



# Wetland 2-1 Operations and Maintenance Manual

**Drury Centre**

Stage 2

Kiwi Property Group Ltd

14/03/2025

DRAFT

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## Document Control

<b>Project Number</b>	P24-447
<b>Project Name</b>	Drury Centre
<b>Client</b>	Kiwi Property Group Ltd
<b>Date</b>	14/03/2025
<b>Version</b>	V0
<b>Issue Status</b>	DRAFT
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## 1. Introduction

The operations and maintenance (O&M) manual details the proposed Wetland 2-1 at Stage 2 of the Drury Centre Precinct development by Kiwi Property No. 2 Limited ("Kiwi Property"). The wetland location is shown in Figure 1..

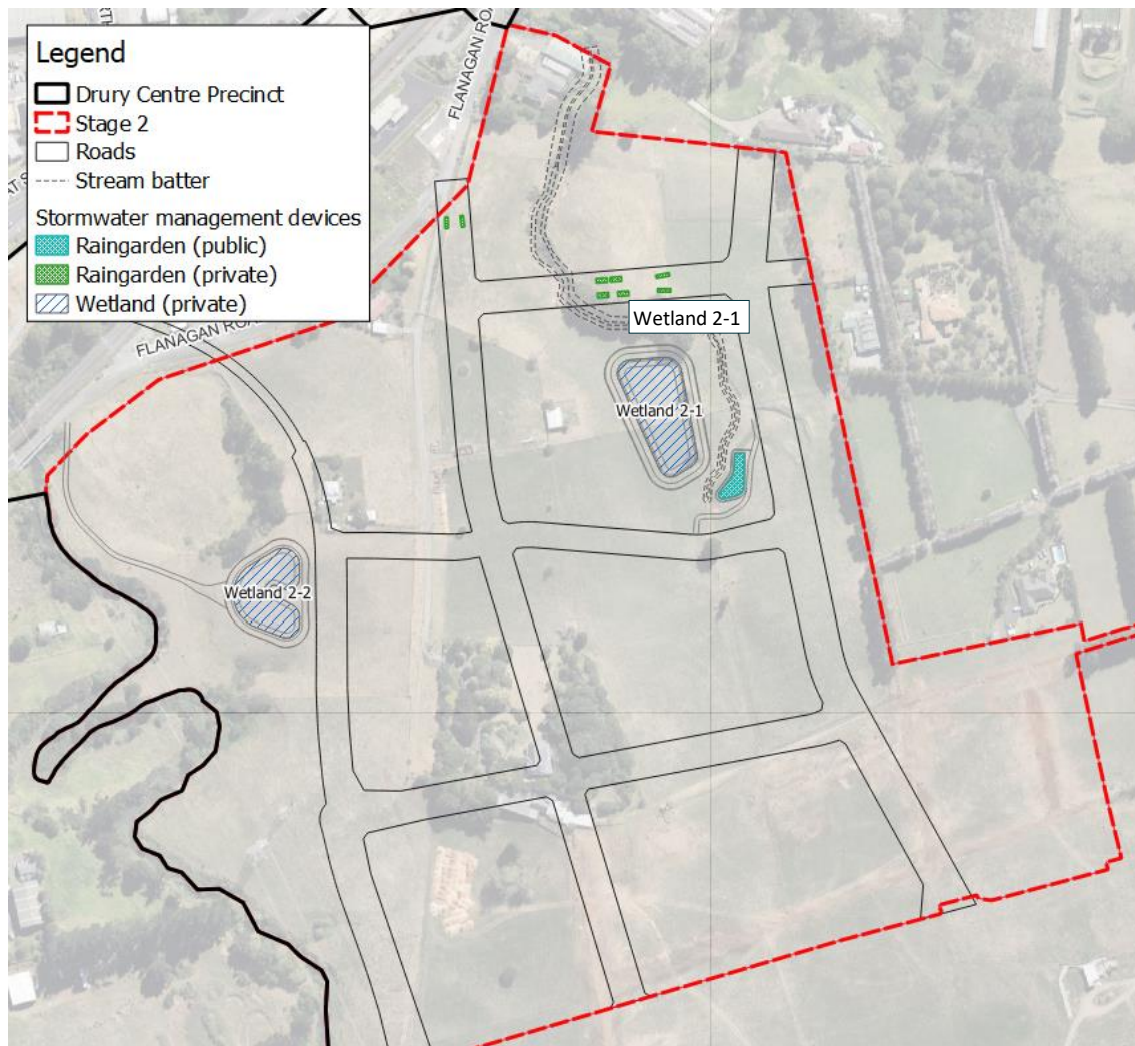


Figure 1: Proposed stormwater management

It is intended that this O&M manual provides:

- Background information on the stormwater treatment and detention facilities at Wetland 2-1,
- Basic background information on the contributing stormwater catchment,
- Design details for the stormwater treatment and detention system: and
- O&M details.

This manual excludes information on the stormwater reticulation system within the contributing catchment area.

The manual is to be updated following consent and construction with final O&M to be provided with CCC

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### 1.1. Contact information

A summary of the contact information relating to the ownership, maintenance manager and designer for the wetland are included in Table 1.

Table 1: Contact information

Asset ID		Resource Consent Number	
Location:		Development Name / Legal Description:	
<b>Asset Owner Details:</b>			
Name:		Adress:	
Telephone Number:			
Email:			
<b>Maintenance Manager Emergency Contact Details:</b>			
Name:			
Telephone Number: (Daytime)			
Telephone Number: (Out of Hours)			
Email:			

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<b>Design Details:</b>			
Name:			
Telephone Number:			
Email:			
<b>Applicant Details:</b>			
Name:			
Telephone Number:			
Email:			
<b>Landowner Details:</b>			
Name:			
Telephone Number:			
Email:			
Notes / Restrictions / Access			

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## 2. System Description

### 2.1. Catchment description

Wetland 2-1 provides stormwater treatment and detention for a 9.21ha stormwater catchment, as detailed in Table 2.

