

Whirinaki Stopbank Cross- Drainage – Preliminary Design

✦ Prepared for

Hawke's Bay Regional Council

✦ 2025

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Quality Control Sheet

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Limitations:

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Executive Summary

The Whirinaki Drain flows through the vicinity of Whirinaki, north of the Esk River in Hawke's Bay. During Cyclone Gabrielle in February 2023, the surrounding area experienced widespread flood damage, including the Whirinaki Pan Pac facility. To increase flood resilience in the area, the Whirinaki Flood Resilience project at Whirinaki Drain proposes the upgrade and extension of the Whirinaki stopbank.

Hawke's Bay Regional Council (HBRC) has engaged Pattle Delamore Partners (PDP) to prepare a preliminary design for the cross-drainage infrastructure associated with the proposed Whirinaki stopbank. The purpose of this report is to present the cross-drainage preliminary design to manage ponding at the toe of the proposed stopbank and to facilitate existing overland flow and cross-drainage towards Whirinaki Drain.

The preliminary design was developed from the relevant authority design standards, the PDP proposed stopbank design, LiDAR and survey information, relevant information from Pan Pac, and consideration of existing services.

The preliminary design is summarised below:

- ∴ Stormwater will be captured and conveyed land side of the 100-year LoS stopbank via grassed swales of depth 0.3 m and widths ranging from 0.5 to 1.5m, and fitted with subsoil drains.
- ∴ Scruffy domes/manholes ranging in size from DN900 to DN1500 will connect the proposed cross-drainage infrastructure to existing stormwater infrastructure and outfall structures to the Whirinaki Drain.
- ∴ Outfall structures through the proposed stopbank will pipe stormwater to Whirinaki Drain via RCRRJ Class 4 pipes ranging in size from DN450 to DN825, with scour protection provided where necessary.
- ∴ A soak pit will discharge to the ground primary flow from the upstream contributing catchment flow path cut-off by the proposed 500-year LoS stopbank (SH2 to gravel beach) towards the north of Whirinaki.
- ∴ Cross-drainage along the proposed stopbank adjacent to Pan Pac involves upgrading existing cross-drainage infrastructure and installing Pan Pac issued stormwater rising main pipes.

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1.0 Introduction

Pattle Delamore Partners Limited (PDP) has been engaged by Hawke's Bay Regional Council (HBRC) to prepare a preliminary design for the cross-drainage infrastructure associated with the proposed upgrade and extension of the stopbank as part of the Whirinaki Flood Resilience project at Whirinaki Drain, Eskdale.

The purpose of this report is to present the preliminary design for the proposed Whirinaki stopbank cross-drainage infrastructure associated with the conveyance and discharge of runoff along the land side of the proposed Whirinaki stopbank.

1.1 Project Overview

The Whirinaki Drain flows through the vicinity of Whirinaki, north of the Esk River in Hawke's Bay. It is situated adjacent to the Whirinaki Pan Pac Forest Products Ltd (Pan Pac) facility, Whirinaki Power Plant, the Ararata Urupā cemetery, and residential properties. The location of the proposed stopbank within the broader Hawke's Bay region is shown in Figure 1 below.

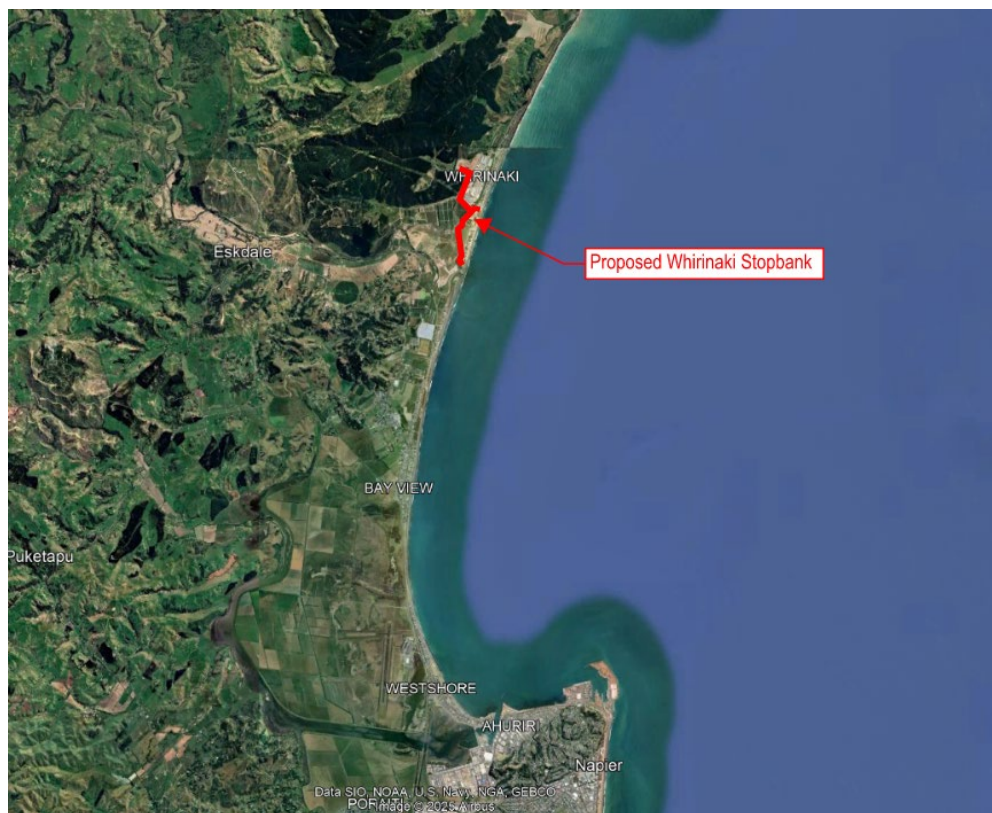


Figure 1: Location of Whirinaki stopbank within the Bay View area.

