal

2. Assessment Methodology

2.1 Overall Methodology

A process for assessing alternatives that reflects the relevant statutory provisions, and best practice as set out in relevant case law, has been designed for this project and is described in Figure 2-1 below.

A wide range of potential options were developed at the beginning of the assessment process. These options were referred to as the Long Long List and are set out in Table 2-1. A fatal flaw assessment of the Long Long List as shown in Figure 2-1 was then undertaken by the project technical team. The fatal flaw criteria and process are set out in Section 4.

Following the fatal flaw assessment, the Long List of options was confirmed by the project technical team. The Long List was then subject to a more detailed technical assessment using a "traffic light" scoring process which is described in Section 5 below. The technical Long List assessment criteria are described in Section 5.2.1 below. The criteria were developed in accordance with the best practice principles set out in Section 1.6 and to address Part 2 of the RMA.

The technical Long List / Traffic Light assessment identified a potential Short List of options, these options were subject to a BPO and project objectives assessment check as shown in Figure 2-1 to confirm the technical Short List of options to be taken forward for a more detailed assessment. This technical Short List assessment process adopted a more detailed multi-criteria analysis (MCA) approach which is set out in Section 6 of this report.

The technical Short List assessment process identified a preliminary preferred option which was then subject to the BPO and project objectives assessment check as shown in Figure 2-1 to confirm the preferred technical option.

As shown in Figure 2-1 the assessment process, provides (by way of feedback loops) for the reassessment of options that were previously discarded if new information identifies that an option should be reconsidered. If this is the case, the option can be reintroduced into the assessment process at whatever stage it was discarded (fatal flaw, Long List, Short List).

The methodology set out in Figure 2-1 makes sure that the assessment is progressively more detailed to ensure that the process is both robust and efficient.

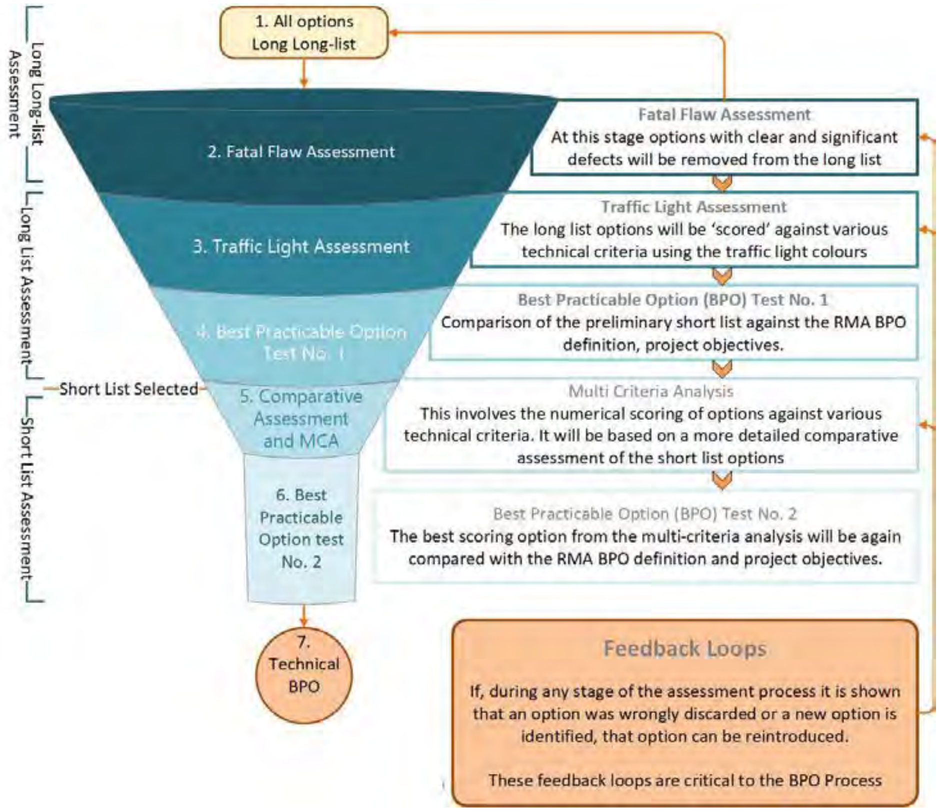


Figure 2-1: Technical Assessment Methodology

2.2 Project Timeline

The following table sets out the timeline for key components of the project and who was responsible for inputting into these components.

Table 2-1: Project Timeline

Timing	Project Phase	Inputs
Workshop 1 29th August 2023	Project problem statement, Project Objectives, fatal flaw criteria, Long List assessment criteria confirmed	Wider project team[9] (Workshop 1)
	Long Long List developed and confirmed	Wider project team (Workshop 1)
4th October 2023	Fatal Flaw Assessment	Project Technical Team
4th October 2023	Long List confirmed	Project Technical Team
Workshop 2 13 October 2023	Long List / Traffic Light Technical Assessment	Wider project team (Workshop 2)
	Preliminary Technical Short List	Wider project team (Workshop 2)
26th October 2023	Community Information Session 1 and Online Survey	Watercare engagement team
1st November	Site visit with Ngāi Tai ki Tāmaki Taiaomaurikura representative	Watercare project lead
1st November 2023	BPO and Objectives Test 1	Project Technical Team
2nd November 2023	Confirmation of the technical Short List	Project Technical Team
Workshop 3 7th November 2023	Short List Technical Assessment (Preliminary)	Wider project team and representative from Ngāi Tai ki Tāmaki (Workshop 3)
7th - 30th November 2023	Further investigations and updating to assessments	Project Technical Team
22nd November 2023	Community Information Session 2	Watercare engagement team
Workshop 4 5th December 2023	Short List Technical Assessment	Wider project team and representative from Ngāi Tai ki Tāmaki (Workshop 4)
Workshop 4 5th December 2023	Preliminary Preferred Technical Option	Wider project team (Workshop 4)
15th December 2023	BPO and Objectives Test 2	Project Technical Team
15th December 2023	Preferred Technical Option confirmed	Project Technical Team
22th February 2024	Site visit with Ngāi Tai ki Tāmaki Taiaomaurikura representatives	Watercare Project lead
18th March 2024	Further hui with Ngāi Tai ki Tāmaki Taiaomaurikura representatives on Preferred Option	Watercare Project lead
2nd April 2024	Further hui with Ngāi Tai ki Tāmaki Taiaomaurikura representatives on Preferred Option	Watercare Project lead

[9] Project technical team and additional Watercare personnel

3. Methodology for Developing Options

3.1 Introduction

The Long Long List of options was based on receiving environments for the discharge of treated wastewater. It was assumed the WWTP would remain at the Okaroro Drive site (except where options relied on treatment occurring at other Watercare WWTPs). Wastewater management options in the network apply to all options e.g. wastewater reduction, inflow & infiltration (I&I), alterative collection systems.

3.2 Components of a Wastewater Scheme

In developing an option, the typical components of a wastewater scheme need to be taken into account. A typical wastewater servicing system requires up to four components, or 'building blocks', namely:

1. **Collection System or Local Wastewater Network**: to collect wastewater from groups of properties and transport it to a wastewater treatment plant or to a common point for connection to a conveyance system.

2. **Conveyance**: to transport raw wastewater from a collection system to a wastewater treatment plant for treatment and subsequent reuse and/or discharge.

3. **Treatment**: to change the wastewater characteristics to meet the standards required for reuse and/or discharge to the environment. The disposal of sludge/biosolids arising from the treatment process is also required.

4. **Reuse and / or Discharge of Treated Wastewater**: discharge pipework is required to return fully treated wastewater to the environment and / or to a reuse system.

These four 'building blocks' (components) of wastewater systems are illustrated in Figure 3-1: Components of a Wastewater System below.

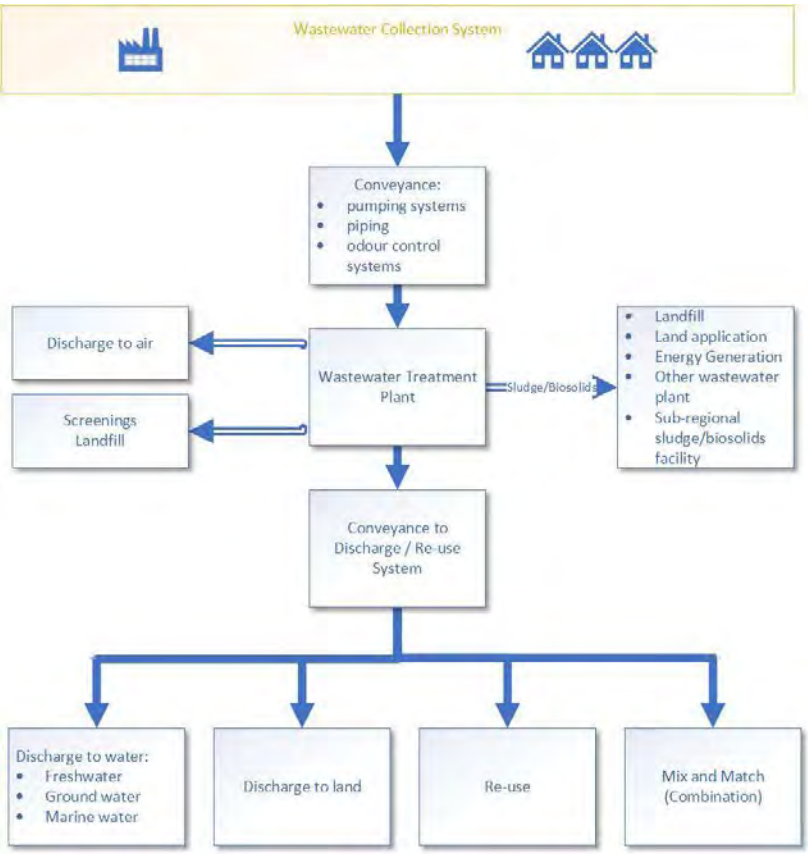


Figure 3-1: Components of a Wastewater System

3.3 'Status Quo' Option

This option would entail retaining the WWTP, the current volume and quality limits and the existing indirect discharge to the tributary of the Te Puru Stream via the current overland flow/pond treatment system. Because the WWTP is nearing the end of it economic life and is reaching capacity, and because there is a clear intent to urbanise new areas of land in Beachlands by developers as well as the population growth predictions, the status quo cannot be advanced and therefore, has not been included in the Long Long List of options.

3.4 Wastewater Treatment Plant Location

Changing the WWTP location has not been considered except in options conveying wastewater to other Watercare wastewater schemes. This is because:

- The Beachlands site has been used for wastewater treatment purposes since 1994.
- There is sufficient land holding to accommodate an upgraded / new WWTP.
- The land on which the WWTP and the overland flow area is designated for wastewater treatment purposes under the Auckland Unitary Plan (AUP).
- The land surrounding the WWTP is zoned Rural Production and Mixed Rural under the AUP, with the nearest dwellings some 300 m northeast of the WWTP site boundary, this reduces the risk associated with reverse sensitivity issues.

4. Fatal Flaw Assessment

4.1 Description of Long Long List Alternatives Considered

A wide range of potential options were developed by the project team, using the methodology described in Section 3. Eleven main options were identified with 27 variations on these options resulting in a total of 32 options considered. A broad range of options ensured that the project team considers established and innovative solutions.

Table 4-1 below sets out the Long Long List of options adopted for the fatal flaw assessment. These options were confirmed by the wider project team in Workshop 1.

Table 4-1: Long Long-list Options

Option	Option Name	Option Description[10]
1a	Mangere (East Tamaki) Raw	Construct new pump station and pipeline to enable raw wastewater from Beachlands / Maraetai to be pumped 16km to East Tamaki and connect into the existing Watercare wastewater network.
1aa	Mangere (East Tamaki) Partially Treated	Construct new pump station and pipeline to enable partially treated wastewater from the Beachlands WWTP to be pumped 16km to East Tamaki and connect into the existing Watercare wastewater network.
1ab	Mangere WWTP Outfall Fully Treated	Construct new pump station and pipeline to enable fully treated wastewater from the Beachlands WWTP to be pumped 30km via East Tamaki or 28km via Flatbush to the Mangere WWTP outfall.
1b	Mangere (Flatbush) Raw	Construct new pump station and pipeline to enable raw wastewater from Beachlands / Maraetai to be pumped 14km to Flatbush and connect into the existing Watercare wastewater network.
1ba	Mangere (Flatbush) Partially Treated	Construct new pump station and pipeline to enable partially treated wastewater from the Beachlands WWTP to be pumped 14km to Flatbush and connect into the existing Watercare wastewater network.
1c	Pukekohe WWTP Raw	Construct new pump station and pipeline to enable raw wastewater from Beachlands / Maraetai to be pumped 50 km to the existing Watercare wastewater network that connects to Pukekohe WWTP.
1ca	Pukekohe WWTP Partially Treated	Construct new pump station and pipeline to enable partially treated wastewater from the Beachlands WWTP to be pumped 50 km to the existing Watercare wastewater network that connects to Pukekohe WWTP.

[10] Conveyance distances are approximate only.

Option	Option Name	Option Description[10]
1cb	Pukekohe Discharge Structure Fully Treated	Construct new pump station and pipeline to enable fully treated wastewater from the Beachlands WWTP to be pumped 50 km to the existing Watercare wastewater network that connects to the Pukekohe WWTP.
1d	South-West WWTP Raw	Construct new pipeline, pump stations and collection points to enable raw wastewater from Beachlands / Maraetai to be pumped 40 km to the existing Watercare wastewater network that connects to the new South-West WWTP (near Glenbrook Beach).
1da	South-West WWTP Partially Treated	Construct new pipeline, pump stations and collection points to enable partially treated wastewater from the Beachlands WWTP to be pumped 40 km to the existing Watercare wastewater network that connects to the new South-West WWTP (near Glenbrook Beach).
1db	South-West WWTP Outfall Fully Treated	Construct new pipeline, pump stations and collection points to enable fully treated wastewater from the Beachlands WWTP to be pumped 40km to the existing Watercare wastewater network that connects to the new South-West WWTP (near Glenbrook Beach).
2a	Over Land Flow (diffuse discharge) to Tributary of Te Puru Stream (Upgraded Existing System)	Maintain the existing indirect discharge to a tributary of the Te Puru Stream via the existing overland flow land treatment system expanded to accommodate increased flows - with or without the pond.
2b	Tributary to Te Puru Stream – direct discharge	Direct discharge to a tributary of the Te Puru Stream, could include land contact, rock bed structure e.g. gabion baskets
2c	Wairoa River	Convey treated wastewater 12 km to a new outfall in the Wairoa River. Discharge on the out-going tide?
2d	Turanga Creek	Convey treated wastewater 10 km to a new outfall in the Turanga Creek / Awa. Discharge on the out-going tide?
3	100% Land	Apply all of the treated wastewater to land.
3a	Land / Stream	A combination of Option 3 with one of Option 2. Seasonal/weather and/or river flow conditions for discharge route. Discharge to land over summer and when stream flow is below minimum allowable. Discharge to stream over winter and when stream flow is above minimum allowable.
4aa	Hauraki Gulf - Pine Harbour Short	Convey treated wastewater to a new marine outfall into the Hauraki Gulf off the coast of Whitford with a short outfall.
4ab	Hauraki Gulf – Pine Harbour Mid	Convey treated wastewater to a new marine outfall into the Hauraki Gulf off the coast of Whitford with a mid length outfall.

Option	Option Name	Option Description[10]
4ac	Hauraki Gulf – Pine Harbour Long	Convey treated wastewater to a new marine outfall into the Hauraki Gulf off the coast of Whitford with a long outfall.
4ad	Hauraki Gulf - Tāmaki Short	Convey treated wastewater to a new marine outfall into the Hauraki Gulf off the coast of Maraetai with a short outfall.
4ae	Hauraki Gulf - Tāmaki Mid	Convey treated wastewater to a new marine outfall into the Hauraki Gulf off the coast of Maraetai with a mid length outfall.
4af	Hauraki Gulf - Tāmaki Long	Convey treated wastewater to a new marine outfall into the Hauraki Gulf off the coast of Maraetai with a long outfall.
4b	Land / Hauraki Gulf	A combination of Options 3 and 4. Seasonal/weather conditions for discharge route. Discharge to land over summer; discharge to Hauraki Gulf over winter and when land is unavailable to accept treated wastewater.
4ba	Land / Hauraki Gulf / Tributary of Te Puru Stream	A combination of Options 3a and 4. Seasonal/weather and/or river flow conditions for discharge route. Discharge to land over summer; Discharge to a tributary of Te Puru stream over winter and when stream flow is above minimum allowable flow. Discharge to Hauraki Gulf over winter and when land is unavailable to accept treated wastewater and when stream flow is below minimum allowable flow for treated wastewater discharge.
5	Managed Aquifer Recharge	Discharge to an aquifer using a Managed Aquifer Recharge (MAR). i.e. high quality water must be used for a groundwater replenishment scheme to purposefully recharge aquifers.
6	100% Reuse – Potable	Direct re-use by supplying drinking water from reclaimed wastewater to the Beachlands / Maraetai community.
7	100% Re-use – Non-Potable	Convey 100% of the treated wastewater to a “purple pipe” reticulation network. Use for domestic (toilets, garden watering, washing machines) irrigation of verges, parks, golf courses, sports fields, industrial reuse etc. A backup discharge route would still be needed as a contingency should re-use demand drop or become unavailable.
8	100% Reuse – Non-Potable - Transition to Potable	Water is treated to a potable standard but not used for that for domestic purposes immediately but is used for other purposes. The non-potable use is retained as per Option 7. Potential to require dual distribution network (Beachlands, Maraetai and Whitford Servicing Strategy June 2023).
9	Supplement supply for the Hunua Dams	Convey treated wastewater 27 km to Hunua water supply dam. Conveyance of the treated wastewater to an appropriate reclaimed standard to the Hunua Dams to supplement the water supply source. Assume 100% of the treated wastewater is discharged.

Option	Option Name	Option Description[10]
10	Tankering	Removal of excess wastewater using tankers and transporting the wastewater to another treatment plant.
10a	Owhanake WWTP Raw	Construct new pipeline, pump stations and collection points to enable raw wastewater from Beachlands Maraetai to be pumped 11km to the Owhanake WWTP on Waiheke Island.
Enhancement (Add-on) Options (can be added to Long List Options Following Fatal Flaw)		
Option 11 This is not a stand alone option	Partial Reuse - Non-Potable	A combination of Option 7 and one of Options 2, 3 or 4. (This option can be explored should one of these receiving environments be selected, as an enhancement to the base scheme). The location of the discharge will dictate the discharge route and the seasonal and/or demand conditions the volume. The volume to non-potable reuse is maximized to meet demand, the remainder is discharged to the receiving environment. Typical examples include verges, reserves, golf courses, industrial re-use, nurseries etc

4.2 Fatal Flaw Criteria

The Long Long List options were assessed against the 'fatal flaw' criteria set out below. This is stage 2 of the assessment process shown in Figure 2-1. The Long Long List of options and the fatal flaw criteria were agreed in the first project team Workshop held on 29/08/23. It was agreed at the workshop that if one of the criteria represents a fatal flaw for an option, the option is removed from the list and any further consideration. This is standard practice for fatal flaw assessments.

The project team carried out an initial fatal flaw assessment which was confirmed by the wider project team.

The fatal flaw criteria are:

- Increase in public health risk
- Significant increase in adverse effects on the natural environment and the community
- Unproven technology
- Prevents growth and economic development (includes allocated capacity)
- Whole of life costs are unsustainable
- Not able to be constructed and/or impractical
- Significantly fails to meet statutory requirements
- Very objectionable to mana whenua

4.3 Results of the Fatal Flaw Assessment

The results of the fatal flaw assessment are set out in Table 4-2 below.

Table 4-2: Results of the fatal flaw assessment

Option	Option Name	Option Description	Reasons for Fatal Flaw
1a	Mangere (East Tamaki) Raw	Construct new pump station and pipeline to enable raw wastewater from Beachlands / Maraetai to be pumped 16km to East Tamaki and connect into the existing Watercare wastewater network.	Whole of life costs are unsustainable • Requires both a pump station and a pipe which will incur high costs and the economies of scale of treatment and staging will be substantially reduced. • Costs associated with odour management and septicity controls will be ongoing and significant. • The transfer of wastewater out of the Beachland / Maraetai service area is not supported by mana whenua.
1aa	Mangere (East Tamaki) Partially Treated	Construct new pump station and pipeline to enable partially treated wastewater from the Beachlands WWTP to be pumped 16km to East Tamaki and connect into the existing Watercare wastewater network.	Not able to be constructed and/or impractical. • Partially treating wastewater to then be mixed with raw sewage in the network is impractical. Any treatment benefits will be lost through mixing the treated wastewater with raw sewage. The cost of treatment for no benefit is not viable. Very objectionable to mana whenua • The transfer of wastewater out of the Beachland / Maraetai service area is not supported by mana whenua.
1ab	Mangere WWTP Outfall Fully Treated	Construct new pump station and pipeline to enable fully treated wastewater from the Beachlands WWTP to be pumped 30km via East Tamaki or 28km via Flatbush to the Mangere WWTP outfall.	Whole of life costs are unsustainable • Pressure loss along rising main will require additional pump stations which have high costs. Not able to be constructed and/or impractical • Rising main would need to traverse existing urban areas which would be very challenging to construct. Very objectionable to mana whenua • The transfer of wastewater out of the Beachland / Maraetai service area is not supported by mana whenua.
1b	Mangere (Flatbush) Raw	Construct new pump station and pipeline to enable raw wastewater from Beachlands / Maraetai to be pumped 14km to Flatbush and	Whole of life costs are unsustainable • Requires both a Pump Station and a pipe which will incur high costs and

Option	Option Name	Option Description	Reasons for Fatal Flaw
		connect into the existing Watercare wastewater network.	the economies of scale of treatment and staging will be substantially reduced. • Costs associated with odour management and septicity controls will be ongoing and significant. Very objectionable to mana whenua • The transfer of wastewater out of the Beachland / Maraetai service area is not supported by mana whenua.
1ba	Mangere (Flatbush) Partially Treated	Construct new pump station and pipeline to enable partially treated wastewater from the Beachlands WWTP to be pumped 14km to Flatbush and connect into the existing Watercare wastewater network.	Not able to be constructed and/or impractical • Partially treating wastewater to then be mixed with raw sewage in the network is impractical. Any treatment benefits will be substantially lost through mixing the partially treated wastewater with raw sewage flow to Mangere. This is an inefficient option form a cost perspective. Very objectionable to mana whenua • The transfer of wastewater out of the Beachland / Maraetai service area is not supported by mana whenua.
1c	Pukekohe WWTP Raw	Construct new pump station and pipeline to enable raw wastewater from Beachlands / Maraetai to be pumped 50 km to the existing Watercare wastewater network that discharges to Pukekohe WWTP.	Prevents growth and economic development (includes allocated capacity) • Takes up allocated capacity for growth that has been provided for a different community. Not able to be constructed and/or impractical • Raw wastewater will have a long residence time in the pipe which will negatively impact the WWTP. High odour / corrosion risk due to septic conditions in rising main. Very objectionable to mana whenua • The transfer of wastewater out of the Beachland / Maraetai service area is not supported by mana whenua.

Option	Option Name	Option Description	Reasons for Fatal Flaw
1ca	Pukekohe WWTP Partially Treated	Construct new pump station and pipeline to enable partially treated wastewater from the Beachlands WWTP to be pumped 50 km to the existing Watercare wastewater network that discharges to Pukekohe WWTP.	Prevents growth and economic development (includes allocated capacity) • Takes up allocated capacity for growth that has been provided for a different community. Whole-of-life costs are unsustainable • Requires both a WWTP and a pipe which will incur high costs and the economies of scale of treatment staging will be lost. • Pressure loss along rising main will require additional pump stations which are cost heavy. Not able to be constructed and/or impractical • Wastewater will have a long residence time in the pipe which will negatively impact the WWTP. High odour / corrosion risk due to septic conditions in rising main. Very objectionable to mana whenua • The transfer of wastewater out of the Beachland / Maraetai service area is not supported by mana whenua.
1cb	Pukekohe Discharge Structure Fully Treated	Construct new pump station and pipeline to enable fully treated wastewater from the Beachlands WWTP to be pumped 50 km to the existing Watercare wastewater discharge structure associated with the Pukekohe WWTP.	Prevents growth and economic development (includes allocated capacity) • Takes up allocated capacity for growth that has been provided for a different community. Whole-of-life costs are unsustainable • Requires both a WWTP, pump station and a long pipe which will incur high costs and the economies of scale of treatment will be lost. • Pressure loss along the pipe will require additional pump stations which have high costs. Very objectionable to mana whenua • The transfer of wastewater out of the Beachland / Maraetai service area is not supported by mana whenua.

Option	Option Name	Option Description	Reasons for Fatal Flaw
1d	South-West WWTP Raw	Construct new pipeline, pump stations and collection points to enable raw wastewater from Beachlands / Maraetai to be pumped 40 km to the existing Watercare wastewater network that discharges to the new South-West WWTP (near Glenbrook Beach).	Prevents growth and economic development (includes allocated capacity) • Takes up allocated capacity for growth that has been provided for a different community. Not able to be constructed and/or impractical • Raw wastewater will have a long residence time in the pipe which will negatively impact the WWTP. High odour / corrosion risk due to septic conditions in rising main. Very objectionable to mana whenua • The transfer of wastewater out of the Beachland / Maraetai service area is not supported by mana whenua.
1da	South-West WWTP Partially Treated	Construct new pipeline, pump stations and collection points to enable partially treated wastewater from the Beachlands WWTP to be pumped 40 km to the existing Watercare wastewater network that discharges to the new South-West WWTP (near Glenbrook Beach).	Prevents growth and economic development (includes allocated capacity) • Takes up allocated capacity for growth that has been provided for a different community. Whole-of-life costs are unsustainable • Requires both a WWTP and pump station and a long pipe which will incur high costs and the economies of scale of treatment staging will be lost. • Pressure loss along rising main will require additional pump stations which have high costs. Not able to be constructed and/or impractical • Wastewater will have a long residence time in the pipe which will negatively impact the WWTP. High odour / corrosion risk due to septic conditions in rising main. Very objectionable to mana whenua • The transfer of wastewater out of the Beachland / Maraetai service area is not supported by mana whenua.

Option	Option Name	Option Description	Reasons for Fatal Flaw
1db	South-West WWTP Outfall Fully Treated	Construct new pipeline, pump stations and collection points to enable fully treated wastewater from the Beachlands WWTP to be pumped 40km to the existing Watercare wastewater network that discharges to the new South-West WWTP (near Glenbrook Beach).	Prevents growth and economic development (includes allocated capacity) • Takes up allocated capacity for growth that has been provided for a different community. Whole-of-life costs are unsustainable • Requires both a WWTP and a long pipe which will incur high costs and the economies of scale of treatment will be lost. • Pressure loss along the pipe will require additional pump stations which are high in cost. Very objectionable to mana whenua • The transfer of wastewater out of the Beachland / Maraetai service area is not supported by mana whenua.
10	Tankering	Removal of excess wastewater using tankers and transporting the wastewater to another treatment plant.	Not able to be constructed and/or impractical • Impractical due to high vehicle movements, noise, carbon emissions and lack of resilience. Very objectionable to mana whenua • The transfer of wastewater out of the Beachland / Maraetai service area is not supported by mana whenua.
10a	Owhanake WWTP Raw	Construct new pipeline, pump stations and collection points to enable raw wastewater from Beachlands / Maraetai to be pumped 11km to the Owhanake WWTP on Waiheke Island.	Prevents growth and economic development (includes allocated capacity) Takes up allocated capacity for growth that has been provided for a different community. Very objectionable to mana whenua • The transfer of wastewater out of the Beachland / Maraetai service area is not supported by mana whenua.

From the 32 Long Long List of options, 13 options were fatally flawed.

5. Long List / Traffic Light Technical Assessment

5.1 Long List Description

After the completion of the fatal flaw assessment process, 20 options were carried forward as the Long List options for the Traffic Light Assessment.

The following provides a description and a schematic of each of the Long List of options. This information was provided to the project's technical experts to assist them in undertaking their Long List assessments. These assessments then informed the Long List / Traffic Light technical assessment (refer to the steps in Figure 2-1).

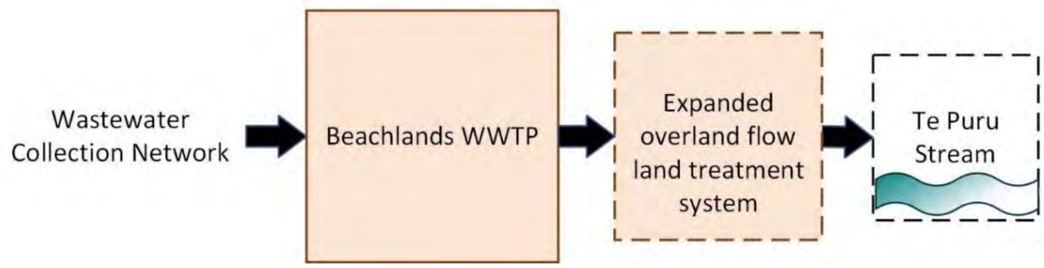
5.1.1 Discharge Location Alternatives

The following options all assess discharging wastewater from an upgraded Beachlands WWTP to alternative receiving environments. Note that Option 2a is similar to the status quo, but with an upgraded WWTP and expanded overland flow treatment system.

While specific treatment options were not specified at this Long List stage, it was assumed that the treatment processes are available and affordable to meet the necessary discharge quality standards for the respective receiving environments.

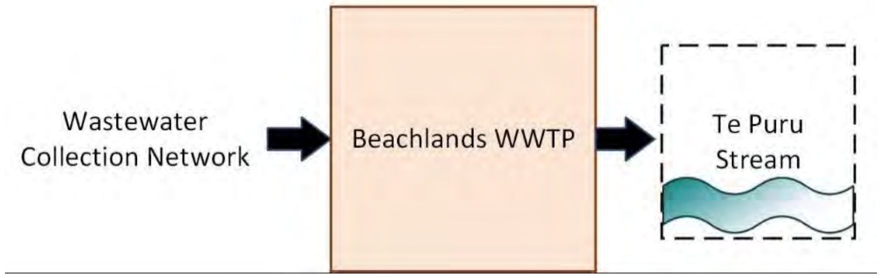
Table 5-1: Discharge Location Long List Options

Option	Option name	Description of Option	Summary of Infrastructure Components
2a	Overland Flow (diffuse discharge) to Tributary to Te Puru Stream (Upgraded Existing System)	Maintain the existing indirect discharge to Te Puru Stream via the existing overland flow land treatment system expanded to accommodate increased flows - with or without the pond.	Upgraded Beachlands WWTP Expanded overland flow treatment system
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

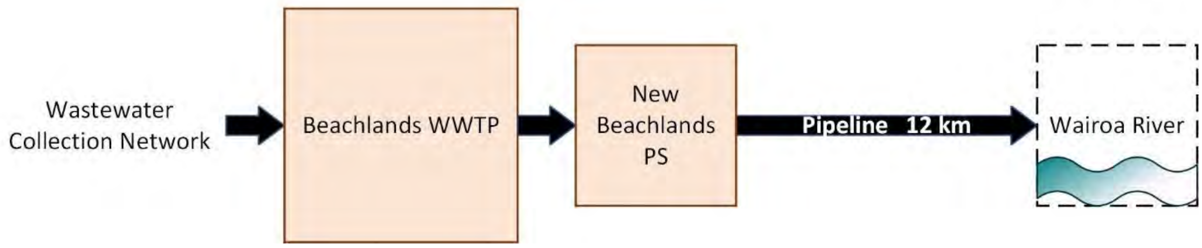


2b	Tributary of Te Puru Stream – direct discharge	Direct discharge toa tributary of the Te Pura Stream, could include land contact, rock bed structure e.g. gabion baskets	Upgraded Beachlands WWTP New discharge structure o Land contact or o Rock bed structure or o Gabion baskets or o Direct pipe discharge
		Key Treatment Parameters	Appropriate Treatment Processes

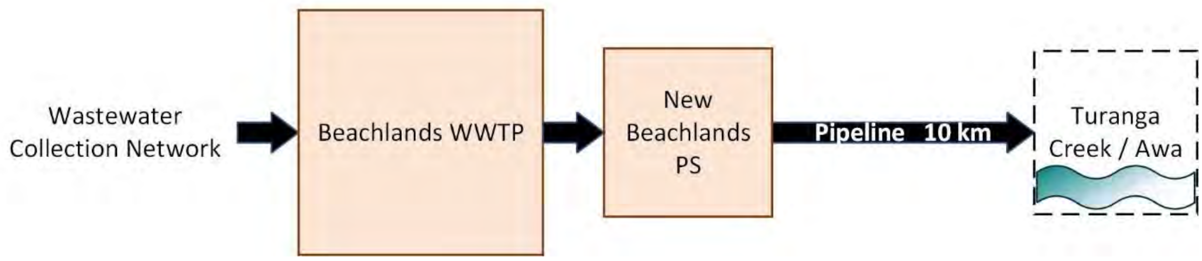
Option	Option name	Description of Option	Summary of Infrastructure Components
		TBC	TBC



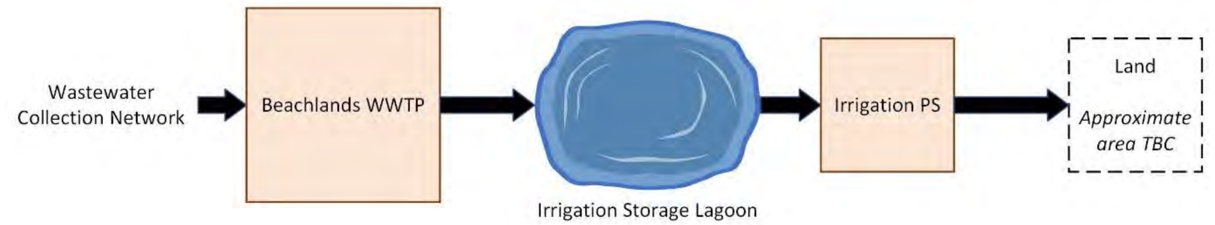
Option	Option name	Description of Option	Summary of Infrastructure Components
2c	Wairao River	Convey treated wastewater **12 km** to a new outfall in the Wairoa River. Discharge on the out-going tide?	Upgraded Beachlands WWTP New Beachlands pump station New 12km pipeline New discharge structure
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC



Option	Option name	Description of Option	Summary of Infrastructure Components
2d	Turanga Creek / Awa	Convey treated wastewater **10 km** to a new outfall in the Turanga Creek / Awa. Discharge on the out-going tide?	Upgraded Beachlands WWTP New Beachlands pump station New 10km pipeline New discharge structure at the Turanga Creek / Awa
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

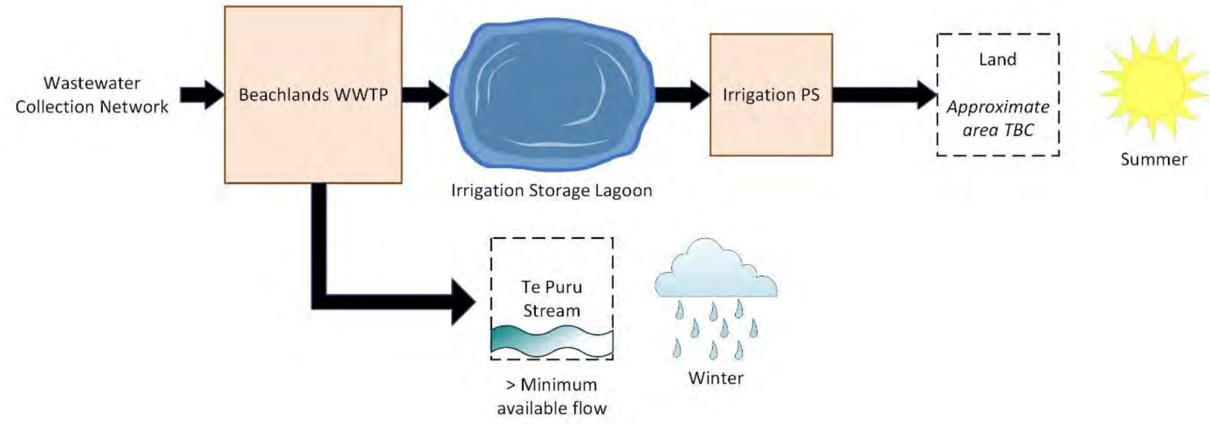


Option	Option name	Description of Option	Summary of Infrastructure Components
3	100% Land Irrigation	Irrigation of all the treated wastewater to land.	Upgraded Beachlands WWTP New irrigation Storage Lagoon New irrigation pump station New pipeline to land application system New land application system
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

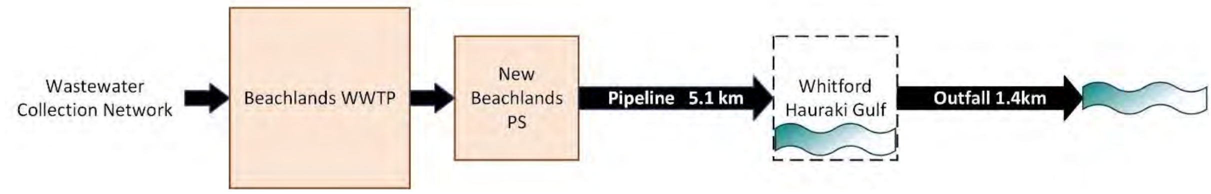


Option	Option name	Description of Option	Summary of Infrastructure Components
3a	Land Irrigation and Tributary of Te Puru Stream Discharge	A combination of Option 3 with one of Option 2. Seasonal/weather and/or river flow conditions for discharge route. Discharge to land over summer and when stream flow is below minimum allowable. Discharge to stream over winter and when stream flow is above minimum allowable.	Upgraded Beachlands WWTP New irrigation Storage Lagoon New irrigation pump station New pipeline to land application system New land application system Discharge structure o Land contact or o Rock bed structure or o Gabion baskets; or o Or direct pipe discharge. Or expanded overland flow treatment system
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

Option	Option name	Description of Option	Summary of Infrastructure Components

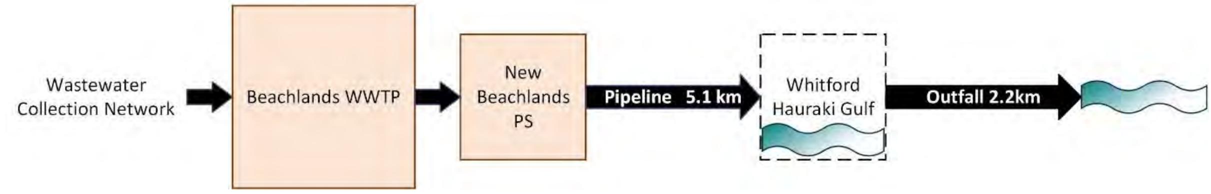


4aa	Hauraki Gulf – Pine Harbour Short	Convey treated wastewater to a new marine outfall into the Hauraki Gulf off the coast of Pine Harbour with a short outfall.	Upgraded Beachlands WWTP New Beachlands pump station New ≈5.1km conveyance pipeline New short outfall pipeline and offshore marine outfall structure/diffuser
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

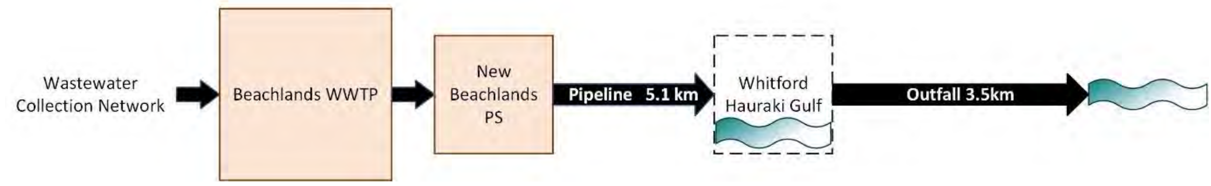


4ab	Hauraki Gulf – Pine Harbour Mid	Convey treated wastewater to a new marine outfall into the Hauraki Gulf off the coast of Pine Harbour with a mid-length outfall.	Upgraded Beachlands WWTP New Beachlands pump station New ≈5.1km conveyance pipeline TBC New mid-length outfall pipeline and offshore marine outfall structure/diffuser
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

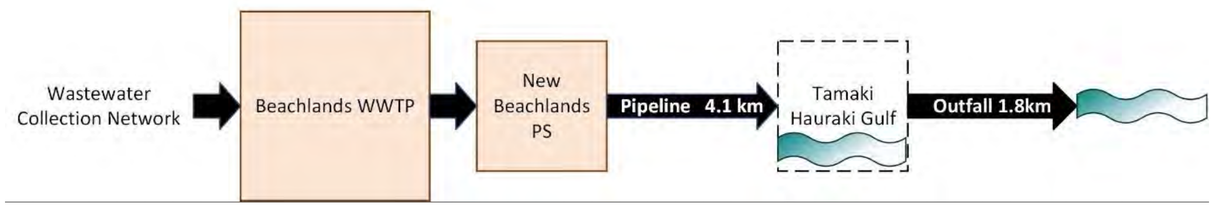
Option	Option name	Description of Option	Summary of Infrastructure Components



4ac	Hauraki Gulf - Pine Harbour Long	Convey treated wastewater to a new marine outfall into the Hauraki Gulf off the coast of Pine Harbour with a long outfall.	Upgraded Beachlands WWTP New Beachlands pump station New ≈5.1km conveyance pipeline New long outfall pipeline and offshore marine outfall structure/diffuser
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

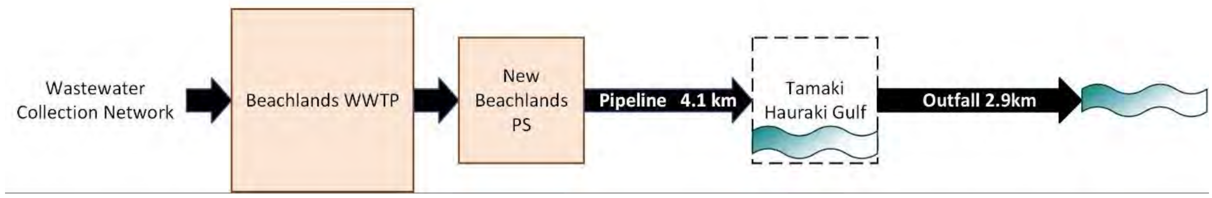


4ad	Hauraki Gulf - Tāmaki Strait Short	Convey treated wastewater to a new marine outfall into the Hauraki Gulf off the coast of Beachlands with a short outfall.	Upgraded Beachlands WWTP New Beachlands pump station New ≈4.1km conveyance pipeline New short outfall pipeline and offshore marine outfall structure/diffuser
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

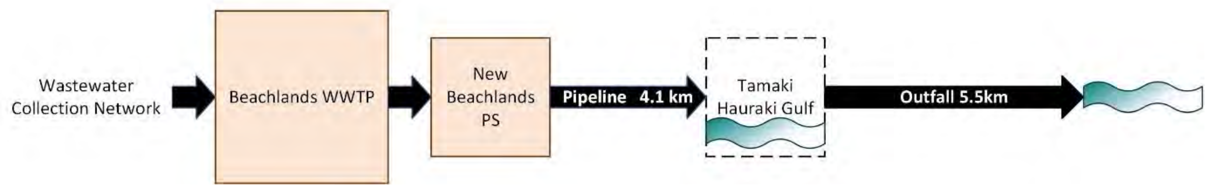


4ae	Hauraki Gulf - Tāmaki Strait Mid	Convey treated wastewater to a new marine outfall into the Hauraki Gulf off the coast of Beachlands with a mid-length outfall.	Upgraded Beachlands WWTP New Beachlands pump station New ≈4.1km conveyance pipeline

Option	Option name	Description of Option	Summary of Infrastructure Components
			New mid-length outfall pipeline and offshore marine outfall structure/diffuser
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

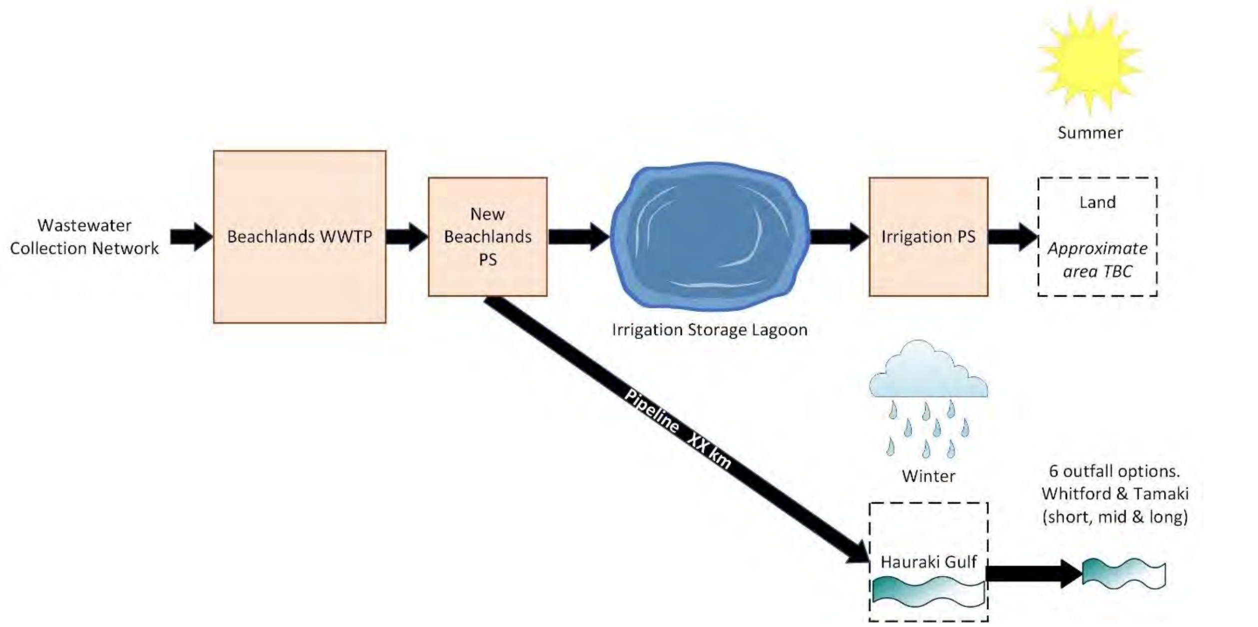


4af	Hauraki Gulf - Tāmaki Strait Long	Convey treated wastewater to a new marine outfall into the Hauraki Gulf off the coast of Beachlands with a long outfall.	Upgraded Beachlands WWTP New Beachlands pump station New ≈4.1km conveyance pipeline New long outfall pipeline and offshore marine outfall structure/diffuser
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC



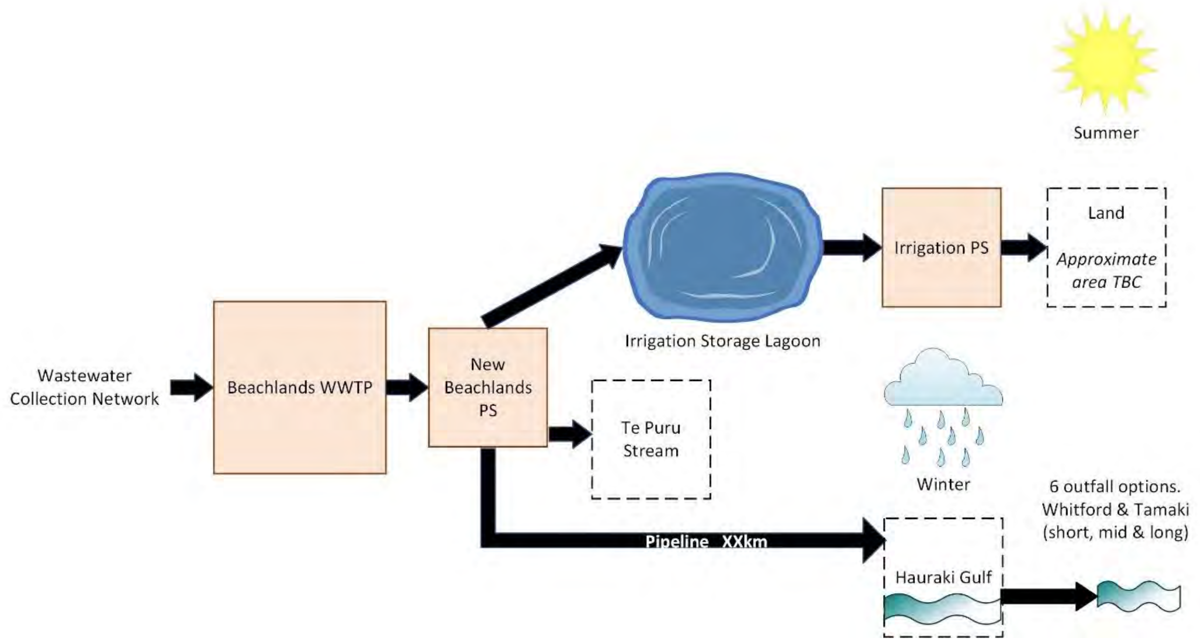
4b	Land Application and Hauraki Gulf Discharge	A combination of Options 3 and 4. Seasonal/weather conditions for discharge route. Discharge to land over summer; discharge to Hauraki Gulf over winter and when land is unavailable to accept treated wastewater.	Upgraded Beachlands WWTP New Beachlands pump station XXkm pipeline to Hauraki Gulf TBC New irrigation Storage Lagoon New irrigation pump station New pipeline to land application system New land application system New XXkm outfall pipeline and offshore marine outfall structure/diffuser TBC.
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

Option	Option name	Description of Option	Summary of Infrastructure Components



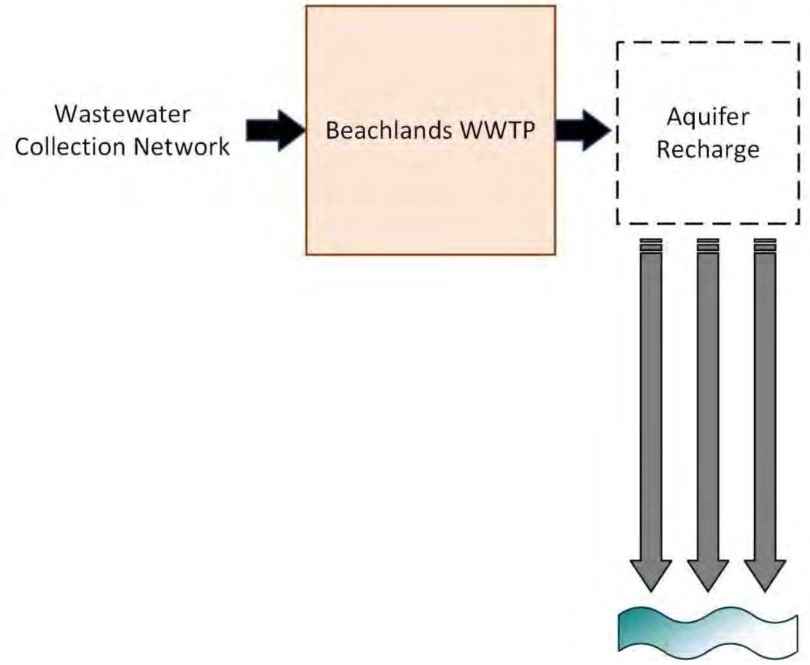
4ba	Land Application, Hauraki Gulf Discharge and Tributary of Te Puru Stream Discharge	A combination of Options 3a and 4. Seasonal/weather and/or river flow conditions for discharge route. Discharge to land over summer; Discharge to a tributary of the Te Puru stream over winter and when stream flow is above minimum allowable flow. Discharge to Hauraki Gulf over winter and when land is unavailable to accept treated wastewater and when stream flow is below minimum allowable flow.	Upgraded Beachlands WWTP New Beachlands pump station XXkm pipeline to Hauraki Gulf TBC New irrigation Storage Lagoon New irrigation pump station New pipeline to land treatment system New XXkm outfall pipeline and offshore marine outfall structure/diffuser New land application system Te Puru Stream possible discharge structure o Land contact or o Rock bed structure or o Gabion baskets; or o Direct pipe discharge Tributary of Te Puru Stream expanded overland flow treatment system
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

Option	Option name	Description of Option	Summary of Infrastructure Components



5	Managed Aquifer Recharge	Discharge to an aquifer using a Managed Aquifer Recharge (MAR). i.e. high quality water must be used for a groundwater replenishment scheme to purposefully recharge aquifers.	Upgraded Beachlands WWTP New XXkm conveyance pipeline to aquifer recharge system New groundwater recharge system
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

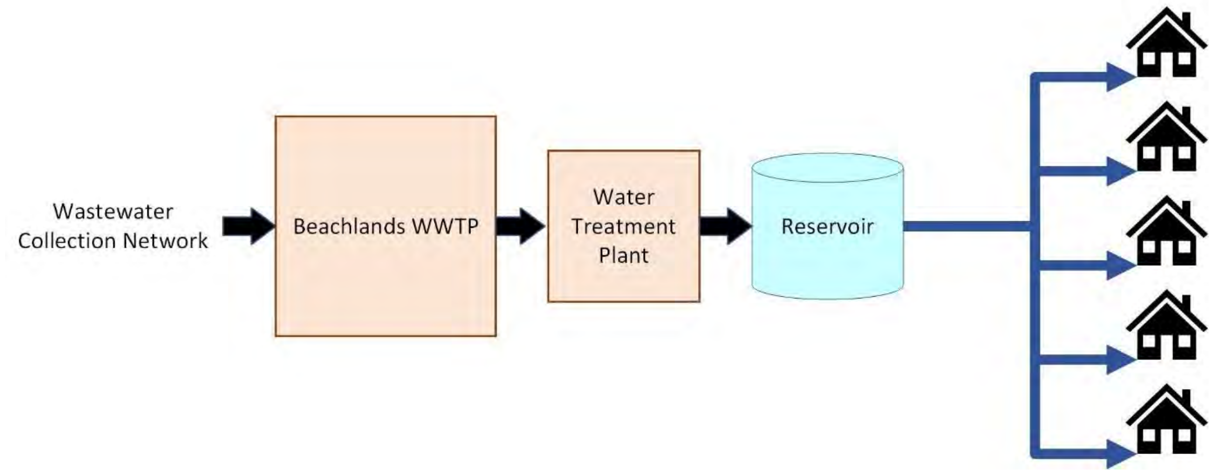
Option	Option name	Description of Option	Summary of Infrastructure Components

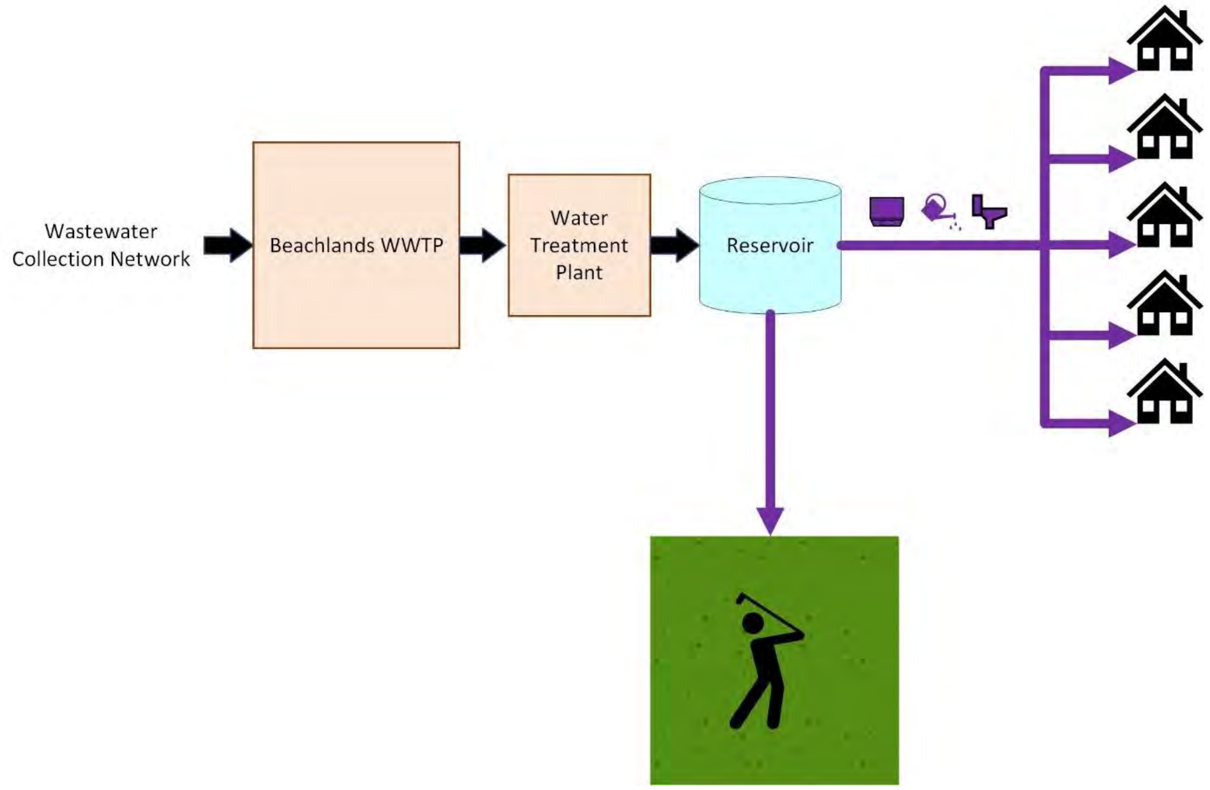


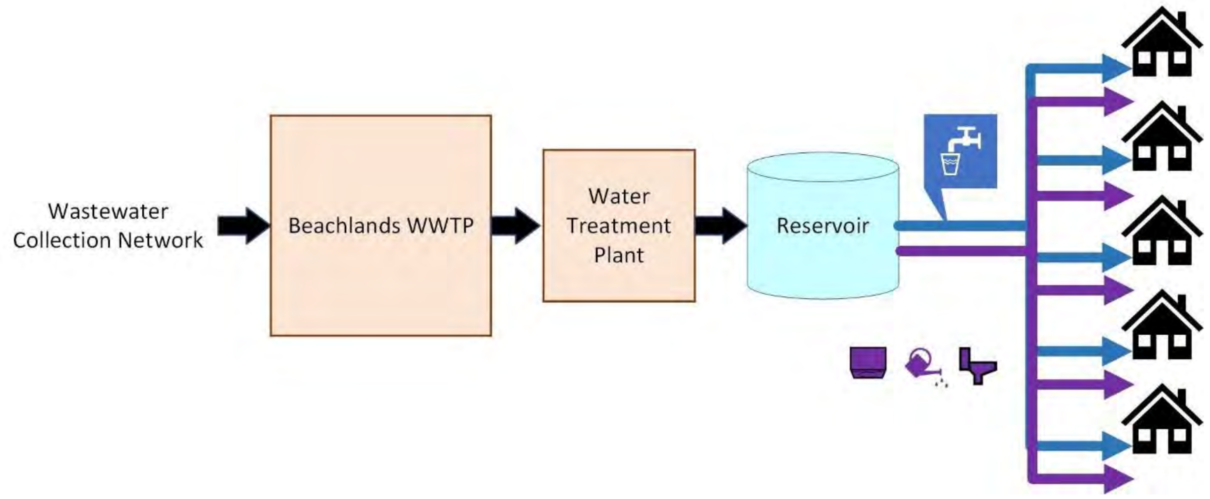
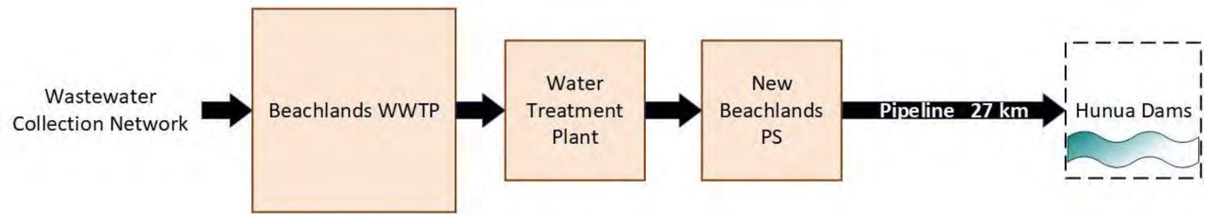
5.1.2 Wastewater Management Alternatives

Table 5-2: Wastewater Management Long List Options

Option	Option name	Description of Option	Summary of Infrastructure Components
6	100% Reuse - Potable	Direct re-use by supplying potable drinking water from reclaimed wastewater to the Beachlands/Maraetai community.	Upgraded Beachlands WWTP New water treatment plant New reservoir New water supply network Backup discharge route for (any) balance of treated wastewater
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

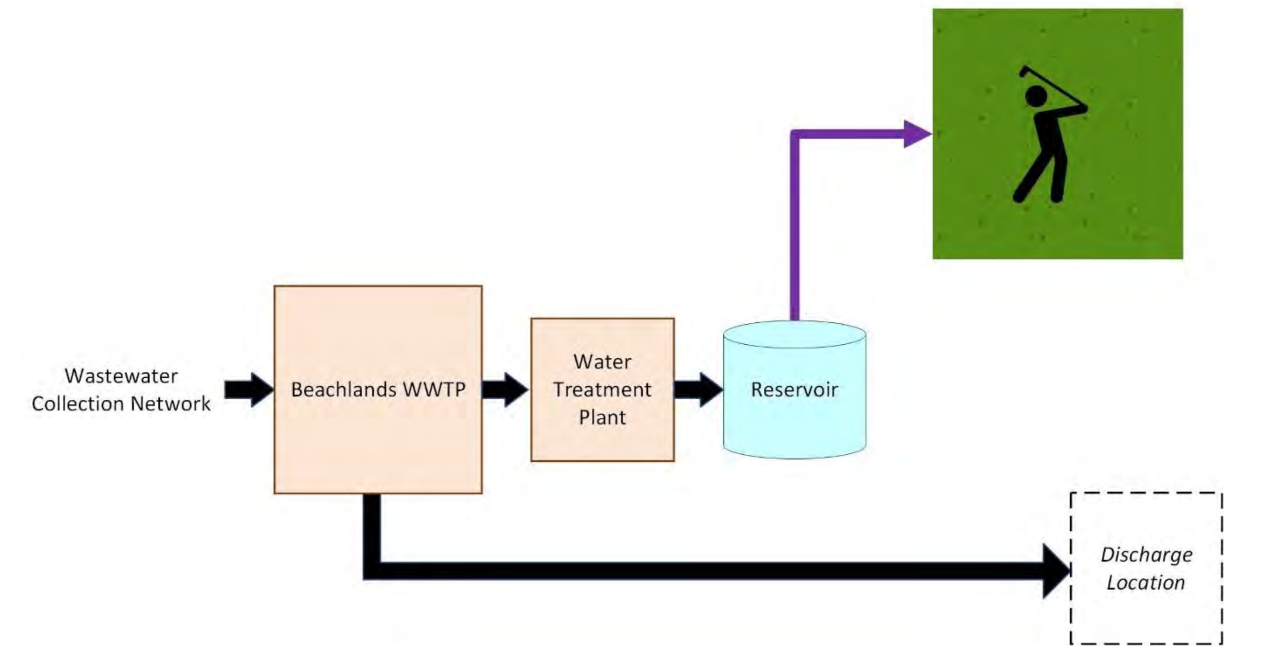
Option	Option name	Description of Option	Summary of Infrastructure Components
			
7	100% Re-use – Non-Potable	Convey 100% of the treated wastewater to a “purple pipe” reticulation network. Use for domestic (toilets, garden watering, washing machines?) irrigation of verges, parks, golf courses, sports fields, industrial re-use, nurseries, agricultural irrigation etc. A backup discharge route would still be needed as a contingency should re-use demand drop or become unavailable.	Upgraded Beachlands WWTP New water treatment plant New reservoir New water supply network
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

Option	Option name	Description of Option	Summary of Infrastructure Components
			
8	100% Reuse – Non-Potable - Transition to Potable	Water is treated to a potable standard but not used for that for domestic purposes immediately but is used for other purposes. The non-potable use is retained. Potential to require dual distribution network (Beachlands, Maraetai and Whitford Servicing Strategy June 2023).	Upgraded Beachlands WWTP New water treatment plant New reservoir New purple pipe water supply network Possible new potable pipe water supply network
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC

Option	Option name	Description of Option	Summary of Infrastructure Components
			
9	Supplement supply for the Hunua Dams.	Convey treated wastewater 27 km to Hunua water supply dam. Conveyance of the treated wastewater to an appropriate reclaimed standard 27km to the Hunua Dams to supplement the water supply source at the Hunua Dams. Assume 100% of the treated ww is discharged to the Hunua Dams.	Upgraded Beachlands WWTP New water treatment plant New water pump station New 27km treated water pipeline New discharge point to a Hunua Dam/reservoir.
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC
			
11[11]	Enhancement options: Partial Reuse - Non-Potable	A combination of Option 7 and one of Options 2, 3 or 4. (This option can be explored should one of these receiving environments be selected, as an enhancement to the base scheme). The location of the discharge will dictate the discharge route and the seasonal and/or demand	Upgraded Beachlands WWTP New water treatment plant New reservoir New water supply network New pipeline – XX km – to discharge location. New discharge facilities.

[11] Option 11 was not scored by the experts as it comprises enhancements that can be incorporated into a range of options.

Option	Option name	Description of Option	Summary of Infrastructure Components
		conditions the volume. The volume to non-potable reuse is maximised to meet demand, the remainder is discharged to the receiving environment. Typical examples include verges, reserves, golf courses, industrial re-use, nurseries etc	
		Key Treatment Parameters	Appropriate Treatment Processes
		TBC	TBC



5.2 Approach to Long List / Traffic Light Technical Assessment

As shown in Figure 2-1, the Long List / traffic light technical assessment involved technical experts being allocated a criterion and undertaking a high-level assessment of each of the Long List of options against their respective criteria. At the Long List workshop each technical expert then presented their score and the justification for the score. The workshop participants discussed the options scores and agreed the final score.

To ensure a consistent and repeatable approach of the Long List assessment, the technical experts were provided with assessment templates for the criterion they were responsible for and with workshop briefing notes. The experts were required to:

1. Use the bespoke template for each criteria the expert was responsible for. The template recorded:
    - The experts involved in undertaking the assessments
    - Information relied on
    - Assumptions
    - Traffic Light scores and reasons for the scores

Assess each option against the criteria as Red, Orange, or Green (Traffic Light) in accordance with the Traffic Light definitions for the relevant criterion set out in Table 5-3 below and record reasons for each score.

Determine an option's recommended traffic light 'score' by first scoring each of the criterion's sub-criteria separately (a full description of the sub-criteria was contained in the assessment template). Determine an overall score by comparing the range of sub-criteria scores and giving an overall score. A qualitative expert judgement approach was followed in determining the scores for the Long List assessment rather than a quantitative approach.

5.2.1 Assessment Criteria

The following principles were applied in developing the Long List assessment criteria:

a. Criteria must assist in differentiating options (e.g. there is no point in including a criterion relating to natural hazards if none of the options will be affected by natural hazards).

b. Criteria need to be designed to address the local context within which the options are located e.g. urban, rural, natural hazards, open space.

c. Criteria need to be easily understood and clearly describe the matters to be assessed.

d. Double counting i.e. assessing the same or similar matters under different criteria should be avoided, where possible.

e. There should not be too many or too few criteria.

The following table sets out the criteria used for the traffic light assessment, the various categories for each of the criterion, an overall description for each of the criterion and the relevant section of Part 2 of the RMA that the criterion addresses. The assessment criteria were agreed by participants at Workshop 1. As previously discussed, the traffic light / longlist assessment is a technical assessment and consequently does not include criteria relating to cultural matters.

Table 5-3: Long List Assessment Criteria

Criteria	Criteria categories / Sub criteria	Description	RMA Part 2 matters addressed
Public Health Protection	Microbiological quality of treated wastewater Risk of public exposure to waterborne pathogens and other contaminants through: • Direct contact with the conveyance or treatment process. • Direct contact with the receiving environment, for example through contact recreation. • Indirect exposure – commercial operations, food gathering (shellfish, fish, watercress etc.) and groundwater use. Spray irrigation / aerosols • Risk of public exposure to pathogens and other contaminant from spray irrigations. Treated wastewater reuse • Risk of contamination of reclaimed water for potable and non-potable reuse.	Degree of public exposure to health risks from treated wastewater discharge (including through land application or re-use options).	Section 5 – enables people and communities to provide for their health and safety.
Natural Environment	Coastal environment • Effects on life supporting capacity - water quality, marine ecology, indigenous biodiversity. • Effects on foreshore and seabed. • Effects on natural character, features and landscapes. • Ability to meet the requirements of s107 of the RMA. Freshwater • Effects on Te Mana o te Wai. • Alignment with NPS-FM compulsory values, other values, national bottom lines. • Ability to meet the requirements of s107 of the RMA. Groundwater • Effects on Te Mana o te Wai.	Potential adverse environmental effects on the receiving environments associated with the options. Ability to meet s107 of the RMA and align with the values and bottom lines of the NPS-FM.	• Section 5 – safeguarding the life-supporting capacity of air, water, soil, and ecosystems. • Section 6(a) - the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development. • Section 6(b) - the protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development.

Criteria	Criteria categories / Sub criteria	Description	RMA Part 2 matters addressed
	• Alignment with NPS-FM compulsory values, other values, national bottom lines. Land • Effects on terrestrial ecology • Effects on highly productive land. • Effects on natural inland wetlands.		• Section 6(c) - the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna. Section 7(d) - intrinsic values of ecosystems. Section 7(f) - maintenance and enhancement of the quality of the environment. Section 7 (h) - the protection of the habitat of trout and salmon.
Social and Community	Amenity values • Nuisance effects (e.g., odour, noise, visual). • Effects on sensitive activities Recreation and food gathering • Effects on recreation activities and values, and food gathering. • Effects on public access to the CMA, rivers, and streams. Heritage and archaeology • Effects on archaeology (non-Māori). • Effects on heritage buildings and sites. Rural and commercial activities • Effects on rural activities. • Effects on commercial operations in the marine environment.	Potential adverse effects on social and community values relating to amenity, recreation and food gathering, archaeology and heritage. Impact on Public access to and along the coastal marine area, and rivers and streams. Impact on rural activities and commercial operations.	• Section 5 – enables people and communities to provide for their social and economic well being. • Section 6(d) - the maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers. • Section 6(f) - the protection of historic heritage from inappropriate subdivision, use, and development. • Section 7(c) - the maintenance and enhancement of amenity values. • Section 7(f) - maintenance and enhancement of the quality of the environment.
Financial Implications	Capital cost • Capital cost of the total scheme including any land acquisition costs, capital gains and product net revenue. Operating and maintenance cost	Comparative capital, operating and maintenance, whole of life costs of the options. Where relevant to the option, land acquisition costs, capital gains and product net revenue. Affordability –	• Section 5 - enables people and communities to provide for their economic well being.

Criteria	Criteria categories / Sub criteria	Description	RMA Part 2 matters addressed
	• Cost effectiveness of operations and maintenance. Whole of life cost • Combination of capital and operation and maintenance costs over the life of the assets. Financial risk • Is the option affordable even if growth does not occur as predicted. • Cost to the community, business and trade waste dischargers.	community, business, and trade waste dischargers	• Section 7(b) - the efficient use and development of natural and physical resources.
Resilience	• Natural hazards • Land stability and erosion affecting infrastructure. • Flooding affecting infrastructure. • Wildfires affecting infrastructure (land application in forests). Climate change • High intensity rainfall peaks affecting the infrastructure. • Prolonged wet weather periods affecting the infrastructure. • Prolonged dry periods affecting the infrastructure. • Prolonged dry periods resulting in an increase of low flows in streams and rivers. • Sea level rise and coastal storm inundation affecting infrastructure (ocean outfall). • Carbon – addressing the carbon component of 40/20/20. Operational resilience • Power supply reliability – effect of outages and rapid changes to electricity pricing. • Scheme complexity leading to operational problems. • Third party damage to infrastructure, e.g., digger hitting cables, pipes etc. • Crop failure/contamination.	Degree to which the option is resilient to natural hazards and climate change, offers operational resilience, addresses the carbon component of 40/20/20. Flexibility to accommodate changes in flows and loads, ability to respond to changes in regulatory standards, changes in technology.	• Section 5 – enables people and communities to provide for their health and safety. • Section 7(i) – the effects of climate change.

Criteria	Criteria categories / Sub criteria	Description	RMA Part 2 matters addressed
	• Loss of market for land application products e.g., cut and carry products, forestry production. • Flexibility • Ability to accommodate changes in flows and loads. • Ability to respond to changes in regulatory standards e.g., emerging contaminants, endocrine disrupting compounds. • Ability to respond to changes in technology.		
Technology and Infrastructure	Reliable and proven technology • Uses reliable, robust and proven technology. Staging and timing • Can the option be staged. • Is the option able to be constructed within the required timeframe. Constructability • Is the option able to be constructed e.g., geotechnical conditions, presence of groundwater, contaminated land. • Is there sufficient land available to accommodate the option and can the land be secured. • Potential to maximise the use existing infrastructure that has a valuable remaining life. • Presence of existing other infrastructure. Capacity • Does the option have capacity to accept projected flows and loads. • Carbon Footprint / Greenhouse gas emissions • Comparative carbon footprint GHG emissions for operation and construction.	Degree to which the option – uses proven technology, existing infrastructure; can be constructed, staged, constructed in the required timeframes; has sufficient capacity, secure land, available infrastructure.	• Section 5 - sustaining the potential of natural and physical resources to meet the reasonably foreseeable needs of future generations. • Section 7(b) - the efficient use and development of natural and physical resources.
Statutory Risks and Conflicts	Barriers to options proceeding • Risk of an option not proceeding due to legislative changes and outcomes of legislative processes e.g., potentially	Legislative processes that could restrict the ability of an option to proceed, scale of consenting complexity and consent	• Sections 5, 6, 7, 8.

Criteria	Criteria categories / Sub criteria	Description	RMA Part 2 matters addressed
	successful applications for customary title under the Takutai Moana Act. Complexity and compliance • Risk of complex consenting processes including s91 deferrals. • Risk of complex compliance requirements and costs. Conflicts with statutory direction • Conflict with the direction of key planning instruments e.g., non-complying activity classification with a supporting “avoid” policy.	compliance. Conflicts with the direction of key planning instruments.	
Opportunities and Benefits	Resource recovery • Treated wastewater beneficial reuse. • Sludge and biosolids beneficial reuse • Nutrient removal	Provides opportunities for resource recovery including beneficial reuse, energy generation, nutrient recovery / reuse.	• Section 5 – sustainable management of resources. • Section 7(b) - the efficient use and development of natural and physical resources. • Section 7 (ba) - the efficiency of the end use of energy.

5.2.2 Traffic Light Definitions

Table 5-4: Traffic Light definitions

sets out the traffic light definitions (scores) that were adopted for each of the assessment criterion. Green is the best and Red is the worst.

Table 5-4: Traffic Light definitions

Criteria	Green	Orange	Red
Public Health Protection	Low degree of public exposure to risk	Medium degree of public exposure to risk	High degree of public exposure to risk
Natural Environment	Low potential adverse effects	Medium potential adverse effects	High potential adverse effects
Social and Community	Low potential adverse effects	Medium potential adverse effects	High potential adverse effects
Financial Implications	Low financial implications	Medium financial implications	High financial implications
Resilience	High degree of resilience	Medium degree of resilience	Low degree of resilience
Technology and Infrastructure	High degree of alignment	Medium degree of alignment	Low degree of alignment
Statutory Risks and Conflicts	Low risks and conflicts	Medium risks and conflicts	High risks and conflicts
Opportunities and Benefits	High opportunities and benefits	Medium opportunities and benefits	Minimal opportunities and benefits

5.2.3 Responsibilities

Appendix A sets out the technical experts who were responsible for each criterion along with other experts who provided additional technical support or reviewed the assessments.

Copies of the technical expert's Long List assessments are attached as Appendix B.

5.2.4 Summary of Preliminary Technical Long List Scores

Table 5-5 is a collation of the overall scores provided by the technical experts in advance of the Long List / Traffic Light workshop. A low overall Traffic Light score is best and a high score is worst. Green = 1, Orange = 2, Red = 3.

Where a traffic light score in the table below is identified as preliminary this indicates the wish of the expert either to draw on the collective knowledge of the workshop participants to help inform the score or the need to undertake further work to confirm the score.

Table 5-5: Preliminary Technical Expert Assessment Summary of Long List Scores (pre workshop)

Option / Criteria	Public Health Protection	Natural Environment	Social and Community	Financial Implications	Resilience	Technology and Infrastructure	Statutory Risks and Conflicts	Opportunities and Benefits	Overall Traffic Light
2a: Overland Flow (diffuse discharge) Tributary of Te Puru Stream		Preliminary							11
2b: Tributary to Te Puru Stream – direct discharge		Preliminary							12
2c: Wairoa River		Preliminary							18
2d: Turanga Creek / Awa		Preliminary							19
3: 100% Land Application		Preliminary	Preliminary						12
3a: Land Application + Tributary of Te Puru Stream		Preliminary							12
4aa: Hauraki Gulf Pine Harbour Short		Preliminary							16
4ab: Hauraki Gulf Pine Harbour Mid		Preliminary							16
4ac: Hauraki Gulf Pine Harbour Long		Preliminary							16
4ad: Hauraki Gulf Tāmaki Strait Short		Preliminary							16
4ae: Hauraki Gulf Tāmaki Strait Mid		Preliminary							11
4af: Hauraki Gulf Tāmaki Strait Long		Preliminary							13

Option / Criteria	Public Health Protection	Natural Environment	Social and Community	Financial Implications	Resilience	Technology and Infrastructure	Statutory Risks and Conflicts	Opportunities and Benefits	Overall Traffic Light
4b: Land Application + Hauraki Gulf		Preliminary							15
4ba: Land Application + Hauraki Gulf + Tributary of Te Puru Stream		Preliminary							15
5: Managed Aquifer Recharge		Preliminary							14
6: 100% Reuse - Potable		Preliminary							14
7: 100% Reuse – Non-Potable		Preliminary							14
8: 100% Reuse – Non-Potable Transition to Potable		Preliminary							15
9: Supplement Supply for Hunua Dams		Preliminary							14

5.3 Long List / Traffic Light Workshop

5.3.1 Purpose and Process

The purpose of the Long List / Traffic Light workshop was to reduce the Long List to a Short List of options.

The process followed at the workshop was that each technical expert responsible for a criterion presented their sub-criteria scores and overall scores for each option and their reasons for the scores. The workshop participants asked questions of the experts and in some cases challenged the experts' scores. Where alternative scores were proposed these was discussed and agreed with the expert and the workshop participants. The changes that were made to the experts' scores are explained in Section 5.3.2 below.

Appendix C contains a list of the workshop participants.

5.3.2 Changes to Specialist Scores

Table 5-6 sets out the changes that were made to the overall scores for each option when assess against each of the criteria as a result of the workshop discussions. Table 5-7 records the reason for the change to the overall score.

Where provisional scores were recorded by the experts in their pre-workshop assessments these were confirmed at the Long List / Traffic Light workshop though either additional information or the collective knowledge of the workshop participants.

Table 5-6: Preliminary Technical Expert Assessment Summary of Long List Scores (updated scores)

Option / Criteria	Public Health Protection	Natural Environment	Social and Community	Financial Implications	Resilience	Technology and Infrastructure	Statutory Risks and Conflicts	Opportunities and Benefits	Overall Traffic Light
2a: Overland Flow (diffuse discharge) Tributary of Te Puru Stream		Changed from green to orange							11 12
2b: Tributary of Te Puru Stream – direct discharge									12
2c: Wairoa River									18
2d: Turanga Creek / Awa									19
3: 100% Land Application			Changed from orange to green	Changed from orange to red					12 (no change)
3a: Land Application + Tributary of Te Puru Stream									12
4aa: Hauraki Gulf Pine Harbour Short									16
4ab: Hauraki Gulf Pine Harbour Mid									16
4ac: Hauraki Gulf Pine Harbour Long									16
4ad: Hauraki Gulf Tāmaki Strait Short									16
4ae: Hauraki Gulf Tāmaki Strait Mid									11
4af: Hauraki Gulf Tāmaki Strait Long									13

Option / Criteria	Public Health Protection	Natural Environment	Social and Community	Financial Implications	Resilience	Technology and Infrastructure	Statutory Risks and Conflicts	Opportunities and Benefits	Overall Traffic Light
4b: Land Application + Hauraki Gulf									15
4ba: Land Application + Hauraki Gulf + Tributary of Te Puru Stream									15
5: Managed Aquifer Recharge									14
6: 100% Reuse - Potable							Changed from green to orange		~~14~~ 15
7: 100% Reuse – Non-Potable									14
8: 100% Reuse – Non-Potable Transition to Potable								Changed from green to orange	15 16
9: Supplement Supply for Hunua Dams							Changed from green to orange		~~14~~ 15

Table 5-7: Traffic Light Score Changes and Reasons

Criterion	Traffic Light Score Change	Reason
Natural Environment	Option 2a changed from green to orange	Most recent data indicates that some standards may not be met downstream.
Social and Community	Option 3 changed from orange to green	New information about the location of the land irrigation area reduced the risk of adverse effects.
Financial Implication	Option 3 changed from orange to red.	The increase in the area required for land irrigation.
Statutory Risks and Conflicts	Option 6 and Option 9 changed from green to orange	There are currently no standards that apply to the reuse of treated wastewater. This could potentially lead to disputes over appropriate standards to be met and loss of public confidence.
Opportunities and Benefits	Option 8 changed from green to orange	The need to remove nutrients for drinking water supply reduces the ability for nutrient recovery and reuse.

5.3.3 Analysis of Preliminary Technical Expert Assessment

As can be seen from Table 5-6, the options that scored the worst were those that involved discharges to the Wairoa River and the Turanga Creek / Awa (Options 2c and 2d). This was primarily due to financial implications, issues with public health protection and effects on these freshwater bodies, particularly the Turanga Creek / Awa. Both options also had issues with constructability, capacity of the receiving environment to assimilate the projected flows and loads and the embodied carbon in the conveyance infrastructure.

The other options that did not score well were those involving the discharge to the Hauraki Gulf in the vicinity of Pine Harbour (Options 4aa, 4ab, 4ac) and the short outfall to the Tāmaki Straight (Option 4ad). This was primarily due to issues with public health protection and effects on the marine environment. The long outfall to the Tāmaki Straight (Option 4af) did not score so well when compared to the medium outfall (Option 4ae) primarily for financial implications due to the length of the outfall.

Options involving the 100% reuse of the wastewater, managed aquifer recharge, supplementary supply for the Hunua Dams (Option 5, 6, 7, 8 and 9) and options involving combination of discharges to land, Hauraki Gulf and the tributary of the Te Puru Stream (Options 4b and 4ba) did not score well due to a combination of financial implications and resilience and constructability issues.

The options that scored the best were those involving the continued discharge to the Tributary of the Te Puru Stream (Options 2a, 2b), primarily for high level of public health protection, minor effects on social and community activities and low financial implications. Other options that scored well were the 100% land irrigation, the combination of land irrigation and discharge to the Tributary of the Te Puru Stream (Options 3 and 3a) and the mid length ocean outfall to the Tāmaki Strait (Option 4ae). The reasons why these options scored well were primarily because of their low risk to public health, minor effects on the natural environment and on social and community activities. The ocean outfall also scored well in terms of resilience, constructability and capacity of the receiving environment to accept projected flows and loads.

5.4 Preliminary Technical Short List

Following the Long List / Traffic Light workshop and the confirmed updates to the overall scores by the experts, the technical team reviewed the five best scoring options. As the five options involved discharges to a range of receiving environments (freshwater, land, marine waters and a combination of land and freshwater) it was determined that the five best scoring options should be the preliminary technical Short List of options and should be subject to a BPO test and assessed against the Project Objectives.

As can be seen from the preliminary technical Short List of options set out in Table 5-8 below, all the options were scored very similarly but Option 4ae: Hauraki Gulf Tāmaki Strait Mid scored slightly better than the other four options.

Table 5-8: Preliminary Technical Short List

Option / Criteria	Public Health Protection	Natural Environment	Social and Community	Financial Implications	Resilience	Technology and Infrastructure	Statutory Risks and Conflicts	Opportunities and Benefits	Overall Traffic Light
2a: Overland Flow (diffuse discharge) Tributary of Te Puru Stream									12
2b: Tributary of Te Puru Stream – direct discharge									12
3: 100% Land Application									12
3a: Land Application + Tributary of Te Puru Stream									12
4ae: Hauraki Gulf Tāmaki Strait Mid									11

5.5 Best Practicable Option Test No. 1[12]

As set out in the Assessment Methodology diagram (Figure 2-1), the next step in the Long List / traffic light assessment process was to take the preliminary technical Short List of options and test them against the RMA BPO definition and the Project Objectives. As this phase is still part of the Long List assessment process the Traffic Light Assessment has been adopted for the BPO Test No 1.

5.5.1 Best Practicable Option Assessment

Section 2 of the RMA defines BPO as:

> *'best practicable option, in relation to a discharge of a contaminant or an emission of noise, means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to—*
>
> (a*) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and*
>
> *(b) the financial implications, and the effects on the environment, of that option when compared with other options; and*
>
> *(c) the current state of technical knowledge and the likelihood that the option can be successfully applied.'*

The following BPO assessment criteria and scores were developed and adopted for the assessment.

Table 5-9: BPO Assessment Criteria and Scoring Guide

BPO Source	Criterion	Description	Score Guide		
RMA BPO definition (a)	Nature of discharge and receiving environment sensitivity	What is the nature of the discharge, and how sensitive is the receiving environment to adverse effects?	Low sensitivity	Medium sensitivity	High sensitivity
RMA BPO definition (b)	Comparison of effects on the environment	How do the effects of each of option compare with the other options in terms of the social and economic effects?	Low effect	Medium effect	High effect
RMA BPO definition (b)	Comparison of effects on the environment	How do the effects of each of option compare with the other options in terms of the cultural effects?	Low effect	Medium effect	High effect
RMA BPO definition (b)	Comparison of effects on the environment	How do the effects of each of option compare with the other options in terms of the biophysical effects?	Low effect	Medium effect	High effect
RMA BPO definition (b)	Comparative financial implications	How do the cost (capital, operational, whole of life) implications of each of option compare with the other options?	Low cost	Medium cost	High cost

[12] The BPO assessment also includes an assessment of the Project Objectives as shown in the Assessment Methodology diagram 2-1

BPO Source	Criterion	Description	Score Guide		
RMA BPO definition (c)	Likelihood that option can be successfully applied	Can the options be successfully implemented e.g. how complex is each option to construct, operate and successfully be applies when compared with the other options?	Low complexity / uncertainty	Medium complexity / uncertainty	High complexity / uncertainty
RMA BPO definition (c)	Technical knowledge	Are the technologies reliable / proven?	Proven, common use	Proven internationally and some use in NZ	Unproven or emerging

The table below provides a summary of the outcomes of the BPO assessment of the preliminary technical Short List of options. An analysis of the assessment is set out in Section 5.5.3 below. As this part of the BPO assessment was a technical assessment, the cultural comparative effects of the shortlisted options and the cultural sensitivities associated with the receiving environments were not taken into account at this stage of the process.

Table 5-10: BPO Assessment of the Preliminary Technical Short List

BPO Criteria	Assessment	Option Scores				
		2a	2b	3	3a	4ae
(a) Receiving environment sensitivity	Both the marine environment and the Te Puru stream are considered to be sensitive receiving environments, however the level of treatment of the discharge can be managed to minimise effects. Land is considered to be the least sensitive receiving environment. This has influenced the score for Option 3a noting that the discharge to land will occur when the Te Puru Stream is at low flow. Note that advice on cultural sensitivities associated with the receiving environments was not available when undertaking the assessment.					
(b) Comparative effects assessment – social and economic	The social and community criterion assessment for the long list options has been relied on for this assessment.					
(b) Comparative effects assessment – cultural						
(b) Comparative effects assessment – natural	The natural environment criterion assessment for the long list options has been relied on for this assessment.					
(b) Comparative financial implications	The financial implications criterion assessment for the long list options has been relied on for this assessment.					
(c) Technical knowledge - complexity	Options 2a and 2b are the least complex to construct and operate as they do not require conveyance to other receiving environments.					

BPO Criteria	Assessment	Option Scores				
		2a	2b	3	3a	4ae
	The other options have a medium level of complexity as they involve conveyance and discharges to other receiving environments.					
(c) Technical knowledge - proven	The technology and infrastructure assessment criterion sub criterion reliable and proven technology assessment for the long list options has been relied on for this assessment.					

5.5.2 Project Objectives Assessment

The following scoring was adopted for assessing the preliminary technical Short List of options against the Project Objectives.

Table 5-11: Approach to Project Objective Scoring

Green	Orange	Red
High degree of alignment	Medium degree of alignment	Low degree of alignment

Table 5-12: Objectives Assessment below provides a summary of the outcomes of the objectives assessment of the preliminary technical Short List of options. An analysis of the assessment is set out in Section 5.5.3 below. Because this was a technical assessment only, the objective relating to recognising the significance of the Hauraki Gulf and the relationship of tangata whenua with the Hauraki Gulf was not scored, and the objective relating to Te Mana o te Wai was only assessed from a technical perspective.