Table 2: Contributing catchment to Wetland 2-1

	<b>Total impervious area (ha)</b>	<b>Total pervious area (ha)</b>	<b>Total contributing catchment area (ha)</b>
Catchment contributing to Wetland 2-1	8.98	0.23	9.21

### 2.2. Design Philosophy

The purpose of the proposed wetland is to provide stormwater treatment and detention for the contributing catchment. The wetland was designed to improve water quality through reducing contaminants such as Total Suspended Solids (TSS) and contaminants bound to the sediment. Planting around promoted biodiversity and improves public perception of the stormwater device.

#### 2.2.1. Key Features

The wetland was designed to meet the following design requirements.

- Water Quality: provide water quality volume equivalent to runoff generated from the catchment for 90<sup>th</sup> percentile storm event.
- Hydrology Mitigation:
  - Retention – Provide retention of at least 5 runoff depth
  - Detention – Provide detention and a drain-down period of 24 hours for the difference between the pre- and post-development runoff volume from the 95<sup>th</sup> percentile, 24-hour rainfall event minus 5mm retention.

#### 2.2.2. Timeline

Construction not yet completed. This section will be completed after the Wetland is constructed.

#### 2.2.3. Critical Levels as per approved Design and As-built Data

The design has not yet been approved. This section will be completed once the design of the wetland has been approved.

### 2.3. As-Built Information

The be provided following consent and construction

### 2.4. Design Standards and Assumptions

The proposed Wetland 2-1 is designed to provide SMAF 1 hydrology mitigation and water quality treatment.

The wetland has been designed in accordance with GD01 guidelines.

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## 2.5. Stakeholder Consultation

A session was held with Healthy Waters to discuss the stormwater management approach for Drury Stage 2 development as part of the Fast-Track application. During the ongoing planning process, further engagements will be held.

## 2.6. Ground conditions

The wetland shall be constructed as per the recommendations of the geotechnical report

## 2.7. Consent information

To be provided following consent approval.

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### 3. System Components and Maintenance Requirements

The system components, related maintenance actions and Health and Safety risks associated with these components are described in the following sections. Details of the proposed Wetland 2-1 design are shown in Figure 2. Further details will be provided during detailed design phase.

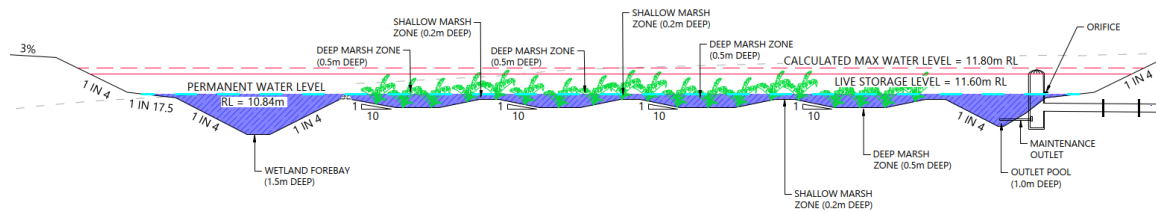


Figure 2: Wetland 2-1 Cross section A, DWG No. P24-447-01-3603-DR

#### 3.1. Inlet Structure Details

Wetland 2-1 has a single inlet. The inlet details can be found in Table 3 below. It is noted that this are indicative sizes and will be finalised in detailed design stage.

Table 3: Wetland Inlets

	Wetland 2-1
Inlet structure	DN600

##### 3.1.1. Routine Maintenance

Key routine maintenance actions identified for Wetland 2-1 inlet are summarised in Table 4 below.

Table 4: Wetland inlet maintenance actions

Component	Recommended Action
Wetland Inlets and Energy Dissipation / Erosion Protection Structures	Inspect for clogging and built up of sediments, debris, and rubbish around the wetland inlet and energy dissipation structure (baffle blocks).
	If the permanent water level of the wetland is above the inlet pipe invert and the wetland is in a low flow state, check that the water level is not artificially elevated by an outlet blockage. If sediment is partially blocking the inlet pipe, remove localised sediment and check if entire forebay require desilting.
	Erosion protection (e.g. rip rap, wingwall, concrete apron, reno mattress) should be inspected for erosion and loss of material. Check for scouring beneath inlet apron and repair/replace lost material.
	Inlet pipe and energy dissipation structures (e.g. baffle blocks) should be inspected for erosion and cracks in the structure, particularly where any exposed reinforcing may corrode. Fix cracks and erosion as necessary.

##### 3.1.2. Health and Safety Risks Associated with Wetland Maintenance

There are a number of health and safety risks associated with working around waterbodies and inlet structures. Some of these potential risks are highlighted in Table 5 below.

Table 5: Health and Safety risks associated with the working around waterbodies

Risk	Mitigation
Deep water (i.e. deeper than knee depth)	Do not enter the water, have rescue rope and second person available.
Steep and slippery banks	Take care and avoid wet soil conditions.
Submerged inlet structure	Check water level is not elevated due to recent rain or blockage. Drain water level before proceeding.
Flow through inlet making work unsafe (i.e. >0.5 m/s)	Ensure no rainfall has occurred in the last 24 hours and non in forecast
Confined space within inlet pipe	Do not enter the confined space.
Deep manholes	Do not enter the confined space. Take extra care when opening manholes.

### 3.2. Proprietary device/Gross Pollutant Trap (GTP)

The development proposed using GTP treatment devices to provide pre-treatment prior to flows entering the wetland.

#### 3.2.1. Routine Maintenance

GTP will be maintained in accordance with manufacturer's instructions.

#### 3.2.2. Health and safety Risk Associated with GTP Maintenance

There are a number of health and safety risks associated with working around the GTPs. Some of these possible risks are highlighted in Table 6 below.