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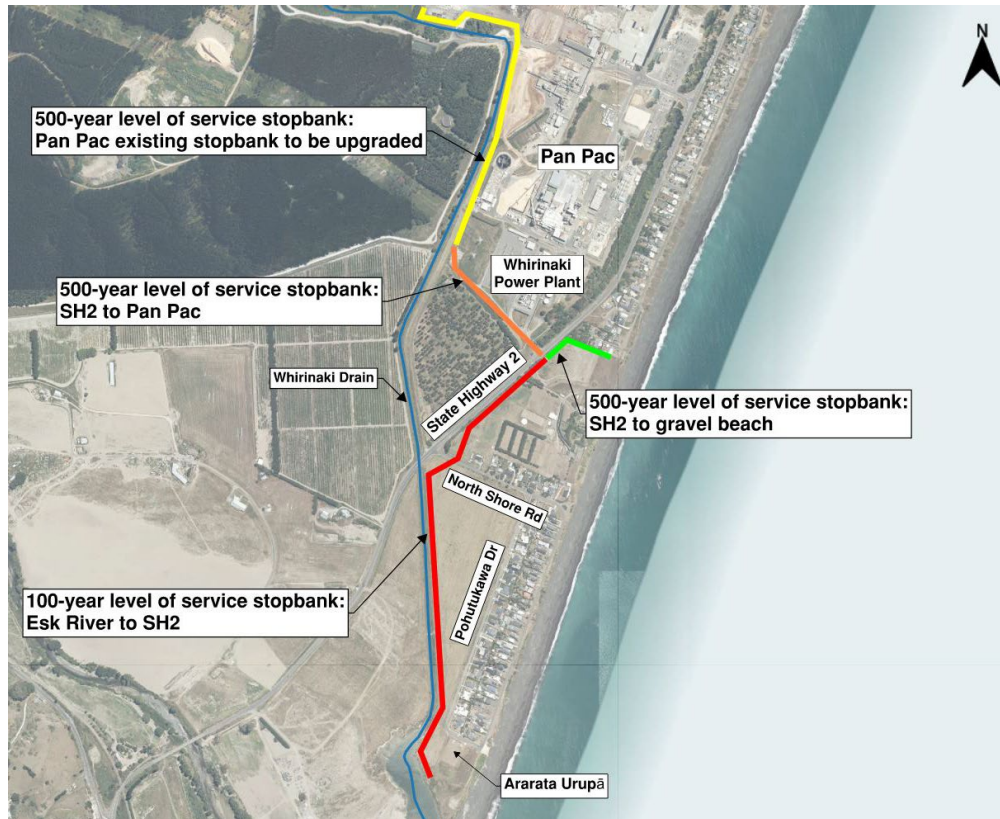
During Cyclone Gabrielle in February 2023, the Esk River and surrounding area experienced widespread flood damage. The Whirinaki Pan Pac facility sustained several million dollars' worth of damage due to flooding of the Whirinaki Drain, according to a 2024 article from Pan Pac (Pan Pac Forest Products Ltd., January 2024).

A number of upgrades are proposed to increase flood resilience in the area. The flood resilience work includes, but is not limited to, the following:

- ∴ 100-year level of service stopbank:
 - Esk River to North Shore Road: Construct a new stopbank to meet a 100-year level of service (LoS).
 - North Shore Road to SH2: Construct a new stopband to meet a 100-year LoS.
- ∴ 500-year level of service stopbank:
 - SH2 to gravel beach: Construct a new stopbank to meet a 500-year LoS
 - SH2 to Pan Pac: Construct a new stopbank to meet a 500-year Lo and tie-in with the existing Pan Pac/Whirinaki stopbank.
 - Pan Pac existing stopbank: The existing stopbank along the western boundary of Pan Pac will be upgraded to a 500-year LoS to protect the Pan Pac site.
- ∴ Cross-drainage infrastructure associated with the proposed stopbank.

Refer to Figure 2 for the extent of the proposed resilience works, with the proposed upgrade to SH2 shown in the clouded area.

Note that the drainage associated with SH2 is not included in this report as it is outside of the scope of the project.



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Figure 2: Extent of the proposed resilience works at Whirinaki.

1.2 Purpose of Preliminary Design

The purpose of the cross-drainage design is to manage ponding at the toe of the proposed stopbank and to facilitate existing overland flow and cross-drainage towards the Whirinaki Drain.

This report outlines the preliminary design of the proposed drainage infrastructure.

2.0 Existing Services

A layout drawing of the existing services at the site was prepared based on the following information sources:

- ✦ Hastings District Council (HDC) Utilities GIS Map.
- ✦ HBRC Regional Assets Information GIS Map.
- ✦ Whirinaki Drain survey by Zorn Surveying Ltd, 16 November 2023.

Refer to drawing series 200 (HB010700006-CI-200) in Appendix A for the location of the existing services.

The key existing services along the 100-year level of service stopbank from the Esk River to SH2, referenced in the proposed stopbank chainages, are:

- ∴ Watermain overflow pipe at approx. CH215 discharging to Whirinaki Drain – DN375 (type reinforced concrete).
- ∴ Stormwater pipe at approx. CH430 discharging Pōhutakawa Drive stormwater to Whirinaki Drain (DN100) (type Novacoil).
- ∴ North Shore Road at approx. CH915, which provides access from SH2 to North Shore Road and Pohutukawa Drive residential areas.
- ∴ Water supply pipe along North Shore Road at approx. CH925 (DN150) (type MDPE).
- ∴ Telecom ducts along North Shore Road at Approx. CH925.
- ∴ Overhead powerlines along North Shore Road at approx. CH925.

The key existing services along the 500-year level of service from SH2 to Pan Pac, referenced in the proposed stopbank chainages, are:

- ∴ Overhead powerlines between CH 550 – CH 700 on the 500-year proposed stopbank.
- ∴ Reinforced concrete culvert from Pan Pac API through the existing stopbank, located at approx. CH700 (DN300).
- ∴ Services (water supply rising mains, and comms) through the existing stopbank at approx. CH910.

There are no outstanding existing services along the 500-year level of service stopbank from SH2 to the gravel beach.