Table 5-12: Objectives Assessment

Objectives	Assessment	Option Scores				
		2a	2b	3	3a	4ae
Work in partnership with the Mana Whenua and engage with the community to identify the best practicable option (BPO) to provide wastewater services for the Beachlands and Maraetai community. The BPO must:						
Recognise the significance of the Hauraki Gulf and the historic, traditional, cultural, and spiritual relationship of the tangata whenua with the Hauraki Gulf and its islands						
Gives effect to Te Mana o te Wai	The options that discharge to receiving environments other than freshwater have a high degree of alignment with Te Mana o te Wai. Option 3a has also been assessed as a high degree of alignment given that the during periods of low flow in the stream					

Objectives	Assessment	Option Scores				
		2a	2b	3	3a	4ae
	most if not all of the treated wastewater will be discharged to land. Options that only discharge to freshwater have been assessed as having a medium degree of alignment based on the very high level of treatment.					
Keep our communities healthy	The public health protection criterion assessment for the Long List options has been relied on for this assessment.					
Protect the health of our environment, particularly the life supporting capacity of land, air, and water.	The natural environment criterion assessment for the Long List options has been relied on for this assessment.					
Provide a solution that caters for planned growth that keeps the overall costs of service to customers (collectively) at sustainable levels.	The financial implications criterion assessment for the Long List options has been relied on for this assessment. All options have been developed to ensure they will provide for projected growth for up to 35 years, but availability of land a potential risk to growth (Option 3)					
Be sustainable and resilient and minimise whole-of-life carbon emissions and optimise resource recovery	The resilience and opportunities and benefits criteria assessments for the Long List options has been relied on for this assessment.					

5.5.3 Analysis

As can be seen from the assessments set out in Table 5-10 and

Table 5-12, all the preliminary technical Short List of options scored a medium or a low score against the BPO assessment criteria and the project objectives except for Option 3.

Option 3 scored high on cost considerations against the BPO comparative financial implications and low degree of alignment against the objective relating to keeping the overall costs of service to customers (collectively) at sustainable levels due to the large irrigation area required (approximately 750ha) and the high cost of land. However, Option 3 scored well against the other BPO criteria and project objectives.

The BPO and objectives assessments were reasonably well aligned with the traffic light assessment and did not identify any additional red traffic light scores which would direct an option to not be progressed for further consideration.

From the above analysis it was considered that all five of the preliminary technical Short List of options passed the Best Practicable Option Test No. 1 and could therefore be taken forward to the technical Short List assessment stage.

6. Technical Short List Assessment

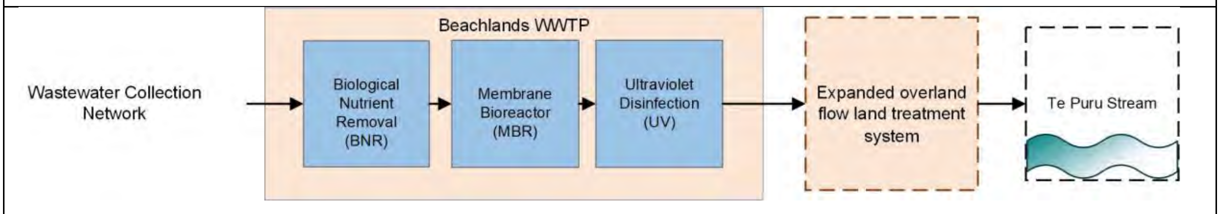
This is Stage 5 of the assessment as shown in Figure 2-1 (Assessment Methodology). It involved the numerical scoring (1 to 5) of the options against the assessment criteria and was informed by a more detailed comparative assessment of the technical Short List options.

6.1 Short List Option Information

To enable a more detailed comparative assessment of the technical short list options a more comprehensive description of the options was developed to assist the technical experts with their Short List assessments. The following tables sets out the information provided to the technical experts.

Option 2a: Tributary of the Te Puru Stream - Diffuse Discharge

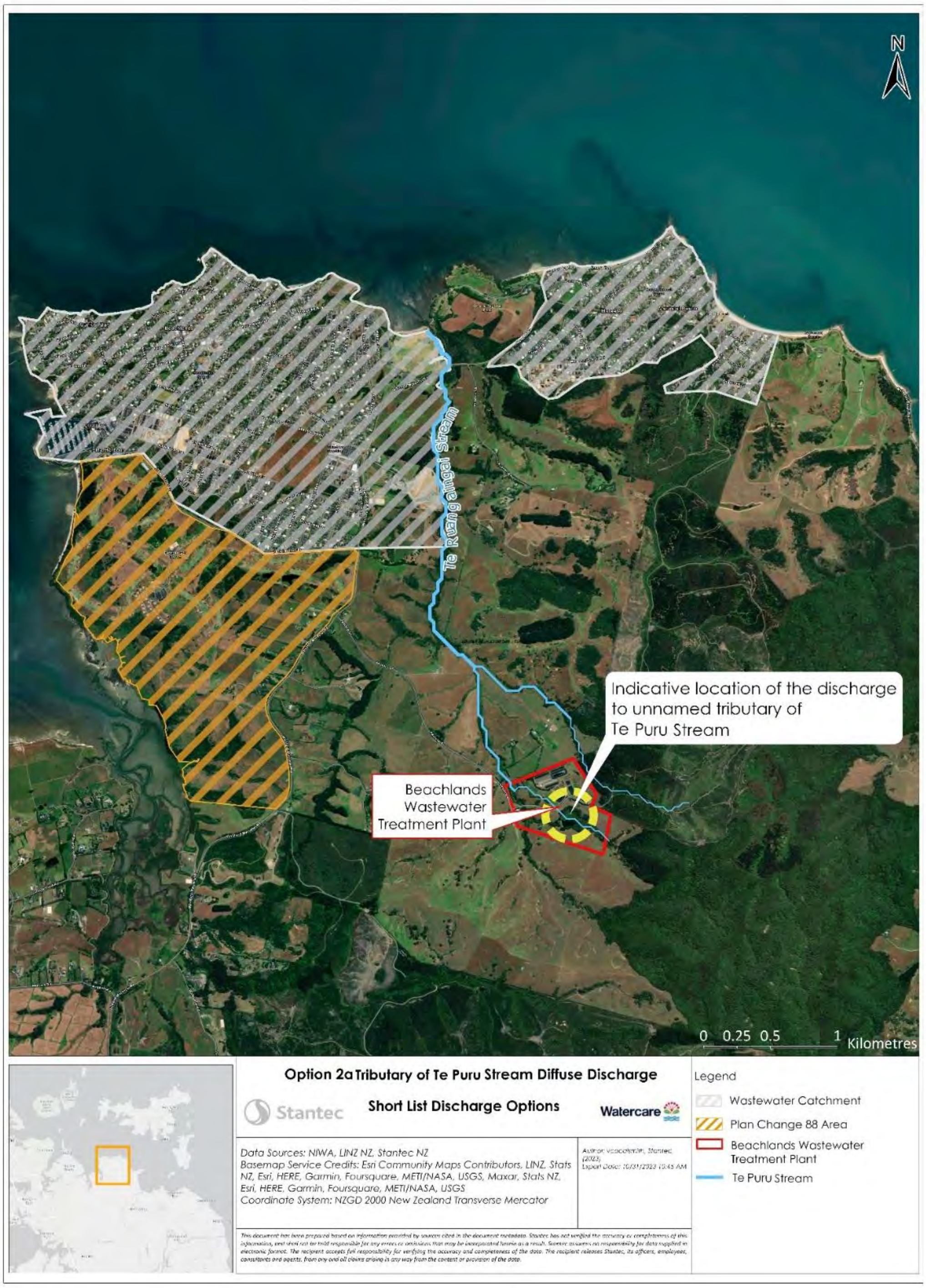
Item	Description
Option Name	2a: Tributary of Te Puru Stream Diffuse Discharge
Discharge Location	Unnamed Tributary of Te Puru Stream
Treatment Option	• Biological Nutrient Removal (BNR) • Membrane Bioreactor (MBR) • Ultraviolet disinfection (UV) • BNR + MBR + UV disinfection
Treatment Location	Existing Beachlands Wastewater Treatment Plant (WWTP) site
Process Diagram	



Typical treated water quality		
Population Equivalent	30,000	
Per Capita Average Daily Flow (ADF)	200 l/p/d (litres per head)	
Average Daily Flow (ADF)	6,000	
Parameter	Median Concentration mg/L	Average Load kg/day
Biological Oxygen Demand (BOD)	1.0	6.0
Total Suspended Solids (TSS)	0.0	0.0
Total Nitrogen (TN)	3.50	21
Total Phosphorus (TP)	0.10	0.6
Faecal Coliforms	<1 cfu/100ml	n/a
Note: The intention is to frame treated wastewater discharge consent on both a load and a concentration dependent basis, depending on the effects of various parameters. This will facilitate staging and flexibility in terms of some concentration limits over the proposed 35 year consent duration.		

Key Components	
Item	Description
Conveyance system	Outlet to stream via the existing discharge point.
Treatment system	Existing Beachlands WWTP site BNR + MBR + UV disinfection
Discharge system	Outlet to stream via the existing overland flow land treatment system expanded to accommodate increased flows; with or without the pond.

Locality Map

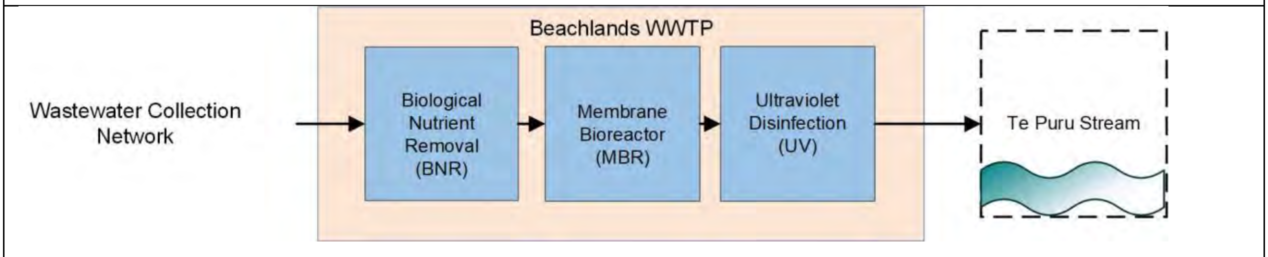


Note:

1. The discharge location is indicative only and may alter pending further investigations.
2. The wastewater catchment is the current reticulated catchment.
3. The Plan Change 88 area is not yet confirmed.

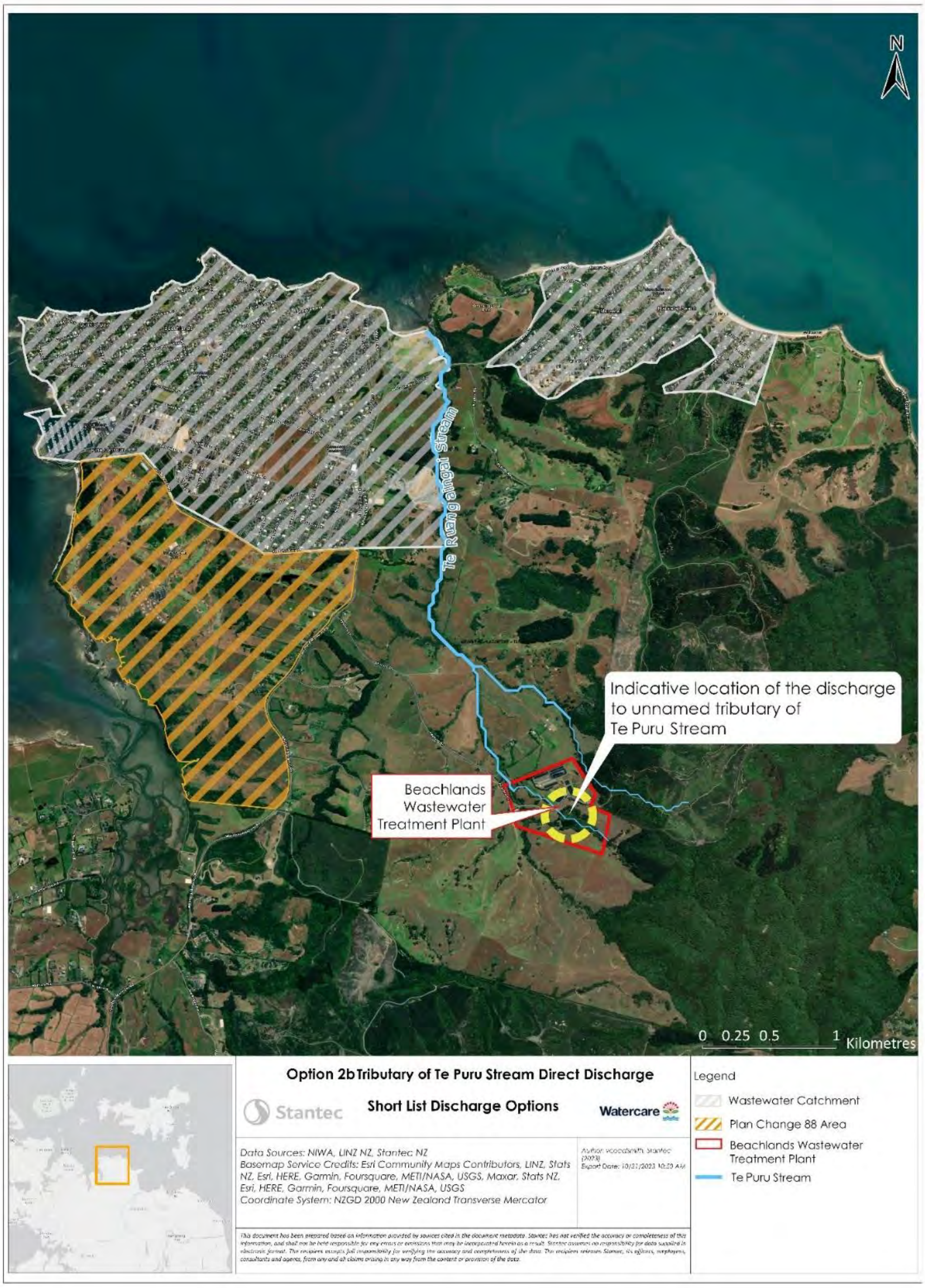
Option 2b: Tributary of the Te Puru Stream - Direct Discharge

Item	Description
Option Name	2b: Unnamed Tributary of Te Puru Stream Direct Discharge
Discharge Location	Unnamed Tributary of Te Puru Stream
Treatment Option	• Biological Nutrient Removal (BNR) • Membrane Bioreactor (MBR) • Ultraviolet disinfection (UV) • BNR + MBR + UV disinfection
Treatment Location	Existing Beachlands Wastewater Treatment Plant (WWTP) site
Process Diagram	



Typical treated water quality		
Population Equivalent	30,000	
Per Capita Average Daily Flow (ADF)	200 l/p/d	
Average Daily Flow (ADF)	6,000	
Parameter	Median Concentration mg/L	Average Load kg/day
Biological Oxygen Demand (BOD)	1.0	6.0
Total Suspended Solids (TSS)	0.0	0.0
Total Nitrogen (TN)	3.50	21
Total Phosphorus (TP)	0.10	0.6
Faecal Coliforms	<1 cfu/100ml	n/a
Note: The intention is to frame treated wastewater discharge consent on both a load and a concentration dependent basis, depending on the effects of various parameters. This will facilitate staging and flexibility in terms of some concentration limits over the proposed 35 year consent duration.		
Key Components		
Item	Description	
Conveyance system	Conveyance to a new discharge structure, potentially downstream of current discharge.	
Treatment system	Existing Beachlands WWTP site BNR + MBR + UV disinfection	
Discharge system	Discharge direct to an unnamed tributary of Te Puru Stream with a new discharge structure.	

Locality Map

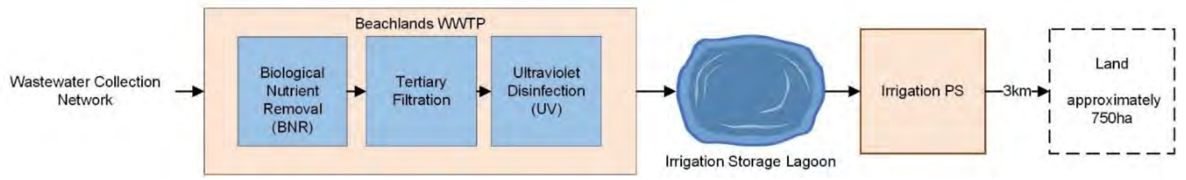


Note:

1. The discharge location is indicative only and may alter pending further investigations.
2. The wastewater catchment is the current reticulated catchment.
3. The Plan Change 88 area is not yet confirmed.

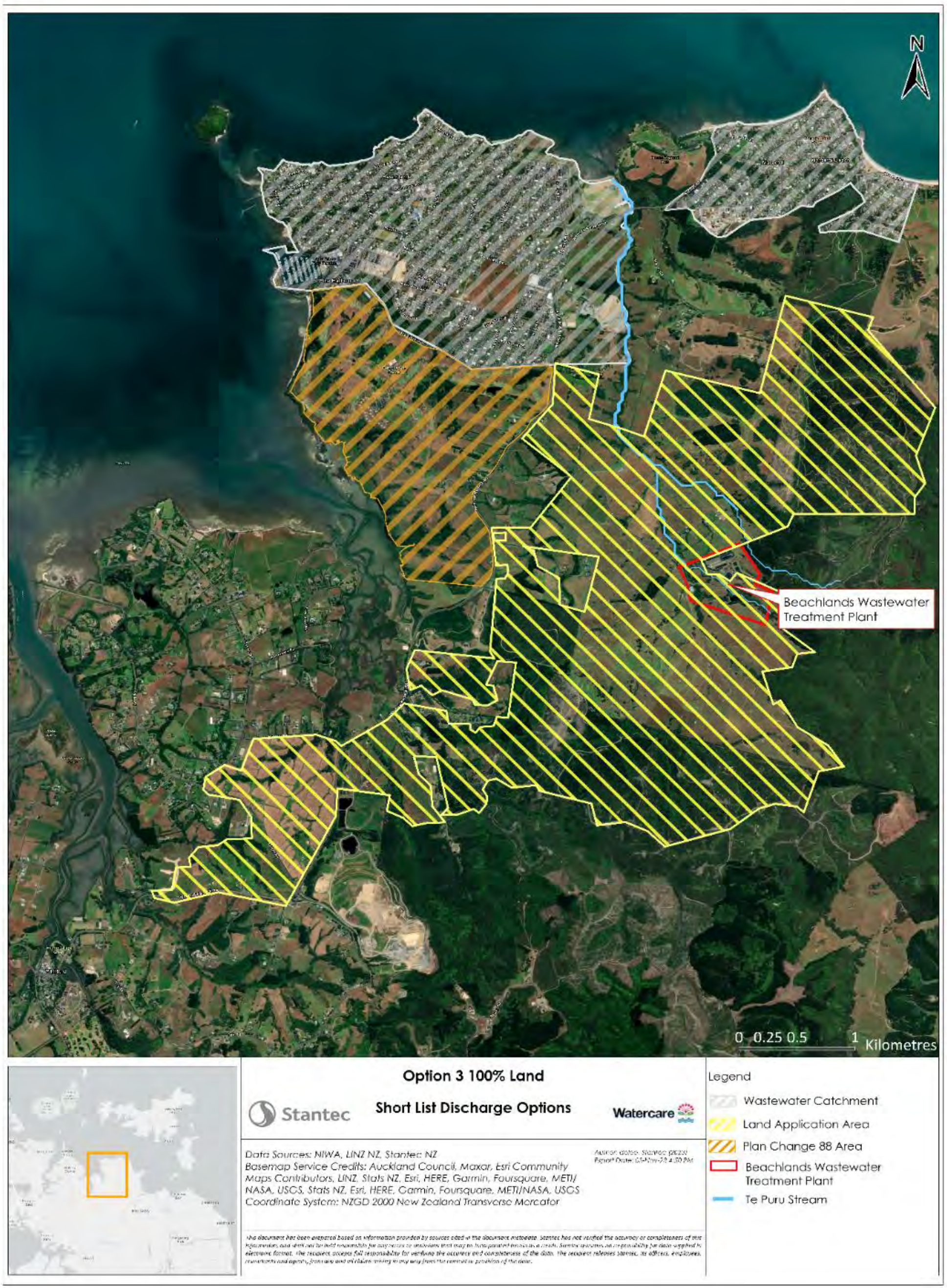
Option 3: 100% Land

Item	Description	
Option Name	100% Land	
Discharge Location	750 ha of land in the vicinity of the Beachlands Wastewater Treatment Plant (WWTP)	
Treatment Option	• Biological Nutrient Removal (BNR) • Tertiary Filtration • Ultraviolet disinfection (UV) • BNR + Tertiary Filtration + UV disinfection	
Treatment Location	Existing Beachlands Wastewater Treatment Plant (WWTP) site	
Process Diagram		



Typical treated water quality		
Population Equivalent	30,000	
Per Capita Average Daily Flow (ADF)	200 l/p/d	
Average Daily Flow (ADF)	6,000	
Parameter	Median Concentration mg/L	Average Load kg/day
Biological Oxygen Demand (BOD)	2.0	12.0
Total Suspended Solids (TSS)	5.0	30.0
Total Nitrogen (TN)	7.0	42
Total Phosphorus (TP)	5.0	30.0
Faecal Coliforms	<10 cfu/100ml	n/a
Key Components		
Item	Description	
Conveyance system	Convey wastewater to suitable land surrounding the WWTP.	
Treatment system	Existing Beachlands WWTP site. BNR + Tertiary Filtration + UV disinfection	
Discharge system	Low pressure sprinklers to rural land.	

Locality Map

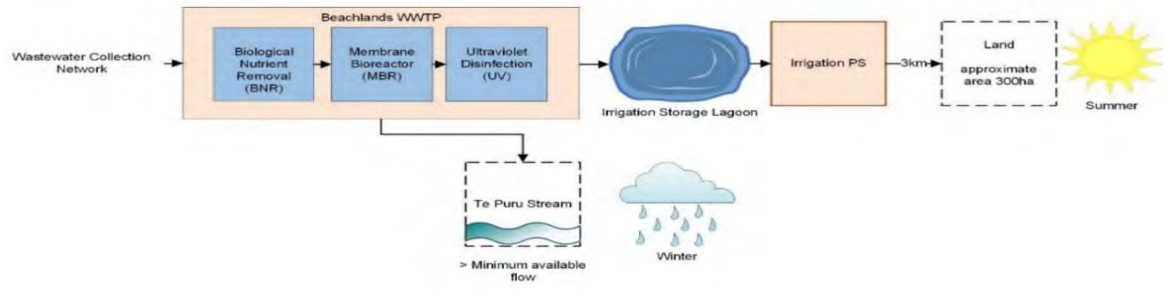


Note:

1. The discharge location is indicative only and may alter pending further investigations.
2. The wastewater catchment is the current reticulated catchment.
3. The Plan Change 88 area is not yet confirmed.
4. The land area indicated is less than 750ha. Remaining land application area is yet to be identified.

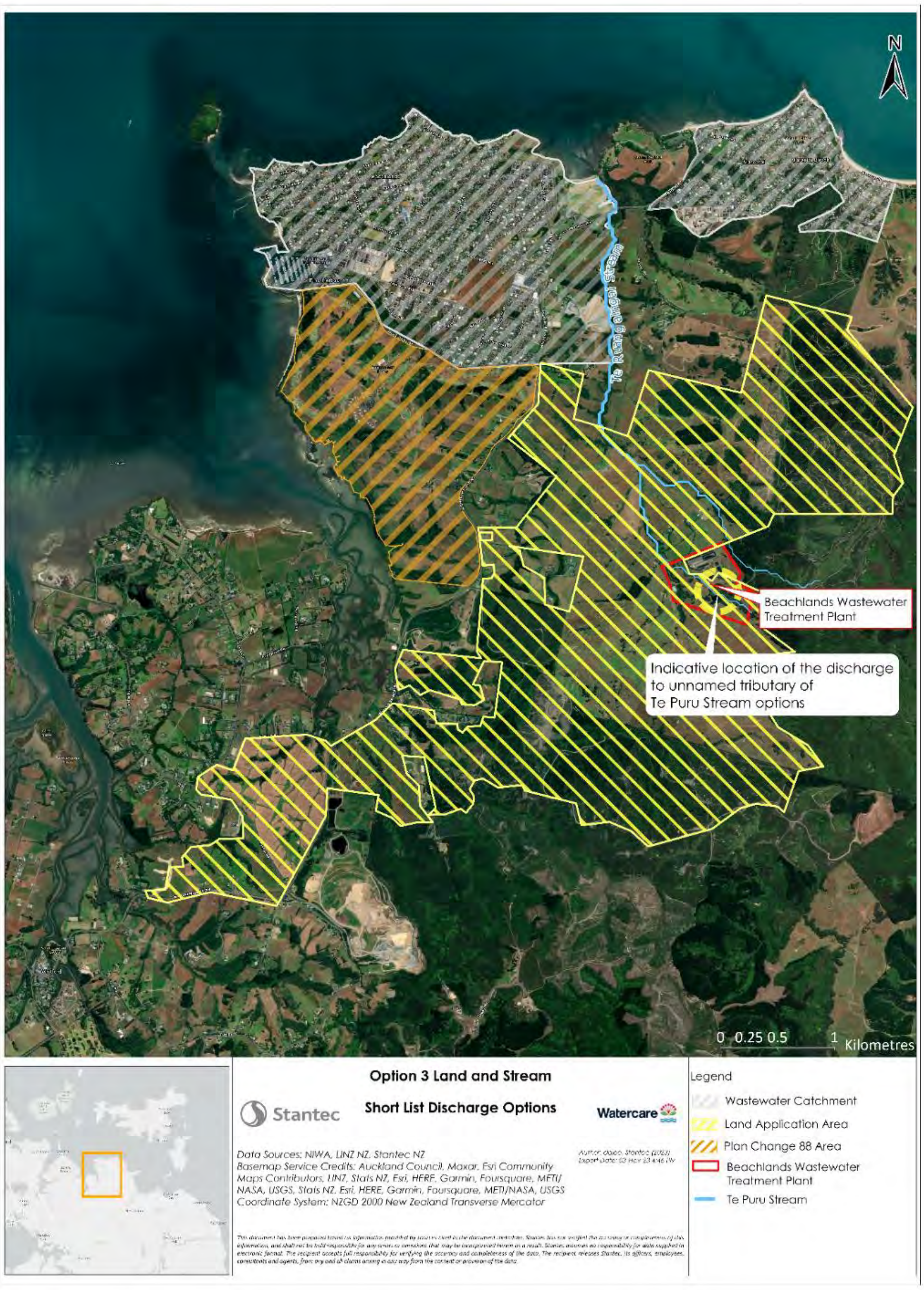
Option 3a: Land/Stream

Item	Description	
Option Name	Land/Stream	
Discharge Location	300 ha of land in the vicinity of the Beachlands WWTP	
Treatment Option	• Biological Nutrient Removal (BNR) • MBR • Ultraviolet disinfection (UV) • BNR + MBR + UV disinfection	
Treatment Location	Existing Beachlands Wastewater Treatment Plant (WWTP) site	
Process Diagram		



Typical treated water quality		
Population Equivalent	30,000	
Per Capita Average Daily Flow (ADF)	200 l/p/d	
Average Daily Flow (ADF)	6,000	
Parameter	Median Concentration mg/L	Average Load kg/day
Biological Oxygen Demand (BOD)	1.0	6.0
Total Suspended Solids (TSS)	0.0	0.0
Total Nitrogen (TN)	3.50	21
Total Phosphorus (TP)	0.10	0.6
Faecal Coliforms	<1 cfu/100ml	n/a
Note: The intention is to frame treated wastewater discharge consent for the stream discharge on both a load and a concentration dependent basis, depending on the effects of various parameters. This will facilitate staging and flexibility in terms of some concentration limits over the proposed 35 year consent duration.		
Key Components		
Item	Description	
Conveyance system	Convey wastewater to suitable land surrounding the WWTP. New discharge structure direct to stream or via the existing overland flow land system.	
Treatment system	Existing Beachlands WWTP site BNR + MBR + UV disinfection	
Discharge system	Low pressure sprinklers to rural land. Outlet direct to stream or via the existing overland flow land system.	

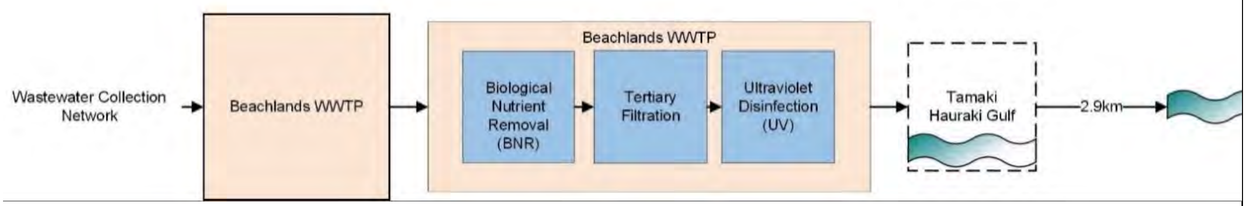
Locality Map



Note:

1. The discharge location is indicative only and may alter pending further investigations.
2. The wastewater catchment is the current reticulated catchment.
3. The Plan Change 88 area is not yet confirmed.

Option 4ae: Hauraki Gulf – Tamaki mid

Item	Description	
Option Name	Hauraki Gulf – Tamaki Mid	
Discharge Location	Tamaki Strait north of Beachlands	
Treatment Option	• Biological Nutrient Removal (BNR) • Tertiary Filtration • Ultraviolet disinfection (UV) • BNR + Tertiary Filtration + UV disinfection	
Treatment Location	Existing Beachlands Wastewater Treatment Plant (WWTP) site	
Process Diagram		
		
Typical treated water quality		
Population Equivalent	30,000	
Per Capita Average Daily Flow (ADF)	200 l/p/d	
Average Daily Flow (ADF)	6,000	
Parameter	Median Concentration mg/L	Average Load kg/day
Biological Oxygen Demand (BOD)	2.0	12.0
Total Suspended Solids (TSS)	5.0	30.0
Total Nitrogen (TN)	7.0	42
Total Phosphorus (TP)	1.0	6.0
Faecal Coliforms	<10 cfu/100ml	n/a
Note: The intention is to frame treated wastewater discharge consent on both a load and a concentration dependent basis, depending on the effects of various parameters. This will facilitate staging and flexibility in terms of some concentration limits over the proposed 35 year consent duration.		
Key Components		
Item	Description	
Conveyance system	Convey wastewater 5.6km to Te Puru Park/Lee Auton Reserve and discharge via 2.9km ocean outfall.	
Treatment system	Existing Beachlands WWTP site BNR + Tertiary Filtration + UV disinfection	
Discharge system	Mid-length ocean outfall into the Tamaki Strait.	

Locality Map

Note:

1. The discharge location is indicative only and may alter pending further investigations.
2. The wastewater catchment is the current reticulated catchment.
3. The Plan Change 88 area is not yet confirmed.

6.2 Approach to Short List Assessment

The Short List assessment process as shown in Figure 2-1 (Assessment Methodology) was basically the same as the Long List assessment process except that a score of 1 to 5 was adopted for assessing the options.

6.2.1 Assessment Criteria

The assessment criteria adopted for the Short List assessments were the same as those used for the Long List assessments and are set out in Table 5-3.

6.2.2 Approach to Short List Scoring

A more fine-grained approach to scoring the Short List options was adopted. This involved using a 1 to 5 score with 1 being the best score and 5 the worst. The table below provides a description of the scores for each criterion and the score colour.

Table 6-1: Short List Scoring Approach

Criterion / Score	1	2	3	4	5
Public Health Protection	Low degree of public exposure to risk	Medium to low degree of public exposure to risk	Medium degree of public exposure to risk	Medium to high degree of public exposure to risk	High degree of public exposure to risk
Natural Environment	Low (less than minor) potential adverse effects	Medium to low (minor) potential adverse effects	Medium (more than minor) potential adverse effects	Medium to high (significant) potential adverse effects	High (significant and unlikely to be mitigated) potential adverse effects
Social and Community	Low (less than minor) potential adverse effects	Medium to low (minor) potential adverse effects	Medium (more than minor) potential adverse effects	Medium to high (significant) potential adverse effects	High (significant and unlikely to be mitigated) potential adverse effects
Financial Implications	Low financial implications	Medium to low financial implications	Medium financial implications	Medium to high financial implications	High financial implications
Resilience	High degree of resilience	Medium to high degree of resilience	Medium degree of resilience	Medium to low degree of resilience	Low degree of resilience
Technology and Infrastructure	High degree of alignment	Medium to high degree of alignment	Medium degree of alignment	Medium to low degree of alignment	Low degree of alignment
Statutory Risks and Conflicts	Low risks and conflicts	Medium to low risks and conflicts	Medium risks and conflicts	Medium to high risks and conflicts	High risks and conflicts
Opportunities and Benefits	High opportunities and benefits	Medium to high opportunities and benefits	Medium opportunities and benefits	Medium to low opportunities and benefits	Low / minimal opportunities and benefits

6.2.3 Responsibilities

Appendix D sets out the technical experts who were responsible for each criterion along with other experts who provided additional technical support or reviewed the assessments.

Copies of the technical expert's Short List assessments are attached as Appendix E.

6.3 Summary of Preliminary Technical Short List Scores

Table 6-2 is a collation of the overall scores provided by the technical experts in advance of the first Short List workshop.

Table 6-2: Preliminary Technical Expert Assessment Summary of Short List Scores (pre workshop)

Option / Criteria	Public Health Protection	Natural Environment	Social & Community	Financial Implications	Resilience	Technology & Infrastructure	Statutory Risks & Conflicts	Opportunities & Benefits	Overall Score
2a: Tributary to Te Puru Stream – diffuse discharge	1	2	2 Provisional	1	1	2	3	3	15
2b: Tributary to Te Puru Stream – direct discharge	1	3	2 Provisional	1	1	2	3	3	16
3: 100% Land	1	1	2 Provisional	5	3	4	2	1	19
3a: Land / Tributary to Te Puru Stream	1	1	2 Provisional	4	3	3	3	2	19
4ae: Hauraki Gulf Tāmaki Mid	1	2	3 Provisional	2	1	2	3	4	18

6.4 Initial Short List Workshop

6.4.1 Purpose and Process

The purpose of the initial Short List workshop was for the technical experts to present their initial assessments and scores to the workshop participants and provide information to Ngāi Tai ki Tāmaki, via its Taiaomaurikura representative at the workshop, to assist the preparation of their feedback for Watercare.

The process followed at the workshop was similar to that followed for the Long List / Traffic Light workshop. Each technical expert responsible for a criterion presented their sub-criterion scores, overall criterion scores for each option and their reasons for the scores. The workshop participants then asked questions of the experts. Scores were not discussed in detail and the workshop participants were asked to provide further feedback and any new information for the expert's consideration post the workshop.

Appendix F contains a list of the workshop participants.

6.4.2 Further Reviews and Updates to Specialist Scores

The technical specialists were provided with further feedback from the workshop participants following the initial Short List workshop along with updates to some of the treated wastewater median parameters following inputs from Watercare. In response, the specialists updated their assessments and scores in readiness for the next Short List workshop.

Table 6-3 sets out the updates that were made to the overall score for each option as a result of the first Short List workshop discussions, the further review and feedback process and new information. Table 6-4 also records the reason for the change to the overall score.

Where provisional scores were recorded by the experts in their pre-workshop assessments these were confirmed either at the Short List workshop or through the further review process.

Copies of the technical experts' updated Short List assessments are attached as Appendix G.

Table 6-3: Preliminary Technical Expert Assessment Summary of Short List Scores (updated post Short List Workshop 1)

Option / Criteria	Public Health Protection	Natural Environment	Social & Community	Financial Implications	Resilience	Technology & Infrastructure	Statutory Risks & Conflicts	Opportunities & Benefits	Overall Score
2a: Tributary to Te Puru Stream – diffuse discharge	1	2	2	1	1	2	3 2 Changed from 3 to 2	3	~~15~~ 14
2b: Tributary to Te Puru Stream – direct discharge	1	3	2	1	1	2	3 2 Changed from 3 to 2	3	~~16~~ 15
3: 100% Land	~~1~~ 2 Changed from 1 to 2	1	2	5	3	4	2	1	~~19~~ 20
3a: Land / Tributary to Te Puru Stream	~~1~~ 2 Changed from 1 to 2	1	2	4	~~3~~ 2 Changed from 3 to 2	3	3	2	19 No Change
4ae: Hauraki Gulf Tāmaki Mid	1	2	3	2	1	2	~~3~~ 4 Changed from 3 to 4	4	~~18~~ 19

Table 6-4: Overall Score Changes and Reasons

Criterion	Score Change	Reason
Public Health Protection	Option 3 changed from 1 to 2. Option 3a changed from 1 to 2.	Lower level of treatment for Option 3 so higher risks than Options 2 and 2a. Options 3 and 3a potential for aerosols drift with pathogens/other contaminants
Resilience	Option 3a changed from 3 to 2	Because this option includes land as a backup the risks of flooding effects, land slips and high intensity rainfall effecting the operation of the scheme are reduced when compared to Option 3.
Statutory Risks and Conflicts	Option 2a changed from 3 to 2. Option 2b changed from 3 to 2. Option 4ae changed from 3 to 4	For options 2a and 2b the Water Services Act 2021 is of limited relevance as it relates primarily to the provision of drinking water rather than wastewater services. The Hauraki Gulf Marine Part Act has implications for Option 4ae which were not previously considered.

6.5 Short List Workshop

The purpose of the second Short List workshop was to determine the preliminary technical preferred option / BPO. The workshop also provided a further opportunity for Ngāi Tai ki Tāmaki Taiaomaurikura representatives to receive information on the technical option assessments, to assist them in preparing their feedback to Watercare.

The process followed at the workshop was similar to previous workshops. Each technical expert responsible for a criterion presented their sub-criterion scores, overall criterion scores for each option and their reasons for the scores. The workshop participants asked questions of the experts. Where alternative scores were proposed these was discussed and agreed with the expert and the workshop participants. The changes that were made to the experts' scores are explained in Section 6.5.1 below.

Appendix H contains a list of the participants at second Short List workshop.

6.5.1 Changes to Expert Scores

The only change made to an overall criterion score for the technical Short List option assessment as a result of the workshop discussions is set out in Table 6-5 below.

Table 6-5: Overall Score Changes and Reasons

Criterion	Score Change	Reason
Public Health Protection	Option 2b changed from 1 to 2.	Option 2b is a direct discharge to the Te Puru Stream and does not have the attenuation benefits when compared to Option 2a which has the overland flow process.

6.5.2 Final Technical Short List Scores

The following table sets out the final technical overall scores for each short list option from the Short List workshop. As shown in Table 6-6, based in it receiving the lowest overall score, the preliminary technical preferred option / BPO was identified as Option 2a being the diffuse discharge to a tributary of the Te Puru Stream.

Table 6-6: Expert Overall Scores from Short List Workshop

Option / Criteria	Public Health Protection	Natural Environment	Social & Community	Financial Implications	Resilience	Technology & Infrastructure	Statutory Risks & Conflicts	Opportunities & Benefits	Overall Score
2a: Tributary to Te Puru Stream – diffuse discharge	1	2	2	1	1	2	2	3	14
2b: Tributary to Te Puru Stream – direct discharge	2	3	2	1	1	2	2	3	16
3: 100% Land	2	1	2	5	3	4	2	1	20
3a: Land / Tributary to Te Puru Stream	2	1	2	4	2	3	3	2	19
4ae: Hauraki Gulf Tāmaki Mid	1	2	3	2	1	2	4	4	19

6.5.3 Analysis of the scores

As shown in Table 6-6, Option 2a had the best overall technical score (14) because it scored 1 when assessed against the Public Health Protection, Financial Implications and Resilience criteria and 2 when assessed against the Natural Environment, Social and Community, Technology and Infrastructure, and Statutory Risks and Conflicts criteria. The worst score for Option 2a was 3 for the Opportunities and Benefits criterion.

The option that had the second best overall technical score (16) was Option 2b. This option did not score so well in terms of the Public Health Protection and Natural Environment criteria when compared to Option 2a. This is because it is a direct discharge to the tributary of the Te Puru Stream and does not have the contamination attenuation benefits of the diffuse discharge of Option 2a.

The option that scored the worst (20) was Option 3, primarily to do with the cost and challenges of securing 750ha of land for the irrigation of the treated wastewater and the lack of resilience associated with the need to discharge 100% of the discharge to land for all of the time.

Options 3a and 4ae equally scored the second worst (19). For Option 3a this was primarily to do with the cost and complexities associated with the provision of infrastructure and management of two receiving environments. Option 4ae had limited opportunities and benefits and medium to high statutory risks.

6.6 Best Practicable Option Test No. 2[13]

As set out in the Assessment Methodology Figure 2-1, the next step in the Short List assessment process was to undertake a BPO and Project Objectives assessment of the preliminary technical preferred option / BPO in comparison with the other Short List Options. The process followed was the same as that used in the BPO Test 1 except for this process a 1 to 5 score was adopted (1 = best 5 = worst).

6.6.1 Best Practicable Option Assessment

To ensure the BPO assessment clearly aligned with the RMA BPO definition (refer Section 5.5.1) and provided a robust test of the preliminary technical preferred option (BPO), the following BPO assessment criteria and scores were developed and adopted for the assessment.

[13] The BPO assessment also includes an assessment of the Project Objectives as shown in the Assessment Methodology diagram 2-1.

Table 6-7: BPO Assessment Criteria and Scoring Guide

BPO Source	Criterion	Description	Score Guide				
RMA BPO definition (a)	Nature of discharge and receiving environment sensitivity	What is the nature of the discharge, and how sensitive is the receiving environment to adverse effects?	1 Low sensitivity	2 Medium to low sensitivity	3 Medium sensitivity	4 Medium to high sensitivity	5 High sensitivity
RMA BPO definition (b)	Comparison of effects on the environment	How do the effects of each of option compare with the other options in terms of the social and economic effects?	Low (less than minor) potential adverse effects	Medium to low (minor) potential adverse effects	Medium (more than minor) potential adverse effects	Medium to high (significant) potential adverse effects	High (significant and unlikely to be mitigated) potential adverse effects
RMA BPO definition (b)	Comparison of effects on the environment	How do the effects of each of option compare with the other options in terms of the cultural effects?	Low (less than minor) potential adverse effects	Medium to low (minor) potential adverse effects	Medium (more than minor) potential adverse effects	Medium to high (significant) potential adverse effects	High (significant and unlikely to be mitigated) potential adverse effects
RMA BPO definition (b)	Comparison of effects on the environment	How do the effects of each of option compare with the other options in terms of the biophysical effects?	Low (less than minor) potential adverse effects	Medium to low (minor) potential adverse effects	Medium (more than minor) potential adverse effects	Medium to high (significant) potential adverse effects	High (significant and unlikely to be mitigated) potential adverse effects
RMA BPO definition (b)	Comparative financial implications	How do the cost (capital, operational, whole of life) implications of each of option compare with the other options?	Low cost	Medium to low cost	Medium cost	Medium to high cost	High cost

BPO Source	Criterion	Description	Score Guide				
RMA BPO definition (c)	Likelihood that option can be successfully applied	Can the options be successfully implemented e.g. how complex is each option to construct, operate and successfully be applies when compared with the other options?	Low complexity/ uncertainty	Medium to low complexity/ uncertainty	Medium complexity/ uncertainty	Medium to high complexity/ uncertainty	High complexity/ uncertainty
RMA BPO definition (c)	Technical knowledge	Are the technologies reliable / proven?	Proven common use	Proven internationally and some use in NZ	Proven internationally but not in NZ	Emerging	Unproven

Table 6-8: BPO Assessment of the Preliminary Technical Preferred Option / BPO below provides a summary of the outcomes of the BPO assessment of the preliminary technical preferred option in comparison with the other Short List Options. Because the BPO assessment was a technical assessment, the cultural comparative effects assessment was not scored and the cultural sensitivities associated with the receiving environments were not taken into account in this part of the process.

Table 6-8: BPO Assessment of the Preliminary Technical Preferred Option / BPO

BPO Criteria	Assessment	Option Scores				
		2a	2b	3	3a	4ae
(a) Receiving environment sensitivity	• Both the marine environment and the Te Puru stream are considered to be more sensitive receiving environments when compared to land. Noting however that the level of treatment of the discharge can be managed to minimise adverse effects. • 2a scores better than 2b. This is because the initial receiving environment for 2a is land, and while the wastewater will ultimately discharge to the stream the initial discharge to land is considered to reduce the receiving environment sensitivity of this option. • Land is considered to be the least sensitive receiving environment. This has influenced the score for Option 3a.	3	4	1	2	4
(b) Comparative effects assessment – social and economic	• The social and community and the public health protection criteria assessment for the Short List options has been relied on for this assessment.	1	2	2	2	2
(b) Comparative effects assessment – cultural	•					
(b) Comparative effects assessment – biophysical	• The natural environment criterion assessment for the Short List options has been relied on for this assessment.	2	3	1	1	2
(b) Comparative financial effects	• The financial implications criterion assessment for the Short List options has been relied on for this assessment.	1	1	5	4	2
(c) Likelihood that option can be successfully applied	• Options 2a and 2b are the least complex to construct, operate and successfully applied as they do not require conveyance to other receiving environments. • Options 4ae has a medium to high level of complexity / uncertainty as it involves conveyance and discharges to the marine receiving environment	1	1	5	5	4

BPO Criteria	Assessment	Option Scores				
		2a	2b	3	3a	4ae
	and the construction of infrastructure associated with this. • Options 3 and 3a have the most complexity / uncertainty. Option 3a involves the construction and management of two receiving environments and securing up to 300ha of land. Option 3 involves conveyance infrastructure and securing an extensive area of land (750ha) which may be difficult to achieve and may not be contiguous.					
(c) Technical knowledge - proven	• The technology and infrastructure assessment criterion sub criterion - reliable and proven technology assessment for the Short List options has been relied on for this assessment.	1	1	3	2	1
Total		9	12	17	16	15

6.6.2 Project Objectives Assessment

The following scoring was adopted for assessing the preliminary technical Short List of options against the project objectives that are set out in Section 1.4.

Table 6-9: Approach to Project Objective Scoring

1	2	3	4	5
High degree of alignment	Medium to high degree of alignment	Medium degree of alignment	Medium to low degree of alignment	Low degree of alignment

The table below provides a summary of the outcomes of the project objectives assessment of the preliminary technical preferred option / BPO in comparison with the other Short List Options. Because this was a technical assessment only, the objective relating to recognising the significance of the Hauraki Gulf and the relationship of tangata whenua with the Hauraki Gulf was not scored, and the objective relating to Te Mana o te Wai was only assessed from a technical perspective.

Table 6-10: Objectives assessment of the Preliminary Technical Preferred Option / BPO

Objectives	Assessment	Option Scores				
		2a	2b	3	3a	4ae
Work in partnership with the Mana Whenua and engage with the community to identify the best practicable option (BPO) to provide wastewater services for the Beachlands and Maraetai community. The BPO must:						

Recognise the significance of the Hauraki Gulf and the historic, traditional, cultural, and spiritual relationship of the tangata whenua with the Hauraki Gulf and its islands						
Gives effect to Te Mana o te Wai	• The options (3 and 4ae) that discharge to receiving environments other than freshwater have a high degree of alignment with Te Mana o te Wai. • Option 3a has a medium to high degree of alignment given that the during periods of low flow in the stream most if not all of the treated wastewater will be discharged to land. • Option 2b has a medium to low level of alignment given it is a direct discharge to freshwater (Te Puru Stream) noting the very high level of treatment. • Options 2a has a medium level of alignment given it is a discharge to freshwater (Te Puru Stream) but noting that is passes through an overland flow area and the very high level of treatment.	3	4	1	2	1
Keep our communities healthy	• The public health protection criterion assessment for the Short List options has been relied on for this assessment.	1	2	2	2	1
Protect the health of our environment, particularly the life supporting capacity of land, air, and water.	• The natural environment criterion assessment for the Short List options has been relied on for this assessment.	2	3	1	1	2
Provide a solution that caters for planned growth that keeps the overall costs of service to customers (collectively) at sustainable levels.	• The financial implications criterion assessment for the Short List options has been relied on for this assessment. • All options have been developed to ensure they will provide for projected growth for up to 35 years, but availability of land (Option 3) and constraints of an ocean outfall (Option 4ae) were considered a potential risk to growth.	1	1	5	4	3
Be sustainable and resilient and minimise whole-of-life carbon emissions and optimise resource recovery	• The resilience, opportunities and benefits criteria assessments and the technology and infrastructure sub-criterion - carbon footprint / greenhouse gas emissions for the Short List options have been relied on for this assessment.	2	2	3	3	3
Total		9	12	12	12	10

6.6.3 Analysis

As can be seen from the assessments set out in Table 6-8 and Table 6-10 the preliminary technical preferred option / BPO (Option 2a) scored the best against both the BPO assessment criteria and against the project objectives.

For the BPO assessment, Option 2a had a total score of 9, with the next closest option being Option 2b with a score of 12. Option 2a was assessed as the best because it scored well in the comparative effects assessment, involves well proven technology and is likely to be successfully implemented. Option 2b scored well for similar reasons but did not score as well in the comparative effects assessment due to the direct discharge to the Te Puru Stream. The options involving land did not score well primarily due to the uncertainties associated with securing such large areas of land in this locality and with Option 3a, the complexity with managing two receiving environments.

The scores for the objectives assessment were closer than those for the BPO assessment with Option 2a having a total score of 9 followed by Option 4ae with a score of 10. The reason why Option 2a scored better than 4ae was cost and that it had great flexibility in providing for growth.

From the above analysis it was considered that the preliminary technical preferred option / BPO (Option 2a) passed the Best Practicable Option Test No. 2[14] and could therefore be recommended to Watercare to be confirmed as the technical preferred option / BPO.

[14] The BPO assessment also includes an assessment of the Project Objectives as shown in the Assessment Methodology diagram 2-1.

7. Mana Whenua Advice and Input

Watercare has undertaken direct engagement with Ngāi Tai ki Tāmaki, as the only iwi with mana whenua status over Beachlands and Maraetai catchment area, to inform the selection of the BPO, to ensure the project objectives are being met and to inform the final resource consent application. The details of the engagement process to date are set out in the *'Beachlands WWTP – Wastewater Discharge Consent Project – Stakeholder Engagement Report – March 2024'.*

While no formal feedback has been provided by Ngāi Tai ki Tāmaki (i.e. Cultural Values Assessment nor Cultural Impact Assessment), Watercare has understood that the key themes communicated by Ngāi Tai ki Tāmaki include:

- The cultural significance for Ngāi Tai ki Tāmaki of Te Puru Stream, the surrounding whenua and wider cultural landscape and Te Maraetai / Tamaki Strait and the Hauraki Gulf.
- The historical grievance caused by the lack of engagement with Ngāi Tai ki Tāmaki on the original decision to place the discharge from the WWTP into the tributary of Te Puru Stream.
- Ngāi Tai ki Tāmaki has a preference for land based discharges of treated wastewater.
- Opposition to conveyance of wastewater out of the Beachlands service area for treatment and discharge in the rohe of another iwi.
- Opposition to a marine discharge and construction of any new structures within the coastal marine area of the Hauraki Gulf.
- Opposition to direct discharge to Te Puru Stream and other waterways within the Ngāi Tai ki Tāmaki rohe.

Watercare has been guided by the above themes in the selection of the BPO for the discharge application. Further, as a result of ongoing engagement with Ngāi Tai ki Tāmaki following the completion of the Short-List Workshops, Watercare has committed to further investigation and support of the opportunities identified for co-design of the overland flow system for the diffuse discharge and the provision of water supply for a proposed nursery for Ngāi Tai ki Tāmaki beyond the WWTP site.

8. Stakeholder Engagement Feedback

In developing the BPO, Watercare undertook direct engagement with key stakeholder (including the Environmental Defence Society, the Hauraki Gulf Forum and Auckland Regional Public Health), the public and potentially affected landowners via direct engagement, Community Information Sessions and an Online Survey.

While the feedback what parties preferred option was varied depending on the party, the key themes received included:

- Opposition by potentially affected landowner to the acquisition and use of privately owned land for the discharge of treated wastewater;
- Opposition from the public to direct discharges into a tributary of Te Puru Stream;
- General opposition by the public and stakeholders to the discharge of treated wastewater into the Hauraki Gulf at any location;
- Mixture of support and opposition by the public to the use of a combined stream and land discharge option;
- Opposition by the public and stakeholders to any discharge activity which negatively impacted water quality either freshwater or coastal water.

Acknowledging the differing themes and positions set above, to the extent possible, Watercare has taken into account the feedback in the selection of the BPO for the discharge application.

9. Confirmed Preferred Option

Based on the technical option assessment and informed by the engagement with Ngāi Tai ki Tāmaki and the feedback from the community and stakeholder engagement, Watercare confirmed Option 2a as the Preferred Option for the discharge of wastewater from the Beachlands WWTP.

Under the Preferred Option, the wastewater from the Beachlands Maraetai community will be collected and treated at the Beachlands WWTP. The plant will be progressively upgraded as population requires over the requested 35-year consent term. Under the Preferred Option, the WWTP will use technology to produce high-quality treated wastewater suitable for discharge via an expanded overland flow system to a tributary of the Te Puru Stream. When fully implemented, the Beachlands WWTP will provide for wastewater servicing for 30,000 population equivalent (PE).

Appendices

Appendix A List of Technical Experts (Long List)

The following table sets out the technical experts responsible for leading the assessments of the Long List of options along with the other experts who provided additional support or who reviewed the assessments.

Criteria	Lead Responsibility	Support / Review
Public Health Protection	Mark James	Jim Bradley - Reuse Alan Pattle - Land
Natural Environment	Mark James	Shane Kelly - Coastal Alan Pattle - Land Mike Stewart – Freshwater
Social and Community	Katja Huls	Johanna McIntosh – Research Paula Hunter - Review
Financial Implications	Jim Bradley	Andrew Slaney – WWTP, conveyance Alan Pattle – Land, Managed Aquifer Recharge Gary Teear - Ocean outfall
Resilience	Andrew Slaney	Jim Bradley - Review Alan Pattle – Land, Managed Aquifer Recharge Gary Teear - Ocean outfall
Technology and Infrastructure	Andrew Slaney	Jim Bradley - Review Alan Pattle – Land, Managed Aquifer Recharge Gary Teear - Ocean outfall
Statutory Risks and Conflicts	Paula Hunter	Simpson Grierson
Opportunities and Benefits	Jim Bradley	Andrew Slaney - Review

Appendix B Long List Technical Expert Assessments

Public Health Protection Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Traffic light definition
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table

2. Authors and experience

Criterion lead:

Author	Role / Experience	Category
Mark James	Strategic and technical advisor, Aquatic ecology	Microbiology Quality
Jim Bradley	Public Health Engineer	Reuse Options
Alan Pattle	Environmental Engineer	Land Application

3. Information sources

Experience with a number of WW discharge projects including Omaha, Snells/Algies, Clarkes Beach, Army Bay and Wellsford.

4. Assumptions

An appropriate level of treatment to reduce the discharge quality to an acceptable level.

Assessment uses the data available

Note that this needs to be run past a microbiologist

5. Traffic light definition

Criteria	Description	Green	Orange	Red
Public Health Protection	Degree of public health exposure to health risks from treated wastewater discharge (including through land application or re-use options).	Low degree of public exposure to risk	Medium degree of public exposure to risk	High degree of public exposure to risk

6. Criterion categories / sub-criteria

Microbiological quality of treated wastewater

Risk of public exposure to waterborne pathogens and other contaminants through:

- Direct contact with the conveyance or treatment process.

- Direct contact with the receiving environment, for example through contact recreation.
- Indirect exposure – commercial operations, food gathering (shellfish, fish, watercress etc.) and groundwater use.

Spray irrigation / aerosols

- Risk of public exposure to pathogens and other contaminant from spray irrigations.

Treated wastewater reuse

- Risk of contamination of reclaimed water for potable and non-potable reuse.

7. Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 – enables people and communities to provide for their health and safety.

8. Assessment method

An option's recommended traffic light 'score' is developed by first scoring each of the criterion's categories separately. An overall score is then identified by comparing the range of category scores and giving an overall score erring on the side of those with higher degree of public exposure to risk effects rather than a lower degree. A qualitative expert judgement approach is followed in determining the scores for the long list assessment rather than a quantitative approach.

9. Assessment table

See below:

Public Health Protection Assessment

Option	Microbiological quality of treated wastewater (Risk to the receiving environment?)	Spray irrigation / aerosols	Treated wastewater reuse	Overall Traffic Light
	Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	
2a Te Puru Stream – diffuse discharge	Relatively good quality water discharged at present, relatively low in microbes, and similar level to upstream. Should meet standards at least for NBL when considering what additional risk is there. Low risk to downstream shellfish beds due to discharge. (Need to get microbial assessment/QMRA of stream for cattle water supply, shellfish gathering, shellfish sample's from Kellys Bay to confirm?)	NA	NA	
2b Te Puru Stream –direct discharge	Could reduce any effects of birds in pond. Levels in outlet very low (more data needed though)	NA	NA	
2c Wairoa River	As for Te Puru Stream direct discharge, except could be more risk to marine farms in bay	NA	NA	
2d Turanga Creek/awa (Whitford)	As for Te Puru Stream direct, but other inputs already? Only a small creek. Loads could be higher in future. TBD	NA	NA	
3 100% land	Low risk after irrigation and groundwater attenuation	Low potential for aerosols drift with pathogens/other contaminants	NA	
3a Land/stream	Low risk in winter, no direct risk to stream in summer if on to land.	Low potential for aerosols drift with pathogens/other contaminants.	NA	
4aa Hauraki Gulf/Whitford - short	Potential high risk to shellfish gathering and recreation. Plume shows dispersal close to coastline. Loads could be much higher in future. TBD	NA	NA	
4ab Hauraki Gulf/Whitford - mid	Potential high risk to shellfish gathering or contact recreation. Plume shows	NA	NA	

Option	Microbiological quality of treated wastewater (Risk to the receiving environment?)	Spray irrigation / aerosols	Treated wastewater reuse	Overall Traffic Light
	Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	
	dispersal close to coastline. Loads could be much higher in future. TBD			
4ac Hauraki Gulf/Whitford - long	Medium to low risk for recreation, gathering of biota	NA	NA	
4ad Hauraki Gulf/Tamaki - short	Potential high risk to shellfish gathering and recreation. Plume shows dispersal close to coastline. Loads could be much higher in future. TBD	NA	NA	
4ae Hauraki Gulf/Tamaki - mid	Low risk to shellfish gathering or contact recreation	NA	NA	
4ad Hauraki Gulf/Tamaki - long	Very low risk for recreation, gathering of biota	NA	NA	
4b Land/Hauraki Gulf	Medium risk from land application (assuming ok for stock) and risk reduced even further in winter depending on length of pipe, depends on which option used	Low potential for aerosols drift with pathogens/other contaminants	NA	
4ba Land/HG/ Te Puru Stream	As above for 4b	Low potential for aerosols drift with pathogens/other contaminants	NA	
5 Aquifer recharge	No risk of adverse effects	NA		
6 100% reuse - potable	No risk of adverse effects	NA	No risk if appropriately treated	
7 100% reuse – non potable	Low risk depending on use eg golf course, may be no risk with other uses.	NA	No risk if appropriately treated but potential for cross connection with potable water supply and human contact with garden sprinklers etc	
8 Initial treatment to non-potable - potable	If potable standard then should be no risk	NA	No risk if appropriately treated	

Option	Microbiological quality of treated wastewater (Risk to the receiving environment?)	Spray irrigation / aerosols	Treated wastewater reuse	Overall Traffic Light
	Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	
9 Supply to Hunua Dam	No risk if well treated (dam?)	NA	NA	
11 Enhancement options – partial reuse	Depends on options, as above	Depends on options		

Colour the Reasons and Traffic Light cells and the Overall Traffic Light cells Red, Orange, or Green depending on the score selected.

Natural Environment Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Traffic light definition
- Criterion categories / sub criteria
- Method of assessment
- Assessment table
- Updated assessment table of any reasons and / or scores for options that were changed as a result of the Long List workshop discussions.

Authors and experience

Criterion lead:

Author	Role / Experience	Category
Mark James	Strategic and technical advisor	Coastal and freshwater
Shane Kelly	Technical advisor-marine science	Coastal
Mike Stewart	Technical advisor - freshwater	Freshwater
Alan Pattle	Technical advisor – ground water and land	Groundwater and Land

2. Information sources

- Experience with a number of WW discharge projects including Omaha, Snells/Algies, Clarkes Beach, Army Bay and Wellsford.

3. Assumptions

- An appropriate level of treatment to reduce the discharge quality to an acceptable level

4. Traffic light definition

Criteria	Description	Green	Orange	Red
Natural Environment (receiving environment)	Potential adverse environmental effects on the receiving environments associated with the options. Ability to meet s107 of the RMA and align with the values and bottom lines of the NPS-FM.	Low potential adverse effects	Medium potential adverse effects	High potential adverse effects

5. Criterion categories / sub-criteria

Coastal environment

- Effects on life supporting capacity - water quality, marine ecology, indigenous biodiversity.
- Effects on foreshore and seabed.
- Effects on natural character, features and landscapes.
- Ability to meet the requirements of s107 of the RMA.

Freshwater

- Effects on Te Mana o te Wai.
- Alignment with NPS-FM compulsory values, other values, national bottom lines.
- Ability to meet the requirements of s107 of the RMA.

Groundwater

- Effects on Te Mana o te Wai.
- Alignment with NPS-FM compulsory values, other values, national bottom lines.

Land

- Effects on terrestrial ecology
- Effects on highly productive land.
- Effects on natural inland wetlands.

6. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 – safeguarding the life-supporting capacity of air, water, soil, and ecosystems.
- Section 6(a) - the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development.
- Section 6(b) - the protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development.
- Section 6(c) - the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna.
- Section 7(d) - intrinsic values of ecosystems.
- Section 7(f) - maintenance and enhancement of the quality of the environment.
- Section 7 (h) - the protection of the habitat of trout and salmon.

7. Assessment method

An option's recommended traffic light 'score' is developed by first scoring each of the criterion's categories separately. An overall score is then identified by comparing the range of category scores and giving an overall score erring on the side of those with higher potential adverse effects rather than the lower effects. A qualitative expert judgement approach is followed in determining the scores for the long list assessment rather than a quantitative approach.

8. Assessment table

See below:

Natural Environment Assessment (11 October 2023)

Option	Coastal Environment	Freshwater (surface)	Groundwater[15]	Land[16]	Overall Traffic Light
	Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	PRELIMINARY
2a Te Puru Stream – diffuse discharge	Quality generally good and with more treatment would meet standards. Microbial levels reasonable and may meet standards now for shellfish etc (TBC). Low adverse effects	Generally, the quality of the current discharge is good and has some land treatment on the edge of the pond, reducing nutrients. Higher nitrogen levels below pond still but as for most parameters reduce downstream to similar levels to upstream and meet current guidelines. Fish and invertebrate diversity/numbers lower below the discharge (conductivity is high) with inverts showing improvement downstream. It is a farmed catchment and habitat could play a part. Low – moderate adverse effects			
2b Te Puru Stream – direct discharge	Lower quality than above. May not meet some standards in estuary. Medium adverse effects	Lower quality than upstream, no land treatment. Does avoid algal growth in pond and bird inputs if no pond. Medium adverse effects (depends on how much the land and pond take out.			
2c Wairoa River	Shellfish beds/farms could be impacted. Potential medium adverse effects.	Would need to see river data but with no land treatment would struggle to meet standards. Similar to 2b depending on other inputs. Potential medium adverse effects.			
2d Turanga Creek/awa (Whitford)	As for 2c, discharge to Whitford estuary could be an issue and is only a small creek. Potential high adverse effects.	Direct to river with no land treatment, different catchment. On top of other discharges into the stream may increase risk of potential adverse effects to unacceptable level.			
3 100% land	With high attenuation of nutrients would be good for coastal environment	With high attenuation of nutrients would be good for surface freshwaters and no **direct** discharge			
3a Land/stream	Would be higher quality water reaching coast than existing	Land treatment/irrigation before discharge in summer, to Te Puru Stream only in winter			
4aa Hauraki Gulf/Whitford - short	Unlikely to be sufficient dilution to meet standards, risk to shellfish beds, coastal biota. Plume shows dispersal close to shore. Potential high adverse effects. In SEA-M2. Need a benthic survey in the area.	No impact on freshwater ecosystems			
4ab Hauraki Gulf/Whitford - mid	Further offshore but still relatively close to coast and risk of effects on shellfish, biota. Plume shows dispersal close to shore. Potential high adverse effects. In SEA-M2.	No impact on freshwater ecosystems			
4ac Hauraki Gulf/Whitford - long	Better dilution than other Whitford options but plume is relatively large and hugs the coast. Close to small reef with reasonably diverse community including kaimoana (mussels).	No impact on freshwater ecosystems			

[15] Alan Pattle provided a presentation at the workshop.
[16] Alan Pattle provided a presentation at the workshop.

Option	Coastal Environment	Freshwater (surface)	Groundwater[15]	Land[16]	Overall Traffic Light
	Reasons and Traffic Light	**Reasons and Traffic Light**	**Reasons and Traffic Light**	**Reasons and Traffic Light**	**PRELIMINARY**
4ad Hauraki Gulf/Tamaki - short	Unlikely to be sufficient dilution to meet standards, risk to shellfish beds, coastal biota. Do need a benthic survey unless existing info? Plume shows dispersal close to shore. Potential high adverse effects.	No impact on freshwater ecosystems			
4ae Hauraki Gulf/Tamaki - mid	Good dilution with rapid dispersal and narrow plume field away from the coast. Little information on habitat quality and biota in the area.	No impact on freshwater ecosystems			
4ad Hauraki Gulf/Tamaki - long	Best dilution with rapid dispersal and narrow, plume field away from the coast. Little information on habitat quality and biota in the area. Very high levels of recreational fishing.	No impact on freshwater ecosystems			
4b Land/Hauraki Gulf	Land treatment/irrigation and discharge to one of Hauraki Gulf options in winter. Depends on option but low risk for mid and long Tamaki Strait outfall options. Medium to high risk of adverse effects for other options.	No **direct** impact on freshwater systems as on land			
4ba Land/HG/ Te Puru Stream	Discharge, to HG in winter or when required. Low risk for mid and long Tamaki Strait outfall options.	Most of discharge to land or HG, Te Puru only a back up so predict little ecological effect.			
5 Aquifer recharge	No effect	No effect			
6 100% reuse - potable	No effect	No effect on ecosystems			
7 100% reuse – non potable	No detectable effect	No **direct** effect on ecosystems			
8 Initial treatment to non-potable - potable	No effect	No effect			
9 Supply to Hunua Dam	No effect	No effect			
11 Enhancement options – partial reuse	Depends on discharge location as above	Depends on discharge location as above			

Updated Natural Environment Assessment (18 October 2023)

2a Te Puru Stream – diffuse discharge	Quality generally good and with more treatment would meet standards. Microbial levels reasonable and may meet standards now for shellfish etc (TBC). Low adverse effects. Note loads will go up significantly so could be an issue close to coast at times	Changed from Green to Orange Generally, the quality of the current discharge is good and has Low adverse effects as some land treatment on the edge of the pond, reducing nutrients. Higher nitrogen levels below pond. still but as for most parameters reduce downstream to similar levels to upstream and meet current guidelines. Latest data shows that some parameters such as nitrate and possibly DRP don't comply with standards/guidelines at Site 15 below the pond but do by the time the water reaches Te Puru Park and potentially the quarry. We are waiting for data between these sites to see where it does start to meet standards. (earlier reports were only based on a one-off sampling). Fish and invertebrate diversity/numbers lower below the discharge (conductivity is high) with inverts showing improvement downstream. It is a farmed catchment and habitat could play a part. Low – moderate adverse effects depending on more data and whether any improvement in treatment.			Changed from Green to Orange Based on recent data standards may not be met for some distance downstream (TBC). Would be low effects if improved treatment ensured standards met after mixing zone. Note many parameters will obviously increase in the stream below the pond, even towards the bottom of the stream – so some questions over whether an increase allowed under NPSFM even if it meets standards.

Social and Community Considerations Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Traffic light definition
- Criterion categories / sub-categories
- Method of assessment
- Assessment table
- Updated assessment table of any reasons and / or scores for options that were changed as a result of the Long List workshop discussions.

2. Authors and experience

Criterion lead: Katja Huls

Author	Role / Experience	Category
Katja Huls	Planner	All
Johanna McIntosh	Research	All

3. Information sources

- 5086-SCTTTP-Marine-Spatial-Plan-WR.pdf (gulfjournal.org.nz)
- "Beachlands: Options for Sustainable Development" (PDF). Archived from the original (PDF) on 18 April 2016. Retrieved 23 November 2017.
- 2018 Census place summary: Te Puru
- Whitford Estuaries Conservation Society
- The Auckland Unitary Plan
- Auckland Council Cultural Heritage Index
- Ministry for Primary Industries – coastal consents

4. Assumptions

- The discharges will not increase erosive flows in the streams and inlets
- Land application sites will be chosen to avoid sensitive sites.

5. Traffic light definition

Criteria	Description	Green	Orange	Red
Social and community considerations	Potential adverse effects on social and community values relating to amenity, recreation and food gathering, archaeology and heritage. Public access to and along the coastal marine area, and rivers and streams.	Low potential adverse effects	Medium potential adverse effects	High potential adverse effects

	Impact on rural activities and commercial operations.			

6. Criterion categories / sub-categories

Amenity values

- Nuisance effects (e.g., odour, noise, visual). Visual – outfall structure – depend on design - orange
- Effects on sensitive activities - Red

Recreation and food gathering

- Effects on recreation activities and values, and food gathering. Red. Fishing, swimming, commercial fishing.
- Effects on public access to the CMA, rivers, and streams. Structures – swimming access may be compromised. Depend on outfall structure and pipe bridges.

Heritage and archaeology

- Effects on archaeology (non-Māori).
- Effects on heritage buildings and sites.

Rural and commercial activities

- Effects on rural activities.
- Effects on commercial operations in the marine environment.

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 – enables people and communities to provide for their social and economic well being.
- Section 6(d) - the maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers.
- Section 6(f) - the protection of historic heritage from inappropriate subdivision, use, and development.
- Section 7(c) - the maintenance and enhancement of amenity values.
- Section 7(f) - maintenance and enhancement of the quality of the environment.

8. Assessment method

An option's recommended traffic light 'score' is developed by first scoring each of the criterion's categories separately. An overall score is then identified by comparing the range of category scores and giving an overall score erring on the side of those with a high potential adverse effects rather than lower effects. A qualitative expert judgement approach is followed in determining the scores for the long list assessment rather than a quantitative approach.

9. Assessment table

See below:

Social and Community Assessment (11 October2023)

Option	Amenity values	Recreation and food gathering	Heritage and archaeology	Rural and commercial activities	Overall Traffic Light
2a Te Puru Stream – diffuse discharge	There are no identified sensitive activities that would be directly impacted by the stream. We are not aware of any complaints regarding the current discharge to the stream.	There are recreation and food gathering activities such as fishing and swimming.	There are recorded middens along Te Puru Stream and the mouth of the stream. There is also a urupa at the mouth of the stream. Advice is needed from mana whenua. This should be addressed in the mana whenua criteria. It is assumed that the increase in flows won't result in effects on the middens.	There are recreation and food gathering based commercial activities such as fishing charters and campgrounds. These are operating currently and are not expected to be affected by any increase in flows. Rural activities are unlikely to be affected.	
2b Te Puru Stream – direct discharge	As above	As above.	As above	As above	
2c Wairoa River	The discharge location is unknown. The Clevedon Scenic Reserve is adjacent to the Wairoa River. There are river-based activities with a view of the river such as the scenic reserve, a sculpture park and a boating club.	The harvest of oysters and other shellfish may be affected by the wastewater discharge. The area is known for wading birds and there are potential bird watching activities. There is a boating club that operates from Clevedon, the Brooklands Boating club.	There is a redoubt on the Wairoa estuary banks and a number of recorded middens. It is assumed that the increase in flows won't result in effects on the middens.	There are commercial enterprises that may be affected by a wastewater discharge. Particularly Clevedon Coast Oysters.	
2d Turanga Creek/Awa	No sensitive activities have been identified.	There is limited information on the recreation values of	There are a number of historic buildings and sites	The area is largely rural and no commercial activities that	

Option	Amenity values	Recreation and food gathering	Heritage and archaeology	Rural and commercial activities	Overall Traffic Light
		this area, but they're not anticipated to be significant. There is an island with a conservation zoning in the inlet. Depending on the recreation values of the island they may be affected.	around the river and also recorded midden. It is assumed that the increase in flows won't result in effects on the middens.	have been identified as affected.	
3 100% Land	As a site has not been identified this can't be assessed.	Land application would not affect seafood harvest or swimming.	Unable to assess as there are no sites currently identified.	Land application may have an impact on farming activities adjacent to the land application area e.g. horticulture and dairying.	Provisional
3a Land/Stream	We are not aware of any complaints regarding the current discharge to the stream.	As the discharge from the stream would be reduced, the status quo may remain with regard to the effects of the discharge on beaches and inlets.	There are recorded middens along Te Puru Stream and the mouth of the stream. There is also a urupa at the mouth of the stream. It is assumed that the increase in flows won't result in effects on the middens.	There are recreation and food gathering based commercial activities such as fishing charters and campgrounds. These are operating currently and are not expected to be affected by any increase in flows. Land application may have an impact on farming activities adjacent to the land application area e.g. horticulture and dairy farming.	
4aa Hauraki Gulf Whitford Short	No sensitive activities have been identified that may be affected by the discharge. There are currently no identified sites for the outfall structure.	The discharge will be in close proximity to the marina. Shellfish gathering may be affected.	There are currently no identified sites for the outfall structure.	Farming activities are not likely to be affected. The construction of the outfall may affect the operation of the Pine Harbour marina.	

Option	Amenity values	Recreation and food gathering	Heritage and archaeology	Rural and commercial activities	Overall Traffic Light
	There will be temporary visual effects associated with the construction of the outfall.				
4ab Hauraki Gulf Whitford Mid	As above.	As above	As above	As above	
4ac Hauraki Gulf Whitford Long	As above.	Shellfish gathering may be affected.	As above	As above	
4ad Hauraki Gulf Tamaki Short	No sensitive activities have been identified that may be affected by the discharge. Depending on the construction methodology there may be temporary visual effects.	The short outfall could have adverse effects shellfish gathering and swimming. Depending on the construction methodology there may be temporary effects on beach access.	There are currently no identified sites for the outfall structure.	There is no information on commercial fishing specific to this area. Clevedon Coast Oysters operates in the vicinity. The specific location of the oyster farms is not known.	
4ae Hauraki Gulf Tamaki Mid	As above.	Depending on the construction methodology there may be temporary effects on beach access.	There are currently no identified sites for the outfall structure.	As above.	
4ad Hauraki Gulf Tamaki Long	As above	Depending on the construction methodology there may be temporary effects on beach access.	There is no information on commercial fishing specific to this area.	As above.	
4b Land / Hauraki Gulf	As a site has not been identified for land application this can't be assessed for the land component. The outfall structure will need to be designed sensitively to minimise visual effects.	The Hauraki Gulf options may impact food gathering and swimming.	Unable to assess in part as there are no land application sites currently identified. There is no information on commercial fishing specific to this area.	There is no information on commercial fishing specific to this area. Land application may have an impact on farming activities adjacent to the land application area e.g.	

Option	Amenity values	Recreation and food gathering	Heritage and archaeology	Rural and commercial activities	Overall Traffic Light
	Depending on the construction methodology there may be temporary visual effects.			horticulture and dairy farming.	
4ba Land / Hauraki Gulf / Te Puru Stream	As a site has not been identified for land application this can't be assessed. The outfall structure will need to be designed sensitively to minimise visual effects.	The Hauraki Gulf and Te Puru stream options may impact food gathering and swimming.	Unable to assess in part as there are no land application sites currently identified. There are recorded urupa and koiwi sites identified for some of the discharge locations. It is assumed increased discharges in the Te Puru stream will not affect these sites in terms of erosive flows.	There is no information on commercial fishing specific to this area. Land application may have an impact on farming activities adjacent to the land application area e.g. horticulture and dairy farming. There are recreation and food gathering based commercial activities such as fishing charters and campgrounds. These are operating currently and are not expected to be affected by any increase in flows.	
5 Managed Aquifer Recharge	No adverse effects have been identified.	Recreation and food gathering is unlikely to be affected by this option.	Unlikely to be affected.	Unlikely to be affected.	
6 100% Reuse - Potable	No adverse effects have been identified.	Recreation and food gathering is unlikely to be affected by this option.	Works are likely to occur in existing developed areas where ground has already been disturbed.	There are unlikely to be effects on commercial and rural activities.	
7 100% Re-use – Non-Potable	No adverse effects have been identified.	Recreation and food gathering is unlikely to be affected by this option.	Works are likely to occur in existing developed areas where ground has already been disturbed.	There are unlikely to be effects on commercial and rural activities.	

Option	Amenity values	Recreation and food gathering	Heritage and archaeology	Rural and commercial activities	Overall Traffic Light
8 Initial treatment to non-potable - potable	No adverse effects have been identified.	Recreation and food gathering is unlikely to be affected by this option.	Works are likely to occur in existing developed areas where ground has already been disturbed.	There are unlikely to be effects on commercial and rural activities.	
9 Supply to Hunua Dam	No adverse effects have been identified.	Recreation and food gathering is unlikely to be affected by this option.	Unlikely to be affected	There are unlikely to be effects on commercial and rural activities.	
11 Enhancement options – partial reuse	No adverse effects have been identified.	Recreation and food gathering is unlikely to be affected by adding this enhancement option.	Works are likely to occur in existing developed areas where ground has already been disturbed.	There are unlikely to be effects on commercial and rural activities.	

Updated Social and Community Assessment (18 October2023)

Option	Amenity values	Recreation and food gathering	Heritage and archaeology	Rural and commercial activities	Overall Traffic Light
3 100% Land	With new information assessed as Green As a site has not been identified this can't be assessed. The identified land area is largely rural with forestry and quarrying activities. There is a cemetery at the south-west boundary which will need to be avoided.	Land application would not affect seafood harvest or swimming.	With new information assessed as Green Unable to assess as there are no sites currently identified. There is a cemetery at the south-west boundary which will need to be avoided. There are relatively few archaeological sites because sites have been buffered and left out of the potential land application area.	Land application may have an impact on farming activities adjacent to the land application area e.g. horticulture and dairying.	With new information assessed as Green Provisional

Financial Implications Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Traffic light definition
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table
- Updated assessment table of any reasons and / or scores for options that were changed as a result of the Long List workshop discussions.

2. Authors and experience

Criterion lead: Jim Bradley

Author	Role / Experience	Category
Jim Bradley	Environmental Engineer / 50+ years	All
Alan Pattle	Land Application Engineer / 40+ years	LA/MAR
Gary Teear	Marine Engineer / 40+ years	Ocean Outfall
Andrew Slaney	Process Engineer / 25 years	All

3. Information sources

- Knowledge of the current Beachlands WWTP
- Information in the Draft "Beachlands Wastewater Treatment Plant Upgrade – Concept Design Basis"
- Typical NZ wastewater scheme costs from experience.
- Typical NZ outfall costs from experience.
- Preliminary outfall location options report (DHI) (dated 12/9/23)

Note: the financial assessments are *very* high level and comparative with no quantitative estimates undertaken at this stage.

4. Assumptions

- Fresh water discharge options: Bardenpho / MBR treatment process.
- Land / Marine outfall options: Existing treatment process (possible without the disc filter)
- Potable reuse options: MBR plus advanced tertiary water treatment plant (eg reverse osmosis)
- Non-potable reuse options: Depends on water use; domestic would be MBR plus UV plus chlorine.

5. Traffic light definition

Criteria	Description	Green	Orange	Red
Financial implications	Comparative capital, operating and maintenance, whole of life costs of the options. Where relevant to the option, land acquisition costs, capital gains and product net revenue. Affordability – community, business, and trade waste dischargers	Low financial implications	Medium financial implications	High financial implications

6. Criterion categories / sub- criteria

Capital cost

- Capital cost of the total scheme including any land acquisition costs, capital gains and product net revenue.

Operating and maintenance cost

- Cost effectiveness of operations and maintenance.

Whole of life cost

- Combination of capital and operation and maintenance costs over the life of the assets.

Financial risk

- Is the option affordable even if growth does not occur as predicted.
- Cost to the community, business and trade waste dischargers.

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 - enables people and communities to provide for their economic well being.
- Section 7(b) - the efficient use and development of natural and physical resources.

8. Assessment method

An option's recommended traffic light 'score' is developed by first scoring each of the criterion's categories separately. An overall score is then identified by comparing the range of category scores and giving an overall score erring on the side of those with higher financial implications rather than lower implications. A qualitative expert judgement approach is followed in determining the scores for the long list assessment rather than a quantitative approach.

9. Assessment table

See below:

Financial Implications Expert Assessment (11 October 2023)

Option		Capital cost Reasons and Traffic Light	Operating and maintenance cost Reasons and Traffic Light	Whole of life cost Reasons and Traffic Light	Financial risk Reasons and Traffic Light	Overall Traffic Light
2a	Te Puru Creek Overland	Assume MBR system for upgraded WWTP for stream discharge	Moderate operating costs (no conveyance)	Combination of first two columns (NPV of capex plus opex).	Can be staged to meet demand.	
2b	Te Puru Creek Direct	Assume MBR system for upgraded WWTP for stream discharge	Moderate operating costs (no conveyance)	Combination of first two columns (NPV of capex plus opex).	Can be staged to meet demand.	
2c	Wairoa River	Assume MBR system for upgraded WWTP. 12 km conveyance. Tidal storage and pumped discharge.	Moderate operating costs plus conveyance pumping.	Combination of first two columns (NPV of capex plus opex).	High conveyance capital cost designed for ultimate population (or duplicate pipeline later).	
2d	Turanga Creek	Assume MBR system for upgraded WWTP. 10 km conveyence. Tidal storage and pumped discharge.	Moderate operating costs plus conveyance pumping.	Combination of first two columns (NPV of capex plus opex).	High conveyance capital cost designed for ultimate population (or duplicate pipeline later).	
3	100% Land	Conventional treatment. Irrigation storage and 150 hectares land application area.	Moderate operating costs plus potential revenue from land scheme (depending on crop eg cut & carry / forestry)	Combination of first two columns (NPV of capex plus opex).	Land can expanded over time to meet demand. But land availability is a risk to growth.	
3a	Land + Te Puru Creek	Similar to above but reduced storage volume and land area due to stream backup option.	Similar but less than 3.	Combination of first two columns (NPV of capex plus opex).	Land can expanded over time to meet demand. But land availability is a risk to growth.	
4aa	Outfall Whitford Short	Whitford Short. Conventional treatment. 5.1 km land + 1.4 km marine outfall (6.5 km total)	Moderate operating costs. Lower level of treatment than Creek / Estuary	Combination of first two columns (NPV of capex plus opex).	High marine outfall capital cost must be designed for ultimate population (land	

Option		Capital cost Reasons and Traffic Light	Operating and maintenance cost Reasons and Traffic Light	Whole of life cost Reasons and Traffic Light	Financial risk Reasons and Traffic Light	Overall Traffic Light
			discharge options. Assume gravity discharge to outfall.		based outfall could potentially be staged).	
4ab	Outfall Whitford Mid	Whitford Mid. Conventional treatment. 5.1 km land + 2.2 km marine outfall (7.3 km total)	Moderate operating costs. Lower level of treatment than Creek / Estuary discharge options. Assume gravity discharge to outfall.	Combination of first two columns (NPV of capex plus opex).	High marine outfall capital cost must be designed for ultimate population (land based outfall could potentially be staged).	
4ac	Outfall Whitford Long	Whitford Long. Conventional treatment. 5.1 km land + 3.5 km marine outfall (8.6 km total)	Moderate operating costs. Lower level of treatment than Creek / Estuary discharge options. Assume gravity discharge to outfall.	Combination of first two columns (NPV of capex plus opex).	High marine outfall capital cost must be designed for ultimate population (land based outfall could potentially be staged).	
4ad	Outfall Tamaki Short	Tamaki Short. Conventional treatment. 4.8 km land + 1.8 km marine outfall (6.6 km total)	Moderate operating costs. Lower level of treatment than Creek / Estuary discharge options. Assume gravity discharge to outfall.	Combination of first two columns (NPV of capex plus opex).	High marine outfall capital cost must be designed for ultimate population (land based outfall could potentially be staged).	
4ae	Outfall Tamaki Mid	Tamaki Mid. Conventional treatment. 4.8 km land + 2.9 km marine outfall (7.7 km total)	Moderate operating costs. Lower level of treatment than Creek / Estuary discharge options. Assume gravity discharge to outfall.	Combination of first two columns (NPV of capex plus opex).	High marine outfall capital cost must be designed for ultimate population (land based outfall could potentially be staged).	
4ad	Outfall Tamaki Long	Tamaki Long. Conventional treatment. 4.8 km land + 5.5 km marine outfall (10.3 km total)	Moderate operating costs. Lower level of treatment than Creek / Estuary discharge options. Assume gravity discharge to outfall.	Combination of first two columns (NPV of capex plus opex).	High marine outfall capital cost must be designed for ultimate population (land based outfall could potentially be staged).	
4b	Outfall + Land	Assume a mid-outfall option + land disposal	Slightly higher operating costs than outfall only (managing land system).	Combination of first two columns (NPV of capex plus opex).		
4ba	Outfall + Land + Stream	Assume a mid-outfall option + land disposal + stream disposal	Slightly higher operating costs than outfall only (managing land system).	Combination of first two columns (NPV of capex plus opex).		

Option		Capital cost	Operating and maintenance cost	Whole of life cost	Financial risk	Overall Traffic Light
		Reasons and Traffic Light	**Reasons and Traffic Light**	**Reasons and Traffic Light**	**Reasons and Traffic Light**	
5	MAR	MBR plus Advanced tertiary WTP for aquifer recharge + 10 km conveyance pipe + injection bores.	Advanced treatment (high operating costs).	Combination of first two columns (NPV of capex plus opex).		
6	Direct Potable	MBR plus Advanced tertiary WTP plus reticulation network for direct potable use	Advanced treatment (high operating costs).	Combination of first two columns (NPV of capex plus opex).		
7	Non-Potable Reuse	Assume an MBR plus reticulation for non-potable reuse.	Moderate operating costs.	Combination of first two columns (NPV of capex plus opex).		
8	Delayed Direct Potable	Same as 6.	Advanced treatment (high operating costs).	Combination of first two columns (NPV of capex plus opex).		
9	Hunua Dam Recharge	MBR plus advanced tertiary WTP plus 27 km conveyance pipe for dam recharge.	Advanced treatment (high operating costs) plus conveyance pumping costs.	Combination of first two columns (NPV of capex plus opex)..		
11	Non Potable Add-on	Side stream tertiary treatment plant for partial non-potable reuse. (depends on scheme)	Moderate operating costs.	Combination of first two columns (NPV of capex plus opex).		

Updated Financial Implications Expert Assessment (18 October 2023

Option		Capital cost	Operating and maintenance cost	Whole of life cost	Financial risk	Overall Traffic Light
		Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	
3	100% Land	Changed to red because of the increase in the land area requirement. Conventional treatment. Irrigation storage and ~~150~~ 300 hectares land application area.	Moderate operating costs plus potential revenue from land scheme (depending on crop eg cut & carry / forestry)	Combination of first two columns (NPV of capex plus opex).	Land can expanded over time to meet demand. But land availability is a risk to growth.	Changed from orange to red

Resilience Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Traffic light definition
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table

2. Authors and experience

Criterion lead: Andrew Slaney

Author	Role / Experience	Category
Andrew Slaney	Process Engineer / 25 years	Overall / wastewater treatment
Jim Bradley	Environmental Engineer / 50+ years	Overall
Alan Pattle	Marine Engineer / 40+ years	Land application / MAR
Gary Teear	Coastal Engineer	Ocean Outfalls

3. Information sources

- Knowledge of the current Beachlands WWTP
- Information in the Draft "Beachlands Wastewater Treatment Plant Upgrade – Concept Design Basis"
- Experience of the authors.
- Preliminary outfall location options report (DHI) (dated 12/9/23)

4. Assumptions

- Fresh water discharge options: Bardenpho / MBR treatment process.
- Land options: Existing treatment process.
- Marine outfall options: Existing treatment process (possibly without the disc filter
- Potable reuse options: MBR plus advanced tertiary water treatment plant (eg reverse osmosis)
- Non-potable reuse options: Depends on water use; domestic would be MBR plus UV plus chlorine.

Note: the above assumptions for treatment type / associated treated wastewater quality based on anticipated receiving environment requirements based on the experience of the authors. No effects assessments have been carried out at this stage.

The assessments are high level for comparison purposes based on the authors' experience with similar types of wastewater systems throughout New Zealand. No detailed assessments have been undertaken on natural hazards and climate change impacts at this stage other than applying generic approaches.

5. Traffic light definition

Criteria	Description	Green	Orange	Red
Resilience	Degree to which the option is resilient to natural hazards and climate change, offers operational resilience, addresses the carbon component of 40/20/20. Flexibility to accommodate changes in flows and loads, ability to respond to changes in regulatory standards, changes in technology.	High degree of resilience	Medium degree of resilience	Low degree of resilience

6. Criterion categories / sub-criteria

Natural hazards

- Land stability and erosion affecting infrastructure.
- Flooding affecting infrastructure.
- Wildfires affecting infrastructure (land application in forests).

Climate change

- High intensity rainfall peaks affecting the infrastructure.
- Prolonged wet weather periods affecting the infrastructure.
- Prolonged dry periods affecting the infrastructure.
- Prolonged dry periods resulting in an increase of low flows in streams and rivers.
- Sea level rise and coastal storm inundation affecting infrastructure (ocean outfall).
- Carbon – addressing the carbon component of 40/20/20.

Operational resilience

- Power supply reliability – effect of outages and rapid changes to electricity pricing.
- Scheme complexity leading to operational problems.
- Third party damage to infrastructure, e.g., digger hitting cables, pipes etc.
- Crop failure/contamination.
- Loss of market for land application products e.g., cut and carry products, forestry production.