Table 6: Health and safety risks associated with working around proprietary devices

Risk	Mitigation
<b>Biological hazards</b> - exposure to infectious agents or biohazards carried by trapped organic matter	Vaccinate workers against relevant diseases. Provide hand hygiene facilities and encourage good hygiene practices. Provide workers with appropriate PPE such as gloves, coveralls, and masks to protect against biological hazards. Implement regular cleaning and disinfection protocols for GTPs.
<b>Exposure of contaminants</b> – workers may be exposed to hazardous contaminants such as chemicals, oils, toxins, or hazardous materials that accumulate in the traps along with debris. This can lead to skin irritation, respiratory issues, or other health problems.	Wear appropriate PPE such as gloves, masks, goggles and coveralls. Provide proper training on handling hazardous materials and use of safety data sheets.
<b>Respiratory issues</b> - from inhaling dust, fumes, or mould present in the trap.	Use respiratory protection when dealing with dust, fumes or mould. Ensure adequate ventilation in the works area. Implement monitoring systems to detect the presence of biogases and ensure adequate ventilation of confined spaces. Establish procedures for safe entry into confined spaces, including atmospheric testing and the use of gas detectors. Provide workers with training on the

	hazards of biogases and the importance of proper ventilation and monitoring.
<b>Electric hazards</b> - shock from working near electrical equipment in or around the trap.	Inspect electrical equipment regularly for damage. Use ground fault circuit interrupters (GFCIs) and proper grounding techniques. Provide workers with training on electrical safety practices and procedures.
<b>Mechanical hazards</b> - workers may encounter mechanical hazards associated with the operation of machinery or equipment used for cleaning, maintaining, or servicing the traps, such as moving parts or pinch points.	Implement machine guarding and safety protocols to prevent workers from coming into contact with moving parts or pinch points. Provide training on the safe operation of machinery and equipment.
<b>Manual handling injuries</b> - musculoskeletal injuries from heavy lifting and manual handling of debris.	Provide training on safe lifting techniques. Use mechanical aids or equipment for lifting heavy debris/manual handling of equipment.
<b>Physical hazards</b> – workers may face slips, trips, or falls during maintenance due to the presence of wet surfaces or uneven terrain.	Wear appropriate health and safety gear to prevent against slips, trips and falls.
<b>Vehicle hazards</b> – workers using vehicles or heavy machinery to access or service the devices, there may be risks of rollovers or accidents associated with operating vehicles in close proximity to the traps or on uneven terrain.	Implement traffic management plans to control vehicle movement around work areas. Ensure operators receive proper training and certification for operating vehicles and machinery safely. Implement vehicle inspection and maintenance procedures to ensure equipment is in good working condition.

### 3.3. Outlet structure

The wetland outlet structure details can be found in It is noted that this are indicative sizes and will be finalised in detailed design stage.

Table 7. It is noted that this are indicative sizes and will be finalised in detailed design stage.

Table 7: Outlet details

	Wetland 2-1
Orifice	150mm Dia
Scruffy dome	1050mm
Outlet pipe	DN750

#### 3.3.1. Routine Maintenance

Key routine maintenance actions identified for the wetland outlet structure are summarised in Table 8 below.

Table 8: Outlet structure maintenance actions

Component	Recommended Action
Wetland outlets	Inspect wetland outlets for blockages caused by heavy sedimentation, floating debris, and rubbish.  The areas around the outlet control structure should be free of blockages and dense vegetation to maintain an unobstructed flow path for stormwater.

	Inspect for evidence of leaky joints or soil seeping around outflow pipe barrel.
	Inspect outfall and water discharge areas for erosion (presence and severity within 30m of discharge point).
	Restore eroded areas and stabilise as necessary
	Erosion (washout, scouring) around outflow pipes can be caused by water flowing from the wetland and out along the outside of pipe, which can lead to embankment failure.
Erosion protection	<p>Inspect areas of erosion protection (rip rap, reno mattress, gabions) to identify any damage or loss of material.</p> <p>Identify any preferential flow paths forming through erosion protection that could be affecting function.</p> <p>Repairs should be carried out as required.</p>
Debris screen	<p>The debris screens should be inspected for the build-up of pollutants, leaves, sticks, branches, litter, and other debris.</p> <p>Accumulated debris can hinder stormwater flows and cause localised flooding, and these should be removed and properly disposed of at an appropriate disposal facility.</p> <p>Visually inspect the debris screens for signs of corrosion, repair or replace if necessary. Check lock and chain for any rust or damage.</p>
Valves	<p>If dewatering is required, inspect all installed valves through their full range of motion. Check for blockages and clear if necessary.</p> <p>If corrosion is present, repair or replace valve.</p>

### 3.3.2. Stream Outfall Maintenance Access Requirements

The wetland outlet is incorporated into a wingwall structure. Further details will be defined in detailed design stage.

### 3.3.3. Health and Safety Risks Associated with Wetland Outlet Structure Maintenance

There are a number of health and safety risks associated with working around waterbodies and inlet structures. Some of these potential risks are highlighted in Table 9 below.

Table 9: Health and safety risks associated with working around wetland outlet structures

Risk	Mitigation
Deep water (i.e. deeper than knee depth)	Do not enter the water, have rescue rope and second person available.
Removing blockage may generate high flow velocities	Lower water level before removing blockage.
Flow through wetland making work unsafe (i.e. >0.5 m/s)	Ensure no rainfall has occurred in the last 24 hours and non in forecast
Confined space within inlet pipe	Do not enter the confined space.
Fall Hazard	Avoid accessing close to steep drop offs, ensure safe site access

### 3.4. Emergency Spillway

The wetland emergency spillway details are shown in Table 10 below. It is noted that this are indicative sizes and will be finalised in the detailed design stage.

Table 10: Spillway details

	Wetland 2-1
Invert of Emergency Spillway	25m @RL 11.85m
Wetland embankment	12.33m RL

#### 3.4.1. Routine Maintenance

Key routine maintenance actions identified for wetland spillway structures are summarised in Table 11 below.