3.0 Basis of Design

3.1 Design Standards

The following design guidelines were referenced during the design process:

- ∴ Hawke's Bay Waterway Guidelines - Stormwater Management, May 2009;
- ∴ Hastings District Council (HDC) Engineering Code of Practice, December 2020; and,
- ∴ Acceptable Solutions and Verifications Methods For New Zealand Building Code Clause E1 Surface Water (2023).

3.2 Design Inputs

The following inputs were utilised in design:

- ∴ PDP proposed stopbank design (latest revision dated July 2025);

- ∴ Land Information New Zealand LiDAR, NZVD, 2023;
- ∴ Whirinaki Drain survey by Surveying the Bay Ltd, 5 June 2025;
- ∴ Torrens Industrial (on behalf of Pan Pac) proposed infrastructure:
 - Discharge pipe from Pan Pac API separator at CH700 (DN300 PE100 pipe);
 - Proposed stormwater rising main pipe sizes at approx. CH700 and CH910 (OD355 HDPe pipe);
 - Rising mains and services at approx. CH910.

3.3 Design Basis

The key basis of design parameters was established as listed in Table 1.

Table 1: Basis of Design Parameters		
Item	Parameter	Comment
Primary flows	20% AEP including climate change elsewhere.	Based on the HDC Engineering Code of Practice for rural residential and commercial areas.
Secondary flows	2% AEP including climate change for existing developments.	Based on the HDC Engineering Code of Practice.
Rainfall	HIRDS v4 RCP 6.0 up to 2100.	
Scour protection required	When outlet velocity > 2 m/s.	
Minimum cross-drainage culvert diameter	DN450	As agreed with HBRC and presented in the concept design.
Backflow protection	Flapgates (or similar) at the outlet to Whirinaki Drain.	As agreed with HBRC and presented in the concept design.
Water quality treatment	No water quality treatment is required as part of the scope.	As agreed with HBRC and presented in the concept design.

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4.0 Catchments, Hydrological and Hydraulic Analysis

4.1 Existing Drainage

Stormwater runoff in the existing Whirinaki catchment drains towards Whirinaki Drain. The soil conditions result in poor infiltration as a result of silt overlaying the in-situ gravels. Localised ponding is common during rainfall events due the area's flat grade and poor infiltration, with SH2 sitting as a high point throughout the catchment. The 10-year to 20-year rainfall events result in flooding along the Whirinaki Drain and overtopping of SH2 (refer to HB010500006R020 – *Assessment of Effects on Flooding for Proposed Whirinaki Stopbank* (PDP, 2025)).

4.2 Pre-Development

The pre-development catchments and overland flow paths are shown below in Figure 3. These represent the hydrological characteristics of the existing site before the construction of the proposed stopbank and have been delineated using available survey and LiDAR information. The pre-development catchment encompasses the area that discharges all associated stormwater into Whirinaki Drain. The pre-development catchment plan is included in Appendix B.

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Figure 3. Pre-development catchment.