Flexibility

- Ability to accommodate changes in flows and loads.
- Ability to respond to changes in regulatory standards e.g., emerging contaminants, endocrine disrupting compounds.
- Ability to respond to changes in technology.

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 – enables people and communities to provide for their health and safety.
- Section 7(i) – the effects of climate change.

8. Assessment method

An option's recommended traffic light 'score' is developed by first scoring each of the criterion's categories separately. An overall score is then identified by comparing the range of category scores and giving an overall score erring on the side of those with lower degree of resilience rather than the higher degree. A qualitative expert judgement approach is followed in determining the scores for the long list assessment rather than a quantitative approach.

9. Assessment table

See below:

Resilience Assessment

Option		Natural Hazards	Climate Change	Operational Resilience	Flexibility	Overall Traffic Light
		Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	
2a	Te Puru Creek Overland	Creek could be at risk from natural hazards	Resilient to climate change	Simple robust system	Limited capacity of stream	
2b	Te Puru Creek Direct	Creek could be at risk from natural hazards	Resilient to climate change	Simple robust system	Limited capacity of stream	
2c	Wairoa River	Coastal conveyance pipeline risk.	Coastal conveyance pipeline risk.	Simple robust system	Limited capacity of estuary.	
2d	Turanga Creek	Coastal conveyance pipeline risk.	Coastal conveyance pipeline risk.	Simple robust system	Limited capacity of estuary.	
3	100% Land	Land susceptible to natural hazards	Neutral for Auckland rainfall but a higher risk with 100% land application (no backup route).	Managing land application system as well as WWTP. No backup option.	Capacity limited by land availability	
3a	Land + Te Puru Creek	Land susceptible to natural hazards	Neutral for Auckland rainfall and have stream as backup.	Managing land application system as well as WWTP.	Capacity limited by land availability but have stream as backup.	
4aa	Outfall Whitford Short	Outfall provides resilience.	Outfall provides resilience.	Simple robust system	Outfall provides high capacity	
4ab	Outfall Whitford Mid	Outfall provides resilience.	Outfall provides resilience.	Simple robust system	Outfall provides high capacity	
4ac	Outfall Whitford Long	Outfall provides resilience.	Outfall provides resilience.	Simple robust system	Outfall provides high capacity	
4ad	Outfall Tamaki Short	Outfall provides resilience.	Outfall provides resilience.	Simple robust system	Outfall provides high capacity	
4ae	Outfall Tamaki Mid	Outfall provides resilience.	Outfall provides resilience.	Simple robust system	Outfall provides high capacity	

Option		Natural Hazards	Climate Change	Operational Resilience	Flexibility	Overall Traffic Light
		Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	
4ad	Outfall Tamaki Long	Outfall provides resilience.	Outfall provides resilience.	Simple robust system	Outfall provides high capacity	
4b	Outfall + Land	Outfall provides resilience.	Outfall provides resilience.	More complex system (multiple discharge routes)	Outfall provides high capacity	
4ba	Outfall + Land + Stream	Outfall provides resilience.	Outfall provides resilience.	More complex system (multiple discharge routes)	Outfall provides high capacity	
5	MAR	Pipeline damage. Lack of backup disposal route,	Relatively insulated.	Pipeline damage. Lack of backup disposal route.		
6	Direct Potable			Complex treatment process. Lack of backup disposal route,	Risk of new contaminants / stricter standards.	
7	Non-Potable Reuse		Less demand for irrigation with increased rainfall.		Risk of new contaminants / stricter standards.	
8	Delayed Direct Potable	Same as 6.	Same as 6.	Same as 6.	Same as 6.	
9	Hunua Dam Recharge	Pipeline damage. Lack of backup disposal route,			Risk of new contaminants / stricter standards.	
11	Non Potable Add-on					

Technology and Infrastructure Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Traffic light definition
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table

2. Authors and experience

Criterion lead: Andrew Slaney

Author	Role / Experience	Category
Andrew Slaney	Process Engineer / 25 years	Overall / wastewater treatment
Jim Bradley	Environmental Engineer / 50+ years	Overall
Alan Pattle	Marine Engineer / 40+ years	Land application / MAR
Gary Teear	Coastal Engineer	Ocean Outfalls

3. Information sources

- Knowledge of the current Beachlands WWTP
- Information in the Draft "Beachlands Wastewater Treatment Plant Upgrade – Concept Design Basis"
- Experience of the authors.
- Preliminary outfall location options report (DHI) (dated 12/9/23)

4. Assumptions

- Fresh water discharge options: Bardenpho / MBR treatment process.
- Land application options: Existing treatment process.
- Marine outfall options: Existing treatment process (possibly without the disc filter).
- It is assumed that the biological trickling filter (BTF) approach used at the marine outfalls for Hastings, Napier, Gisborne and Greymouth is unlikely to be appropriate / acceptable for discharges into the more sensitive Hauraki Gulf environment (this needs confirming from both environmental and cultural / social effects perspectives). If a BTF were acceptable then the cost savings would be significant compared with other treatment options.
- Potable reuse options: MBR plus advanced tertiary water treatment plant (eg reverse osmosis)
- Non-potable reuse options: Depends on water use; domestic would be MBR plus UV plus chlorine.

Note: the above assumptions for treatment type / associated treated wastewater quality based on anticipated receiving environment requirements based on the experience of the authors. No effects assessments have been carried out at this stage.

5. Traffic light definition

Criteria	Description	Green	Orange	Red
Technology and infrastructure (whole of scheme)	Degree to which the option - Degree to which the option – uses proven technology, existing infrastructure; can be constructed, staged, constructed in the required timeframes; has sufficient capacity, secure land, available infrastructure.	High degree of alignment	Medium degree of alignment	Low degree of alignment

6. Criterion categories / sub-criteria

Reliable and proven technology

- Uses reliable, robust and proven technology.

Staging and timing

- Can the option be staged.
- Is the option able to be constructed within the required timeframe.

Constructability

- Is the option able to be constructed e.g., geotechnical conditions, presence of groundwater, contaminated land.
- Is there sufficient land available to accommodate the option and can the land be secured.
- Potential to maximise the use existing infrastructure that has a valuable remaining life.
- Presence of existing other infrastructure.

Capacity

- Does the option have capacity to accept projected flows and loads.

Carbon

- Comparative carbon footprint for operation and construction.

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 - sustaining the potential of natural and physical resources to meet the reasonably foreseeable needs of future generations.
- Section 7(b) - the efficient use and development of natural and physical resources.

8. Assessment method

An option's recommended traffic light 'score' is developed by first scoring each of the criterion's categories separately. An overall score is then identified by comparing the range of category scores and giving an overall score erring on the side of those with a lower degree of alignment rather than a higher degree. A qualitative expert judgement approach is followed in determining the scores for the long list assessment rather than a quantitative approach.

9. Assessment table

See below:

Technology and Infrastructure Assessment

Option		Reliable and proven technology	Staging and timing	Constructability	Capacity	Carbon	Overall Traffic Light
		Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	
2a	Te Puru Creek Overland	Assume MBR system for upgraded WWTP for stream discharge	WWTP can be staged	Relatively straightforward.	Limited assimilative capacity of stream.	Relatively low carbon footprint	
2b	Te Puru Creek Direct	Assume MBR system for upgraded WWTP for stream discharge	WWTP can be staged	Relatively straightforward.	Limited assimilative capacity of stream.	Relatively low carbon footprint	
2c	Wairoa River	Assume MBR system for upgraded WWTP. Tidal storage and pumped discharge.	WWTP can be staged	Relatively straightforward WWTP; conveyance pipeline and tidal storage basin could be difficult.	Limited assimilative capacity of estuary.	Embodied carbon in conveyance pipeline.	
2d	Turanga Creek	Assume MBR system for upgraded WWTP. Tidal storage and pumped discharge.	WWTP can be staged	Relatively straightforward WWTP; conveyance pipeline and tidal storage basin could be difficult.	Limited assimilative capacity of estuary.	Embodied carbon in conveyance pipeline.	
3	100% Land	Conventional treatment. Irrigation storage and pumped discharge.	Acquire land as needed – may need PWA	Difficult to acquire enough land for 100% land application. Large storage volume needed for winter / wet weather.	Unlikely to acquire enough land for 100% land application. Large storage volume needed for winter / wet weather.	Assume forestry (carbon sequestration)	
3a	Land + Te Puru Creek	Similar to above.	Acquire land as needed – may need PWA	Less land needed if stream is available for discharge over winter.	Less land needed if stream is available for discharge over winter.	Assume forestry (carbon sequestration)	

Option		Reliable and proven technology	Staging and timing	Constructability	Capacity	Carbon	Overall Traffic Light
		Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	
4aa	Outfall Whitford Short	Conventional treatment plus outfall	Outfall has to be sized for ultimate population.	Relatively straightforward.	Outfall has high capacity	Embodied carbon in conveyance pipeline.	
4ab	Outfall Whitford Mid	Conventional treatment plus outfall	Outfall has to be sized for ultimate population.	Relatively straightforward.	Outfall has high capacity	Embodied carbon in conveyance pipeline.	
4ac	Outfall Whitford Long	Conventional treatment plus outfall	Outfall has to be sized for ultimate population.	Relatively straightforward.	Outfall has high capacity	Embodied carbon in conveyance pipeline.	
4ad	Outfall Tamaki Short	Conventional treatment plus outfall	Outfall has to be sized for ultimate population.	Relatively straightforward.	Outfall has high capacity	Embodied carbon in conveyance pipeline.	
4ae	Outfall Tamaki Mid	Conventional treatment plus outfall	Outfall has to be sized for ultimate population.	Relatively straightforward.	Outfall has high capacity	Embodied carbon in conveyance pipeline.	
4ad	Outfall Tamaki Long	Conventional treatment plus outfall	Outfall has to be sized for ultimate population.	Relatively straightforward.	Outfall has high capacity	Embodied carbon in conveyance pipeline.	
4b	Outfall + Land	Combination of land and outfall.	Outfall has to be sized for ultimate population.	Outfall always available for discharge so land area can be small.	Outfall has high capacity	Embodied carbon in conveyance pipeline.	
4ba	Outfall + Land + Stream	Combination of land stream and outfall.	Outfall has to be sized for ultimate population.	Similar to above.	Outfall has high capacity	Embodied carbon in conveyance pipeline.	
5	MAR	Note done in New Zealand. Requires	Land requirements low. WWTP / WTP Construction	Standard construction elements.	Limited by aquifer capacity	High level of treatment (energy and embodied carbon)	

Option		Reliable and proven technology	Staging and timing	Constructability	Capacity	Carbon	Overall Traffic Light
		Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	
		advanced level of treatment.	timeframe could be long. Approvals and consenting timeframe also.				
6	Direct Potable	Note done in New Zealand. Requires advanced level of treatment.	WWTP / WTP Construction timeframe could be long. Approvals and consenting timeframe also.			High level of treatment (energy and embodied carbon)	
7	Non-Potable Reuse	Non potable reuse is done in NZ and is relatively common in Australia.			Winter demand will be low.	Slightly lower level of treatment than potable.	
8	Delayed Direct Potable	Note done in New Zealand. Requires advanced level of treatment.	WWTP / WTP Construction timeframe could be long. Approvals and consenting timeframe also.	Same as 6.	Same as 6.	High level of treatment (energy and embodied carbon)	
9	Hunua Dam Recharge	Indirect potable reuse, less uncommon than direct potable reuse.	Approvals plus long conveyance pipeline.			High level of treatment (energy and embodied carbon) plus conveyence	
11	Non Potable Add-on	Non potable reuse is done in NZ and is relatively common in Australia.				Slightly lower level of treatment than potable.	

Statutory Risks and Conflicts Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Traffic light definition
- Criterion categories / sub-categories
- Method of assessment
- Assessment table
- Updated assessment table of any reasons and / or scores for options that were changed as a result of the Long List workshop discussions.

2. Authors and experience

Criterion lead: Paula Hunter

Author	Role / Experience	Category / sub-criteria
Paula Hunter	Planner	All
Simpson Grierson	Legal	Legislative barriers to options proceeding.

3. Information sources

Marine and Coastal Area (Takutai Moana) Act 2011 (MACAA)

MACAA applications

Hauraki Gulf Marine Park Act 2000

New Zealand Coastal Policy Statement

National Policy Statement for Freshwater Management

National Policy Statement for Highly Productive Land

Auckland Unitary Plan

4. Assumptions

Assessments have not been informed by information of effects on Māori cultural values, mauri, mahinga kai, wāhi tapū and sites of significance.

5. Traffic light definition

Criteria	Description	Green	Orange	Red
Statutory Risks and Conflicts	Legislative processes that could restrict the ability of an option to proceed, scale of consenting complexity and consent compliance. Conflicts with the direction of key planning instruments.	Low risks and conflicts	Medium risks and conflicts	High risks and conflicts

6. Criterion categories / sub-criteria

Legislative barriers to options proceeding

- Risk of an option not proceeding due to legislative changes and outcomes of legislative processes e.g., potentially successful applications for customary title under the Takutai Moana Act.

Consenting complexity and compliance

- Scale of complexity of consenting processes including s91 deferrals.
- Scale of complexity of compliance requirements and costs.

Conflicts with statutory direction

- Conflict with the direction of key planning instruments e.g., non-complying activity classification with a supporting “avoid” policy.

7. Part 2

The RMA Part 2 matters addressed under this criterion are:

- Sections 5, 6, 7, 8.

8. Assessment method

An option’s recommended traffic light ‘score’ is developed by first scoring each of the criterion’s categories separately. An overall score is then identified by comparing the range of category scores and giving an overall score erring on the side of those with higher risks and conflicts rather than those lower risks and conflicts. A qualitative expert judgement approach is followed in determining the scores for the long list assessment rather than a quantitative approach.

9. Assessment table

See below:

Statutory Risks and Conflicts Assessment (11 October 2023)

Option	Legislative barriers to options proceeding	Complexity and compliance	Conflicts with statutory direction	Overall Traffic Light
2a: Te Puru Stream – diffuse discharge	No legislative barriers identified	One receiving environment, expanded overland flows system	Potential conflict with NPS-FM - Te Mana o te Wai – putting the health and well being of the Te Pura stream first.	
2b: Te Puru Stream – direct discharge	No legislative barriers identified	One receiving environment, new discharge structure	Potential conflict with NPS-FM - Te Mana o te Wai – putting the health and well being of the Te Pura stream first.	
2c: Wairoa River	No legislative barriers identified	One receiving environment, conveyance infrastructure	Potential conflict with NPS-FM - Te Mana o te Wai – putting the health and well being of the Waioa River first. Wairoa River is a larger water body.	
2d: Turanga Creek / Awa	No legislative barriers identified	One receiving environment, conveyance infrastructure	Potential conflict with NPS-FM - Te Mana o te Wai – putting the health and well being of the Turanga Creek / Awa first.	
3: 100% Land	No legislative barriers identified	Potentially more than one land application area, conveyance infrastructure to land application area, storage	Contributes to putting health and well being of freshwater first (NPS-FM), does not conflict with NPS Highly Productive Land as land will remain in production of some type.	
3a: Land / Te Puru Stream	No legislative barriers identified	Two receiving environments, potentially more than one land application area, conveyance infrastructure to land application area	Potential conflict with NPS-FM - Te Mana o te Wai – putting the health and well being of the Te Pura stream first, but discharge to the stream will only occur in the winter.	
4aa: Hauraki Gulf Whitford Short	Potential risks associated with applications for customary rights and titles lodged under the Marine and Coastal Area (Takutai Moana) Act.	One receiving environment, ocean outfall (short), conveyance infrastructure	Subject to constraints that should be avoided, need further information to understand construction and operation effects on water quality, recreation values, ecology and indigenous biodiversity, natural character.	

Option	Legislative barriers to options proceeding	Complexity and compliance	Conflicts with statutory direction	Overall Traffic Light
			Puts health and well being of freshwater first (NPS-FM)	
4ab: Hauraki Gulf Whitford Mid	Potential risks associated with applications for customary rights and titles lodged under the Marine and Coastal Area (Takutai Moana) Act.	One receiving environment, ocean outfall (mid), conveyance infrastructure	Subject to constraints that should be avoided, need further information to understand construction and operation effects on water quality, recreation values, ecology and indigenous biodiversity, natural character. Puts health and well being of freshwater first (NPS-FM)	
4ac: Hauraki Gulf Whitford Long	Potential risks associated with applications for customary rights and titles lodged under the Marine and Coastal Area (Takutai Moana) Act.	One receiving environment, ocean outfall (long), conveyance infrastructure	Subject to constraints that should be avoided, need further information to understand construction and operation effects on water quality, recreation values, ecology and indigenous biodiversity, natural character. Puts health and well being of freshwater first (NPS-FM)	
4ad: Hauraki Gulf Tāmaki Short	Potential risks associated with applications for customary rights and titles lodged under the Marine and Coastal Area (Takutai Moana) Act.	One receiving environment, ocean outfall (short), conveyance infrastructure	Subject to constraints that should be avoided, need further information to understand construction and operation effects on water quality, recreation values, ecology and indigenous biodiversity, natural character. Puts health and well being of freshwater first (NPS-FM)	
4ae: Hauraki Gulf Tāmaki Mid	Potential risks associated with applications for customary rights and titles lodged under the Marine and Coastal Area (Takutai Moana) Act.	One receiving environment, ocean outfall (mid), conveyance infrastructure	Subject to constraints that should be avoided, need further information to understand construction and operation effects on water quality, recreation values, ecology and indigenous biodiversity, natural character.	

Option	Legislative barriers to options proceeding	Complexity and compliance	Conflicts with statutory direction	Overall Traffic Light
			Puts health and well being of freshwater first (NPS-FM)	
4af: Hauraki Gulf Tāmaki Long	Potential risks associated with applications for customary rights and titles lodged under the Marine and Coastal Area (Takutai Moana) Act.	One receiving environment, ocean outfall (long), conveyance infrastructure	Subject to constraints that should be avoided, need further information to understand construction and operation effects on water quality, recreation values, ecology and indigenous biodiversity, natural character. Puts health and well being of freshwater first (NPS-FM)	
4b: Land / Hauraki Gulf	Potential risks associated with applications for customary rights and titles lodged under the Marine and Coastal Area (Takutai Moana) Act.	Two receiving environments, potentially more than one land application area, conveyance infrastructure to land application area	Subject to constraints that should be avoided, need further information to understand construction and operation effects on water quality, recreation values, ecology and indigenous biodiversity, natural character. Contributes to putting health and well being of freshwater first (NPS-FM)	
4ba: Land / Hauraki Gulf / Te Puru Stream	Potential risks associated with applications for customary rights and titles lodged under the Marine and Coastal Area (Takutai Moana) Act.	Three receiving environments, potentially more than one land application area, conveyance infrastructure to land application area	Subject to constraints that should be avoided, need further information to understand construction and operation effects on water quality, recreation values, ecology and indigenous biodiversity, natural character. Contributes to putting health and well being of freshwater first (NPS-FM)	
5: Managed Aquifer Recharge	No legislative barriers identified	One receiving environment, conveyance infrastructure, discharge system	Potential conflict with NPS-FM Te Mana o te Wai – putting the health and well being of groundwater first.	
6: 100% Reuse - Potable	No legislative barriers identified	No receiving environment consents, new WTP, reservoir, water supply network	No conflicts with statutory direction identified	

Option	Legislative barriers to options proceeding	Complexity and compliance	Conflicts with statutory direction	Overall Traffic Light
7: 100% Reuse – Non-Potable	No legislative barriers identified	Potential multiple receiving environment consents, backup receiving environment, new WTP, reservoir, water supply network	No conflicts with statutory direction identified	
8: 100% Reuse – Non-Potable Transition to Potable	No legislative barriers identified	Potential multiple receiving environment consents, backup receiving environment, new WTP, reservoir, water supply network	No conflicts with statutory direction identified	
9: Supplement Supply for Hunua Dams	No legislative barriers identified	New WTP, conveyance infrastructure, discharge system	No conflicts with statutory direction identified	
11: Enhancement Options	No legislative barriers identified	Potential multiple receiving environment consents, backup receiving environment, conveyance infrastructure, new WTP, reservoir, water supply network	No conflicts with statutory direction identified	

Updated Statutory Risks and Conflicts Assessment (18 October 2023)

Option	Legislative barriers to options proceeding	Complexity and compliance	Conflicts with statutory direction	Overall Traffic Light
6: 100% Reuse – Potable	No legislative barriers identified. Changed from green to red. There are currently no standards that apply to the reuse of treated wastewater. This could potentially lead to disputes over appropriate standards to be met and loss of public confidence.	No receiving environment consents, new WTP, reservoir, water supply network	No conflicts with statutory direction identified	Changed from Green to Orange
7: 100% Reuse – Non-Potable	No legislative barriers identified. Changed from green to orange. There are currently no standards that apply to the reuse of treated wastewater. This could potentially lead to disputes over appropriate standards to be met and loss of public confidence. Issue not so significant for non-potable use.	Potential multiple receiving environment consents, backup receiving environment, new WTP, reservoir, water supply network	No conflicts with statutory direction identified	
8: 100% Reuse – Non-Potable Transition to Potable	No legislative barriers identified. Changed from green to red. There are currently no standards that apply to the reuse of treated wastewater. This could potentially lead to disputes over appropriate standards to be met and loss of public confidence.	Potential multiple receiving environment consents, backup receiving environment, new WTP, reservoir, water supply network	No conflicts with statutory direction identified	
9: Supplement Supply for Hunua Dams	No legislative barriers identified. Changed from green to red. There are currently no standards that apply to the reuse of treated wastewater. This could potentially lead to disputes over appropriate standards to be met and loss of public confidence.	New WTP, conveyance infrastructure, discharge system	No conflicts with statutory direction identified	Changed from Green to Orange
11: Enhancement Options				

Opportunities and Benefits Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Traffic light definition
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table
- Updated assessment table of any reasons and / or scores for options that were changed as a result of the Long List workshop discussions.

2. Authors and experience

Criterion lead: Jim Bradley

Author	Role / Experience	Category
Jim Bradley	Environmental Engineer / 50+ years	All
Andrew Slaney	Process Engineer / 25 years	All

3. Information sources

- The information sources used for the Opportunities and Benefits Criterion include:
- Knowledge of the current Beachlands WWTP
- Information in the Draft "Beachlands Wastewater Treatment Plant Upgrade – Concept Design Basis"
- Watercare and Stantec personnel's wastewater treatment and management knowledge of the New Zealand sector and overseas
- Assumed (at this stage) technology and infrastructure criteria information

Authors and experience of those involved in this section of the Report.

4. Assumptions

a. Overall Assumptions

The Wastewater Treatment Plan is based on the "Product Factory" concept as depicted below. Concepts and developments within Watercare in recent times have adapted this approach. The approach is consistent with the principles of the circular economy.

b. Treated Wastewater Beneficial Reuse Assumption

a) Assessment based on the quality/degree of treatment of the treated wastewater and the extent/amount of treated wastewater to be beneficially reused

b) Assessment does not take into account "possible people's perceptions" of the beneficial reuse e.g. potable reuse, aquifer recharge of water supply source

c) Consents/other approvals etc can be sought for each of the beneficial reuse means included in the options.

d) The assessment includes nutrient recovery when treated wastewater is applied to land.

c. Sludge and Biosolids Beneficial Reuse Assumptions

a) This assessment based on degree of treatment of liquid phase needed i.e. high degree of treatment, the more sludge/biosolids produced that can be beneficially reused

b) Includes vermiculture, biochar, other reusable sludge/biosolids material

c) Assume no chemicals or other products used in the WWTP processes that render biosolids not beneficially reusable

d) Assumes possible future/pending regulations on Emerging Organic Contaminants (EOC's) and/or microplastics does not limit beneficial reuse on land

d. Energy Generation

Energy generation is not included in the table as it is assumed that based on the design population of the scheme (around 40,000), based on the authors' experience, primary clarifiers and anaerobic digestion are unlikely to be economic and therefore none of the scheme options will provide energy generation possibilities. In addition it is noted that the carbon in primary solids will be needed for biological nitrogen / phosphorus removal as with the current plant and a number of others in New Zealand.

In terms of incineration of sludge / biosolids to produce energy, this possibility is included in the sludge / biosolids beneficial use category.

5. Traffic light definition

Criteria	Description	Green	Orange	Red
Opportunities and Benefits	Provides opportunities for resource recovery including beneficial reuse, energy generation, nutrient removal.	High opportunities and benefits	Medium opportunities and benefits	Minimal opportunities and benefits

6. Criterion categories / sub-criteria

Resource recovery

- Treated wastewater beneficial reuse.
- Sludge and biosolids beneficial reuse
- Energy generation.
- Nutrient removal

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 – sustainable management of resources.
- Section 7(b) - the efficient use and development of natural and physical resources.
- Section 7 (ba) - the efficiency of the end use of energy.

8. Assessment method

An option's recommended traffic light 'score' is developed by first scoring each of the criterion's categories separately. An overall score is then identified by comparing the range of category scores and giving an overall score erring on the side of those with a minimum opportunities and benefits rather than higher opportunities and benefits. A qualitative expert judgement approach is followed in determining the scores for the long list assessment rather than a quantitative approach.

9. Assessment table

See below:

Opportunities and Benefits Assessment (11 October 2023)

Option		Treated wastewater beneficial reuse	Sludge and biosolids beneficial reuse	Nutrient recovery / reuse	Overall Traffic Light
		Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	
2a	Te Puru Creek Overland	Option based on Te Puru Stream discharge – no conveyance line of WWTP site to facilitate reuse	All options produce same quantity of biosolids and have similar opportunities for beneficial use.	No reuse of nutrients.	
2b	Te Puru Creek Direct	Option based on Te Puru Stream discharge – no conveyance line of WWTP site to facilitate reuse		No reuse of nutrients.	
2c	Wairoa River	While likely to be also be high quality treated wastewater (like 2a and 2b) could tap into conveyance line to Wairao River discharge		No reuse of nutrients.	
2d	Turanga Creek	While likely to be also be high quality treated wastewater (like 2a and 2b) could tap into conveyance line to Turanga Creek discharge		No reuse of nutrients.	
3	100% Land	100% to land application so maximise beneficial reuse with appropriate crop(s) and management regime(s) selected		Uptake of nutrients by crops.	
3a	Land + Te Puru Creek	Some treated wastewater to land so maximises the beneficial reuse of that proportion providing appropriate techniques used like Option 3		Uptake of nutrients by crops, but less than option 3a.	
4aa	Outfall Whitford Short	Marine outfall Whitford short, assumes not as highly treated so not the same reuse potential		No reuse of nutrients.	

Option		Treated wastewater beneficial reuse	Sludge and biosolids beneficial reuse	Nutrient recovery / reuse	Overall Traffic Light
		Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	
4ab	Outfall Whitford Mid	Marine outfall Whitford mid, assumes not as highly treated so not the same reuse potential		No reuse of nutrients.	
4ac	Outfall Whitford Long	Marine outfall Whitford long, assumes not as highly treated so not the same reuse potential		No reuse of nutrients.	
4ad	Outfall Tamaki Short	Marine outfall Tamaki short, assumes not as highly treated so not the same reuse potential		No reuse of nutrients.	
4ae	Outfall Tamaki Mid	Marine outfall Tamaki mid, assumes not as highly treated so not the same reuse potential		No reuse of nutrients.	
4ad	Outfall Tamaki Long	Marine outfall Tamaki long, assumes not as highly treated so not the same reuse potential		No reuse of nutrients.	
4b	Outfall + Land	A land component so some beneficial reuse providing appropriate crop(s) and management regimes(s) selected		Some land application / nutrient reuse.	
4ba	Outfall + Land + Stream	A land component so some beneficial reuse providing appropriate crop(s) and management regimes(s) selected		Some land application / nutrient reuse.	
5	MAR	Formulated on beneficial reuse of treated wastewater that is treated to high/reclaimed water quality		Nutrients are undesirable for drinking water supply but treated to remove most nutrients.	

Option		Treated wastewater beneficial reuse	Sludge and biosolids beneficial reuse	Nutrient recovery / reuse	Overall Traffic Light
		Reasons and Traffic Light	Reasons and Traffic Light	Reasons and Traffic Light	
6	Direct Potable	Formulated on beneficial reuse of treated wastewater that is treated to high/reclaimed water quality		Nutrients are undesirable for drinking water supply but treated to remove most nutrients.	
7	Non-Potable Reuse	Formulated on beneficial reuse of treated wastewater that is treated to high/reclaimed water quality			
8	Delayed Direct Potable	Formulated on beneficial reuse of treated wastewater that is treated to high/reclaimed water quality			
9	Hunua Dam Recharge	Formulated on beneficial reuse of treated wastewater that is treated to high/reclaimed water quality		Nutrients are undesirable for drinking water supply but treated to remove most nutrients.	
11	Non Potable Add-on	This is a combination of options – reuse depending on method and extent of reuse including seasonal use		Use of nutrients in irrigation systems.	

Updated Opportunities and Benefits Assessment (18 October 2023)

7	**Non-Potable Reuse**	**Formulated on beneficial reuse of treated wastewater that is treated to high/reclaimed water quality**		**Some uptake of nutrients – vegetation, crop irrigation.**	
8	Delayed Direct Potable	Formulated on beneficial reuse of treated wastewater that is treated to high/reclaimed water quality		Changed to red. Nutrients are undesirable for drinking water supply but treated to remove most nutrients.	Changed to Orange

Appendix C Long List Workshop Participants

Participant	Organisation
Chris Allen	Watercare
Dean Lawrence	Watercare
Helen Jansen	Watercare
Iris Tscharntke	Watercare
Jonathan Piggot	Watercare
Michael Webster	Watercare
Nathaniel Wilson	Watercare
Priyan Perera	Watercare
Rory Buchanan	Watercare
Tanvir Bhamji	Watercare
Andrew Slaney	Stantec
Jim Bradley	Stantec
Katja Huls	Stantec
Paula Hunter	Stantec
Sharu Delilkan	Stantec
Allan Pattle	PDP
Mark James	Aquatic Sciences
Warren Bangma	Simpson Grierson
Shane Kelly	Coast and Catchment

Appendix D List of Technical Experts (Short List)

The following table sets out the technical experts responsible for leading the assessments of the Short List of options along with the other experts who provided additional support or who reviewed the assessments.

Criteria	Lead Responsibility	Support / Review
Public Health Protection	Mark James	Alan Pattle – Land irrigation Rebecca Stott - Microbiological quality of treated wastewater Jim Bradley - Reuse
Natural Environment	Mark James	Shane Kelly – Coastal and Freshwater Alan Pattle - Land Mike Stewart – Freshwater
Social and Community	Katja Huls	Shane Kelly – recreation and Food Gathering Paula Hunter - Review
Financial Implications	Andrew Slaney	Jim Bradley - Review Alan Pattle – Land irrigation Gary Teear - Ocean outfall
Resilience	Andrew Slaney	Jim Bradley - Review
Technology and Infrastructure	Andrew Slaney	Jim Bradley - Review
Statutory Risks and Conflicts	Paula Hunter	Simpson Grierson - Legislative barriers to options proceeding.
Opportunities and Benefits	Jim Bradley	Andrew Slaney - Review

Appendix E Short List Technical Expert Assessments

Public Health Protection Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions and limitations
- Traffic light definition
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table
- Conclusions

2. Authors and experience

Criterion lead: Mark James

Author	Role / Experience	Category
Mark James	Strategic and technical advisor, Aquatic ecology	Microbiology Quality
Jim Bradley	Public Health Engineer	Reuse Options
Alan Pattle	Environmental Engineer	Land Application
Rebecca Stott	Microbiology expert, involved in a number of WW discharge projects, QMRA	Microbiological quality of treated wastewater

3. Information sources

Extensive experience with a number of WW discharge projects including Omaha, Snells/Algies, Clarkes Beach, Army Bay and Wellsford.

Previous QMRA

Assessment uses the data available, including latest monitoring data for influent, effluent, upstream, after pond, Site 15 with limited data to date for Site E (reference), Site F and Te Puru Park(more data to come for site sin between).

4. Assumptions and limitations

At least the current level of treatment and discharge.

QMRA to be completed on final BPO to confirm level of risk for recreation and food gathering at key sites.

Assume land/stream option will use land for most of year and maybe stream in winter when ground saturated?

5. Public Health Protection Criterion – description and sub-criteria

Description	Sub-criteria		
	Microbiological quality of treated wastewater	Spray irrigation / aerosols	Treated wastewater reuse
Degree of public health exposure to health risks from treated wastewater discharge (including through land application or re-use options).	Risk of public exposure to waterborne pathogens and other contaminants through: • Direct contact with the conveyance or treatment process. • Direct contact with the receiving environment, for example through contact recreation. • Indirect exposure – commercial operations, food gathering (shellfish, fish, watercress etc.) and groundwater use.	• Risk of public exposure to pathogens and other contaminant from spray irrigations.	• Risk of contamination of reclaimed water for potable and non-potable reuse.

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
Low degree of public exposure to risk	1
Medium to low degree of public exposure to risk	2
Medium degree of public exposure to risk	3
Medium to high degree of public exposure to risk	4
High degree of public exposure to risk	5

7. Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 – enables people and communities to provide for their health and safety.

8. Assessment method

An option's recommended 1 to 5 score is developed by first scoring each of the criterion's sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with higher degree of public exposure to risk effects rather than a lower degree. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Public Health Protection Criterion

Option	Microbiological quality of treated wastewater	Spray irrigation / aerosols	Treated wastewater reuse	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Te Puru Stream – diffuse discharge	Relatively good quality water discharged at present, relatively low in microbes, and similar or reduced level to upstream and reference site. Low level of use – recreation at outlet from Te Puru Stream and in Kellys Bay, shellfish gathering low level Kellys Bay. Should meet standards at least for NBL noting higher microbial levels upstream and at bottom Te Puru Stream to discharge form Pond. Low risk to downstream shellfish beds due to discharge. (Need to get microbial assessment/QMRA of stream for cattle water supply, shellfish gathering, shellfish sample's from Kellys Bay to confirm?) Yet to look at load effects)	NA	NA	
2b: Te Puru Stream – direct discharge	Could reduce any effects of birds in pond (doesnt appear to be an issue). Levels in outlet very low (more data needed though). Proposed limit of <1 cfu/100 ml (?) in discharge should not create any risk downstream even though attenuation not as great as Option 2a.	NA	NA	
3: 100% to land	Lower level of treatment proposed (limit in discharge <10 cfu/100 ml) so higher risk than Options 2 and 2a. Low risk still after irrigation and groundwater attenuation. Levels in gro8ndwater generally very low due to attenuation	Low potential for aerosols drift with pathogens/other contaminants	NA	
3a: Land and Te Puru Stream	Low risk in winter to downstream surface waters as similar to Option 2 or 2a. No risk to stream system in summer if onto land due to added attenuation.	Low potential for aerosols drift with pathogens/other contaminants	NA	
4ae: Hauraki Gulf Tāmaki Mid	Will be rapidly diluted close to discharge (use of appropriate diffuser) Low risk to shellfish gathering or contact recreation as some distance away.	NA		

10. Conclusion

All five options present a low risk to public health for the following reasons:

- The discharge will have very high quality with low levels of microbial contamination. Levels slightly higher for land application and mid Tamaki but there will be further attenuation on land and rapid dilution offshore.
- There is a low level of recreation use in the stream and low levels of recreation and shellfish gathering in Bay. Rapid dilution from mid-Tamaki and will be undetectable by time water reaches shellfish beds.

Natural Environment Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions and limitations
- Traffic light definition
- Criterion categories / sub criteria
- Method of assessment
- Assessment table
- Conclusions

2. Authors and experience

Criterion lead: Mark James

Author	Role / Experience	Category
Mark James	Strategic and technical advisor	Coastal and freshwater
Shane Kelly	Technical advisor-marine science	Coastal
Mike Stewart	Technical advisor - freshwater	Freshwater
Alan Pattle	Environmental Engineer	Land

3. Information sources

Extensive experience with a number of WW discharge projects including Omaha, Snells/Algies, Clarkes Beach, Army Bay and Wellsford.

Assessments use the data available, including latest monitoring data for influent, effluent, upstream, after pond, Site 15 with limited data to date for Site E (reference), Site F and Te Puru Park(more data to come for site sin between).

Bio-researches annual compliance reports.

4. Assumptions and limitations

- BNR and MBR with discharge of:

	Option 2, 2a, 3a	Option 3	Option 4ae
	BNR +MBR + UV	BNR?? +MBR + UV	BNR, tertiary filtration, UV
BOD	<1 mg/L	<2.0 mg/L	<2.0 mg/L
TSS	0 mg/L	<5.0 mg/L	<5.0 mg/L
Ammoniacal-N	<0.50 mg/L	<0.5 mg/L	<0.5 mg/L
Nitrate	<2.0 mg/L.	<5.0 mg/L	<5.0 mg/L
TN	<3.5 mg/L	<7.0 mg/L	<7.0 mg/L
DRP	<0.10 mg/L	<4.0 mg/L	<0.4 mg/L
TP	<0.10 mg/L	<5.0 mg/L	<1.0 mg/L

- Assumes loads as per Stantec xls (sent 2nd Nov)
- Assume land/stream option will use land for most of year and maybe stream in winter when ground saturated.
- Appropriate extension of land treatment as buffer before stream for Option 2a.
- Waiting for more stream water quality monitoring data especially for sites between Site 15 and the Te Puru mouth.
- Assumes currents are as modelled at Mid-Tamaki site but needs to be confirmed by putting in ADCP (3-4 weeks)
- Assumes nothing special at mid-Tamaki site but needs confirmation from benthic survey.

5. Natural Environment – description and sub-criteria

Description	Sub-criteria			
	Coastal environment	Freshwater Surface	Freshwater Groundwater	Land
Potential adverse environmental effects on the receiving environments associated with the options. Ability to meet s107 of the RMA and align with the values and bottom lines of the NPS-FM.	• Effects on life supporting capacity - water quality, marine ecology, indigenous biodiversity. • Effects on foreshore and seabed. • Effects on natural character, features and landscapes. • Ability to meet the requirements of s107 of the RMA.	• Effects on Te Mana o te Wai. • Alignment with NPS-FM compulsory values, other values, national bottom lines. • Ability to meet the requirements of s107 of the RMA.	• Effects on Te Mana o te Wai. • Alignment with NPS-FM compulsory values, other values, national bottom lines.	• Effects on terrestrial ecology • Effects on highly productive land. • Effects on natural inland wetlands.

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
Low (less than minor) potential adverse effects	1
Medium to low (minor) potential adverse effects	2
Medium (more than minor) potential adverse effects	3
Medium to high (significant) potential adverse effects	4
High (significant and unlikely to be mitigated) potential adverse effects	5

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 – safeguarding the life-supporting capacity of air, water, soil, and ecosystems.

- Section 6(a) - the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development.
- Section 6(b) - the protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development.
- Section 6(c) - the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna.
- Section 7(d) - intrinsic values of ecosystems.
- Section 7(f) - maintenance and enhancement of the quality of the environment.
- Section 7 (h) - the protection of the habitat of trout and salmon.

8. Assessment method

An option's recommended 1 to 5 score is developed by first scoring each of the criterion's sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with higher potential adverse effects rather than the lower effects. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Natural Environment Criterion

Option	Coastal Environment	Freshwater	Groundwater	Land	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Te Puru Stream – diffuse discharge	The proposed higher level of treatment (BNR+ MBR+UV) along with some attenuation through a land buffer zone would generally improve the quality of the bay that the stream flows into though loads will be higher with the larger population. However, the change is likely to be undetectable for the coast but any increase may not be acceptable. The increase in loads, may offset any improvement to the bay from a higher level of treatment. Medium to low (minor) adverse effects.	The proposed level of treatment (BNR+MBR+UV) will improve the quality of the discharge and potentially the stream. There will be some increase in loads but this will be more of an issue for the coast as the final receiving environment and for the stream will be more than compensated for by the reduced nutrient levels. There are indications that the existing discharge increases the nutrient levels downstream even to Te Puru Park compared with upstream and reference sites, and does not meet guidelines. The proposed level of treatment may mean standards/guideline are met downstream eg at Site 15 below the first confluence but the mixing zone has not yet been determined and could be closer to the discharge from the pond. Fish and invertebrate diversity/numbers are very low below the discharge (conductivity is high) with inverts showing improvement downstream. Communiites at present are "poor" downstream and would not meet the NPSFM NBL. It is a farmed catchment and habitat could play a part as even one of the reference site had low invertebrate scores. Overall, with the new treatment effects are potentially low for water quality. Whether this results in an improvement in biota is yet to be established.	NA?	NA	Note many parameters will obviously increase in the stream below the pond, even towards the bottom of the stream – so some questions over whether an increase allowed under NPSFM even if it meets standards.
2b: Te Puru Stream – direct discharge	Lower quality than above as less attenuation before entering the stream and eventually the estuary. May not meet some standards in stream and estuary. Water quality at the nearest Council monitoring sites (Outer Tamaki and Wairoa Bay) has fluctuated between good and marginal rankings in the past 10 years, but median values for the water quality indicators used for determining these rankings have been below regional water quality guidelines over the past 10 years (note that the WQ rankings are not based on median values). Higher loads would go into the coastal environment although any effects of this may be hard to detect Potentially medium adverse effects due to increase in loads.	Will be lower quality than diffuse discharge and with no land buffer which presently can halve the concentrations and potentially loads of some nutrients. Does avoid algal growth in pond and bird inputs if no pond. Medium to low (minor) adverse effects (depends on how much the land and pond take out and where standards should apply).	NA	NA	
3: 100% to land	85-90% reduction in contaminants, even with higher loads and reduced treatment means very	Assuming the groundwater doesn't reach surface waters until the estuary/coast the potential adverse effects low. Even if there were some	With low areal loading rates for contaminants and relatively short pathways under irrigation areas	Effects on land likely to be increased saturation in winter (neutral for grass/fodder) but more productive in summer for grass/fodder.	

Option	Coastal Environment Reasons and Score	Freshwater Reasons and Score	Groundwater Reasons and Score	Land Reasons and Score	Overall Score
	low levels reaching the coast and would take some time. Low potential for adverse effects	contaminants reaching waterways the levels would be significantly reduced going through soils and groundwater.	(500m average) changes to groundwater concentrations unlikely to be detectable		
	There may be issues with capacity of the stream to take 3x the volume (yet to be assessed). High quality discharge should apply to all options and preferably BNR and MBR but note most of contaminants will be removed before reaching waterways.				
3a: Land and Te Puru Stream	If most of the contaminants are removed then low risk of effects on coastal waters. Score depends on which stream option chosen and reductions before water reaches coast.	Land treatment/irrigation before discharge in summer, to Te Puru Stream when soils saturated and natural flows in stream likely to be higher. Low potential for adverse effects with high level of treatment and land buffer before stream.	With low areal loading rates for contaminants and relatively short pathways under irrigation areas (500m average) changes to groundwater concentrations unlikely to be detectable.	Effects on land likely to more productive for grass/fodder	
4ae: Hauraki Gulf Tāmaki Mid	Water quality at the nearest Council monitoring sites (Outer Tamaki and Wairoa Bay) has fluctuated between good and marginal rankings in the past 10 years, but median values for the water quality indicators used for determining these rankings have been below regional water quality guidelines over the past 10 years (note that the WQ rankings are not based on median values). Good dilution with rapid dispersal and narrow plume field, away from the coast. Little information on habitat quality and biota in the area. However, the Gulf is degraded and needs to be improved. The option would increase the input from treated WW to the Gulf by an estimated 3-5% and would be 0.4 % of what is estimated to come from rivers into the HG(TBC) Emerging issues including reduced denitrification and low oxygen in bottom waters at times. Recent arrival of exotic Caulerpa (which is reportedly sensitive to nutrient inputs) would need to be considered. Potentially medium to low effects.	No impact on freshwater ecosystems and would actually improve quality of stream.	NA	NA	
	We consider that a reduction in the level of treatment for offshore cf with stream discharge lowers the score. The Hauraki Gulf is showing signs of degradation that must be addressed and any increase in nutrients especially loads is likely to be unacceptable. The increase in loads would be a concern for nitrogen processes and oxygen levels in bottom waters even if the changes may not be detectable.				

10. Conclusion

- Option 2a Te Puru Stream – diffuse discharge
- Overall minor potential for adverse effects. The main reason for this option not being low is the increase in loads to the coast as the final receiving environment. Whether this will be detectable or have an obvious adverse effect is yet to be determined. The stream on the other hand transfers water relatively quickly to the coast.
- There could be some effect of load on the stream but not as much as at bottom of catchment. It is possible that the improved treatment will result in the stream meeting standards/guidelines but whether this happens quickly enough is yet to be assessed.
- Option 2b Te Puru Stream – direct discharge.
- Loads will be higher than diffuse discharge to the stream and may results in standards/guidelines not being met in the stream or receiving coastal environment. Increased risk of potential adverse effects compared with diffuse discharge. Risk to coastal waters may be medium (more than minor?) but potentially medium to low (minor) for freshwater.
- Option 3 - 100% land
- Positive and negative effects due increased ground saturation in winter but more productive land in summer. Some contaminants (maybe up to 10% discharge load from treatment plant) would still reach waterways over long term (decades for full effect). Generally low level of effects due to attenuation before reaching coast.
- Option 3a – Land and Te Puru Stream
- Generally, a better option as provides better quality water in discharge and potential for attenuation in soils and groundwater. If soils saturated then assume could be put through a small land buffer and into stream as for Option 2a – maybe up to 50% of year. Lower residual load from groundwater to streams – may 1/3 of Option 3.
- Option 4ae – Hauraki Gulf Mid
- Good dilution of contaminants offshore but some question around increased loads to a degraded environment. The lower level of treatment results in potential for minor adverse effects on coastal waters but no effect on stream. Stream quality would improve at least in the upper reaches of the Te Puru Stream.

Social and Community Considerations Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions and limitations
- Traffic light definition
- Criterion categories / sub-categories
- Method of assessment
- Assessment table
- Conclusions

2. Authors and experience

Criterion lead: Katja Huls

Author	Role / Experience	Category
Katja Huls	Planner	All
Shane Kelly	Environmental Scientist	Recreation and Food Gathering
Workshop Participants	Confirmation of provisional score	Recreation and Food Gathering

3. Information sources

- The Ministry of Fisheries website
- 5086-SCTTTP-Marine-Spatial-Plan-WR.pdf (gulfjournal.org.nz)
- "Beachlands: Options for Sustainable Development" (PDF).
- Archived from the original (PDF) on 18 April 2016. Retrieved 23 November 2017.
- 2018 Census place summary: Te Puru
- Whitford Estuaries Conservation Society
- The Auckland Unitary Plan
- Auckland Council Cultural Heritage Index
- The Ministry for Primary Industries – coastal consents
- Understanding the Social Impacts of Freshwater Reform: A Review of Six Limit-Setting SIAs, Mike Mackay and Nick Taylor for the Ministry of Environment 2020
- State of our Gulf Report 2017 (State of our Gulf 2017 - Knowledge Auckland (link))
- Use of treated sewage or wastewater as an irrigation water for agricultural purposes – Environmental, health, and economic impacts (link) Science Direct.
- Auckland Region Mountain Biking Trails (link)
- Proposed Plan Change 88 to the Auckland Unitary Plan
- Community Survey and Community Information session report and summary from Watercare Services Ltd 01/11/2023

4. Assumptions and limitations

- The discharges will not increase erosive flows in the streams and inlets.
- Land application sites will be chosen to avoid sensitive sites.
- Engineered Overflow Points in the wastewater network have not been assessed in terms of their location, nor the need for additional overflow points or their effects.
- Cultural effects are within the ambit of this assessment; however, Mana Whenua feedback has not been received yet. Their feedback may impact the scoring.
- A Quantitative Microbial Risk Assessment has not been conducted which may impact the scoring.
- An economic assessment has not been conducted on the impacts of wastewater re-use on rural land.
- A targeted survey of commercial stakeholders has not been conducted.
- Community feedback was received from 61 participants in an online survey and 30 - 40 participants in a community information session. Some may have participated in both sessions.
- An archaeological assessment has not been completed.
- To date recreation surveys have not been undertaken.
- The assessments for the recreation and food gathering sub-criteria are preliminary and will require input from workshop participants.

5. Social and Community Considerations Criterion – description and sub-criteria

Description	**Sub-criteria**			
	Amenity values	Recreation and food gathering	Heritage and archaeology	Rural and commercial activities
Potential adverse effects on social and community values relating to amenity, recreation and food gathering, archaeology and heritage. Public access to and along the coastal marine area, and rivers and streams. Impact on rural activities and commercial operations.	• Nuisance effects (e.g., odour, noise, visual). • Effects on sensitive activities	• Effects on recreation activities and values, and food gathering. • Effects on public access to the CMA, rivers, and streams.	• Effects on archaeology. • Effects on heritage buildings and sites.	• Effects on rural activities • Effects on commercial operations in the marine environment

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
Low (less than minor) potential adverse effects	1
Medium to low (minor) potential adverse effects	2
Medium (more than minor) potential adverse effects	3
Medium to high (significant) potential adverse effects	4
High (significant and unlikely to be mitigated) potential adverse effects	5

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 – enables people and communities to provide for their social and economic well being.
- Section 6(d) - the maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers.
- Section 6(f) - the protection of historic heritage from inappropriate subdivision, use, and development.
- Section 7(c) - the maintenance and enhancement of amenity values.
- Section 7(f) - maintenance and enhancement of the quality of the environment.

8. Assessment method

An option's recommended 1 to 5 score is developed by first scoring each of the criterion's sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with higher potential adverse effects rather than the lower effects. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Social and Community Considerations Criterion

Option	Amenity values	Recreation and food gathering	Heritage and archaeology	Rural and commercial activities	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Tributary to Te Puru Stream – diffuse discharge	1 The stream flows approximately 4.5km to Kelly's Beach. The stream channel is tidal here and approximately 12m wide between the mangrove tree lines. Amenity values are unlikely to be affected by the discharge to the stream because the discharge will not be discernible from natural flows in the stream. The discharge is unlikely to generate any odours associated with the stream environment.	3 (provisional) The Te Puru (Te Ruangaingai) Stream traverses the eastern side of Te Puru Park, which is a sports ground and community facility. It enters the CMA at Kelly's Bay on the eastern side of the Park. Kelly's Bay is tidal with a sandy beach and walkways to Omana Beach to the east and Shelly Bay to the west. The amount of shellfish gathering in Kelly's Beach is not known. MoH and Fisheries NZ and Councils generally advise against gathering shellfish from urban areas. Risks will be assessed further with a Quantitative Microbial Risk Assessment. Land based recreation is unlikely to be affected by the discharge to the stream because the discharge will not be discernible from natural flows in the stream. Swimming recreation may be affected due to negative perceptions associated with wastewater discharges (feedback from community engagement).	3 The urupa in Te Puru Park could be affected by flood waters that have mixed with the treated wastewater discharge. This matter should be considered and assessed by mana whenua. There are two midden on the banks of the tidal portion of the Te Puru (Te Ruangaingai) Stream near the coast (S11-559 and S11-560). These are not expected to be affected by treated wastewater discharges.	1 Commercial activities other than rural activities are not evident in the vicinity of the Te Puru Stream. It is not expected that treated wastewater discharges in the stream will impact the surrounding rural activities. There is limited commercial fishing in the vicinity of Kelly's Bay.	2
2b: Tributary to the Te Puru Stream – direct discharge	1 The stream flows approximately 4.5km to Kelly's Beach. The stream channel is tidal here and approximately 12m wide between the mangrove tree lines. Amenity values are unlikely to be affected by the discharge to the stream because the discharge will not be discernible from natural flows in the stream. The discharge is unlikely to generate any odours associated with the stream environment.	3 (provisional) The Te Puru (Te Ruangaingai) Stream traverses the eastern side of Te Puru Park, which is a sports ground and community facility. It enters the CMA at Kelly's Bay on the eastern side of the Park. Kelly's Bay is tidal with a sandy beach and walkways to Omana Beach to the east and Shelly Bay to the west. The amount of shellfish gathering in Kelly's Beach is not known. MoH and Fisheries NZ and Councils generally advise against gathering shellfish from urban areas. Risks will be assessed further with a Quantitative Microbial Risk Assessment. Land based recreation is unlikely to be affected by the discharge to the stream because the discharge will not be discernible from natural flows in the stream. Swimming recreation may be affected due to negative perceptions associated with wastewater discharges (feedback from community engagement).	3 The urupa in Te Puru Park could be affected by flood waters that have mixed with the treated wastewater discharge. This matter should be considered and assessed by mana whenua. There are two midden on the banks of the tidal portion of the Te Puru (Te Ruangaingai) Stream near the coast (S11-559 and S11-560). These are not expected to be affected by treated wastewater discharges.	1 Commercial activities other than rural activities are not evident in the vicinity of the Te Puru Stream. It is not expected that treated wastewater discharges in the stream will impact the surrounding rural activities. There is limited commercial fishing in the vicinity of Kelly's Bay.	2

Option	Amenity values	Recreation and food gathering	Heritage and archaeology	Rural and commercial activities	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	
3: 100% to land	2 The indicative land application area is extensive and includes land zoned Countryside Living which enables rural-residential living activities including lifestyle blocks, “hobby farming”, fruit and vegetable growing and equestrian activities. While the Public Health Protection assessment concludes that there is low potential for aerosols drift from the discharge, residents could consider this as a risk. Sensitive land uses are located in the urban areas and are remote from the identified land application area.	2 (provisional) Equestrian activities occur on the rural land and there are a number of mountain bike trails in the Maraetai and Whitford forests. These could lead to direct contact with the treated wastewater and any pathogens within it. These risks will be assessed further with a Quantitative Microbial Risk Assessment.	1 Known cultural and archaeological sites have been identified and will be excluded from any land application area with a buffer. Heritage buildings and sites are not affected by this option.	4 The indicative land application area is extensive and includes land zoned for rural production activities and Countryside Living. Irrigation with treated wastewater may affect land values for land marketed as rural lifestyle living. Irrigation may improve yield from rural land in dry seasons. There is potential risk associated with effects of the discharge on rural production activities (dairy, fruit, vegetables) and market perceptions. Risks of pathogens will be assessed further with a Quantitative Microbial Risk Assessment.	2
3a: Land and Tributary to the Te Puru Stream	2 The assessment for this option is the same as the matters set out for the land and for the stream options. A precautionary approach has been adopted for the score, based on the score for the land option.	3 (provisional) The assessment for this option is the same as the matters set out for the land and for the stream options. A precautionary approach has been adopted for the score, based on the score for the stream options.	2 The assessment for this option is the same as the matters set out for the land and for the stream options. A precautionary approach has been adopted for the score, based on the score for the stream options.	2 Because this option also involves a large land area the assessments for Option 3 are equally relevant but as the land requirement is less a lower score has been adopted.	2
4ae: Hauraki Gulf Tāmaki Mid	2 It is assumed the wastewater pipe and ocean outfall would be buried and not visible from the reserve or beach therefore any amenity effects are likely to be temporary in nature associated with construction.	3 (provisional) This part of the Hauraki Gulf is particularly valued for marine recreation such as swimming, shellfish gathering, fishing, boating and sailing. The various beaches are a very popular weekend destination during the summer months. For this reason, a wastewater discharge to the Tamaki Strait could impact the perception of this coastline as a marine destination. This is corroborated by feedback from an online survey conducted by Watercare. The expected dilution at the outfall is high and shellfish are unlikely to experience actual effects provided that the discharge is compliant. Public access to the beach will be unlikely to be affected during construction, but there may be access restrictions to parts of the beach and reserve during construction.	3 Two midden (R11-2368, R112138) and a Midden/Oven (R11-2654) may be affected by construction work. The urupa on the eastern side of Te Puru Park was discovered accidentally and it is possible that there are other burials in the vicinity. An archaeological assessment and guidance from Mana Whenua would assist with better understanding the risk of this occurring.	3 The treated wastewater discharge will be released 2.9km into the Tamaki Strait. Commercial fishing and marine farming occur in the Strait. The risk of effects on fish and shellfish is likely to be minor due to the very high dilution rates, but further assessment is required. A Quantitative Microbial Risk Assessment will support assessing this risk further. While the expected dilution rates are very high, the perception associated with wastewater discharges and the effects on shellfish may negatively impact the marketing of products produced via marine farming in this area.	3

10. Conclusion

All options have an overall score of 2 - medium to low (minor) potential adverse effects except Option 4ae: Hauraki Gulf Tāmaki Mid. This option had a score of 3 medium (more than minor) potential adverse effects, primarily because it had higher scores for the recreation and food gathering, heritage and archaeology and rural and commercial activities sub-criteria.

None of the option sub-criteria were scored as having High (significant and unlikely to be mitigated) potential adverse effects (5). The highest scoring sub-criteria was rural and commercial activities for Option 3: 100% to land which was assessed as having medium to high (significant) potential adverse effects (4)

Financial Implications Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Approach to scoring
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table
- Conclusions

2. Authors and experience

Criterion lead: Andrew Slaney

Author	Role / Experience	Category
Jim Bradley	Environmental Engineer / 50+ years	All
Alan Pattle	Land Application Engineer / 40+ years	Land application
Gary Teear	Marine Engineer / 40+ years	Ocean Outfall
Andrew Slaney	Process Engineer / 25 years	All
ALTA	Cost estimators (yet to be undertaken)	All

3. Information sources

- Knowledge of the current Beachlands WWTP
- Information in the Draft "Beachlands Wastewater Treatment Plant Upgrade – Concept Design Basis"
- Typical NZ wastewater scheme costs from experience.
- Typical NZ outfall costs from experience.
- Typical land costs in the application area
- Preliminary outfall location options report (DHI) (dated 12/9/23)
- WWTP cost curves from 2018 Boffa Miskell / GHD report for DIA
- Snells Beach WWTP cost (currently under construction)

4. Assumptions and limitations

- BNR / MBR treatment option completely replaces existing WWTP
- BNR treatment option assumes some reuse of existing assets (eg clarifier) to be considered during concept design.
- Outfall cost based on float and sink installation (marine outfall on top of seabed). Alternative is buried / tunnelled which would be significantly more expensive.
- Outfall foreshore transition assumed not rocky coastline.
- Net present value (NPV) based on 35 years at 4.3% p.a. discount rate

- Annual maintenance cost of 2.0% of capital cost
- Additional pumping energy and chemical costs included where applicable
- Other WWTP operating costs (labour, sludge, electrical energy costs) excluded from this comparison as these costs would be similar across all schemes (other than those mentioned above).

5. Financial implications criterion – description and sub-criteria

Description	Sub-criteria			
	Capital cost	Operating and maintenance cost	Whole of life cost	Financial risk
Comparative capital, operating and maintenance, whole of life costs of the options. Where relevant to the option, land acquisition costs, capital gains and product net revenue. Affordability – community, business, and trade waste dischargers	• Capital cost of the total scheme including any land acquisition costs, capital gains and product net revenue.	• Cost effectiveness of operations and maintenance	• Combination of capital and operation and maintenance costs over the life of the assets	• Is the option affordable even if growth does not occur as predicted. • Cost to the community, business and trade waste dischargers.

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
Low financial implications	1
Medium to low financial implications	2
Medium financial implications	3
Medium to high financial implications	4
High financial implications	5

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 - enables people and communities to provide for their economic well being.
- Section 7(b) - the efficient use and development of natural and physical resources.

8. Assessment method

An option's recommended 1 to 5 score is developed by first scoring each of the criterion's sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with higher financial implications rather than lower implications. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Financial Implications Criterion

Option	Capital cost	Operating and maintenance cost	Whole of life cost (NPV)	Financial risk	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Te Puru Stream – diffuse discharge	1 Lowest capex	1 Lowest opex	1 Lowest NPV	1 Lowest risk	1
2b: Te Puru Stream – direct discharge	1 Lowest capex	1 Lowest opex	1 Lowest NPV	1 Lowest risk	1
3: 100% to land	5 Highest capex	5 Highest opex	5 Highest NPV	5 Land price risk	5
3a: Land and Te Puru Stream	4 Second highest capex	4 Second highest opex	4 Second highest NPV	4 Land price risk	4
4ae: Hauraki Gulf Tāmaki Mid	2 Second lowest capex	2 Second lowest opex	2 Second lowest NPV	3 Outfall sized for ultimate population Risk of higher outfall cost if float and sink unacceptable and marine outfall has to be buried / bored (could be a 4 in this case).	2*

* Could go up to 3 if marine outfall needs to be buried / bored.

10. Conclusions

- Options 2a and 2b are essentially the same in terms of the accuracy of the estimates (the only difference being the Te Puru Stream arrangements).
- The financial risks associated with Options 2a and 2b are lowest providing the assessed treatment quality meets environmental requirements in the stream.
- The high costs for Options 3 and 3a reflect the high land costs in the area and the tight soils and resulting large areas required for land application (750 ha for Option 3 and 300 ha for option 3a).
- Marine outfall cost has a reasonably high risk due to the sensitivity of the Hauraki Gulf environment which could result in the outfall to be buried or bored for part or all of its length in the Gulf.

Resilience Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions and limitations
- Traffic light definition
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table
- Conclusions

2. Authors and experience

Criterion lead: Andrew Slaney

Author	Role / Experience	Category
Andrew Slaney	Process Engineer / 25 years	Overall / wastewater treatment
Jim Bradley	Environmental Engineer / 50+ years	Overall

3. Information sources

- Knowledge of the current Beachlands WWTP
- Information in the Draft "Beachlands Wastewater Treatment Plant Upgrade – Concept Design Basis"
- Experience of the authors.
- Preliminary outfall location options report (DHI) (dated 12/9/23)

4. Assumptions and limitations

- Fresh water discharge options: BNR / MBR treatment process (highest level of treatment)
- Land application options: Conventional BNR process with tertiary filtration & UV
- Land application options: Pasture cut and carry system (not forestry)
- Marine outfall options: Conventional BNR process with tertiary filtration & UV

5. Resilience Criterion – description and sub-criteria

Description	Sub-criteria			
	Natural hazards	Climate Change	Operational resilience	Flexibility
Degree to which the option is resilient to natural hazards and climate change, offers operational resilience, addresses the carbon component of 40/20/20. Flexibility to accommodate changes in flows and loads, ability to respond to changes in regulatory standards, changes in technology.	• Land stability and erosion affecting infrastructure. • Flooding affecting infrastructure. • Wildfires affecting infrastructure (land application in forests).	• High intensity rainfall peaks affecting the infrastructure. • Prolonged wet weather periods affecting the infrastructure. • Prolonged dry periods affecting the infrastructure. • Prolonged dry periods resulting in an increase of low flows in streams and rivers. • Sea level rise and coastal storm inundation affecting infrastructure (ocean outfall).	• Power supply reliability – effect of outages and rapid changes to electricity pricing. • Scheme complexity leading to operational problems. • Third party damage to infrastructure, e.g., digger hitting cables, pipes etc. • Crop failure/contamination. • Loss of market for land application products e.g., cut and carry products, forestry production.	• Ability to accommodate changes in flows and loads. • Ability to respond to changes in regulatory standards e.g., emerging contaminants, endocrine disrupting compounds. • Ability to respond to changes in technology.

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
High degree of resilience	1
Medium to high degree of resilience	2
Medium degree of resilience	3
Medium to low degree of resilience	4
Low degree of resilience	5

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 – enables people and communities to provide for their health and safety.

8. Section 7(i) – the effects of climate change.

9. Assessment method

An option's recommended 1 to 5 score is developed by first scoring each of the criterion's sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with lower degree of resilience rather than the higher degree. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

10. Assessment table

See below:

Resilience Criterion

Option	Natural Hazards	Climate Change	Operational Resilience	Flexibility	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Te Puru Stream – diffuse discharge	1. Low risk from natural hazards. Can use storage lagoon to control discharge volume and rate.	1. Resilient to climate change impacts. The highly treated wastewater could be a benefit to stream flow and ecology.etc.	1. Modern and proven BNR / MBR / UV WWTP and freshwater discharge system.	1. MBR lends itself to future reuse opportunities and/or even more treatment standards for stream discharge. eg reverse osmosis.	1
2b: Te Puru Stream – direct discharge	1. See above	1. See above	1. See above	1. See above	1
3: 100% to land	3. Flooding / land slips risk.	3. Increased frequency of high intensity rainfall events is a risk to land application.	4. Land application management adds complexity to operation. Crop market risks.	3. Land management / crop type could be difficult to change if necessary due to market or other factors.	3
3a: Land and Te Puru Stream	3. Similar to option 3.	3.. Similar to option 3	3. Somewhere between options 2 and 3.	2. Somewhere between options 2 and 3.	3
4ae: Hauraki Gulf Tāmaki Mid	1. Low risk from natural hazards	1. Resilient to climate change impacts	1. Standard WWTP and marine discharge system.	1. Similar to stream option. Conveyance pipe provides reuse opportunities to tap into treated wastewater (refer opportunities category).	1

[Colour the Reasons and Score cells and the Overall Scorer cells in accordance with the score colours in the score table above.]

11. Conclusions

- Water based discharges have a generally higher resilience than land application systems which are highly dependent on weather and soil conditions.
- MBR technology provides greater flexibility and opportunities for future reuse (eg Hunua recharge or purple pipe non potable reuse).
- Conventional BNR technology can also be upgraded to provide reuse opportunities but would require more upgrading compared with the MBR option.

- Ocean outfall option is somewhat less flexible due to high infrastructure investment.
- Experience with offshore marine outfalls in New Zealand (20 or so) shows by and large a sustainable and resilient long term solution providing appropriately sized and located and treated wastewater quality is appropriate for the receiving environment.

Technology and Infrastructure Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Traffic light definition
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table
- Conclusions

2. Authors and experience

Criterion lead: Andrew Slaney

Author	Role / Experience	Category
Andrew Slaney	Process Engineer / 25 years	Overall / wastewater treatment
Jim Bradley	Environmental Engineer / 50+ years	Overall

3. Information sources

- Knowledge of the current Beachlands WWTP
- Information in the Draft "Beachlands Wastewater Treatment Plant Upgrade – Concept Design Basis"
- Experience of the authors.
- Preliminary outfall location options report (DHI) (dated 12/9/23)

4. Assumptions and limitations

- Fresh water discharge options: BNR / MBR treatment process (highest level of treatment)
- Land application options: Conventional BNR process with tertiary filtration & UV
- Land application options: Pasture cut and carry system (not forestry)
- Marine outfall options: Conventional BNR process with tertiary filtration & UV
- Carbon footprint includes total lifetime emissions (embodied plus operational)
- Carbon footprint includes nitrous oxide emissions

5. Technology and Infrastructure Criterion – description and sub-criteria

Description	Sub-criteria				
	Reliable and proven technology	Staging and timing	Constructability	Capacity	Carbon
Degree to which the option - Degree to which the option – uses proven technology, existing infrastructure; can be constructed, staged, constructed in the required timeframes; has sufficient capacity, secure land, available infrastructure.	• Uses reliable, robust and proven technology.	• Can the option be staged. • Is the option able to be constructed within the required timeframe.	• Is the option able to be constructed e.g., geotechnical conditions, presence of groundwater, contaminated land. • Is there sufficient land available to accommodate the option and can the land be secured. • Potential to maximise the use existing infrastructure that has a valuable remaining life. • Presence of existing other infrastructure.	• Does the option have capacity to accept projected flows and loads.	• Comparative carbon footprint for operation and construction.

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
High degree of alignment	1
Medium to high degree of alignment	2
Medium degree of alignment	3
Medium to low degree of alignment	4
Low degree of alignment	5

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 - sustaining the potential of natural and physical resources to meet the reasonably foreseeable needs of future generations.
- Section 7(b) - the efficient use and development of natural and physical resources.

8. Assessment method

An option's recommended 1 to 5 score is developed by first scoring each of the criterion's sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with a lower degree of alignment rather than a higher degree. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Option	Reliable and proven technology	Staging and timing	Constructability	Capacity	Carbon Footprint / Greenhouse Gas Emissions	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Te Puru Stream – diffuse discharge	1. MBR technology is now a mature technology in NZ.	1. Some elements of the WWTP can be staged for population growth.	1. New MBR treatment plant constructed on the existing WWTP site with minimal disruption to existing operation	3. The stream receiving environment has a limited capacity to accept discharges (compared with a marine outfall).	1. Embodied carbon in new WWTP; low operational emissions.	2
2b: Te Puru Stream – direct discharge	1. MBR technology is now a mature technology in NZ.	1. Some elements of the WWTP can be staged for population growth	1. New MBR treatment plant constructed on the existing WWTP site with minimal disruption to existing operation.	3. The stream receiving environment has a limited capacity to accept discharges (compared with a marine outfall).	1. Embodied carbon in new WWTP; low operational emissions	2
3: 100% to land	3. Conventional treatment plant is reliable but a 100% land scheme carries a weather related risk as no backup. Also a large area (750 ha) to manage.	3. Land acquisition / purchase is a risk to program for both obtaining consents and constructing the scheme on time.	3. Land application scheme is large and complex; spread over varying topography and multiple land parcels.	5. Highly unlikely to secure sufficient land area for 100% application. Weather and crop / land management risks to land capacity also.	5. High embodied carbon in irrigation network. Higher nitrous oxide (N2O) emission factor from land application compared with water discharges.	4
3a: Land and Te Puru Stream	2. Somewhere between options 2 & 3. 300 ha land area. Having the stream as a backup reduces the risk.	2. Somewhere between options 2 & 3.	2. Somewhere between options 2 & 3.	3. Similar to option 2.	4. Somewhere between options 2 & 3.	3
4ae: Hauraki Gulf Tāmaki Mid	1. Highly reliable system. Approximately 20 offshore outfalls currently in New Zealand.	2. Outfall must be constructed for ultimate population (no staging ability)	2. Long overland / road route conveyance pipe more disruptive than local stream options. If marine outfall is not buried (float and sink installation) then should not be too difficult.	1. The best option in terms of future growth capacity, providing outfall and conveyance pipes are sized adequately.	2. Embodied carbon in WWTP and outfall pipe. Low operational emissions.	2

10. Conclusions

- Water receiving environments for treated wastewater (either fresh or marine) have generally higher reliability and are generally less complex than land application systems.
- MBR treatment plants are becoming increasingly common in New Zealand as the technology matures and the capital costs reduce compared with conventional BNR plants.
- Operationally MBR plants are more complex however Watercare have experience now operating Pukekohe WWTP so this is not considered a significant differentiator.
- Modular development of treatment capacity and land application areas are easily staged however conveyance pipes and marine outfalls are not.
- The MBR option would most likely be a complete new facility.
- Conventional BNR treatment would allow some existing assets to be retained and incorporated into the new / upgraded WWTP.
- Options 3 (100% land) (and possible 3a) are unlikely to be compatible with Watercare’s target 40% reduction in infrastructure carbon due to the large irrigation network (assuming not forestry sequestration).

Statutory Risks and Conflicts Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Traffic light definition
- Criterion categories / sub-categories
- Method of assessment
- Assessment table
- Conclusions

2. Authors and experience

Criterion lead: Paula Hunter

Author	Role / Experience	Category / sub-criteria
Paula Hunter	Planner	All
Simpson Grierson	Legal	Legislative barriers to options proceeding.

3. Information sources

Marine and Coastal Area (Takutai Moana) Act 2011 (MACAA)

MACAA applications

Hauraki Gulf Marine Park Act 2000

New Zealand Coastal Policy Statement

National Policy Statement for Freshwater Management

National Policy Statement for Highly Productive Land

Auckland Unitary Plan

4. Assumptions and limitations

Assessments have not been informed by information of effects on Māori cultural values, mauri, mahinga kai, wāhi tapū and sites of significance.

5. Statutory Risks and Conflicts – description and sub-criteria

Description	Sub-criteria		
	Legislative barriers to options proceeding	Consenting complexity and compliance	Conflicts with statutory direction
Legislative processes that could restrict the ability of an option to proceed, scale of consenting complexity and consent compliance. Conflicts with the direction of key planning instruments.	• Risk of an option not proceeding due to legislative changes and outcomes of legislative processes e.g., potentially successful applications for customary title under the Takutai Moana Act.	• Scale of complexity of consenting processes including s91 deferrals. Scale of complexity of compliance requirements and costs.	• Conflict with the direction of key planning instruments e.g., non-complying activity classification with a supporting "avoid" policy.

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
Low risks and conflicts	1
Medium to low risks and conflicts	2
Medium risks and conflicts	3
Medium to high risks and conflicts	4
High risks and conflicts	5

7. Part 2

The RMA Part 2 matters addressed under this criterion are:

- Sections 5, 6, 7, 8.

8. Assessment method

An option's recommended 1 to 5 score is developed by first scoring each of the criterion's sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with higher risks and conflicts rather than those lower risks and conflicts. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Statistical Risks and Conflicts Assessment

Option	Legislative barriers to options proceeding	Complexity and compliance	Conflicts with statutory direction	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Tributary of Te Puru Stream – diffuse discharge	3 Watercare must give effect to Te Mana o te Wai as part of any functions, powers and duties imposed by the Water Services Act	1 One receiving environment, expanded overland flow area, compliance / monitoring requirements assumed to be slightly more complex than current requirements, compared to options involving new receiving environments consenting not as complex.	5 Challenging to argue that the discharge of treated wastewater to a tributary of the Te Puru Stream prioritises the health and well-being of the stream first, over secondly the health needs of people (such as drinking water) and thirdly the ability of people and communities to provide for their social, economic and cultural well-being. Challenging to argue this option will not result in the loss of stream values so potentially need to prove functional need to discharge to the stream i.e. the activity can only occur in that environment.	3
2b: Tributary of Te Puru Stream – direct discharge	3 Watercare must give effect to Te Mana o te Wai as part of any functions, powers and duties imposed by the Water Services Act	1 One receiving environment, new discharge structure, compliance / monitoring requirements assumed to be slightly more complex than current requirements, compared to options involving new receiving environments consenting not as complex.	5 Challenging to argue that the discharge of treated wastewater to a tributary of the Te Puru Stream prioritises the health and well-being of the stream first, over secondly the health needs of people (such as drinking water) and thirdly the ability of people and communities to provide for their social, economic and cultural well-being. Challenging to argue this option will not result in the loss of stream values so potentially requirement to prove functional need to discharge to the stream i.e. the activity can only occur in that environment.	3
3: 100% Land	1 No legislative barriers identified	4 750ha land required, assumed one contiguous area not achievable which could lead to consenting and compliance complexities, potential complexities if need to rely on the Public Works Act for investigations and land purchase, conveyance infrastructure to land applications areas, storage requirements, potential need for consents under the NESFM – natural wetlands.	2 Gives effect to Te Mana o te Wai as the discharge is 100% to land, if natural wetlands significant ecological areas etc. identified in land application areas potential to avoid them, no significant policy conflict identified.	2
3a: Land / tributary of Te Puru Stream	2 Watercare must give effect to Te Mana o te Wai as part of any functions, powers and duties imposed by the Water Services Act	5 300 ha land required, two receiving environments resulting in complex consenting and compliance / monitoring requirements, potential complexities if need to rely on the Public Works Act for investigations and land purchase, conveyance infrastructure to land applications areas, storage requirements, potential need for consents under the NESFM – natural wetlands.	3 Better gives effect to Te Mana o te Wai when compared to options 2a and 2b, but still need to get through the hierarchy and functional need tests, if natural wetlands significant ecological areas etc. identified in land application areas potential to avoid them.	3
4ae: Hauraki Gulf Tāmaki Mid	3 Potential risks associated with applications for customary rights and titles lodged under the Marine and Coastal Area (Takutai Moana) Act.	3 One receiving environment, conveyance infrastructure (5.6km) to outfall, new 2.9km ocean outfall, consenting complexities with conveyance, new outfall and discharge	3 Need to avoided where practicable, or remedied or mitigated adverse effects in areas of high recreational use, fishing or shellfish gathering; commercial development; significant ecological value, potential outfall location traverses an SEA Marine 2 area, gives effect to Te Mana o te Wai as the discharge is to the CMA.	3

10. Conclusion

Option 3a: 100% to land has scored best as it has a low risk of not proceeding due to legislative changes and outcomes of legislative processes, it gives effect to Te Mana o te Wai as the option does not involve a discharge to freshwater and no conflicts of any significance with other statutory directions. All the other options score a “3” – medium risks and conflicts.

Options 2a and 2b did not score well against the sub-criteria “conflicts with statutory direction” due to the challenges of giving effect to Te Mana o te Wai. Option 3a did not score well against sub-criterion complexity and compliance primarily because it comprises two receiving environments.

Opportunities and Benefits Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Traffic light definition
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table

2. Authors and experience

Criterion lead: Jim Bradley

Author	Role / Experience	Category
Jim Bradley	Environmental Engineer / 50+ years	All
Andrew Slaney	Process Engineer / 25 years	All

3. Information sources

- The information sources used for the Opportunities and Benefits Criterion include:
- Knowledge of the current Beachlands WWTP
- Information in the Draft "Beachlands Wastewater Treatment Plant Upgrade – Concept Design Basis"
- Watercare and Stantec personnel's wastewater treatment and management knowledge of the New Zealand sector and overseas
- Assumed (at this stage) technology and infrastructure criteria information
- Authors and experience of those involved in this section of the Report.

4. Assumptions and limitations

a. Overall Assumptions

The Wastewater Treatment Plan is based on the "Product Factory" concept as depicted below. Concepts and developments within Watercare in recent times have adopted this approach. The approach is consistent with the principles of the Circular Economy.

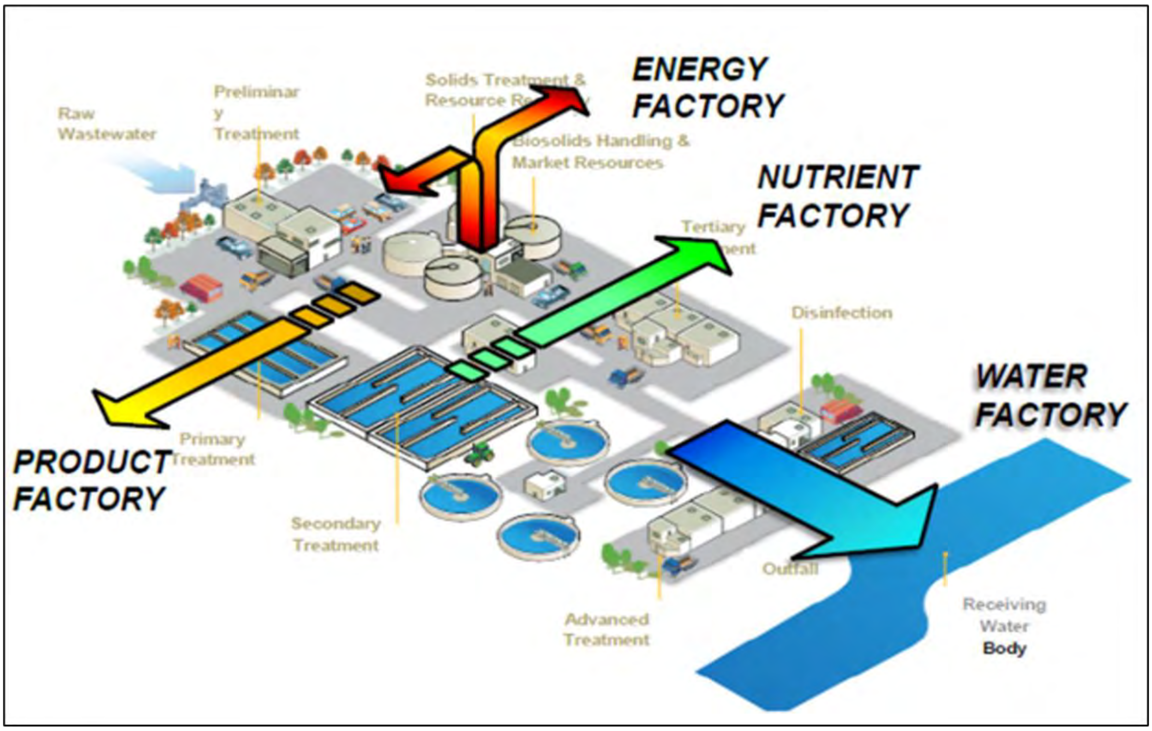


Figure 1 – The Product Factory Approach

b. Treated Wastewater Beneficial Reuse Assumption

e) Assessment based on the quality/degree of treatment of the treated wastewater and the extent/amount of treated wastewater to be beneficially reused
f) Assessment does not take into account "possible people's perceptions" of the beneficial reuse e.g. potable reuse, aquifer recharge of water supply source
g) Consents/other approvals etc can be sought for each of the beneficial reuse means included in the options.
h) The assessment includes nutrient recovery when treated wastewater is applied to land.
i) Conveyance lines of Option 4ae Tamaki mid Hauraki Gulf outfall can be tapped in for beneficial reuse of treated wastewater (consents and other approvals permitting).

c. Sludge and Biosolids Beneficial Reuse Assumptions

e) This assessment is based on degree of treatment of liquid phase needed i.e.for a high degree of treatment, there is more sludge/biosolids produced which could be beneficially reused. In this respect the MBR WWTP will produce more sludge/biosolids than the conventional BNR Plant, but this would only be a relatively small percent increase.
f) Includes vermiculture, biochar, other reusable biosolids material.
g) Assume no chemicals or other products used in the WWTP processes that render biosolids not beneficially reusable.
h) Assumes possible future/pending regulations on Emerging Organic Contaminants (EOC's) and/or microplastics does not limit beneficial reuse on land or any other reuse technique.

d. Energy Generation

Energy generation is not included in the table as it is assumed that based on the design population of the scheme (around 30,000 PE), based on the authors' experience, primary clarifiers and anaerobic digestion are unlikely to be economic and therefore none of the scheme options will provide energy generation possibilities. In addition it is noted that the carbon in primary solids will be needed for biological nitrogen / phosphorus removal as with the current plant and a number of others in New Zealand and internationally.

In terms of combustion or gasification of sludge to produce energy, this possibility is included in the sludge / biosolids beneficial use category.

5. Opportunities and Benefits Criterion – description and sub-criteria

<table>
<tr><th rowspan="2">Description</th><th colspan="3">Sub-criteria</th></tr>
<tr><th>Treated wastewater beneficial reuse</th><th>Sludge and biosolids beneficial reuse</th><th>Nutrient recovery and reuse</th></tr>
<tr>
<td>Provides opportunities for resource recovery including beneficial reuse, energy generation, nutrient recovery / reuse.</td>
<td>The degree and amount of beneficial reuse of treated wastewater for each of the short listed options will depend on many factors. These include:
The overall nature of the option and its infrastructure components and their locations e.g. conveyance lines, discharge points etc
The quality of the treated wastewater
The quantity of treated wastewater available that maybe beneficially reused and above the basic option formulation
The base reuse option e.g. land application compared to a direct discharge (steam or Hauraki Gulf discharge option)
The "add-ons" that maybe feasible, acceptable and where necessary consentable in terms of use of treated wastewater as compared to the options fundamental function(s)</td>
<td>This includes for the range and extent of beneficial reuses of sludges and biosolids, biosolids being sludges treated to specified levels. The extent of such practices will depend on many factors including:
Amount and quality of the sludge/biosolids
Demand for particular beneficial reuse practices
Approvals and when necessary resource consents granted for particular reuse practices such as application of biosolids to land, sale of biosolids to be the home gardener etc
Overall economics of a particular practice/beneficial reuse option
Meeting statutory planning provisions
Māori cultural, other cultural and social/neighbour considerations (neighbour to a beneficial reuse site and others)
Beneficial reuse techniques can for example include:
Application to agricultural, forestry, other crops
Turf culture, parks/gardens, nurseries
Compost made mixed green waste
Landfill and quarry restoration and capping
Energy production through furnacing e.g. cement kiln supplementary energy feed
Gasification/pyrolysis</td>
<td>This covers the beneficial reuse of nutrient in the treated wastewater
This do not include beneficial reuse of nutrients included in sludges and biosolids
This would also include the possibilities of extracting phosphorus by way of the struvite process extraction from the centrate return water, however such processes are not likely to be used in the WWTP types being considered</td>
</tr>
</table>

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
High opportunities and benefits	1
Medium to high opportunities and benefits	2
Medium opportunities and benefits	3
Medium to low opportunities and benefits	4
Low / minimal opportunities and benefits	5

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 – sustainable management of resources.
- Section 7(b) - the efficient use and development of natural and physical resources.
- Section 7 (ba) - the efficiency of the end use of energy.

8. Assessment method

An option's recommended 1 to 5 score is developed by first scoring each of the criterion's sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with low / minimal opportunities and benefits rather than higher opportunities and benefits. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Opportunities and Benefits Criterion

Option	Treated wastewater beneficial reuse	Sludge and biosolids beneficial reuse	Nutrient recovery / reuse	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Tributary of Te Puru Stream – diffuse discharge	4 Option based on overland flow to the Te Puru Stream discharge – no conveyance line from the WWTP site to facilitate reuse. Some minimal use and soakage area. High level of treatment provides opportunity for future reuse.	1 All options produce similar quantity of sludge and biosolids and have similar opportunities for beneficial use but with MBR slightly more sludge/biosolids.	5 No to minimal reuse of nutrients.	3
2b: Tributary of Te Puru Stream – direct discharge	4 Option based on Te Puru Stream direct discharge – no conveyance line from the WWTP site to facilitate reuse. High level of treatment provides opportunity for future reuse.	1 All options produce similar quantity of biosolids and have similar opportunities for beneficial use but with MBR slightly more sludge/biosolids.	5 No reuse of nutrients.	3
3: 100% Land	1 100% to land application so maximise beneficial reuse with appropriate crop(s) and management regime(s) selected (750 ha area)	1 WWTP has tertiary filtration so more sludge than BNR alone. Still slightly less than MBR options 2a and 2b	1 Uptake of nutrients by crops can be maximised.	1
3a: Land / tributary of Te Puru Stream	2 Some treated wastewater to land so maximises the beneficial reuse of that proportion providing appropriate techniques used like Option 3 (300ha area)	1 Same as Options 2a and 2b.	2 Uptake of nutrients by crops, but less than option 3a as less area	2
4ae: Hauraki Gulf Tāmaki Mid	4 Marine outfall Tamaki mid, assumes not as highly treated so not the same reuse potential but option to reuse 5.6km conveyance	3 Less, but not much less than MBR and BNR and tertiary filtration options.	5 No reuse of nutrients unless off take off conveyance line to land application for beneficial reuse	4

10. Conclusions

- Options 2a and 2b have no to little beneficial reuse of treated wastewater or nutrients but a high potential for beneficial use of sludge / biosolids.
- The 100% land application Option 3 and to a lesser extent Option 3a have a high potential for beneficial use of treated wastewater and associated nutrient uptake through crops.
- The outfall option 4ae has the lowest potential for beneficial reuse opportunities although the conveyance line to the coast could be tapped into.
- All options but particularly 2a and 2b provide opportunities for additional treatment and beneficial reuse (eg Hunua dam recharge or purple pipe non potable reuse)

Appendix F Initial Short List Workshop Participants

Attendee	Organisation
Chris Allen	Watercare
Dean Lawrence	Watercare
Helen Jansen	Watercare
Iris Tscharntke	Watercare
Jonathan Piggot	Watercare
Michael Webster	Watercare
Nathaniel Wilson	Watercare
Priyan Perera	Watercare
Rory Buchanan	Watercare
Tanvir Bhamji	Watercare
Ashlee Adams	Watercare
Annmarie Halst	Watercare
Revell Butler	Ngāi Tai ki Tāmaki
Luke Faithfull	Mitchell Daysh
Andrew Slaney	Stantec
Jim Bradley	Stantec
Katja Huls	Stantec
Paula Hunter	Stantec
Sharu Delilkan	Stantec
Allan Pattle	PDP (via teams)
Mark James	Aquatic Sciences
Padraig McNamara	Simpson Grierson
Warren Bangma	Simpson Grierson
Shane Kelly	Coast and Catchment

Appendix G Updated Short List Technical Expert Assessments

Public Health Protection Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Traffic light definition
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table
- Conclusions

2. Authors and experience

Criterion lead:

Author	Role / Experience	Category
Mark James	Strategic and technical advisor, Aquatic ecology	Microbiology Quality
Jim Bradley	Public Health Engineer	Reuse Options
Alan Pattle	Environmental Engineer	Land Application
Rebecca Stott	Microbiology expert, involved in a number of wastewater (**WW**) discharge projects, and Qualitative Microbial Risk Assessment (**QMRA**)	Microbiological quality of treated wastewater

3. Information sources

Extensive experience with a number of WW discharge projects including Omaha, Snells/Algies, Clarkes Beach, Army Bay and Wellsford.

Previous QMRA for Beachlands WWTP (2004)[17] estimated that human health risks are likely to be below tolerable risks for which freshwater and marine recreational water guidelines are based.

However, health risks associated with pathogenic bacteria and protozoa were substantially increased if faecal contamination from wildlife to the farm pond is considered. QMRA methodology has evolved since 2004 with the availability of new dose response models particularly for viruses (e.g. norovirus) which are typically the main aetiological agent associated with waterborne outbreaks.

Assessment uses the data available, including latest monitoring data for influent, effluent, upstream, after pond, Site 15 with limited data to date for Site E (reference), Site F and Te Puru Park (more data to come for sites in between).

[17] Stott, H.R. and McBride, G.B. 2004 Quantitative health risk assessment for a proposed upgrade to the Beachlands/Maraetai Sewage Treatment Plant, NIWA report prepared for Earth consult Ltd and Manukau Water, NIWA Client Report HAM2004-117, 45p

4. Assumptions and limitations

At least the current level of treatment and discharge quality.

QMRA to be completed on final Best Practicable Option (**BPO**) to confirm level of risk for recreation and food gathering at key sites.

Assume land/stream option will use land for most of year and maybe stream in winter when ground saturated.