Table 11: Emergency spillway maintenance actions

Component	Recommended Action
Emergency spillway	<p>Inspect and maintain grass cover at 100 mm height. Ensure spillway is clear of trees and shrubs (only grass present).</p> <p>Inspect earth embankment for erosion, scour, slumping and any loss of soil.</p> <p>Cavities, erosion and scour should be repaired with engineered fill compacted to the earthwork's specifications.</p> <p>Check embankments for settlement, erosion, scouring, cracking, sloughing, separation, seepage, tomos, etc.</p>

#### 3.4.2. Health and Safety Risk Associated with Emergency Spillway Maintenance

There are a number of health and safety risks associated with working around the spillway. Some of these potential risks are highlighted in the Table 12 below.

Table 12: Health and safety risks associated with working around the spillway

Risk	Mitigation
Deep water (i.e. deeper than knee depth)	Do not enter the water, have rescue rope and second person available.
Steep and slippery banks	Take care and avoid wet soil conditions.
Erosion, scouring of spillway	Do not access unstable spillway. Stay away from edge of erosion/failure.
Drop offs	Do not mow close to drop off at downstream shoulder of spillway.

### 3.5. Waterbody

The waterbody area is susceptible to sediment deposition and aquatic weed growth (although aquatic weed growth is unlikely in the deeper areas of the wetland). Refer to the Auckland Council Pest Plants Search Database (Auckland Council, 2019) for identifying aquatic weeds (refer to the list of references in Section 5.0 for details). There is also a potential for algae blooms during summer months particularly as the water is unshaded.

### 3.5.1. Routine Maintenance

Key routine maintenance actions identified for the wetland waterbody are summarised in Table 13 below. The future catchment development and resulting sediment loads could change this frequency. Therefore, sediment accumulation rates should be monitored annually.

Table 13: Waterbody maintenance actions

Component	Recommended Action
Main Pond	<p>Probe sediment to check if sediment exceeds 50% of design water depth or if build-up is affecting the normal operation of the pond, such as vegetation dying or excessive odour. If this is the case, desilting is required.</p> <p>If desilting is required, sediments should be tested for relevant contaminants (e.g. heavy metals, PAHs) prior to removal to determine appropriate options for disposal of the sediment.</p> <p>Once sediment has been removed and dewatered, moisture content testing should be done to ensure that it meets the disposal requirements. If required, further dewatering or additives, such as sawdust, may be required.</p> <p>Rubbish and other floating debris need to be removed from the pond's surface and in areas where it collects.</p> <p>Inspect the pond for algal blooms or dead fish, which may signal eutrophication (a condition characterised by a combination of super-dense aquatic vegetation or algae growth and low dissolved oxygen levels in pond water), high nutrient or high contaminant levels in the stormwater runoff. Strong odours (such as rotten smells) can also be indicative of eutrophic conditions.</p> <p>Determine best method for addressing problem. Refer to TR2013/026 (de Winton et al., 2013). Could use flushing of pond if outlet can be blocked off.</p> <p>Check if barley straw bales need to be installed or replaced. Attach barley bales securely to marked stakes in October and remove by the following April.</p> <p>Check the waterbody for invasive aquatic weed species which can clog the flow of water through the pond. Refer to the Auckland Council Pest Plants Search Database (Auckland Council, 2019) and the Regional Pest Management Strategy (Auckland Regional Council, 2007) (refer to the list of references in Section 5.0 for details). Contact AC and the Auckland Council Biosecurity Team for further instruction (+64 9 301 0101).</p> <p>Control of aquatic weeds may require dewatering of the pond for chemical or mechanical management. Refer to TR2013/026 (de Winton et al., 2013) for more detail on control methods.</p> <p>Visually inspect for spills or pollution incidents (oil, paint, concrete etc.). This can affect vegetation growth, aesthetics, or cause other harmful or nuisance effects. Report contamination to Auckland Council Pollution Response team (+64 9 377 3107).</p>



### 3.5.2. Health and Safety Risks Associated with Waterbody

There are a number of health and safety risks associated with working around a waterbody. Some of these potential risks are highlighted in the Table 14 below.

Table 14: Health and safety risks associated with working around waterbodies

Risk	Mitigation
Deep water (i.e. deeper than knee depth)	Do not enter the water, have rescue rope and second person available.
Steep and slippery banks	Take care and avoid wet soil conditions.
Deep sediment/silt	Avoid entering deep sediment. Probe sediment levels before proceeding.
Unstable banks	Avoid standing on unstable banks.
Flow through waterbody making work unsafe (i.e. >0.5 m/s)	Ensure no rainfall has occurred in the last 24 hours and none is forecast.
Contaminated sediment/water	Test sediment for relevant contaminants prior to desilting and take appropriate steps, such as wearing PPE, to avoid any harmful effects

### 3.6. Marsh Area

Wetland 2-1 has a marsh area around the edge. This area is planting that is permanently submerged. Around the wetland edges, vegetation is planted on the 3 m wide bench surrounding most of the pond. This area is susceptible to aquatic weed growth, as well as the loss of desirable wetland plant species.

Pest plants can affect the wetland's vegetation by outcompeting desirable native species. Due to the large number of pest plant species, refer to the Auckland Council Pest Plants Search Database (Auckland Council, 2019) and the Regional Pest Management Strategy for a comprehensive list of pest plants (Auckland Regional Council, 2007).

#### 3.6.1. Routine Maintenance

Key routine maintenance actions identified for the wetland marsh areas are summarised in Table 15 below.