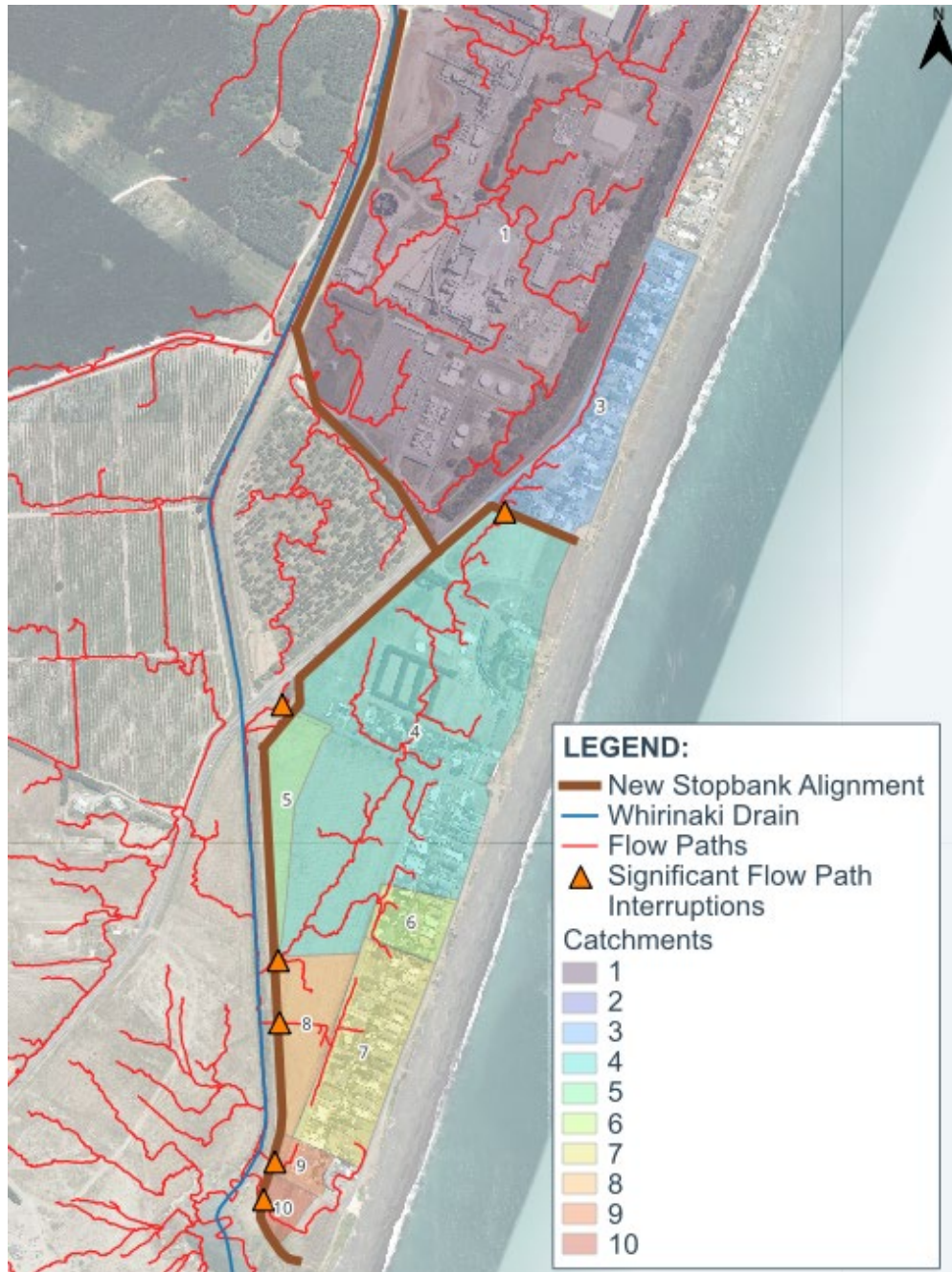
4.3 Post Development

The post-development catchments are shown in Figure 4. These represent the hydrological characteristics of the site after the construction of the proposed stopbank is complete and have been determined based on available survey and LiDAR information. These were delineated into catchments draining to proposed swales/stormwater infrastructure.

The proposed new alignment design results in the cutoff of overland flow paths in the following locations (see Figure 4):

- ∴ Along Whirinaki Drain by the 100-year level of service stopbank from Esk River to North Shore Road.
- ∴ The northern residential catchments by the 500-year level of service stopbank from SH2 to the gravel beach.
- ∴ At the junction of North Shore Road and SH2 through the raising of North Shore Road.

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Figure 4. Post-development catchments.

Note that the existing Pan Pac stopbank is included under the pre-development site.

The proposed stormwater cross-drainage design aims to address the effects on the overland flow paths by redirecting flows to cross-drainage infrastructure.

The proposed cross-drainage infrastructure will manage flood risks to pre-development levels.

The flows from the post-development catchments were calculated using the Rational Method. The time of concentration was identified for each catchment using the Ramser-Kirpich method as recommended by the HBRC Stormwater Guidelines. A minimum time of concentration of 10 minutes was adopted for any catchments with smaller calculated times of concentration. An overview of the catchment parameters is provided in Table 2. Refer to Figure 4 for the respective catchment areas.

The post-development catchment plan is included in Appendix B.

Table 2: Post Development Catchment Flows					
Catchment ¹	Area (ha)	Runoff Coefficient	Q _{20% AEP} (L/s) ²	Q _{10% AEP} (L/s) ²	Q _{100% AEP} (L/s) ²
1	29.2	0.86	2197	2662	4516
2	4.00	0.64	319	388	669
3	4.13	0.50	379	463	812
4	17.1	0.31	653	795	1371
5	0.92	0.26	55	68	120
6	1.07	0.50	124	152	268
7	3.59	0.50	413	507	897
8	1.99	0.25	91	111	195
9	0.55	0.37	47	57	101
10	0.53	0.25	30	37	66
<p><i>Notes:</i></p> <ol style="list-style-type: none"> Catchment locations and delineations are provided in Appendix A Q is the peak flow rate assessed for the catchment during the 5-year, 10-year, and 100-year ARI design storms with allowance for climate change. 					

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5.0 Proposed Preliminary Design

The proposed preliminary design is as described below and detailed in the drawings listed in Table 3.

Table 3: Preliminary Design Drawing Set	
Drawing No.	Description
HB010500006-GN-001	Cover Sheet
HB010500006-GN-002	Drawing List
HB010500006-CI-401	Proposed Swale Layout Plan Sheet 1
HB010500006-CI-402	Proposed Swale Layout Plan Sheet 2
HB010500006-CI-421	Infiltration Basin & Soakpit Details
HB010500006-CI-422	Proposed Pan Pac Stormwater Layout Plan
HB010500006-CI-423	Stormwater Details Sheet 1
HB010500006-CI-424	Stormwater Details Sheet 2
HB010500006-CI-425	Stormwater Details Sheet 3
HB010500006-CI-426	Stormwater Details Sheet 4
HB010500006-CI-427	Stormwater Details Sheet 5

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5.1 Overview of Design

The cross-drainage infrastructure has been sized to capture and convey the 20% AEP (inclusive of climate change) runoff event without ponding.

For the events larger and up to the 1% AEP (inclusive of climate change), it is expected that some ponding will occur on the landside of the stopbank, with the ponding expected to subside as the water levels within the Whirinaki Drain drop. The ponding is limited to undeveloped areas and to areas that would have been flooding during pre-development conditions (Refer to HB010500006R020 – *Assessment of Effects on Flooding for Proposed Whirinaki Stopbank* (PDP, 2025)).

The preliminary design has considered the total upstream contributing catchment and allowance (i.e., capacity) has been made for future Hasting District Council stormwater infrastructure to be connected to the cross-drainage (e.g., North Shore Road and Pohutukawa Road) to discharge up to the 10% AEP (inclusive of climate change) rainfall event.

The preliminary design is described in the sections below.

5.2 100-year Level of Service Stopbank:

5.2.1 Esk River to North Shore Road

Cross-drainage is required for the 100-year level of service stopbank from Esk River to North Shore Road because the proposed stopbank interrupts the existing overland flow paths into Whirinaki Drain, as well as existing stormwater infrastructure. Drainage for the catchments to the south of North Shore Road will be provided by drainage swales and penetrations through the stopbank.

Refer to Drawing HB010500006-CI-401 and HB010500006-CI-402 in Appendix B.

Stormwater runoff draining towards the stopbank and the Whirinaki Drain will be managed as follows:

- ∴ Existing infrastructure:
 - The existing DN375 watermain scour pipe (size TBC) is to partially remain in place up to a new scruffy dome at CH215, while the remainder is abandoned and replaced with a DN450 (Outfall-01).
 - The existing Novacoil pipe from Pohutukawa Drive will remain and tie into a new manhole at approximately CH430, where it will drain via subsoil drains to Outfall-02.
- ∴ Three grassed swales with a maximum depth of 0.3 m will capture runoff towards the stopbank and direct runoff towards cross-drainage infrastructure through the proposed stopbank (i.e., Outfall-01 and Outfall-02). The swales will have the following characteristics:
 - Trapezoidal shape with 0.5 – 1.5 m base and maximum side slopes of 1V:4H.
 - Subsoil drains where slopes are less than 1V:200H.
 - Grassed via hydroseeding.
 - Note that due to space constraints, all swales have top widths of less than 4 m, and this will result in some being undersized. However, due to no nearby existing infrastructure, ponding during rainfall events will not pose any further flood risk.
- ∴ Scruffy domes are shown on layout drawing HB010500006-CI-401 and 402, included in Appendix B, and consist of the following:
 - SWMH-01: DN900 scruffy dome approx. at CH215.
 - SWMH-02: DN1050 scruffy dome approx. at CH430.
 - SWMH-03: DN1500 scruffy dome approx. at CH510.