5. Public Health Protection Criterion – description and sub-criteria

Description	Sub-criteria		
	Microbiological quality of treated wastewater	Spray irrigation / aerosols	Treated wastewater reuse
Degree of public health exposure to health risks from treated wastewater discharge (including through land application or re-use options).	Risk of public exposure to waterborne pathogens and other contaminants through: • Direct contact with the conveyance or treatment process. • Direct contact with the receiving environment, for example through contact recreation. • Indirect exposure – commercial operations, food gathering (shellfish, fish, watercress etc.) and groundwater use.	• Risk of public exposure to pathogens and other contaminant from spray irrigations.	• Risk of contamination of reclaimed water for potable and non-potable reuse.

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
Low degree of public exposure to risk	1
Medium to low degree of public exposure to risk	2
Medium degree of public exposure to risk	3
Medium to high degree of public exposure to risk	4
High degree of public exposure to risk	5

7. Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 – enables people and communities to provide for their health and safety.

8. Assessment method

An option’s recommended 1 to 5 score is developed by first scoring each of the criterion’s sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with higher degree of public exposure to risk effects rather than a lower degree. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Public Health Protection Criterion (Updated 4 December 2023)

Option	Microbiological quality of treated wastewater	Spray irrigation / aerosols	Treated wastewater reuse	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Tributary of Te Puru Stream – diffuse discharge	1 Relatively good quality water discharged at present, relatively low in microbes, and similar or reduced level to upstream and reference site. Low level of use – recreation at outlet from Te Puru Stream and in Kellys Bay, shellfish gathering low level Kellys Bay. Should meet standards at least for National Bottom Lines (**NBL**) under the NPSFM noting higher microbial levels upstream and at bottom Te Puru Stream to discharge form Pond. Low risk to downstream shellfish beds due to discharge. (Need to get microbial assessment/QMRA of stream for cattle water supply, shellfish gathering, shellfish sample's from Kellys Bay to confirm) Providing concentration in the proposed discharge is the same or similar in future, increase in volume should not have much effect but it is the dilution in the stream that will affect the effective concentration of pathogens downstream where exposure could occur. We will be considering this impact of volume in the QMRA. It potentially (for a 3x increase in volume) may not make much of a difference but that is why we are doing the modelling.	NA	NA	1
2b: Tributary of Te Puru Stream – direct discharge	~~1~~ 2 Could reduce any effects of birds in pond (may not be an issue). Levels in outlet very low (more data needed though). Proposed limit of <10 cfu/100 ml in discharge should not create any risk downstream. Attenuation not as great as Option 2a thus potential for minor effects.	NA	NA	~~1~~ 2
3: 100% to land	1 Lower level of treatment proposed (limit in discharge <14 cfu/100 ml) so higher risk than Options 2 and 2a. Low risk still after irrigation and groundwater attenuation. Further assessment of the hydrology is required. Saturated flow could be an issue if land application rates cause soils to be over-saturated? Land application provides another potential barrier to people being exposed by increasing the distance of pathogens to human receptors. Levels of pathogens in groundwater are generally very low due to attenuation providing that no bypass flows or other connected hydrological pathways present. If there was a bypass flow, transport of pathogens could be quite rapid. Viruses like rotavirus may last up to several days in soils. If this was the case this would be a minor potential adverse effect, i.e score of 2.	2 Low potential for aerosols drift with pathogens/other contaminants. Can be managed.	NA	2
3a: Land and Te Puru Stream	1 Low risk, when using stream discharge, to downstream surface waters as similar to Option 2 or 2a. No risk to stream system when	2 Low potential for aerosols drift with pathogens/other contaminants Can be managed	NA	2

Option	Microbiological quality of treated wastewater	Spray irrigation / aerosols	Treated wastewater reuse	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	
	applied to land (see above) in summer if onto land due to added attenuation.			
4ae: Hauraki Gulf Tāmaki Mid	1 Will be rapidly diluted close to discharge (use of appropriate diffuser) Low risk to shellfish gathering or contact recreation as some distance away.	NA		1

10. Conclusion

All five options present a low risk to public health for the following reasons:

- Under all options, the discharges will have high quality with low levels of microbial contamination. Application levels are slightly higher for land application and mid Tamaki but there will be further attenuation on land and rapid dilution offshore.
- There is a low level of recreation use in the stream and low levels of recreation and shellfish gathering in Kellys Bay. There will be rapid dilution from discharges into the CMA under the mid-Tamaki option, with microbes undetectable by the time water reaches shellfish beds.

Natural Environment Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions and limitations
- Traffic light definition
- Criterion categories / sub criteria
- Method of assessment
- Assessment table
- Conclusions

2. Authors and experience

Criterion lead: Mark James

Author	Role / Experience	Category
Mark James	Strategic and technical advisor	Coastal and freshwater
Shane Kelly	Technical advisor-marine science	Coastal
Mike Stewart	Technical advisor - freshwater	Freshwater
Alan Pattle	Environmental Engineer	Land

3. Information sources

Extensive experience with a number of WW discharge projects including Omaha, Snells/Algies, Clarkes Beach, Army Bay and Wellsford.

Assessments use the data available, including latest monitoring data for influent, effluent, upstream, after pond, Site 15 with limited data to date for Site E (reference), Site F and Te Puru Park(more data to come for site sin between).

Bio-researches annual compliance reports.

4. Assumptions and limitations

Population	people	30,000				
Per capita ADF	l/p/d	200				
ADF	m3/day	6,000				
	2a & 2b Stream & 3a Stream / Land		4 ae Hauraki Gulf		3 100% Land	
Parameter	Median conc. mg/L	Average load kg/day	Median conc. mg/L	Average load kg/day	Median conc. mg/L	Average load kg/day
BOD	5.0	n/a	5.0	30.0	20.0	120.0
TSS	5.0	n/a	5.0	30.0	20.0	120.0
NH4-N	0.50	3.0	1.00	6.0	1.00	6.0
NOx-N	2.0	12.0	5.0	30.0	5.0	30.0
SIN	2.5	15.0	6.0	36.0	6.0	36.0
TN	5.0	30	10.0	60	7.0	42
DRP	1.0	6.0	Monitoring only		4.0	24.0
TP	1.0	6.0	Monitoring only		5.0	30.0
Faecal coliforms	<10	n/a	<10	n/a	<100	n/a

- Assumes loads as per Stantec (sent 20^{nd} Nov)
- Assume land/stream option will use land for most of year and maybe stream in winter when ground saturated.
- Appropriate extension of land treatment as buffer before stream for Option 2a. Likely to be a diffuse discharge between the current outlet and the bridge.
- Waiting for more stream water quality monitoring data especially for sites between Site 15 and the Te Puru mouth – we need data for sites G and C.
- Assumes the TN increase is due to non-biodegradable organic N at least in the short term, not available for biological uptake
- Assumes currents are as modelled at Mid-Tamaki site but needs to be confirmed by putting in ADCP (3-4 weeks), full benthic survey at site if that is taken forward.
- Assumes nothing special at mid-Tamaki site.

5. Natural Environment – description and sub-criteria

Description	Sub-criteria			
	Coastal environment	Freshwater Surface	Freshwater Groundwater	Land
Potential adverse environmental effects on the receiving environments associated with the options. Ability to meet s107 of the RMA and align with the values and bottom lines of the NPS-FM.	• Effects on life supporting capacity - water quality, marine ecology, indigenous biodiversity. • Effects on foreshore and seabed. • Effects on natural character, features and landscapes. • Ability to meet the requirements of s107 of the RMA.	• Effects on Te Mana o te Wai. • Alignment with NPS-FM compulsory values, other values, national bottom lines. • Ability to meet the requirements of s107 of the RMA.	• Effects on Te Mana o te Wai. • Alignment with NPS-FM compulsory values, other values, national bottom lines.	• Effects on terrestrial ecology • Effects on highly productive land. • Effects on natural inland wetlands.

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
Low (less than minor) potential adverse effects	1
Medium to low (minor) potential adverse effects	2
Medium (more than minor) potential adverse effects	3
Medium to high (significant) potential adverse effects	4
High (significant and unlikely to be mitigated) potential adverse effects	5

7. RMA Part 2

- The RMA Part 2 matters addressed under this criterion are:
- Section 5 – safeguarding the life-supporting capacity of air, water, soil, and ecosystems.
- Section 6(a) - the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development.
- Section 6(b) - the protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development.
- Section 6(c) - the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna.
- Section 7(d) - intrinsic values of ecosystems.

- Section 7(f) - maintenance and enhancement of the quality of the environment.
- Section 7 (h) - the protection of the habitat of trout and salmon.

8. Assessment method

An option's recommended 1 to 5 score is developed by first scoring each of the criterion's sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with higher potential adverse effects rather than the lower effects. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Natural Environment Criterion (Updated 6 December 2023)

Option	Coastal Environment	Freshwater	Groundwater	Land	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Te Puru Stream – diffuse discharge	The proposed higher level of treatment (BNR+ MBR+UV) along with some attenuation through an increased land buffer zone would generally improve the quality of the input to the bay, though loads will be higher with the larger population. DIN loads will be similar but TN and DRP and TP loads will be higher. While the change is likely to be undetectable for the coast in general, flushing of the Bay is relatively slow. The increase in loads, may offset any improvement to the bay from a higher level of treatment. Medium to low (minor) adverse effects. If this proceeds, then will need a limited survey of shellfish along the coast close to the Te Puru Stream outlet.	The proposed level of treatment (BNR+MBR+UV) will improve the quality of the discharge and should improve the quality of the stream. There will be some increase in loads especially TN and for phosphorus (not for DIN) but this will be more of an issue for the coast as the final receiving environment. There are indications that the existing discharge increases the nutrient levels downstream even to Te Puru Park compared with upstream and reference sites and does not meet guidelines. The proposed level of treatment should mean standards/guidelines are now met downstream for dissolved inorganic nitrogen (DIN) eg at Site 15 below the first confluence. The assumption is that there will be an expansion of the buffer planted zone and potentially pond/wetland area to ensure the same level of attenuation from the WWTP before entering the stream as the volume increases. Fish and invertebrate diversity/numbers are very low below the discharge (conductivity is high) with inverts showing improvement downstream. Communities at present are "poor" downstream and would not meet the NPSFM NBL. It is a farmed catchment and habitat could play a part as even one of the reference site had low invertebrate scores. Conductivity was a concern expressed by Bioresearches and at times will be close if not exceeding the level that can impact on stream biota. The current levels in the discharge will need to be reduced significantly, this can be managed. Similarly, phosphorus levels will exceed the NBL downstream and should be reduced significantly through use of alum. Overall, with the new treatment including overland flow treatment, effects are potentially low for water quality in terms of nitrate and ammonia and may meet guidelines below Site 15. Whether this results in an improvement in biota is yet to be established.	NA?	NA	2 Note many parameters will obviously increase in the stream below the pond, even towards the bottom of the stream – so some questions over whether an increase allowed under NPSFM even if it meets standards.
2b: Te Puru Stream – direct discharge	Lower quality than above as no attenuation before entering the stream and eventually the estuary. Water quality at the nearest Council monitoring sites (Outer Tamaki and Wairoa Bay) has fluctuated between good and marginal rankings in the past 10 years, but median values for the water quality indicators used for determining these rankings have been below	Will be lower quality than diffuse discharge as there is no land buffer/attenuation. The overland flow treatment/pond presently can halve the concentrations and potentially loads of some nutrients. Will not meet NPSFM NBLs	NA	NA	3

Option	Coastal Environment	Freshwater	Groundwater	Land	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	
	regional water quality guidelines over the past 10 years (note that the WQ rankings are not based on median values). Higher loads would go into the coastal environment for DRP, TP and TN although any effects of this may be hard to detect Potentially medium adverse effects due to increase in loads and potentially slow flushing.	Medium (minor) adverse effects (depends on how much the land and pond take out and where standards should apply).			
3: 100% to land	85-90% reduction in contaminants, even with higher loads and reduced treatment means very low levels reaching the coast and would take some time. Low potential for adverse effects	Assuming the groundwater doesn't reach surface waters until the estuary/coast the potential adverse effects low. Even if there were some contaminants reaching waterways the levels would be significantly reduced going through soils and groundwater.	With low areal loading rates for contaminants and relatively short pathways under irrigation areas (500m average) changes to groundwater concentrations unlikely to be detectable. Do need to check nitrate levels in bores if this proceeds.	Effects on land likely to be increased saturation in winter (neutral for grass/fodder) but more productive in summer for grass/fodder.	1
3a: Land and Te Puru Stream	If most of the contaminants are removed then low risk of effects on coastal waters. Score depends on which stream option chosen and reductions before water reaches coast.	Land treatment/irrigation before discharge in summer, to Te Puru Stream when soils saturated and natural flows in stream likely to be higher. Low potential for adverse effects with high level of treatment and land buffer before stream.	With low areal loading rates for contaminants and relatively short pathways under irrigation areas (500m average) changes to groundwater concentrations unlikely to be detectable.	Effects on land likely to more productive for grass/fodder	1
4ae: Hauraki Gulf Tāmaki Mid	Water quality at the nearest Council monitoring sites (Outer Tamaki and Wairoa Bay) has fluctuated between good and marginal rankings in the past 10 years, but median values for the water quality indicators used for determining these rankings have been below regional water quality guidelines over the past 10 years (note that the WQ rankings are not based on median values). Good dilution with rapid dispersal and limited plume field, away from the coast. Little information on habitat quality and biota in the area. Video footage indicates that the existing seabed environment in the vicinity of the potential Mid Tāmaki outfall does not contain features of significant ecological value. Habitats at the site consisted of soft sediment interspersed with exposed patches of a remnant bed of dense shell. No rocky reefs, living biogenic habitats or regionally significant benthic species were observed within the survey area. However, the Gulf is degraded and needs to be improved. The option would increase the input from treated WW to the Gulf by an estimated 3-5% and would be 0.4 % of what is estimated to come from rivers into the HG(TBC) Emerging issues including reduced denitrification and low oxygen in bottom waters at times. Recent arrival of exotic Caulerpa (which is reportedly sensitive to nutrient inputs) would need	No impact on freshwater ecosystems and would actually improve quality of stream.	NA	NA	2

Option	Coastal Environment	Freshwater	Groundwater	Land	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	
	to be considered. Potentially medium to low effects.				
	We consider that a reduction in the level of treatment for offshore cf with stream discharge lowers the score. The Hauraki Gulf is showing signs of degradation that must be addressed and any increase in nutrients especially loads is likely to be unacceptable. The increase in loads would be a concern for nitrogen processes and oxygen levels in bottom waters even if the changes may not be detectable.				

10. Conclusion

- Option 2a Te Puru Stream – diffuse discharge
- Overall minor (medium to low) potential for adverse effects. The main reason for this option not being low is the increase in loads to the coast as the final receiving environment. Whether this will be detectable or have an obvious adverse effect is yet to be determined. The stream on the other hand transfers water relatively quickly to the coast but potential for changes to stream habitat, at least short-term with 3x the volume, lower the score. Noting that at time sin summer the only flow in the immediate tributary is from the WWTP.
- There could be some effect of load on the stream but not as much as at bottom of catchment. It is possible that the improved treatment will result in the stream meeting standards/guidelines at the bridge.
- Option 2b Te Puru Stream – direct discharge.
- Loads will be higher than diffuse discharge to the stream and may results in standards/guidelines not being met in the stream or receiving coastal environment. Increased risk of potential adverse effects compared with diffuse discharge. Risk to coastal and fresh waters may be medium (more than minor?) and may not meet standards int eh stream.
- Option 3 - 100% land
- Positive and negative effects due increased ground saturation in winter but more productive land in summer. Some contaminants (maybe up to 10% discharge load from treatment plant) would still reach waterways over long term (decades for full effect). Generally low level of effects due to attenuation before reaching coast.
- Option 3a – Land and Te Puru Stream
- Generally, a better option as provides better quality water in discharge and potential for attenuation in soils and groundwater. If soils saturated then assume could be put through a small land buffer and into stream as for Option 2a – maybe up to 50% of year. Lower residual load from groundwater to streams – may 1/3 of Option 3.
- Option 4ae – Hauraki Gulf Mid
- Good dilution of contaminants offshore but some question around increased loads to a degraded environment. The lower level of treatment results in potential for minor adverse effects on coastal waters but no effect on stream. Stream quality would improve at least in the upper reaches of the Te Puru Stream.

Social and Community Considerations Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions and limitations
- Traffic light definition
- Criterion categories / sub-categories
- Method of assessment
- Assessment table
- Conclusions

2. Authors and experience

Criterion lead: Katja Huls

Author	Role / Experience	Category
Katja Huls	Planner	All
Shane Kelly	Environmental Scientist	Recreation and Food Gathering
Workshop Participants	Confirmation of provisional score	Recreation and Food Gathering

3. Information sources

- 5086-SCTTTP-Marine-Spatial-Plan-WR.pdf, April 2017 (gulfjournal.org.nz)
- "Beachlands: Options for Sustainable Development", 'A Sustainable Development Plan for Beachlands' July 2008 (PDF).
- 2018 Census place summary: Te Puru
- Whitford Estuaries Conservation Society (whitford estuaries (whitfordestuary.org))
- The Auckland Unitary Plan Operative in part (Updated November 2023)
- Auckland Council Cultural Heritage Index (geospatial database)
- Understanding the Social Impacts of Freshwater Reform: A Review of Six Limit-Setting SIAs, Mike Mackay and Nick Taylor for the Ministry of Environment 2020
- State of our Gulf Report 2017 (State of our Gulf 2017 - Knowledge Auckland (link))
- Use of treated sewage or wastewater as an irrigation water for agricultural purposes – Environmental, health, and economic impacts, Ofori et. al. 2020 (link) Science Direct.
- Auckland Region Mountain Biking Trails (link)
- Proposed Plan Change 88 to the Auckland Unitary Plan, notified 26 January 2023.
- Community Survey and Community Information session report and summary from Watercare Services Ltd 1 November 2023

4. Assumptions and limitations

- The discharges will not increase erosive flows in the ~~streams and~~ inlets.
- Erosive flows in the stream will be managed with stream bank strengthening using best practice methods.
- Land application sites will be chosen to avoid sensitive sites.

- Engineered Overflow Points in the wastewater network have not been assessed in terms of their location, nor the need for additional overflow points or their effects.
- While cultural effects are within the ambit of ~~this~~ a typical social and community assessment; ~~however~~ Mana Whenua feedback ~~has not been received yet. Their feedback may impact the scoring~~ addressing Maori cultural effects is separate to this assessment because it is appropriate that this assessment is conducted by Mana Whenua .
- A Quantitative Microbial Risk Assessment has not been conducted which may impact the scoring.
- An economic assessment has not been conducted on the impacts of wastewater re-use on rural land.
- A targeted survey of commercial stakeholders has not been conducted.
- Community feedback was received from 61 participants in an online survey and 30 - 40 participants in a community information session. Some may have participated in both sessions.
- An archaeological assessment has not been completed, but known archaeological sites and heritage sites identified in the Auckland Council Cultural Heritage Inventory[18] have been included in the assessment.
- To date recreation surveys have not been undertaken.
- The assessments for the recreation and food gathering sub-criteria are preliminary and will require input from workshop participants.

5. Social and Community Considerations Criterion – description and sub-criteria

Description	Sub-criteria			
	Amenity values	Recreation and food gathering	Heritage and archaeology	Rural and commercial activities
Potential adverse effects on social and community values relating to amenity, recreation and food gathering, archaeology and heritage. Public access to and along the coastal marine area, and rivers and streams. Impact on rural activities and commercial operations.	• Nuisance effects (e.g., odour, noise, visual). • Effects on sensitive activities	• Effects on recreation activities and values, and food gathering. • Effects on public access to the CMA, rivers, and streams.	• Effects on archaeology and recorded sites of significance. • Effects on heritage buildings and sites.	• Effects on rural activities • Effects on commercial operations in the marine environment

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
Low (less than minor) potential adverse effects	1
Medium to low (minor) potential adverse effects	2
Medium (more than minor) potential adverse effects	3
Medium to high (significant) potential adverse effects	4
High (significant and unlikely to be mitigated) potential adverse effects	5

[18] The Cultural Heritage Inventory (CHI) is a computer database containing information on over 20,000 heritage places including archaeological and maritime sites, built and botanical heritage areas and places and sites of significance to mana whenua.

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 – enables people and communities to provide for their social and economic well being.
- Section 6(d) - the maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers.
- Section 6(f) - the protection of historic heritage from inappropriate subdivision, use, and development.
- Section 7(c) - the maintenance and enhancement of amenity values.
- Section 7(f) - maintenance and enhancement of the quality of the environment.

8. Assessment method

An option's recommended 1 to 5 score is developed by first scoring each of the criterion's sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with higher potential adverse effects rather than the lower effects. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Social and Community Considerations Criterion (Updated 1 December 2023)

Option	Amenity values	Recreation and food gathering	Heritage and archaeology	Rural and commercial activities	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Tributary to Te Puru Stream – diffuse discharge	1 The stream flows approximately 4.5km to Kelly's Beach. The stream channel is tidal here and approximately 12m wide between the mangrove tree lines. Amenity values are unlikely to be affected by the discharge to the stream because the discharge will not be discernible from natural flows in the stream. The discharge is unlikely to generate any odours associated with the stream environment.	3 (provisional) The Te Puru (Te Ruangaingai) Stream traverses the eastern side of Te Puru Park, which is a sports ground and community facility. It enters the CMA at Kelly's Bay on the eastern side of the Park. Kelly's Bay is tidal with a sandy beach and walkways to Omana Beach to the east and Shelly Bay to the west. The amount of shellfish gathering in Kelly's Beach is not known. MoH and Fisheries NZ and Councils generally advise against gathering shellfish from urban areas. Risks will be assessed further with a Quantitative Microbial Risk Assessment. Land based recreation is unlikely to be affected by the discharge to the stream because the discharge will not be discernible from natural flows in the stream. Swimming recreation may be affected due to negative perceptions associated with wastewater discharges (feedback from community engagement).	3 The urupa in Te Puru Park could be affected by flood waters that have mixed with the treated wastewater discharge. This matter should be considered and assessed by mana whenua. There are two known midden on the banks of the tidal portion of the Te Puru Stream near the coast (referenced as S11-559 and S11-560 in the Auckland Council Cultural Heritage Index). These are not expected to be affected by treated wastewater discharges.	1 Commercial activities other than rural activities are not evident in the vicinity of the Te Puru Stream. It is not expected that treated wastewater discharges in the stream will impact the surrounding rural activities. There is limited commercial fishing in the vicinity of Kelly's Bay.	2
2b: Tributary to the Te Puru Stream – direct discharge	1 The stream flows approximately 4.5km to Kelly's Beach. The stream channel is tidal here and approximately 12m wide between the mangrove tree lines. Amenity values are unlikely to be affected by the discharge to the stream because the discharge will not be discernible from natural flows in the stream. The discharge is unlikely to generate any odours associated with the stream environment.	3 (provisional) The Te Puru (Te Ruangaingai) Stream traverses the eastern side of Te Puru Park, which is a sports ground and community facility. It enters the CMA at Kelly's Bay on the eastern side of the Park. Kelly's Bay is tidal with a sandy beach and walkways to Omana Beach to the east and Shelly Bay to the west. The amount of shellfish gathering in Kelly's Beach is not known. MoH and Fisheries NZ and Councils generally advise against gathering shellfish from urban areas. Risks will be assessed further with a Quantitative Microbial Risk Assessment. Land based recreation is unlikely to be affected by the discharge to the stream because the discharge will not be discernible from natural flows in the stream. Swimming recreation may be affected due to negative perceptions associated with wastewater discharges (feedback from community engagement).	3 The urupa in Te Puru Park could be affected by flood waters that have mixed with the treated wastewater discharge. This matter should be considered and assessed by mana whenua. There are two known midden on the banks of the tidal portion of the Te Puru (Te Ruangaingai) Stream near the coast (S11-559 and S11-560). These are not expected to be affected by treated wastewater discharges.	1 Commercial activities other than rural activities are not evident in the vicinity of the Te Puru Stream. It is not expected that treated wastewater discharges in the stream will impact the surrounding rural activities. There is limited commercial fishing in the vicinity of Kelly's Bay.	2
3: 100% to land	2 The indicative land application area (750ha) is extensive and includes land zoned Countryside	2 (provisional) Equestrian activities occur on the rural land and there are a number of mountain bike trails in the	12	4	2

Option	Amenity values	Recreation and food gathering	Heritage and archaeology	Rural and commercial activities	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	
	Living which enables rural-residential living activities including lifestyle blocks, "hobby farming", fruit and vegetable growing and equestrian activities. While the Public Health Protection assessment concludes that there is low potential for aerosols drift from the discharge, residents could consider this as a risk. Sensitive land uses are located in the urban areas and are remote from the identified land application area.	Maraetai and Whitford forests. These could lead to direct contact with the treated wastewater and any pathogens within it. These risks will be assessed further with a Quantitative Microbial Risk Assessment.	Known cultural and archaeological sites have been identified and will be excluded from any land application area with a buffer. There is the potential, within the proposed land application area, for other cultural and archaeological sites to be discovered during construction. A buffer will also be applied around these areas to exclude them. No formal feedback has yet been received from mana whenua on the effectiveness of a buffer, or its appropriate size. An archaeological assessment and guidance from Mana Whenua would assist with better understanding the risk of undiscovered sites occurring. Heritage buildings and sites are not affected by this option.	The indicative land application area is extensive and includes land zoned for rural production activities and Countryside Living. Irrigation with treated wastewater may affect land values for land marketed as rural lifestyle living. Irrigation may improve yield from rural land in dry seasons. There is potential risk associated with effects of the discharge on rural production activities (dairy, fruit, vegetables) and market perceptions. Risks of pathogens will be assessed further with a Quantitative Microbial Risk Assessment.	
3a: Land and Tributary to the Te Puru Stream	2 The assessment for this option is the same as the matters set out for the land and for the stream options. A precautionary approach has been adopted for the score, based on the score for the land option.	3 (provisional) The assessment for this option is the same as the matters set out for the land and for the stream options. A precautionary approach has been adopted for the score, based on the score for the stream options.	2 The assessment for this option is the same as the matters set out for the land and for the stream options. A precautionary approach has been adopted for the score, based on the score for the stream options.	2 Because this option also involves a large land area (300ha) the assessments for Option 3 are equally relevant but as the land requirement is less a lower score has been adopted.	2
4ae: Hauraki Gulf Tāmaki Mid	2 It is assumed the near shore section of the wastewater pipe and ocean outfall ~~while on land~~ would be buried and not visible from the reserve or beach therefore any amenity effects are likely to be temporary in nature associated with construction. Note that the outfall will lay on the seabed further into the strait, however assessment the seabed does is not included in the scope of this assessment.	3 (provisional) This part of the Hauraki Gulf is particularly valued for marine recreation such as swimming, shellfish gathering, fishing, boating and sailing. The various beaches are a very popular weekend destination during the summer months. For this reason, a wastewater discharge to the Tamaki Strait could impact the perception of this coastline as a marine destination. This is corroborated by feedback from an online survey conducted by Watercare. The expected dilution at the outfall is high and shellfish are unlikely to experience actual effects provided that the discharge is compliant. Public access to the beach will be unlikely to be affected during construction, but there may be access restrictions to parts of the beach and reserve during construction.	3 Two midden (R11-2368, R112138) and a Midden/Oven (R11-2654) may be affected by construction work. The urupa on the eastern side of Te Puru Park was discovered accidentally while developing the fields and it is possible that there are other burials in the vicinity. An archaeological assessment and guidance from Mana Whenua would assist with better understanding the risk of this occurring.	3 The treated wastewater discharge will be released 2.9km into the Tamaki Strait. Commercial fishing and marine farming occur in the Strait. The risk of effects on fish and shellfish is likely to be minor due to the very high dilution rates, but further assessment is required. A Quantitative Microbial Risk Assessment will support assessing this risk further. While the expected dilution rates are very high, the perception associated with wastewater discharges and the effects on shellfish may negatively impact the marketing of products produced via marine farming in this area.	3

10. Conclusion

All options have an overall score of 2 - medium to low (minor) potential adverse effects except Option 4ae: Hauraki Gulf Tāmaki Mid. This option had a score of 3 medium (more than minor) potential adverse effects, primarily because it had higher scores for the recreation and food gathering, heritage and archaeology and rural and commercial activities sub-criteria.

None of the option sub-criteria were scored as having High (significant and unlikely to be mitigated) potential adverse effects (5). The highest scoring sub-criteria was rural and commercial activities for Option 3: 100% to land which was assessed as having medium to high (significant) potential adverse effects (4).

Financial Implications Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Approach to scoring
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table
- Conclusions

2. Authors and experience

Criterion lead: Andrew Slaney

Author	Role / Experience	Category
Jim Bradley	Environmental Engineer / 50+ years	All
Alan Pattle	Land Application Engineer / 40+ years	Land application
Gary Teear	Marine Engineer / 40+ years	Ocean Outfall
Andrew Slaney	Process Engineer / 25 years	All
ALTA	Cost estimators (yet to be undertaken)	All

3. Information sources

- Alta P95 capital cost estimates (see Alta memo dated 22/11/23)

4. Assumptions and limitations

- MBR treatment option completely replaces existing WWTP – buffer ponds can be reused for storage of treated effluent to manage discharge.
- BNR treatment option assumes some reuse of existing assets (eg clarifier) to be considered during concept design.
- Outfall cost based on float and sink installation (marine outfall on top of seabed). Alternative is buried / tunnelled which would be significantly more expensive.
- Outfall foreshore transition assumed not rocky coastline.
- Net present value (NPV) based on 35 years at 4.3% p.a. discount rate.
- Annual maintenance cost of 2.0% of base capital cost (excluding contingencies).
- Additional pumping energy and chemical costs included where applicable.
- Other WWTP operating costs (labour, sludge, electrical energy costs) common to all schemes and included at $350 per 1,000 m^3 volume treated.
- Range of costs shown in assessment table reflect confidence interval of -10% + 30%.

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5. Financial implications criterion – description and sub-criteria

Description	Sub-criteria			
	Capital cost	Operating and maintenance cost	Whole of life cost	Financial risk
Comparative capital, operating and maintenance, whole of life costs of the options. Where relevant to the option, land acquisition costs, capital gains and product net revenue. Affordability – community, business, and trade waste dischargers	• Capital cost of the total scheme including any land acquisition costs, capital gains and product net revenue.	• Cost effectiveness of operations and maintenance	• Combination of capital and operation and maintenance costs over the life of the assets	• Is the option affordable even if growth does not occur as predicted. • Cost to the community, business and trade waste dischargers.

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
Low financial implications	1
Medium to low financial implications	2
Medium financial implications	3
Medium to high financial implications	4
High financial implications	5

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 - enables people and communities to provide for their economic well-being.
- Section 7(b) - the efficient use and development of natural and physical resources.

8. Assessment method

An option's recommended 1 to 5 score is developed by first scoring each of the criterion's sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with higher financial implications rather than lower implications. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Financial Implications Criterion (Update 29 November 2023)

Option	Capital cost	Operating and maintenance cost	Whole of life cost (NPV)	Financial risk	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Tributary of Te Puru Stream – diffuse discharge	1 Lowest capex $270 – $430M	1 Lowest opex $52M PV	1 Lowest NPV $320 – $480M	1 Lowest risk	1
2b: Tributary of Te Puru Stream – direct discharge	1 Lowest capex $270 – $430M	1 Lowest opex $52M PV	1 Lowest NPV $320 – $480M	1 Lowest risk	1
3: 100% to land	5 Highest capex $320 – 510M	5 Second highest opex $54M PV	5 Highest NPV $370 – $560M	5 Land price risk	5
3a: Land and Te Puru Stream	4 Second highest capex $310 – $490M	4 Highest opex $56M PV	4 Second highest NPV $370 – $550M	4 Land price risk	4
4ae: Hauraki Gulf Tāmaki Mid	2 Third lowest capex $280 – $450M	2 Lowest opex $52 PV	2 Third lowest NPV $330 – 500M	3 Outfall sized for ultimate population Risk of higher outfall cost if float and sink unacceptable and marine outfall has to be buried / bored (could be a 4 in this case).	2*

* Could go up to 3 if marine outfall needs to be buried / bored.

10. Conclusions

- Options 2a and 2b are essentially the same in terms of the accuracy of the estimates (the only difference being the Te Puru Stream arrangements).
- The financial risks associated with Options 2a and 2b are lowest providing the assessed treatment quality meets environmental requirements in the stream.
- The high costs for Options 3 and 3a reflect the high land costs in the area and the tight soils and resulting large areas required for land application (750 ha for Option 3 and 300 ha for option 3a). The estimated costs include costs associated acquisition and any objections under the Public Works Act 1981.
- Marine outfall cost has a reasonably high risk due to the sensitivity of the Hauraki Gulf environment which could result in the outfall to be buried or bored for part or all of its length in the Gulf.

Resilience Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions and limitations
- Traffic light definition
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table
- Conclusions

2. Authors and experience

Criterion lead: Andrew Slaney

Author	Role / Experience	Category
Andrew Slaney	Process Engineer / 25 years	Overall / wastewater treatment
Jim Bradley	Environmental Engineer / 50+ years	Overall

3. Information sources

- Knowledge of the current Beachlands WWTP
- Information in the Draft "Beachlands Wastewater Treatment Plant Upgrade – Concept Design Basis"
- Experience of the authors.
- Preliminary outfall location options report (DHI) (dated 12/9/23)

4. Assumptions and limitations

- Fresh water discharge options: BNR / MBR treatment process (highest level of treatment)
- Land application options: Conventional BNR process with tertiary filtration & UV
- Land application options: Pasture cut and carry system (not forestry)
- Marine outfall options: Conventional BNR process with tertiary filtration & UV

5. Resilience Criterion – description and sub-criteria

Description	Sub-criteria			
	Natural hazards	Climate Change	Operational resilience	Flexibility
Degree to which the option is resilient to natural hazards and climate change, offers operational resilience, addresses the carbon component of 40/20/20. Flexibility to accommodate changes in flows and loads, ability to respond to changes in regulatory standards, changes in technology.	• Land stability and erosion affecting infrastructure. • Flooding affecting infrastructure. • Wildfires affecting infrastructure (land application in forests). • Earthquakes	• High intensity rainfall peaks affecting the infrastructure. • Prolonged wet weather periods affecting the infrastructure. • Prolonged dry periods affecting the infrastructure. • Prolonged dry periods resulting in an increase of low flows in streams and rivers. • Sea level rise and coastal storm inundation affecting infrastructure (ocean outfall).	• Power supply reliability – effect of outages and rapid changes to electricity pricing. • Scheme complexity leading to operational problems. • Third party damage to infrastructure, e.g., digger hitting cables, pipes etc. • Crop failure/contamination. • Loss of market for land application products e.g., cut and carry products, forestry production.	• Ability to accommodate changes in flows and loads. • Ability to respond to changes in regulatory standards e.g., emerging contaminants, endocrine disrupting compounds. • Ability to respond to changes in technology.

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
High degree of resilience	1
Medium to high degree of resilience	2
Medium degree of resilience	3
Medium to low degree of resilience	4
Low degree of resilience	5

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 – enables people and communities to provide for their health and safety.
- Section 7(i) – the effects of climate change.

8. Assessment method

An option's recommended 1 to 5 score is developed by first scoring each of the criterion's sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with lower degree of resilience rather than the higher degree. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Resilience Criterion (Updated 29 November 2023)

Option	Natural Hazards	Climate Change	Operational Resilience	Flexibility	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Tributary of Te Puru Stream – diffuse discharge	1. Low risk from natural hazards. Can use storage lagoon to control discharge volume and rate.	1. Resilient to climate change impacts. The increased volume of highly treated wastewater could be a benefit to stream flow and ecology etc during prolonged periods of dry weather.	1. Modern and proven BNR / MBR / UV WWTP and freshwater discharge system.	1. MBR lends itself to future reuse opportunities and/or even more treatment standards. eg reverse osmosis.	1
2b: Tributary of Te Puru Stream – direct discharge	1. Low risk from natural hazards. Can use storage lagoon to control discharge volume and rate.	1. Resilient to climate change impacts. The highly treated wastewater could be a benefit to stream flow and ecology etc.	1. Modern and proven BNR / MBR / UV WWTP and freshwater discharge system	1. MBR lends itself to future reuse opportunities and/or even more treatment standards. eg reverse osmosis.	1
3: 100% to land	3. Flooding / land slips risk with no backup option.	3. Similar to Natural Hazards criterion. Increased frequency of high intensity rainfall events is a risk to land application.	4. Land application management adds complexity to operation. Crop market risks.	3. Land management / crop type could be difficult to change if necessary due to crop market changes or other factors.	3
3a: Land and Te Puru Stream	~~3~~ 2. Flooding / land slips risk but have stream backup option. Changed from 3 to 2.	~~3~~ 2. Increased frequency of high intensity rainfall events is a risk to land application but have the stream as a backup option. Changed from 3 to 2.	3. Land application management adds complexity to operation, crop market risks but not a significant as Option 3 as smaller land area and stream discharge.	2. Land management / crop type could be difficult to change if necessary due to market or other factors but not a significant as Option 3 as smaller land area and stream discharge.	~~3~~ 2 Changed from 3 to 2.
4ae: Hauraki Gulf Tāmaki Mid	1. Low risk from natural hazards.	1. Resilient to climate change impacts and the outfall would not be affected by sea level rise or inundation given the outfall would be buried from the shoreline to the mid channel and then laid on the seabed surface to the discharge point	2. Standard WWTP and some complexity with marine discharge system.	1. Conventional BNR technology can also be upgraded to provide reuse opportunities but would require more upgrading compared with the MBR option. Conveyance pipe provides reuse opportunities to tap into treated wastewater (refer opportunities category).	1

10. Conclusions

- Water based discharges have a generally higher resilience than land application systems which are highly dependent on weather and soil conditions.
- MBR technology provides greater flexibility and opportunities for future reuse (eg Hunua recharge or purple pipe non potable reuse).
- Conventional BNR technology can also be upgraded to provide reuse opportunities but would require more upgrading compared with the MBR option.
- Ocean outfall option is somewhat less flexible due to high infrastructure investment.
- Experience with offshore marine outfalls in New Zealand (20 or so) shows by and large a sustainable and resilient long-term solution providing appropriately sized and located and treated wastewater quality is appropriate for the receiving environment.

Technology and Infrastructure Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Traffic light definition
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table
- Conclusions

2. Authors and experience

Criterion lead: Andrew Slaney

Author	Role / Experience	Category
Andrew Slaney	Process Engineer / 25 years	Overall / wastewater treatment
Jim Bradley	Environmental Engineer / 50+ years	Overall

3. Information sources

- Knowledge of the current Beachlands WWTP
- Information in the Draft "Beachlands Wastewater Treatment Plant Upgrade – Concept Design Basis"
- Experience of the authors.
- Preliminary outfall location options report (DHI) (dated 12/9/23)

4. Assumptions and limitations

- Fresh water discharge options: BNR / MBR treatment process (highest level of treatment)
- Land application options: Conventional BNR process with tertiary filtration & UV
- Land application options: Pasture or other crop cut and carry system (not forestry).
- Marine outfall options: Conventional BNR process with tertiary filtration & UV
- Carbon footprint includes total lifetime emissions (embodied plus operational)
- Carbon footprint includes nitrous oxide emissions

5. Technology and Infrastructure Criterion – description and sub-criteria

Description	Sub-criteria				
	Reliable and proven technology	Staging and timing	Constructability	Capacity	Carbon footprint / GHG emissions
Degree to which the option - Degree to which the option – uses proven technology, existing infrastructure; can be constructed, staged, constructed in the required timeframes; has sufficient capacity, secure land, available infrastructure.	• Uses reliable, robust and proven technology.	• Can the option be staged. • Is the option able to be constructed within the required timeframe.	• Is the option able to be constructed e.g., geotechnical conditions, presence of groundwater, contaminated land. • Is there sufficient land available to accommodate the option and can the land be secured. • Potential to maximise the use existing infrastructure that has a valuable remaining life. • Presence of existing other infrastructure.	• Does the option have capacity to accept projected flows and loads.	• Comparative carbon footprint / GHG emissions for operation and construction.

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
High degree of alignment	1
Medium to high degree of alignment	2
Medium degree of alignment	3
Medium to low degree of alignment	4
Low degree of alignment	5

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 - sustaining the potential of natural and physical resources to meet the reasonably foreseeable needs of future generations.
- Section 7(b) - the efficient use and development of natural and physical resources.

8. Assessment method

An option's recommended 1 to 5 score is developed by first scoring each of the criterion's sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with a lower degree of alignment rather than a higher degree. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Technology and Infrastructure Criterion (Updated 29 November 2023)

Option	Reliable and proven technology	Staging and timing	Constructability	Capacity	Carbon Footprint / Greenhouse Gas Emissions	**Overall Score**
	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Tributary of Te Puru Stream – diffuse discharge	1. MBR technology is now a mature technology in NZ.	2. Some elements of the WWTP can be staged for population growth.	1. New MBR treatment plant constructed on the existing WWTP site with minimal disruption to existing operation	3. The stream receiving environment has a lower capacity to accept discharges compared with a marine outfall so scores higher to provide differentiation for this criterion. Refer to Natural Environment criterion.	1. Embodied carbon in new WWTP; low operational emissions.	2
2b: Tributary of Te Puru Stream – direct discharge	1. MBR technology is now a mature technology in NZ.	1. Some elements of the WWTP can be staged for population growth.	1. New MBR treatment plant constructed on the existing WWTP site with minimal disruption to existing operation	3. The stream receiving environment has a lower capacity to accept discharges compared with a marine outfall so scores higher to provide differentiation for this criterion. Refer to Natural Environment criterion.	1. Embodied carbon in new WWTP; low operational emissions	2
3: 100% to land	3. Conventional treatment plant is reliable but a 100% land scheme carries a weather risk (high intensity rainfall events causing flooding and potential land instability and damage to infrastructure) as there is no backup. Also a large area (750 ha) to manage.	3. Land acquisition / purchase is a risk to program for both obtaining consents and constructing the scheme on time.	3. Land application scheme is large and complex; spread over varying topography and multiple land parcels.	~~3~~ 4. Watercare has the power under the PWA 1981 to aquire land. However, this is subject to an objections process. Accordingly, it may be difficult for Watercare to secure a sufficient land area for 100% application, particularly within required timeframes. Weather and crop / land management risks to land capacity also. Changed from 3 to 4.	5. High embodied carbon in irrigation network. Higher nitrous oxide (N2O) emission factor from land application compared with water discharges. Forestry is not assumed for this option hence no carbon sequestration credit.	4
3a: Land and Te Puru Stream	2. MBR technology is now a mature technology in NZ. Land area not as large as for Option 3 (300 ha). Having the stream as a backup reduces the risk.	2. Some elements of the WWTP can be staged for population growth. Land acquisition / purchase is a risk to program not as high as for Option 3 as area required not as large.	2. New MBR treatment plant constructed on the existing WWTP site with minimal disruption to existing operation. Land application scheme is not as large and complex as Option 3.	3. The stream receiving environment has a limited capacity to accept discharges (compared with a marine outfall). This option also involves discharge to land (300 ha). While Watercare has the ability to compulsorily acquire land under the PWA, this is subject to a right of objection. Accordingly, this may be difficult, as outlined above, in relation to Option 3.	4. Embodied carbon in new WWTP; low operational emissions. High embodied carbon in irrigation network, higher nitrous oxide (N2O) emission factor from land application compared with water discharges.	3
4ae: Hauraki Gulf Tāmaki Mid	1. Highly reliable system. Approximately 20 offshore outfalls currently in New Zealand.	2. Outfall must be constructed for ultimate population (no staging ability)	2. Long overland / road route conveyance pipe more disruptive than local stream options. The foreshore and initial section of the outfall will be buried. Assuming the majority of the marine outfall is not buried (that is, float and sink) then this section should not be too difficult.	1. The best receiving environment in terms of capacity, providing outfall and conveyance pipes are sized adequately.	2. Embodied carbon in WWTP and outfall pipe. Low operational emissions.	2

10. Conclusions

- Water receiving environments for treated wastewater (either fresh or marine) have generally higher reliability and are generally less complex than land application systems.
- MBR treatment plants are becoming increasingly common in New Zealand as the technology matures and the capital costs reduce compared with conventional BNR plants.
- Operationally MBR plants are more complex however Watercare have experience now operating Pukekohe WWTP so this is not considered a significant differentiator.
- Modular development of treatment capacity and land application areas are easily staged however conveyance pipes and marine outfalls are not.
- The MBR option would most likely be a complete new facility.
- Conventional BNR treatment would allow some existing assets to be retained and incorporated into the new / upgraded WWTP. (All reusable assets like the storm buffer pond can be reused for both BNR+MBR plant and conventional BNR treatment). Watercare have advised that most of the existing assets cannot be reused.
- Option 3 (100% land) and possible Option 3a are unlikely to be compatible with Watercare's target 40% reduction in infrastructure carbon due to the large irrigation network (assuming not forestry sequestration).
- While Watercare has the ability to compulsorily acquire land under the PWA 1981, there may be difficulties and delays associated with obtaining all of the land required, due to landowner's right of objection.

Statutory Risks and Conflicts Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Approach to scoring
- Criterion categories / sub-categories
- Method of assessment
- Assessment table
- Conclusions

2. Authors and experience

Criterion lead: Paula Hunter

Author	Role / Experience	Category / sub-criteria
Paula Hunter	Planner	All
Simpson Grierson	Legal	Legislative barriers to options proceeding.

3. Information sources

Marine and Coastal Area (Takutai Moana) Act 2011 (MACAA)

MACAA applications

Hauraki Gulf Marine Park Act 2000 (HGMPA)

New Zealand Coastal Policy Statement 2010

National Policy Statement for Freshwater Management 2020

National Policy Statement for Highly Productive Land 2022

Auckland Unitary Plan Operative in Part (Updated 10 November 2023)

Water Services Act 2021

Resource Management Act 1991

4. Assumptions and limitations

Assessments have not been informed by information of effects on Māori cultural values, mauri, mahinga kai, wāhi tapū and sites of significance.

5. Statutory Risks and Conflicts – description and sub-criteria

Description	Sub-criteria		
	Legislative barriers to options proceeding	Consenting complexity and compliance	Conflicts with statutory direction
Legislative processes that could restrict the ability of an option to proceed, scale of consenting complexity and consent compliance. Conflicts with the direction of key planning instruments.	• Risk of an option not proceeding due to legislative changes and outcomes of legislative processes e.g., potentially successful applications for customary title under the Takutai Moana Act.	• Scale of complexity of consenting processes including s91 deferrals. • Scale of complexity of compliance requirements and costs.	• Conflict with the direction of key planning instruments e.g., non-complying activity classification with a supporting “avoid” policy.

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
Low risks and conflicts	1
Medium to low risks and conflicts	2
Medium risks and conflicts	3
Medium to high risks and conflicts	4
High risks and conflicts	5

7. Part 2

The RMA Part 2 matters addressed under this criterion are:

- Sections 5, 6, 7, 8.

8. Assessment method

An option’s recommended 1 to 5 score is developed by first scoring each of the criterion’s sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with higher risks and conflicts rather than those lower risks and conflicts. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Statutory Risks and Conflicts Assessment (Updated 1 December 2023)

Option	Legislative barriers to options proceeding	Complexity and compliance	Conflicts with statutory direction	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Tributary of Te Puru Stream – diffuse discharge	~~3~~ 1 Watercare must give effect to Te Mana o te Wai as part of any functions, powers and duties imposed under the Water Services Act Changed from a 3 to a 1 as the Water Services Act 2021 relates primarily to the provision of drinking water rather than wastewater services. This wastewater consenting process does not involve Watercare performing a function or exercising a power under that Act that is caught by the s14(2) requirement to give effect to Te Mana o te Wai. Suggest 1 instead.	1 One receiving environment, expanded overland flow area, compliance / monitoring requirements assumed to be slightly more complex than current requirements, compared to options involving new receiving environments consenting not as complex.	~~5~~ 4 Some challenges to demonstrating that the discharge of treated wastewater to a tributary of the Te Puru Stream prioritises the health and well-being of the stream first, over secondly the health needs of people (such as drinking water) and thirdly the ability of people and communities to provide for their social, economic and cultural well-being. Challenging to argue this option will not result in the loss of stream values so potentially need to prove functional need to discharge to the stream i.e. the activity can only occur in that environment. Changed from a 5 to a 4 as the as the Natural Environment assessment identified that the attenuation through the over land flow area assists in the improvement of the quality of the discharge when compared to Option 2b.	~~3~~ 2 Changed from a 3 to a 2
2b: Tributary of Te Puru Stream – direct discharge	~~3~~ ! Watercare must give effect to Te Mana o te Wai as part of any functions, powers and duties imposed under the Water Services Act Changed from a 3 to a 1 as the Water Services Act 2021 relates primarily to the provision of drinking water rather than wastewater services. This wastewater consenting process does not involve Watercare performing a function or exercising a power under that Act that is caught by the s14(2) requirement to give effect to Te Mana o te Wai. Suggest 1 instead.	1 One receiving environment, new discharge structure, compliance / monitoring requirements assumed to be slightly more complex than current requirements, compared to options involving new receiving environments consenting not as complex.	5 Some challenges to demonstrating that the discharge of treated wastewater to a tributary of the Te Puru Stream prioritises the health and well-being of the stream first, over secondly the health needs of people (such as drinking water) and thirdly the ability of people and communities to provide for their social, economic and cultural well-being. Challenging to argue this option will not result in the loss of stream values so potentially requirement to prove functional need to discharge to the stream i.e. the activity can only occur in that environment. Scored a 5 when compared to Option 2a.	~~3~~ 2 Changed from a 3 to a 2
3: 100% Land	1 No legislative barriers identified	4 750ha land required, assumed one contiguous area not achievable which could lead to consenting and compliance complexities, potential complexities if need to rely on the Public Works Act for investigations and land purchase, conveyance infrastructure to land applications areas, storage requirements, potential need for consents under the NESFM – natural wetlands.	2 Gives effect to Te Mana o te Wai as the discharge is 100% to land, if natural wetlands significant ecological areas etc. identified in land application areas potential to avoid them, no significant policy conflict identified.	2
3a: Land / tributary of Te Puru Stream	2 1 Watercare must give effect to Te Mana o te Wai as part of any functions, powers and duties imposed under the Water Services Act Changed from a 3 to a 1 as the Water Services Act 2021 relates primarily to the provision of drinking water rather than wastewater services. This wastewater consenting process does not involve Watercare performing a function or exercising a power under that Act that is caught by the s14(2) requirement to give effect to Te Mana o te Wai. Suggest 1 instead.	5 300 ha land required, two receiving environments resulting in complex consenting and compliance / monitoring requirements, potential complexities if need to rely on the Public Works Act for investigations and land purchase, conveyance infrastructure to land applications areas, storage requirements, potential need for consents under the NESFM – natural wetlands.	3 Better gives effect to Te Mana o te Wai when compared to options 2a and 2b, but still need to get through the hierarchy and functional need tests, if natural wetlands significant ecological areas etc. identified in land application areas potential to avoid them.	3

Option	Legislative barriers to options proceeding	Complexity and compliance	Conflicts with statutory direction	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	
4ae: Hauraki Gulf Tāmaki Mid	~~3~~ 4 Potential risks associated with applications for customary rights and titles lodged under the Marine and Coastal Area (Takutai Moana) Act. Changed from a 3 to a 4 due to the requirements of the Hauraki Gulf Marine Part Act - s7 relating to recognising the national significance of Hauraki Gulf and s8 relating to the protection and, where appropriate, the enhancement of the Hauraki Gulf must be had regard to by the consent authority:	~~3~~ 4 One receiving environment, conveyance infrastructure (5.6km) to outfall, new 2.9km ocean outfall, consenting complexities with conveyance, new outfall and discharge. Changed from a 3 to a 4 given advice at the workshop regarding the number of iwi and hapū with interests in the Tāmaki Straight and wider Hauraki Gulf.	3 Need to avoid where practicable, or remedy or mitigate adverse effects in areas of high recreational use, fishing or shellfish gathering; commercial development; significant ecological value, protection of indigenous biological diversity, preservation of natural character (NZCPS, Unitary Plan), potential outfall location traverses an SEA Marine 2 area (Unitary Plan), gives effect to Te Mana o te Wai as the discharge is to the CMA.	~~3~~ 4 Changed from a 3 to a 4

10. Conclusion

Option 3a: 100% to land has scored best as it has a low risk of not proceeding due to legislative changes and outcomes of legislative processes, it gives effect to Te Mana o te Wai as the option does not involve a discharge to freshwater and no conflicts of any significance with other statutory directions. All the other options score a “3” – medium risks and conflicts.

Options 2a and 2b did not score well against the sub-criteria “conflicts with statutory direction” due to the challenges of giving effect to Te Mana o te Wai. Option 3a did not score well against sub-criterion “complexity and compliance” primarily because it comprises two receiving environments.

Opportunities and Benefits Criterion

1. Introduction

The following sets out the approach and assessment for this criterion and records:

- Authors and experience
- Information sources
- Assumptions
- Traffic light definition
- Criterion categories / sub-criteria
- Method of assessment
- Assessment table

2. Authors and experience

Criterion lead: Jim Bradley

Author	Role / Experience	Category
Jim Bradley	Environmental Engineer / 50+ years	All
Andrew Slaney	Process Engineer / 25 years	All

3. Information sources

The information sources used for the Opportunities and Benefits Criterion include:

- Knowledge of the current Beachlands WWTP.
- Information in the Draft "Beachlands Wastewater Treatment Plant Upgrade – Concept Design Basis".
- Watercare and Stantec personnel's wastewater treatment and management knowledge of the New Zealand sector and overseas.
- Assumed (at this stage) technology and infrastructure criteria information.
- Authors and experience of those involved in this section of the Report.

4. Assumptions and limitations

a. Overall Assumptions

The Wastewater Treatment Plan is based on the "Product Factory" concept as depicted below. Concepts and developments within Watercare in recent times have adopted this approach. The approach (recovery and reuse of resources) is consistent with the principles of the Circular Economy (which embraces sustainability).

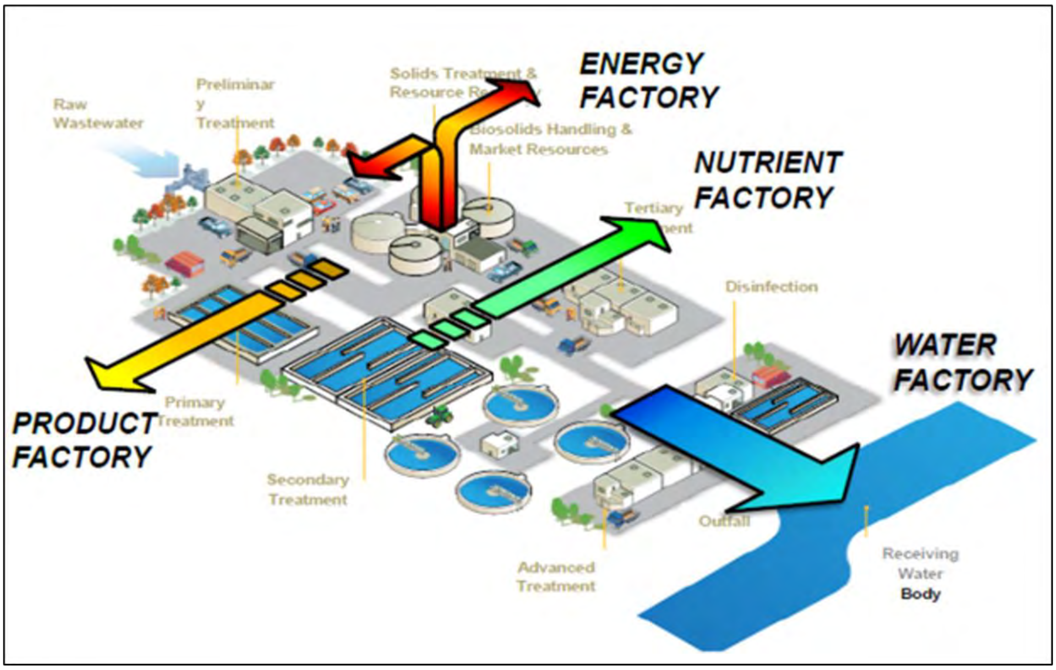

Figure 1 – The Product Factory Approach

b. Treated Wastewater Beneficial Reuse Assumptions:

j) Land application options assume that suitable relatively flat and stable land is available that enables beneficial use of the treated wastewater (eg for crops, dry stock etc)

k) Assessment based on the quality/degree of treatment of the treated wastewater and the extent/amount of treated wastewater to be beneficially reused for the option as described, but keeping in mind future opportunities.

l) Assessment does not take into account "possible people's perceptions" of the beneficial reuse e.g. potable reuse, aquifer recharge of water supply source.

m) Consents/other approvals etc can be sought for each of the beneficial reuse means included in the options.

n) The assessment includes nutrient recovery when treated wastewater is applied to land.

o) Conveyance lines of Option 4ae Tamaki mid Hauraki Gulf outfall can be tapped in for beneficial reuse of treated wastewater (consents and other approvals permitting).

c. Sludge and Biosolids Beneficial Reuse Assumptions

i) This assessment is based on degree of treatment of liquid phase needed i.e. for a high degree of treatment, there is more sludge/biosolids produced which could be beneficially reused. In this respect the MBR WWTP will produce more sludge/biosolids than the conventional BNR Plant, but this would only be a relatively small percent increase.

j) Includes vermiculture, biochar, other reusable biosolids material.

k) Assume no chemicals or other products used in the WWTP processes that render biosolids not beneficially reusable provided for land application etc appropriate loading rates are used. Alum will be used to reduce TP so it will have chemical in the sludge. Zinc is also high in the current biosolids due to rainwater collection and use within the area.

l) Assumes possible future/pending regulations on Emerging Organic Contaminants (EOC's) and/or microplastics does not limit beneficial reuse on land or any other reuse technique.

d. Energy Generation

Energy generation is not included in the table as it is assumed that based on the design population of the scheme (around 30,000 PE), and based on the authors' experience, primary clarifiers and anaerobic digestion are unlikely to be economic and therefore none of the scheme options will provide energy generation possibilities.

In addition, it is noted that the carbon in primary solids will be needed for biological nitrogen / phosphorus removal as with the current plant and a number of others in New Zealand and internationally.

In terms of combustion or gasification of sludge to produce energy, this possibility is included in the sludge / biosolids beneficial use category.

5. Opportunities and Benefits Criterion – description and sub-criteria

Description	**Sub-criteria**		
	Treated wastewater beneficial reuse	Sludge and biosolids beneficial reuse	Nutrient recovery and reuse
Provides opportunities for resource recovery including beneficial reuse, energy generation, nutrient recovery / reuse.	The degree and amount of beneficial reuse of treated wastewater for each of the short listed options will depend on many factors. These include: • The overall nature of the option and its infrastructure components and their locations e.g. conveyance lines, discharge points etc • The quality of the treated wastewater • The quantity of treated wastewater available that maybe beneficially reused and above the basic option formulation • The base reuse option e.g. land application compared to a direct discharge (steam or Hauraki Gulf discharge option) • The "add-ons" that maybe feasible, acceptable and, where necessary, consentable in terms of use of treated wastewater as compared to the options fundamental function(s)	This includes for the range and extent of beneficial reuses of sludges and biosolids, biosolids being sludges treated to specified levels. The extent of such practices will depend on many factors including: • Amount and quality of the sludge/biosolids • Demand for particular beneficial reuse practices • Approvals and when necessary resource consents granted for particular reuse practices such as application of biosolids to land, sale of biosolids to be the home gardener etc • Overall economics of a particular practice/beneficial reuse option • Meeting statutory planning provisions • Māori cultural, other cultural and social/neighbour considerations (neighbour to a beneficial reuse site and others) Beneficial reuse techniques can for example include: • Application to agricultural, forestry, other crops	• This covers the beneficial reuse of nutrient in the treated wastewater • This does not include beneficial reuse of nutrients included in sludges and biosolids • This would also include the possibility of extracting phosphorus by way of the struvite process extraction from the centrate from dewatering , however such processes are not likely to be used in the WWTP types being considered

		• Turf culture, parks/gardens, nurseries • Compost made mixed green waste • Landfill and quarry restoration and capping • Energy production through furnacing e.g. cement kiln supplementary energy feed • Gasification/pyrolysis

6. Approach to scoring

When scoring each option against the criterion a score between 1 to 5 has been adopted with 1 being the best score and 5 the worst. The table below provides a description of the score and associated score colour.

Description	Score
High opportunities and benefits	1
Medium to high opportunities and benefits	2
Medium opportunities and benefits	3
Medium to low opportunities and benefits	4
Low / minimal opportunities and benefits	5

7. RMA Part 2

The RMA Part 2 matters addressed under this criterion are:

- Section 5 – sustainable management of resources.
- Section 7(b) - the efficient use and development of natural and physical resources.
- Section 7 (ba) - the efficiency of the end use of energy.

8. Assessment method

An option's recommended 1 to 5 score is developed by first scoring each of the criterion's sub-criteria separately. An overall score is then identified by comparing the range of sub-criteria scores and giving an overall score erring on the side of those with low / minimal opportunities and benefits rather than higher opportunities and benefits. A qualitative expert judgement approach is followed in determining the scores for the short list assessment rather than a quantitative approach.

9. Assessment table

See below:

Opportunities and Benefits Criterion (Updated 1 December 2023)

Option	Treated wastewater beneficial reuse	Sludge and biosolids beneficial reuse	Nutrient recovery / reuse	Overall Score
	Reasons and Score	Reasons and Score	Reasons and Score	
2a: Tributary of Te Puru Stream – diffuse discharge	4 3 Option based on overland flow to the Te Puru Stream discharge – no conveyance line from the WWTP site to facilitate reuse. Some minimal use and soakage area. High level of treatment provides opportunity for future reuse. Change reflects greater recognition of future opportunities	1 All options produce similar quantity of sludge and biosolids and have similar opportunities for beneficial use but with MBR slightly more sludge/biosolids.	5 No to minimal reuse of nutrients.	3
2b: Tributary of Te Puru Stream – direct discharge	4 3 Option based on Te Puru Stream direct discharge – no conveyance line from the WWTP site to facilitate reuse. High level of treatment provides opportunity for future reuse. Change reflects greater recognition of future opportunities	1 All options produce similar quantity of biosolids and have similar opportunities for beneficial use but with MBR slightly more sludge/biosolids.	5 No reuse of nutrients.	3
3: 100% Land	1 100% to land application so maximise beneficial reuse with appropriate crop(s) and management regime(s) selected (750 ha area)	~~1~~ 2 WWTP has tertiary filtration so more sludge than BNR alone. For a comparative assessment still slightly less than MBR options 2a and 2b	1 Uptake of nutrients by crops can be maximised.	1
3a: Land / tributary of Te Puru Stream	2 Some treated wastewater to land so maximises the beneficial reuse of that proportion providing appropriate techniques used like Option 3 (300ha area)	1 All options produce similar quantity of sludge and biosolids and have similar opportunities for beneficial use but with MBR slightly more sludge/biosolids.	2 Uptake of nutrients by crops, but less than option 3a as less area	2
4ae: Hauraki Gulf Tāmaki Mid	4 Marine outfall Tamaki mid, assumes the discharge quality if not as highly treated as the stream discharge options so not the same reuse potential but option to reuse 5.6km conveyance	3 Less biosolids produced due to no tertiary filter, but not much less than MBR and BNR and tertiary filtration options.	5 No reuse of nutrients unless off take off conveyance line to land application for beneficial reuse	4

10. Conclusions

- Options 2a and 2b have no to little beneficial reuse of treated wastewater or nutrients as it stands because there is no conveyance pipe from the site, but a high potential for beneficial use of sludge / biosolids. MBR treated wastewater at the plant has the potential for reuse if conveyed off site at a later time. The high quality also facilitates adding advanced treatment if a high quality reclaimed water was required.
- The 100% land application Option 3 and to a lesser extent Option 3a have a high potential for beneficial use of treated wastewater and associated nutrient uptake through crops.
- The outfall option 4ae has the lowest potential for beneficial reuse opportunities although the conveyance line to the coast could be tapped into.
- All options but particularly 2a and 2b provide opportunities for additional treatment and beneficial reuse (eg Hunua dam recharge or purple pipe non potable reuse)

Appendix H Short List Workshop Participants

Participant	Organisation
Chris Allen	Watercare
Dean Lawrence	Watercare
Helen Jansen	Watercare
Iris Tscharntke	Watercare
Jonathan Piggot	Watercare
Michael Webster	Watercare
Nathaniel Wilson	Watercare
Priyan Perera	Watercare
Rory Buchanan	Watercare
Tanvir Bhamji	Watercare
Annmarie Halst	Watercare
Zaelene Maxwell Butler	Ngāi Tai ki Tāmaki
Revell Butler	Ngāi Tai ki Tāmaki
Luke Faithful	Mitchell Daysh
Andrew Slaney	Stantec
Sam Hewitt	Stantec
Jim Bradley	Stantec
Katja Huls	Stantec
Paula Hunter	Stantec
Sharu Delilkan	Stantec
Alan Pattle	PDP
Mark James	Aquatic Sciences
Padraig McNamara	Simpson Grierson
Warren Bangma	Simpson Grierson
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ATTACHMENT 5

PRELIMINARY ASSESSMENT OF LAND AREA FOR OVERLAND FLOW SYSTEM MEMO 1
2 APR 24

memorandum

TO	Tanvir Bamji	FROM	Oliver Hunt and Alan Pattle
	Watercare Services Ltd	DATE	2 April 2024
RE	Beachlands WWTP: Preliminary assessment of land area requirements for overland flow system expansion – Memorandum 1		

1.0 Background

Watercare Services Ltd (**Watercare**) is currently undertaking technical assessments to inform a resource consent application for the discharge of treated wastewater from the Beachlands Wastewater Treatment Plant (**WWTP**). The consent will provide for projected population growth and an increase the capacity of the WWTP to 30,000PE. The Best Practicable Option (“BPO”) for the discharge has been identified as the continued use and expansion of the existing overland flow system from the Beachlands WWTP which is used to create a diffuse discharge to the Te Puru Stream.

Watercare has engaged PDP to complete a preliminary assessment of the design of the existing overland flow system, to confirm the system can be expanded, and to identify potential expansion areas on the Watercare site at Beachlands. This memorandum has been prepared to detail the assessment and recommendations. The assessment confirms that the expansion of the overland flow system to service an increase in capacity to 30,000PE is feasible, and can be accommodated within land owned by Watercare at the Beachlands WWTP site.

2.0 Existing Discharge System

2.1 Construction

PDP has completed a detailed inspection of the existing overland flow system at the Beachlands WWTP site. Based on our inspection and discussion with the operators we understand the system functions as follows:

- The existing system consists of four dispersion zones each with three parallel series of PVC pipes elevated above the ground in the upslope section of the overland flow area covering an area of approximately 1.5 hectares. Wastewater flows through the pipes via gravity and is dispersed through holes drilled in the pipes.
- The length of overland flow slope between the distribution pipes and the pond edge ranges from approximately 50 – 100 m dependent on the location within the dispersal area and if the individual distribution pipe is at the top or the bottom of the array.
- The dispersal system does not utilise all zones or pipes within zones consistently. Most of the wastewater is discharged from the lower two sets of pipelines and the first three zones. Only at higher flows do all of the zones and pipelines provide discharge.

- Dependent on the position within the dispersal area, the average slope appears to vary between approximately 10-14% with an average fall over the length of the dispersal area of approximately 10 m[1].
- Following dispersal over land and through the vegetated discharge field and riparian plantings, the treated wastewater discharge enters a reach of the tributary which has been dammed. This has created a vegetated, gentle slope to the water's edge compared to the more steeply incised reaches of the stream both upstream and downstream of the farm pond.
- The overland flow system operates continuously/on demand. There are no systems or controls in place to periodically rest individual zones.
- Based on PDP's inspection on 19/03/24, the dispersal system is performing poorly with sub-optimal dispersion between the four zones, some areas had no visible wastewater discharge, and within the zones themselves with highly variable flows between adjacent orifices.
- The overland flow slope itself does not provide uniform sheet flow down the entire length of the slope. PDP observed rapid concentration and channelisation of wastewater within 5 – 10 m of the dispersal system. At the base of the slope, treated wastewater was observed to discharge into the pond in three discrete locations following its dispersal at the top of the slope.

It should be noted that the performance of the system is currently non-critical as further treatment past the point of discharge to the top of the overland flow system is not required to meet current consent limits.

3.0 Design Guidance

The Process Design Manual for Land Treatment of Municipal Wastewater Effluents (USEPA, 2006) provides detailed information on the design, construction, and typical performance of overland flow systems.

3.1 Sizing and Construction

There are a wide variety of layouts, distribution systems, application rates, slopes and slope lengths which are described by the USEPA. The existing system at the Beachlands WWTP generally falls outside the typical design parameters for overland flow systems. Critical differences in the design of the existing system include:

- Dispersal method – Dispersal systems typically employ either sprinklers at the top of the slope or a single dispersal pipe at the top of the slope.
- Slope length – Slope lengths typically do not exceed 60 m for overland flow systems.
- Slope gradient – Typical gradients for overland flow systems are 2-8% with 1-2% and 9-12% only recommended with additional earthworks to terrace the system.
- Slope uniformity – Overland flow slopes are generally graded to ensure a high degree of uniformity which promotes sheet flow.
- Planting/vegetation – Overland flow systems are generally planted with water tolerant grasses which are periodically harvested.

[1] Due to the tree cover over the majority of the dispersal area it is expected that the reliability of the available LIDAR data used in this assessment will be reduced.

- Loading rate examples for secondary treated wastewater vary from 0.09 to 0.28 m^3/h for each metre of distribution pipework
- Operation – typically overland flow systems are operated intermittently to allow for rest periods.

Residence time on the slope is generally one of the most critical factors for contaminant removal. Given that the Beachlands system is both steeper and longer than a typical system the residence time may not be dissimilar to that recommended by the USEPA. The current loading rate is approximately 0.3 m^3/hr.m if run continuously, meaning that the existing system is operated at the higher end of the examples provided in literature.

Generally the construction and operation of the existing overland flow system is at the high end of the specifications set out by the USEPA.

3.2 Expansion Requirements

The assessment of suitable areas based on the assumption that the required total “width” of the system at the projected design flow for 30,000pe, is three times the current width. The current system is loading at the higher end of examples provided in literature, therefore, it is expected that the increase in wastewater volumes will require at least an equivalent increase in discharge width. This correlates to approximately an additional 500 m of overland flow areas in terms of the width of the slope and approximately 4 ha of additional area based on the design parameters of the existing system, which would increase the entire overland flow system to 5.5 ha based on application rates that are the same or similar to the current scheme.

A larger area could be required if application rates are reduced to be more conservative. This will be confirmed as the design of the expanded system is completed. While 500 m additional is the minimum area and width we recommend allowing for, it would be prudent for the consent application to include all of the suitable areas to allow for flexibility in the design process.

For reference, at 30,000 PE, assuming an average flow of 5,400 m^3, an application rate of 0.1 m^3/m/h which is at the bottom of the USEPA range (high strength wastewater, cold climate, sensitive receiving environment) would require a total width of 2,250 m and, assuming a slope length of 50 m, a total treatment area of 11.25 ha. Conversely, using an application rate of 0.5 m^3/m/h which is at the top of the USEPA range (low strength wastewater, warm climate, low sensitivity receiving environment) would require a total width of 450 m and, assuming a slope length of 50 m, a total area of 2.25 ha.

The actual width and area required for the overland flow system will be confirmed during the detailed design phase. It is anticipated that the application rate will fall somewhere in the middle of the USEPA range as per the above 5.5 ha total.

3.3 Suitable Area Assessment

PDP has utilised topographical contours sourced from Auckland Council’s Geomaps database to assess the slope in areas near the existing Beachlands WWTP. The assessment has excluded the current WWTP site and the existing overland flow system area.

Using gradient, the surrounding area has been divided into three different categories:

- 2-8% - Suitable, this land is most likely to be suitable for construction of an overland flow system without significant earthworks.
- 8-12% - Potentially suitable, the land could be suitable for construction of an overland flow system however some earthworks would likely be required.

- 12-16% - Marginal, based on the design of the existing system it may be possible to utilise parts of this land however significant earthworks could be required and the system would fall outside the usual design parameters for an overland flow system.

In all instances, further assessment would be required to confirm the nature of any specific sites selected as part of any detailed design process.

The results of this initial investigation are presented in Figure 1 attached to this memorandum. There are several areas inside the Watercare property which include land which may be suitable for expansion of the overland flow system. Three areas have been identified as potentially suitable:

- Area A – approx. 1.5 ha
- Area B1 – approx. 3 ha
- Area B2 – approx. 5.5 ha

Based on the assessment, PDP have drawn the following conclusions:

- There is insufficient land on the northern side of the stream and within land currently owned by Watercare to complete a full expansion of the overland flow system. However, there may be suitable land for an initial 50% expansion of the existing system (Area A, Figure 1).
- In combination with the Area A and the existing overland flow area, either B1 or B2 could provide enough suitable land;
- There is likely enough suitable land if both Area B1 and Area B2 (on the south side of the stream) are used. Dependent on the final design of the slopes, area B2 may be sufficient to provide the full expansion of the overland flow system.
- The total area available including 10 ha in areas A, B1 and B2 combined with 1.5 ha of existing overland flow area could provide sufficient treatment area even at the lowest end of the application rates set out the USEPA guidelines.

Overall, the preferred option is to retain the existing overland flow slope and construct a new overland flow slope or slopes in Area B2. The final total area requirements, including buffer areas and conveyance, will be confirmed during the detailed design phase of the process.

There is an important issue with all areas identified. As shown in Figure 1, with the exception of the modified area around the existing pond, all of the riparian areas along the streams near the WWTP are heavily incised with steep banks which are unlikely to be suitable for a direct diffuse discharge to the stream without a high risk of erosion. Some form of collection system may be needed at the bottom of each slope to capture the run-off from the slope and transport it into the stream or pond and the final discharge could be via overland flow through the riparian margin of the pond or stream.

4.0 Terrestrial Ecology

4.1 Relevance

Given the likelihood that some disturbance of the riparian strip and possibly in the treatment areas themselves will be required to facilitate discharge to the stream for any extension areas, an assessment of the terrestrial ecology has been undertaken to identify any key constraints.

4.2 Assessment

A PDP ecologist conducted a preliminary assessment of the terrestrial ecology at the site with a desktop review of existing ecological databases and a site visit on the 16th of February 2024. Vegetation was surveyed within the three areas being considered for the overland flow system expansion (A, B1 and B2), and within 100 m from the outer edge of the proposed areas.

Exotic pasture grassland occurs within the three possible overland flow treatment areas; indigenous shrubland dominates riparian margins of the stream, and areas of exotic trees are present. Wetlands were observed in the gullies adjacent to Areas B1 and B2, and within the stream riparian margins within 100 m of the proposed system.

Site conditions varied across the different vegetation types. The raupō reedland upstream of the current treatment area appeared to be relatively healthy, and the open water pond provides habitat for waterfowl. However, although stock were generally excluded from riparian margins and wetlands by fencing, some evidence of grazing occurred on the true left river bank on the western edge of the property. The spread of exotic vegetation at the site may alter connectivity of wetland areas in the future; for example, the regional pest plants crack willow (*Salix fragilis*) and grey willow (*Salix cinerea*) were locally dominant, and woolly nightshade (*Solanum mauritianum*) was common throughout the shrub tier on stream banks. Actions to exclude stock, remove pest plants and exotic species, and replant in appropriate indigenous species could significantly improve the quality of this site.

Potential adverse effects associated with the proposed expansion options depend on the detailed designs and their site-specific effects on hydraulic and nutrient loading rates. Due to the presence of wetlands, wetland delineation should be completed for all wetlands on the site and an Ecological Impact Assessment (EcIA) is recommended.

5.0 Summary

Area B2 (Figure 1) has been identified as the preferred area for expansion of the Beachlands WWTP overland flow system in addition to retaining the existing area. The detailed design of the overland flow slope or slopes will be completed in future stages of work, however, it is acknowledged that due to the topography of the area south of the pond the expanded overland flow system may require some form of collection system to convey the discharge to the stream/pond and avoid erosion. This final discharge could take the form of high-rate overland/diffuse discharge through the riparian margin of the pond or stream.

This assessment confirms that the expansion of the overland flow system to service an increase in capacity to 30,000PE is feasible, and can be accommodated with land owned by Watercare at the Beachlands WWTP site.

6.0 References

Ministry for the Environment. (2022). *Wetland Delineation Protocols*. Ministry for the Environment. Wellington, New Zealand.

USEPA. (2006). *Process Design Manual Land Treatment of Municipal Wastewater Effluents.* Cincinnati: U.S. Environmental Protection Agency.

7.0 Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Watercare Services Ltd and others (not directly contracted by PDP for the work), including Aquatic Environmental Sciences Ltd. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This memorandum has been prepared by PDP on the specific instructions of Watercare Services Ltd for the limited purposes described in the memorandum. PDP accepts no liability if the memorandum is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

PATTLE DELAMORE PARTNERS LIMITED

Yours faithfully

Prepared by

Oliver Hunt

Senior Environmental Engineer

Reviewed by

Daryl Irvine

Technical Director – Water Infrastructure

Approved by

Alan Pattle

Technical Director - Water and Geotechnics

pdp

FIGURE 1: SUITABLE LAND AREA FOR AN EXPANSION OF THE BEACHLANDS WWTP OVERLAND FLOW SYSTEM

WATERCARE BEACHLANDS MARAETAI WWTP

SOURCE:
1. AERIAL IMAGERY: EAGLE TECHNOLOGY, LINZ, STATSNZ, NIWA, NATURAL EARTH, © OPENSTREETMAP CONTRIBUTORS., EAGLE TECHNOLOGY, LAND INFORMATION NEW ZEALAND, GEBCO, COMMUNITY MAPS CONTRIBUTORS.
2. ELEVATION INFORMATION SOURCED FROM LINZ (AUCKLAND 1 M LIDAR 2016-2017).
3. WASTEWATER DISPERSAL PIPEWORK SOURCED FROM WATERCARE.

0 100 200
METRES
SCALE : 1:7,500 (A4)
N

REVISION: 01 | DATE: JAN 24 | BY: JR
CLIENT: WATERCARE SERVICES LIMITED

A02803202_GIS001

ATTACHMENT 6

ASSESSMENT OF OVERLAND FLOW SYSTEM TREATMENT PERFORMANCE
MEMO 2
2 APR 24

memorandum

TO	Tanvir Bamji	FROM	Oliver Hunt and Alan Pattle
	Watercare Services Ltd	DATE	2 April 2024
RE	Beachlands WWTP: Assessment of Overland Flow System Treatment Performance – Memorandum 2		

1.0 Background

Watercare Services Ltd (**Watercare**) is currently undertaking technical assessments to inform the resource consent application for the discharge of treated wastewater from the Beachlands Wastewater Treatment Plant (**WWTP**). The consent will provide for projected population growth and an increase in the capacity of the WWTP to 30,000PE. The Best Practicable Option ("**BPO**") for the discharge was identified as the continued use and expansion of the existing overland flow system which is used to create a diffuse discharge from the Beachlands WWTP to the Te Puru Stream.

Watercare has engaged PDP to provide advice on expansion of the existing overland flow system. PDP has previously completed a preliminary assessment of the design of the existing overland flow system to determine if the system can be expanded and has identified potential expansion areas for further investigation. This assessment concluded that the expansion of the overland flow system to service an increase in capacity to 30,000PE is feasible, and can be accommodated with land owned by Watercare at the Beachlands WWTP site as detailed in a memorandum dated 27 March 2024 (Memorandum 1).

This memorandum has been prepared to assess the treatment performance of the existing overland flow system, inform work to determine if the receiving environment water quality targets are likely to be met (by others), and identify areas of uncertainty in the system performance for further investigation.

2.0 Typical Overland Flow System Treatment Performance

This section has been prepared to review and summarise the typical performance of overland flow systems in literature. It is important to note that the Beachlands WWTP overland flow system is unique in that it is used to polish highly treated wastewater effluent. PDP are not aware of any other examples where an overland flow system receives such a high-quality effluent. Typically, overland flow systems have been used to treat wastewater ranging from screened raw sewage through to secondary treated effluent (e.g., pond, sand filter, simple package plant systems).

2.1 Treatment Processes

Overland flow can provide treatment to wastewater through a combination of physical, biological, and chemical processes (Wightman, George, Zirschky, Filip, & Sims, 1982). Total suspended solids (TSS) are largely removed by settling and filtration through the vegetation on the slope while carbonaceous biochemical oxygen demand (cBOD) is removed by biological growth/activity. For the purposes of the Beachlands system, the primary parameters of concern are nitrogen and phosphorus.

cBOD and TSS may also be important from a water quality/ecological perspective, however, the proposed MBR system will produce effluent with low levels of cBOD and TSS, with effluent concentrations expected to be < 7 mg/L for both parameters. It is unlikely that any form of overland flow system will provide any further removal of BOD and TSS. Furthermore, it is a possibility that the effluent leaving the overland flow system could contain higher levels of cBOD and TSS than the MBR effluent as organic matter is collected/dissolved into the wastewater stream from plant sources on the slope (Kemp, Filip, & George, 1978).

The removal mechanisms for nitrogen and phosphorus in an overland flow system are relatively complex and are heavily influenced by the nature of the wastewater applied, the flowrate/loading rate, and the soils present at the site. Nitrogen can be removed by a variety of methods including ammonia volatilisation, adsorption of ammonium ions, biological nitrification-denitrification, and plant uptake. The conditions which control which processes occur, and how effective they are, can be influenced in the design of the slope to promote greater aeration or to promote anoxic conditions. There is considerable uncertainty with a large range of removal rates reported throughout the literature (Overcash, 1978). In many instances it appears that variability in construction of the slope is a significant factor in the effectiveness of the treatment (Kemp, Filip, & George, 1978).

For phosphorus, the primary methods of removal are chemical precipitation, adsorption to near surface soils and plant uptake (Kemp, Filip, & George, 1978). Generally, plant uptake may account for a small percentage of phosphorus removal along the slope. Adsorption of phosphorus onto the soil matrix, as well as chemical precipitation of phosphorus compounds with $CaCO_3$ or iron and aluminium oxides, may provide a greater removal of phosphorus. However, by their nature, overland flow systems provide limited contact with soils as there is typically minimal movement of water through the soil itself. Soils also have a finite capacity to adsorb phosphorus and therefore removal may be reduced with system age dependent on the nature of the soils present at the overland flow site. For Beachlands, it is expected that the soils will have a high potential for phosphorus retention based on preliminary soil sampling results which indicate good anion storage capacity (ASC) and low Olsen P throughout the soil profile (PDP, 2024).

2.2 Typical Treatment Performance

In the literature, overland flow systems have been used to treat a wide range of influent quality. Table 2 provides several examples of overland flow treatment performance including several systems that treat oxidation pond effluent. PDP are not aware of any existing overland flow systems which are designed to provide further treatment to WWTP effluent of the proposed long-term treatment quality of the Beachlands WWTP.

As shown in Table 2, the current median effluent concentrations from the Beachlands WWTP are approximately at or below the maximum performance of an overland flow system. This issue will be accentuated with the further reduction in effluent nutrient concentrations from the proposed MBR plant. There may be some further reduction of nutrients over the slope however, this is difficult to quantify due to the absence of any research on treated of high-quality wastewater effluent by overland flow.

It should also be noted, that in some instances, there may be potential for the concentrations to increase over the overland flow system, including BOD, *E. Coli*/faecal coliforms from non-human sources, and TSS. This is shown in Utah Water example in Table 2. Concentrations of BOD and TSS in the slope runoff exceeded the influent concentrations in all trials.

Table 1: Overland Flow Effluent Quality compared to Beachlands WWTP Effluent Quality							
Parameter	**BOD (Applied)**	**TSS (Applied)**	**NH4-N (Applied)**	**NO3-N(Applied)**	**Total Nitrogen (Applied)**	**DRP (Applied)**	**Total Phosphorus (Applied)**
Units	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Current WWTP Effluent Median[1]	6.16	8.07	0.08	4.60	6.02	0.80	1.02
Proposed MBR Effluent Median[6]	≤ 5	≤ 5	≤ 0.5	≤ 2			
USEPA Overland Flow System Maximum Performance[2]	10	15	1	5			
USACE Test Site (Summer, Secondary Effluent)[3]	5 (45)	3 (47)	4 (21.7)	6.2 (7.1)	13.6 (38.7)	1.1 (5.7)	3.3 (6.1)
Cheviot, Canterbury (Pond Effluent)[4]		39 (63)	0.37 (13)	0.2 (0.5)	5.1 (19.1)	1.1 (5.7)	2 (7.6)
Utah Water Research Lab (Pond Effluent, three application rates)[5]	8 – 10.2 (7.8)	11.8 – 15.4 (11.2)	0.14 – 0.59 (2.33)	0.04-0.12 (0.07)	2.2 - 2.9 (4.6)	1.2-1.5 (1.9)	1.5 – 1.9 (2.3)

Notes:

1. *Provided by Watercare for the period Sep 2023 – Feb 2024, n=62.*
2. *Obtained from USEPA Design Manual Section 9.1.3* (USEPA, 2006)
3. (Martel, Jenkins, & Palazzo, 1980)
4. (PDP, 2014)
5. (Kemp, Filip, & George, 1978)
6. *Provided by Aquatic Environmental Services Ltd*
7. *Concentrations in brackets are the concentration of wastewater applied to the top of the slope.*

3.0 Existing Performance Information

PDP has provided a summary of the design and construction of the overland flow system in the Memorandum 1, dated 22 March 2024. We are not currently aware of any previous work to quantify treatment provided by the overland flow system. However, the performance of the system is currently non-critical as further treatment past the point of discharge to the top of the overland flow system is not required to meet current consent limits.

PDP inspected the overland flow system on 19/03/2024. PDP observed poor dispersion of wastewater and rapid concentration/ channelisation of flows down the slope which are commonly reported as leading to poor treatment performance in experiments described in the literature. However, it is important to recognise following:

- Additional attenuation of contaminants in the overland flow system is not required to meet the existing consent limits.
- Watercare has commenced the process of renewing the existing system, however, this has been placed on hold until the new consent is finalised. We anticipate that as part of the detailed design of the expansion upgrades will also be made to the existing system so both the existing and new systems operate is a similar manner and with similar efficiency. It is expected that these improvements will improve the performance noted by PDP during the site visit.

3.1 Qualitative Review of Water Quality Data

As a proxy for information on the performance of the overland flow slope, PDP has reviewed the water quality information available for the WWTP outlet, the farm pond (Site B, sampled at outlet) and Site 15 (downstream of the first tributary confluence) as shown in Figure 1. The average concentration of key parameters as a percentage of the treated wastewater concentration is provided in Table 2.

Figure 1: Beachlands WWTP Environmental Sampling Sites

Table 2: Average Residual Concentration as a Percentage of WWTP Effluent Concentrations		
Parameter	**Farm Pond**	**Site 15**
Nitrate-N	59%	36%
Total Nitrogen	63%	36%
Ammoniacal-N[1]	581%	212%
Total Phosphorus	57%	32%
Dissolved Reactive Phosphorus	56%	28%
Conductivity	86%	53%

Notes:

1. *N=26 for ammoniacal nitrogen due to insufficient detection limits on WWTP samples prior to 4/12/23.*
2. *N = 62 for all other samples*

Based on this sampling data PDP have identified the following trends:

- Most nutrients are reduced by similar levels across the overland flow/pond combined system.
- Processes are occurring to produce ammoniacal nitrogen within the combined system, likely decomposition of organic matter within the pond.
- Key nutrients such as nitrate, total nitrogen, dissolved reactive phosphorus, and total phosphorus experience greater reduction in concentration relative to comparatively inert parameters such as electrical conductivity.

3.2 Quantitative Assessment of Overland Flow/Pond System Performance

To expand on these observations, PDP has completed a quantitative assessment of nutrient removal utilising sampling data over the wastewater disposal system collected between September 2023 and February 2024. In Table 3, the median concentrations across the system from the WWTP Outlet (Composite), through the farm pond and down to Site 15 are provided. The locations of the environmental sampling sites are provided in Figure 1. The median has been used in this instance as breakdown of the sampling results has revealed that some parameters can have significant short-term spikes in concentration, often associated with wet weather events.

To complete a qualitative assessment of the treatment processes, the conductivity of the wastewater/freshwater has been assumed to be unaffected by any processes other than dilution. There may be some effect of adsorption of ions within the overland flow system, however, this is expected to be negligible and is difficult to quantify. Using the median values and straightforward flow/mass balance approach the ratio of the various flow streams has been calculated with the WWTP flow assumed as 1 “flow unit”. These ratios are presented in Table 4 along with an extrapolation to the include the predicted three-fold increase in wastewater discharge as the Beachlands WWTP capacity increases to the predicted 30,000 PE proposed under the consent application.

Table 3: Median concentrations across the Overland Flow/Pond system					
Parameter	**WWTP Effluent**	**U/S Pond (Site A)²**	**Farm Pond (Site B)**	**Tributary (Site E)²**	**Site 15**
Nitrate-N (mg/L)	5.02	0.0205	2.71	0.115	1.59
Total Nitrogen (mg/L)	6.25	0.18	3.70	0.27	2.10
Ammoniacal-N¹ (mg/L)	0.03	0.0277	0.28	0.02	0.07
Total Phosphorus (mg/L)	0.87	0.0305	0.47	0.028	0.26
Dissolved Reactive Phosphorus (mg/L)	0.73	0.014	0.38	0.015	0.18
Conductivity (µS/cm)	141	20	122	16	71

Notes:
1. *N=26 for ammoniacal nitrogen due to insufficient detection limits on WWTP samples prior to 4/12/23.*
2. *N = 20*
3. *N = 62 for all other samples*

Table 4: Beachlands WWTP Flow Ratios (Median)		
Flow Stream	**Ratio to WWTP Flow (Median Conditions)¹**	**Extrapolation to Future WWTP Flows²**
WWTP Effluent	1	3
U/S Pond	0.19	0.19
D/S Pond	1.19	3.19
Site 15 Tributary	1.10	1.10
D/S Site 15	2.29	4.29

Notes:
1. *Environmental flows calculated as a ratio of the WWTP flow stream using conductivity sampling presented in Table 3 and a mass/flow balance method.*
2. *Ratio of flows in future scenario based on a three-fold increase in WWTP flows and no change to base flows in the stream/tributaries.*

These flow ratios can then be used to determine the “fraction” of each parameter which has been “removed by treatment processes” vs. simple dilution. These results are provided in Table 5, however, it is important to note that these are an estimate only with significant limitations including the limited sampling range (n=62, Sep 2023 – Feb 2024). These should not be interpreted as the treatment performance of the system under all conditions.