Table 15: Marsh area maintenance actions

Component	Recommended Action
Marsh Areas (including the littoral zone)	<p>Inspect wetland plant health and any build-up of dead plant material. Remove debris as necessary.</p> <p>Inspect littoral zones for exotic and invasive/nuisance aquatic vegetation and remove accordingly.</p> <p>Control of invasive vegetation may be done manually or with appropriate herbicide, making sure to consider the proximity to the sensitive stream environment. Application of herbicides may need to be done by a properly licenced and registered professional. Refer to TR2013/026 (de Winton et al., 2013) for more detail on control methods.</p> <p>Inspection frequency may need to be increased during the growing season.</p>

#### 3.6.2. Health and Safety Risks Associated with Marsh Areas

There are a number of health and safety risks associated with working around a waterbody. Some of these potential risks are highlighted in the Table 16 below

Table 16: Health and safety risks associated with working around marsh areas

Risk	Mitigation
Deep water (i.e. deeper than knee depth)	Do not enter the water, have rescue rope and second person available.
Deep sediment/silt	Avoid entering deep sediment. Probe sediment levels before proceeding.
Unstable banks	Avoid standing on unstable banks.
Flow through waterbody making work unsafe (i.e. >0.5 m/s)	Ensure no rainfall has occurred in the last 24 hours and none is forecast.
Contaminated sediment/water	Test sediment for relevant contaminants prior to desilting and take appropriate steps, such as wearing PPE, to avoid any harmful effects

### 3.7. Riparian Vegetation/Landscaping

The proposed wetland has large areas of riparian vegetation surrounding them. This area is susceptible to weed growth, as well as the loss of desirable native plant species.

Pest plants can affect the wetland's vegetation by outcompeting desirable native species. Due to the large number of pest plant species, refer to the Auckland Council Pest Plants Search Database (Auckland Council, 2019) and the Regional Pest Management Strategy for a comprehensive list of pest plants (Auckland Regional Council, 2007) (refer to the list of references in Section 5.0 for details).

#### 3.7.1. Riparian vegetation maintenance actions

Component	Recommended Action
Riparian Vegetation/ Landscaping	<p>Vegetation maintenance works including staking, trimming, lawn mowing, weed control, and replacement planting (only during planting season).</p> <p>Inspect riparian plant health and any build-up of dead plant material. Remove debris as necessary. Replace unhealthy or dead planting and undergo ongoing maintenance until established. When new planting is being carried out, exposed soil should be protected with mulch or organic matting such as coconut fibre to prevent soil erosion. Maintenance intervals will vary with growth rates and seasons.</p> <p>Identify weeds. Refer to the Auckland Council Pest Plants Search Database (Auckland Council, 2019) and the Regional Pest Management Strategy (Auckland Regional Council, 2007) (refer to the list of references in Section 5.0 for details). Notify AC and the Auckland Council Biosecurity Team if pest species present (+649 301 0101).</p> <p>Using appropriate control methods for the weed present, undertake weed control around the wetland and in the wider property using a combination of mechanical control, manual removal and herbicide. Specialist to be contacted if further weed inspection and removal is required. Where soil erosion is observed, repair as necessary. Soil can be eroded from wetland banks particularly after heavy rainfall and/or where vegetation cover is poor.</p>

### 3.7.2. Health and Safety Risks Associated with Riparian Vegetation

There are a number of health and safety risks associated with working around riparian vegetation. Some of these potential risks are highlighted in the Table 17 below.

Table 17: Health and safety risks associated with working around riparian vegetation

Risk	Mitigation
Deep water (i.e. deeper than knee depth)	Do not enter the water, have rescue rope and second person available.
Deep sediment/silt	Avoid entering deep sediment. Probe sediment levels before proceeding.
Unstable banks	Avoid standing on unstable banks.
Stinging insects	Wear long sleeved clothing and take care during summer months.
Pollen/Dust	Wear respirator while mowing during summer.

### 3.8. Wildlife

The proposed Wetland 2-1 will provide habitat for a large number of terrestrial and aquatic wildlife such as ducks and pukekos.

Mosquitos, pest animals such as rabbits, and stinging insects such as wasps can create health and safety hazards, which can negatively affect maintenance activities. For example, rabbit burrows can create a trip hazard for maintenance workers, or wasps can sting maintenance workers.

Pest fish can both physically affect the wetland itself and have negative effects on desirable native fish species. Common pest fish species that workers should be aware of include brown bullhead catfish, gambusia, gudgeon, koi, marron, orfe, perch, rudd and tench. For further details, refer to the Regional Pest Management Strategy (Auckland Regional Council, 2007).

#### 3.8.1. Routine Maintenance

Key routine maintenance actions identified for the wetland wildlife are summarised in Table 18 below

Table 18: Wildlife maintenance actions

Component	Recommended Action
Wildlife	Regular inspection is required to ensure that desirable species are not threatened, and pest species are controlled. Areas for mosquito controlling organisms (e.g. minnows) should be maintained.  A visual inspection of the wetland area to check for and the removal of dead or sick waterfowl (e.g. ducks) and fish (e.g. eels, grass carp) should be carried out. Record and provide number of dead animals removed to Council Operations team.
Pest Fish	Assess pest fish population numbers (from visual observations of pest fish surfacing in the wetland). Identify species, referring to the Regional Pest Management Strategy (Auckland Regional Council, 2007). Notify AC and the Auckland Council Biosecurity Team (+64 9 301 0101)
Waterfowl	Observe waterfowl population numbers and note problems.  If waterfowl numbers become unmanageable (when complaints are received or wetland condition is negatively affected), erect additional signage to prohibit public duck feeding and investigate other methods of control (e.g. predator decoys).

	When complaints are received or when maintenance activities are affected, excessive mosquito populations should be controlled by draining down the wetland to avoid stagnant water.
Perst	Infestation of rabbits or rodents should be dealt with by a suitably qualified professional.  Avoid contact with insects, such as wasps. If nests are on site, seek a suitably qualified professional to remove nests.

### 3.8.2. Health and Safety Risks associated with Wildlife

There are a number of health and safety risks associated with working around ecology. Some of these risks are highlighted in the Table 21 below.