- ∴ The proposed inlet structures (e.g., scruffy domes) will discharge captured runoff into the Whirinaki Drain via the following proposed cross-drainage outfalls:
 - Outfall-01: DN450 RCRRJ Class 4 pipe at CH215; and,
 - Outfall-02: DN825 RCRRJ Class 4 pipe at CH510.

All services through the stopbank are to have a filter collar as per the details.

The estimated discharge velocity at each of the outlets is listed in Table 4 below. All culverts will have flap gate outlets on the downstream end for backflow prevention in Whirinaki Drain flood events. Scour protection will be provided for culverts with an outlet velocity greater than 2 m/s.

Table 4: Culvert Outlet Flows and Velocities			
Culvert Chainage	20% AEP inlet flow (L/s)	20% AEP flow outlet velocity (m/s)	Scour Protection
Outfall-01	77	1.2	Proposed typical outlet detail with no riprap.
Outfall-02	1,352	2.8	Proposed typical outlet detail with riprap.

Note that cross-drainage infrastructure between North Shore Road and State Highway 2 is not required due to the proposed stopbank not intercepting any existing flow paths along this section.

5.2.2 North Shore Road Culvert

The raising of SH2 for the 100-year level of service stopbank requires drainage via swales to direct flows towards the junction of SH2 and North Shore Road. Under pre-development conditions, stormwater flows across the low point close to the intersection between SH2 and North Shore Rd and discharges into Whirinaki Drain immediately downstream of the existing SH2 culverts.

Cross-drainage is required as the raising of North Shore Rd changes the road levels and the existing low point. Drainage for the contributing catchment between the 100-year level of service stopbank and SH2 (refer to Figure 4) will be provided by swales and a culvert through North Shore Road.

Note that runoff from the raised SH2 portion (designed by others) from the crossing of the 500-year LoS stopbank over SH2 towards North Shore Road will be captured by roadside swales and directed toward the North Shore Road and SH2 junction. PDP designed the SH2 drainage, and this is reported elsewhere.

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The stormwater draining to the junction of North Shore Road and SH2 will be managed as follows:

- ∴ Two grassed swales (one upstream and one downstream of the North Shore Road culvert) with maximum depths of 0.3 m will capture runoff towards the junction and direct runoff towards cross-drainage infrastructure through the raised road. The swales will have the following characteristics:
 - Trapezoidal shape with 1.5 m base and maximum side slopes of 1V:5H.
 - DN100 subsoil drain.
 - Grassed via hydroseeds.
- ∴ Cross-drainage piped infrastructure through North Shore Road at approx. CH900: DN375 RCRRJ Class 4 pipe laid at 1% grade with a traversable headwall at both ends.

Refer to Drawing HB010500006-CI-402 in Appendix C.

The estimated discharge velocity of the culvert is 1.63 m/s. Both the culvert outlet and swale outfall to Whirinaki Drain will be fitted with rip rap to protect against scour and erosion.

5.3 500-year Level of Service Stopbank:

5.3.1 SH2 to Gravel Beach

Cross-drainage is required for the 500-year LoS stopbank from SH2 to the gravel beach as it cuts off the existing overland flow path to the downstream catchments that discharge into Whirinaki Drain (refer to Figure 5).



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Figure 5. Soak pit location.

There were two options considered; one being sizing a soak pit for the 100-year event to eliminate the need for a penetration through the stopbank. However, this option was not pursued due to size constraints and not addressing allowance for a secondary flow path if the soakage was blocked.

The proposed drainage design is a soak pit upgradient of the stopbank and a double culvert through the stopbank to provide secondary flow in larger events, described in more detail below.

Soakage is considered feasible in the location due to shallow (less than 2 m thick) silts overlaying beach gravels. The beach gravels are expected to have a very high infiltration and are subject to confirmation by means of a soakage test before construction.

The soak pit is designed to capture and discharge to the ground the 10% AEP 1-hour flows as per the Acceptable Solutions and Verification Methods of the E1 Surface Water building code clause.

Refer to Drawing HB010500006-CI-421 in Appendix B.

The proposed infrastructure will consist of the following:

- ∴ DN1050 scruffy dome located within the existing overland flow path and low point, inset 0.2 m below the natural ground level.
- ∴ Soak pit with a base area of approx. 190 m² with the following details:
 - Soak pit to be offset min. 5 m from toe of stopbank.
 - Allow for the soak pit to be excavated min. 1 m into natural gravels (beach gravels).
 - Soak pit to be filled with washed and clean 100 mm to 150 mm rock.
 - Subsoil drains (DN200) connected to the DN1050 scruffy dome to disperse runoff through the soak pit media.
 - Bidim geotextile to be installed around the top and sides (not bottom) of the rock media.
- ∴ Overflow channel towards stopbank culvert at CH 125 with depth of 0.2 m and base width of 1.5 m.
- ∴ Twin DN300 RCRRJ Class 4 pipes, with headwalls, to cross-drain runoff above 10% AEP event. All services through the stopbank are to have a filter collar as per the details.

It is estimated that some ponding will occur for events above a 10% AEP. Due to the lay of the land, this ponding is not likely to increase the flood risk of nearby properties.

5.3.2 SH2 to Pan Pac

Stormwater from the Pan Pac site is collected and treated onsite by Pan Pac's internal stormwater infrastructure and discharged to the Whirinaki Drain as part of the consented activities.