Table 5: Concentration Reduction due to Processes other than Dilution		
Parameter	**WWTP Effluent -> Farm Pond[1]**	**Farm Pond -> Site 15[1]**
Nitrate-N (mg/L)	1.81 (36%)	-0.24 (-9%)
Total Nitrogen (mg/L)	1.89 (30%)	-0.10 (-3%)
Ammoniacal-N (mg/L)	-0.29 (-874%)	0.17 (61%)
Total Phosphorus (mg/L)	0.32 (37%)	-0.003 (-1%)
Dissolved Reactive Phosphorus (mg/L)	0.28 (38%)	0.044 (11%)

Notes:

1. *Additional change in concentration after dilution has been accounted for.*
2. *Bracketed figure represents the percentage removal of upstream concentration by non-dilution processes.*
3. *Negative changes represent an increase in the concentration from the upstream site to the downstream site.*

These results quantify the change in concentrations within the current overland flow/farm pond system. Overall, (from the WWTP outlet to Site 15) the system is estimated to remove approximately 30 – 35% of both nitrogen and phosphorus. In addition, it is notable that:

- Natural processes are occurring to produce an increase in ammoniacal nitrogen, approximately 0.3 mg/L under median conditions. This is likely due to mineralisation (ammonification) of organic nitrogen within an anaerobic base layer in the pond.
- Under median conditions, approximately 40-50% of this ammoniacal nitrogen is nitrified as wastewater flows out of the pond and into the turbulent/well-aerated stream. Monitoring data indicates that nitrate increases slightly to Site 15, likely as a result of this process.

Overall dilution predictions, based on this dataset, for the current and future (three-fold increase) scenarios are summarised in Table 6:

Table 6: Beachlands WWTP Dilution to Site 15 by Scenario		
Scenario	**Wastewater to Site 15 Flow Ratio**	**Dilution**
Current	1:2.29	56%
Future (three-fold increase)	3:4.29	30%

While the dilution effects have been quantified, it remains unclear what fractions of this reduction are attributable to the overland flow system vs. natural biological processes in the pond. Given the available information on the construction and operation of the overland flow system, it is unlikely that the overland flow slope is constructed in a way which promotes highly effective treatment. Based on studies of pilot scale overland flow systems, the careful preparation and maintenance of the overland flow slope is critical to maximising treatment performance (Kemp, Filip, & George, 1978). This could indicate that the pond is providing most of the treatment performance. Production of ammonia within the pond adds further evidence that there are significant processes occurring within the pond. As part of the detailed design phase of the process, PDP recommends that an investigation on the current performance of the system is completed to quantify the treatment performance of the overland flow system and inform the design of any future expansion.

Higher wastewater flows under the interim and Stage 2 scenarios will likely reduce the hydraulic retention time of the pond. If the pond is providing most of the observed nutrient removal this risks the expanded system providing reduced treatment performance if an expanded or additional pond is not provided.

Subject to further investigations, in the event pond is found to be the primary treatment process, the overland flow system could be designed to provide for some form of pond/wetland/riparian planted area at the toe of the new overland flow slopes to mimic the existing system more closely. Wastewater would likely be dispersed overland through a riparian margin into the existing farm pond as final form of discharge.

It is noted that in Memo 1, PDP identified that there was sufficient area (up to 11.5 ha) to provide overland flow treatment systems, even at the lowest end of the application rate range specified by the USEPA, within the existing Watercare site. If the pond is found to be the primary treatment process, it is expected that an application rate at the upper end of the USEPA range could be used. This will reduce the overland flow area requirements and result in sufficient available area for the potential pond/wetland areas in addition to the proposed overland flow areas.

4.0 Summary

A review of available overland flow literature has indicated that in some settings, overland flow systems can provide additional removal of well-treated wastewater. However, there are no examples of an overland flow system which is used to provide additional treatment to wastewater which is similar in nature and quality to that of the predicted MBR effluent quality. In the literature, it is common that overland flow systems produce effluent which is of worse quality that predicted MBR effluent quality. In some systems, the overland flow system increased concentrations of BOD, and TSS.

For the Beachlands WWTP, PDP is not aware of any information on the treatment performance of the existing overland flow system. PDP have attempted to quantify the treatment performance using sampling data from Sep 2023 – Feb 2024 from the WWTP effluent and environmental sampling points. Based on this assessment, it is expected that under median conditions the current combination of overland flow and retention within the farm pond provides removal of approximately 30 – 40% of total phosphorus and total nitrogen. Additionally, it is noted that ammoniacal nitrogen is generated within the system, likely due to mineralisation of organic nitrogen within the pond and that a large portion of this ammoniacal nitrogen is nitrified in the stream immediately downstream of the pond.

However, it is not possible to separate the individual performance of the overland flow slope and the farm pond. Without quantification of the performance of the overland flow slope vs. the farm pond it is not possible to predict with certainty the treatment performance of the upgraded system.

Under the expanded overland flow systems increased volumes will reduce the hydraulic residence time of the pond and therefore likely reduce the treatment capacity. This poses a risk as additional attenuation of nutrients within the overland flow/pond/wetland system is required to meet the proposed receiving water quality limits (as assessed by others). To mitigate this risk, PDP suggest that Watercare proceed on the basis that, subject to the results of ongoing investigations to inform detailed design, the consent application provides for new pond/wetland areas at the toe of the overland flow slopes. This will allow closer replication of the existing system/performance in the event the pond is providing the majority of the additional treatment. PDP recommends that, as part of the detailed design phase of the process, that Watercare undertake further investigations to quantify the performance of the existing system components to inform the design of the expanded system. If further investigations suggest that, based on a more complete understanding of the performance of different components of the current system, it is not necessary to provide an additional pond/wetland area, that area can be removed from the application after lodgement.

5.0 References

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6.0 Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Watercare Services Ltd and others (not directly contracted by PDP for the work), including Aquatic Environmental Sciences Ltd. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This memorandum has been prepared by PDP on the specific instructions of Watercare Services Ltd for the limited purposes described in the memorandum. PDP accepts no liability if the memorandum is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

PATTLE DELAMORE PARTNERS LIMITED

Yours faithfully

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ATTACHMENT 7

ASSESSMENT OF OVERLAND FLOW SYSTEM TREATMENT PERFORMANCE
MEMO 3-INTERIM
17 MAY 24

memorandum

TO	Tanvir Bamji	FROM	Khun Chueaphoodee & Oliver Hunt
	Watercare Services Ltd	DATE	17 May 2024
RE	Beachlands WWTP: Assessment of Overland Flow System Treatment Performance – Memorandum 3 (Interim)		

1.0 Background

Watercare Services Ltd (**Watercare**) is currently undertaking technical assessments to inform the resource consent application for the discharge of treated wastewater from the Beachlands Wastewater Treatment Plant (**WWTP**). The consent will provide for projected population growth and an increase in the capacity of the WWTP to 30,000PE over a proposed 35-year term. The Best Practicable Option (**BPO**) for the discharge was identified as the continued use and expansion of the existing Overland Flow System (**OLF**) which is used to create a diffuse discharge from the Beachlands WWTP to the Te Puru Stream.

Pattle Delamore Partners (**PDP**) previously completed a desktop assessment of the existing OLF treatment performance, outlined in PDP's memorandum *"Beachlands WWTP: Assessment of Overland Flow System Treatment Performance – Memorandum 2"* (PDP, 2024). Following the recommended outcomes from this assessment, Watercare has engaged PDP to complete a more detailed investigation into the performance of the OLF and pond at Beachlands. This investigation aims to assess the performance of the overland flow slope and the farm pond individually to determine their respective contributions to wastewater treatment post discharge from the WWTP. This assessment will help the design of any new or expanded OLF. The investigation involves site inspections, sampling of treated wastewater at various points within the overland flow and farm pond system, and measurement and analysis of water quality parameters to quantify treatment efficiency.

This memorandum has been prepared to describe the methodology used and the results of the OLF and Pond investigations undertaken between 9 April 2024 and 11 May 2024. Please note that this is an interim report, as not all laboratory results were available at the time of issue. To date, the first six of ten rounds of weekly sampling have been completed, however, laboratory results are only available for the first four sampling rounds. The conclusions and discussions herein are subject to change following PDP's receipt and analysis of additional laboratory results.

2.0 Investigations

2.1 Overland Flow System and Farm Pond Overview

PDP conducted a walk-through of the OLF area and identified, at the time of the site visit, three active dispersion zones, labelled A, B, and C. During the site visit no flow was observed from Zone D, and no readily accessible sampling points were located for Zone D. Each zone features two sets of pipes at the top. Poor dispersion of wastewater and rapid concentration or channelisation of flows were observed down the slope. A full description of the existing OLF is provided in PDP Memorandum 1 "Beachlands WWTP: Preliminary assessment of land area requirements for overland flow system expansion – Memorandum 1".

In each zone, following the channelisation of water, treated wastewater was observed discharging into the pond at three discrete locations after dispersing at the top of the slope. All treated wastewater flows into the farm pond, where it mixes with water entering the pond through the pond inlet on the eastern side. Pond inlet flows have been very low during the sampling period. The treated wastewater collected in the pond then flows out on the western side. The approximate sampling locations and zone boundaries are shown in Figure 1. Photographs were taken at each sampling location and are shown in Appendix B.

2.2 Sampling and Analysis

2.2.1 Treated wastewater sampling methodology

Grab samples of treated wastewater were collected weekly from the system. One sample of the discharged treated wastewater taken from the dispersal pipes at the top of the zones[1], a set of wastewater samples was collected from the bottom of the slope from each zone (labelled A Bottom, B Bottom, and C Bottom, respectively), and finally samples were also collected at the inlet and outlet of the farm pond.

The collected treated wastewater samples were sent to Hill Laboratories for analysis. All samples were tested for the following parameters:

- pH
- Electrical Conductivity (EC)
- Chloride
- Sodium
- Carbonaceous Biochemical Oxygen Demand (BOD)
- Turbidity
- Total Nitrogen (TN)
- Ammoniacal-N (NH_4-N)
- Nitrate-N (NO_3-N)
- Nitrite-N (NO_2-N)
- Total Kjeldahl Nitrogen (TKN)
- Total Oxidised Nitrogen (TON)
- Total Phosphorus (TP)
- Dissolved Reactive Phosphorus (DRP)
- Escherichia coli (*E. coli*)
- Faecal coliforms
- Chlorophyll a

[1] Note that for the first two sampling rounds separate samples were taken from the top of each zone (A Top, B Top, and C Top). Due to consistent results across the top of the zones this was reduced to only one sample to represent all the dispersed wastewater from round three onwards.

pdp

FIGURE 1: SAMPLING LOCATIONS

WATERCARE BEACHLANDS MARAETAI WWTP

SOURCE:
1. AERIAL IMAGERY: EAGLE TECHNOLOGY, LINZ, STATSNZ, NIWA, NATURAL EARTH, © OPENSTREETMAP CONTRIBUTORS., EAGLE TECHNOLOGY, LAND INFORMATION NEW ZEALAND, GEBCO, COMMUNITY MAPS CONTRIBUTORS.

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REVISION: 01 | DATE: MAY 24 | BY: JR
CLIENT: WATERCARE SERVICES LIMITED

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All sampling has been carried out on days without heavy rain to minimise dilution of samples on the slope from rainfall and to manage health and safety risks. PDP also took field measurements of dissolved oxygen (DO), pH, conductivity, and temperature at each sampling location shown in Figure 1.

3.0 General Field Observations

The slope area was densely vegetated, and avian presence was observed in the farm pond. The inlet was shallow, measuring less than 5 cm in depth, and stagnant. The highest flow rate was consistently in the dispersion lines recorded in Zone C, while Zones A and B exhibited minimal flow in both rounds of sampling. Channelisation was observed at the bottom of the slope, where the discharged treated wastewater formed a stream in each zone especially at the bottom of Zone C (Refer to Appendix B for site photographs). There was notably more flow at the bottom of Zone C compared to Zones A and B due to the higher flowrate at the discharge.

As noted in Memorandum 1, the dispersal system operates on demand via gravity from the WWTP. The dispersal system has not been designed to evenly distribute wastewater across the slopes and sub-optimal maintenance of the dispersion lines has exacerbated this problem. The discharge of wastewater across the slope varies significantly based on the instantaneous flowrate of wastewater from the WWTP. There are currently no systems in place to control or measure this variation in flow within the overland flow system. This means that the results should be interpreted with caution, particularly when considering the overall overland flow system performance.

Based on the observations to date, Zone C is the primary zone dispersion of low to average dry weather flows. Lower discharge rates have been observed in Zone A and Zone B, these zones have consistently had the lowest application rate during PDP's site visits.

During the third and fourth rounds of sampling, PDP observed a decrease in both the pond and inlet levels compared to the preceding rounds. Additionally, no treated wastewater was being dispersed at the top Zones A and B, along with the dispersion lines. Consequently, minimal flows were observed at the bottom of the slope in Zones A and B. This lack of flow made it challenging to obtain samples from these locations without disturbing sediment or picking up solids. Results for these zones in rounds three and four should be interpreted with caution.

4.0 Results and Discussion

4.1 Assessment Methodology

PDP reviewed the sampling results and provided analysis of the treatment efficiency across the multiple treatment processes. Based on comparison of key contaminant concentrations at different stages in the disposal system we have provided commentary on:

- The general treatment effectiveness of the overland flow area.
- Performance of and variance between individual zones of the overland flow area.
- Overall treatment effectiveness of the combined overland flow/pond system.
- Estimated contribution of the farm pond to overall treatment performance.

4.2 General Observations

This section presents the results from the first four rounds of sampling and compares them with the assumptions and findings previously documented in (PDP, 2024). The raw laboratory results are shown in Appendix A. The key observations and conclusions based on the available laboratory results are as follows:

- The majority of contaminants in the pond and outlet can be attributed to the treated wastewater discharge, as indicated by the consistent concentrations of total sodium and chloride across the slopes and to the pond outlet. Nutrient concentrations (various nitrogen and phosphorus species) were much lower in the inlet compared to the outlet of the farm pond and discharged treated wastewater.
- EC, total sodium, and chloride levels stayed relatively similar across the sampling points indicating that the OLF slope and the farm pond do not alter these parameters. This provides evidence that the assumptions made previously in Memorandum 2 were generally correct.
- BOD levels were generally below the laboratory detection limit of 2 g/m^3 across all samples collected from the OLF slope, including the treated wastewater from the dispersion lines. No detectable increase in BOD was generated across the OLF slope or through the pond. Outliers in BOD levels were noted in samples collected from the bottom of Zone B and the inlet from the third and fourth rounds of sampling, this was due to low wastewater flow in these zones, leading to disturbance and sediment pickup during sample collection
- Turbidity levels slightly increased as treated wastewater flowed through the OLF slope, with notably elevated levels at the inlet and bottom of Zones A and B during the third sampling round. These are considered outliers due to low wastewater flow in these zones, leading to disturbance and sediment pickup during sample collection. The general increase in turbidity across the slope highlights the risk identified in Memorandum 2 regarding potential TSS increases in certain OLF systems. However, the water discharged from the slopes still have excellent clarity with turbidity <5 NTU on average.
- PDP highlighted the risk of increasing BOD and TSS concentrations in Memorandum 2. No increase in BOD was detected and the increase in turbidity was relatively low. It appears that this risk is low with the slope grade and planting of the existing OLF.
- Chlorophyll-a levels were below the laboratory detection limit of 0.003 g/m^3 across all samples, except for the inlet. This indicates that there is not significant growth of algae except for the stagnant area near the pond inlet which exhibited slightly higher chlorophyll-a levels consistent with observations of algal growth during sampling.
- Faecal coliforms and *E. coli* were generally low at the dispersion lines across all zones and increased as the treated wastewater flowed through the OLF and the pond. This confirms that the risks of increasing pathogen loads over the slope and through the pond raised in PDP Memorandum 2 are currently being realised.

In addition to the general trends identified above, notable trends around reduction or increase in the key nutrient levels and the treatment performance of the OLF system around removal of these nutrients are discussed in further detail in Sections 4.2 - 4.5.

From the initial laboratory results, the samples from dispersion lines (A Top, B Top, and C Top) show roughly equal contaminant concentrations. This was expected; however, it was necessary to confirm that residence time in the dispersal system was not modifying the nature of the influent wastewater. From the third round of sampling onwards, only one sample has been collected from the dispersion lines in Zone C.

4.3 Total Nitrogen Performance

The total nitrogen (TN) levels in the treated wastewater discharge were marginally lower than the previously reported median of 5.02 g/m³. Similarly, the total nitrogen levels at the farm pond outlet ranged from 3.2 to 4.2 g/m³, which is marginally lower than the previously reported median concentration of 3.7 g/m³.

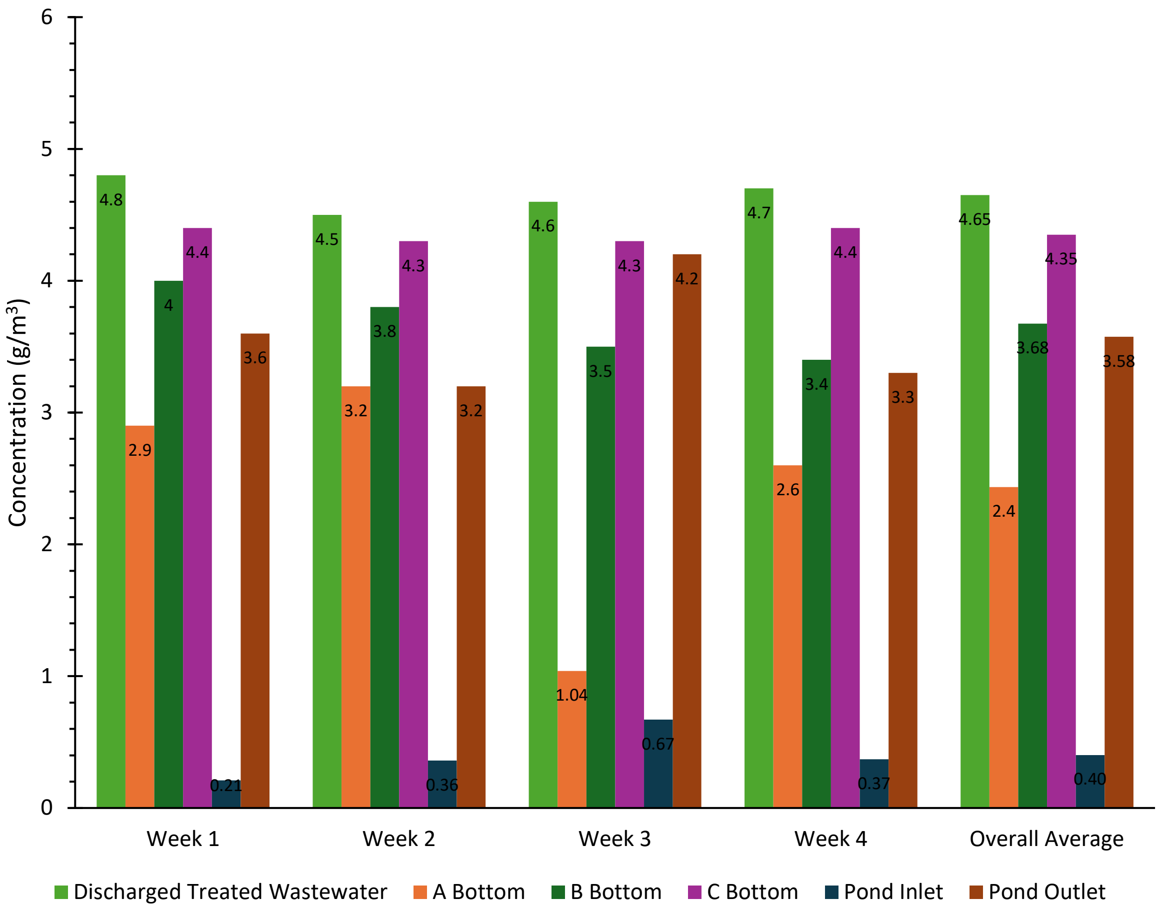

Figure 2: Total Nitrogen Concentrations

- TN removal was observed across all zones, although the removal efficiency varied.
- Zone A exhibited the highest TN removal, with an average of 48%, followed by Zones B and C with 21% and 6% removal, respectively.
- The lower removal efficiency in Zone C is likely due to higher flow rates, steeper slopes, and greater channelisation, resulting in lower retention time on the OLF slope and thus lower treatment levels.
- Based on estimates of the flows to each zone, the preliminary results indicate the pond is still the primary means of TN removal. However, the higher levels of removal in Zones A and B indicate that there is potential for achieving higher levels of removal than is currently being achieved with the majority of the wastewater discharged preferentially to Zone C. Good design and operation of the slopes will be key to achieving improved results.
- The combined OLF slope and pond reduction in TN is consistent with the 30% removal determined in Memorandum 2.

4.4 Ammoniacal Nitrogen Performance

The ammoniacal nitrogen levels in the treated wastewater discharge is higher than what was previously reported (0.06 g/m^3 vs 0.03 g/m^3). However, the ammoniacal nitrogen levels return to the levels similar to the previously reported median concentration of 0.03 g/m^3 at the bottom of the slope.

At the farm pond outlet, the ammoniacal nitrogen levels have slightly decreased, averaging 0.14 g/m^3 compared to the previously reported median concentration of 0.28 g/m^3.

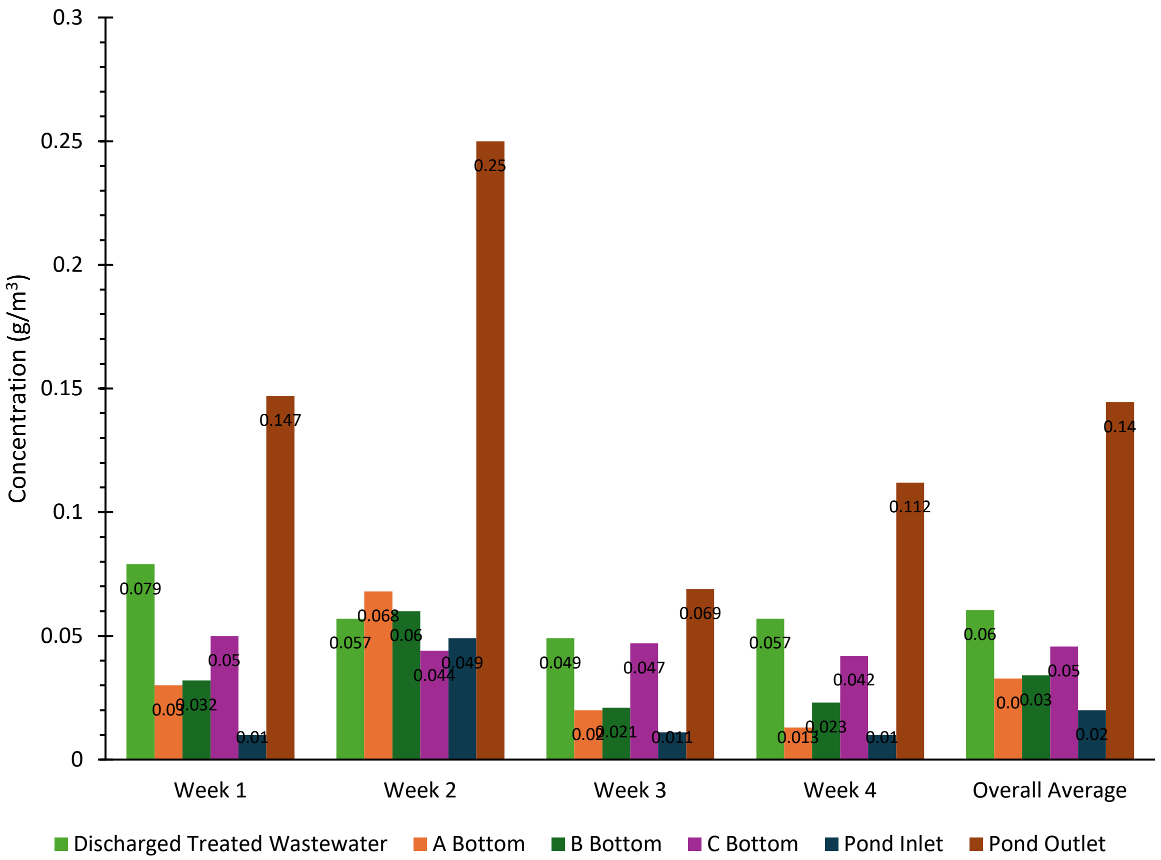

Figure 3: Ammoniacal Nitrogen Concentrations

It should be noted that, negative removal efficiency means increase in contaminant levels.

- Overall, there is a decrease in ammoniacal nitrogen from the top to the bottom of the OLF slope, with removal efficiency varying across the zones, mirroring trends observed in TN concentrations. Zone A demonstrated the highest average removal efficiency at 66%, followed by Zone B and Zone C at 56% and 22%, respectively. This general decease in ammoniacal nitrogen across the OLF slope suggests that the existing setup adequately maintains aerobic conditions for the current treated wastewater flows and loads.
- There is a significant increase in ammoniacal nitrogen in the pond as was previously assumed in Memorandum 2. Over this sampling period the ammonia concentration increases 285% across the farm pond from the bottom of the overland flow area. It is noted that the concentration of ammoniacal nitrogen in the discharge is generally elevated above that reported in Memorandum 2, likely due to the smaller data set, and this may explain why the results indicate a lower increase in ammoniacal nitrogen than the 8.74 times increase previously reported in Memorandum 2.

- As previously reported, the generation of ammoniacal nitrogen is likely due to mineralisation (ammonification) of organic nitrogen within an anaerobic base layer in the pond, and potential contamination from avian life consistently present during sampling. This leads to an increase in ammoniacal nitrogen in the OLF system overall.
- As noted in Memorandum 2, this elevated ammoniacal nitrogen concentration was rapidly reduced downstream of the pond.

4.5 Nitrate Performance

The nitrate levels in the treated wastewater discharge were lower than previously reported, ranging from 3.3 to 3.7 g/m³, compared to the previously reported median of 5.02 g/m³. At the farm pond outlet, the nitrate levels were also slightly lower, ranging from 2 to 2.43 g/m³, compared to the previously reported median concentration of 2.71 g/m³.

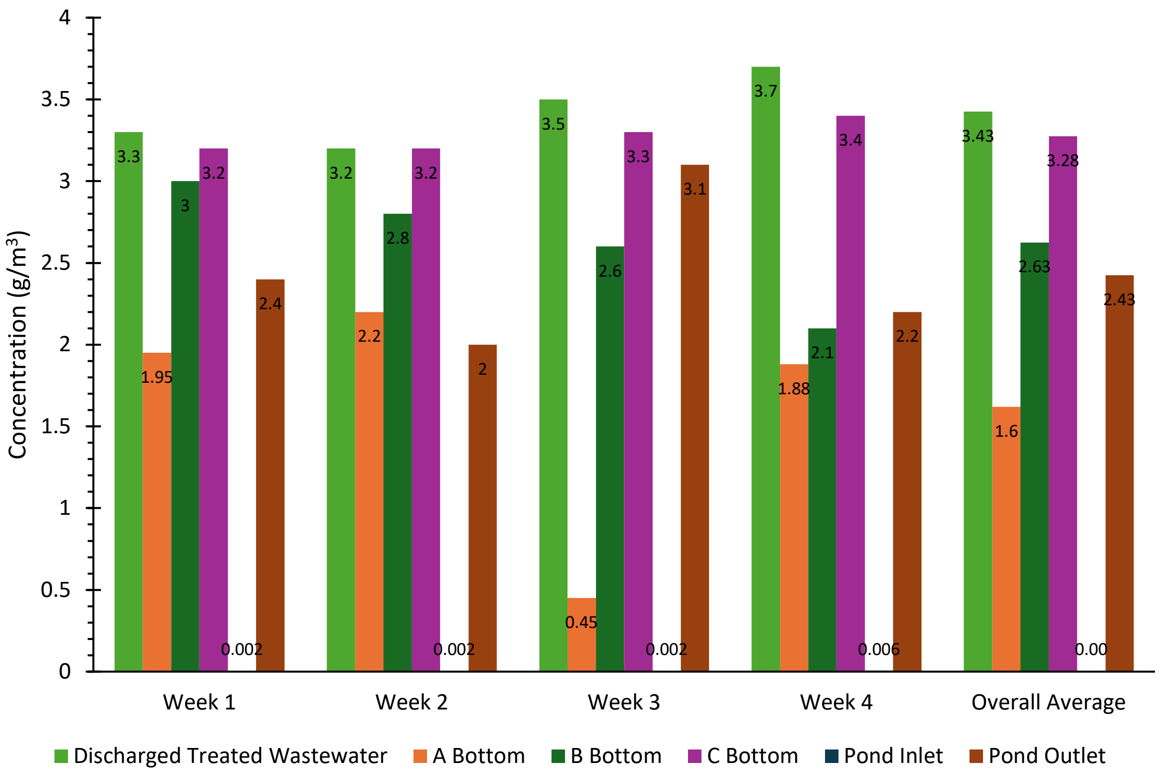

Figure 4: Nitrate Concentrations

- Similar to the TN results, Zone A exhibited the highest nitrate removal, with an average of 53% over two weeks, followed by Zone B with 23% and Zone C with 4%.
- The lower removal efficiency in Zones B and C is likely due to higher flow rates, steeper slopes, and greater channelisation, resulting in lower retention time on the OLF slope and thus lower treatment levels.
- Based on estimates of the flows to through zone, the preliminary results indicate the pond is still the primary means of nitrate removal. However, the higher levels of removal in Zones A indicates that there is potential for achieving higher levels of removal than is currently being achieved with the majority of the wastewater discharged preferentially to Zone C. Good design and operation of the slopes will be key to achieving improved results.

- The combined OLF slope and pond provided a 30% reduction in nitrate, similar to the previously quantified 36% in Memorandum 2.

4.6 Total Phosphorus Performance

Total phosphorus (TP) levels in the treated wastewater discharge were lower than previously reported, with an average concentration of 0.37 g/m³ compared to the previously reported median of 0.87 g/m³.

Similarly, TP levels at the farm pond outlet were slightly lower than previously reported, averaging 0.36 g/m³ compared to the previously reported median concentration of 0.47 g/m³.

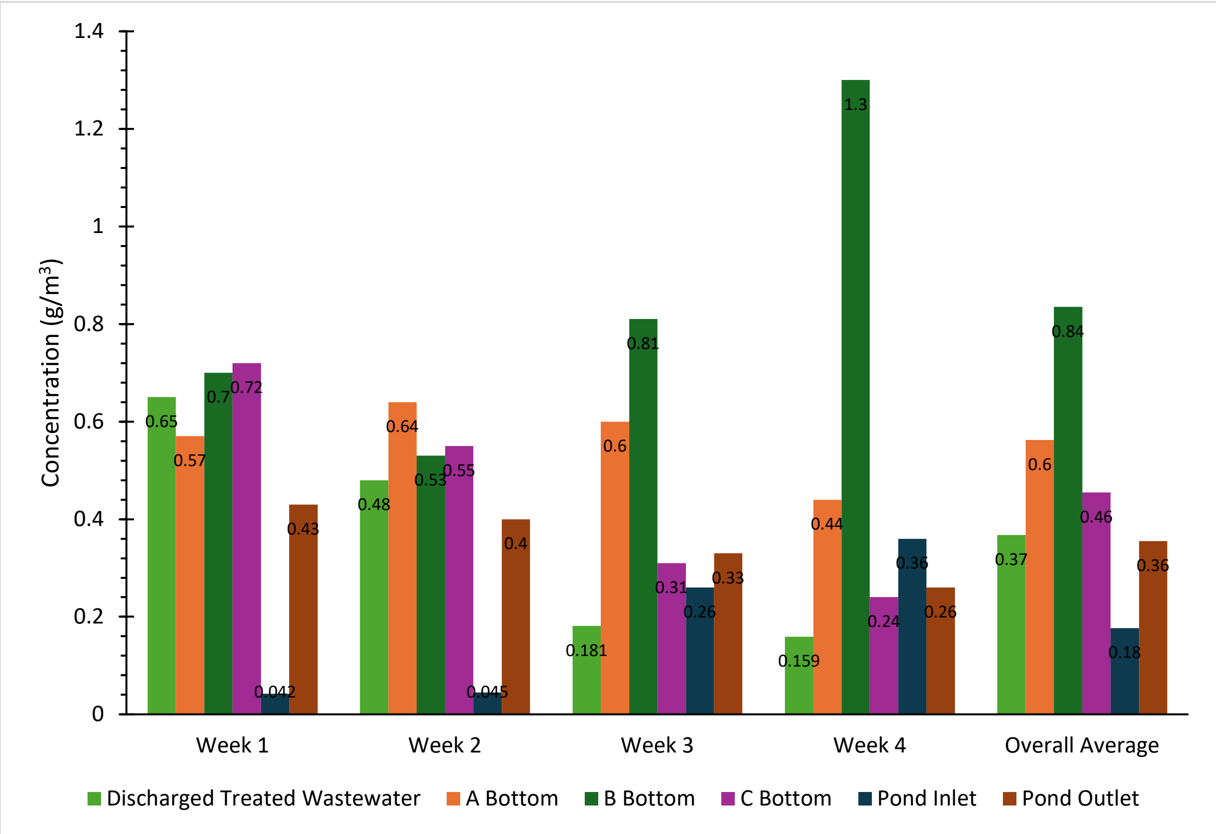

Figure 5: Total Phosphorus Concentrations

- There were increase in TP levels across all zones. These were generally small with average increases of 4%, 9%, and 13% in Zones A, B, and C, respectively during weeks one and two. Large increases were seen in weeks three and four, however, these results should be interpreted with care as wastewater was not being dispersed onto these zones at the time of sampling.
- Increases in TP is likely associated with an increase in suspended solids as the treated wastewater flows down the OLF slope, as evidenced by the increase in turbidity across the slope areas (See Appendix A).
- Overall, pond outlet concentrations were relatively consistent over the four sampling rounds. Increases or decreases seem to be as a result of fluctuating treated wastewater concentrations. This could indicate the wastewater is reaching an equilibrium with phosphorous in soil producing relatively consistent final results.

4.7 Dissolved Reactive Phosphorus Performance

Dissolved reactive phosphorus (DRP) levels in the treated wastewater discharge were lower than previously reported, with an average concentration of 0.27 g/m³ based on the lab results, compared to the previously reported median of 0.73 g/m³. At the farm pond outlet, DRP levels were also slightly lower, with an average of 0.25 g/m³ compared to the previously reported median concentration of 0.38 g/m³.

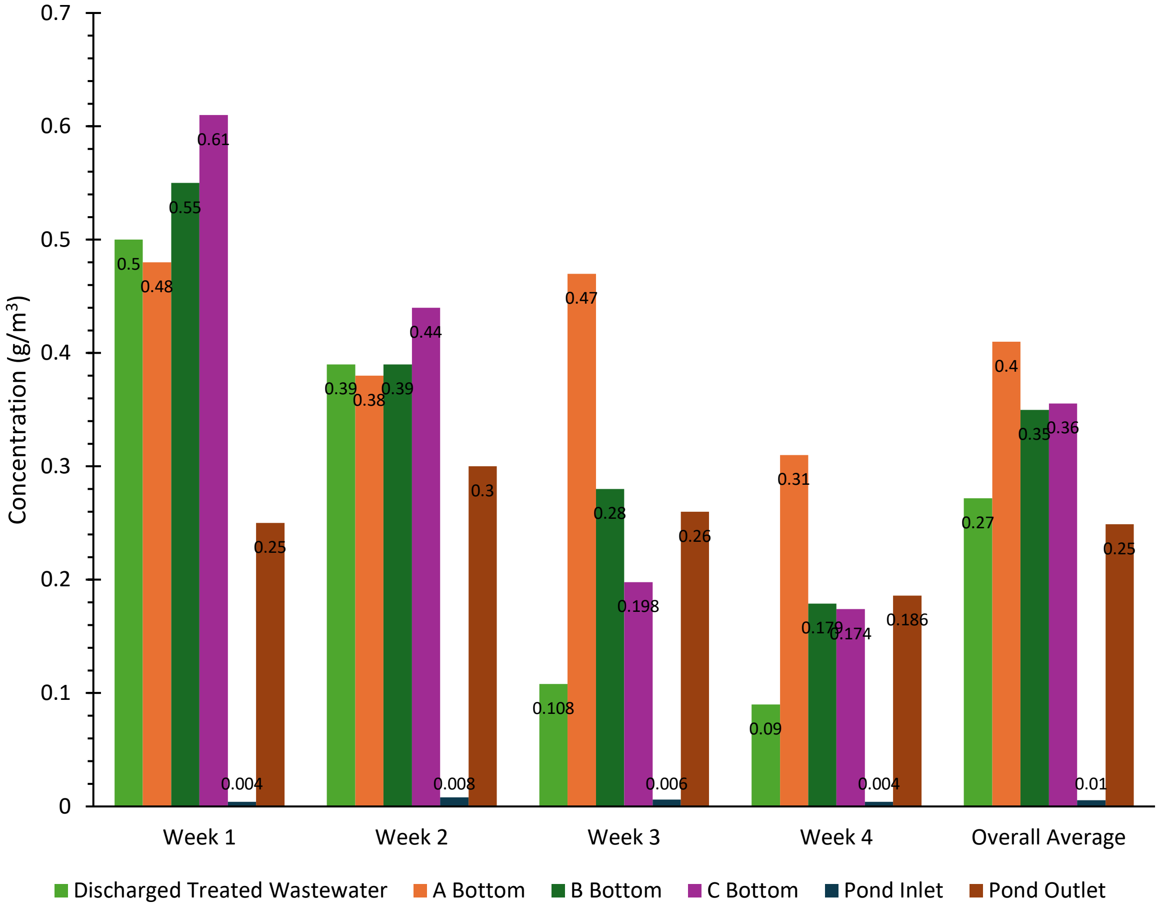

Figure 6: Dissolved Reactive Phosphorus Concentrations

- Similar to the trend observed from TP removal performance, the treatment performance varied across the zones, but overall, the average DRP level across the zones increased by 85%.
- Similar to TP removal, the majority of DRP removal was achieved in the pond, which provided an average removal of 28%.

5.0 Summary

PDP has completed six sampling rounds at the date of this memorandum, however, only four rounds of lab results have been received. The sampling consists of samples from the dispersal system, an individual sample from the lower section of Zones A, B, and C, the pond inlet, and the pond outlet. The results have been analysed and interpreted as follows:

- Concentrations of sodium and chloride indicate the flows out of the farm pond are almost entirely wastewater over the sampling period.
- Previous assumptions about negligible change in electrical conductivity through the system (Memorandum 2) are likely correct.

- The uneven and inconsistent nature of the dispersion system is reducing the level of treatment provided by the overland flow slopes. Similarly, the absence of gentle, well graded slopes and rapid concentration/channelisation of wastewater within Zones B and C is reducing the performance of these zones. An improved dispersion system and better preparation of the slopes to promote sheet flow may result in improved performance of the existing overland flow system.
- The overland flow area is providing some removal of contaminants, particularly in Zone A where the application rate is lower. However, based on preliminary results, the pond provides the majority (>50 %) of treatment for key contaminants including total nitrogen, nitrate-nitrogen, total phosphorus and dissolved reactive phosphorus.
- Ammoniacal-nitrogen concentrations generally decrease over the overland flow area; however, ammoniacal-nitrogen concentrations increase in the pond. As detailed in Memorandum 2, this is thought to be due to mineralisation of organic nitrogen in anaerobic areas of the pond/pond base. Avian faecal matter may also make a minor contribution to this increase.
- Risks of increase BOD and TSS/turbidity concentrations highlighted in Memorandum 2 were not realised in the sampling completed to date. However, there is a clear increase in faecal contamination post discharge to the top of the overland flow slopes. Faecal coliform counts increase both over the slopes and through the pond, most likely from avian sources. These results are consistent with elevated faecal coliform counts detected in the upstream catchment.
- **Generally, the sampling completed to date confirms the assumptions made and anticipated results previously set out in PDP Memorandum 2**.

These conclusions are preliminary only and should be considered indicative only. Sampling work continues and this memorandum will be updated following the completion of the scheduled ten-week sampling programme. The final results, interpretation, and conclusions drawn may change as a result of analysis of a larger dataset. These final results will be used to inform the design process of any modification or expansion to the Beachlands overland flow system.

6.0 Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Watercare Services Ltd and others (not directly contracted by PDP for the work), including Aquatic Environmental Sciences Ltd. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

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PATTLE DELAMORE PARTNERS LIMITED

Yours faithfully

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Technical Director - Water and Geotechnics

Appendix A: Laboratory Results

Laboratory Results

Sample Name	Date	Turbidity	pH	EC	Total Sodium	Chloride	TN	TKN	TON	TP	cBOD5	Chlorophyll a	Faecal Coliforms	E. coli	NH4-N	NO2-N	NO3-N	NO3-N + NO2-N	DRP
		NTU	pH Units	mS/m	g/m^3	g/m^3	g/m^3	g/m^3	g/m^3	g/m^3	g O2/m^3	g/m^3	cfu/100mL	cfu/100mL	g/m^3	g/m^3	g/m^3	g/m^3	g/ g/m^3
Inlet	9/04/2024	9.7	6.6	43	62	110	0.21	0.21	0.21	0.042	< 2	0.005	160	150	< 0.01	< 0.002	< 0.002	< 0.002	< 0.004
Outlet	9/04/2024	7.4	7.3	238	400	710	3.6	1.15	1	0.43	< 2	< 0.003	250	250	0.147	0.096	2.4	2.5	0.25
A Top	9/04/2024	1	7.1	240	370	710	4.9	1.18	1.1	0.66	< 2	< 0.003	< 10	< 10	0.079	0.21	3.5	3.7	0.59
A Bottom	9/04/2024	6.2	7.2	242	400	660	2.9	0.95	0.92	0.57	< 2	< 0.003	320	310	0.03	0.004	1.95	1.96	0.48
B Top	9/04/2024	0.85	7.1	239	390	680	4.8	1.24	1.16	0.64	< 2	< 0.003	90	50	0.085	0.23	3.3	3.5	0.53
B Bottom	9/04/2024	9.9	7.7	240	400	710	4	1.07	1.04	0.7	< 2	< 0.003	120	120	0.032	0.008	3	3	0.55
C Top	9/04/2024	1.09	7	239	390	700	4.8	1.25	1.17	0.65	< 2	< 0.003	40	40	0.079	0.24	3.3	3.5	0.5
C Bottom	9/04/2024	3	7.3	240	390	640	4.4	1.09	1.04	0.72	< 2	< 0.003	80	70	0.05	0.034	3.2	3.3	0.61
Inlet	17/04/2024	10	6.7	42.6	59	111	0.36	0.36	0.31	0.045	< 2	0.041	420	420	0.049	< 0.002	0.002	0.002	0.008
Outlet	17/04/2024	2.3	7.6	286	450	840	3.2	1.09	0.84	0.4	< 2	< 0.003	130	130	0.25	0.056	2	2.1	0.3
A Top	17/04/2024	0.52	7.1	257	390	750	4.5	1.05	0.86	0.53	< 2	< 0.003	< 10	< 10	0.187	0.13	3.3	3.5	0.42
A Bottom	17/04/2024	17.6	7.6	266	420	730	3.2	0.98	0.91	0.64	< 2	< 0.003	640	630	0.068	0.002	2.2	2.2	0.38
B Top	17/04/2024	0.66	7.2	260	400	740	4.5	1.1	1.02	0.49	< 2	< 0.003	20	20	0.082	0.167	3.3	3.4	0.41
B Bottom	17/04/2024	6.5	7.5	262	390	750	3.8	1	0.94	0.53	< 2	< 0.003	440	160	0.06	0.002	2.8	2.8	0.39
C Top	17/04/2024	0.83	7.1	262	400	720	4.5	1.08	1.02	0.48	< 2	< 0.003	60	60	0.057	0.186	3.2	3.4	0.39
C Bottom	17/04/2024	3.5	7.6	260	400	730	4.3	1.08	1.04	0.55	< 2	< 0.003	300	300	0.044	0.029	3.2	3.3	0.44
Pond Inlet	30/04/2024	33	6.4	28.6	39	62	0.67	0.67	0.66	0.26	12	0.006	< 100	< 100	0.011	< 0.002	< 0.002	0.002	0.006
Pond Outlet	30/04/2024	2.1	7.6	159	260	380	4.2	1.04	0.97	0.33	< 2	< 0.003	500	500	0.069	< 0.10	3.1	3.1	0.26
C Top	30/04/2024	0.57	7.3	155.4	260	350	4.6	1.1	1.05	0.181	< 2	< 0.003	< 10	< 10	0.049	< 0.10	3.5	3.5	0.108
A Bottom	30/04/2024	25	7.4	157.6	250	360	1.04	0.58	0.56	0.6	< 2	< 0.003	400	400	0.02	< 0.10	0.45	0.45	0.47
B Bottom	30/04/2024	37	7.4	152.4	250	340	3.5	0.85	0.83	0.81	4	< 0.003	300	300	0.021	< 0.10	2.6	2.6	0.28
C Bottom	30/04/2024	6.2	7.6	155.8	260	360	4.3	1.03	0.98	0.31	2	< 0.003	220	160	0.047	< 0.10	3.3	3.3	0.198
Inlet	3/05/2024	106	7	27.9	38	64	0.37	0.36	0.36	0.36	7	0.128	10	10	< 0.010	< 0.002	0.006	0.006	< 0.004
Outlet	3/05/2024	2	7.9	177.9	270	410	3.3	1.02	0.91	0.26	< 2	< 0.003	150	100	0.112	< 0.10	2.2	2.3	0.186
C Top	3/05/2024	0.62	7.2	155.6	240	350	4.7	1.03	0.97	0.159	< 2	< 0.003	180	< 10	0.057	< 0.10	3.7	3.7	0.09
A Bottom	3/05/2024	10.7	7.9	163.1	260	370	2.6	0.71	0.7	0.44	< 2	< 0.003	1000	1000	0.013	< 0.10	1.88	1.88	0.31
B Bottom	3/05/2024	116	7.3	153.9	250	360	3.4	1.24	1.22	1.3	< 2	< 0.003	280	260	0.023	< 0.10	2.1	2.1	0.179
C Bottom	3/05/2024	5.8	7.6	156.2	250	370	4.4	0.98	0.94	0.24	< 2	< 0.003	160	160	0.042	< 0.10	3.4	3.5	0.174
Pond Inlet avg.		17.6	6.6	38	53	94	0.4	0.41	0.4	0.12	5.3	0.017	227	223.3	0.0	0.0	0.0	0.0	0.0
Pond Outlet avg.		3.9	7.5	228	370	643	3.7	1.09	0.94	0.39	2	0.003	293	293.3	0.2	0.1	2.5	2.6	0.270
A Top avg.		0.7	7.2	217	340	603	4.7	1.11	1.00	0.46	2	0.003	10	10.0	0.1	0.1	3.4	3.6	0.373
A Bottom avg.		16.3	7.4	222	357	583	2.4	0.84	0.80	0.60	2	0.003	453	446.7	0.0	0.0	1.5	1.5	0.443

B Top avg.		0.7	7.2	218	350	590	4.6	1.15	1.08	0.44	2	0.003	40	26.7	0.1	0.2	3.4	3.5	0.349
B Bottom avg.		17.8	7.5	218	347	600	3.8	0.97	0.94	0.68	2.7	0.003	287	193.3	0.0	0.0	2.8	2.8	0.407
C Top avg.		0.8	7.1	219	350	590	4.6	1.14	1.08	0.44	2	0.003	37	36.7	0.1	0.2	3.3	3.5	0.333
C Bottom avg.		4.2	7.5	218.6	350	577	4.3	1.07	1.02	0.53	2	0.003	200	176.7	0.0	0.1	3.2	3.3	0.416

Notes:

1. *Type notes here values denoted as "less than", "<" are lower than the laboratory detection limits.*

Appendix B: Site Photographs

A Top Sampling Point

B Top Sampling Point

C Top Sampling Point

A Bottom Sampling Point

B Bottom Sampling Point

C Bottom Sampling Point

Pond Inlet Sampling Point

Pond Outlet Sampling Point

ATTACHMENT 8

OVERLAND FLOW SYSTEM LAND IMPACTS
MEMO 4
2 APR 24

memorandum

TO	Tanvir Bhamji	FROM	Oliver Hunt, Mark Bellingham and Alan Pattle
	Watercare Services Ltd	DATE	17 May 2024
RE	Assessment of Potential Effects on Soils and Ecology from Beachlands WWTP Overland Flow System (Memorandum 4)		

1.0 Background

Watercare Services Ltd (**Watercare**) is currently undertaking technical assessments to inform a resource consent application for the discharge of treated wastewater from the Beachlands Wastewater Treatment Plant (**WWTP**). The consent will provide for projected population growth and an increase the capacity of the WWTP to 30,000PE over a proposed term of 35 years. The Best Practicable Option (**BPO**) for the discharge has been identified as the continued use and expansion of the existing overland flow system from the Beachlands WWTP which is used to create a diffuse discharge to the Te Puru Stream.

Pattle Delamore Partners (**PDP**) has previously completed work to assess the overland flow area required for expansion of the WWTP's capacity to 30,000 PE, summarise the current performance data available for the existing system, and to detail the interim results of a sampling regime investigating the specific performance of the existing system (PDP Memorandums 1, 2 and 3).

This memorandum has been prepared to assess the potential adverse effects on soils, groundwater, and ecology of the proposed discharge of wastewater to land within the existing and proposed overland flow areas. This assessment concludes that effects of the proposed discharge are likely to be minimal and can be adequately avoided through suitable design of the expanded overland flow area.

2.0 Description of Overland Flow System

The United States Environmental Protection Agency (**USEPA**) provides the following description of generic overland flow treatment: "the controlled application of wastewater onto grass-covered, uniformly graded, gentle slopes, with relatively impermeable surface soils" (USEPA, 2006). Overland flow systems are designed to provide for biological activity to occur as the wastewater flows over the surface of the land. Typically, wastewater application rates exceed the infiltration capacity of the soils, and it is expected that the majority of wastewater applied to the top of the slope runs off at the bottom and is captured in a controlled manner rather than infiltrating into deep soil layers or any aquifer below the overland flow area.

As noted in Memorandum 1, the existing overland flow area differs from the USEPA guidelines in several aspects. It is anticipated that native vegetation, as is currently present in the existing area, will be retained in the existing area and included in proposed area. However, other changes may form part of the final design which more closely follow the USEPA standards including the improvements to the dispersal systems.

Overall, overland flow areas have been selected as they generally conform to the requirements of the USEPA guidelines including low soil permeability and gentle slope. It is anticipated that losses of wastewater via infiltration will generally be low. Most wastewater applied to the top of the slopes will be discharged into the farm pond in a controlled manner either, as run-off from the existing area, or, will be conveyed to a discharge point on the banks of the farm pond from the proposed areas (Area B2). Losses due to evaporation/evapotranspiration are expected to be negligible.

3.0 Potential Effects on Ecology

The wider Watercare WWTP site at Beachlands includes Significant Ecological Areas (SEAs) identified in the Auckland Unitary Plan (AUP). Within these SEAs, PDP has identified that there are possibly wetlands within the gullies between Areas B1 and B2 and in the riparian margins of the stream downstream of the farm pond (Memorandum 1).

The SEA identified in the AUP includes the constructed farm pond and existing overland flow area, both of which are used for treatment/discharge of wastewater. These areas are part of the Beachlands WWTP and have been part of the WWTP since 2006. These areas are not natural ecosystems, they have been developed to facilitate wastewater treatment and discharge and therefore do not meet the SEA criteria in the AUP or the natural inland wetlands criteria of the NPS-FM.

Two areas have been identified as possible additional wastewater disposal areas. Area A (the western area, refer Figure 1) is mostly within the 100-metre buffer of the wetlands within the downstream riparian margin. Area B (the eastern area) primarily drains or could be modified to drain to the existing farm pond. Some of Area B is within 100m of the downstream riparian SEA/wetlands, however, with the proposed overland flow slope design, the wastewater field will not drain into these downstream riparian wetland areas. The development of Area B, with drainage into the existing farm pond and not into any downstream wetlands is unlikely to have any additional adverse ecological effects on the SEA and wetlands in the Te Puru Stream catchment.

It is anticipated that the existing overland flow area will continue to drain directly into the farm pond.

It is also noted that the proposed overland flow expansion, dependent on the final design, has the potential to increase the area of native flora present at the Watercare site. This may a provide positive effect as a result of the discharge.

4.0 Potential Effects on Soils

The soils at the site are described in PDP (2024) as consisting of 200 – 300mm deep silty topsoil overlying a silty clay subsoil. This report is attached to this memorandum for convenience. The soils are predominantly mottled or gley indicating poor drainage characteristics as evidenced by the slow field infiltration test results in the region of 2.4mm/hr for the topsoil and 0.6mm/hr for the subsoil. The typical soil profile is shown in Figure 1. Further profile photos are included in the attachments to the soils reports including adjacent to the existing area and at the proposed expansion area.

Figure 1: Soil Profile observed within the proposed overland flow expansion area

The soil chemical characteristics (Table 3, PDP, 2024) indicate conditions favourable for the retention of solutes from migration off site. Both cation and anion exchange capacity are at the high end of the typical range for soils which is conducive to adsorption of soluble residues from the wastewater. In addition, the natural phosphorus content of the soil (Olsen P) is low providing capacity for further uptake of phosphorous in the wastewater.

While development of the OLF system may involve earthworks to recontour parts of the site this is unlikely to expose soils characteristics that are different from those existing. The existing profile as exemplified in Figure 1 shows a low permeability regolith profile several meters deep. Topsoil would be reinstated to provide a growing medium in any earthworks areas.

Given the deep soils, low hydraulic conductivity, and high adsorptive capacity of the soils, downwards migration of soluble residues below the overland flow system is expected to be strongly retarded and limited. This provides a baseline for the groundwater effects assessment discussed in Section 5 below.

5.0 Potential Effects on Groundwater

The existing and proposed overland flow areas (Area B2) are located over variable geology consisting of the East Coast Bays Formation (**ECBF**) of the Waitemata Group, the Basal Waitemata Beds and Waipapa Group greywacke. The boundary between the main geological units as taken from NZ Geological map series (Sheet no. 3, IGNS, 2001) is shown in Figure 3 (PDP, 2010) attached to this memorandum. In the area of the site the contact between the ECBF and the greywacke daylights along a sinuous line formed by erosion of the two units. In this area the beds of the ECBF dip moderately (10º to 15º) to the west. The thickness of regolith over unweathered bedrock has been recorded in bore 23094 which is the production bore for the Pine Harbour water supply located in a similar geological setting on a ridge to the overland flow site at the end of Tui Brae Road. The regolith thickness is 7m in that bore which is considered a reasonable estimate for the thickness of regolith at the OFS site.

The groundwater level in the ECBF is inferred to be at RL40m about 1.3km to the west of the overland flow site (Figure 2). However, the reliability of this measurement is low as it is based on an assumed wellhead level for the bore and is likely to underestimate the depth to groundwater. Based on the general groundwater level trend shown in the Figure 2, the groundwater level beneath the site is expected to be no higher than 10 m to 15 m below ground under the high plateau area of the overland flow site and at stream level along the tributaries. Groundwater beneath the site is expected to move along flow paths that discharge to the tributary of Te Puru Stream within the immediate downstream reaches.

The recharge area that feeds groundwater flowing under the overland flow site is expected to comprise not only the local ECBF outcrop but also the underlying greywacke unit that will discharge either directly to the streams or up into the ECBF in this area. This recharge area consists of the hills to the east of the WWTP site and is estimated to be 4 to 6 times the area of the overland flow site. Hence, groundwater flow beneath the site will likely comprise a similar ratio of local to upgradient recharge.

Any potential contaminants from the overland flow site that migrate downwards through the regolith into the groundwater are therefore expected to have flow path lengths no longer than hundreds of metres to the nearest stream discharge zone. This is a conservative (i.e., overrated) assessment and sets a limited envelope of potential effects from the overland flow site. No existing bores or other groundwater takes occur within this area.

As discussed in Section 4.0, the quantum of residues that infiltrate to groundwater beneath the overland flow site is expected to be minor due to the low permeability of the regolith. Further, any residues that reach groundwater over time will mix with the upgradient throughflow reducing the net potential effect on the water quality in the groundwater and the surface water discharge zone. In comparison to the discharge of the treated wastewater from the overland flow system runoff itself this input to the tributary of Te Puru Stream is expected to be undetectable.

6.0 Summary

The proposed use of the existing overland flow areas and expanded overland flow areas (Area B) is expected to have minimal effects on the soils, groundwater, and ecology of these areas due to:

- Appropriate design of overland flow system to minimise drainage through surface soils and to safely capture slope run-off.
- Existing soil characteristics indicate low potential for drainage to groundwater and a high capacity for contaminant retention within the soil profile.
- The final design of the overland flow areas can allow for controlled discharge of wastewater into the farm pond and therefore can any potential effects on the SEA (excluding that area which is already used for wastewater treatment/discharge) or any wetlands.

There may also be the potential for positive effects on terrestrial ecology if, subject to the final design, the overland flow areas are planted with native flora.

7.0 References

PDP. (2010). *Groundwater Supply AEE – Pine Harbour Marina Development.* Auckland.

PDP. (2024). *Beachlands Maraetai WWTP Options Assesment: Soil Sampling LA site – Factual Report.* Auckland.

USEPA. (2006). *Process Design Manual Land Treatment of Municipal Wastewater Effluents.* Cincinnati: U.S. Environmental Protection Agency.

8.0 Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Watercare Services Ltd and others (not directly contracted by PDP for the work). PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This memorandum has been prepared by PDP on the specific instructions of Watercare Services Ltd for the limited purposes described in the memorandum. PDP accepts no liability if the memorandum is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Prepared by

Oliver Hunt

Senior Environmental Engineer

Prepared by

Mark Bellingham

Technical Director - Ecology

Reviewed and Approved by

Alan Pattle

Technical Director - Water and Geotechnics

pdp

FIGURE 1: SUITABLE LAND AREA FOR AN EXPANSION OF THE BEACHLANDS WWTP OVERLAND FLOW SYSTEM

WATERCARE BEACHLANDS MARAETAI WWTP

SOURCE:
1. AERIAL IMAGERY: EAGLE TECHNOLOGY, LINZ, STATSNZ, NIWA, NATURAL EARTH, © OPENSTREETMAP CONTRIBUTORS., EAGLE TECHNOLOGY, LAND INFORMATION NEW ZEALAND, GEBCO, COMMUNITY MAPS CONTRIBUTORS.
2. ELEVATION INFORMATION SOURCED FROM LINZ (AUCKLAND 1 M LIDAR 2016-2017).
3. WASTEWATER DISPERSAL PIPEWORK SOURCED FROM WATERCARE.

REVISION: 01 | DATE: JAN 24 | BY: JR
CLIENT: WATERCARE SERVICES LIMITED

A02803202_GIS001

KEY:

- 23094 New Production Well
- 22646 PDP Located Farm Well (ARC bore ID)
- 22996 Farm Well (ARC bore ID - if unknown Consent No is used)
- (6.0) Approximate Groundwater Level (m RL)
- General Groundwater Flow Direction
- Flow Cross Section
- Potential Extent of Aquifer within the Beachlands Waitemata Block
- Approximate Groundwater Contours (m RL)
- Potential Zone of Influence

Source:
1. Base plan derived from Sheet_ R11 NZMS260 NZTopo 2004.
2. Bore data supplied by ARC, received 29/02/2008.
3. Groundwater levels derived from ARC database 29/02/2008 and additional ARC data received 10, 18 & 21/12/2009.

No.	Revision	Date	App.
B	Issued for Consent	Jan 10	
A	Issued for Review	Sep 09	

	By	Checked	Date
Designed	P.N.		Mar 09
Drawn	D.R.		Mar 09
Approved for issue:			
Approved for construction:			

This drawing is not for construction unless signed as approved

Client : Pine Harbour Marina Ltd

Project : Groundwater Supply AEE - Pine Harbour Marina Development

Title : Borehole Location Plan

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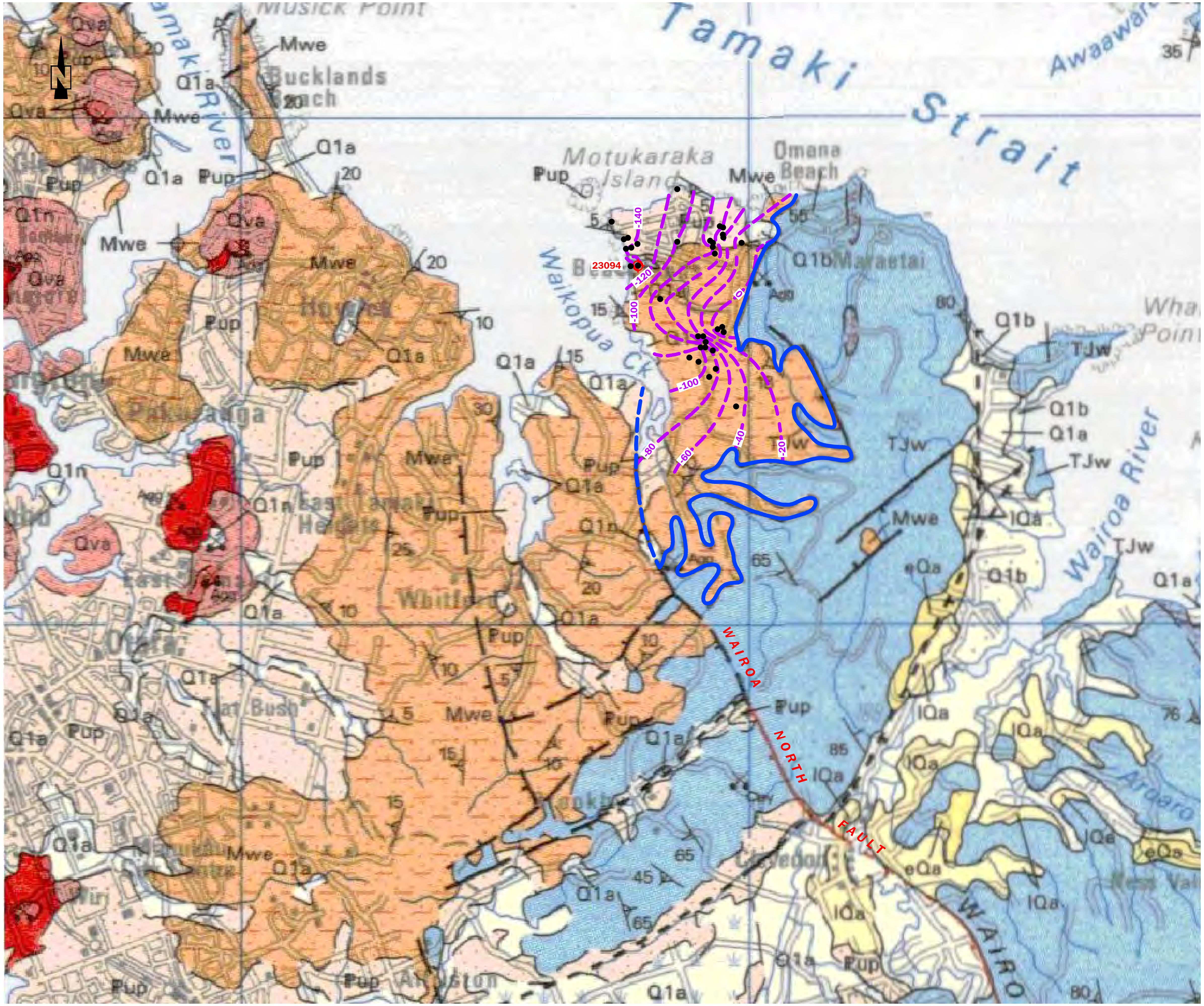
PATTLE DELAMORE PARTNERS LTD

Auckland Wellington Christchurch

Scale 1:30,000 (A3)

Project No. :	Figure No. :	Revision :
A02086410	2	B

Filed : A02086410D002.dwg Image : A02086410I002.jpg



KEY:

23094 New Production Well

Potential Extent of Confined Aquifer within the Beachlands Waitemata Block

-20 Base of Waitemata Contours (m RL)

Base of Waitemata Datapoints for Contours

Source:
1. Base plan derived from IGNS Map 3 (Auckland) 1:250,000, 2001.
2. Base of Waitemata contours derived from borehole log data received from ARC on 18 & 21/11/2009 (see Appendix E).

No.	Revision	Date	App.
B	Issued for Consent	Jan 10	
A	Issued for Review	Sep 09	

	By	Checked	Date
Designed	P.N.		Mar 09
Drawn	D.R.		Mar 09
Approved for issue:			
Approved for construction:			

Client : Pine Harbour Marina Ltd

Project : Groundwater Supply AEE - Pine Harbour Marina Development

Title : Geology

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Auckland Wellington Christchurch

Scale 1:75,000 (A3)

Project No. :	Figure No. :	Revision :
A02086410	3	B

Filed : A02086410D002.dwg Image : Map 3 (Auckland Area) 250k.jpg

memorandum

TO	Tanvir Bhamji	FROM	Khun Chueaphoodee
	Watercare Services Ltd	DATE	17 May 2024
RE	Beachlands Maraetai WWTP Options Assessment: Soil Sampling LA site – Factual Report		

1.0 Introduction

Watercare Services Limited (**Watercare**) is currently in the process of renewing its resource consent for the Beachlands Wastewater Treatment Plant (**WWTP**) with a focus on evaluating a land application scheme and stream hydraulic assessment. The assessment aims to identify the Best Practicable Option (**BPO**) for managing the treated wastewater discharge within the Beachlands catchment. Pattle Delamore Partners Ltd (PDP) has been engaged by Watercare to undertake assessment of land, 32PJ+Q2 Beachlands (Land parcel CT NA95C/569) identified within a larger area as potentially suitable for land treatment. Manaaki Whenua's S-Map indicates that the site features an approximately equal distribution of soil siblings Batonf (Mottled Orthic Brown Soil), Bushcroft*f* (Mottled Orthic Bown Soil), and Eureka*f* (Acidic Orthic Gley).

This memorandum has been prepared by PDP to describe the methodology used during its field investigations and presents the factual results of the field investigations completed on 25 October 2023. The primary goal of the work was to provide basic soil properties and hydrogeological information to develop the conceptual site model and to assess the suitability of the investigation area for the purposes of land treatment.

2.0 Investigations

PDP caried out soil assessments at three to four locations (refer Figure 1, Appendix A) at the 32PJ+Q2 Beachlands site on 25 October 2023 including:

- Field soil infiltration testing using a Guelph Permeameter at 4 locations on the property;
- Field soil sampling at depths of 0 – 75 mm for topsoil, 75 – 150 mm for subsoil, and 0 – 150 mm for the whole soil profile along 160 m transect for laboratory nutrient assay and heavy metals assessment;
- Offsite hydraulic conductivity laboratory testing soil infiltration cores of topsoil (0 – 75 mm) and shallow sub soils (range between 110 – 340 mm depending on location); and
- Shallow soil profile observations at a depth of 0 – 150 mm within the area of hydraulic core extraction

Soil sampling was carried out along an approximately 100 m long transect as shown in Appendix A. The sampling locations along the transect were chosen to give representative coverage of both flat and sloping areas within the land parcel. Areas where stock faeces were present were avoided due to the risk of affecting the nutrient sampling results. Areas such as troughs, fence lines and gateways were also avoided. An ArcGIS application was used to record testing site and sampling transect locations. The GPS accuracy is expected to be within 4 m, which is considered suitable for the purposes of soil monitoring at this scale.

The weather during the investigation period was characterised by morning overcast conditions with intermittent drizzle, clearing to fine and sunny in the afternoon. Information related to rainfall was obtained post-investigation based on climate data obtained at a personal weather station coded IAUCKLAN744. There was of 8 mm of rainfall in the preceding 3 days. The temperature was approximately 19 °C on the day. A total of 62 mm rainfall total was recorded for the month of October.

2.1 Onsite Soil Infiltration Testing Methodology – Geulph Permeameter

In-situ infiltration testing was conducted using a Guelph Permeameter at two depths across four locations, shown in Appendix A. All tests were conducted on slightly sloped pastureland. 6 cm wide and 15 cm deep cylindrical boreholes were initially dug at each location. The rate of constant outflow of water, together with the diameter of the borehole, and height of water in the borehole, were then used to determine hydraulic conductivity of the soil. The tests were completed in the near surface topsoil, at a depth of 15 cm with a head of 10 cm. A second measurement was taken at a depth of ~30 cm with a head of approximately 15 cm per borehole. The infiltration rate was then recorded in intervals ranging from 30 seconds to 2 minutes depending on the rate of fall per test in accordance with PDP 2023 methodology. Infiltration rates were observed until steady state infiltration rates had been achieved; durations ranged from 8 – 30 minutes per test at each depth.

2.2 Soil Sampling Methodology for Nutrient Assay and Heavy Metals

Composite soil samples were taken using a manual soil corer to collect approximately 36 soil cores along ethe 160 m transect to form a single composite sample for each depth range at each transect (see Appendix A for transect locations). Three composite samples were collected from each location at depths from
0 – 75 mm, 75 – 150 mm, and 0 – 150 mm below ground level (BGL) for nutrient and heavy metals sampling. Soil samples were couriered to Hill Laboratories for analysis.

2.3 Metholodology for Core Collection for Offsite Hydraulic Conductivity Laboratory Testing

Six undisturbed soil cores were collected from the sampling location at three points along the transect (See Appendix A) in accordance with "Field guide to taking core samples for physical analyses" published by Landcare Research.

Stainless steel rings (100 mm diameter, 750 mm deep) were provided by Landcare Research to collect and retain each core sample.

Cores were usually taken on pasture free soil, but pasture was trimmed from any cores containing pasture, and a stainless-steel ring was gently tapped into the soil surface. The steel ring, with the soil core sample intact, was carefully removed from the soil. Both ends of the sample were trimmed to leave an almost flat surface approximately 5 mm above the liner. A second core was taken at each location at approximately 300 mm depth for analysis of the subsoil. The steel rings, with sample intact, were individually sealed in cling film, to prevent moisture loss, and transported to the Landcare Research Soil Physics Laboratory for analysis of unsaturated hydraulic conductivity (K_{-40}).

3.0 Results

3.1 General Soil observations

Pasture was approximately 5 – 10 cm, comprised of typical dense pasture across the investigated site at all sampling locations. No ponding or signs of water were observed at the site. However, it was noted that the soil was relatively wet due to rainfall on preceding days. Topsoils at all sampling points were typical brown, allophanic soil with little variation both visually and in texture. Topsoil was generally denser and wet with a layer of dryer and crumblier subsoil. Large rocks and stones were observed throughout the site.

Groundwater was not observed in any locations and is assumed to be below 0.5 m BGL.

3.2 Onsite Soil infiltration Testing – Geulph Permeameter

From the known reservoir dimensions, water head height, borehole radius, and soil texture category, the field measured saturated hydraulic conductivities (K_{fs}) were calculated and are presented in Table 1 below.

Table 1: Summary of Guelph Permeameter Soil Infiltration Testing

Location	Testing Depth (mm)	K_{fs} (m/s)	Clean Water Infiltration Capacity (mm/hr)	Longer-Term Lower-End Estimated Treated Wastewater Infiltration Capacity Range (mm/day)[1]
GP1	150	5.7×10^{-7}	2.06	1.98 – 4.94
GP1	300	2.3×10^{-8}	0.08	0.08 – 0.20
GP2	150	6.4×10^{-7}	2.29	2.20 – 5.50
GP2	300	3.9×10^{-7}	1.42	1.36 – 3.40
GP3[2]	150	8.7×10^{-6}	31.32	30.07 – 75.17
GP3	300	2.1×10^{-7}	0.75	0.72 – 1.80
GP4	150	8.6×10^{-7}	3.11	2.98 – 7.46
GP4	300	7.8×10^{-8}	0.28	0.27 – 0.68
Average topsoil[3]		6.9×10^{-7}	2.45	2.35 – 5.87
Average subsoil[3]		1.6×10^{-7}	0.59	0.57 – 1.43

Notes:

1. *4-10% of clean water infiltration capacity used as per US EPA (2006).*
2. *Test results from GP3 were outliers which are not indicative of expected soil properties at the site and were excluded from average infiltration capacity calculations.*
3. *Calculated as arithmetic mean, GP3 results were excluded from the calculations.*

The testing was conducted on a day with mixed weather conditions with light showers in the morning and clear sunny weather in the afternoon.

Slowest clean water infiltration capacity 2.06 mm/hr for topsoil and 0.08 mm/hr subsoil were observed at sampling location GP1 and the fastest infiltration capacity for both depths were observed at location GP4 with 3.11 mm/hr observed for topsoil and 0.28 mm/hr for subsoil.

Overall, the average clean water hydraulic conductivity of the topsoil is in line with what can be expected from silty clay soil with the average permeability of 2.45 mm/hr. The average clean water hydraulic conductivity of the subsoil is also in line with what can be expected from clayey soil at 0.6 mm/hr.

Clean water was used for the testing. It should be noted that lower infiltration rates are expected with irrigation of treated wastewater which may promote suspended solids and/or biofilm within soil pore space, which acts to reduce soil permeability over time.

3.3 Offsite Soil Bulk Density and hydraulic Conductivity

Soil bulk density and hydraulic conductivity of the soil cores are presented in Table 2.

Table 2: Offsite Soil Bulk Density and Hydraulic Conductivity Results.

Location	Sample Name	Depth (mm)	Bulk Density (g/cm^3)	K_{sat} (mm/hr)	K_{40} (mm/hr)
GP1	TS1-917	0 – 100	0.92	6	2
	TS2-817	0 – 100	0.81	168	23
	SS1-863	110 – 290	**1.46**	4	2
	SS2-973	240 – 300	**1.45**	2	2
GP2	TS1-958	0 – 100	0.82	59	16
	TS2-980	0 – 100	0.87	9	1
	SS1-882	240 – 300	1.06	28	22
	SS2-972	240 – 340	1.06	165	108
GP3	TS1-857	0 – 100	0.90	367	25
	TS2-860	0 – 100	0.90	196	47
	SS1-788	240 – 300	1.10	43	35
	SS2-976	240 – 300	1.12	175	73
Average topsoil[2]			0.87	61	11
Average subsoil[2]			1.20	69	40

Notes:

1. *Topsoil K_{sat} and K_{40} test results from GP3 were considered outliers which are not indicative of expected soil properties at the investigated site.*
2. *Calculated as arithmetic mean, topsoil K_{sat} and K_{40} results for samples collected at GP3 were excluded.*

Unsaturated hydraulic conductivity provides a good indication of soil permeability at near-saturated conditions (that are typical of field saturated levels) and the sustainable hydraulic loading rate which allows for drainage through smaller pores, with larger pores air-filled to assist with soil and plant health.

Target bulk density ranges for allophanic and all other soils are 0.5 – 1.3 g/cm^3 and 0.6 – 1.4 g/cm^3, respectively (Sparling , et al., 2008). In general, the bulk density across the sampling locations is within the guideline ranges except for the subsoil sampled at GP1 indicating some compaction of the soil in this area.

3.4 Soil Sampling for Nutrient Assay and Heavy Metals

3.4.1 Soil Nutrient Assay Results

Soil nutrient testing results for investigated site are presented in Table 3. The results shown are mean values from 36 samples per depth along the transect.

Table 3: Soil Nutrient Testing Results at Different Sampling Depths

Parameter	Guideline Value	0 - 75 mm Depth	75 - 150 mm Depth	0 - 150 mm Depth
pH	5.5 - 6.3[1]	5.7	5.9	5.7
Olsen P (mg/L)	20 – 50[2]	**14**	**11**	**15**
Potassium, K (me/100 g)	0.5 – 0.8[3]	0.69	0.7	0.68
Calcium, Ca (me/100 g)	-	5.9	3.7	4.5
Magnesium, Mg (me/100 g)	1 – 3[3]	2.16	1.17	1.54
Sodium, Na (me/100 g)	0.2 – 0.5[3]	**0.15**	**0.11**	**0.12**
C/N Ratio	8 – 12[2]	**14.1**	**13.8**	**14.3**
Anion Storage Capacity, ASC (%)	30 – 60[3]	43	**64**	57
Total Carbon, TC (%)	3.5 – 12[4]	10.1	7.4	8
Total Nitrogen, TN (%)	0.35 - 0.7[1]	0.72	0.54	0.56
Cation Exchange Capacity, CEC (me/100g)	12 – 25	19	17	16
Base Saturation				
K (%)	2 – 5[3]	3.7	4	4.2
Ca (%)	50 – 75[3]	32	21	28
Mg (%)	5 – 15[3]	11.6	6.7	9.5
Na (%)	1 – 2[3]	**0.8**	**0.6**	**0.7**
Total (%)	-	48.1	32.3	42.4

Notes:

1. *Derived from Provisional Targets for Soil Quality Indicators in New Zealand (Sparling et al. 2008) for pasture on all soils except Organic.*
2. *Derived from Provisional Targets for Soil Quality Indicators in New Zealand (Sparling et al. 2008) for pasture on sedimentary & allophonic soils.*
3. Derived from Technical Note: Soil Tests & Interpretation (Version 5) by Hill Laboratories.
4. *Derived from Provisional Targets for Soil Quality Indicators in New Zealand (Sparling et al. 2008) for all soil orders and land use.*
5. *Values outside of guideline ranges are shown in* ***bold****.*

Soil nutrients results indicated:

- The nutrient levels, namely Olsen P, Sodium, and Magnesium in the soils are generally sub-optimal for pasture yield.
- Olsen P levels are below the optimal range for pasture across the soil profile.
- In general, sodium levels are slightly below the optimum range for pasture growth. Sodium is only of secondary importance in the soil test as its uptake by plants is large dependent on the plant species involved and the potassium status.

- Total nitrogen levels are within guideline range and carbon levels are on the higher end of the recommended which results in elevated C/N ratios across soil profile. Normally low nitrogen can favour the growth of less desirable or lower-quality forage species, which can affect pasture quality and livestock nutrition.
- Anion Storage Capacity (ASC) levels are generally on the higher end of the guideline range. ASC level in the sub soil is slightly above the guideline values in the subsoil indicating an increased capacity for phosphorus retention. This can be beneficial in preventing phosphorus runoff into water bodies; however, elevated ASC levels cab can also reduce phosphorus availability to plants.

3.4.1 Soil Heavy Metal Results

Heavy metal sampling results for the site are presented in Table 4.

Table 4: Soil Heavy Metal Testing Results at Different Sampling Depths

Parameter	Units	Guideline Limit Value	0 - 75 mm Depth	75 - 150 mm Depth	0 - 150 mm Depth
'Total' Arsenic	mg/kg	20[1]	2.4	3.2	2.6
'Total' Cadmium	mg/kg	1.5[2]	0.3	0.27	0.25
'Total' Chromium	mg/kg	300[1]	14.2	13.4	12.1
'Total' Cobalt	mg/kg	-	1.93	3	2.2
'Total' Copper	mg/kg	150[3]	5	5	5
'Total' Iron	mg/kg	-	15,000	22,000	17,100
'Total' Lead	mg/kg	530[1]	7.7	10.7	7.7
'Total' Manganese	mg/kg	-	191	192	170
'Total' Mercury	mg/kg	1[4]	<0.12	0.14	<0.12
'Total' Nickel	mg/kg	60[4]	6.8	7.2	6.1
'Total' Zinc	mg/kg	190[1]	24	22	22

Notes:

1. *Guideline limits derived from Eco-SGVs for agricultural land for all soil types published in Development of soil guideline values for the protection of ecological receptor (Updated) (Manaaki Whenua Landcare Research, 2019).*
2. *Derived from Eco-SGVs for all soil types and biomagnification.*
3. *Derived Eco-SGVs for typical aged soil.*
4. *Derived from Guidelines for the Safe Application of Biosolids to Land in New Zealand (Water, N. Z., & Wastes Association.)*

Soil heavy metal sampling results are well below guideline limits across all soil depths.

3.5 Soil Profile

A soil profile photograph was taken of the excavated pit formed by the soil infiltration core removal process at each location. The soil profile photographs are shown in Appendix B. Generally, the soil profiles across all sampling locations can be described as having compact silty topsoil and clayey sub soil. Soil profile at sampling point GP1 was observed to be relatively more compact and wet with texture similar to that of gley compared to other sampling locations.

4.0 Conclusions

The site investigations have provided information regarding the hydraulic conductivities, heavy metal, and nutrients of the soil within the identified area. This information can be used to give a high-level understanding of the characteristics of the soils in the potential land application area close to the existing wastewater treatment plant.

The soil found below the approximately 0.2 – 0.3 m of topsoil across the sampling locations at the site generally matched those identified by Manaaki Whenua's S-Map database.

In-situ soil infiltration testing results using Guelph permeameter were in line with what can be expected in silty clay and clay soils for topsoil, and subsoil, respectively. Soil nutrient test resulting shows sub-optimal phosphorus levels for pasture yield. The soil also contains relatively high anion storage capacity (ASC) indicating increased capacity for phosphorus retention.

Laboratory soil hydraulic conductivity tests are highly variable across the samples. In general, the average bulk density results are within the target ranges.

5.0 References

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Sparling , Graham, Lilburne, Linda and Vojvodic-Vukovic, Maja. 2008. *Provisional Targets for Soil Quality Indicators in New Zealand.* Lincoln, Canterbury, New Zealand : Manaaki Whenua Press, 2008.

6.0 Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Watercare Services Ltd, Hill Laboratories and Maanaki Whenua/Landcare Research. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This memorandum has been prepared by PDP on the specific instructions of Watercare Services Ltd for the limited purposes described in the memorandum. PDP accepts no liability if the memorandum is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

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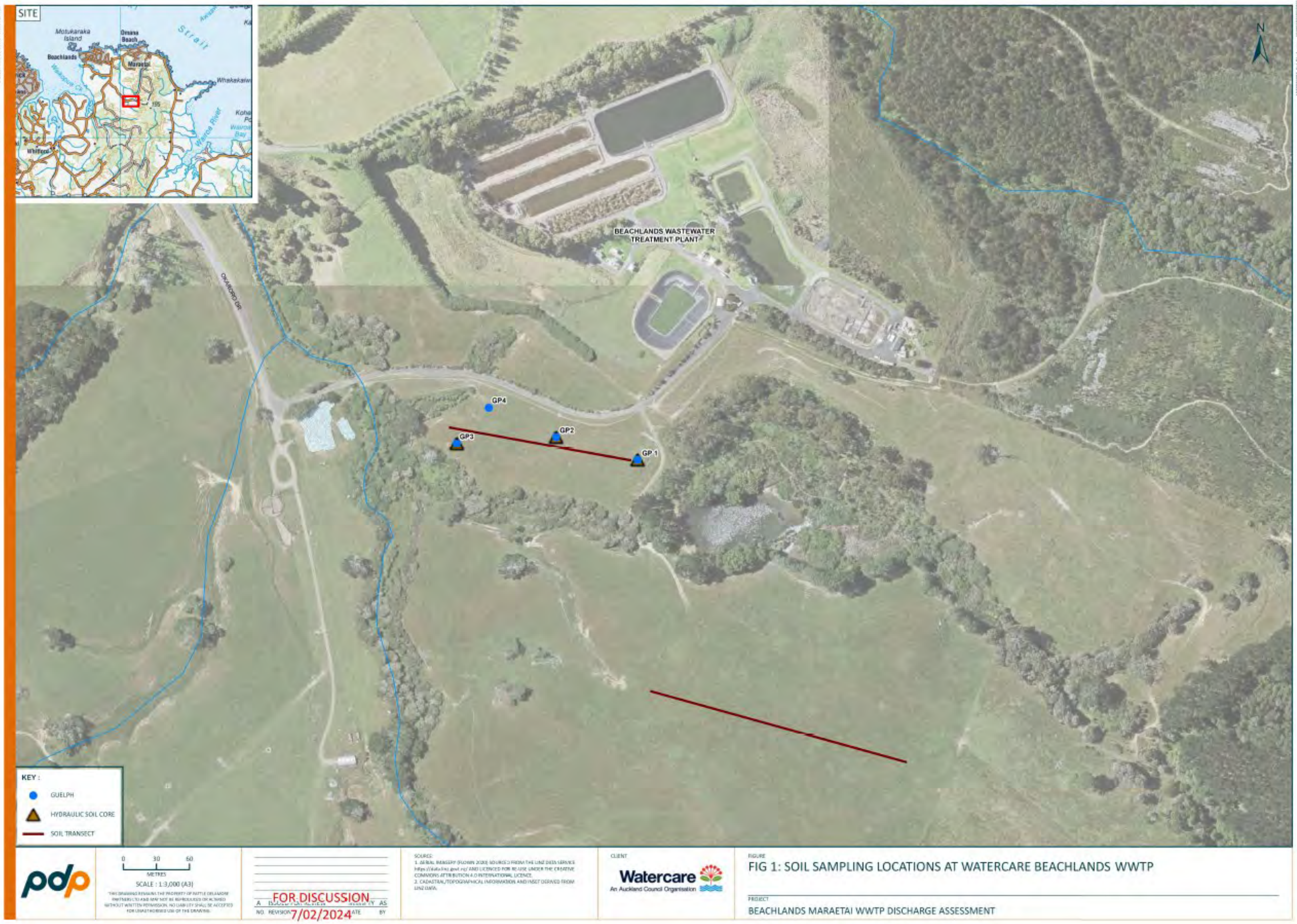

Appendix A: Soil Sampling Locations at Water Beachlands WWTP

Appendix B: Soil Profile and Site Photographs

Soil Profile at Sampling Point GP1

Soil Profile at Sampling Point GP2

Soil Profile at Sampling Point GP3

Photograph of the site in the morning

Photograph of the site in the afternoon

Close-up Photograph of the Pasture on Site

ATTACHMENT 9

STREAM HYDRAULIC ASSESSMENT

26 March 2024

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AUCKLAND 1141

Dear Tanvir

BEACHLANDS MARAETAI WWTP RESOURCE CONSENT RENEWAL: STREAM HYDRAULIC ASSESSMENT

1.0 Introduction

This letter prepared by Pattle Delamore Partners Limited (PDP) summarises the characterisation and flow in a tributary and main stem of the Te Puru Stream that receives discharge from Watercare Services Limited's (WSLs) Beachlands Maraetai Wastewater Treatment Plant (Beachlands Maraetai WWTP). This assessment is intended to support the Beachlands Maraetai WWTP resource consent renewal.

The hydraulic assessment of the stream involved:

1. Stream walkover between the pond and the bridge, and topographical survey of the pond outlet, stream channel and weir at the bridge;

2. Installation of a continuous water level sensor and manual flow gauging (three rounds) for assistance to develop flow duration curves;

3. Producing flow duration curves to assist others with assessing the water quality impacts of the WWTP discharge; and

4. Undertaking HEC-HMS modelling and visually inspecting the stream to assess flows, velocities, and erosion within the tributary of the Te Puru Stream.

2.0 Stream Network

Beachlands Maraetai WWTP currently discharges treated wastewater into a tributary of the Te Puru Stream via a pond (i.e., Te Puru Farm Pond which is part of the current overland flow system) as shown in Figure 1. Figure 1 shows an approx. 340 m long reach below the pond with a stream slope of approximately 2%-4% through WSL land, upstream of a bridge culvert. Downstream of this bridge, the tributary continues through farmland before joining the Te Puru Stream main stem at the location indicated as Point C in the Site Plan in Appendix A, and eventually discharges into the Hauraki Gulf at Kelly's Beach.

This erosion assessment has focused on the tributary and main stem upstream of the Quarry, where the contribution of wastewater to total stream flow is greatest. Specific assessment has been made of the reach between the pond and the bridge, and adjacent to water quality sampling point C and the Quarry (shown in Appendix A). These locations have been selected based on the access provided; most of the stream is situated on private property.

Treated effluent discharge occurs into the current overland flow system that comprises a vegetated strip around the northern extent of the pond and the on-line pond itself (Figure 1). The edge of this pond and a section of the stream reach shown in Figure 2 have been surveyed as included in Appendix B.