Table 19: Safety risks associated with working around ecology

Risk	Mitigation
Steep and slippery banks	Take care and avoid wet soil conditions.
Unstable banks	Avoid standing on unstable banks.
Stinging insects	Wear long sleeved clothing and take care during summer months.
Pollen/Dust	Wear respirator while mowing during summer.

### 3.9. Access and Security

Wetland 2-1 is located adjacent to Stream A. An access track off Road 6 is proposed to provide vehicular access to the wetland. The access track for the wetland is shown in Figure 3Figure 3: Wetland 2-1 Layout Plan, and can be referred to in drawing P24-447-01-3601-DR.

Further details regarding accessibility of the wetland structures will be provided during detailed design stage.

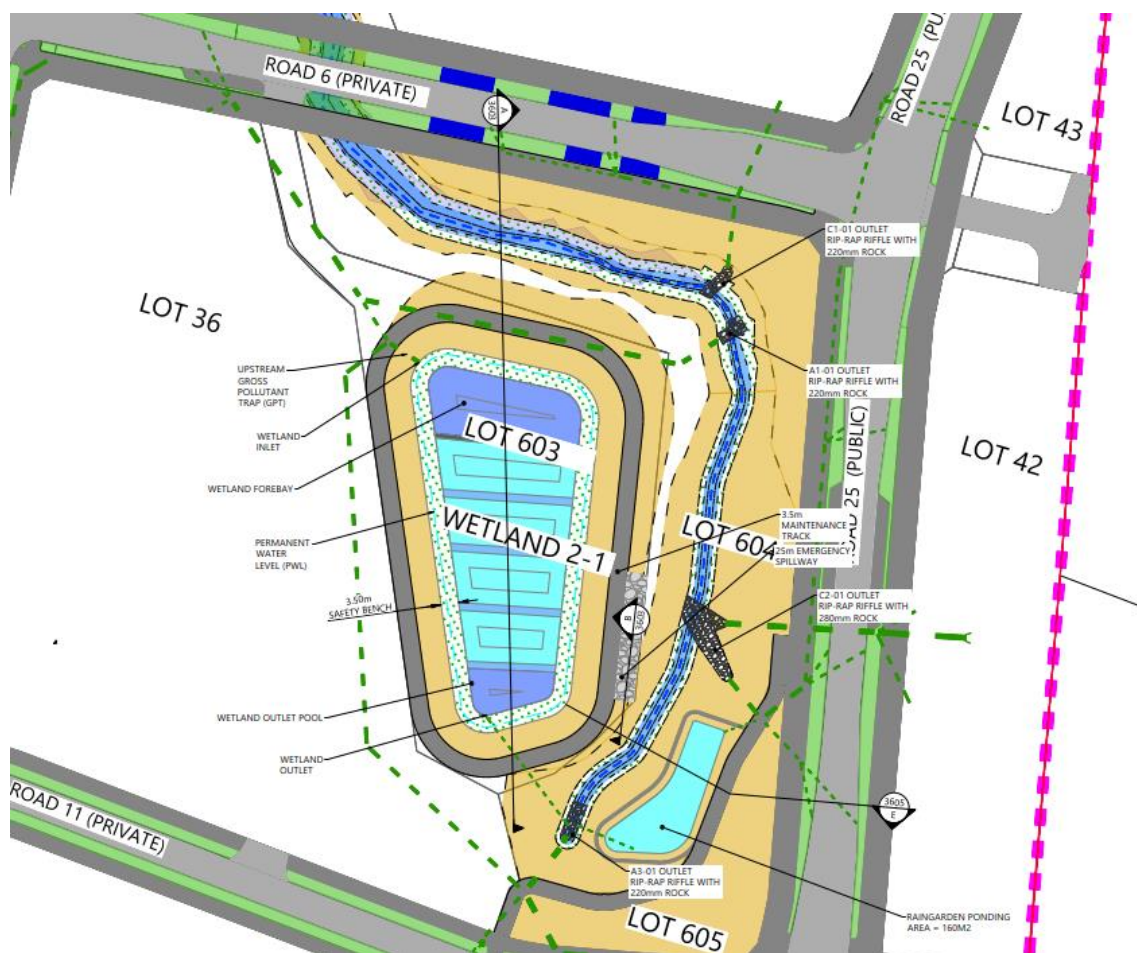


Figure 3: Wetland 2-1 Layout Plan

### 3.9.1. Routine maintenance

Key routine maintenance actions identified for the wetland maintenance access are summarised in Table 20 below.

Table 20: Maintenance actions

Component	Recommended Action
Maintenance Accessway	Vehicular access to wetlands, structural integrity, width sufficient for plant and machinery access. Check presence of weeds. Remove if present.
Fences/Handrails	Check condition of perimeter/safety fences and handrails.
Signage	Check signage for graffiti or damage.

### 3.9.2. Health and Safety Risks

There are a number of health and safety risks associated with working around a waterbody. Some of these potential risks are highlighted in the Table 21 below.

Table 21: Health and safety risks associated with working around a waterbody

Risk	Mitigation
Steep and slippery banks	Take care and avoid wet soil conditions.
Unstable banks	Avoid standing on unstable banks.
Public	Have a plan if an unwanted encounter occurs.

## 4. Wetland Plans

### 4.1. Fast Track Consent Plans

Please refer to the Fast Track Consent Plans:

- P24-447-01-3000-DR Overall Stormwater Layout Plan
- P24-447-01-3001-DR to 3004-DR Stormwater Layout Plan Sheets
- P24-447-01-3103-DR Stormwater Treatment Catchment Plan
- P24-447-01-3200-DR Proposed Overland Flowpath Plan
- P42-447-01-3601-DR Wetland 2-1 Layout Plan
- P24-447-01-3603-DR Wetland 2-1 Cross Section Plan





## Wetland 2-2 Operations and Maintenance Manual

**Drury Centre**

Stage 2

Kiwi Property Group Ltd

14/03/2025

DRAFT

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## Document Control

<b>Project Number</b>	P24-447
<b>Project Name</b>	Drury Centre
<b>Client</b>	Kiwi Property Group Ltd
<b>Date</b>	14/03/2025
<b>Version</b>	V0
<b>Issue Status</b>	DRAFT
<b>Originator</b>	Jasmin Moll – 3 Waters Engineer
<b>Reviewer</b>	Bidara Pathirage – Senior Associated – 3 Waters Engineer
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## 1. Introduction

The operations and maintenance (O&M) manual details the proposed Wetland 2-2 at Stage 2 of the Drury Centre Precinct development by Kiwi Property No. 2 Limited ("Kiwi Property"). The wetland location is shown in Figure 1.