It is proposed to upgrade the existing DN300 stormwater outfall, approx. at CH700 and install Pan Pac issued OD355 HDPE stormwater rising mains at CH700 (API Rising Main) and CH915 (Central Rising Main).

Refer to Drawing HB010500006-CI-422 in Appendix B.

Stormwater discharging to Whirinaki Drain will be managed as follows:

- ∴ Replace the existing DN300 stormwater pipe with a DN450 RCRRJ Class 4 pipe at CH700 with the following additional components:

- DN1200 scruffy dome to capture surface runoff from the southern end of the Pan Pac site;
 - Outlet fitted with headwall, flap gate, and riprap; and,
 - Stormwater rising main from API to be installed in the same trench (OD355 PE100 pipe).
- ∴ Install Pan Pac issued OD355 PE100 HDPE rising main at CH700 (API Rising Main) and CH915 (Central Rising Main) with the following components:
- Pipework (supplied by Pan Pac) will be OD355 PE100 HDPE electro fusion (EF) jointed pipes;
 - All services through the stopbank are to have a filter collar as per the details;
 - Outlet fitted with headwall, flap gate, and riprap; and,
 - Isolation valves on either side (by others).

The rising main outlet velocities have been provided by Pan Pac and are discussed in Table 5 below.

Table 5: Pan Pac Rising Main Outlet Flows and Velocities		
Culvert Chainage	Outlet Velocity (m/s)	Scour Protection
API Rising Main	1.95	Proposed typical outlet detail with no riprap.
Central Rising Main	1.5	Proposed typical outlet detail with no riprap.

6.0 Preliminary Cost Estimate

The preliminary cost estimate is provided in Table 6, with a detailed cost estimate breakdown for each portion of infrastructure attached in Appendix C.

Table 6: Preliminary Cost Estimate		
No.	Description	Cost (Excl. GST)
1	Preliminary and General	\$91,600
2	Swales	\$97,300
3	Soakage	\$164,000
4	Outfalls and Associated Infrastructure	\$160,200
5	Contingency	\$165,000
Total		\$678,100

The following assumptions were made for this cost estimate:

- ∴ The costs are exclusive of GST.
- ∴ Preliminary and general cost of 20% has been estimated.
- ∴ A 30% contingency has been allowed for.

7.0 References

Pan Pac Forest Products Ltd (January 2024), *A welcome sight on the horizon: Steam rises again from Pan Pac.* <https://www.panpac.co.nz/a-welcome-sight-on-the-horizon-steam-rises-again-from-pan-pac/>.

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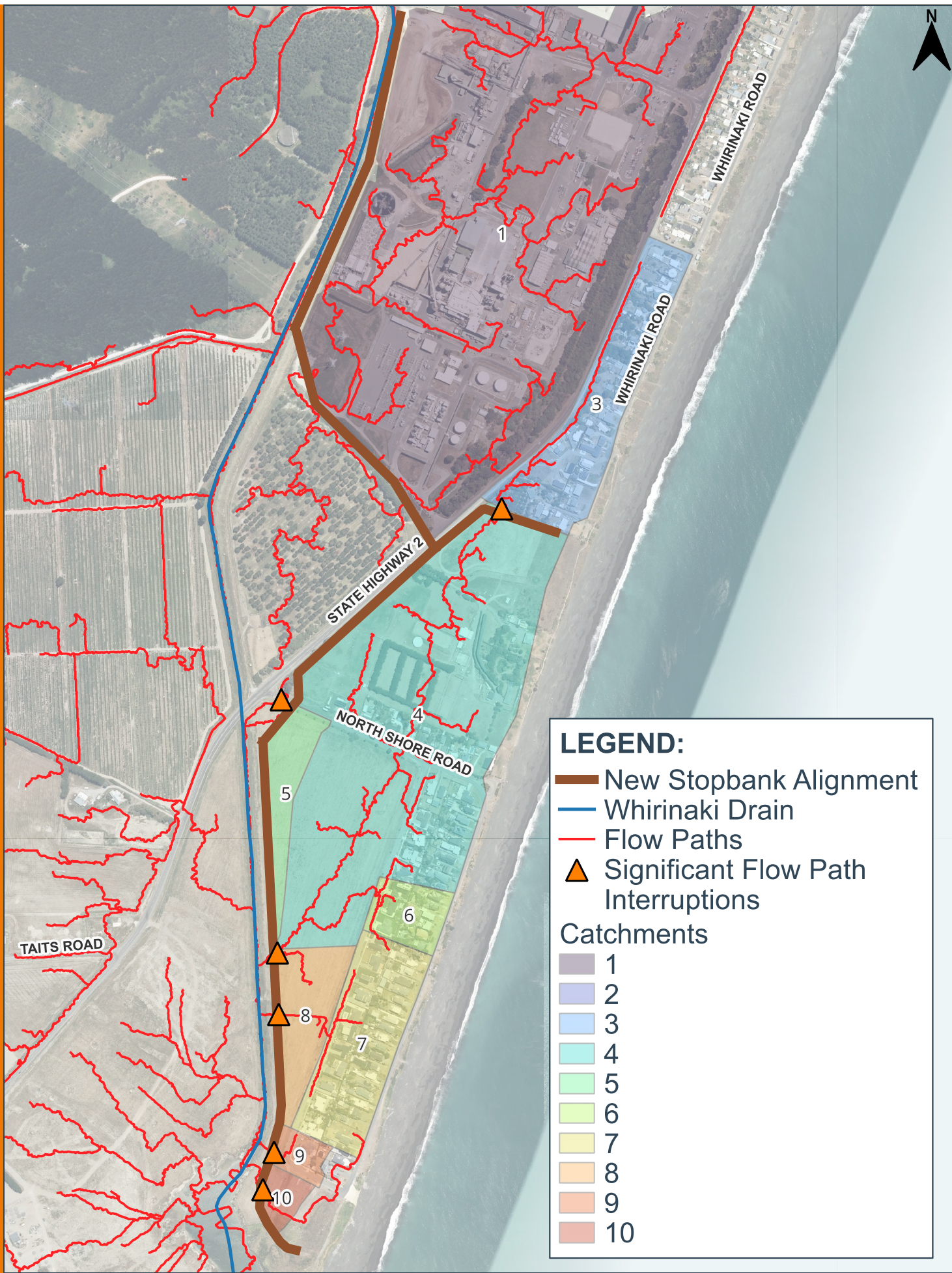
Appendix A: Existing Infrastructure Drawings

Refer to Preliminary Design Report.