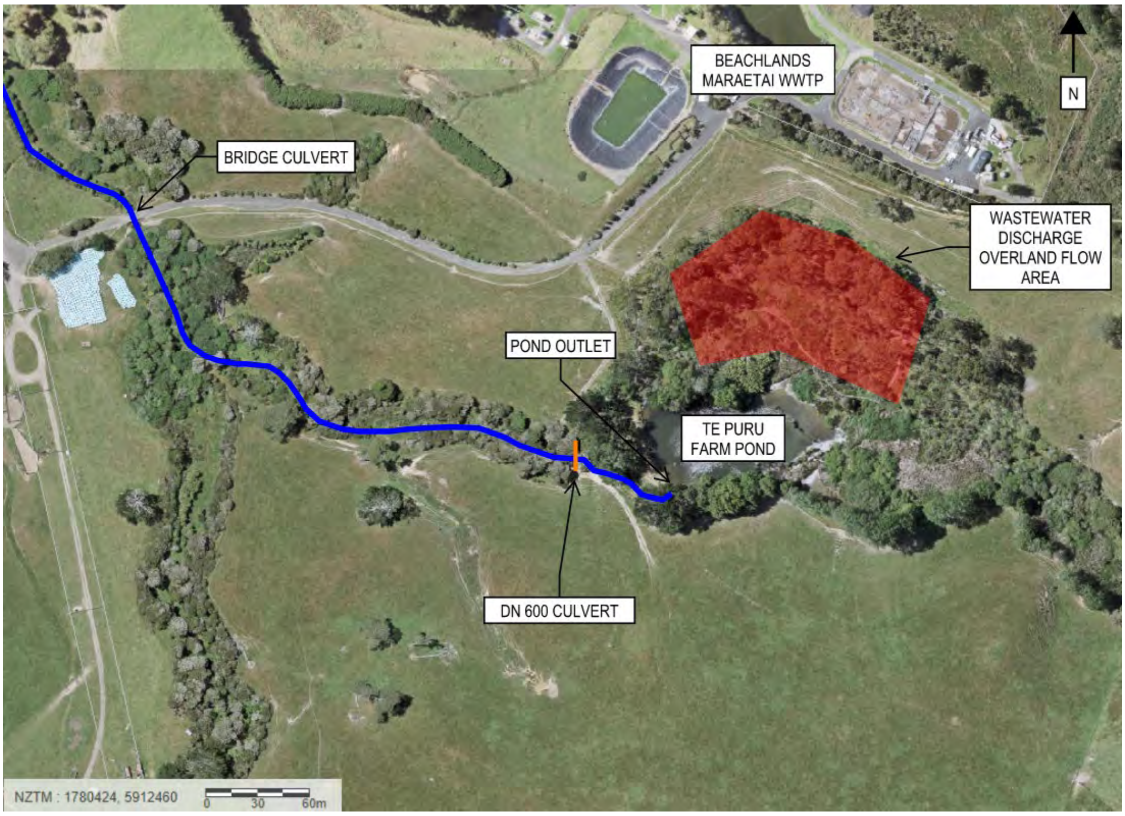

Figure 1: Stream Reach between Pond and Bridge

Figure 2: WWTP Discharge Pond Outlet Channel (18/01/2024)

3.0 WWTP Discharge

Daily discharge data for the period of January 2021 to October 2023 was obtained from WSL. The average existing and future WWTP discharges utilised for our hydraulic assessment are outlined in Table 1. As shown in Table 1, the wastewater inflows to the WWTP are expected to increase significantly in future due to population growth. This assessment has assumed that there is a steady rate of discharge into the pond for each scenario in Table 1 (assuming an approx. pond volume of 450 m^3 prior to storm events). The estimated future scenario has assumed that all WWTP discharge into the pond is upstream of the outlet shown in Figure 2.

Table 1: WWTP Discharge

Scenario	Average Discharge (m^3/s)
Existing WWTP Discharge[1]	0.021
Estimated Future WWTP Discharge[2]	0.070

Notes:
1. *Based on hourly totalised WWTP discharge data from January 2021 to October 2023.*
2. *Based on a future average daily discharge of 6,000 m^3/d.*

4.0 Data Collection

A water level sensor was installed on the downstream side of the bridge culvert, as shown in Figure 3, and on the site plan in Appendix A. This sensor has recorded the level of the stream for the last 3 months (the level sensor was installed on 27th October 2023 and remains in place). The levels have been used to estimate flows within the stream to support its characterisation (i.e., the production of flow duration curves).

To supplement the data from the level sensor, manual flow gauging was undertaken at various cross sections upstream of the bridge. This data was collected on 27th October, 15th November 2023 and 18th January 2024. During these site visits, the majority of flow through the tributary upstream of the bridge was observed to be pond discharge, indicating minimal natural baseflow through this section of stream.

Figure 3: Downstream Extent of Bridge (18/01/2024)

5.0 Flow Duration Curves

Synthetic flow duration curves were created using Hydstra software, utilising the level sensor and stream gauging data records, in addition to data from a stream gauging site for a nearby catchment (Mangemangeroa Stream catchment). The nearby gauging site was used due to the limited data collection time for the Te Puru Stream. Flow duration curves were produced at the locations of Site 1 (the bridge), Site 2 (point C) and Site 3 (adjacent to Manukau Quarries LP, i.e., the Quarry) as shown in Appendix A. Refer to Appendix C for further details on the methodology used and for the flow duration curves themselves.

6.0 Hydrological Modelling

A simple HEC HMS model was developed for the reach between the pond and the bridge to determine the theoretical stream flow and corresponding velocities for the 90%, 2, 5 and 10 year ARI (average recurrence interval) events. These values were used to assess the contribution of wastewater into the stream during storm events and estimate theoretical stream velocities.

Modelling has been limited to the extent of stream between the pond and the bridge; this being the reach where the effects of erosion are expected to be greatest due to the lesser dilution that occurs here.

6.1 Contribution of Wastewater Discharge to Stream Flow

Table 2 summarises the outputs of the hydrological modelling used to determine peak flows from various storm events and the contribution from the wastewater discharges which are 0.021 m^3/s and 0.070 m^3/s for the existing and future scenarios respectively, as per Table 1. It should be noted that the estimated future scenario includes the impacts of an increase in rainfall due to climate change.

Table 2: HEC-HMS Model Outputs

Scenario[4,5]	Location[6]	Peak Flow (m^3/s)			
		90th %ile	2-yr ARI	5-yr ARI	10-yr ARI
Existing	Reach between pond outlet and bridge	0.03 (70% WW)	0.62 (3% WW)	1.22 (2% WW)	1.83 (1% WW)
Future	Reach between pond outlet and bridge	0.08 (88% WW)	1.04 (7% WW)	1.98 (4% WW)	2.91 (2% WW)
Existing	At bridge	0.07 (30% WW)	3.66 (1% WW)	6.55 (<1% WW)	9.06 (<1% WW)
Future	At bridge	0.12 (58% WW)	5.45 (1% WW)	9.42 (1% WW)	12.88 (1% WW)

Notes:

1. *Modelled using HEC-HMS v1.11 modelling software, based on the SCS Method in accordance with TP108 (ARC, 1999).*
2. *Average Recurrence Interval (ARI).*
3. *Rainfall intensities used for modelling retrieved from NIWA High Intensity Rainfall Design System V4.*
4. *The existing scenario is based on existing rainfall data and existing WWTP discharge as per Table 1.*
5. *The future scenario based on future rainfall intensities with climate change (included as per RCP8.5 for the period 2081-2100) and future WWTP discharge as per Table 1. The 90th percentile storm does not allow for an increase in rainfall for climate change. Pre-development curve numbers have been used.*
6. *Refer to Appendix A for specific locations of these points.*

Table 2 confirms that for storm events where erosion is most likely i.e. the 2-year ARI event (the bank full event), existing and future wastewater is only a minor portion of the total flow in the stream.

6.2 Stream Velocities

The peak flows from Table 2 were used to estimate velocity in the stream as outlined in Table 3 using Mannings equation. This data indicates that velocities in the stream are currently around 0.8 m/s for typical rainfall event flow conditions (i.e. smaller rainfall events and typical WWTP discharge), and in the range of 2 m/s - 5 m/s during larger storm events. There is erosive potential in the 2-year ARI event, with velocities in excess of 2 m/s, the expected threshold for any significant erosion. This data shows that estimated future wastewater discharges create a minimal increase in velocity of up to 0.3 m/s for 90thpercentile event flow and no effect on velocities at high flows. Consequently, this change in regime will have less than a minor effect on erosion of the streambed.

Table 3: Estimated Velocities

Scenario[1]	Location	Average Velocity[2] (m/s)			
		90th %ile	2-yr ARI	5-yr ARI	10-yr ARI
Existing	Reach between pond and bridge	0.8	2.5	3.2	3.8
Existing + Future WW Discharge	Reach between pond and bridge	1.1	2.6	3.3	3.8
Existing	At bridge	0.7	3.3	4.2	4.7
Existing + Future WW Discharge	At bridge	0.8	3.3	4.2	4.8

Notes:

1. *The existing scenario is based on existing stream flows from Table 2, which include existing WWTP discharge as per Table 1. For the second scenario, the estimated future WWTP discharge as per Table 1 was added on.*
2. *Velocities based on Mannings equation, using average cross sections taken from the Topographical Survey (Appendix B), and a Mannings roughness of 0.03 for the natural stream section.*

7.0 Bank and Bed Erosion Assessment

During site visits on 6th September 2023, 27th October 2023 and 18th January 2024, the stream was inspected for erosion as shown in the photos included as Appendix D. As noted in Section 2.0, this was limited to between the pond and the bridge (Figures A-J), and adjacent to water quality sampling points C (Figure K to P) and the Quarry (Figure Q). The locations where these photos were taken is shown in Appendix A.

7.1 Stream Reach between Pond and Bridge

Between the pond and the bridge, some bank erosion was observed:

- Figure B shows velocities in the steep section of the stream a short distance downstream of the pond, upstream of Figure C where the left stream bank has been undercut to bedrock;
- Figure E shows the stream banks being undercut adjacent to the farm track where the stream changes direction upstream of the DN 600 culvert; and
- Figure J shows the toe of stream banks being eroded away, with tree roots observed.

Stream banks are being undercut to bedrock on the outside of meandering points. The majority of this erosion is expected to have occurred during storm events, based on the flows and velocities in Table 2 and 3. While undercutting was observed, the stream banks appear to be stable for the majority of the reach with established vegetation present and no large bank failure was observed. Through this reach, an increase in flow from future wastewater discharges is expected to marginally increase erosive potential where the stream meanders but not elsewhere in the reach. This may weaken banks in storm events / bank full flows but will only be in the localised areas. Vegetation is supporting bank stability in places. The undersized culvert at the farm track will attenuate flows and reduce downstream erosive velocities beyond the culvert outlet (a scour pool was not observed).

Downstream of the pond outlet, riprap was observed on the stream banks as shown in Figure D. Minimal bank erosion was observed here, however it is presumed that this riprap was placed for preventative erosion protection and/or diversion of the stream. Further riprap can be seen at the pond outlet as shown in Figure A, and immediately downstream of the bridge as shown in Figure I .

An existing DN 600 culvert is positioned downstream of the pond as shown on in Appendix B and Figures F and G. Based on the flows estimated from HEC-HMS modelling, this culvert appears to be insufficiently sized for the current and future 10-year average recurrence interval (ARI) stream flows. During a site visit on the 23rd October 2023 this pipe was observed to be over half full at the inlet and outlet at typical stream flows. This indicates that the culvert would be a constriction during storm events, however no evidence of overtopping was observed. The culvert also does not have an adequate upstream headwall or downstream wingwall to protect against erosion. WSL may need to investigate the capacity of this culvert further to prevent localised erosion from the additional wastewater flows.

7.2 Confluence with Te Puru Stream (Point C)

Some erosion was observed adjacent to Point C:

- Figure L shows bank erosion downstream of a farm culvert. This farm culvert, observed to be a DN 1200 concrete culvert, is located upstream of Point C as shown in Appendix A (is outside of WSL land). The culvert was observed to be over half full during typical stream flows (i.e., baseflows and average WWTP discharge), indicating that the culvert would be a restriction in storm events.
  The erosion observed is assumed to be associated with the farm track overtopping; and

- Figure O shows banks being undercut and some instability adjacent to the stream. This bank erosion was observed downstream of the confluence and appears to be due to eddying formed by this increase in flow from the adjacent catchment during higher flows and the meandering of the stream through this section.

Upstream of Point C away from the culvert, Figure M shows a reasonably stable section of stream with naturally formed riffles, runs, pools and meandering stream.

7.3 Adjacent to Quarry

Figure Q shows the stream adjacent to the Quarry where vegetation growth around the stream increases and the stream widens as the grade of the stream decreases. No more than minor bank erosion was observed here.

8.0 Conclusions

Our assessment indicates that minor bank instabilities are currently occurring in the stream at localised points where weak material is being undercut and stream flow reaches firmer material e.g. bedrock. Any increase in erosive potential due to the increased future wastewater discharge is expected to be minor resulting in no more than a minor effect on stream bank erosion.

9.0 Limitations

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Watercare Services Limited. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

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Yours faithfully

PATTLE DELAMORE PARTNERS LIMITED

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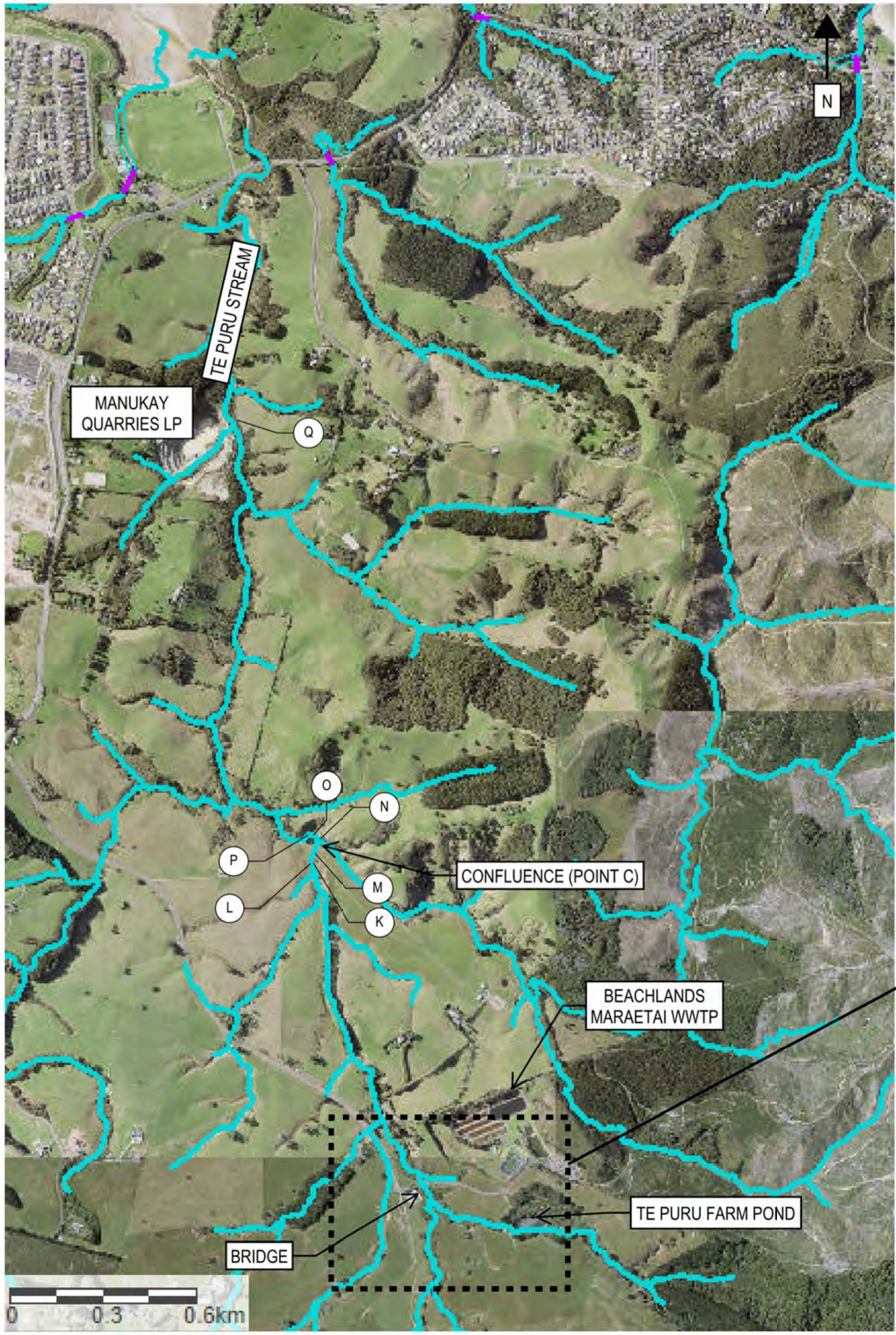
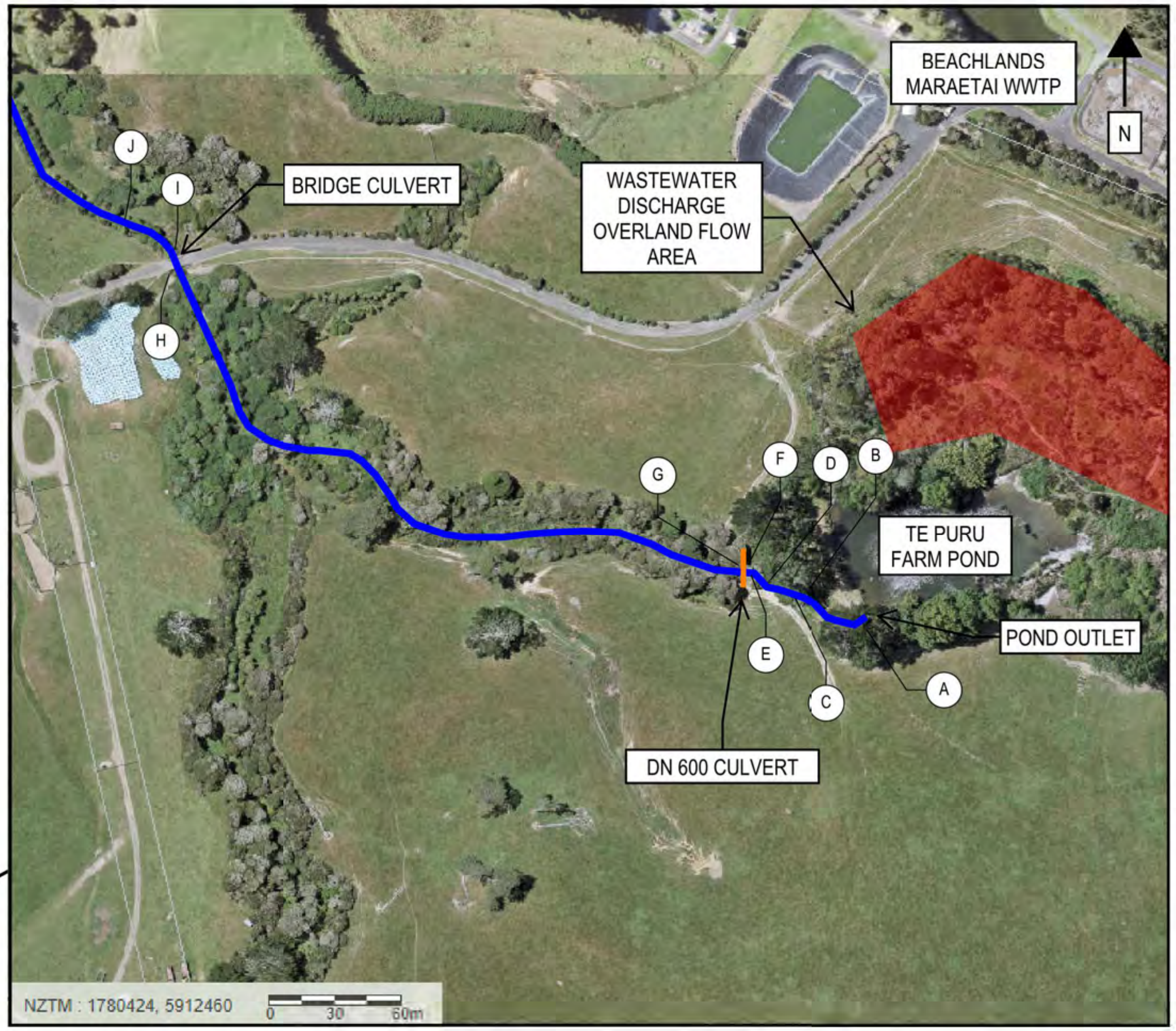
Appendix A: Site Plan

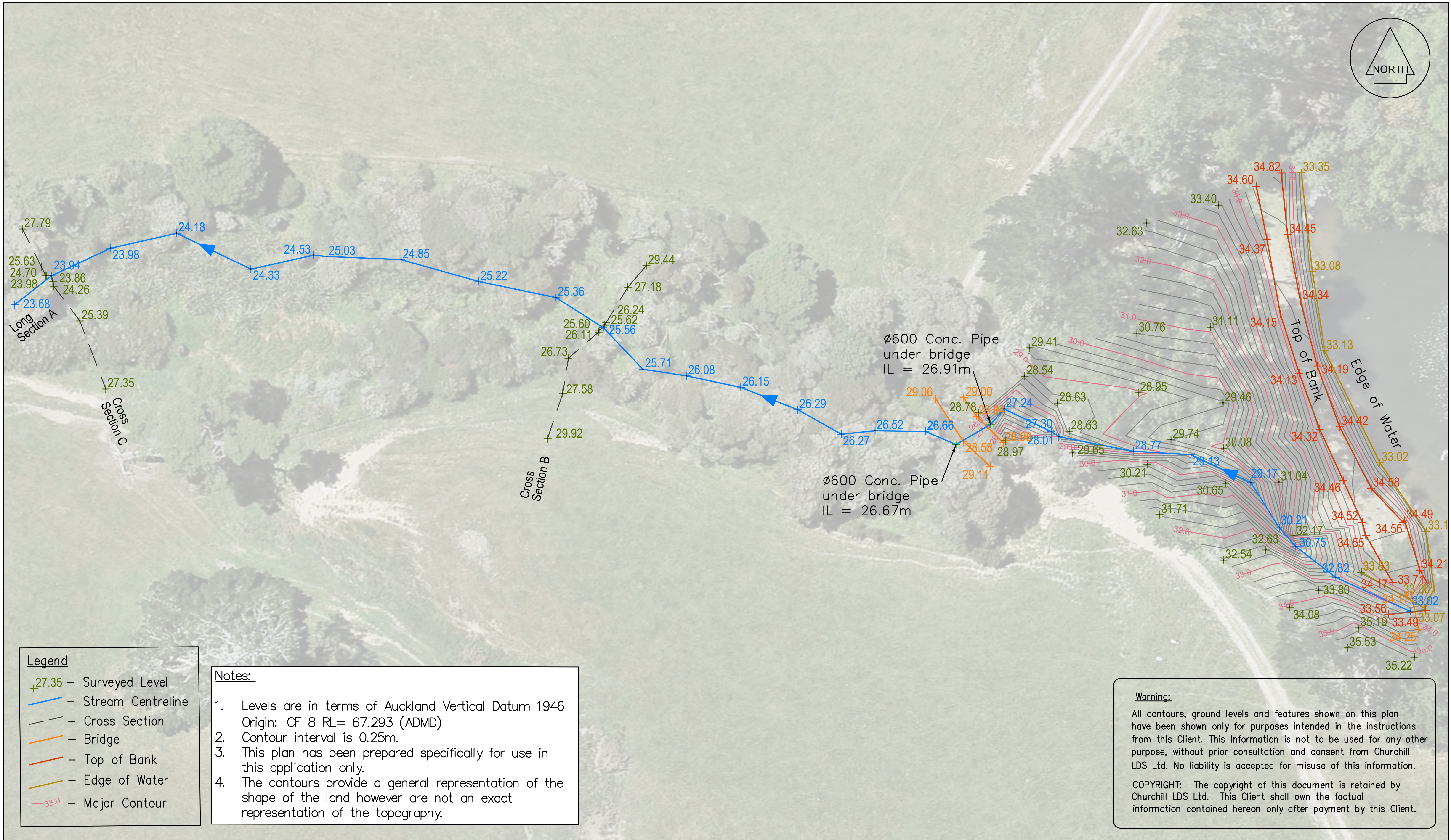




APPENDIX A - SITE PLAN

NOTE: SEE APPENDIX D FOR IMAGES e.g. (A)

Appendix B: Topographical Survey



Legend

- 27.35 – Surveyed Level
- Stream Centreline
- Cross Section
- Bridge
- Top of Bank
- Edge of Water
- 33.0 – Major Contour

Notes:

1. Levels are in terms of Auckland Vertical Datum 1946 Origin: CF 8 RL= 67.293 (ADMD)
2. Contour interval is 0.25m.
3. This plan has been prepared specifically for use in this application only.
4. The contours provide a general representation of the shape of the land however are not an exact representation of the topography.

Warning:

All contours, ground levels and features shown on this plan have been shown only for purposes intended in the instructions from this Client. This information is not to be used for any other purpose, without prior consultation and consent from Churchill LDS Ltd. No liability is accepted for misuse of this information.

[redacted]

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TOPOGRAPHICAL SURVEY PLAN

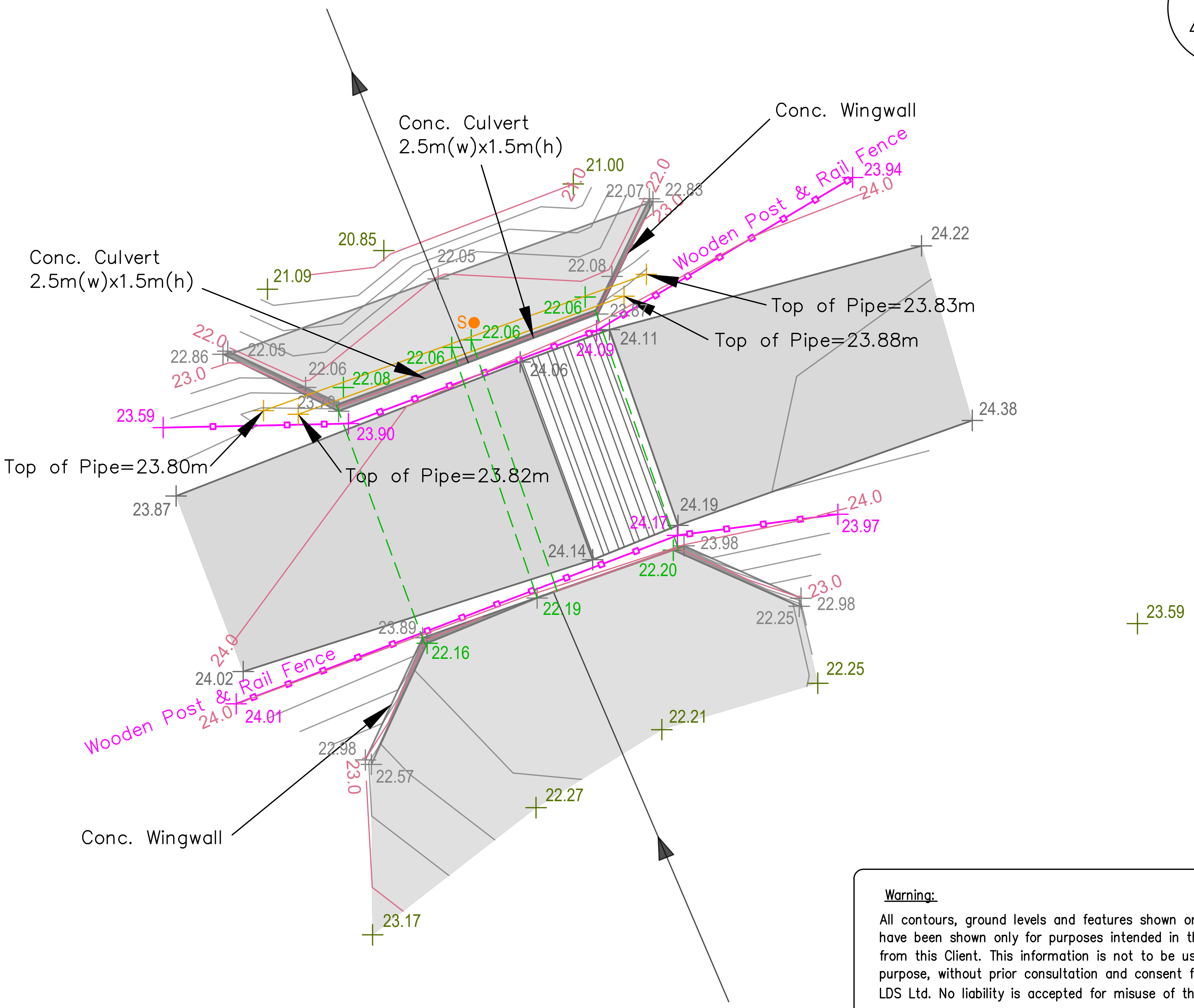
PROJECT: 100 OKARORO DRIVE, BEACHLANDS

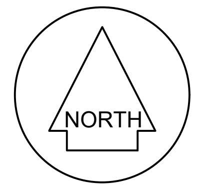
AMENDMENT SCHEDULE

CLIENT:	PATTLE DELAMORE PARTNERS LTD
AUTOCAD: N/23035/AUTOCAD/23035-100/101	SCALE: 1:500 (A3)
CIVILCAD: N/23035/12D/23035 TOPO	DATE DRAWN: NOV 2023
SURVEYOR: JB	DRAWN: JB
DESIGNED:	CHECKED: LRF
	23035-100

Notes:

1. Levels are in terms of Auckland Vertical Datum 1946
Origin: CF 8 RL= 67.293 (ADMD)
2. Contour interval is 0.25m.
3. This plan has been prepared specifically for use in this application only.





Legend
- 27.35 – Surveyed Level
- 33.0 – Major Contour
- Fence
- S – Sensor
- Cattle Stop
- Concr. Driveway
- Unknown Pipe

Warning:

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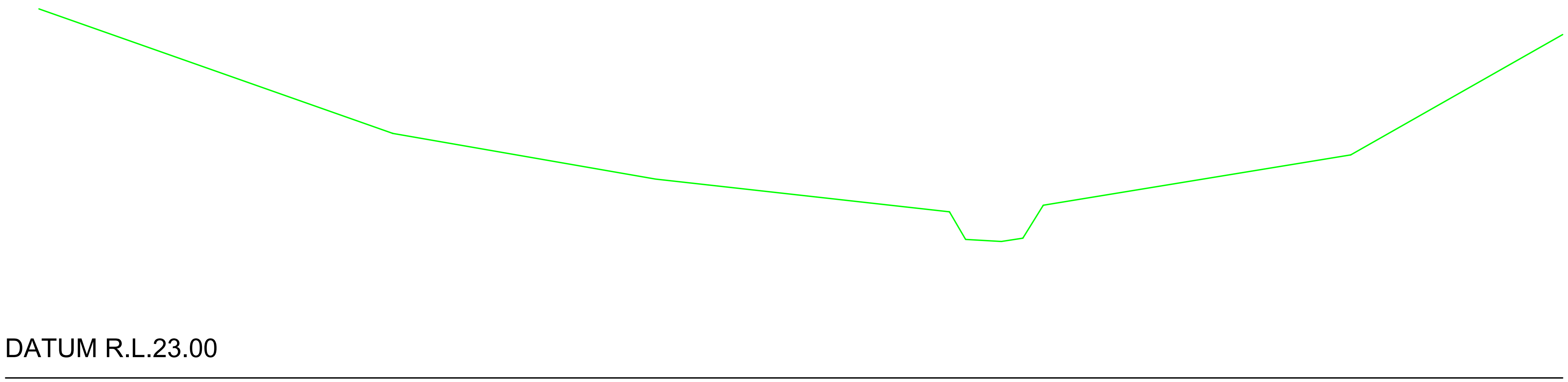
TOPOGRAPHICAL SURVEY PLAN

PROJECT: 100 OKARORO DRIVE, BEACHLANDS

AMENDMENT SCHEDULE

CLIENT: PATTLE DELAMORE PARTNERS LTD

AUTOCAD: N/23035/AUTOCAD/23035-100/101	SCALE: 1:100 (A3)
CIVILCAD: N/23035/12D/23035 TOPO	DATE DRAWN: NOV 2023
SURVEYOR: JB DRAWN: JB	23035-101
DESIGNED: CHECKED: LRF	



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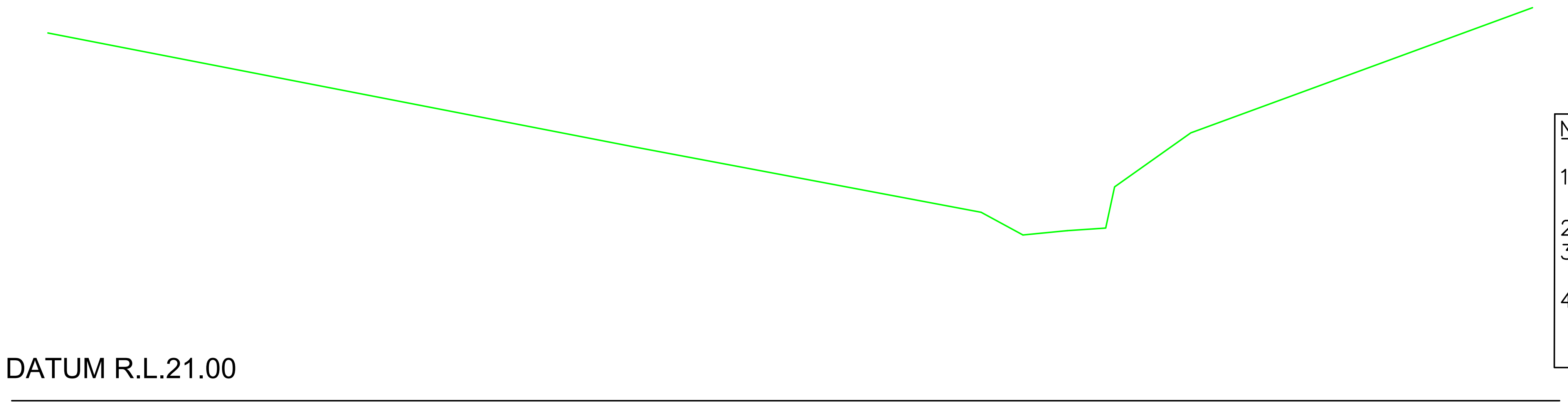

CROSS SECTION C
Horizontal Scale 1 : 100
Vertical Scale 1 : 100

Notes:

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CROSS SECTION PLAN

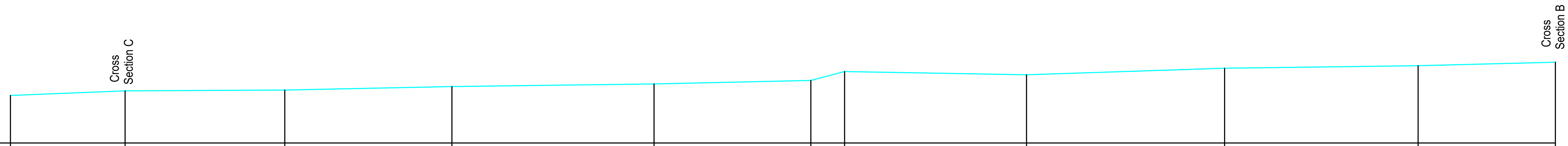
PROJECT: 100 OKARORO DRIVE, BEACHLANDS

AMENDMENT SCHEDULE

CLIENT: PATTLE DELAMORE PARTNERS LTD
AUTOCAD: N/23035/AUTOCAD/23035-102
SCALE: 1:100 (A3)
CIVILCAD: N/23035/12D/23035 TOPO
DATE DRAWN: NOV 2023
SURVEYOR: JB
DRAWN: JB
DESIGNED:
CHECKED: LRF

23035–102

DATUM R.L.21.00



Natural Ground	23.68	23.94	23.98	24.18	24.33	24.53	25.03	24.85	25.22	25.36	25.56
Chainage	0.00	6.48	15.51	24.96	36.39	45.25	47.16	57.45	68.65	79.59	87.35

LONG SECTION A
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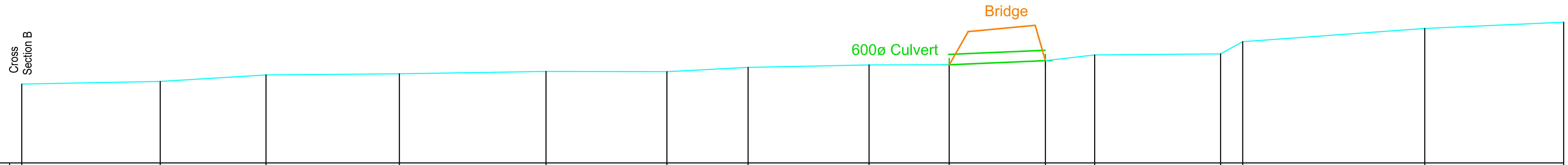
Vertical Scale 1 : 250



Natural Ground	25.56	25.71	26.08	26.15	26.29	26.27	26.52	26.66	26.67	26.91	27.24	27.30	28.01	28.77	29.13
Chainage	87.35	95.35	101.45	109.15	117.62	124.60	129.28	136.27	140.89	146.44	149.29	156.56	157.84	168.35	176.37

LONG SECTION A
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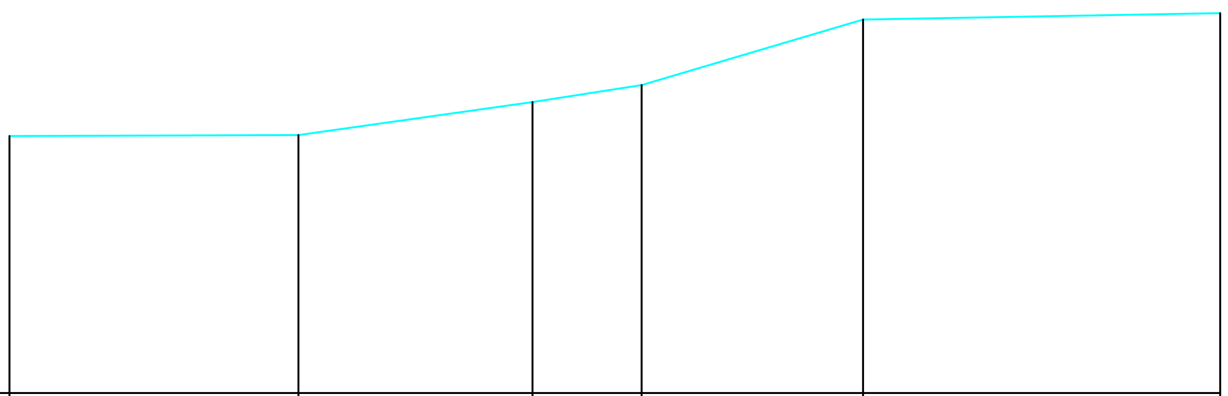
Vertical Scale 1 : 250



Natural Ground	29.13	29.17	30.21	30.75	32.82	33.02
Chainage	176.37	185.53	192.95	196.41	203.43	214.75

LONG SECTION A
Horizontal Scale 1 : 250
Vertical Scale 1 : 250

Notes:

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LONGITUDINAL SECTION PLAN

PROJECT: 100 OKARORO DRIVE, BEACHLANDS

AMENDMENT SCHEDULE

CLIENT: PATTLE DELAMORE PARTNERS LTD
AUTOCAD: N/23035/AUTOCAD/23035–103 SCALE: 1:250 (A3)
CIVILCAD: N/23035/12D/23035 TOPO DATE DRAWN: NOV 2023
SURVEYOR: JB DRAWN: JB
DESIGNED: CHECKED: LRF
23035–103

Appendix C: Flow Duration Curves

Te Puru Stream Flow Duration Curve Method

In order to develop a synthetic flow record for the Te Puru Stream at the Bridge, the Auckland Council Flow monitoring site on the Mangemangeroa Stream was used as a surrogate. The Mangemangeroa Stream catchment is of broadly similar size, with a similar landuse and is the closest monitored catchment to the Te Puru catchment (approximately 8 km separation).

To correlate the two sites, relative catchment area was used as a scaling factor. The Te Puru Stream has a catchment of 2.109km^2 at the bridge and the Mangemangeroa Stream Catchment is 4.756km^2 based on the MFE River Environment Classification Network. Thus, the synthetic Te Puru Stream flow record was created by scaling the Mangemangeroa flow record by 0.424. Flow in the surrogate timeseries was compared to flow gaugings obtained by PDP staff and found to be relatively similar for the dates measured.

Once the flow had been synthetically developed for the Te Puru Stream at the Bridge, flow gauging comparisons were done to determine the scaling factor to create synthetic flow records further down the catchment at locations C and Quarry (as shown in Appendix A of A02803201L001). Using the comparison flow gaugings scaling factors of 1.84 and 2.24 were used to develop flow records at C and Quarry respectively.

Auckland Council provided PDP with the flow timeseries from 14/07/2000 through to 01/03/2023. This is the most up to date processed data that Auckland Council holds.

Manual gaugings undertaken at the bridge site compared relatively well with synthetic flow record. For example, for a gauged flow of 24 l/s the synthetic flow indicated 18l/s at the site. This indicates at these flows the synthetic flow record will be conservative (i.e. estimated dilution of wastewater will be less than reality).

For the sites further down the Te Puru catchment, these were again scaled based on flow gaugings as no further information was available to be able to translate the flow series to. Further long term data capture is recommended to enable refinement of the flow duration curves.

PDP has provided the following datasets:

- Te Puru Catchment Flow Duration Curve (FDC) without Naturalisation at the Bridge (i.e. with the wastewater flow still included)
- Te Puru Catchment FDC with Naturalisation at the Bridge
- Te Puru Catchment C FDC without Naturalisation
- Te Puru Catchment C FDC with Naturalisation
- Te Puru Quarry Catchment FDC without Naturalisation
- Te Puru Quarry Catchment FDC with Naturalisation

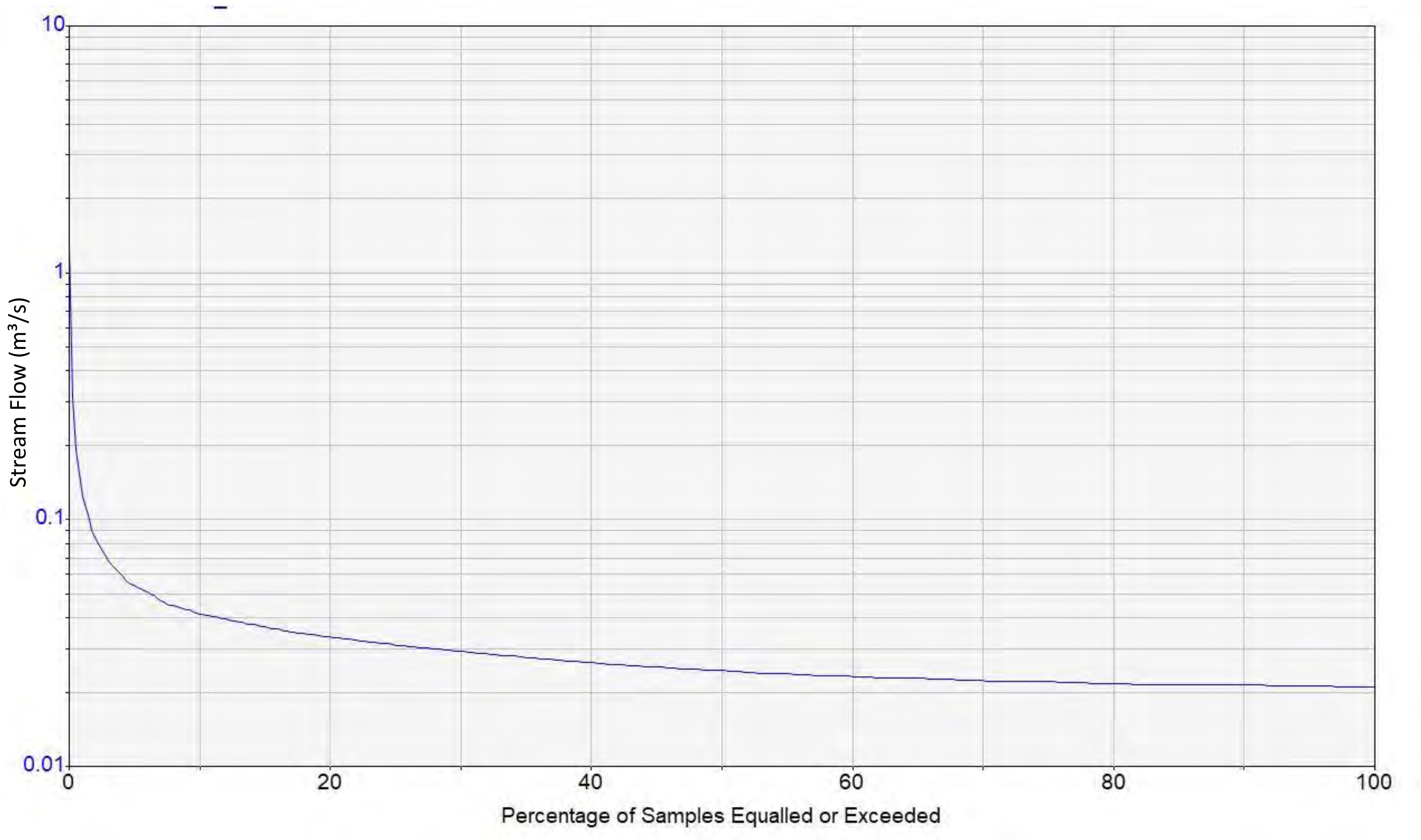

FIGURE 1: BRIDGE SITE FLOW DISTRIBUTION CURVE – WITHOUT NATURALISATION

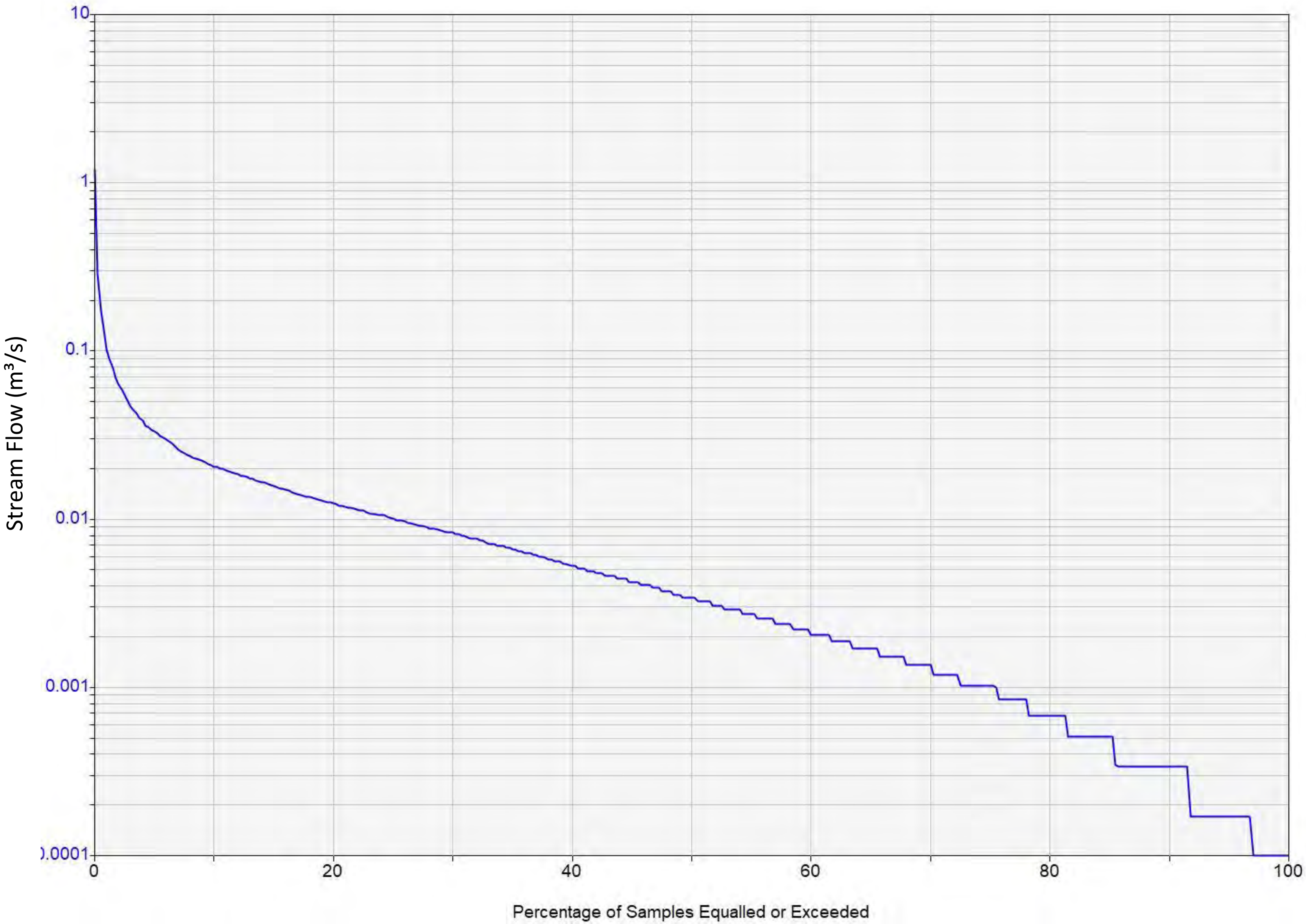

FIGURE 2: BRIDGE SITE FLOW DISTRIBUTION CURVE – WITH NATURALISATION

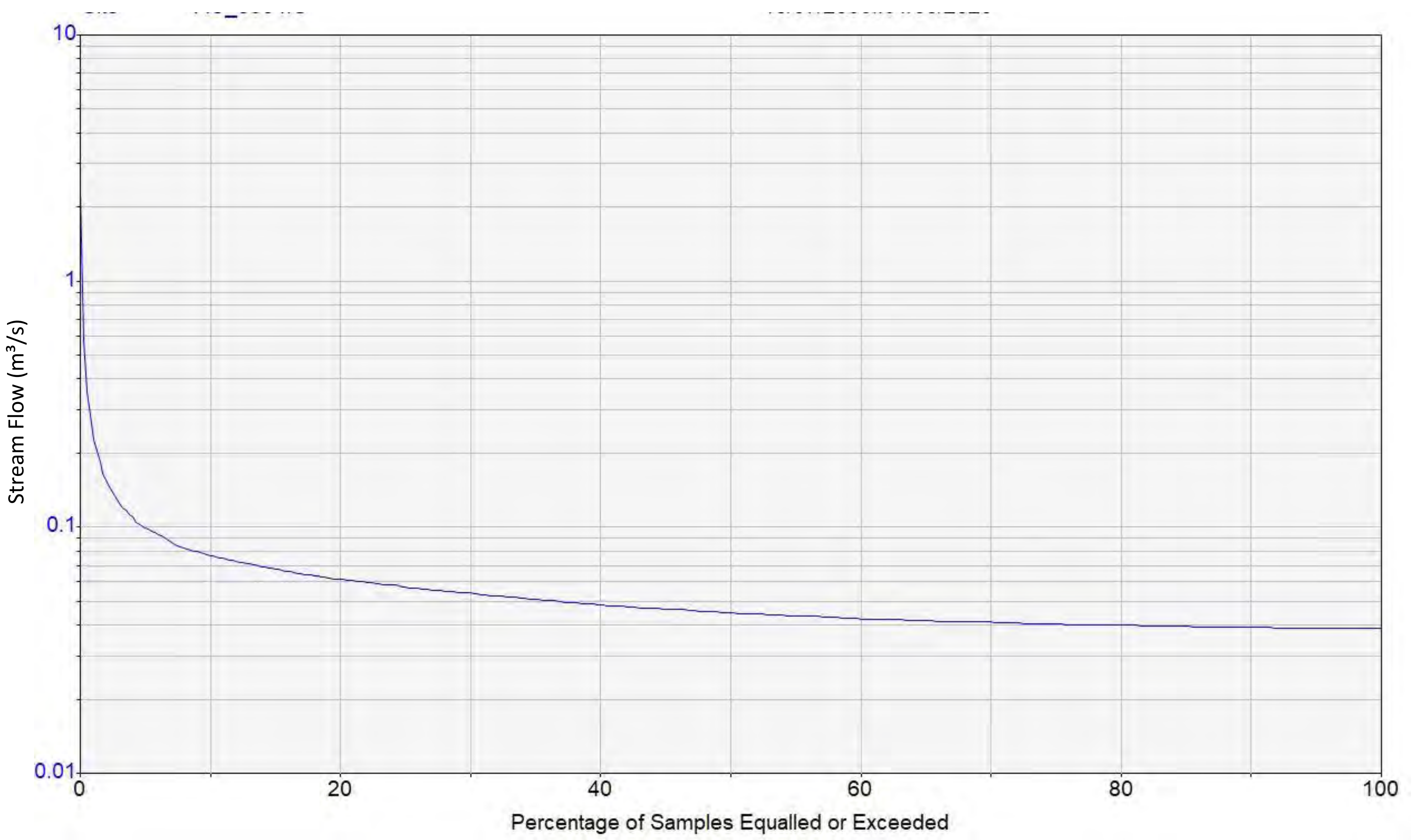

FIGURE 3: SITE C FLOW DISTRIBUTION CURVE – WITHOUT NATURALISATION

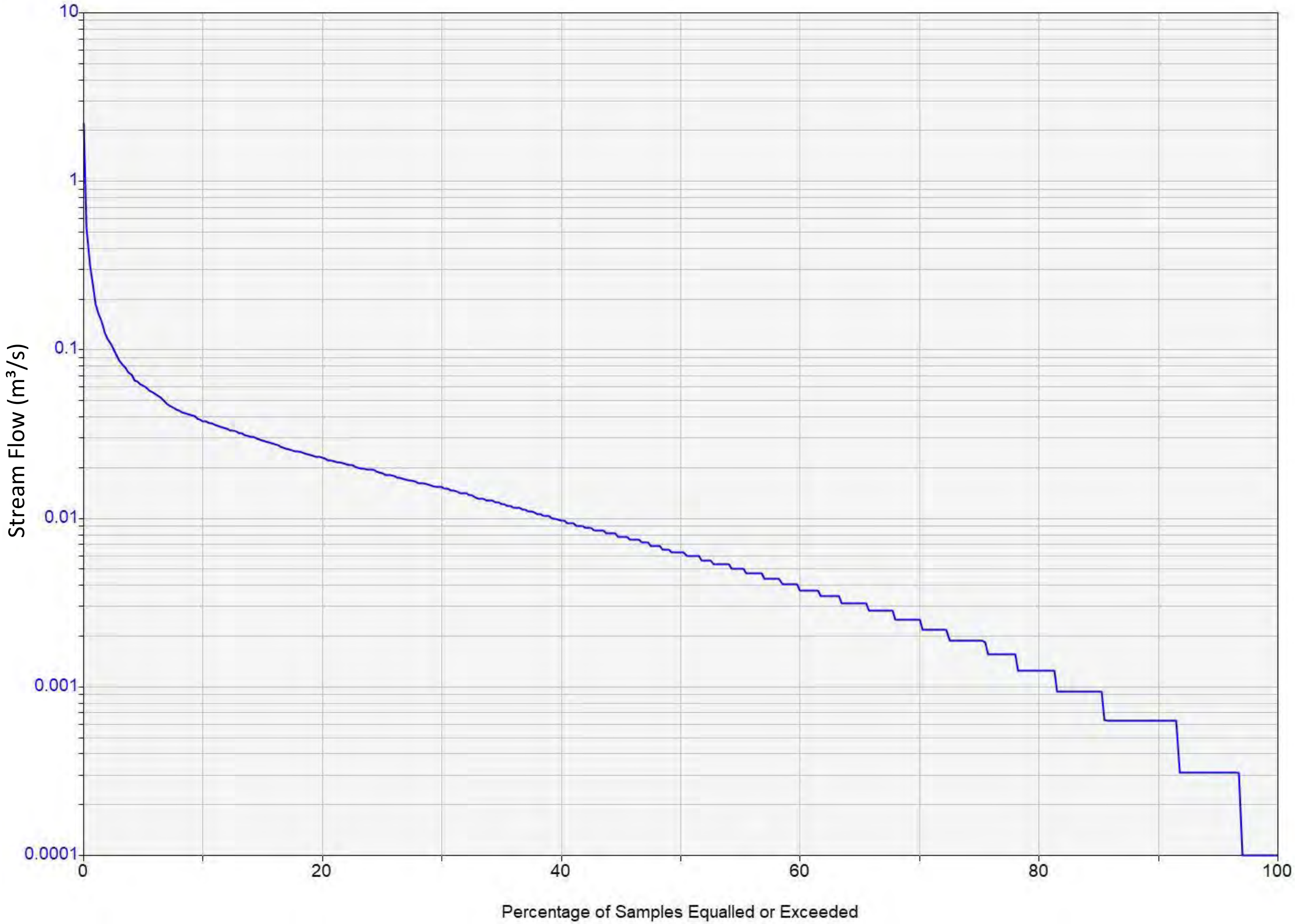

FIGURE 4: SITE C FLOW DISTRIBUTION CURVE – WITH NATURALISATION

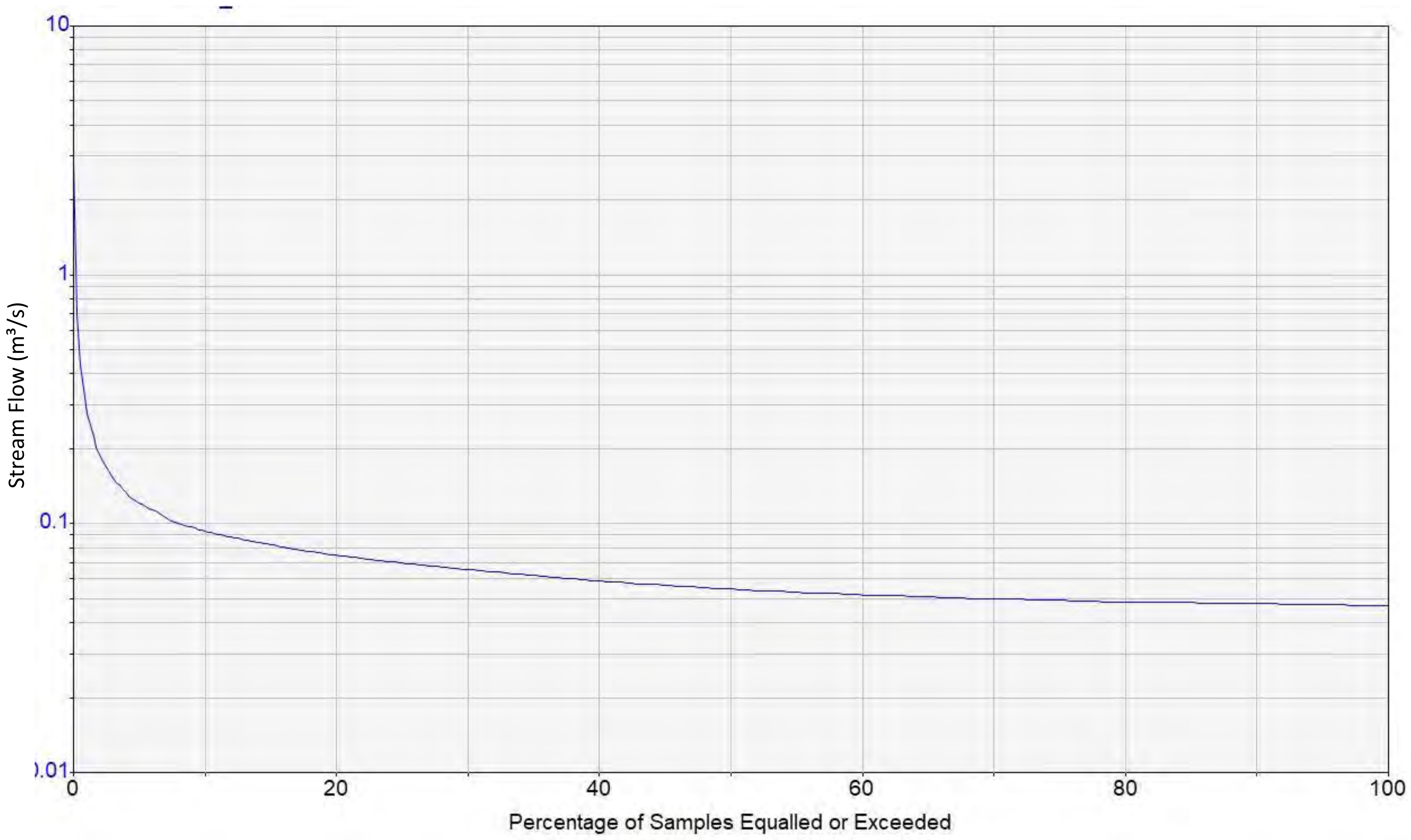

FIGURE 5: QUARRY SITE FLOW DISTRIBUTION CURVE – WITHOUT NATURALISATION

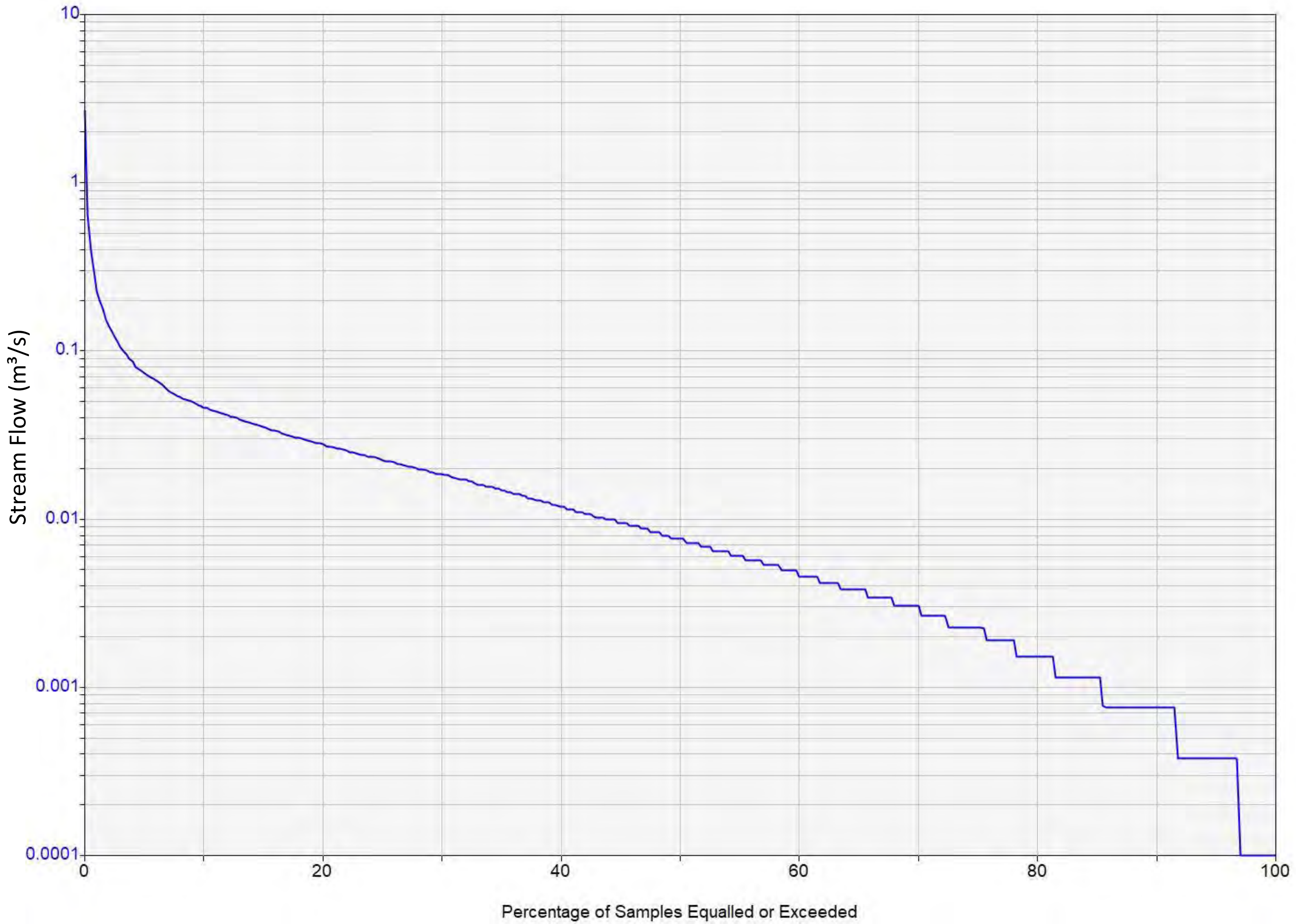

FIGURE 6: QUARRY SITE FLOW DISTRIBUTION CURVE – WITH NATURALISATION

Appendix D: Erosion Assessment Images

Figure A: WWTP Discharge Pond Outlet Channel (18/01/2024)

Figure B: Normal Flow within Stream (18/01/2024)

Figure C: Undercutting of Stream Bank (18/01/2024 – Facing Downstream)

Figure D: Riprap along Stream (18/01/2024 – Facing Downstream)

Figure E: Undercutting of Stream Bank Example 2 (06/09/2023 – Facing Upstream)

Figure F: DN 600 Culvert Inlet (06/09/2023)

Figure G: DN 600 Culvert Outlet (18/01/2024)

Figure H: Upstream Extent of Bridge (18/01/2024)

Figure I: Downstream Extent of Bridge (18/01/2024)

Figure J: Bank undercutting downstream of Bridge (18/01/2024)

Figure K: Downstream Extent of DN 1200 Farm Culvert (18/01/2024)

Figure L: Erosion Downstream of DN 1200 Farm Culvert (18/01/2024)

Figure M: Upstream of Point C (18/01/2024 - Facing Upstream)

Figure N: Point C (18/01/2024 - Facing Upstream)

Figure O: Bank undercutting at Point C (18/01/2024 - Facing Upstream)

Figure P: Point C (18/01/2024 - Facing Downstream)

Figure Q: Stream adjacent to Quarry (18/01/2024 - Facing Upstream)

ATTACHMENT 10

ASSESSMENT OF MICROBIOLOGICAL EFFECTS & HEALTH RISK

APR 24

Beachlands WWTP Discharge: Assessment of microbiological effects and health risk

Prepared for Watercare

April 2024

Prepared by:
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NIWA CLIENT REPORT No: 2024069HN
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NIWA Project: AES24201

Quality Assurance Statement		
	Reviewed by:	James Sukias
	Formatting checked by:	Jo Downey
	Approved for release by:	Michael Bruce

Contents

Tables

Figures

Executive summary

Watercare Services Limited has a resource consent to discharge treated wastewater from Beachlands Wastewater Treatment Plant (WWTP) to the Te Puru Stream via an overland flow scheme and pond system on a tributary of the Te Puru Stream. The consent expires in 2025, and Watercare wishes to reconsent that discharge. As part of the reconsenting process, an assessment of the potential human health risks following exposure to discharged treated wastewater is required both for the current treatment plant discharge and for future discharge scenarios that consider population growth in the area with associated increases in wastewater volume.

Watercare commissioned NIWA to assess the potential health risks following exposure to treated diluted wastewater in association with primary contact recreation (e.g., swimming), consumption of uncooked watercress harvested in the Te Puru stream and consumption of raw harvested shellfish. A Quantitative Microbial Risk Assessment (QMRA) was used to assess health risks arising from viral enteric infection. Others will use these estimated health risks as inputs for a full assessment of environmental effects.

Outputs from estimated flows in the Te Puru stream from PDP and hydrodynamic modelling by DHI were used as key inputs to QMRA modelling, allowing estimates of Individual Infection Risks (IInfR) to be calculated for three freshwater sites for both swimming and watercress consumption, swimming at 10 marine sites and shellfish consumption from three sites. The estimated risks were incremental risks due to the discharge of well-treated effluent into the environment.

The estimated incremental risks were highest in the Te Puru stream, downstream from the discharge, and the risks became less as the well-treated effluent was diluted in the marine environment. However, it was clear from microbiological monitoring data that activities in the Te Puru catchment, other than the wastewater plant, were degrading water quality and resulted in additional risks to human health. High levels of faecal indicator bacteria (FIBs) were observed in the Te Puru stream at substantially higher levels than in the WWTP discharge. This makes the Te Puru stream an unsuitable source of stock drinking water and indicates that the average individual infection risk is expected to be greater than 7% per swimming event.

The WWTP risk estimates used norovirus as a reference pathogen. Risk estimates were carried out for:

- 16 exposure sites – three freshwater and 13 marine sites.
- Three exposure mechanisms – swimming, and watercress and shellfish consumption (not all exposure routes were assessed for each site).
- Seven levels of treatment or log reduction values (LRV)- 1 to 7 $\log_{10}$ reductions in virus concentrations.
- 3 discharge scenarios – Current, Interim and Stage 2.

Health risks arising from exposure to norovirus, the reference pathogen, were related to the exposure site, exposure mechanism and the level of wastewater treatment assumed in the modelling.

- Health risks were greatest in the Te Puru stream, downstream from the discharge point for all discharge scenarios.

- Consumption of uncooked watercress harvested in the Te Puru stream resulted in the highest overall risks and was similar to primary contact/swimming risks in the stream.
- Risks in the marine environment from contact/swimming or consuming raw/lightly cooked shellfish result in risks of an order of magnitude lower than in the freshwater environment, assuming other things remain constant.
- Higher levels of treatment resulted in lower levels of risk, assuming other things remain constant.
- Increasing discharge from the plant increases the risk in the marine environment, though it had little effect on the risk estimates in the Te Puru stream.

QMRAs can help inform decisions about what level of wastewater treatment may be required by placing the health risk results in policy documents. Given that the highest risks were estimated in the freshwater environment, the National Policy Statement – Freshwater Management 2020 – Amended January 2024 (Ministry for the Environment 2024) was used as a guideline. Ensuring that the incremental risk from the dilute well- treated effluent is no greater than 1% at any exposure site for any exposure mechanism requires a log reduction value (LRV) of five, based on watercress consumption.

The watercress assessment is highly precautionary as the risks from watercress consumption are poorly quantified and understood. However, based on the assessment of the risks of swimming, an LRV greater than four would be required to keep risks below 1%.

The results reported here are the potential health risks attributable to norovirus derived from the Beachlands WWTP and are *incremental* health risks associated with a single model pathogen in the WWTP discharge. Usually, viruses are the principal pathogen of concern from well-treated wastewater. If, however, the WWTP fails to achieve these reductions, non-viral pathogens such as bacteria or protozoa may also be of concern.

1 Introduction

The Beachlands Wastewater Treatment Plant (WWTP) is operated by Watercare Services Limited. Watercare has a resource consent to discharge treated wastewater to the Te Puru Stream. As part of the process of reconsenting the existing discharge, an assessment of the potential human health risks following exposure to discharged treated wastewater is required for the current treatment plant discharge and also for future discharge scenarios that consider population growth in the area with associated increases in wastewater volume.

To address consenting requirements, Watercare Services Limited commissioned NIWA to prepare a Quantitative Microbial Risk Assessment (QMRA) and assess the potential for adverse effects on human health following recreation in, or consumption of foods such as shellfish and watercress gathered from, waters affected by the discharge of treated wastewater from the Beachlands WWTP. The QMRA relates to microbial pathogens and the incremental risks associated with the Beachlands WWTP discharge.

To assist with the assessment of health risks, NIWA also undertook an assessment of the wastewater discharge and microbial water quality of the receiving environment and at downstream locations where recreation occurs. This assessment focuses primarily on faecal indicator bacteria (FIB) and provides a broader "microbiological context" for health risks to recreational users as it incorporates other contaminant sources (e.g., diffuse, urban runoff, wildlife) in addition to the Beachlands WWTP.

The current operation at Beachlands- Maraetai (Beachlands) WWTP is an activated sludge plant with biological nutrient removal (BNR). The treatment of wastewater at the WWTP consists of initial screening followed by primary treatment in aerated lagoons (four-stage Bardenpho lagoon), settlement in clarifying basins, and disk filtration followed by UV disinfection (Figure A-3). Stormflows are buffered in lagoons before passing back through the WWTP for final treatment and discharge. Figure A-1 provides a schematic of the WWTP and treatment units.

The UV disinfected treated effluent is piped to a riparian buffer zone for land application where it is discharged via above-ground perforated distribution channels in parallel resulting in ground soakage to a large pond ("Farm Pond"). The outlet from the Farm Pond flows into a tributary of the Te Puru Stream which flows through moderately steep pastoral land down to the estuary at Te Puru Park/Kelly's Beach. The Farm Pond is located approximately 4.1 km upstream from the estuary.

The Beachlands WWTP currently serves a population of around 10,000. However, there is a need to extend this capacity to meet population growth due to housing development in the area. Watercare is planning to stage plant capacity with an interim upgrade of the plant to serve around 20,000 and a Stage 2 upgrade to serve 30,000 people (Andrew Slaney, process engineer, Stantec, pers comm). It is proposed that the plant will continue to discharge to the tributary of the Te Puru stream with increased effluent volume.

The catchment surrounding the Te Puru Stream is low relief, and mainly low intensity pastoral agriculture with areas of native forest and regenerating bush in stream gullies. The Te Puru Stream forms from a number of tributaries. The "reference" tributary joins Te Puru stream (Site E) at around 350 m downstream from the Farm Pond. The main stem of the stream (the Black Barn Tributary) joins at around 1.2 km further downstream (Site C) (Figure B-1). The Te Puru Stream drains into the estuary (Te Puru Park) just downstream from a quarry ("Quarry" site) (Figure 3-2). The estuary is around 1.1 km in length and fringed by mangroves on mudflats on the seaward side. The Te Puru Stream flows out across the beach for around one hour before and after low tide following a channel for about 150 m to the low water spring tide level.

Health risk assessment

Health risk assessment studies often use "faecal indicators" (faecal indicator bacteria, FIB) to estimate faecal contamination and human health risks. In New Zealand fresh waters, *Escherichia coli* (*E. coli*) is the preferred FIB, and enterococci are the preferred FIB for coastal waters. However, the association between indicators and pathogens, disease-causing organisms, tends to break down in wastewater treatment. In these circumstances, complying with FIB numerical limits, such as those in the "Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas" (MfE/MoH 2003) referred to here as the Guidelines, does not guarantee safety.

Risk assessments overcome the problem of a lack of a relationship between indicator organisms and pathogens by considering the actual or likely content of pathogens discharged in the treated wastewater effluent and the subsequent health risk to individuals exposed to residual pathogens.

Quantitative Microbial Risk Assessment (QMRA) quantifies the human health risks associated with wastewater treatment and disposal schemes. This procedure uses dose-response data for pathogens alongside water users' exposure to potentially contaminated water. The procedure may include health risks from consuming harvested food (including mahinga kai, such as shellfish) that may be exposed to treated, diluted wastewater (i.e., effluent). These data are used in computer simulations to estimate an individual's infection or illness risk.

QMRA is increasingly used to quantify the human health risks associated with wastewater treatment and disposal schemes (World Health Organization 2016). NIWA has developed a standardised QMRA methodology that may be customised and applied to most circumstances involving the discharge of treated wastewater to recreational waters.

1.1 Scope of report

This QMRA was undertaken using site-specific and other information. Site-specific information regarding the dilution of treated effluent in the environment was provided by DHI and PDP, the expected level of pathogens in wastewater from other New Zealand studies, and information regarding the volumes of food and water ingested as well and the infectivity of viruses (e.g., dose-response) come from the literature.

NIWA carried out a site visit but performed no fieldwork or data collection for this QMRA. Microbiological water quality data for the Beachlands WWTP and receiving environment were provided by Aquatic Environmental Sciences and Coasts and Catchment. The QMRA modelling was based on previous models of a similar nature (e.g., McBride 2017; Stott et al. 2023; Wood and Hudson 2023), which included updated parameters since the *2004 QMRA Report* on Beachlands WWTP (Stott and McBride 2004) was carried out.

Quantitative risk assessment involves a multistage process of identifying candidate pathogens, routes whereby the community may be exposed to organisms and modes of exposure. In this case, it was assumed that the candidate pathogen was norovirus and that the two key exposure routes were swimming and the consumption of foods exposed to diluted effluent, such as raw or lightly cooked shellfish and uncooked watercress[1]. These assumptions are reasonable, as other New Zealand QMRAs indicated that norovirus (in its disaggregated form) represents the greatest risk to individuals from swimming and shellfish consumption compared to other pathogens commonly considered in QMRA modelling of the Individual Infection Risk (IInfR).

The potential impacts on the quality of livestock drinking water abstracted from Te Puru Stream was considered within the microbiological context assessment.

1.2 Outline of report

The report is laid out into sections:

- Section 2 describes the microbiological context for the likely impact of the wastewater discharge observed from the perspective of discharged wastewater characteristics and background health risks indicated by the microbial water quality of the local receiving environment.
- Section 3 describes the methodology for the QMRA, the parameters used for modelling health risks, and the resulting modelled health risks.
- Section 4 summarises the potential public health impact of the Beachlands WWTP discharge for livestock drinking water, recreational water users and consumers of shellfish and watercress.

[1] Watercress and the possibility of watercress harvesting was identified upstream of the WWTP (Jason Scharvi-Coles, Process Technician, Watercare Services Limited, Pers comm 27 Oct 2023) and harvesting may occur downstream of the WWTP.

2 Microbiological context

To assist with the assessment of health risks, a microbiological assessment of the receiving environment was undertaken as a component of the QMRA. This assessment focuses primarily on faecal indicator bacteria (FIB) and provides a broader context for health risks to recreational users as it incorporates other contaminant sources (e.g., diffuse, urban runoff, wildlife) in addition to Beachlands WWTP. Data used to establish this "microbiological context" for the local receiving environment and Te Puru Stream included compliance monitoring of wastewater discharge volumes and concentrations of faecal indicator bacteria such as faecal coliforms, *E. coli* and enterococci measured in the discharge and receiving environment.

These data were used to estimate the risks from human contact with treated wastewater using criteria and guideline values from the New Zealand Recreational Water Quality Guidelines (Ministry for the Environment and Ministry of Health 2003), and the National Policy Statement for Freshwater Management (Ministry for the Environment (Manata Mo Te Taiao) and Te Kaawanatanga o Aotearoa (New Zealand Government) 2024). It is important to note that these Guidelines should not be used to assess risks from wastewater discharges, as the treatment process may alter the relationship between FIB and pathogens. This lack of a reliable relationship is one of the key reasons why the QMRA approach was chosen to estimate risk. However, analysing FIB data and comparing them with the Guidelines and other frameworks does provide another way to estimate the prevailing health risk to water users from contamination sources other than well treated wastewater, particularly during recreational or bathing seasons. Data were also used to assess spatial patterns of risk.

The potential risk to livestock consuming water sourced from the Te Puru stream containing treated wastewater was also considered and assessed using guideline values from the Australian and New Zealand Guidelines for Fresh and Marine Water quality (ANZECC and ARMCANZ 2000).

FIB concentrations can provide some indication of the effect that discharge of treated wastewater has on the receiving waters. However, this report does not attribute risk to any specific source. This is particularly relevant for discharged wastewaters as the relationship between indicator and pathogen is not assured. While wastewater treatment effectively reduces FIB concentrations, other pathogens may be less affected by treatment processes and thus persist at levels that still pose health risks to the public if exposed.

2.1 Data sources

Water quality and discharge data were provided by Aquatic Environmental Sciences Ltd (Mark James) and Coast and Catchment (Shane Kelly). NIWA collated available compliance, and other relevant monitoring data for wastewater discharge, and the receiving environment. Data were reviewed and the outcomes of an exploratory data analysis used to provide a context for the QMRA.

Datasets used for this assessment were sourced from several different monitoring programmes. As part of the WWTP monitoring plan, concentrations of faecal indicator bacteria (faecal coliforms and *E. coli)* are measured weekly from grab samples of secondary treated wastewater and tertiary treated effluent to verify the efficacy of the UV disinfection process and quality of discharged wastewater. Additionally, a short-term intensive monitoring campaign was undertaken from September 2023 to March 2024) for the WWTP. This also included raw and treated wastewater quality and a synoptic water quality survey along the Te Puru Stream to Te Puru Park as well as analysis of enterococci in addition to faecal coliforms and *E. coli.* Consequently, datasets are not of equivalent lengths and monitoring of selected variables (e.g., enterococci) was initiated during the life of the spatial survey for the Te Puru stream.

2.1.1 Wastewater

Data for WWTP flows (total daily discharge m^3/d) and faecal indicator bacteria (FIB) (faecal coliform and *E. coli*) were supplied for treated effluent pre- and post- UV treatment for 1 Jan 2018 – 14 Jan 2024.

Frequency of analysis for FIB concentrations was typically weekly and are expressed as CFU/100 mL after membrane filtration analysis. Data were used with limited modification including:

- Calculation of instantaneous load as a product of the daily average wastewater flow (discharge rate) and FIB concentration on the day the grab sample was collected.
- Removal of data due to erroneous results. This included n=18 data points for FIB results reported as < 10 CFU/100 mL in pre-UV treated wastewater samples as concentrations as low as this in secondary treated wastewater seems unlikely. For tertiary treated wastewater, three outlier values were removed for faecal coliform concentrations reported as 2 or 3 orders of magnitude higher than *E. coli*. These discrepancies seem improbable considering the majority of faecal coliforms typically comprise *E. coli.* One erroneous result for FIBs (faecal coliform, *E. coli* and enterococci) was removed from the short-term sampling campaign due to improbably high 10^3-10^4 CFU/100 mL concentrations in the discharged wastewater ("WWTP Outlet").

Current limits for the microbial quality of treated wastewater from Beachlands WWTP is a consented median of ≤ 14 faecal coliforms CFU/100 mL determined from 10 consecutive samples (ARC 2005; Watercare Services Limited 2022). There is no consent limit stipulated for *E. coli.* However, *E. coli* are a subgroup of faecal coliforms and are the main contributor particularly where animal wastes and human sewage are the primary source of faecal contamination (Horan 2003). As a conservative approach similar limits may be considered for *E. coli* concentrations in the treated wastewater.

No pathogen data is available for the WWTP.

2.1.2 Receiving environment

Treated wastewater from the WWTP discharges via surface irrigation to a riparian buffer as an overland flow scheme for the disposal of the UV-disinfected effluent. Depending on the slope and saturation of the soil horizon, wastewater will travel as overland flow or infiltrate the soil horizon and travel as subsurface flow towards a large pond (Farm Pond) located on a tributary of the Te Puru Stream.

The Te Puru stream flows down through a catchment mainly dominated by pastoral land use eventually reaching the coast and discharging into the estuarine environment at Kelly's beach. The stream is reasonably narrow (average width 1.7 m) and shallow at typically <0.5 m depth during summer low flows (Bioresearches 2022). Stream flow varies spatially with headwater tributaries experiencing lower flows, while water flows generally increase with distance downstream.

A short-term monitoring programme was established to provide spatial water quality characteristics for the Te Puru stream and selected tributary sites during spring to late summer low flow conditions. Data for this limited duration monitoring programme was available from 11 September 2023 to 6 March 2024 and was supplied by Coast and Catchment (Shane Kelly).

Information from the short-term monitoring sites was cross-referenced with the QMRA site locations.

2.2 Results

Data were examined to characterise the discharged wastewater and the nature and scale of its effects on the environment. Exploratory analysis was undertaken using TimeTrends V11 and R 4.2.2.

The locations of various sample points are indicated in Figure A-1 for WWTP sampling sites, Figure 3-2 for QMRA sites and Figure B-1 for the Te Puru Stream spatial monitoring survey.

2.2.1 Beachlands WWTP Wastewater discharge

The daily discharge limit for the Beachlands WWTP is 2,800 m^3/d (Watercare Services Limited 2022).

Time series data for wastewater discharge (m^3/d) is summarised in Figure 2-1 for total daily rates. The time series for 2021 is incomplete due to missing data. Data indicates discharge rates fluctuate throughout the year and are punctuated intermittently by short periods of considerably higher flows that exceed the daily discharge limit of 2,800 m^3/d.

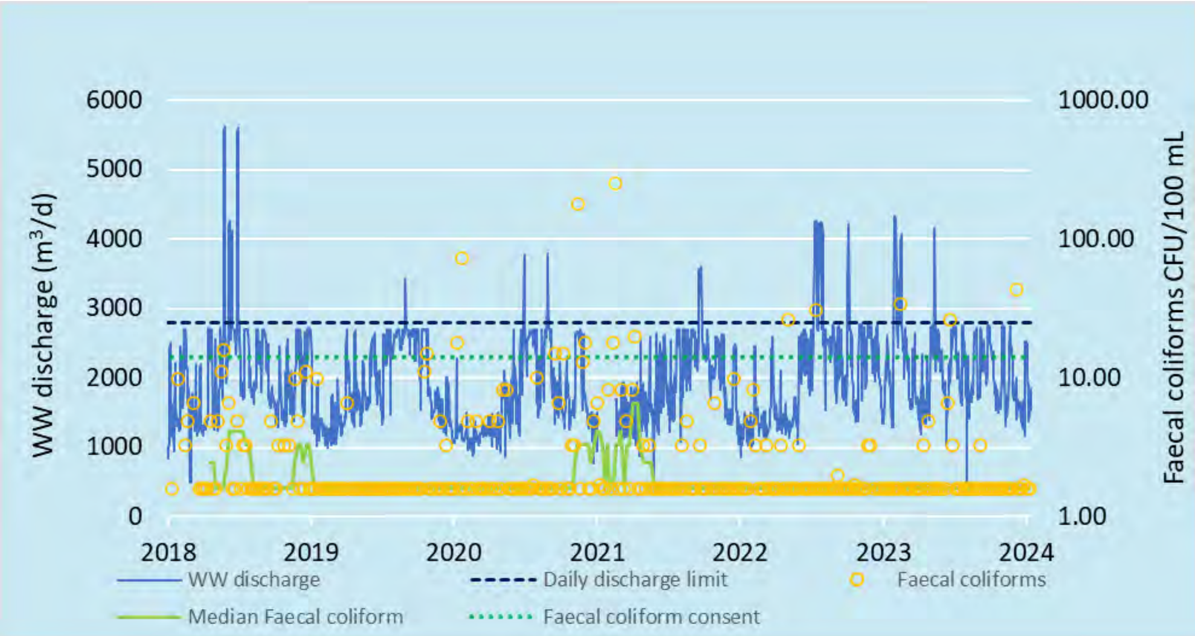

Figure 2-1: Time series of wastewater total daily flows and faecal coliform levels in wastewater discharged from Beachlands WWTP. All data shown from 1 Jan 2018 to 14 Jan 2024. Consent limits for discharge (m^3/d) and faecal coliforms (median CFU/100mL) shown. Median faecal coliforms shown as running median on 10 consecutive samples. Note $\log_{10}$ scale on y-axis for faecal coliforms. Note also that flow balancing ponds are used to prevent discharges exceeding the daily discharge consent limit where possible.

There is evidence of seasonal variation in wastewater discharge with larger median and mean discharge rates in the winter months June – September (Figure 2-2). Conversely, late summer and early spring months experience lower flows influenced by generally drier conditions.

Annual mean discharge rates range from 2041 m^3/d (2018) to 2139 m^3/d (2023) with a slight consistent upward trend in daily average flow on an annual basis since 2020 (Figure 2-3). Deseasonalised trend analysis suggests that this increase is approximately 1.6% per year.

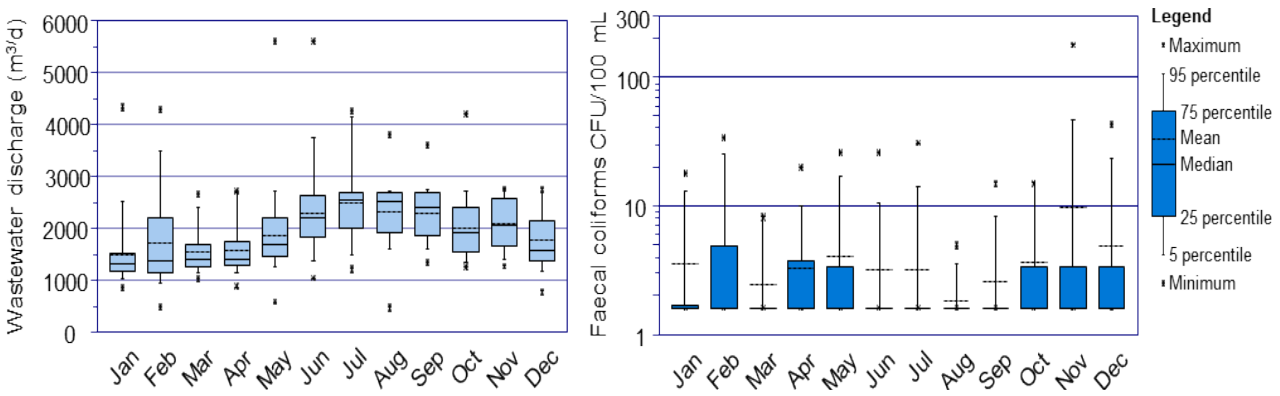

Figure 2-2: Seasonal (monthly) summary of daily wastewater discharge and faecal coliform concentration in UV treated wastewater (2018-2023 inclusive). Censored data shown for faecal coliforms. Note log_{10} scale on y-axis for faecal coliform data. Median shown as dotted line, mean as solid line.

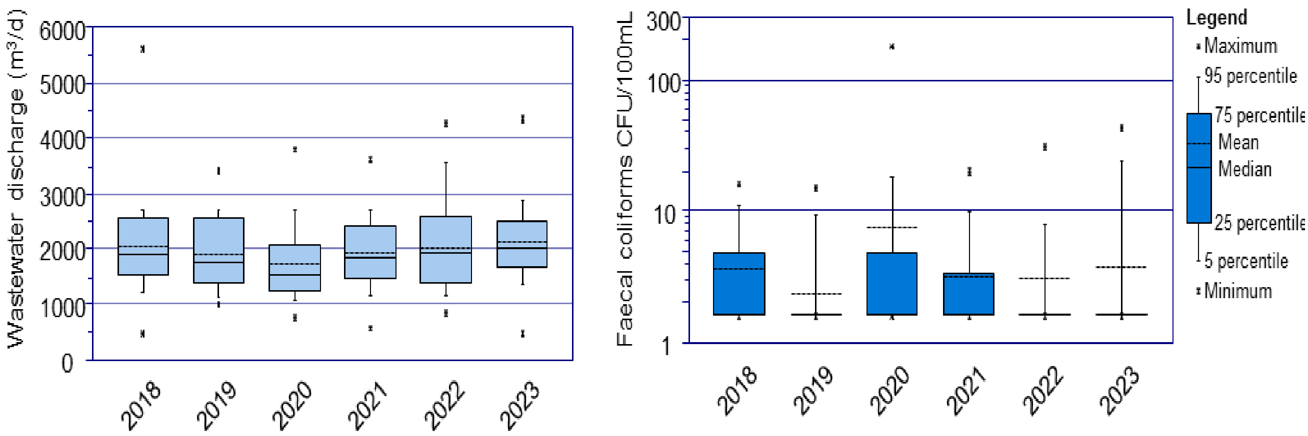

Figure 2-3: Annual (yearly) summary of daily discharge characteristics and faecal coliform concentrations in UV disinfected wastewater for 2028-2023 inclusive. Censored data shown for faecal coliforms. Note log_{10} scale on y-axis for faecal coliform data. Median shown as dotted line, mean as solid line.