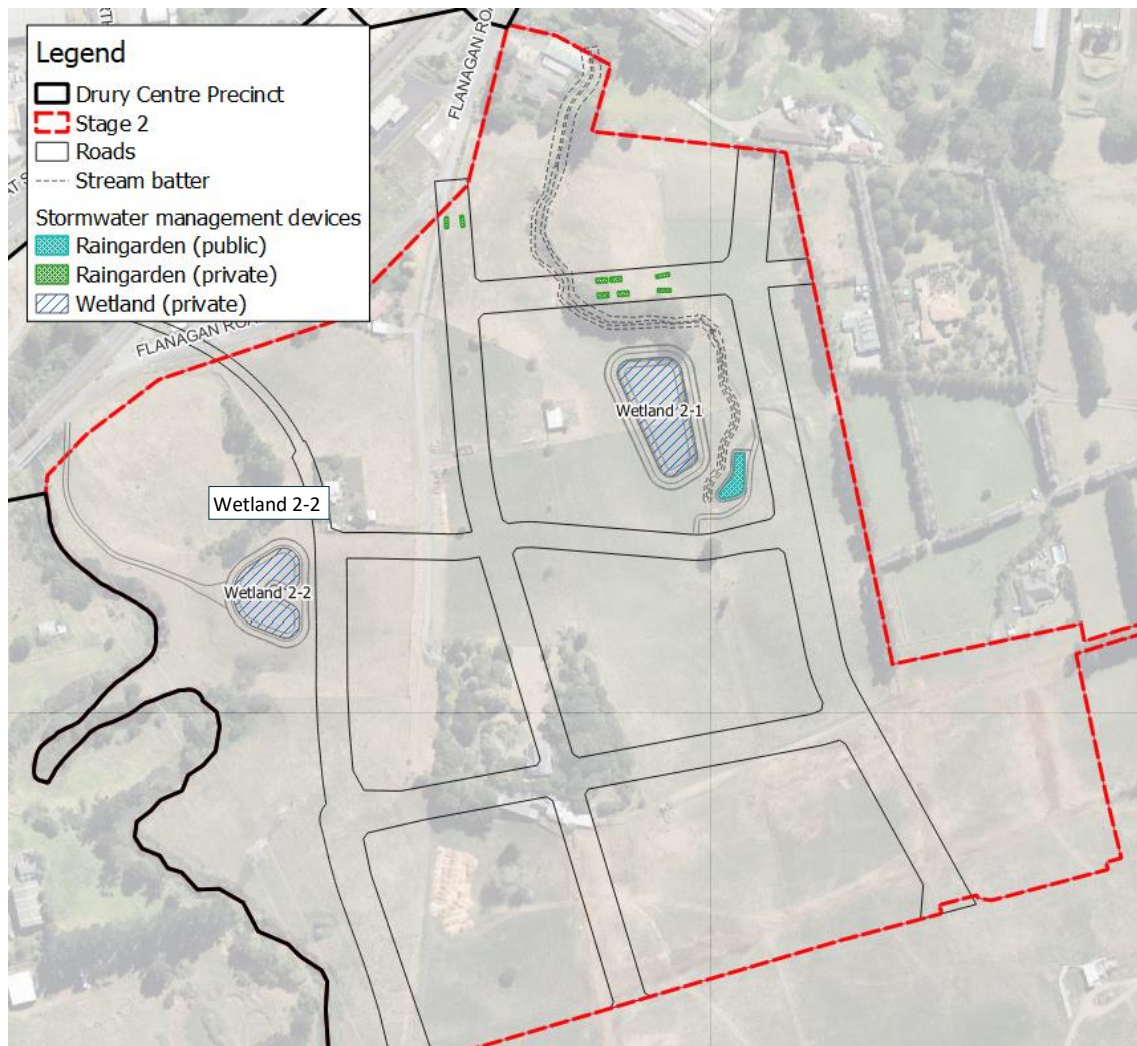


Figure 1: Proposed stormwater management

It is intended that this O&M manual provides:

- Background information on the stormwater treatment and detention facilities at Wetland 2-2,
- Basic background information on the contributing stormwater catchment,
- Design details for the stormwater treatment and detention system: and
- O&M details.

This manual excludes information on the stormwater reticulation system within the contributing catchment area.

The manual is to be updated following consent and construction with final O&M to be provided with CCC

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### 1.1. Contact information

A summary of the contact information relating to the ownership, maintenance manager and designer for the wetland are included in Table 1.

Table 1: Contact information

Asset ID		Resource Consent Number	
Location:		Development Name / Legal Description:	
<b>Asset Owner Details:</b>			
Name:		Adress:	
Telephone Number:			
Email:			
<b>Maintenance Manager Emergency Contact Details:</b>			
Name:			
Telephone Number: (Daytime)			
Telephone Number: (Out of Hours)			
Email:			

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<b>Design Details:</b>			
Name:			
Telephone Number:			
Email:			
<b>Applicant Details:</b>			
Name:			
Telephone Number:			
Email:			
<b>Landowner Details:</b>			
Name:			
Telephone Number:			
Email:			
Notes / Restrictions / Access			



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## 2. System Description

### 2.1. Catchment description

Wetland 2-2 provides stormwater treatment and detention for a 2.88ha stormwater catchment, as detailed in Table 2.