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Appendix B: Catchments

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LEGEND:

- New Stopbank Alignment
- Whirinaki Drain
- Flow Paths
- Significant Flow Path Interruptions

Catchments

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Post Development Catchments

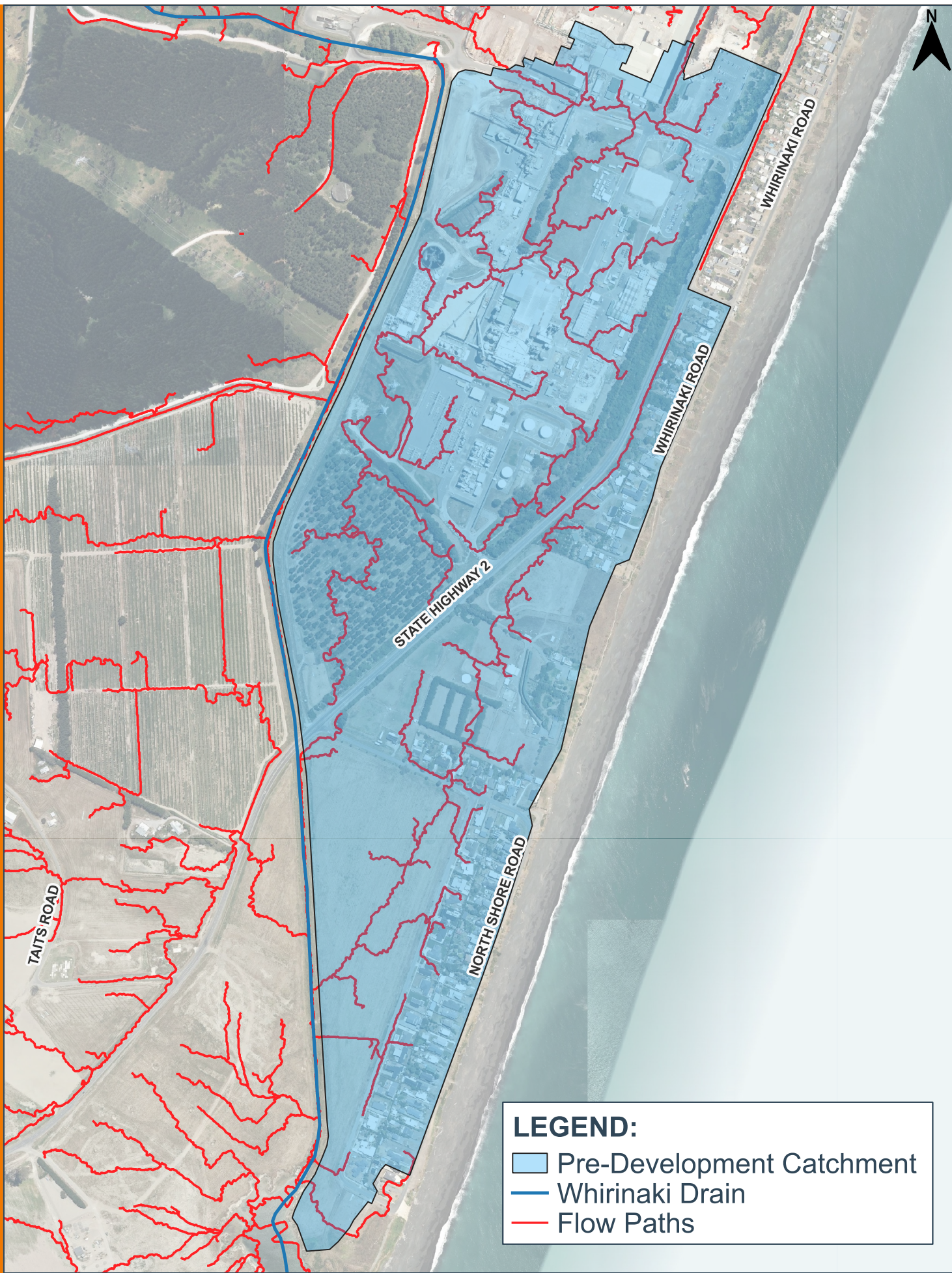
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REVISION: 01 | DATE: 07 25 | BY: AG



LEGEND:

- Pre-Development Catchment
- Whirinaki Drain
- Flow Paths

Appendix C: Cross-Drainage Design Drawings

Refer to Preliminary Design Report.

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Appendix D: Cost Estimate

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Whirinaki Drainage Upgrade Preliminary Design Cost Estimate