Wastewater microbiological characteristics

Faecal indicator bacteria (faecal coliforms and *E. coli*) are monitored in the secondary treated wastewater after disc filter treatment and before UV treatment, and after UV treatment to confirm disinfection is achieved. Concentrations of faecal coliforms in the UV treated wastewater varies over two orders of magnitude (Figure 2-2). However, levels in the discharged wastewater are mostly below 10 CFU/100 mL. Current consent limits are for a median concentration of ≤ 14 faecal coliforms/ 100 mL (based on 10 consecutive samples) and for the majority of the time, concentrations remain below this threshold. On occasions, elevated levels of faecal coliforms are observed but these do not appear to coincide with relatively high discharge rates (Figure 2-1). High levels of FIB in UV- disinfected wastewater whether faecal coliform or E. coli do not seem to be linked to the performance of the UV process (see discussion below). However, FIB concentrations in UV-treated wastewaters show less variability at higher UV transmissivity (%) levels (Figure A-5).

The monthly median and mean faecal coliform concentrations in the treated wastewater are typically less than 5 CFU/100 mL (Figure 2-2). However, there is an observed increase in faecal coliform concentrations in discharged wastewater during the summer months. Notably, average and 95th percentile concentrations are highest between November and February, likely due to reduced dilution of the wastewater during this period. This suggests a greater potential for faecal contamination in the receiving environment during summer in relation to the microbiological faecal indicator bacteria quality associated with the discharged effluent from the Beachlands WWTP.

Faecal coliform concentrations in UV disinfected wastewaters are summarised in Table 2-1. Annual medians were consistently < 2 CFU/100 mL. Consent limits being considered for the various scenario options are likely to be median faecal coliforms <10 CFU/100 mL and a 90th and 95th percentile of 100 CFU/100 mL (Andrew Slaney, Process Engineer, Stantec). These conditions are met under current operating conditions (Table 2-1) based on annual summaries. Seasonal variations in wastewater characteristics in Figure 2-2 illustrates the importance of monitoring to detect any deviations in treated wastewater quality. In instances where elevated concentrations are identified, increasing the frequency of monitoring can help distinguish between spurious results and the need for action to rectify treatment system inefficiencies.

Table 2-1: Annual summary of faecal coliform concentrations in UV treated wastewater discharged from Beachlands WWTP. Note all data summarised.

Year	N	Mean	Median	95th percentile	Maximum
2018	44	3.7	1.6	11.0	16
2019	53	2.4	1.6	9.3	15
2020	52	8.8	1.6	18.0	180
2021	51	8.1	1.6	17.6	250
2022	52	3.0	1.6	7.9	31
2023	52	3.7	1.6	24.1	43

The removal performance of the WWTP is assessed using both the short-term monitoring dataset and the compliance monitoring dataset. These datasets allow for the assessment of removal efficacy throughout the WWTP and specifically for the UV disinfection process.

The Beachlands WWTP demonstrates relatively consistent removal performance for the UV disinfection process with average $\log_{10}$ removal ranging from 3.2 to 3.9 throughout the year (Figure 2-5). Highest removal rates are typically observed during summer months coinciding with periods of elevated FIB concentrations in secondary treated wastewater prior to UV treatment (Figure 2-4).

This observation highlights the WWTP's capacity for UV disinfection, as it effectively manages high concentrations of FIB in UV influent wastewaters without compromising disinfection efficiency. The removal efficacy of UV treatment did not seem to be affected by discharge flows or the transmissivity of the UV process (Figure A-2 and Figure A-5). However, while FIB are effectively inactivated by UV disinfection, other pathogens such as viruses exhibit different responses to UV treatment. Some viruses are reported to be particularly resilient to UV disinfection processes with their susceptibility varying depending on the specific type of virus (Malayeri et al. 2016).

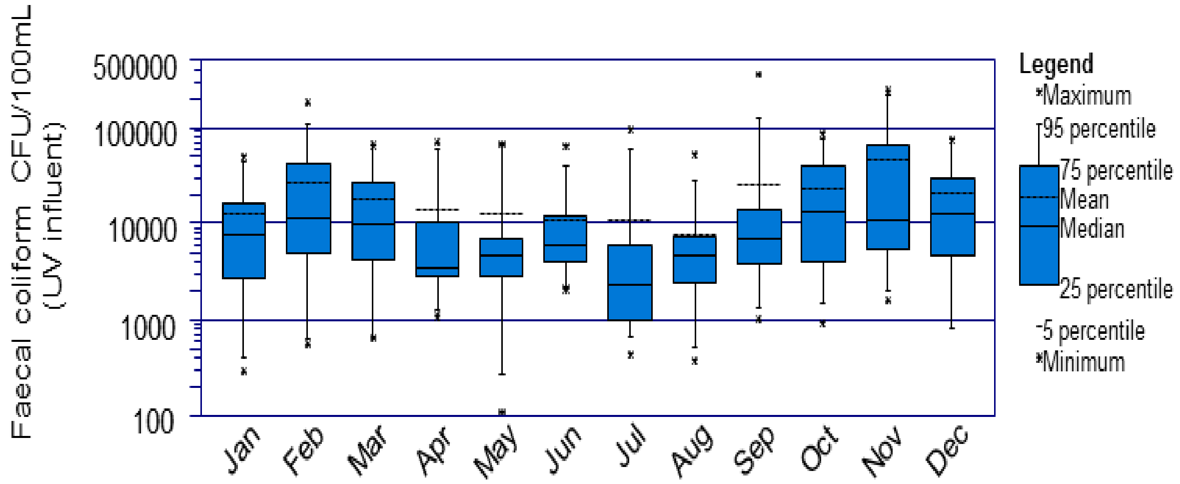

Figure 2-4: Seasonal variability in faecal coliform concentrations in wastewaters immediately upstream of the UV treatment system. Censored data. Note $\log_{10}$ scale on y-axis. Median shown as dotted line, mean as solid line.

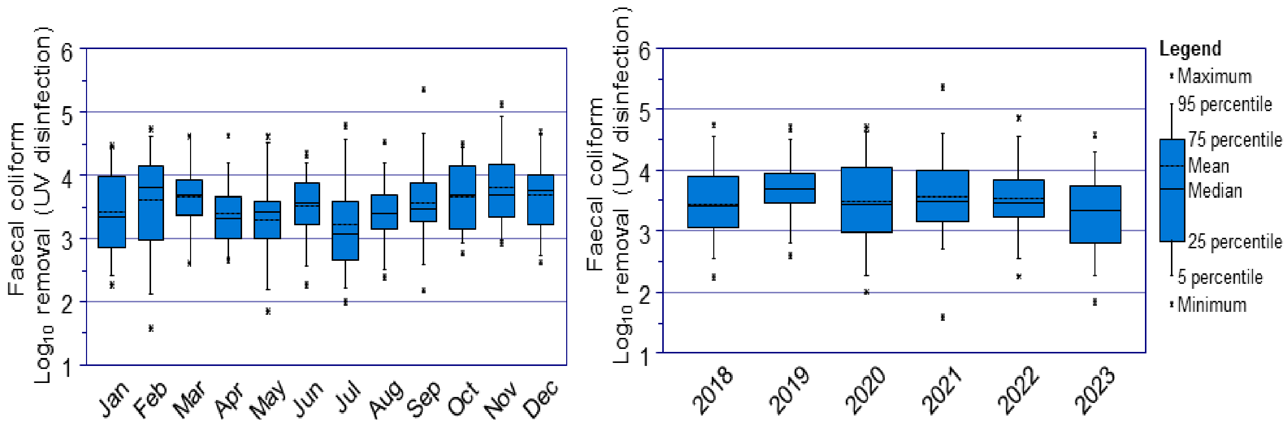

Figure 2-5: Seasonal and annual removal performance for UV disinfection of wastewater at Beachlands WWTP. Log_{10} removal shown for faecal coliforms from censored data. Median shown as dotted line, mean as solid line.

Overall, data indicate effective removal of FIB throughout the WWTP with 2-3 log_{10} removal prior to the UV treatment system, typically resulting in around 6 log_{10} overall removal for faecal coliforms, *E. coli* and enterococci (from inlet to outlet) (Table 2-2). Similar removal is observed for the different types of FIBs. Although removal remains relatively consistent during the sampling campaign, greater variability is observed during late summer, particularly in February (Figure 2-6).

Table 2-2: Removal (log10) of faecal indicator bacteria through the WWTP. Censored data from 1 October 2023 to 6 Mar 2024 inclusive. Data from short-term monitoring campaign from the WWTP inlet and WWTP outlet.

Faecal indicator bacteria	N	Min	Median	Mean	95th percentile	Max
Faecal coliform	63	4.4	6.6	6.5	7.3	7.4
E. coli	63	5.2	6.4	6.4	6.9	7.0
Enterococci	63	4.6	6.0	6.0	6.5	7.8

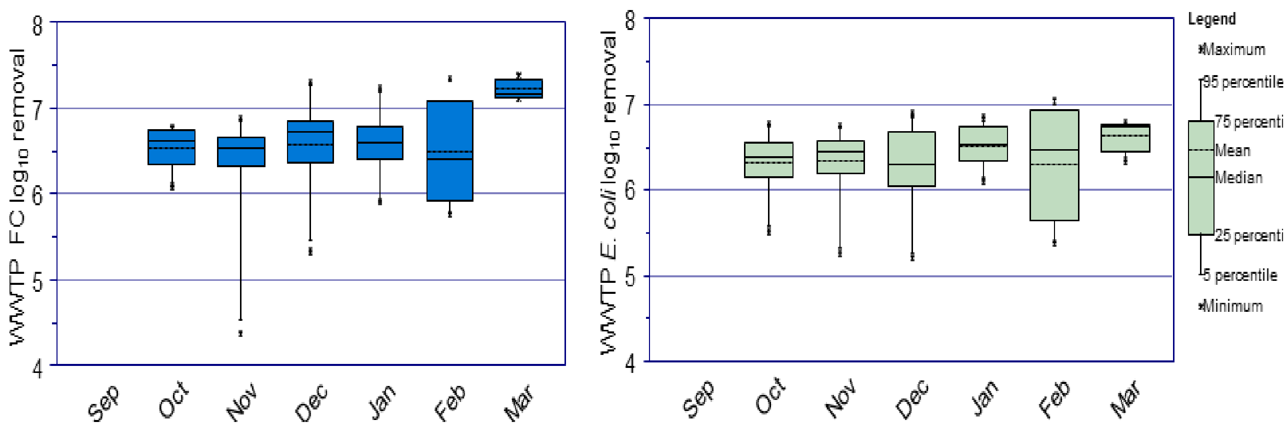

Figure 2-6: Seasonal variability in microbial removal performance of the WWTP for faecal coliforms (left) and E. coli (right) . Censored data shown. Median shown as dotted line, mean as solid line.

2.2.2 Impact of wastewater discharge on receiving waters

As previously observed, there was little noticeable increase in the total daily volume of wastewater discharged between 2018 and 2023 (Figure 2-3). Additionally, concentrations of FIB in UV treated wastewater remained relatively constant over this period (Figure 2-1 and Figure 2-3). Consequently, the flux or instantaneous load of FIB has also remained stable during this time as shown in Figure 2-7. These flux or load estimates serve as indicators of the potential impact on receiving waters. For instance, the median daily flux of faecal coliforms discharged ranged from $3x10^7$ /day to $4x10^7$ /day for faecal coliforms during the period 2018 to 2023.

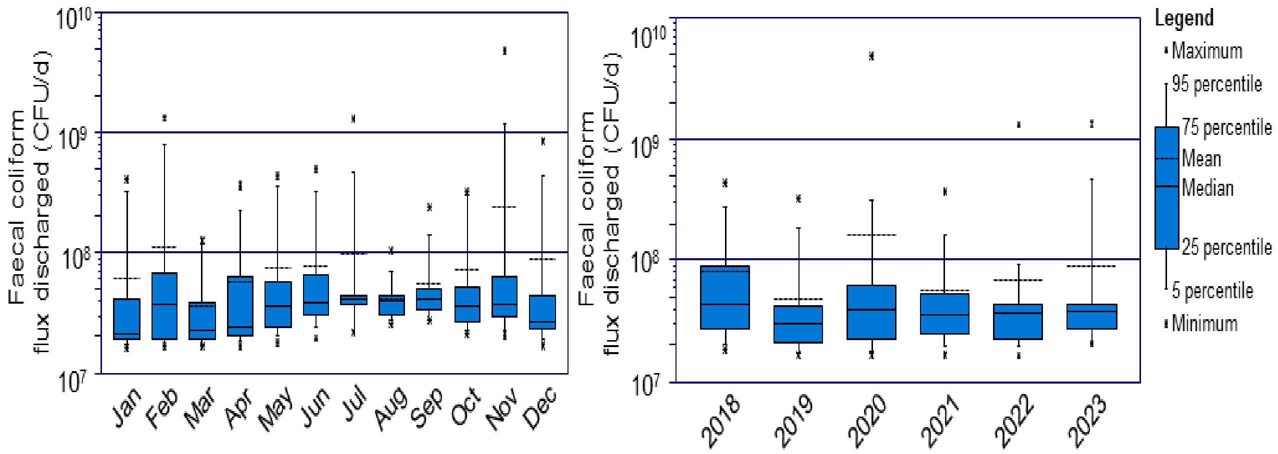

Figure 2-7: Seasonal and annual summary of calculated daily wastewater flux of faecal coliform (#/d) or instantaneous load discharged from the WWTP (2018-2023 inclusive). Censored data. Note $\log_{10}$ scale on y-axis. Median shown as dotted line, mean as solid line.

Figure 2-7 illustrates that the average flux or load of faecal coliform values peak during the summer months, suggesting a greater release of FIB during the season when recreational activities in downstream receiving waters are likely greatest. Moreover, the 95th percentile flux values remain high throughout the year at ≥ 10^8 CFU/day. Similar trends are observed for the flux of *E. coli* from the WWTP (data not shown). This indicates that extreme FIB loads are possible year-round with potential implications for similar trends in viruses.

While exposure to higher levels of FIB suggests an increased health risk, it is important to note that this observation is specific to faecal coliforms and *E. coli* which serve as indicators of the likely presence of pathogens. However, it highlights the importance of ongoing monitoring to ensure continued protection of environmental and public health.

2.2.3 Receiving environment

Relatively sparse microbiological water quality data exists for the tributary of Te Puru Stream and the main stem of the Te Puru Stream potentially influenced by the Beachlands WWTP discharge. Microbial water quality data from the short-term monitoring campaign is shown in Figure 2-9 and Figure 2-10 for FIB concentrations in discharged treated wastewater and at reference and impact sites downstream from the WWTP. Various guideline values are shown to enable comparison with results of the short-term monitoring.

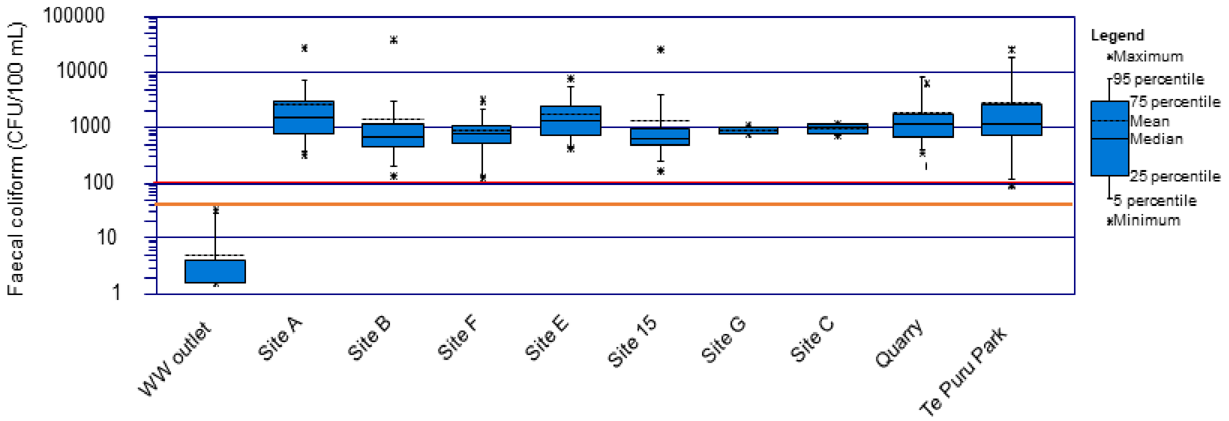

Figure 2-8: Spatial trend in faecal coliform concentrations for final treated wastewater and at various sites along the Te Puru Stream. ANZECC (2000) guideline for livestock drinking water quality shown as thick red line (median 100/100 mL) and MfE/MoH (2003) shellfish harvesting as thick orange line (median 14/100 mL).

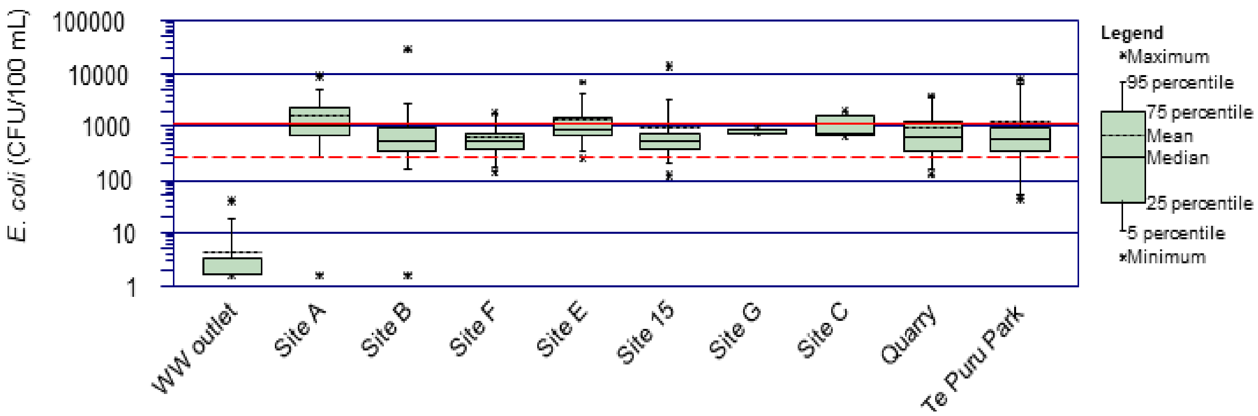

Figure 2-9: Spatial trend in *E. coli* concentrations for final treated wastewater and at various sites along the Te Puru Stream. NPS-FM median (260/100 mL) (dashed red line) and 95th percentile (1200/100 mL) (solid red line) numeric attribute values for human contact shown for Band E.

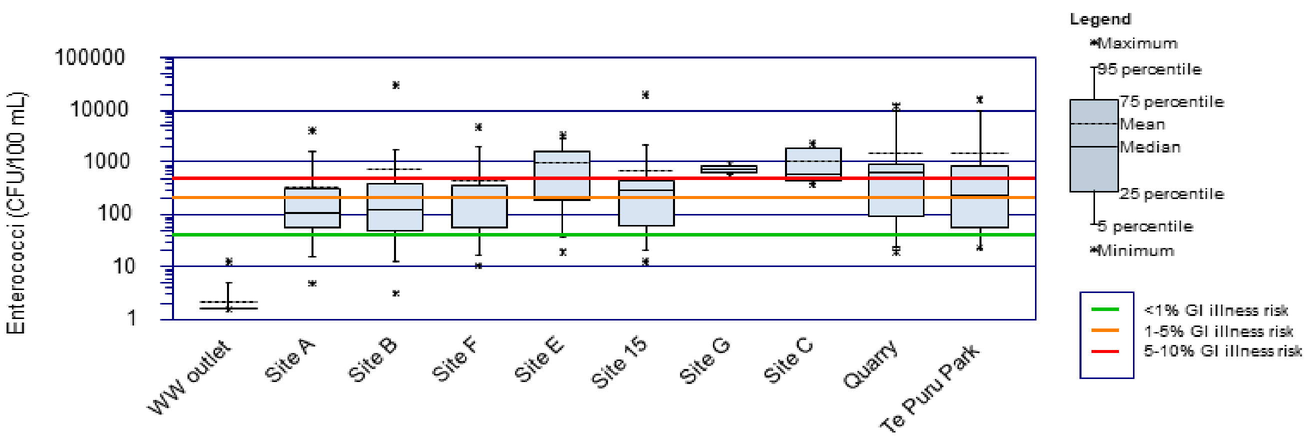

Figure 2-10: Spatial trend in enterococci concentrations for final treated wastewater and at various sites along the Te Puru Stream. MfE/MoH (2003) guidelines for recreation in marine waters shown (green = 40/100 mL; amber = 200/100 mL; red = 500/100 mL) corresponding to potential gastrointestinal illness risk categories.

The data indicate that the wastewater discharge has no discernible impact on FIB levels in the receiving environment, particularly in the Te Puru stream downstream from the WWTP. Faecal coliform, *E. coli* and enterococci show similar spatial trends with concentrations typically three orders of magnitude higher than those in treated wastewater. Of note is that Site E which serves as a reference site located upstream on a different tributary and unaffected by the WWTP discharge, consistently shows higher levels of FIB compared to Sites B and F which are directly downstream of the WWTP.

Concentrations of faecal indicators in the Black Barn tributary (north–west catchment) are typically 1.5 – 2 times higher than that at the Black Barn site (downstream from the Farm Pond) indicating that agricultural sources are probably the major contributor to contamination. Other reference tributaries also show high levels of faecal contamination.

Concentrations of FIB are also notably higher at Site A, located upstream of the Farm Pond[2]. Site A will be contributing to the poor water quality of the Farm Pond itself. The elevated levels at Site B will be influenced by high concentrations of FIB in inflowing waters from Site A. Furthermore, observations of large numbers of birds in the area suggests a contribution to the high FIB concentrations at Site B from avian sources.

Median concentrations for FIB remain high at Site 15 (the Bridge site used in the QMRA) with a slight increase observed at Site C, potentially attributable to inputs from a large tributary. FIB values are also high, though more variable at the Quarry site and at Te Puru Park. Site 15 is the closest downstream site to the WWTP, where the public can access the Te Puru stream, and the Quarry site is the lowest point on the river at which tidal effects do not influence it. These sites were chosen to represent the freshwater risks for the QMRA.

The persistently high levels of FIB along the Te Puru Stream network could be attributed to several factors. Agricultural sources are probably the major contributor to contamination, with input from ephemeral drainage ditches from adjoining pastoral land evident as well as unregulated cattle access, with opportunities for direct faecal deposition into the stream. Limited dilution in the stream due to low natural flow rates may contribute to the sustained elevation of FIB levels. There does not appear to be a significant relationship between FIB levels and distance from the discharge point, indicating that dilution from stream flow is minimal. For example, the median normalised flow at site 15 is estimated to be 3.4 L/s compared to a wastewater discharge rate of 23 L/s (data provided by PDP). Dilution modelling by PDP further supports this observation, indicating that treated wastewater comprises almost the entirety of flow in the Te Puru Stream for 50% of the time at Site 15 (the Bridge).

The Te Puru stream flows through areas of pastoral land-use where livestock access to the stream may occur despite fencing for stock exclusion. Reports of livestock observed in the stream at Site 15 highlights this challenge (Rebecca Stott, *pers comm*). The presence of livestock in the vicinity of the stream directly contributes to the microbial loading in the stream, thereby influencing FIB levels.

[2] The Farm Pond receives drainage waters from the riparian land application site.

2.2.4 Health risk implications

Concentrations of FIB in the receiving environment are often compared with various microbiological water quality guidelines to assess potential risks. However, these guidelines recommend against their application in waters with point sources of pollution. However, for the purposes of this microbiological context, they have been used to assess the potential risks from a variety of contaminating sources as a comparator for the QMRA which assesses the incremental risks attributed solely to the WWTP.

Human contact

It is unlikely that the Te Puru stream will be used for recreational activities. However, human contact with water may occur through harvesting of mahinga kai. The presence of kakahi (freshwater mussels) has been reported at Site E (upstream from the confluence with the Farm pond tributary at the Bridge site) and watercress at several sites along the Te Puru stream including Site A (above the Farm Pond), Site F, Site 15 (QMRA site "the Bridge") and further downstream at sites G and C (Bioresearches 2022) (Rebecca Stott *pers comm*).

The NPS-FM provides criteria for water suitability for human contact based on concentrations of *E. coli* (Ministry for the Environment (Manata Mo Te Taiao) and Te Kaawanatanga o Aotearoa (New Zealand Government) 2024)(Table 9). Four metrics (numeric attribute states) are proposed to assess the suitability of sites for contact. These metrics include the % exceedances over 540 *E. coli*/100 mL and 260 *E. coli* /100 mL, as well as median and 95th percentile concentrations. In Figure 2-9, data for all sites are presented together with median (> 260 *E. coli*/100 mL) and 95th percentile (>1200 *E. coli*/100 mL) values for Band E. It is evident that all sites exceed these thresholds and are consequently graded as Band E. For this attribute band, the predicted average risks of infection exceed 7% based on a random exposure on a random day.

Enterococci is the preferred indicator for assessing the potential risks associated with recreational activities in marine waters. Concentrations of enterococci from the spatial survey are compared with the marine risk thresholds in the Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (Ministry for the Environment and Ministry of Health 2003), which include gastrointestinal illness risks.

Table H1 of the MfE/MoH (2003) guidelines provides three illness risk thresholds that are used for long-term grading of marine recreational water quality based on 95th percentiles:

Waters graded "A" are considered to have a very high recreational water quality, likely to cause fewer than 1 case of gastrointestinal illness out of 100 exposures (< 1% IIR).
Waters graded "B" are considered to have high recreational water quality, likely to cause up to 5 cases of gastrointestinal illness out of 100 exposures (≥ 1% to ≤ 5% IIR).
Waters graded "C" represents a risk of up to 10% for gastrointestinal illness (> 5% to ≤ 10% IIR).
Waters graded "D" represents a risk of more than 10% for gastrointestinal illness (>10% IIR).

Figure 2-10 presents the results for enterococci for all sites from the spatial survey alongside the corresponding risk thresholds. It is evident that all sites exceed the three thresholds. Notably, the Te

Puru Park site (an estuarine site where recreational activity is most likely to occur) is categorized as Grade D, indicating an associated potential risk of gastrointestinal illness exceeding 10%.

Shellfish consumption

Microbiological water quality guidelines for recreational shellfish harvesting are outlined in the MfE/MoH (2003) guidelines. According to these recommendations, median concentrations of faecal coliforms should not exceed 14 per 100 mL and no more than 10% of samples should exceed 43 faecal coliforms/100 mL. From the data presented in Figure 2-8 and in Table B-2, it is evident that the Te Puru Park site significantly exceeds the shellfish harvesting criteria and as such, it would not be considered suitable for shellfish harvesting. However, although several species of shellfish are present at this site, their current size makes them too small for legal harvesting (Sim-Smith 2023).

Livestock drinking water

The (ANZECC and ARMCANZ 2000) guidelines provide recommendations for the microbiological quality of livestock drinking water with a guideline value of a median concentration of 100 faecal coliforms per 100 mL. Figure 2-8 depicts faecal coliform concentrations at various sites alongside the guideline value for livestock drinking water. All sites exceed this value, making them unsuitable as a source of drinking water for livestock. Moreover, the ANZECC guidelines recommend that investigations into likely causes are warranted when 20% of results exceed four times the median trigger value. As shown in Table B-2, this criterion is met for all sites, emphasizing the need for an understanding of the sources and underlying causes of elevated concentrations of FIB in the Te Puru Stream network.

3 QMRA

This Quantitative Microbial Risk Assessment (QMRA) aims to assist Watercare and the local community in understanding the potential health risks associated with the discharge of treated wastewater from the Beachlands Wastewater Treatment Plant into the Te Puru stream,

Kelly's Beach, and Tamaki Strait. The assessment only considers risks associated with wastewater discharge, and it does not account for background risks or risks associated with other potential sources of microbial contaminants, such as agriculture (Phiri et al. 2020) , wildfowl (Moriarty et al. 2011), stormwater into the stream, or illicit dischargesfrom boats into the sea (Landrigan et al.

2020). Therefore, the estimated risk will be the incremental risks from wastewater rather than the total risks.

The health risk assessment process comprises multiple steps (described graphically in Figure 3-1), including:

1. Select the hazard(s), i.e., the pathogen(s) of concern—exposure to which can give rise to illness.
2. Assess exposures to the pathogens at key sites.
3. Characterise the pathogens' dose response.
4. Risk characterisation.

The "Quantitative" aspect of QMRA relates particularly to item 4—risk characterisation—in which Monte Carlo computer simulation is used. These simulations use repetitive sampling where possible, to take into account variability and uncertainty in model inputs, so does not restrict the analysis to using single point estimates, which may misrepresent the risk. This approach is particularly important given that higher risks may be caused by combinations of inputs toward the extremes of their ranges, the combined effects of which may not be detected when using single values.

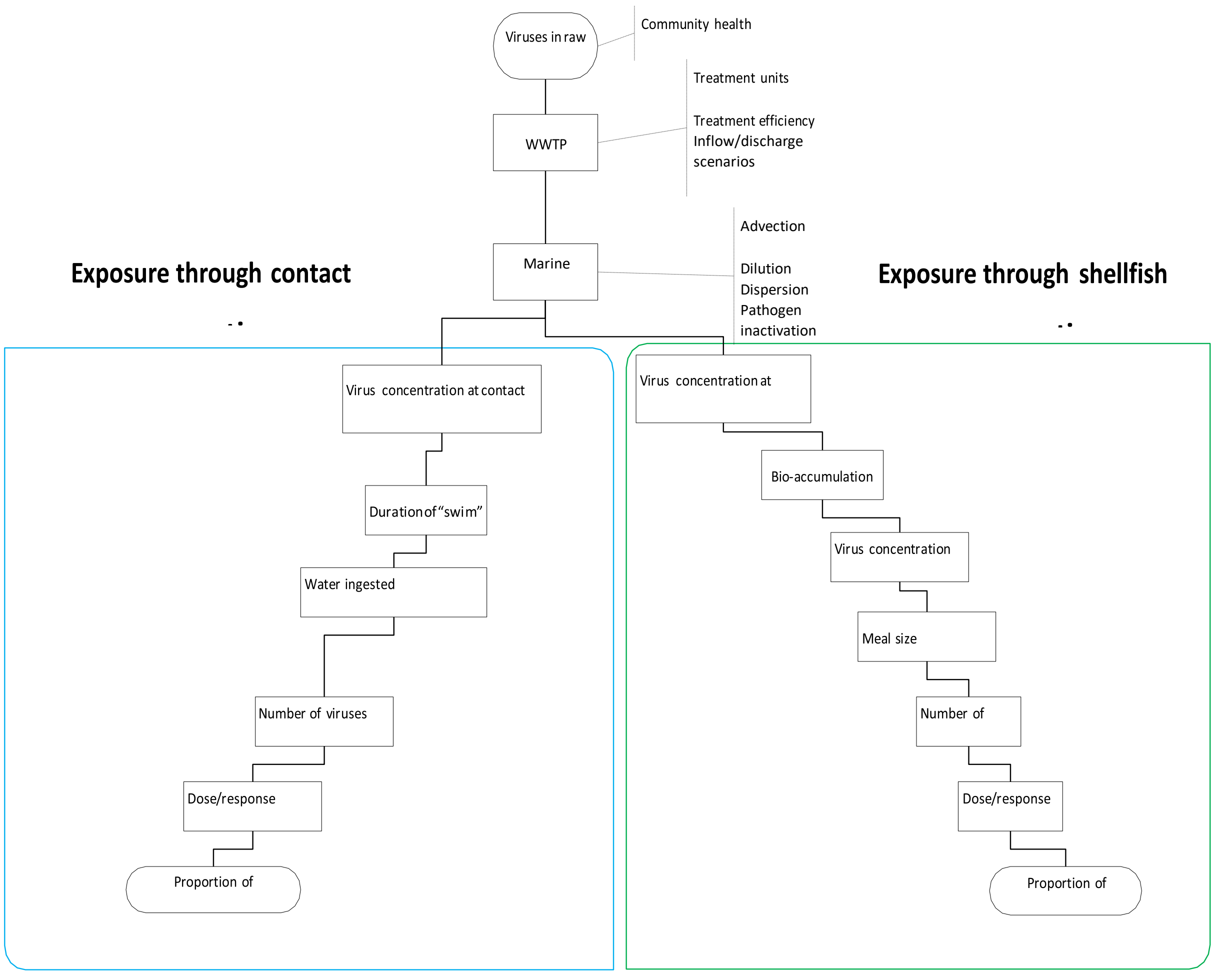

Figure 3-1: Schematic describing the QMRA process for the marine environment.

3.1 Select Hazard

Human-derived wastewater potentially contains a wide range of pathogenic organisms, which can harm human health if they enter into the environment. Assessing the risk from every potential pathogen found in treated wastewater is impracticable. Instead, in this analysis, norovirus is chosen as a reference pathogen (World Health Organization 2016). Reference pathogen(s) represent the risk of a broader group of pathogens that may be found in the expected exposure pathways. The exposure pathway is the route people outside the boundary of Beachlands wastewater treatment plant could come into contact with a pathogen from the effluent.

The most likely exposure pathway involves a hazardous event where pathogens are not removed/inactivated by the treatment system and are discharged into the Te Puru stream, which flows into the sea at Kelly's Beach and moves east or west along the coast. People could come into contact and ingest dilute well-treated effluent at various points in the Te Puru stream and the sea via activities such as primary contact (swimming) or through the consumption of food such as shellfish in the marine environment or, in the case of Te Puru stream, consumption of watercress. Other exposure pathways, such as secondary contact (boating, fishing, etc.,) will also be present but are not considered as these represent lower risks per event than primary contact or food consumption.

3.1.1 Why norovirus?

For people exposed to treated effluent from human sources, epidemiological evidence (Sinclair et al. 2009; Landrigan et al. 2020) and evidence from previous QMRAs (Soller et al. 2010; Stott and Wood 2022) point towards norovirus causing a significant burden of enteric illness. Viruses, such as norovirus, show a tendency to be more resistant to disinfection than bacterial pathogens such as *Campylobacter* or protozoal pathogens such as *Giardia* or helminths that are rare in New Zealand water (McBride 2017), so pathogens other than viruses were not considered.

The choice of pathogenic virus considers the burden of illness and the ability to quantify the risk. In a previous QMRA of the Beachlands WWTP, carried out in 2004 (Stott and McBride 2004), norovirus was not considered; there was no published dose-response model at the time. Instead, Adenovirus and Rotavirus were chosen as reference pathogens for respiratory and oral ingestion routes, respectively.

In this current study, the respiratory route was not considered, as previous studies (Stott and Wood 2022; Wood and Hudson 2023) indicate that illness rates are generally lower than those of the oral route. Rotavirus, though highly infectious and potentially very serious, particularly for children, has limited evidence of waterborne infection in NZ (McBride 2017), and there is now a vaccination programme (Health New Zealand 2024). So, norovirus was chosen as the reference pathogen.

3.2 Assess exposure routes

Assessing exposure requires identifying and quantifying the routes whereby people could be exposed to pathogens from wastewater. This includes assessing the source of the pathogen(s), barriers to preventing people from being exposed to pathogens and mechanisms of exposure (World Health Organization 2016). This assessment includes choices of what to include and exclude from the QMRA. In the first part of this section, we provide a qualitative description of the exposure routes before quantifying them.

3.3 Qualitative description of exposure and site assessment

In this assessment, wastewater is the source of pathogens. The most likely route a person outside the Beachlands WWTP comes into contact with a pathogen from wastewater is through the well- treated wastewater discharged into the Te Puru stream, which flows down into Kelly's Beach and, ultimately, Tamaki Strait.

There are three barriers to exposure: firstly, the wastewater treatment system that removes and or inactivates pathogens; secondly, dilution in the environment that reduces the concentration of pathogens in water; and thirdly, the removal of pathogens from the environment by various mechanisms, including inactivation. Only the first two barriers are considered. Pathogens, such as norovirus, persist in the environment for some time (Rexin et al. 2024), so removing pathogens from the environment is not considered.

For norovirus, there are two modes of exposure from diluted treated wastewater. They are accidental ingestion whilst swimming or splashing in the water and the consumption of food exposed to well-treated wastewater.

The combination of barriers, modes of exposure and the environment downstream of the WWTP, as it moves from a freshwater to a marine environment, has implications for modes of exposure, particularly for the consumption of food exposed to dilute wastewater. Watercress was identified downstream of the WWTP (Bioresearches 2024 Draft), and recreational and commercial shellfish harvesting was identified.

Dr Shane Kelly (Coast and Catchment Environmental Consultants) provided the locations of marine exposure sites, and Dr Mark James (Aquatic Environmental Sciences) provided freshwater sites. The marine sites included safeswim sites[3] augmented by other sites where swimming may occur, such as Kelly's Beach. Shellfish exposure was assessed at three sites. Shellfish risks were not assessed for Kelly's Beach as they are too small to harvest (Sim-Smith 2023). The approximate site locations are shown in Figure 3-2 and coordinates are given in Table 3-1.

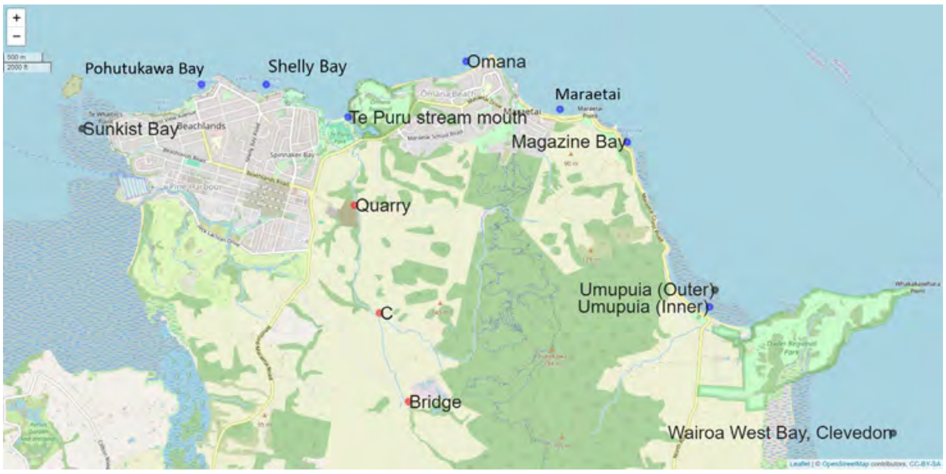

Figure 3-2: Location of QMRA assessment sites. Red = River sites, Blue = Marine (swim), Black = Marine (shellfish).

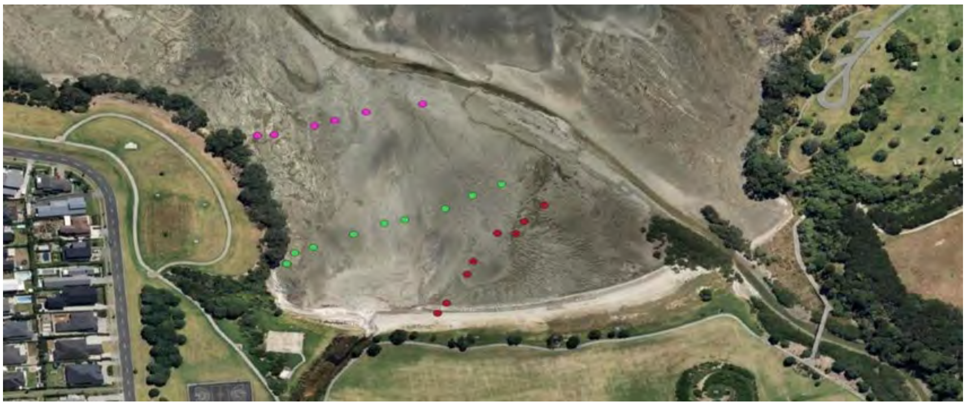

Figure 3-3: Location of QMRA assessment sites on Kelly's Beach. The beach is covered with water part of the day, so dilution at three transects following the water's edge were chosen to represent the mid-Kellys beach site. Pink - Northern, green – Mid, dark red - Eastern transect (image provided by John Oldman, DHI).

[3] Safeswim combines real-time monitoring of the wastewater and stormwater networks with predictive models, to provide forecasts of water quality at swimming sites.

Table 3-1: Coordinates of sites assessed for health risks. Excluding coordinates of three transects.

Site	Longitude	Latitude	Type
Wairoa West Bay, Clevedon	175.0952	-36.9172	Shellfish
Umupuia (Outer)	175.0700	-36.901	Shellfish
Sunkist Bay	174.9803	-36.8827	Shellfish
Magazine Bay	175.0575	-36.8842	Marine
Shelly Bay	175.0064	-36.8777	Marine
Pohutukawa Bay	174.9972	-36.8777	Marine
Omana	175.0347	-36.8751	Marine
Umupuia (Inner)	175.0692	-36.9029	Marine
Maraetai	175.0480	-36.8805	Marine
Te Puru stream mouth175.0179-36.8814MarineBridge	175.0265	-36.9136	River
C	175.0224	-36.9036	River
Quarry	175.0189	-36.8914	River

The health risks to norovirus exposure are assessed based on infection due to exposure to dilute treated wastewater. Norovirus is also highly infectious and is easily transmitted from a person infected through wastewater to another person. However, only primary transmission from wastewater is included in this analysis, excluding secondary person-to-person transmission. This is in line with the approach adopted by National Policy Statement for Freshwater Management NPS-FM (Ministry for the Environment 2023) and Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (MfE and MoH 2003).

3.4 Quantifying exposure routes

The goal of quantifying exposure routes is to estimate the norovirus dose an individual may receive during an exposure event. The quantification involves estimating the concentration of norovirus in raw (influent) wastewater, removal of norovirus through treatment systems, dilution of wastewater in the environment, and ingesting food and water. The modelling parameters are discussed below and, with the exception of the dilution parameters, are summarised in Table 3-3.

3.4.1 The concentration of norovirus in raw wastewater

Information on the concentration of norovirus in influent (raw) wastewater is not available for Beachlands WWTP. So, along with many of the more recent New Zealand QMRAs (Cressey 2021; Dada 2021; Stott et al. 2023; Wood and Hudson 2023), this QMRA uses standard factors for norovirus and assumes the hockey stick function (McBride 2005) adequately describes the distribution. The hockey stick function is described by minimum, median, and maximum values of $1x10^3$, $1x10^5$, and $1x10^7$ genome copies/L, respectively, and a breakpoint at the 95th percentile.

Hamadieh et al. (2021) reported maximum concentrations of ~$1x10^{8.5}$ genome copies/L which are greater than those used in New Zealand QMRAs. Eftim et al. (2017) noted in their systematic literature review that the concentration of norovirus was lower in New Zealand than in Europe or

Africa. Given the observation that New Zealand studies suggest lower norovirus concentrations than elsewhere in the world, it is reasonable to stick with the standard factors used in previous New Zealand QMRAs.

3.4.2 Removal of norovirus by the treatment process

One of the principal roles of a wastewater treatment plant is to remove pathogenic microorganisms before the effluent discharges to the environment. Estimates of the efficacy of pathogen removal under current, interim and Stage 2 flow conditions equate to 23, 42 and 71 L/s discharge rates, respectively, were unavailable when preparing the QMRA. Instead, simulations of 10-fold, 100-fold, 1,000-fold and 10,000-fold, 100,000-fold, 1,000,000-fold and 10,000,000-fold are carrier out. These levels of treatments are referred to as 1, 2, 3, 4, 5, 6, and 7 log reduction values (LRV). Based on the estimated virus influent and effluent concentration data in the previous QMRA (Stott and McBride 2004), the LRVs for the plant were inferred to be in the range of 4.3-6.0 based on time of year, for two viruses, adenovirus and rotavirus[4].

3.4.3 Dilution

Treated effluent enters the Te Puru steam and flows down to Kelly's Beach and into Tamaki Strait. The plume of highly diluted treated wastewater moves along the coast rather than crossing the Tamaki Strait (*pers com* John Oldman, DHI), so sites on Waiheke Island were not considered.

Three discharge scenarios were considered: current (23 L/s), interim (42 L/s) and Stage 2 (71 L/s) flow conditions. Dilution in the Te Puru stream was estimated from flow duration curves provided by PDP. DHI provided estimates of dilution in the marine environment.

PDP estimated naturalised flow duration curves for the Bridge site and used scaling factors of 1.84 and 2.24 to develop flow records at site C and Quarry, respectively. It was believed that these estimates would underestimate the naturalised flow, and any resulting estimates of dilution would be conservative[5]. Dilution estimates using the three scenarios assumed constant outflow from the WWTP. As the median naturalised flow at the Bridge was estimated to be 3.4 L/s, treated effluent, 23 L/s under current conditions, makes up a substantial proportion of the flow.

DHI provided two sets of dilution figures covering a period from 2 January 2020 to 20 December 2020. One set of figures estimated the dilution at the surface, and the other was close to the seabed for the sites identified by Dr Shane Kelly (Coast and Catchment Environmental Consultants).

Inspection of the dilution figures noted that dilution estimates were particularly high, or absent, probably as an artefact of the modelling process, during the start of January and a decision was made only to use data from 17 January onwards.

The dilution figures are presented in Figure 3-4. Dilutions were the lowest at the Bridge site, the closest sited below the plant and increased as the water flowed downstream. Below the quarry site, there is a tidal influence in the stream. The dilution at the Te Puru stream mouth (median dilution is

[4] Assumes estimated virus concentration in influent and effluent is perfectly positively correlated.

[5] Note attached to flow duration curves by Phil Hook (PDP) 31 January 2024

13,700 fold under current conditions), is substantially higher than in the freshwater environment upstream (median dilution 1.1 at the Bridge under current conditions).

When the initial dilution analysis was carried out, it was noted that some of the sites in Kelly's Beach would only occasionally be covered by water. Given this observation, three transects were made in Kelly's Beach (Northern, Mid and Eastern Transect) to estimate the dilution at the water's edge rather than a fixed point on the beach. See DHI report for details.

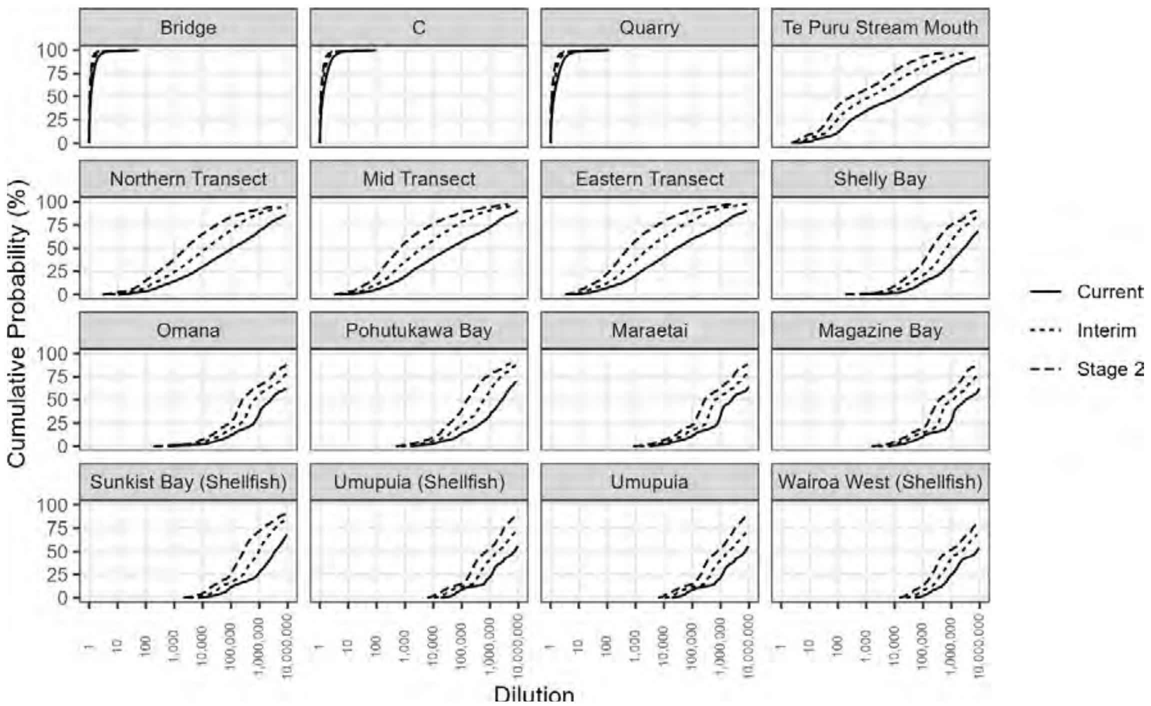

Figure 3-4: Cumulative distribution curves for dilution at 16 sites and three discharge scenarios. . The sites are in order from lowest dilution (top left) to highest dilution (bottom right). Note the logarithmic scale for the dilution axis and values of over 10,000,000 have not been plotted. The lowest dilutions are in the Te Puru stream. Once the flow enters Kelly's Beach the dilutions increase rapidly.

3.4.4 Ingestion of food and water

Viruses in water can be ingested directly through water consumption or indirectly through the ingestion of animals or plants that have been exposed to viruses in water. In the case of direct ingestion, the question is how much water people consume, and for foods, the question is how much food is consumed and what the virus content of the foods is.

3.4.5 Direct ingestion of water

Water-related activities can result in the unintentional ingestion of water. Swimming, known as primary contact, tends to result in greater volumes of water being ingested than secondary contact activities such as boating or fishing, etc., (Dorevitch et al. 2011). Evidence suggests that children ingest water at a higher rate and spend more time in the water swimming than adults (Dufour et al. 2017). So, children swimming in water were chosen as a susceptible partof the population.

New Zealand specific data is not available. However, the World Health Organization (2016) guidance on QMRAs quotes a range of figures for the volume of water accidentally ingested during swimming, ranging from 20-100 mL per event. Though the World Health Organization (2021) Guidelines on recreational water quality quote higher per event figures of 140-250 mL for children.

The volume of water accidentally ingested is likely to vary from persons to persons. Schets et al. (2011) published information on duration of swimming with average durations ranging from 8-240 minutes and 12-270 minutes for children in seawater and freshwater, respectively. Dufour et al. (2017) estimated ingestion rate in the range from 0-280 mL/h with an arithmetic mean of 32 mL/h.

In this work we assumed a log normal distribution with minimum, mean, standard deviation and maximum ingestion rates of 5, 53, 75 and 250 mL/h. The duration of events was modelled with a PERT distribution with a minimum value of 12 minutes, mode of 1 hour and maximum of 4 hours. These figures have been used in previous QMRAs (Stott and Wood 2022; Wood and Stott 2023) and result in a mean ingestion volume of approximately 64 ml per event with 5^{th} and 95^{th} percentile ranging from 6.6 to 216 mL per event. The mean values are in the range given by the World Health Organization (2016) guidance on QMRAs, and though the parameters are different from those used by Cressey (2021), the overall results are similar.

3.4.6 Ingestion of watercress

Watercress, also called wātakirihi or kōwhitiwhiti is a valued mahinga kai for tanagata whenua and may be consumed in raw or cooked form (Eason et al. 2020). Microbial contamination, *Escherichia coli*, a faecal indicator organism, and *Campylobacter*, a pathogen, have been detected on watercress (Edmonds and Hawke 2004; Donnison et al. 2009). As well as the possibility of pathogens attaching to the surface of plants, there is evidence that pathogens, such as norovirus, can be internalised by plants such as lettuce, and in addition, hydroponically grown produce internalise more pathogens than soil-grown pathogens (King et al. 2020).

To calculate the amount of norovirus that may be ingested when eating watercress, we need to estimate the amount of watercress consumed and the concentration of pathogens in the watercress.

There is little specific evidence (i.e., published data) for watercress around norovirus contamination; instead, we used lettuce as a model. DiCaprio et al. (2012) demonstrated that hydroponically grown lettuce could efficiently internalise norovirus. However, Urbanucci et al. (2009) did not find norovirus to become internalised in their experimental setup, and the conclusion of a study by Wei et al. (2011) was somewhere in between.

Therefore, considerable uncertainty exists about how efficiently pathogens can be internalised or attached to lettuce from water. QMRAs of norovirus in lettuce have considered internalisation and surface attachment (Sales-Ortells et al. 2015) and internalisation only (Chandrasekaran and Jiang 2018). Chandrasekaran and Jiang (2018) modelled virus transport efficiency from water to the root (74%) and root to leaf (48%) but with wide bands of uncertainty.

Where there is minimal data or wide bands of uncertainty, the appropriate course of action is to assume the worst-case scenario (National Research Council 2009). In this case, it would be to assume that the norovirus concentration in the plant is the same as the water it is growing in, and that norovirus is present on the surface of the leaves either in the form of water or attached to the leaves. In this case, it would appear reasonable only to consider the mass of the leaves and any attached water and ignore the additional contamination solely due to the surface, which would be a minor component of the overall microbial load. For this exercise, we assume that 1 gram of plant matter equals 1 millilitre of water and ignore any virus inactivation in the plant.

Various workers have estimated the quantity of watercress consumed during a single meal. These New Zealand estimates vary from 40-230 g per meal (40 (Eason et al. 2020), 155 (Phillips et al. 2011) and 230 g (Turner et al. 2005)). So, for the worst-case scenario, it was assumed that the mean size was 250 g/meal, but a best-case scenario 40 g/meal was also simulated to test how sensitive the risk model would be. Unlike shellfish or primary contact risk assessments, the consumption amount used is a fixed point estimate and can be described as a screening assessment (World Health Organization 2016)

3.4.7 Shellfish

Shellfish can bioaccumulate pathogens in their flesh, so consuming 1 g of shellfish is equivalent to ingesting more than 1 mL of water. Burkhardt and Calci (2000) estimated Bioaccumulation Factors (BAF) for shellfish and noted that BAF varied by season. Following the precautionary approach, we used the maximum BAF value (Burkhardt and Calci 2000). By combining McBride's (2012) estimates of shellfish consumption using survey data from Parnell et al. (2001) along with BAF and the concentration of pathogens in the water, it is possible to estimate the pathogen dose associated with the consumption of raw or lightly cooked shellfish. McBride (2012) estimates that the mean meal size of 100 g is similar to the average shellfish meal size estimated by Guy et al. (2021), which is 106 g.

3.5 Dose-response

The risks from norovirus depend on the dose individuals receive i.e., the number of viruses ingested. Teunis et al. (2008) developed a dose-response model for norovirus, which suggests that higher doses lead to a higher chance of infection. Information from the Teunis et al. (2008) was used to estimate what proportion of the population was susceptible to norovirus and what proportion of those who are inflected become ill.

Noroviruses are a diverse group of single-stranded RNA viruses that currently consist of 10 genogroups (Chhabra et al. 2019). Teunis et al. (2008) only report dose-response models for norovirus genogroup 1 (GI), whereas concentrations of norovirus genogroup 2 (GII) are typically greater in raw sewage in New Zealand than those of GI. Due to the lack of a specific dose-response model for genogroup 2 (GII)[6] we assume that GI and GII have the same dose-response relationship.

Since Teunis et al. (2008) developed the dose-response, analytical techniques have also improved. We therefore include a dose-response method harmonisation factor (MHF) to account for these differences (Kundu et al. 2013).

Norovirus may exist in aggregated (clumped) and disaggregated forms, and Deere and Ryan (2022) recommend that norovirus QMRAs modelled in both aggregated and disaggregated forms. However, previous QMRA modelling e.g., McBride, Graham B (2014), indicated that disaggregated norovirus creates a consistently greater illness risk than the aggregated form. In response, we have limited our consideration and discussion to illness risks arising from the disaggregated norovirus form (i.e., we

[6] A model has recently been proposed for NoV GII by Teunis et al. (2020) but the application of this dose-response model is less certain.

have taken the more conservative approach) – this is consistent with previous QMRA practice (e.g., McBride (2017)).

3.6 Risk characterisation

Risk characterisation brings together information on dose response and the probability of illness given exposure over a specified time period. This QMRA estimated health risks in terms of Individual Infection Risks (IInfR) per exposure event: a swim, a feed of raw or lightly cooked shellfish or watercress.

Monte Carlo statistical modelling allows for a range of likely conditions to be included in health risk estimates, including relatively infrequent but highly influential elevated virus concentrations (McBride 2005; Haas et al. 2014). A "Monte Carlo" approach allows for repeated sampling from various parameter distributions to build a *risk profile*. Variability, such as the concentration of pathogens in shellfish meal size, is taken into account by taking many random samples from defined statistical distributions. The parameters of variables used within the QMRA modelling are shown in Table 3-3. The Monte Carlo simulations were conducted in Excel using the @Risk add-in (Palisade 2020).

Health risks are estimated following exposure of a hypothetical population (a group of 100 "individuals") to an individual "dose" on any particular day. The total number of individuals becoming ill from 100 people exposed is determined as the risk outcome for that iteration. This procedure is repeated for a total of 10,000 iterations drawn at random from the distributions of key input variables. For instance, the consumption of one million shellfish meals is simulated to capture the variability and uncertainty in the model's inputs.

3.7 Scenarios modelled

The population served by the Beachlands WWTP currently serves a population of 10,000 people and is predicted to grow. Three scenarios serving different populations and volumes of effluent discharge were considered, are listed in Table 3-2.

Table 3-2: Modelled scenarios -population served, effluent flow and scenario name.

Scenario name	Population served (people)	Volume of treated effluent discharged to the Te Puru stream (L/s)
Current	10,000	23
Interim	18,000	42
Stage 2	30,000	71

3.8 Results

The results of the QMRA are presented in tabular and graphical forms. It is possible to compare the results against either the related Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (MfE and MoH 2003) or the National Policy Statement for Freshwater

Management, the NPS-FM (Ministry for the Environment 2023) for swimming. There are no guidelines for the consumption of shellfish or watercress. The values for freshwater are based on infection risk from *Campylobacter* and the risk of gastrointestinal illness (from a range of pathogens) in marine environments.

The same metric, infection risks, is used for marine and freshwater environments to facilitate easier comparisons. In addition, shellfish and watercress risk are also compared against the same infection metric. The graphical results are presented against the five attribute bands from Table 9 of the NPS-FM (see Table 3-4). There are national targets for 80% of rivers to be suitable for swimming (blue, green and yellow category) by 2030 (Ministry for the Environment 2023).

Table 3-3: Summary of QMRA modelling input parameters.

Component	Statistic/parameter		Distributions/comments
Influent virus concentration			Bounded "hockey stick" distribution (McBride 2005), strongly right-skewed.
Influent norovirus concentration, genome copies per litre (gc/L)	Minimum	$1x10^3$	Typical range found for New Zealand cities (e.g., Napier, New Plymouth— (McBride 2011; McBride 2012; McBride 2017)).
	Median	$1x10^5$	
	Maximum	$1x10^7$	
Hockey stick, norovirus, Xp	Unitless	0.95	
Treatment efficacy			
Wastewater treatment efficacy, Log10 virus reduction (LRV)	Unitless	1 - 7	LRVs represent a range of treatment efficacies
Exposure parameters - swimming			
Duration of swim (hours)	Minimum	0.2	Distribution for a child after Schets et al. (2011) based on distribution using Program Evaluation and Review Technique (PERT) .
	Mode	1	
	Maximum	4	
Swimmers water ingestion rate (mL per hour)	Minimum	5	Truncated lognormal distribution (ESR 2016), (Table 19); (Dufour et al. 2017) for children (<16 yr). The minimum value was set at 5 mL/h, an ingestion rate equivalent to one tablespoon of seawater per hour. This estimation of the minimum value took into account information from ESR (2021), which evaluated the raw data from Dufour et al. (2017) and the observation that ingestion rates appear to be greater than inhalation rates, so the minimum value was set to be greater than the minimum inhalation rate of Dorevitch et al. (2011).
	Mean	53	
	Std. Dev	75	
	Maximum	250	
Exposure parameters - watercress			
Meal size (g)	Minimum	40	Point estimates used in calculations figures after Eason et al. (2020), and 230 g Turner et al. (2005)).
	Maximum	250	
Exposure parameters - shellfish			
Shellfish meal size (g)	α	2.2046	A log logistic distribution was used, truncated below at 5 g and above at 800 g, from bivalve mollusc consumption data from Parnell et al. (2001) and McBride (2012).
	β	75.072	
	γ	–0.903	
Bioaccumulation factor, ratio	Mean	49.9	

Component	Statistic/parameter		Distributions/comments
	Std. Dev.	20.93	Using normal distributions, truncated at 1 and 100. The pathogen dose ingested on eating 100 grams of shellfish is BAF x the number of pathogens in the equivalent volume of water (Burkhardt and Calci 2000). The chosen factors are for F+ coliphage in winter. The use of a normal distribution for BAFs allows half of these factors to be below 50 yet retain a precautionary approach.
Dose Response			
Probability infection norovirus GI_5 per exposure event (disaggregated)	α	0.04	Beta-binomial (for individual doses, i) is described by two parameters α and β (Teunis et al. 2008), Table III, 8fII1+8fIIb, no aggregation. ID_{50} infection =26.
	β	0.055	
Fraction of secretor-positive individuals (susceptible to norovirus infection)	Unitless	0.74	Proportion susceptible, P (Teunis et al. 2008).
The conditional probability of illness given infection NoV (norovirus)	Unitless	0.68	Pr (ill|Inf) NoV: estimated from Soller et al. (2008)
Method harmonisation factor for norovirus,	Unitless	18.5	The dose-response equation and current monitoring methods use RT-qPCR methodology but on different genetic target sequences with differences in critical threshold standard curves (McBride, Graham B. et al. 2013). Current PCR methods more effectively detect virions, norovirus concentration data divided by harmonisation factor.

Table 3-4: Summary of average infection risks from the NPS-FM.

Attribute Band	(Infection) Risk (%)
A - blue	1
B - green	2
C - yellow	3
D - orange	>3 and <7
E - red	>7

3.8.1 Swimming risks

The mean Individual Infection Risk (IInfR)% is highest at low Log Reduction Values (LRV); as LRV increases, the risks decrease. The sites with the highest risks were the Bridge, site C and Quarry (see Figure 3-5 and Figure 3-6). The risk falls as we move into the marine environment, Te Puru stream mouth, Kelly's Beach, and into sites along the coast. The numerical results for each scenario are presented in Table 3-5 to Table 3-7.

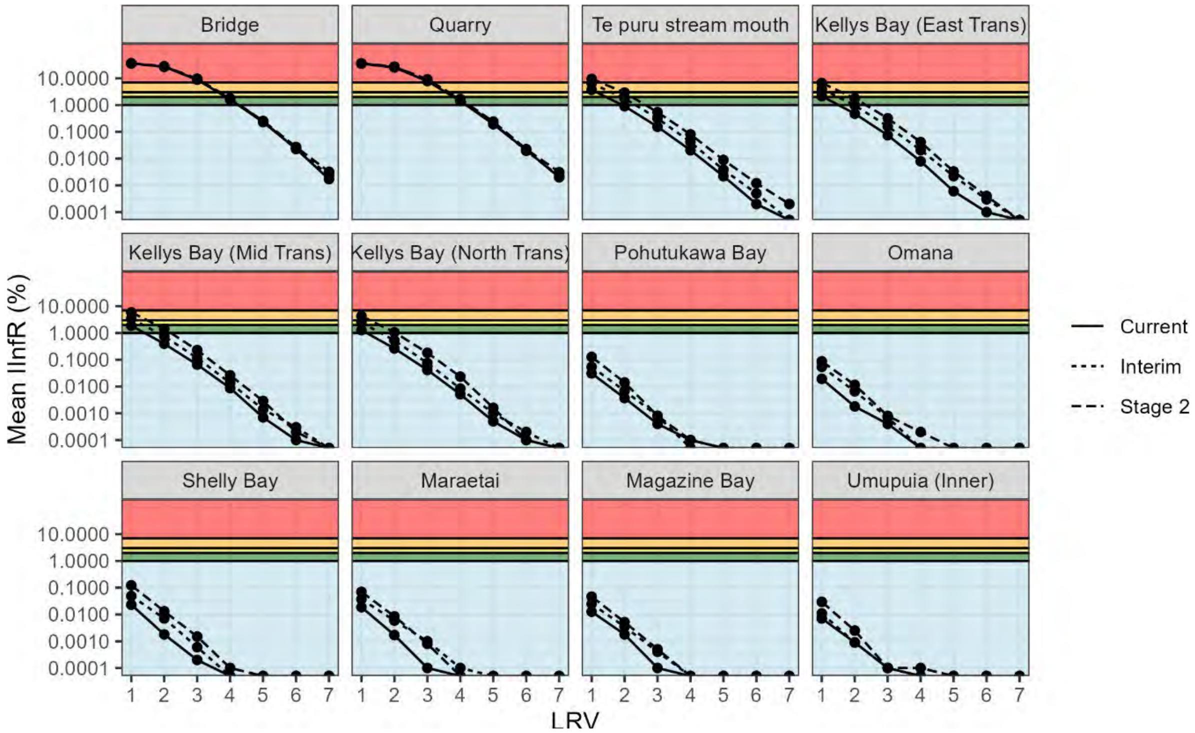

Figure 3-5: Mean infection risk (IInfR) from swimming at 12 sites (3 river and 9 marine). The colours relate to the NPS-FM categories: blue IInfR < 1% per event, green 1 -2%, yellow 2-3%, orange 3-7% and red>7%

Due to the low level of dilution in the Te Puru stream, the increase in discharge volume makes minimal difference in the overall risks (Figure 3-6). Though the flow may increase, the concentration of treated effluent remains the same. At sites with higher dilution, in the marine environment, increase in flow makes a more noticeable increase in risk (Figure 3-5).

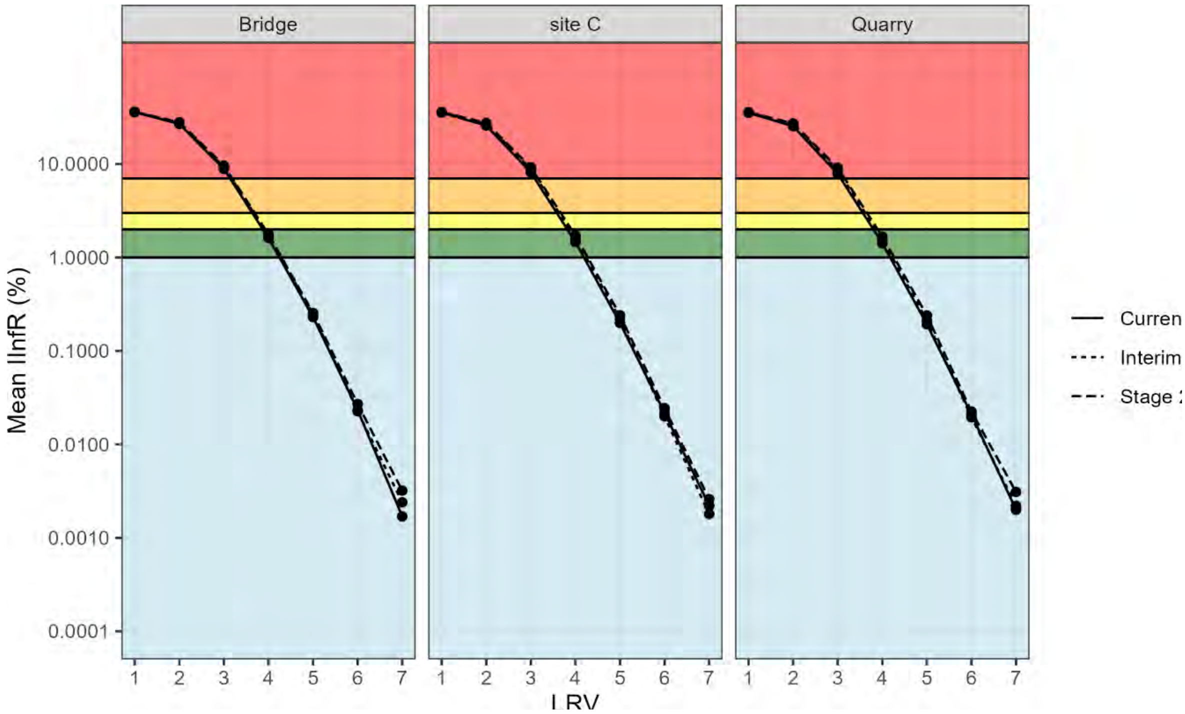

Figure 3-6: Mean infection risk (IInfR) from primary contact recreation at three sites in the Te Puru stream. The colours relate to the NPS-FM categories: blue IInfR < 1% per event, green 1 -2%, yellow 2-3%, orange 3-7% and red >7%. Higher levels of treatment result in lower risks.

Table 3-5: Estimated Individual Infection Risks (IInfR) % for swimming at various sites and levels of treatment for the current situation. Site C not shown, values between results from Bridge and Quarry sites.

		Log Reduction Values						
Site	**Type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Bridge	River	35.8568	26.8367	8.8485	1.6142	0.2302	0.0233	0.0017
Quarry	River	35.3138	25.3612	7.8621	1.4218	0.1931	0.0209	0.002
Te Puru stream mouth	Marine	3.7073	0.9078	0.1539	0.0205	0.0022	0.0002	<0.0001
Kelly’s Beach (East Trans)	Marine	2.1469	0.4768	0.0745	0.0079	0.0006	0.0001	<0.0001
Kelly’s Beach (Mid Trans)	Marine	1.8781	0.3969	0.066	0.0087	0.0007	0.0001	<0.0001
Kelly’s Beach (North Trans)	Marine	1.2841	0.2644	0.0417	0.0051	0.0005	0.0001	<0.0001
Pohutukawa Bay	Marine	0.0310	0.0037	0.0004	0.0001	<0.0001	<0.0001	<0.0001
Omana	Marine	0.0193	0.0018	0.0004	<0.0001	<0.0001	<0.0001	<0.0001
Shelly Bay	Marine	0.0232	0.0018	0.0002	<0.0001	<0.0001	<0.0001	<0.0001
Maraetai	Marine	0.0188	0.0017	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Magazine Bay	Marine	0.0127	0.0018	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Umupuia (Inner)	Marine	0.0071	0.0009	0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Table 3-6: Estimated Individual Infection Risks (IInfR) % for swimming at various sites and levels of treatment for the interim scenario.

		Log Reduction Values						
Site	**Type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Bridge	River	36.0961	27.5595	9.3046	1.7083	0.2459	0.0226	0.0024
Quarry	River	35.7183	26.5196	8.5621	1.5684	0.2111	0.0195	0.0022
Te Puru stream mouth	Marine	6.4807	1.7647	0.3161	0.0416	0.0038	0.0005	<0.0001
Kelly's Beach (East Trans)	Marine	3.9705	0.9701	0.1609	0.0207	0.0022	0.0003	<0.0001
Kelly's Beach (Mid Trans)	Marine	3.4452	0.7585	0.1162	0.0137	0.0014	0.0003	<0.0001
Kelly's Beach (North Trans)	Marine	2.4431	0.5287	0.0753	0.0084	0.001	0.0002	<0.0001
Pohutukawa Bay	Marine	0.0543	0.0069	0.0008	<0.0001	<0.0001	<0.0001	<0.0001
Omana	Marine	0.0542	0.0066	0.0007	<0.0001	<0.0001	<0.0001	<0.0001
Shelly Bay	Marine	0.049	0.0071	0.0006	<0.0001	<0.0001	<0.0001	<0.0001
Maraetai	Marine	0.0373	0.0059	0.001	0.0001	<0.0001	<0.0001	<0.0001
Magazine Bay	Marine	0.0249	0.0035	0.0004	<0.0001	<0.0001	<0.0001	<0.0001
Umupuia (Inner)	Marine	0.0110	0.0009	0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Table 3-7: Estimated Individual Infection Risks (IInfR) % for swimming at various sites and levels of treatment for the Stage 2 scenario.

		Log Reduction Values						
Site	**Type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Bridge	River	36.2398	27.9538	9.6281	1.7742	0.2546	0.0271	0.0032
Quarry	River	35.9687	27.2249	9.1028	1.6747	0.2398	0.0225	0.0031
Te Puru stream mouth	Marine	9.5143	2.9343	0.5416	0.0803	0.0089	0.0012	0.0002
Kelly's Beach (East Trans)	Marine	6.6750	1.7806	0.3204	0.0414	0.0033	0.0004	<0.0001
Kelly's Beach (Mid Trans)	Marine	5.9304	1.4411	0.2306	0.0262	0.0029	0.0002	<0.0001
Kelly's Beach (North Trans)	Marine	4.2925	1.0641	0.1818	0.0234	0.0016	0.0001	<0.0001
Pohutukawa Bay	Marine	0.1278	0.0142	0.0008	0.0001	<0.0001	<0.0001	<0.0001
Omana	Marine	0.0874	0.0115	0.0008	0.0002	<0.0001	<0.0001	<0.0001
Shelly Bay	Marine	0.1226	0.0132	0.0015	0.0001	<0.0001	<0.0001	<0.0001
Maraetai	Marine	0.0701	0.0085	0.0008	<0.0001	<0.0001	<0.0001	<0.0001
Magazine Bay	Marine	0.0465	0.0052	0.0005	<0.0001	<0.0001	<0.0001	<0.0001
Umupuia (Inner)	Marine	0.0295	0.0025	0.0001	0.0001	<0.0001	<0.0001	<0.0001

3.8.2 Risks from watercress consumption.

Risks from watercress are only assessed in the freshwater environment and relate to watercress consumed in its raw form and uncooked. Our understanding of the ability of watercress to internalise norovirus is limited, so the assumptions made in the QMRA are precautionary, including using a meal size at the upper end of the estimated average meal sizes. The results are shown in Figure 3-7.

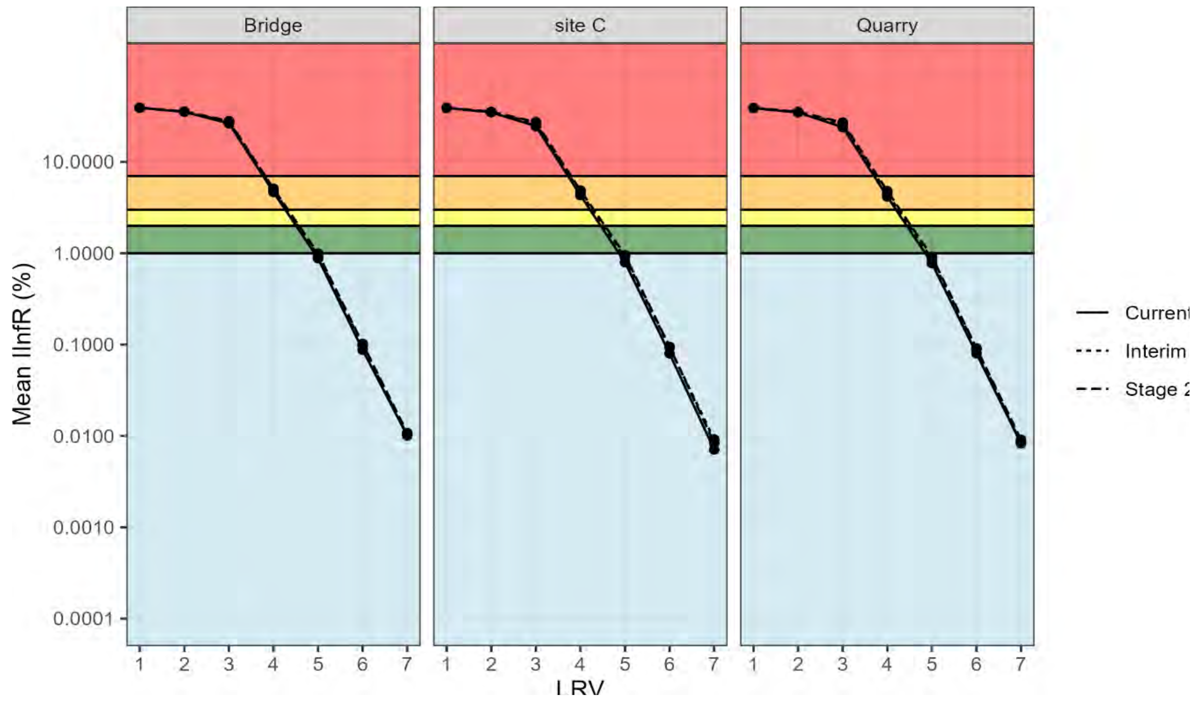

Figure 3-7: Mean infection risk (IInfR) from consumption of watercress harvested at three sites in the Te Puru stream assuming a meal size of 250 g. The colours relate to the NPS-FM categories: blue IInfR < 1% per event, green 1 -2%, yellow 2-3%, orange 3-7% and red >7%.

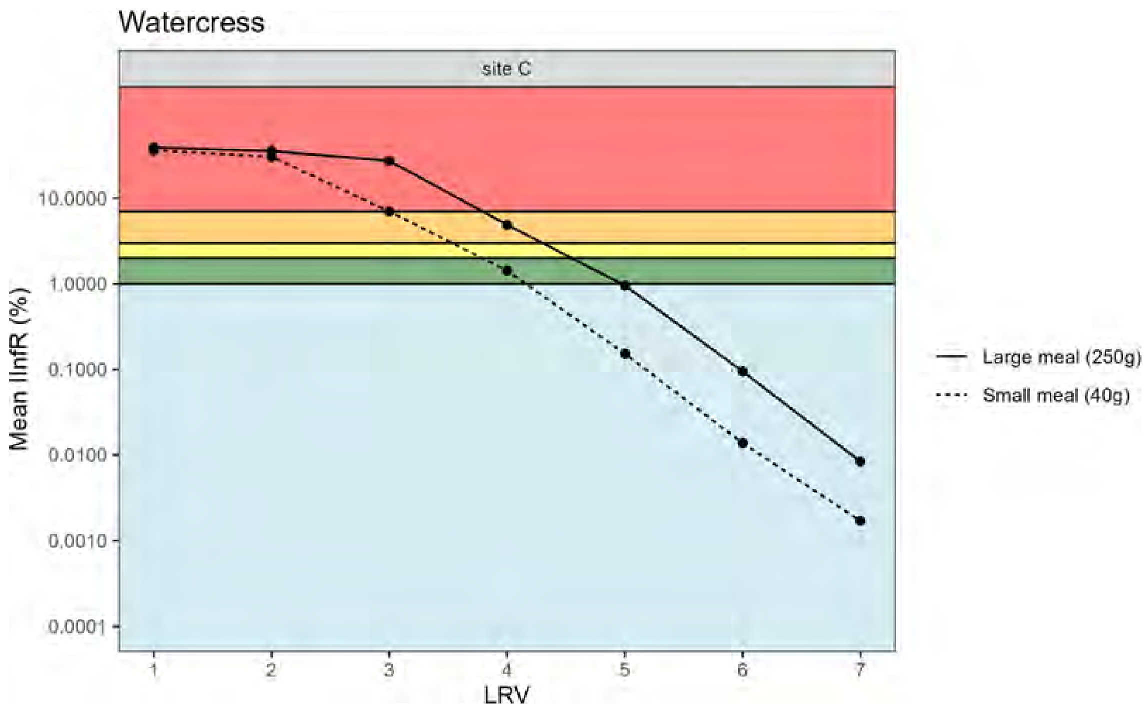

Figure 3-8: Mean infection risk (IInfR) from consumption of large and small watercress meal size harvested from site C. The colours relate to the NPS-FM categories: blue IInfR < 1% per event, green 1 -2%, yellow 2-3%, orange 3-7% and red >7%.

Though using the larger meal size is appropriate for assessing risk, it is instructive to see how sensitive the model is to the quality of watercress ingested. The larger meal size is approximately six times larger than the small mean size. The risk from the smaller mean size is lower than the large meal size (Figure 3-8). However, the difference in risk, at size C for a LRV of 4 is only a factor of approximately 3.5. So, halving the meal size does not result in halving the estimated risk. A full list of risk estimates are presented in Table 3-8.

Table 3-8: Estimated Individual Infection Risks (IInfR) % for consuming watercress harvested at three sites on the Te Puru stream.

			Log Reduction Values						
Site	**Scenario**	**Meal Size**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Bridge	Current	Large meal (250 g)	39.0324	35.2912	26.362	4.6653	0.8777	0.0875	0.0101
Bridge	Interim	Large meal (250 g)	39.1709	35.5648	27.4721	4.9172	0.9421	0.0977	0.0102
Bridge	Stage 2	Large meal (250 g)	39.2486	35.7409	28.0846	5.1056	0.9953	0.1022	0.0108
Bridge	Current	Small meal (40 g)	36.1463	29.9434	6.6303	1.3316	0.1407	0.0148	0.0023
Bridge	Interim	Small meal (40 g)	36.3984	30.6445	7.0047	1.4333	0.1575	0.0159	0.0013
Bridge	Stage 2	Small meal (40 g)	36.5403	30.9935	7.2642	1.4874	0.1645	0.0168	0.0022
site C	Current	Large meal (250 g)	38.8059	34.9014	24.6775	4.3173	0.7961	0.0798	0.0071
site C	Interim	Large meal (250 g)	39.0286	35.2796	26.3075	4.6341	0.9039	0.0934	0.0092
site C	Stage 2	Large meal (250 g)	39.1516	35.5276	27.3287	4.8918	0.9553	0.0947	0.0084
site C	Current	Small meal (40 g)	35.769	28.7529	6.1099	1.2145	0.1269	0.012	0.0015
site C	Interim	Small meal (40 g)	36.1301	29.9029	6.5843	1.3561	0.1456	0.0149	0.0015
site C	Stage 2	Small meal (40 g)	36.3693	30.5261	6.9821	1.4287	0.1525	0.0138	0.0017
Quarry	Current	Large meal (250 g)	38.7089	34.7436	23.9775	4.1658	0.7783	0.0799	0.0083
Quarry	Interim	Large meal (250 g)	38.9625	35.1728	25.8166	4.5324	0.8661	0.0896	0.0083
Quarry	Stage 2	Large meal (250 g)	39.091	35.4188	27.0622	4.806	0.9203	0.0916	0.0091
Quarry	Current	Small meal (40 g)	35.6414	28.2111	5.8852	1.1953	0.1238	0.0121	0.0015
Quarry	Interim	Small meal (40 g)	36.0297	29.5997	6.4362	1.3058	0.1415	0.0152	0.0014
Quarry	Stage 2	Small meal (40 g)	36.2762	30.3638	6.8191	1.3852	0.1462	0.0154	0.0015

3.8.3 Risks from shellfish consumption

No shellfish harvesting sites have been identified close to the Te Puru steam mouth. The estimated risks under all discharge scenarios and levels of treatment (LRV) are less than 1% IInfR.

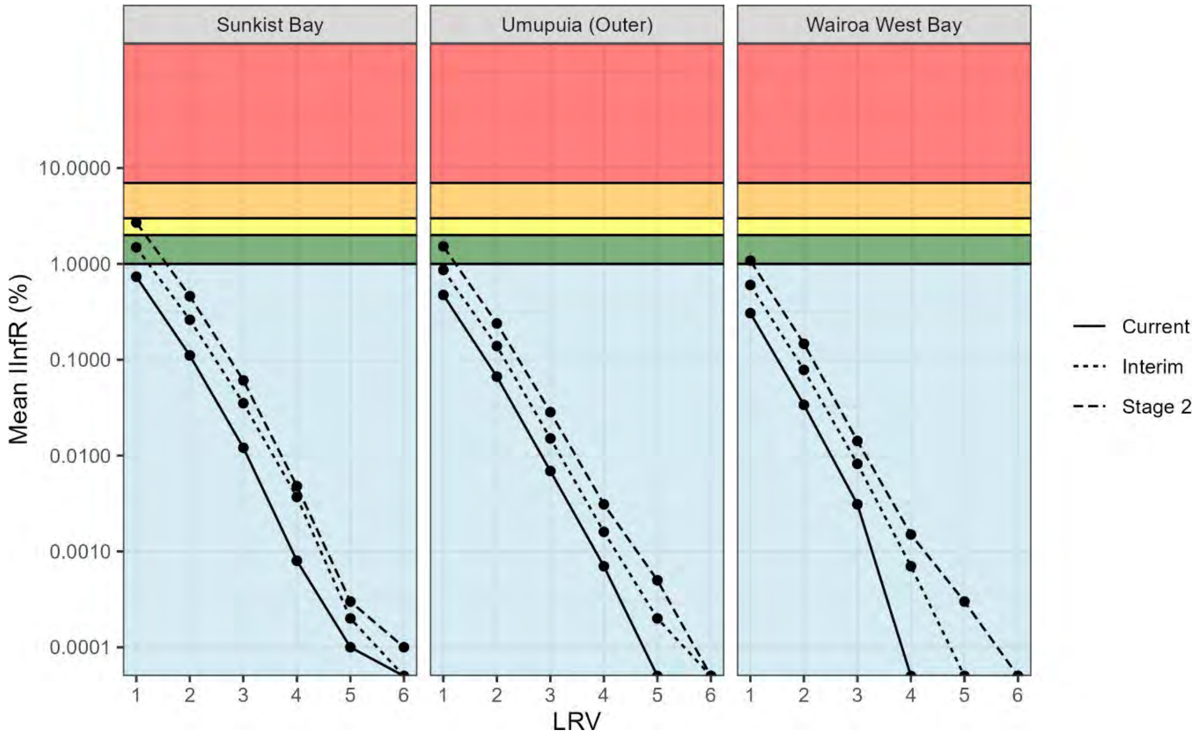

Figure 3-9: Mean infection risk (IInfR) from shellfish consumption from three sites. The colours relate to the NPS-FM categories: blue IInfR < 1% per event, green 1 -2%, yellow 2-3%, orange 3-7% and red>7%.

Table 3-9: Estimated Individual Infection Risks (IInfR) % for consuming shellfish harvested at three marine sites.

		Log Reduction Values					
site	scenario	1	2	3	4	5	6
Sunkist Bay	Current	0.7352	0.1109	0.0121	0.0008	0.0001	<0.0001
Sunkist Bay	Interim	1.4901	0.2614	0.0352	0.0037	0.0002	<0.0001
Sunkist Bay	Stage 2	2.7046	0.4606	0.0609	0.0048	0.0003	0.0001
Umupuia (Outer)	Current	0.4743	0.0666	0.0069	0.0007	<0.0001	<0.0001
Umupuia (Outer)	Interim	0.8650	0.1389	0.0151	0.0016	0.0002	<0.0001
Umupuia (Outer)	Stage 2	1.5271	0.2390	0.0284	0.0031	0.0005	<0.0001
Wairoa West Bay	Current	0.3064	0.0338	0.0031	<0.0001	<0.0001	<0.0001
Wairoa West Bay	Interim	0.6033	0.0784	0.0082	0.0007	<0.0001	<0.0001
Wairoa West Bay	Stage 2	1.0817	0.1469	0.0142	0.0015	0.0003	<0.0001

4 Discussion and Conclusions

From the results in Sections 2 and 3, the following inferences can be made:

4.1.1 Microbial quality of the WWTP discharge

Wastewater monitoring indicates a consistent microbiological quality of disinfected treated effluent with median levels below 2 counts/100 mL, well within the current consent limit of median ≤ 14 faecal coliforms/100 mL.

Concentrations of faecal indicator bacteria levels in discharged wastewaters are predominantly below 10 CFU/100 mL with 95th percentiles remaining under 25 CFU/100 mL. This suggests that the current treatment measures are in line with proposed consent conditions accommodating interim and future population growth scenarios. These proposed conditions include median concentrations of < 10 faecal coliforms /100 mL and 90th and 95th percentiles of 100 faecal coliforms/100 mL. Furthermore, there is no present evidence indicating a deterioration in treated wastewater quality with higher flows as shown in Figure 2-3 and Figure A-4.

There is evidence of a weak seasonality effect with slightly higher levels of faecal coliforms in treated effluent in the summer months (Figure 2-2) suggesting greater potential for impact from wastewater discharge on the receiving environment during summer.

Overall, current data highlight the efficacy of current treatment processes in maintaining wastewater quality within acceptable limits, despite varying flow rates. However, ongoing assessment of wastewater quality will be essential to ensure that treatment facilities remain effective in managing potential changes in wastewater characteristics associated with increased population and flow rates projected to increase from 23 L/s currently to 71 L/s for future population growth scenarios.

4.1.2 Efficacy of removing FIB

There was no evidence of deterioration of disinfection efficacy by the UV plant in response to discharge flows (Figure 2-1 and Figure A-4). Highest removal rates were typically seen during the summer months coinciding with elevated FIB concentrations in UV influent wastewaters (Figure 2-4 and Figure 2-5).

Removal of FIB by the WWTP ranged from 4.4 log_{10} to 7.8 log_{10} with median log_{10} reductions of 6.6, 6.5 and 6.0 for faecal coliforms, *E. coli* and enterococci respectively (Table 2-2 and Figure 2-6).

While the removal of FIB serves as a useful indicator of overall treatment efficacy, it does not guarantee complete removal of all viral pathogens and may overestimate the reduction of viable viruses. FIB are larger in size compared to viruses, making them easier to remove through conventional wastewater treatment processes such as sedimentation and filtration. FIB are also more susceptible to inactivation and die-off due to tertiary disinfection such as UV treatment.

However, the removal of FIB during wastewater treatment serves as an upper limit of the log reduction value (LRV) for virus removal in the Beachlands WWTP as viruses may exhibit greater resistance to treatment processes particularly disinfection treatment and are not as effectively removed.

Opportunities for removal of microbes, including viruses, exist after UV treatment during surface irrigation and land application of treated wastewater to the riparian buffer zone. Processes such as solar disinfection, infiltration into the soil horizon, attenuation in the soil matrix through filtration and attachment to soil particles and microbial degradation can attenuate and reduce viral transport to the Farm Pond, enhancing the overall removal efficiency further (Schijven et al. 2017).

4.2 The receiving environment

There was no evidence of an annual increase in daily average FIB load discharged from the WWTP (Figure 2-7), but a seasonal trend was apparent, with average FIB instantaneous load peaking in summer months, indicating a potential for higher environmental loading from the WWTP during that time.

The discharge from the WWTP, however, does not account for elevated FIB levels in the receiving environment and Te Puru stream; sites in these locations had median concentrations up to three or more orders of magnitude higher than the treated effluent. These higher levels implicate additional sources of faecal contamination within the Te Puru stream catchment. Potential sources of contamination contributing to the poor water quality of the stream include the presence and density of birds such as those residing at the Farm Pond, runoff and drainage from low intensity agriculture, and direct deposition by cattle. These factors can collectively contribute to FIB contamination beyond what is solely attributable to the WWTP discharge.

The additional faecal inputs from various sources, including livestock, will significantly affect the microbial quality of the stream water posing associated risks. Depending on the contributing source, these risks may not differ substantially from waters affected by human sources (Soller et al. 2010).

4.2.1 Potential health risks

The disparity between the "high" level of FIB in the Te Puru Stream and the "low" level of FIB discharged in the WWTP treated effluent implies the presence of other sources of contamination beyond the WWTP. In this microbiological context, risks associated with human contact and shellfish consumption at freshwater or estuarine sites are based on FIB levels and reflect the impact of faecal contaminants from all sources other than just the wastewater treatment plant.

Human contact

Comparing FIB water quality with risk thresholds for human contact activities, FIB levels at all sites in the Te Puru stream and local receiving environment correspond to Band E (red) categories. Predicted infection risks exceed 7% on average for these freshwater environments. Downstream estuarine sites are anticipated to have a risk of illness greater than 10% according to the MfE/MoH (2003) grading criteria.

Shellfish consumption

FIB water quality conditions at all sites exceed criteria for recreational shellfish harvesting, making them unsuitable for shellfish gathering. However, the shellfish observed in the estuary at Te Puru Park are considered too small for harvesting, further reinforcing the unsuitability of these sites for shellfish collection and consumption at the present time.

Livestock drinking water

Levels of faecal indicator bacteria in Te Puru stream resulting from the WWTP discharge are considered to be negligible. However, the presence of high faecal contamination in the stream which may be abstracted for cattle drinking water, exceeds median values of 600 faecal coliforms/100 mL.

This is well above the recommended median value of 100 faecal coliforms /100mL for livestock drinking water and is therefore not considered suitable for this purpose at any site along the Te Puru Stream network.

4.3 Wastewater risk assessment (QMRA)

The low level of FIB in the treated effluent is not a guarantee of safety as there is the potential for the relationship between indicator organisms and pathogens to be altered by the treatment process (MfE/MoH 2003). In this case, a Quantitative Microbial Risk Assessment (QMRA) was chosen as an alternative approach to assess human health risks. The QMRA can help estimate the risks associated with the WWTP (wastewater treatment plant), which is particularly useful when there are multiple sources of microbial hazards in the environment.

The overall QMRA findings showed that the efficacy of treatment, as indicated by the Log Reduction Values (LRV), was a significant factor in modifying the risk to human health together with other factors such as dilution and the mechanism of exposure (swimming, consumption of watercress or shellfish). The higher the levels of treatment efficacy, the lower the risk, while greater levels of dilution of treated effluent also lower the risk.

The level of dilution varied according to the exposure site and discharge scenario. Marine sites further away from the wastewater discharge tended to have higher dilution levels and lower risk. Within the Te Puru stream, there is little opportunity for the treated effluent to become diluted downstream of the plant until it reaches the marine environment. So, the estimated risks did not vary significantly in the stream downstream from the plant.

Increasing discharge from the plant from the Current to Interim and Stage 2 resulted in increased risks in the marine environment but very little increase in risks in the Te Puru stream. An assumption within the QMRA model is that the concentration of pathogens in effluent does not change with the scenarios, though the volume increases. Therefore, as long as the level of treatment remains constant, we do not expect the risks to change in the stream as we move from the Current to Stage 2 discharge flows.

The mechanism by which an individual could become exposed to dilute treated effluent also influences risk. While there are multiple exposure routes for an exposure site, such as swimming or consumption of uncooked watercress, watercress has the highest estimated risk.

4.3.1 Stream environment

The highest risks in the QMRA were estimated at the Bridge site, immediately below the discharge of the WWTP under the Stage 2 scenario for watercress consumption. The risks under Stage 2 scenario at the Bridge for LRV = 5, the IInfR were 0.995% for watercress consumption and 0.255% for swimming. Moving downstream, the watercress risks fell to 0.920% at the Quarry, an absolute difference of 0.075 percentage points between the Bridge and the Quarry site. Likewise, the swimming risks fell to 0.240%, a difference of 0.015 percentage points. The difference between the current and Stage 2 scenarios was 0.118 and 0.024 percentage points for watercress and swimming, respectively. The difference between the A and B attributes bands from the NPS-FM is a difference of one percentage point.

4.3.2 Marine environment

For the sites assessed, the highest risks were from swimming at the Te Puru stream mouth under the Stage 2 scenario, followed by the three other assessment sites along the shoreline in Kelly's Beach. The risks in Kellys Beach were an order of magnitude higher than swimming at sites outside the Kelly's Beach bay area.

Shellfish have the ability to bioaccumulate viruses. So for a similar site at Umupuia, the shellfish risks are approximately 50 greater than that for swimming. Using an LRV = 1, for illustrative purposes, the swimming risks are 0.0295% and the shellfish risks are 1.5271% under Stage 2 scenario.

4.3.3 Level of treatment required

The actual risks to health in the Te Puru stream, Kelly's Beach and along the coastlines from contact with water depends on a number of factors and the wastewater discharge is only one of these factors. However to manage the incremental risks from the WWTP and keep the Individual Infection Risk (IInfR) below 1% would require treatment to achieve 5 LRV for sites in the Te Puru stream and this would ensure health risks at all the other sites for swimming and shellfish consumption would be kept below 1%. This assessment is based on a watercress analysis which is highly precautionary, nevertheless the assessment of swimming risks calls for an LRV of over 4.

4.4 Health Risk

In considering the predicted health risks from this QMRA, it should be noted that risk modelling did not consider the potential impact on health from other types of human pathogens that could be discharged from the Beachlands WWTP or faecal contaminants derived from other sources that could be conveyed to the Te Puru Stream and downstream coastal environment.

The results reported here are the potential health risks attributable to norovirus derived from the Beachlands WWTP and are *incremental* health risks associated with a single model pathogen in the WWTP discharge. Usually, viruses are the principal pathogen of concern from well-treated wastewater. If, however, the WWTP fails to achieve these reductions, non-viral pathogens such as bacteria or protozoa may also be of concern.

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6 Glossary of abbreviations and terms

E. coli	*Escherichia coli*. The preferred faecal indicator bacteria for freshwater microbiological water quality assessment in New Zealand.
exposure pathway	Describes the source of the pathogen, transport route, barriers to exposure and the mechanism of exposure.
FIB	Faecal indicator bacteria. Excreted bacteria whose presence indicates faecal contamination and the potential presence of other excreted microorganisms such as pathogens.
hazardous event	An event which introduces a hazard (pathogen) into the water or fails to remove the hazard from the water.
hydroponically grown	Grown in water as opposed to soil.
PERT distribution	The Program Evaluation and Review Technique or PERT distribution is a continuous statistical distribution defined by minimum, mode and maximum values. It is used to model values obtained from expert opinion.
QMRA	Quantitative Microbial Risk Assessment.
Uncertainty	Lack of knowledge about the true value.
Variability	Observed differences are due to the true heterogeneity of a quantity (World Health Organization 2016), such as the variability of children's height in a class.
WWTP	Wastewater Treatment Plant.

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Appendix A Beachlands Wastewater Treatment Plant

A site visit to Beachlands Wastewater Treatment Plant was undertaken on 27/10/2023 to provide familiarisation with the WWTP site and the discharge receiving environment (Figure A-3).

The existing treatment configuration of Beachlands WWTP is shown as a schematic in Figure A-1.

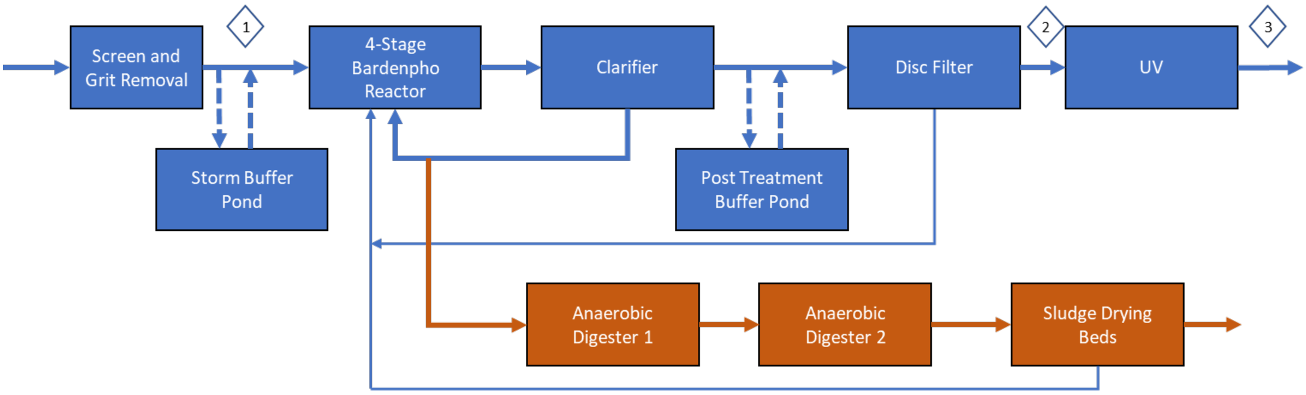

Figure A-1: Schematic of the wastewater treatment processes at Beachlands-Maraetai (Beachlands) Wastewater treatment plant. Wastewater sampling sites for microbiological water quality assessment shown. 1: raw wastewater after screening (WW inlet); 2: Pre-UV; 3: Post-UV (WW outlet).

Figure A-2: Location of Beachlands WWTP, Farm Pond and Te Puru Stream and estuary in the Beachlands catchment area.

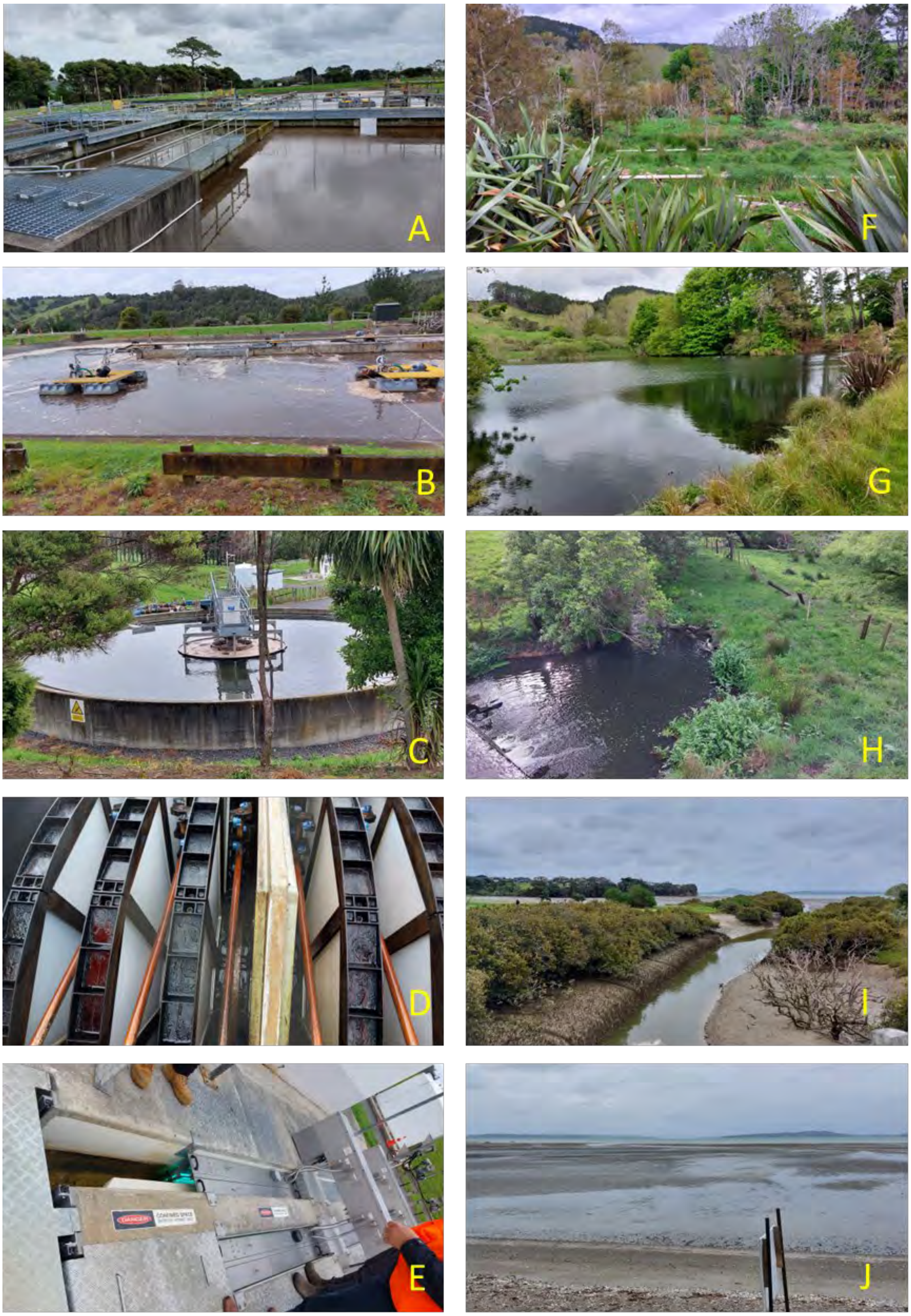

Figure A-3: Beachlands WWTP and receiving environment. WWTP (A-E); receiving environment (riparian land application F, Farm Pond G); Te Puru Stream (Bridge site H, Te Puru Park I); Estuary (J). Site visit 27 October 2023, R. Stott.

Wastewater discharge characteristics

Preliminary analysis of data for the WWTP is shown below (data supplied by Aquatic Services and Coast and Catchment) for the 2018-2024 data.

Exploration of effluent monitoring data for faecal coliform concentrations for the period Jan 2018 to Jan 2024 for which discharge data is available, does not reveal any evidence of a relationship between faecal coliform concentration in the treated wastewater and wastewater total daily discharge rates or UV transmissivity (%) (Figure A-4 and Figure A-5).

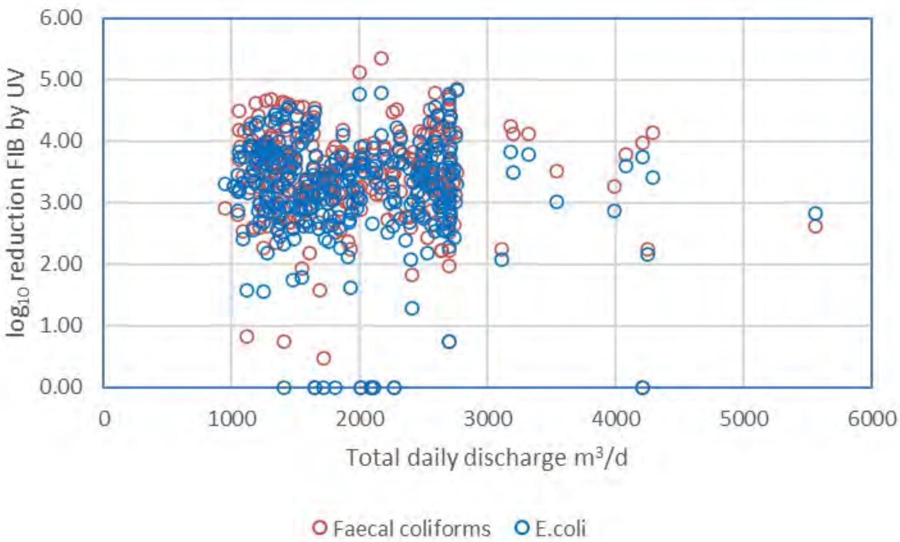

Figure A-4: Relationship between log_{10} removal of faecal coliforms by UV disinfection and total daily flow of discharged wastewater from the WWTP. Note: use of the flow balancing pond allows discharges to remain below the 2800 m^3/d in most instances.

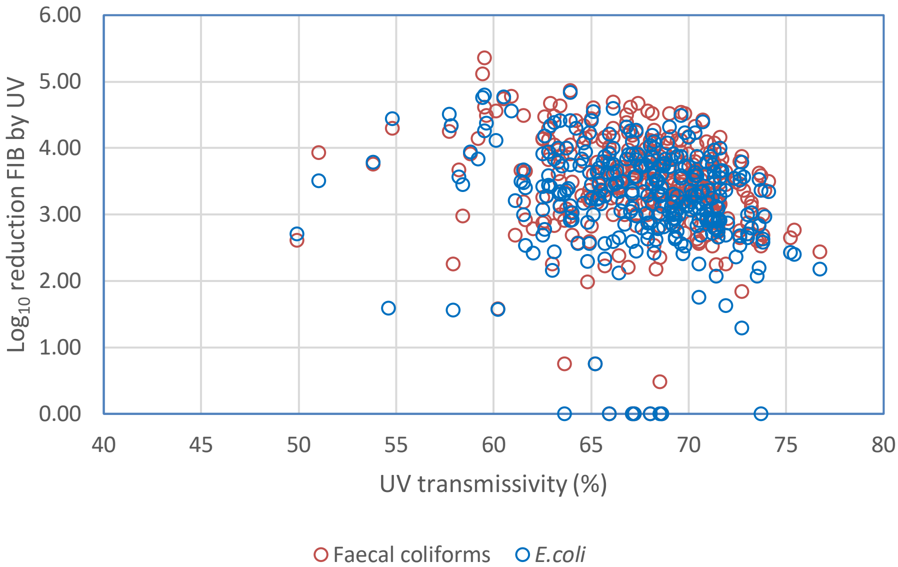

Figure A-5: Relationship between log_{10} removal of faecal coliforms by UV disinfection and UV transmissivity (%).

Appendix B Receiving environment

Short-term environmental monitoring

Sites used for the short-term monitoring campaign (September 2023 – March 2024) are shown in Figure B-1. Additional sites "Quarry" and "Te Puru Park" are shown in Figure 3-2. A description of the sites is shown in Table B-1.

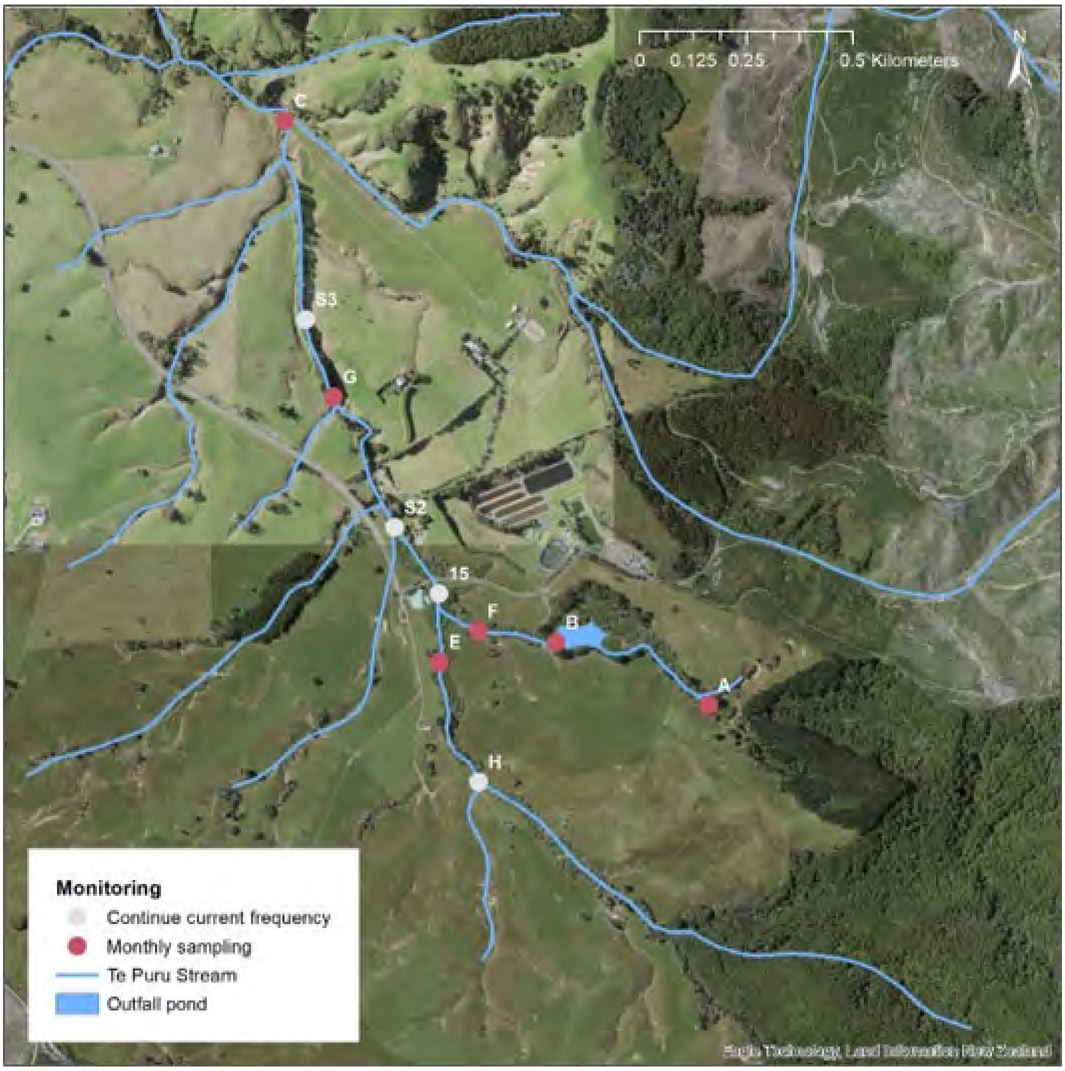

Figure B-1: Location of sites sampled for the short-term spatial survey (Sept 2023 - Mar 2024). Figure supplied by Coast and Catchment (Shane Kelly).

Table B-1: Site description and locations used in the short-term environmental monitoring campaign and cross referenced to QMRA sites. Site descriptions from Bioresearches, 2022 report.

Waterway	Site description	Site
WWTP	Raw wastewater	Wastewater influent
WWTP	Final treated (UV disinfected) wastewater	Wastewater outlet
Farm Pond Tributary	Reference site upstream of Farm Pond	Site A
Farm Pond Tributary	Effect site immediately downstream of Farm Pond discharge	Site B
Reference Tributary	Effect site approx.. 200 m downstream of Farm Pond and immediately upstream of the Te Puru Stream tributary confluence	Site F
Reference Tributary	Reference site just upstream of the confluence with the Farm Pond tributary and Te Puru Stream tributary	Site E
Te Puru Stream Tributary	Effect site immediately downstream of the confluence of the Farm Pond tributary and the Reference Tributary	Site 15 (QMRA = The Bridge)
Te Puru Stream Tributary	Effect site approx.. 600 m downstream of the Farm Pond Tributary and Reference Tributary confluence	Site G
Te Puru Stream	Effect site approx. 100 m upstream of the confluence with the main stem of the Te Puru Stream	Site C (QMRA = C)
Te Puru Stream	Quarry site	Quarry (QMRA = Quarry)
Te Puru Stream	Discharge of Te Puru Stream into Kelly's Beach estuarine environment	Te Puru Park (QMRA = Te Puru Stream mouth)

Microbiological water quality: spatial survey

A summary of microbiological water quality for treated wastewater and Te Puru Stream sites are shown in Table B-2, Table B-3 and Table B-4.

Table B-2: Summary of faecal coliform concentrations in treated wastewater and at various sites along the Te Puru Stream. Data from short-term monitoring campaign 11/9/2023 - 6/3/2024.

Site	N	Median	95th percentile	% of samples > 43 FC/100 mL
WW outlet (UV disinfected)	64	1.6	27.9	
Site A	73	1500	7340	100
Site B	73	680	3010	100
Site F	24	805	2120	100
Site E	24	1300	5430	100
Site 15 (the Bridge)	73	660	4040	100
Site G	3	780	-	100
Site C	3	1000	-	100
Quarry	15	700	5125	100
Te Puru Park	24	690	11100	100

Table B-3: Summary of *E. coli* concentrations in treated wastewater and at various sites along the Te Puru Stream. Data from short-term monitoring campaign 11/9/2023 - 6/3/2024.

Site	N	% > 540	% > 260	Median	95th percentile
WW outlet (UV disinfected)	64	0	0	1.6	18.9
Site A	73	81	95	1000	4770
Site B	73	48	82	540	2740
Site F	24	50	83	555	1800
Site E	24	83	96	880	4540
Site 15 (the Bridge)	73	49	92	520	3250
Site G	3	100	100	810	-
Site C	3	100	100	800	-
Quarry	15	60	87	640	3650
Te Puru Park	24	50	83	575	6760

Table B-4: Summary of enterococci concentrations in treated wastewater and at various sites along the Te Puru Stream. Data from short-term monitoring campaign 11/9/2023 - 6/3/2024.

Site	N	Median	95th percentile
WW outlet (UV disinfected)	64	1.6	5.25
Site A	73	110	1555
Site B	73	130	1780
Site F	24	225	2080
Site E	24	535	3020
Site 15 (the Bridge)	73	290	2170
Site G	3	750	-
Site C	3	600	-
Quarry	15	660	10040
Te Puru Park	24	245	9700

ATTACHMENT 11

ASSESSMENT OF EFFECTS ON TE PURU STREAM DISCHARGE
28 MARCH 24

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Ref:	Init:	Date:
44802111/03	JWO	28th March 2024

Assessment of Proposed Te Puru Stream Discharge

The following provides a summary of the modelling we have carried out to assess the effects of the current and proposed discharge of treated wastewater to the Te Puru Stream, Beachlands (Figure 1).

The wastewater treatment plant (**WWTP**) is located approximately 3.5 km upstream of the stream mouth on the central tributary of the stream that discharges to Kellys Beach.

The assessment includes estimating the level of dilution of the treated wastewater plume at Kellys Beach and the wider marine receiving environment and estimating the extent of the nutrient footprints from both the Te Puru catchment and the WWTP discharges.

WWTP discharge rates representing existing current and planned short-term and long-term scenarios have been considered.

These discharge rates and the associated Total Nitrogen (TN) and Total Phosphorous (TP) loadings for each stage before entering the constructed wetland system are shown in Table 1.

The current average dry weather discharge rate corresponds with the observed mean flow from the WWTP monitoring data for 2020.

Note that the TN and TP loads in Table 1 are those discharged to the pond system, i.e. from the WWTP outlet. Further removal of nutrients will occur as it passes through the overland flow system before the treated wastewater is discharged to the Te Puru Stream (discussed below).

Table 1. Discharge Scenario data.

	Current	**Short-Term**	**Long-Term Stage 2**
Average daily dry weather discharge (m^3)	2,000	3,600	6,000
Average daily dry weather discharge (m^3/s)	0.023	0.042	0.069
Median TN load (kg/day)	14.0	25.0	30.0
Median TP load (kg/day)	2.0	3.6	6.0

Executive Summary

A hydrodynamic model of the Te Puru Stream has been set up to assess the level of dilution that would be achieved for treated wastewater being discharged from the existing Te Puru WWTP located 3.5 km upstream of the Te Puru Stream mouth.

Three scenarios are being considered: Current, Short-Term and Long-Term Stage 2. The average dry weather flow for each of these scenarios is assumed to be 2000, 3600 and 6000 m^3/day respectively.

The model focusses on the marine receiving environment which includes the part of the stream that is influenced by tides (i.e. up to the Quarry Site), Kellys Beach, Tamaki Strait and the beaches and embayments east and west of Kellys Beach.

Because the section of Te Puru Stream up to the Quarry Site (which is approximately 2.5 km downstream of the WWTP discharge point) is influenced by tides, the level of dilution achieved is larger than the relatively low dilutions that are achieved close to the discharge point.

The model has been run for a full calendar year (2020) which includes an extended period of relatively low stream flows. During this period, the contribution of the WWTP to the Te Puru Stream is significant and so minimum levels of dilutions are achieved.

Minimum dilutions under the Current discharge scenario range from 10 to 20-fold near the Te Puru Stream Mouth and at Kellys Beach. Minimum dilutions under this scenario in Shelley Bay and at Omana (the beaches immediately adjacent to Kellys Beach) are greater than 6000-fold while at Pohutukawa Bay minimum dilutions of around 5000-fold are achieved.

Minimum dilutions under the Short-Term discharge scenario range from 5 to 10-fold near the Te Puru Stream Mouth and at Kellys Beach. Minimum dilutions under this scenario in Shelley Bay and at Omana (the beaches immediately adjacent to Kellys Beach) are greater than 3000-fold while at Pohutukawa Bay minimum dilutions of greater than 2000-fold are achieved.

Minimum dilutions under the Long-Term Stage 2 discharge scenario range from 3 to 6-fold near the Te Puru Stream Mouth and at Kellys Beach. Minimum dilutions under this scenario in Shelley Bay and at Omana (the beaches immediately adjacent to Kellys Beach) are greater than 1500-fold while at Pohutukawa Bay minimum dilutions of greater than 1000-fold are achieved.

The model has also been used to assess the relative input of nutrients from the catchment and the WWTP. Here the average level of dilution achieved over a full year are considered because mean annual TN and TP concentrations are being considered.

Immediately downstream of the Whitford-Maraetai Road bridge the predicted TN and TP concentrations due to catchment inputs and those from the Current WWTP discharge are 0.85 mg/L and 0.07 mg/L respectively.

These estimates are made up of the Current WWTP discharge contribution of 0.12 mg/L and 0.01 mg/L for TN and TP respectively and the catchment derived concentrations of 0.73 and 0.05 mg/L for TN and TP respectively.

The combined estimates (i.e. catchment plus WWTP nutrients) are very similar to actual monitoring data at Te Puru Park of 0.74 and 0.07 mg/L for TN and TP respectively.

Under the Short-Term discharge the contribution of the WWTP discharge to the mean TN and TP would increase from 0.12 mg/L and 0.01 mg/L respectively to 0.23 mg/L and 0.04 mg/L.

Under the Long-Term Stage 2 discharge, the contribution of the WWTP discharge to the mean TN and TP would increase to 0.44 mg/L and 0.07 mg/L.

The higher levels of dilution that are achieved in the wider marine receiving environment (compared to the in-stream dilutions) mean that changes in nutrient concentrations in the wider marine receiving environment due to the proposed WWTP discharges would remain below detectable limits.

Model Setup

Te Puru Stream discharges into the south-eastern corner of Kellys Beach via a small sub-tidal channel which extends approximately 1000 m across the inter-tidal flats of Kellys Beach (Figure 2).

As detailed in Zeldis et al., 2009[1], Te Puru Stream is tidally influenced some 1500 m upstream of its mouth near the Quarry site (Figure 2). The marine model focusses on this area of the Te Puru Stream and so has simplified bathymetry upstream of the Quarry Site which reflects the channel width and depth derived from LIDAR data. This ensures the mixing of the catchment inflows, WWTP discharge and marine waters are well represented in the model.

For this work we have refined the model used for assessing the potential outfall discharge options (DHI Report 44802111/02) to schematise the Te Puru stream where it is influenced by tides and included a fine resolution mesh for all the inter-tidal areas between Bucklands Beach (to the west) and the Wairoa River (to the east) embayment. To adequately resolve the Te Puru Stream a minimum element size of 5 m was used while for the inter-tidal sections of the model elements with an area of approximately 500 m^2 were used. As for the outfall assessment work, the model has five vertical layers with the discharges being released into the surface layer of the model.

Te Puru flow data was derived from gauged flows for the Mangemangeroa Stream which is located to the very west of the Whitford embayment (Figure 1). Work carried out by PDP determined that stream flow at the Quarry site could be derived by applying a factor of 2.24 to the Mangemangeroa gauged flows. Mangemangeroa gauged flows from 2020 included an extended period of lower flows over the first five months of the year, a typical number of higher winter flow events and it had a typical sequence of high Spring flow events (Figure 3). 2020 has therefore been chosen as being representative of the range of potential flows that occur within Te Puru Stream.

[1] Zeldis, J., Pattinson, P., Gray, S., Walsh, C., Hamilton, D., Hawes, I. 2009. Assessment of effects of sewage plant inflow on Te Puru Stream, Estuary and adjacent Tamaki Strait waters. NIWA Client Report : CHCO1/84.

Figure 1. Te Puru stream and location of WWTP.

Figure 2. Kellys Beach where the Te Puru Stream discharges to the marine receiving environment and the Quarry site in the Te Puru Stream.

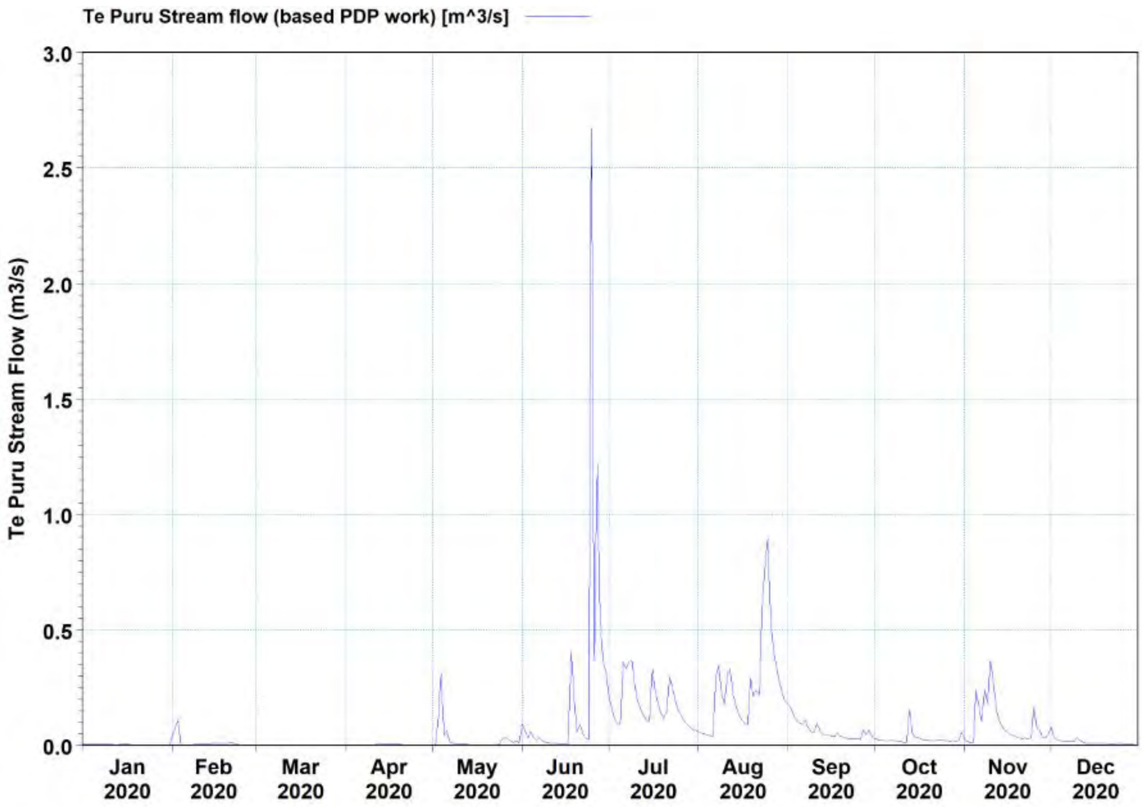

Figure 3. Estimated Te Puru stream flow at the Quarry Site (excluding the WWTP discharge) based on the scaled gauged Mangemangeroa Stream flows.

Discharge Scenarios Relative to Estimated Stream Flow

At times, the WWTP discharge will make up a significant portion of the flows in Te Puru Stream.

The estimated 50th percentile flow at the Quarry site for 2020 is 34 L/s - lower than the 50th percentile estimate for the period 2001-2022 of 47 L/s. The average levels of dilution from the modelling will be somewhat conservative but the lowest levels of estimated dilution (which occur when stream flows are very low) will be representative of worst-case conditions in terms of quantifying potential risk.

Figure 4 shows the percentage of time during 2020 that a given percentage of the Te Puru Stream flows would be due to the WWTP discharge scenarios being considered.

For example, for 40% of the time (i.e. corresponding to the extended period of low flows in early 2020) more than 90% of the flows in the stream at the Quarry site would be due to the Long-Term Stage 2 discharge and for around 75% of the time the Long-Term Stage 2 discharge will make up about half of flows in the stream at the Quarry site.

During the period of data collection of Zeldis et al. (2009) the WWTP discharge was gauged at 10 L/s (about one-half of the current mean discharge rate) and the gauged stream flow[2] at the Quarry site was 48 L/s. This is likely to be due to the extended period of dry weather in March 2001 which would have led to very low soil moisture levels so that, despite 12 hours of rain on the 2nd of April, stream flows remained relatively low for the period 6th- 11th of April 2001.

This means that around 20% of the stream flow at the time of the Zeldis observations would have been due to the WWTP discharge. This is a relatively low contribution to flows compared to WWTP discharge rates being considered and 2020 stream flows being modelled and should be accounted for if results from the modelling (detailed below) are benchmarked against any conclusions of Zeldis et al. (2009).

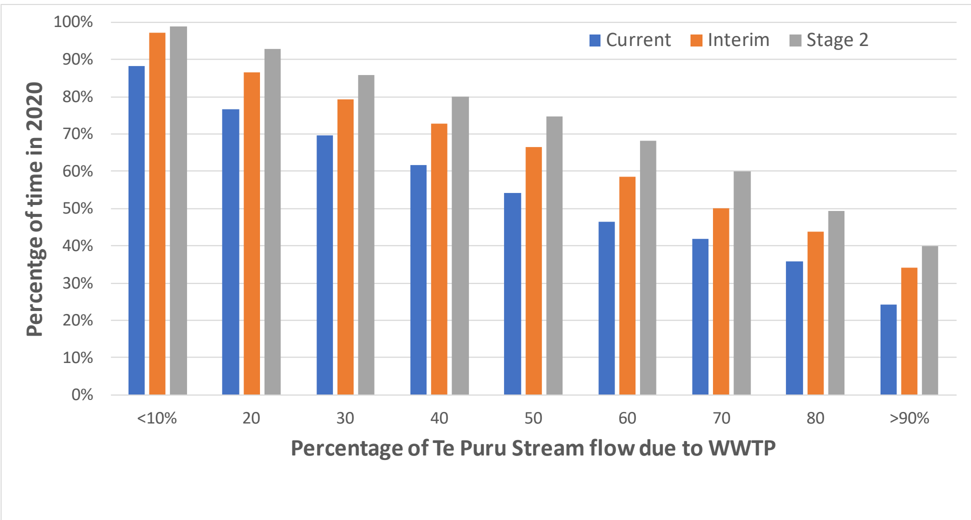

Figure 4. Percentage of time the WWTP discharge contributes a certain portion of flows within Te Puru Stream.

[2] Which would have included the WWTP discharge.

Dilution Estimates

Dilution estimates were quantified for all of 2020 based on the estimated stream flow (Figure 3) and the average dry weather flows for the Current, Short-Term and Long-Term Stage 2 WWTP scenarios (Table 1).

Spatial maps of the estimated percentile dilutions (1st, 5th and 25th) are provided below while time-series data at ten individual sites (Figure 5) and three transects across Kellys Beach (discussed below) have been supplied to input to the Quantitative Microbial Risk Assessment (Figure 5).

Figure 5. Individual sites where time-series of surface and near-bed dilution estimates for all of 2020 have been extracted for the three WWTP discharge scenarios being considered.

Because of the very dynamic nature of the hydrodynamics at Kellys Beach, quantifying the public health risk for Kellys Beach is difficult to do just considering one site.

For example, at low tide the lowest levels of dilution (and therefore highest risk) will occur along the fringes of the sub-tidal channel (Figure 2).

However, on the incoming tide there will be a zone of lowest dilution which follows the movement of the water line inshore as the tide rises. The lowest level of dilution along the beach face will be very close to those in the Te Puru Mouth towards the eastern end of the beach but dilutions towards the western end of the beach will be higher than those towards the eastern end of the beach.

At high tide, the lowest levels of dilution will occur along the beach face with a gradient from east (where lowest levels of dilution will be similar to the Te Puru Mouth dilutions) to west (with dilution at this end of the beach determined by wind conditions on any given day and proximity of the beach to the subtidal channel).

In theory, the highest level of risk for Kellys Beach will be the same as the Te Puru Stream mouth. This level of risk will occur because contact recreation along Kellys Beach could occur at the Stream Mouth at low tide (when dilutions are highest at the Te Puru Mouth site).

To give an indication of potential gradient of risk across the inter-tidal area of Kellys Beach dilution estimates have been extracted across three transects across Kellys Beach (Figure 6) and the minimum dilution across each transect (irrespective of where it happens) for each hour of the model determined.

Essentially this provides a moving QMRA site which tracks the area of highest risk (lowest dilution) over time. This area will generally correspond to the water's edge but at times water from the inter-tidal channel (where lower levels of dilution occur) could be transported into the offshore areas of Kellys Beach approaching high water.

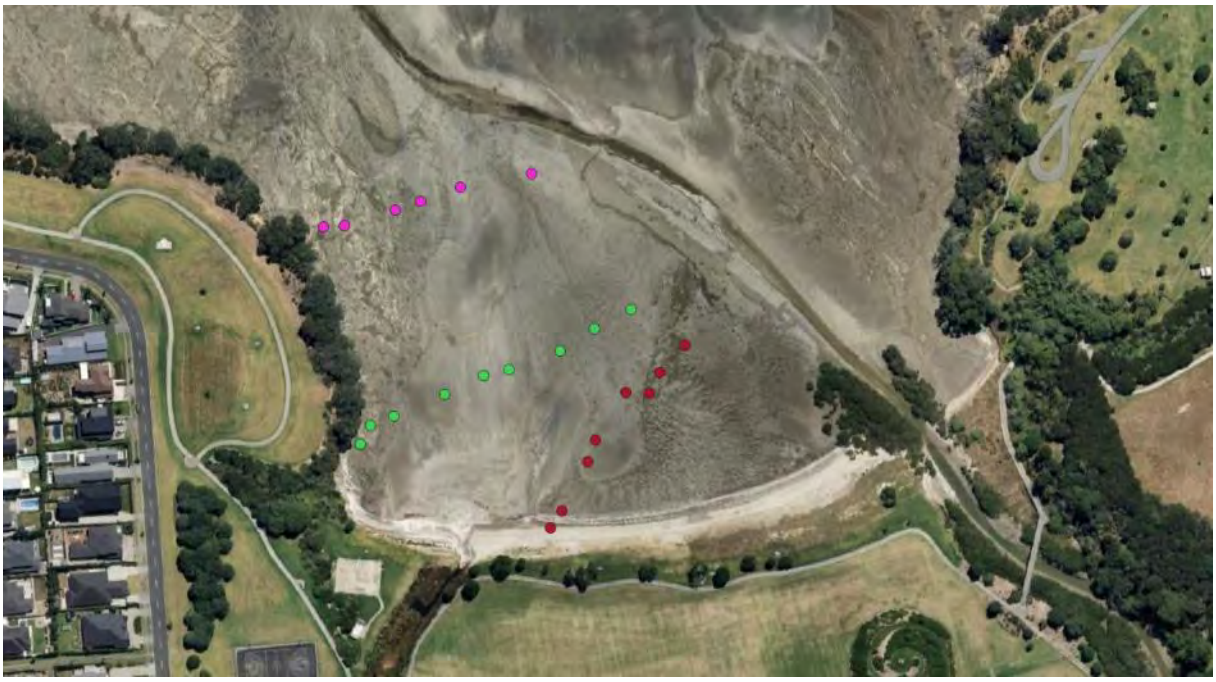

Figure 6. Aerial image of Kellys Beach showing the main subtidal channel and the sites where dilution estimates are extracted across three inter-tidal transects. The northern transect is shown as magenta symbols, the mid-transect is shown as green symbols and the eastern-transect is shown with red symbols,

The level of dilution achieved at each of the QMRA sites and transects are summarised Table 2 through to Table 7 for both the surface and near-bed layers of the model. The treated wastewater plume will become fully vertically mixed within the Te Puru Stream itself and so there is very little significant differences between the surface and near-bed layer estimates.

Figure 7 to Figure 15 show the spatial plots of the estimated 1st, 5th and 25th dilution which show the spatial gradients in dilution that occur between Pohutukawa Bay and Omana. Outside the area shown in the figure dilutions are very high (discussed below) and beyond a zone extending some 1000-1500 m offshore between Sunkist and Magazine Bay (Figure 5) dilutions in excess of 3000-fold occur.

At the Te Puru River Mouth site, the 1st percentile dilution (i.e. one that is only exceeded 1% of the time) is 10, 5 and 3 under the Current, Short-Term and Long-Term Stage 2 discharge scenarios.

For Kellys Beach the 1st percentile dilutions are very similar across all three transects – around 20-fold for the Current, 10-fold for the Short-Term and 6-fold for the Long-Term Stage 2 scenario. These dilutions are slightly higher than the Te Puru Mouth minimum dilutions and reflect the slight increase in dilution seen within the subtidal channel at low tide and the proximity of the seaward end of the transects to the subtidal channel just after low water.

For the other percentile estimates (2nd through to 50th) there is a north-mid-east gradient in dilutions with the highest dilution occurring across the Northern transect. The 2nd through to 50th percentile dilutions are significantly higher than at the Te Puru Stream site due to the influence of the tidal currents across the inter-tidal area.

Moving away from Kellys Beach the predicted level of dilution is significantly higher than within Kellys Beach itself. This is due to the treated wastewater plume being transported either into the deeper waters of the Tamaki Strait or mixing with water moving from the east (on the rising tide) or from the west (on the falling tide). In all cases this leads to the treated wastewater plume becoming much more diluted outside the area of Kellys Beach.

Figure 7. Estimated depth-averaged 1st percentile dilutions for the Current WWTP discharge scenario. Dilutions of less than those shown occur 1% of the time.

Figure 8. Estimated depth-averaged 5th percentile dilutions for the Current WWTP discharge scenario. Dilutions of less than those shown occur 5% of the time.

Figure 9. Estimated depth-averaged 25th percentile dilutions for the Current WWTP discharge scenario. Dilutions of less than those shown occur 25% of the time.

Figure 10. Estimated depth-averaged 1st percentile dilutions for the Short-Term WWTP discharge scenario. Dilutions of less than those shown occur 1% of the time.

Figure 11 Estimated depth-averaged 5th percentile dilutions for the Short-Term WWTP discharge scenario. Dilutions of less than those shown occur 5% of the time.

Figure 12 Estimated depth-averaged 25th percentile dilutions for the Short-Term WWTP discharge scenario. Dilutions of less than those shown occur 25% of the time.

Figure 13. Estimated depth-averaged 1st percentile dilutions for the Long-Term Stage 2 WWTP discharge scenario. Dilutions of less than those shown occur 1% of the time.

Figure 14 Estimated depth-averaged 5th percentile dilutions for the Short-Term WWTP discharge scenario. Dilutions of less than those shown occur 5% of the time.

Figure 15. Estimated depth-averaged 25th percentile dilutions for the Short-Term WWTP discharge scenario. Dilutions of less than those shown occur 25% of the time.

Table 2. Percentile estimates of surface layer dilutions at the ten QMRA sites and Kellys Beach transect for the Current scenario. These estimates ignore the first 10-days of the model run to allow dilution values to reach quasi-equilibrium at all the QMRA sites.

Percentiles	Wairoa West Bay, Clevedon	Umupuia Outer	Maraetai	Magazine Bay	Shelly Bay	Pohutukawa Bay	Omana	Umupuia Inner	Sunkist Bay	Northern Transect	Mid Transect	Eastern Transect	Te Puru stream mouth
1	87,460	28,893	9,418	15,687	8,430	4,917	6,568	30,707	16,841	20	20	18	10
2	102,886	40,684	13,051	20,692	14,796	8,858	11,539	43,850	22,124	51	37	26	12
5	169,673	60,176	25,919	41,002	30,195	20,487	25,043	61,614	53,019	166	102	61	25
10	404,592	126,271	92,283	101,842	67,523	73,432	77,840	121,590	90,970	471	284	231	75
20	796,418	878,355	404,477	653,117	314,554	308,489	343,279	811,851	627,861	2,779	1,099	985	177
30	1,529,184	1,414,678	894,811	1,068,633	745,212	874,640	822,967	1,406,233	1,349,843	9,755	3,090	2,729	483
50	7,648,008	6,274,904	2,330,568	3,039,283	3,020,719	3,075,059	2,558,304	6,181,807	4,128,785	109,282	35,287	25,395	13,018

Table 3. Percentile estimates of near-bed layer dilutions at the ten QMRA sites and Kellys Beach transect for the Current scenario. These estimates ignore the first 10-days of the model run to allow dilution values to reach quasi-equilibrium at all the QMRA sites.

Percentiles	Wairoa West Bay, Clevedon	Umupuia Outer	Maraetai	Magazine Bay	Shelly Bay	Pohutukawa Bay	Omana	Umupuia Inner	Sunkist Bay	Northern Transect	Mid Transect	Eastern Transect	Te Puru stream mouth
1	86,562	28,947	9,702	15,715	8,552	5,105	6,598	31,179	17,173	20	20	18	10
2	102,072	40,949	13,093	20,777	14,939	9,093	11,118	44,287	22,340	53	36	26	12
5	169,684	60,217	26,063	41,246	29,867	21,158	25,043	61,850	53,272	165	103	61	25
10	404,977	125,879	92,262	101,872	68,406	73,978	78,764	120,912	91,344	463	284	230	75
20	796,810	882,711	407,425	653,209	310,209	319,246	338,692	818,321	627,217	2,770	1,098	980	176
30	1,523,735	1,414,662	895,826	1,068,301	748,678	883,939	819,458	1,406,415	1,347,818	9,783	3,074	2,702	486
50	7,648,184	6,287,845	2,338,968	3,023,715	3,031,052	3,097,270	2,558,439	6,209,194	4,154,101	108,538	34,824	24,893	12,993

Table 4. Percentile estimates of surface layer dilutions at the ten QMRA sites and Kellys Beach transect for the Short-Term scenario. These estimates ignore the first 10-days of the model run to allow dilution values to reach quasi-equilibrium at all the QMRA sites.

Percentiles	Wairoa West Bay, Clevedon	Umupuia Outer	Maraetai	Magazine Bay	Shelly Bay	Pohutukawa Bay	Omana	Umupuia Inner	Sunkist Bay	Northern Transect	Mid Transect	Eastern Transect	Te Puru stream mouth
1	40,061	16,070	5,124	8,144	3,327	2,133	3,005	16,447	7,056	9	10	9	5
2	47,019	19,505	6,256	10,497	5,278	3,414	5,470	18,748	9,395	22	16	12	6
5	77,641	28,399	12,404	19,304	11,187	8,532	11,519	29,520	22,525	62	41	25	10
10	182,109	57,839	38,287	45,850	23,501	26,320	33,232	55,930	38,069	141	92	73	28
20	353,346	326,394	126,483	236,530	91,293	82,324	111,794	331,880	187,430	579	283	241	61
30	619,869	537,466	340,083	390,367	228,630	224,694	309,756	528,949	365,840	1,878	600	532	123
50	2,383,171	1,635,168	628,247	1,027,488	714,192	675,055	695,563	1,677,036	1,031,517	13,302	3,680	2,782	1,352

Table 5. Percentile estimates of near-bed layer dilutions at the ten QMRA sites and Kellys Beach transect for the Short-Term scenario. These estimates ignore the first 10-days of the model run to allow dilution values to reach quasi-equilibrium at all the QMRA sites.

Percentiles	Wairoa West Bay, Clevedon	Umupuia Outer	Maraetai	Magazine Bay	Shelly Bay	Pohutukawa Bay	Omana	Umupuia Inner	Sunkist Bay	Northern Transect	Mid Transect	Eastern Transect	Te Puru stream mouth
1	39,798	16,131	5,163	8,145	3,318	2,223	2,991	16,574	7,155	9	10	9	5
2	46,560	19,512	6,321	10,531	5,345	3,747	5,347	18,993	9,540	22	16	12	6
5	77,567	28,355	12,499	19,427	11,388	8,765	11,592	29,616	22,521	63	41	25	10
10	181,803	58,012	38,495	46,046	23,383	26,796	32,868	55,791	38,395	145	93	73	28
20	353,789	326,925	128,019	236,674	92,139	85,476	110,878	331,340	188,315	579	282	239	61
30	619,229	536,726	339,670	389,877	227,040	228,146	309,506	529,367	365,726	1,846	596	524	123
50	2,383,475	1,635,034	629,267	1,031,086	713,033	678,767	698,097	1,674,840	1,032,295	12,901	3,620	2,751	1,348

Table 6. Percentile estimates of surface layer dilutions at the ten QMRA sites and Kellys Beach transect for the Long-Term Stage 2 scenario. These estimates ignore the first 10-days of the model run to allow dilution values to reach quasi-equilibrium at all the QMRA sites.

Percentiles	Wairoa West Bay, Clevedon	Umupuia Outer	Maraetai	Magazine Bay	Shelly Bay	Pohutukawa Bay	Omana	Umupuia Inner	Sunkist Bay	Northern Transect	Mid Transect	Eastern Transect	Te Puru stream mouth
1	19,284	8,406	3,044	4,566	1,526	1,060	1,786	8,183	3,670	6	6	5	3
2	23,092	9,405	3,638	6,136	2,413	1,601	3,178	9,467	4,833	9	8	7	4
5	38,533	15,254	7,037	10,420	5,266	3,894	6,233	16,068	10,566	29	19	12	5
10	76,648	30,483	18,891	23,155	10,560	11,273	15,944	29,893	18,160	62	38	28	14
20	169,805	153,917	49,975	86,679	29,958	26,995	46,099	156,186	73,913	174	100	82	31
30	277,446	242,315	138,760	173,324	78,380	61,716	129,498	239,920	127,862	468	179	159	53
50	917,246	664,754	275,343	377,368	212,476	180,334	263,880	652,891	298,970	2,554	646	532	309

Table 7. Percentile estimates of near-bed layer dilutions at the ten QMRA and Kellys Beach transect sites for the Long-Term Stage 2 scenario. These estimates ignore the first 10-days of the model run to allow dilution values to reach quasi-equilibrium at all the QMRA sites.

Percentiles	Wairoa West Bay, Clevedon	Umupuia Outer	Maraetai	Magazine Bay	Shelly Bay	Pohutukawa Bay	Omana	Umupuia Inner	Sunkist Bay	Northern Transect	Mid Transect	Eastern Transect	Te Puru stream mouth
1	19,292	8,404	3,066	4,596	1,542	1,106	1,775	8,198	3,706	6	6	5	3
2	22,946	9,434	3,671	6,186	2,433	1,684	3,148	9,512	4,870	9	8	7	4
5	38,485	15,203	7,040	10,447	5,317	3,992	6,267	16,144	10,659	29	20	12	5
10	76,480	30,522	18,985	23,248	10,598	11,247	15,813	29,978	18,351	63	38	28	14
20	169,616	153,923	50,430	87,501	30,421	27,714	45,970	156,160	74,622	174	99	81	31
30	277,180	242,153	138,867	173,144	77,079	62,911	129,441	239,664	128,597	467	177	158	53
50	920,336	665,517	275,059	378,016	213,688	182,850	264,803	653,672	300,189	2,474	638	524	312

Nutrient Footprints

The assumed nutrient loads discharged to the Te Puru Stream (Table 8) have been used to derive nutrient footprints for the catchment and the WWTP under the three discharge scenarios considered.

As detailed in Stewart et al. (2024)[3], it has been assumed that WWTP Total Nitrogen (TN) would be attenuated by a factor of 2.84 through the overland flow system and WWTP Total Phosphorous (TP) would be attenuated by a factor of 3.44.

Nutrients have been modelled using a conservative tracer approach which assumes no loss of water column nutrients to sediments, to the atmosphere or any uptake of nutrients by phytoplankton. As discussed in detail in Zeldis et al. (2009), this approach will provide appropriate estimates of nutrients in the marine receiving environment.

Mean annual catchment loads have been derived from data from the NZ Rivers Map portal[4] which provides mean annual flow (m^3/s) and mean annual nutrient concentrations for both TN and TP. The estimated mean annual flow for the Te Puru Stream in the NZ Rivers Map database is 0.225 m^3/s.

The 50th percentile of the Te Puru Stream Site E monitoring data (upstream of the WWTP collected Sept 23 to Jan 24) are 0.310 and 0.036 mg/L respectively for TN and TP. The NZ Rivers Map data at this monitoring site are 0.584 mg/L for TN and 0.036mg/L for TP.

For the whole of the Te Puru Catchment the mean annual TN and TP concentrations from the NZ Rivers Map database are 0.538 mg/L for TN and 0.038 mg/L for TP.

The NZ Rivers Map data therefore provides reasonable estimates of mean annual nutrient loads generated in the Te Puru Stream catchment.

Note that data from the NIWA ETI tool[5] for the Turanga Creek, Whitford (lower, left of Figure 1) indicate that mean annual TN and TP loads are generally around 25% higher than summer loads but this probably reflects higher flows rather than increased concentrations of TN an TP.

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[3] Stewart, M., James, M., and Kelly, S. 2024. Beachlands Wastewater Treatment Plant – ecological and human health effects assessment. Report WSL2303–D1, Streamlined Environmental.
[4] Whitehead, A.L., Booker, D.J. 2019. Communicating biophysical conditions across New Zealand's rivers using an interactive webtool. New Zealand Journal of Marine and Freshwater Research 53: 278–287.
[5] Zeldis, J., Plew, D., Whitehead, A., Madarasz-Smith, A., Oliver, M., Stevens, L., Robertson, B., Burge, O., Dudley, B. 2017. The New Zealand Estuary Trophic Index (ETI) Tools: Web Tool 1 - Determining Eutrophication Susceptibility using Physical and Nutrient Load Data. Ministry of Business, Innovation and Employment Envirolink Tools: C01X1420.

Table 8. Derived nutrient loads for the WWTP, catchment, combined (WWTP + catchment) and percentage contribution the WWTP would have to the total nutrient load. Attenuated loads are the load discharged to the Te Puru Stream and the Bridge site following the full treatment chain.

	Current	Short-Term	Long-Term Stage 2
Attenuated WWTP loads			
Mean annual TN load (kg/yr)	1,799	3,213	3,856
Mean annual TP load (kg/yr)	212	382	637
Te Puru Catchment			
Mean annual TN load (kg/yr)	3,825	3,825	3,825
Mean annual TP load (kg/yr)	270	270	270
Combined			
Mean annual TN load (kg/yr)	5625	7038	7681
Mean annual TP load (kg/yr)	482	652	907
WWTP percentage of total load			
TN	32%	46%	50%
TP	44%	59%	70%

Based on the mean flow for 2020, catchment source concentrations of 0.74 mg/L for TN and 0.05 mg/L for TP have been applied to achieve the delivery of the mean annual catchment loads for 2020 shown in Table 8.

The model simulations do not include the role of oceanic derived nutrients or the input of other river systems, both of which will increase nutrient concentrations in the marine receiving environment above those modelled. For example, data from the NIWA ETI tool indicate that offshore of the Whitford embayment the average oceanic TN and TP concentrations are 0.04 and 0.01 mg/L respectively and the TN load from the Wairoa River (near the most eastern QMRA site, Figure 5) is around 160,000 kg/yr and the TN load for the Tamaki River is around 60,000 kg/yr.

Figure 16 shows the TN and TP footprints just for the catchment derived nutrient loads of 3,825 and 270 tonnes per year respectively.

Figure 17 shows the WWTP derived TN and TP footprints for the Current scenario and Figure 18 shows the combined WWTP + catchment TN and TP footprints for this discharge scenario.

Figure 19 shows the WWTP derived TN and TP footprints for the Short-Term scenario and Figure 20 shows the combined WWTP + catchment TN and TP footprints for this discharge scenario.

Figure 21 shows the WWTP derived TN and TP footprints for the Long-Term Stage 2 scenario and Figure 22 shows the combined WWTP + catchment TN and TP footprints for this discharge scenario.

Immediately downstream of the Whitford-Maraetai Road bridge the predicted TN and TP concentrations combining catchment inputs and the Current WWTP discharge are 0.85 mg/L and 0.07 mg/L respectively.

These estimates are made up of the Current WWTP discharge contribution of 0.12 mg/L and 0.01 mg/L for TN and TP respectively and the catchment derived concentrations of 0.73 and 0.05 mg/L for TN and TP respectively.

The combined estimates are very similar to actual monitoring data from Te Puru Park of 0.74 and 0.07 mg/L for TN and TP respectively.

Immediately downstream of the Whitford-Maraetai Road bridge the increase in mean annual TN concentration for the Short-Term discharge scenario is 0.07 mg/L while the increase in mean annual TP is 0.04 mg/L. For the Long-Term Stage 2 scenario these increases are estimated to be 0.44 mg/L for TN and 0.23 mg/L for TP.

These values reflect the combination that the WWTP discharge makes to the average Te Puru Stream flow (Figure 4) and the percentage increase in TN and TP loads shown in Table 8.

Towards the mouth of the Te Puru Stream the incoming tide provides significant additional dilution to the dilution that occurs in-stream meaning that the average level of dilution at the Te Puru Stream mouth ranges from greater than 10,000-fold under the Current scenario greater than 1,300-fold under the Short-Term and greater than 300-fold under the Long-Term Stage 2 scenario (Table 2).

This results in very low nutrient concentrations relating to the WWTP discharges in the marine receiving environment.

For example, within the mouth of the Te Puru Stream under the Long-Term Stage 2 scenario (when the predicted dilution at this site is the lowest of all the scenarios considered) the maximum increase in TN is 0.006 mg/L while for TP the maximum increase is estimated to be 0.002 mg/L.

As such, increases in TN and TP within the marine receiving environment due to all three WWTP discharge scenarios will be below detectable limits.

The effect of the WWTP discharge in terms of in-stream nutrients (i.e. upstream of the Quarry site) is discussed in detail in Stewart et al. (2024).

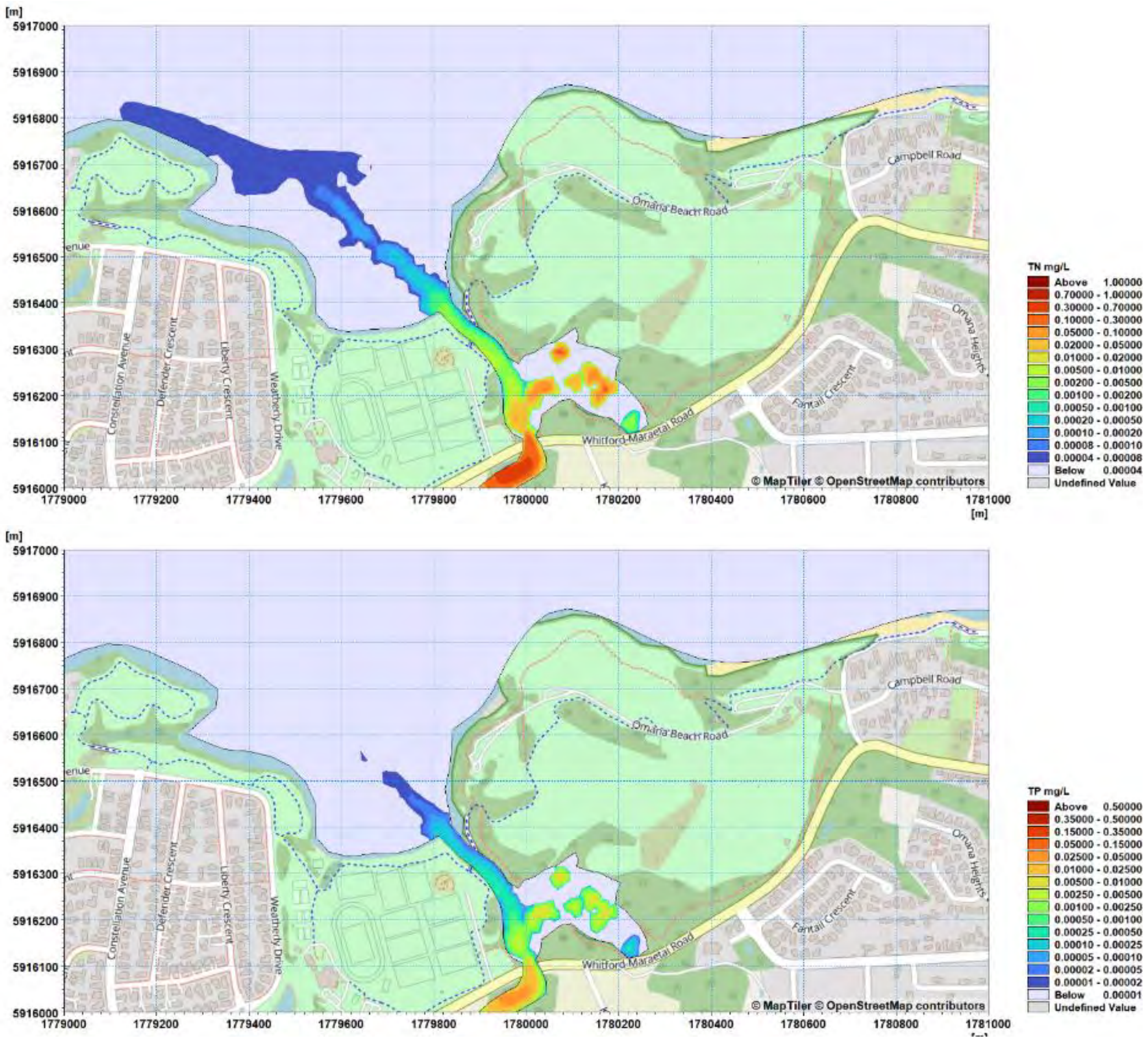

Figure 16. Total Nitrogen (top) and Total Phosphorus (bottom) footprints for the Te Puru Stream catchment (excluding any input of WWTP discharge).

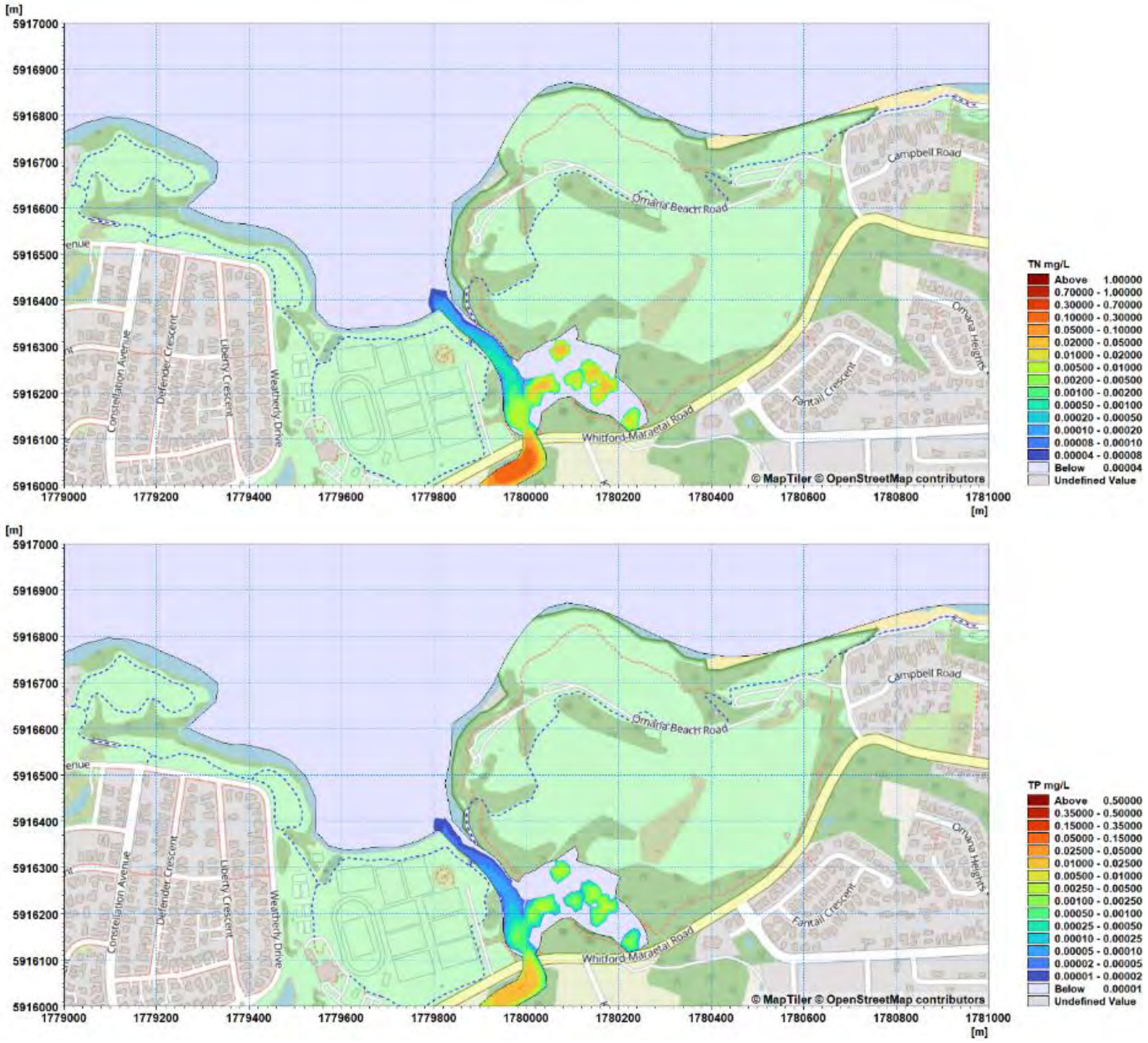

Figure 17. Total Nitrogen (top) and Total Phosphorous (bottom) footprints for the Current WWTP discharge (excluding any catchment inputs).

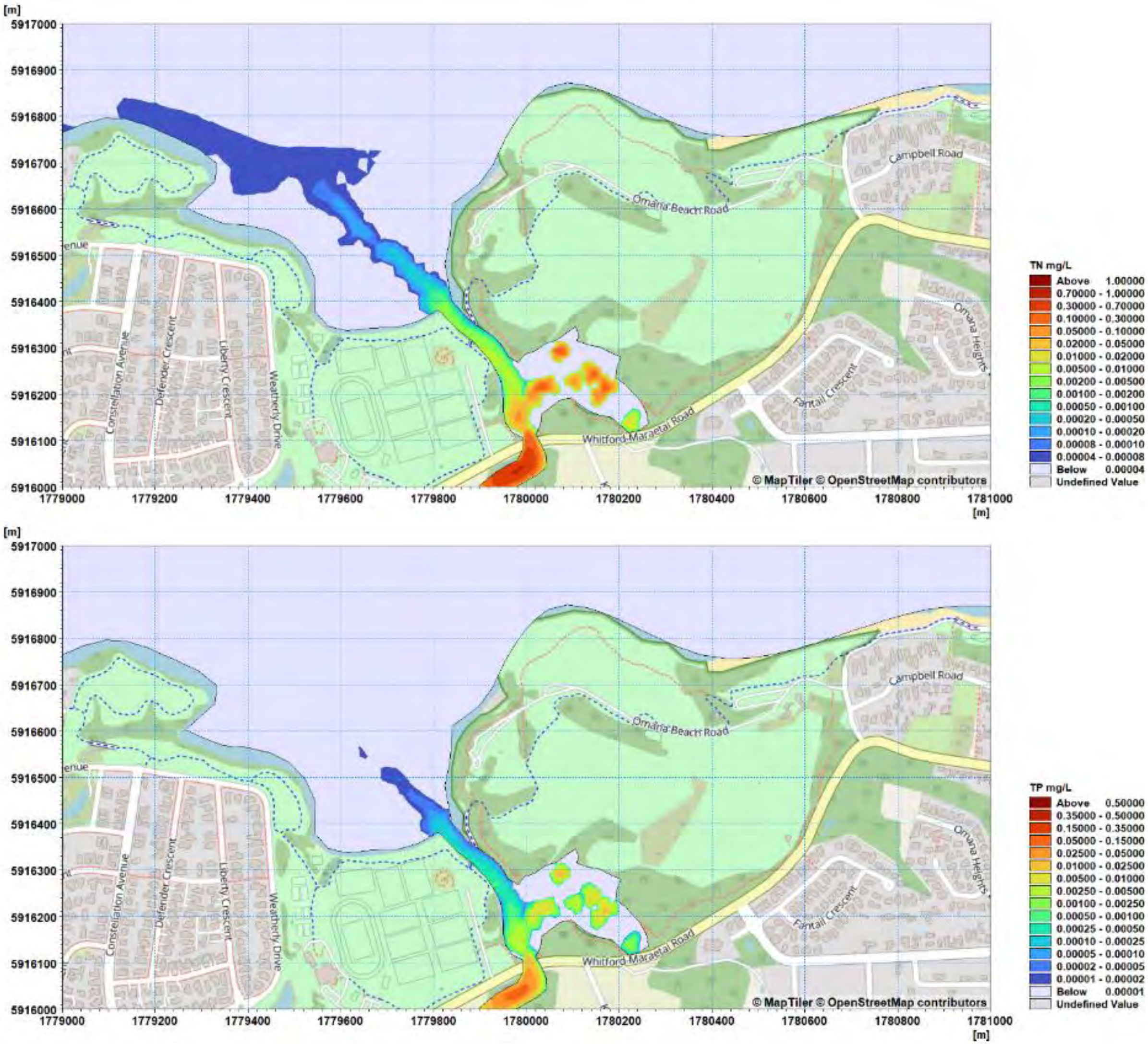

Figure 18. Combined catchment and WWTP Total Nitrogen (top) and Total Phosphorous (bottom) footprints for the Current WWTP discharge.

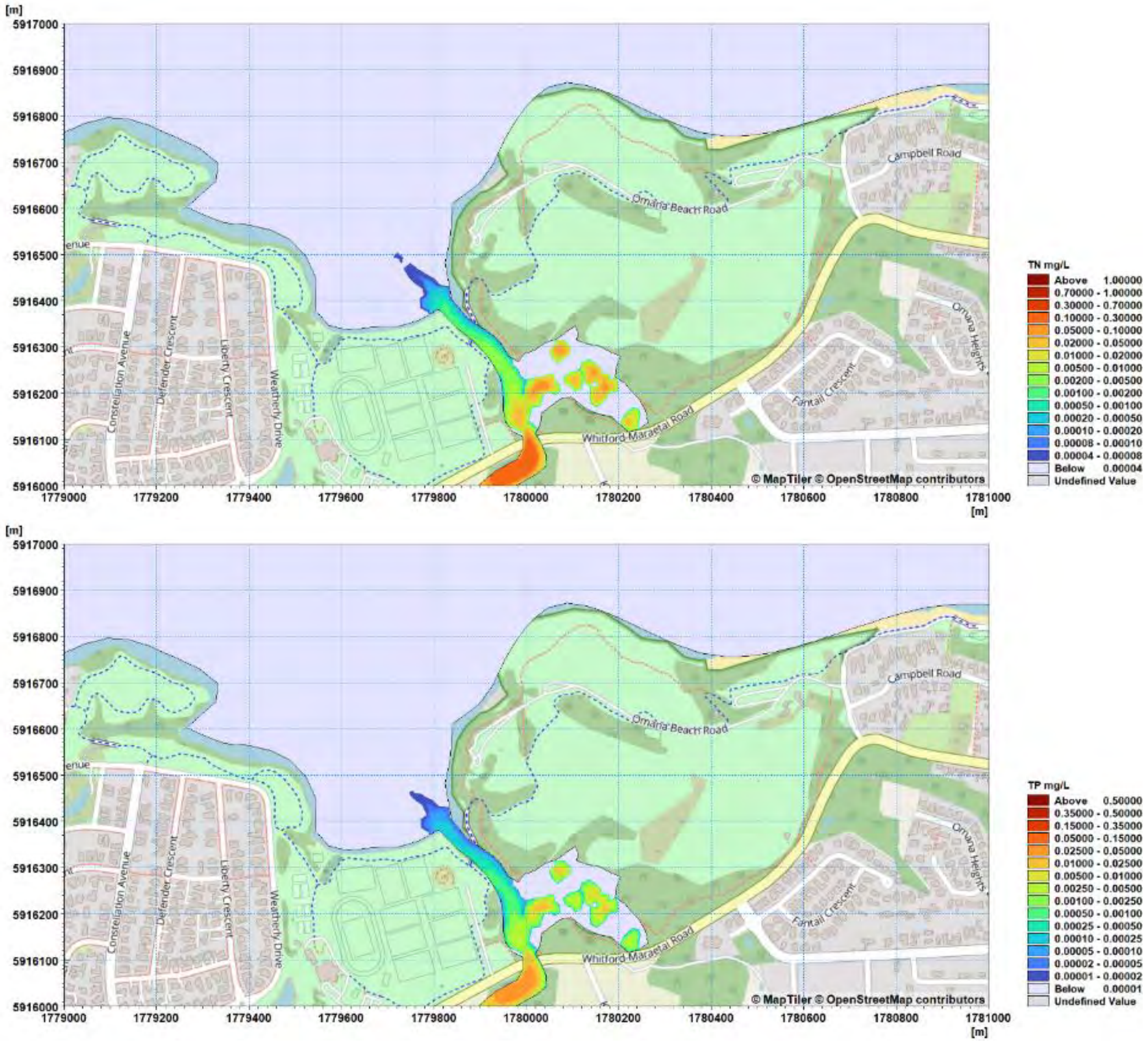

Figure 19. Total Nitrogen (top) and Total Phosphorous (bottom) footprints for the Short-Term WWTP discharge (excluding any catchment inputs).

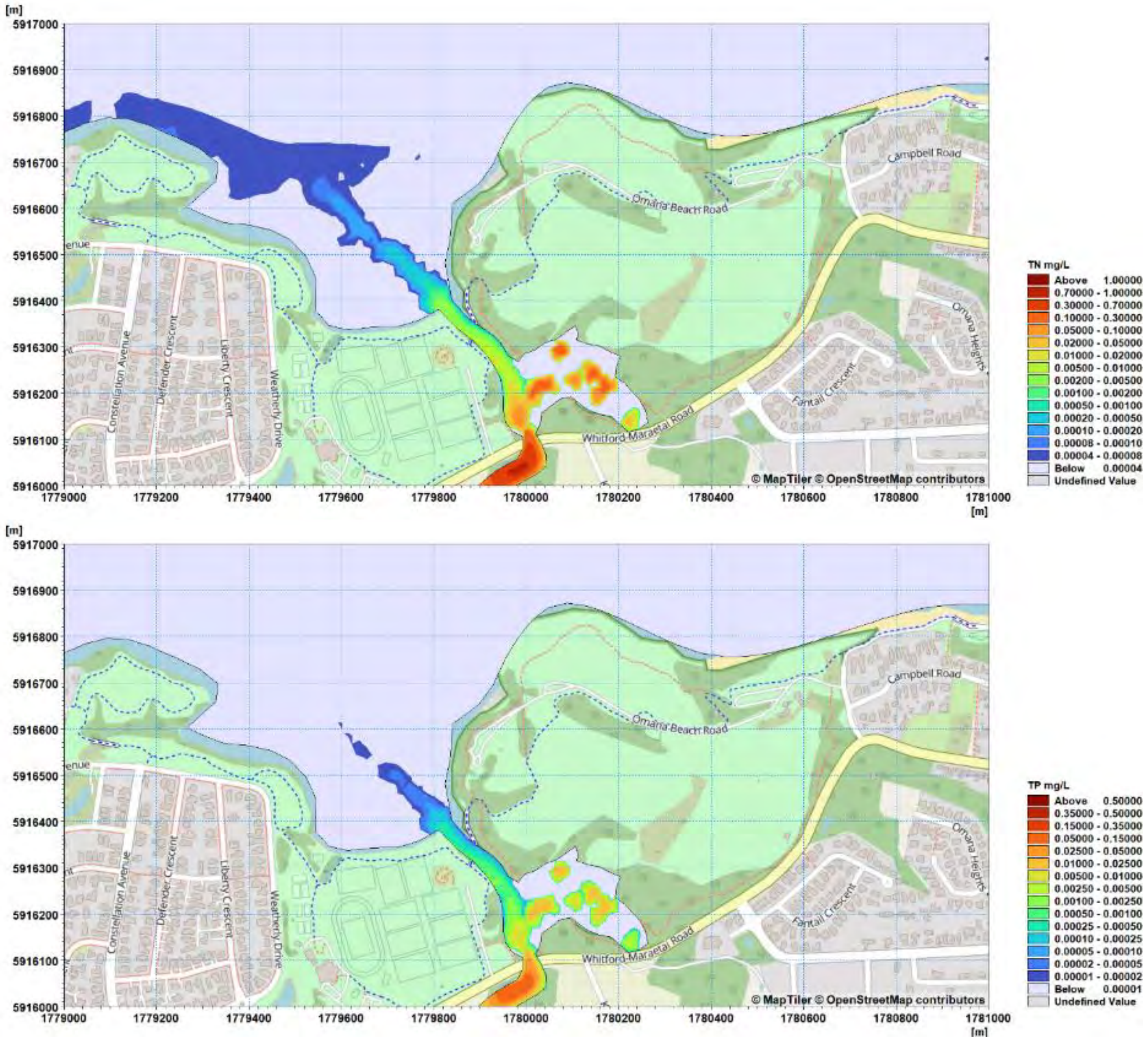

Figure 20. Combined catchment and WWTP Total Nitrogen (top) and Total Phosphorous (bottom) footprints for the Short-Term WWTP discharge.

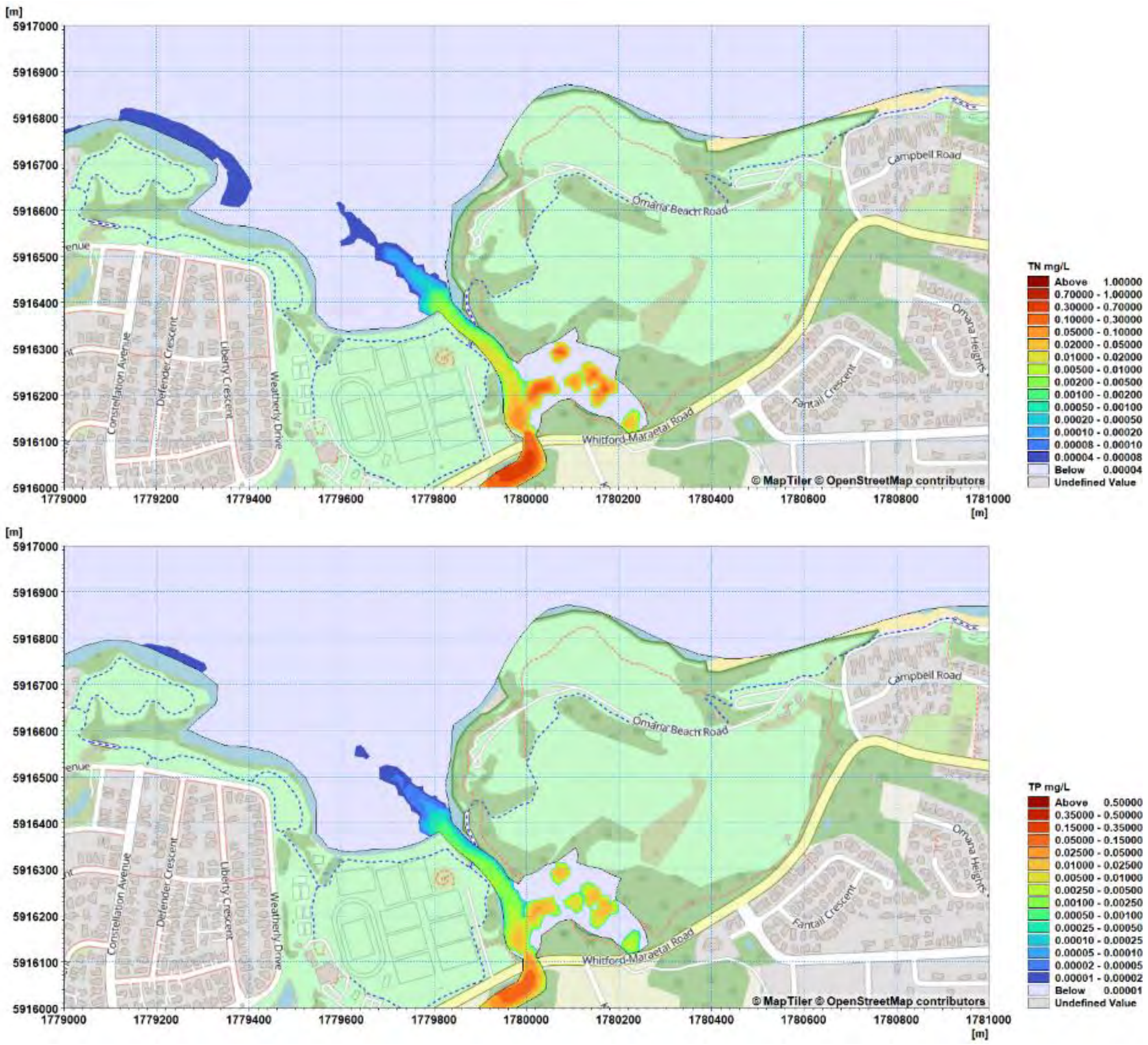

Figure 21. Total Nitrogen (top) and Total Phosphorous (bottom) footprints for the Long-Term Stage 2 WWTP discharge (excluding any catchment inputs).

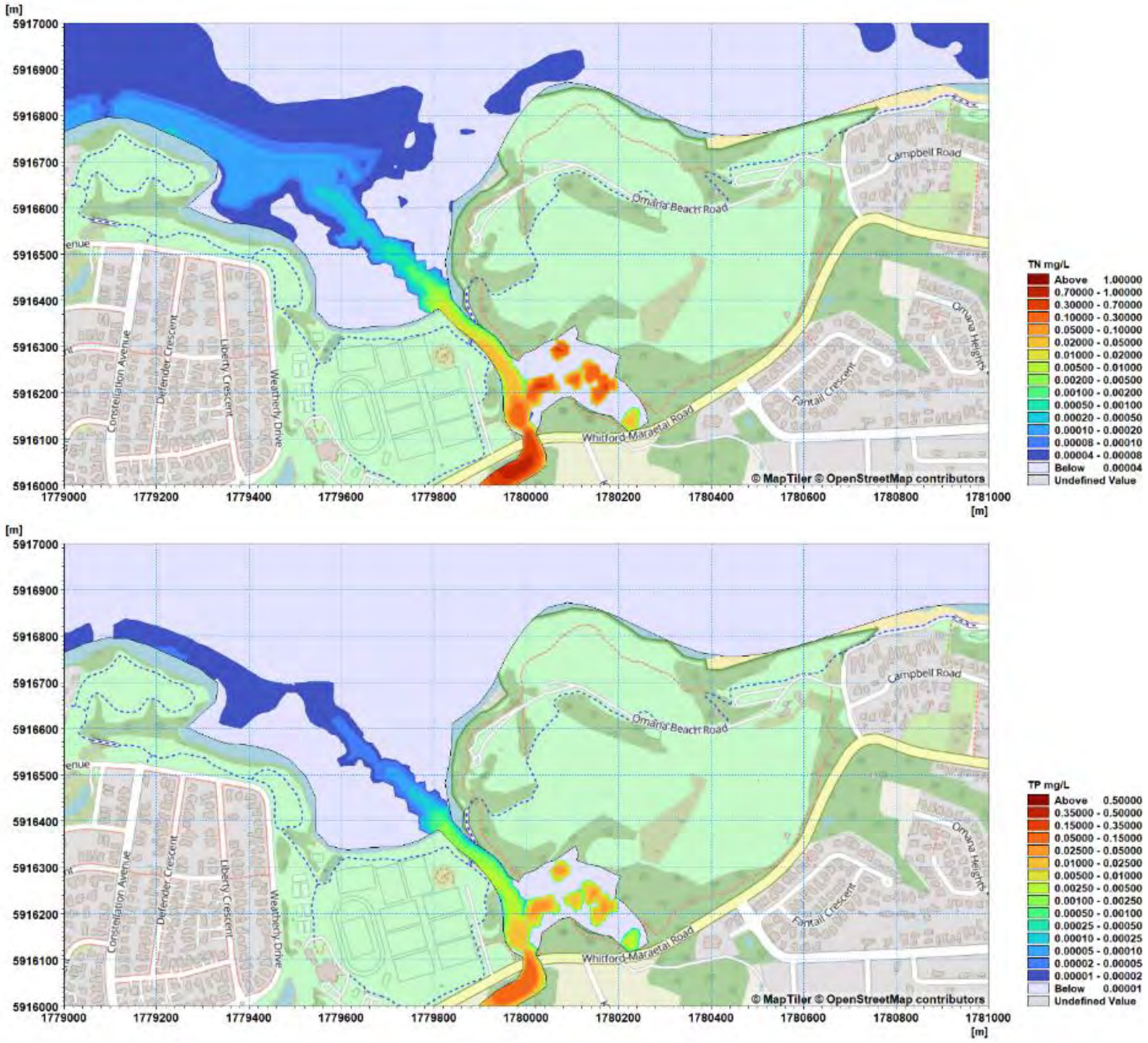

Figure 22. Combined catchment and WWTP Total Nitrogen (top) and Total Phosphorous (bottom) footprints for the Long-Term Stage 2 WWTP discharge.