Client Name: Hawke's Bay Regional Council
 Revision: 2
 Date: 30/07/2025

Schedule of Quantities					
Item	Description	Unit	Qty	Rate	Amount
Whirinaki Culvert Upgrade					
1	Preliminary and General				
1.1	Preliminary and General Items	LS	20%	\$ 457,818.10	\$ 91,570.00
Sub-Total Section 1					\$ 91,570.00
2	Swale SWS-01 (CH0 - CH75)				
2.1	Strip topsoil to stockpile	m ²	223	\$ 5.00	\$ 1,115.00
2.2	Excavate to channel depth	m ³	39	\$ 10.00	\$ 390.00
2.3	Spread topsoil on channel batters and base	m ²	224	\$ 8.00	\$ 1,792.00
2.4	Hydroseed channel batters and base	m ²	224	\$ 10.00	\$ 2,240.00
2.5	Supply and install DN 110 PVC pipe punched and drainage aggregate	m	75	\$ 57.00	\$ 4,275.00
Sub-Total Section 2					\$ 9,812.00
3	Outfall at CH 75				
3.1	Supply and installation of DN 900 manhole and scruffy dome	ea	1	\$ 3,610.00	\$ 3,610.00
3.2	Supply and installation of DN 450 concrete pipe	m	23	\$ 530.00	\$ 12,190.00
3.3	Supply and installation of DN 450 flapgate	ea	1	\$ 9,550.00	\$ 9,550.00
3.4	Supply and installation of DN 450 headwall at outlet	ea	1	\$ 5,000.00	\$ 5,000.00
Sub-Total Section 3					\$ 30,350.00
4	Swale SWS-02 (CH 125 - CH 372)				
4.1	Strip topsoil to stockpile	m ²	993	\$ 5.00	\$ 4,965.00
4.2	Excavate to channel depth	m ³	203	\$ 10.00	\$ 2,030.00
4.3	Spread topsoil on channel batters and base	m ²	994	\$ 8.00	\$ 7,952.00
4.4	Hydroseed channel batters and base	m ²	994	\$ 10.00	\$ 9,940.00
4.5	Supply and install DN 110 PVC pipe punched and drainage aggregate	m	250	\$ 57.00	\$ 14,250.00
Sub-Total Section 4					\$ 39,137.00
5	Manhole at CH 300				
5.1	Supply and installation of DN 1050 manhole	ea	1	\$ 2,650.00	\$ 2,650.00
Sub-Total Section 5					\$ 2,650.00
6	Outfall at CH375				
6.1	Supply and installation of DN1500 scruffy dome	ea	1	\$ 10,000.00	\$ 10,000.00
6.2	Supply and installation of DN825 concrete pipe	m	19	\$ 1,530.00	\$ 29,070.00
6.3	Supply and installation of DN825 flapgate	ea	1	\$ 31,300.00	\$ 31,300.00
6.4	Supply and installation of DN 825 headwall at outlet	ea	1	\$ 5,000.00	\$ 5,000.00
6.5	Supply and installation of DN ₅₀ =400 riprap at outlet	m ³	2	\$ 450.00	\$ 900.00
Sub-Total Section 6					\$ 76,270.00
7	Swale SWS-03 (CH 375 - CH 750)				
7.1	Strip topsoil to stockpile	m ²	557	\$ 5.00	\$ 2,785.00
7.2	Excavate to channel depth	m ³	62	\$ 10.00	\$ 620.00
7.3	Spread topsoil on channel batters and base	m ²	652	\$ 8.00	\$ 5,216.00
7.4	Hydroseed channel batters and base	m ²	652	\$ 10.00	\$ 6,520.00
7.5	Supply and install DN 110 PVC pipe punched and drainage aggregate	m	375	\$ 57.00	\$ 21,375.00
Sub-Total Section 7					\$ 36,516.00
8	Swale SWS-04 (North Shore Road to Whirinaki Drain)				
8.1	Strip topsoil to stockpile	m ²	301	\$ 5.00	\$ 1,505.00
8.2	Excavate to channel depth	m ³	72	\$ 10.00	\$ 720.00
8.3	Spread topsoil on channel batters and base	m ²	307	\$ 8.00	\$ 2,456.26
8.4	Hydroseed channel batters and base	m ²	307	\$ 10.00	\$ 3,070.32
8.5	Supply and install DN 110 PVC pipe punched and drainage aggregate	m	70	\$ 57.00	\$ 3,990.00
Sub-Total Section 8					\$ 11,741.58
9	North Shore Road Culvert				
9.1	Supply and installation of DN375 concrete pipe	m	25	\$ 321.00	\$ 8,025.00
9.2	Supply and installation of DN375 headwall at inlet and outlet	ea	2	\$ 5,000.00	\$ 10,000.00
Sub-Total Section 9					\$ 18,025.00

Item	Description	Unit	Qty	Rate	Amount
	Whirinaki Culvert Upgrade				
10	Soak Pit and Culvert (CH 120, SH2 to Gravel Beach)				
10.1	Strip topsoil to stockpile	m ²	190	\$ 5.00	\$ 950.00
10.2	Excavate to soak pit depth	m ³	570	\$ 71.00	\$ 40,470.00
10.3	Drainage washed rock fill (100 - 150 mm)	m ³	353	\$ 212.00	\$ 74,920.80
10.4	Supply and install DN 220 PVC pipe punched and drainage aggregate	m	53	\$ 96.60	\$ 5,119.80
10.5	Supply and installation of DN 1050 manhole and scruffy dome	ea	1	\$ 5,210.00	\$ 5,210.00
10.6	Supply and installation of bidim geotextile liner	m ²	352	\$ 6.20	\$ 2,179.92
10.7	Supply and installation of two DN 300 concrete pipe	m	30	\$ 170.00	\$ 5,100.00
10.8	Supply and installation of DN 300 flapgate	ea	2	\$ 9,550.00	\$ 19,100.00
10.9	Supply and installation of DN 300 headwall at inlet	ea	2	\$ 5,000.00	\$ 10,000.00
10.10	Supply and installation of DN ₅₀ =400 riprap at outlet	m ³	2	\$ 450.00	\$ 900.00
	Sub-Total Section 10				\$ 163,950.52
11	Outfall at CH 700 (Pan Pac SW & API)				
11.1	Supply and installation of DN 1200 scruffy dome	ea	1	\$ 5,210.00	\$ 5,210.00
11.2	Supply and installation of DN 450 concrete pipe	m	23	\$ 530.00	\$ 12,190.00
11.3	Supply and installation of DN 450 flapgate	ea	1	\$ 9,550.00	\$ 9,550.00
11.4	Supply and installation of DN 450 headwall at outlet	ea	1	\$ 5,000.00	\$ 5,000.00
11.5	Supply and installation of DN ₅₀ =400 riprap at outlet	m ³	2	\$ 450.00	\$ 900.00
	Sub-Total Section 11				\$ 32,850.00
12	Outfall at CH 915 (Pan Pac Raw Water Supply)				
12.1	TBD				\$ -
	Sub-Total Section 12				\$ -
13	Contingency				
13.1	Contingency Sum	LS	30%	\$ 549,388.10	\$ 165,000.00
	Sub-Total Section 13				\$ 165,000.00
	Total Price (excluding GST) - Total				\$ 677,872.10