Table 2: Contributing catchment to Wetland 2-2

	Total impervious area (ha)	Total pervious area (ha)	Total contributing catchment area (ha)
Catchment contributing to Wetland 2-2	2.74	0.14	2.88

### 2.2. Design Philosophy

The purpose of the proposed wetland is to provide stormwater treatment and detention for the contributing catchment. The wetland was designed to improve water quality through reducing contaminants such as Total Suspended Solids (TSS) and contaminants bound to the sediment. Planting around promoted biodiversity and improves public perception of the stormwater device.

#### 2.2.1. Key Features

The wetland was designed to meet the following design requirements.

- Water Quality: provide water quality volume equivalent to runoff generated from the catchment for 90<sup>th</sup> percentile storm event.
- Hydrology Mitigation:
  - Retention – Provide retention of at least 5 runoff depth
  - Detention – Provide detention and a drain-down period of 24 hours for the difference between the pre- and post-development runoff volume from the 95<sup>th</sup> percentile, 24-hour rainfall event minus 5mm retention.

#### 2.2.2. Timeline

Construction not yet completed. This section will be completed after the Wetland is constructed.

#### 2.2.3. Critical Levels as per approved Design and As-built Data

The design has not yet been approved. This section will be completed once the design of the wetland has been approved.

### 2.3. As-Built Information

The be provided following consent and construction

### 2.4. Design Standards and Assumptions

The proposed Wetland 2-2 is designed to provide SMAF 1 hydrology mitigation and water quality treatment.

The wetland has been designed in accordance with GD01 guidelines.

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## 2.5. Stakeholder Consultation

A session was held with Healthy Waters to discuss the stormwater management approach for Drury Stage 2 development as part of the Fast-Track application. During the ongoing planning process, further engagements will be held.

## 2.6. Ground conditions

The wetland shall be constructed as per the recommendations of the geotechnical report

## 2.7. Consent information

To be provided following consent approval.

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### 3. System Components and Maintenance Requirements

The system components, related maintenance actions and Health and Safety risks associated with these components are described in the following sections. Details of the proposed Wetland 2-2 design are shown in Figure 2. Further details will be provided during detailed design phase.

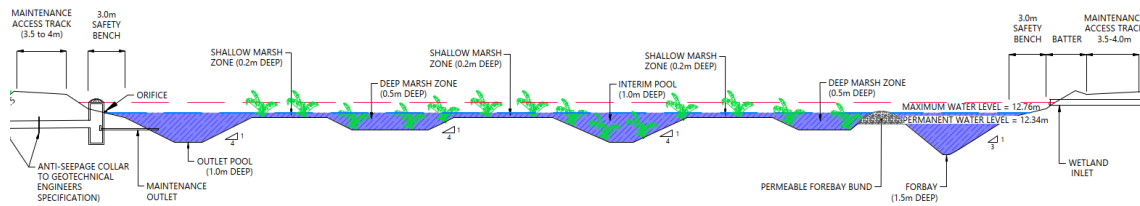


Figure 2: Wetland 2-2 Cross section A, DWG No. P24-447-01-3604-DR

#### 3.1. Inlet Structure Details

Wetland 2-2 has a single inlet. The inlet details can be found in Table 3 below. It is noted that this are indicative sizes and will be finalised in detailed design stage.

Table 3: Wetland Inlets

	Wetland 2-2
Inlet structure	DN375

##### 3.1.1. Routine Maintenance

Key routine maintenance actions identified for Wetland 2-2 inlet are summarised in Table 4 below.

Table 4: Wetland inlet maintenance actions

Component	Recommended Action
Wetland Inlets and Energy Dissipation / Erosion Protection Structures	Inspect for clogging and built up of sediments, debris, and rubbish around the wetland inlet and energy dissipation structure (baffle blocks).  If the permanent water level of the wetland is above the inlet pipe invert and the wetland is in a low flow state, check that the water level is not artificially elevated by an outlet blockage. If sediment is partially blocking the inlet pipe, remove localised sediment and check if entire forebay require desilting.
	Erosion protection (e.g. rip rap, wingwall, concrete apron, reno mattress) should be inspected for erosion and loss of material. Check for scouring beneath inlet apron and repair/replace lost material.
	Inlet pipe and energy dissipation structures (e.g. baffle blocks) should be inspected for erosion and cracks in the structure, particularly where any exposed reinforcing may corrode. Fix cracks and erosion as necessary.

##### 3.1.2. Health and Safety Risks Associated with Wetland Maintenance

There are a number of health and safety risks associated with working around waterbodies and inlet structures. Some of these potential risks are highlighted in Table 5 below.

Table 5: Health and Safety risks associated with the working around waterbodies

Risk	Mitigation
Deep water (i.e. deeper than knee depth)	Do not enter the water, have rescue rope and second person available.
Steep and slippery banks	Take care and avoid wet soil conditions.
Submerged inlet structure	Check water level is not elevated due to recent rain or blockage. Drain water level before proceeding.
Flow through inlet making work unsafe (i.e. >0.5 m/s)	Ensure no rainfall has occurred in the last 24 hours and non in forecast
Confined space within inlet pipe	Do not enter the confined space.
Deep manholes	Do not enter the confined space. Take extra care when opening manholes.

### 3.2. Proprietary device/Gross Pollutant Trap (GTP)

The development proposed using GTP treatment devices to provide pre-treatment prior to flows entering the wetland.

#### 3.2.1. Routine Maintenance

GTP will be maintained in accordance with manufacturer's instructions.

#### 3.2.2. Health and safety Risk Associated with GTP Maintenance

There are a number of health and safety risks associated with working around the GTPs. Some of these possible risks are highlighted in Table 6 below.

Table 6: Health and safety risks associated with working around proprietary devices

Risk	Mitigation
<b>Biological hazards</b> - exposure to infectious agents or biohazards carried by trapped organic matter	Vaccinate workers against relevant diseases. Provide hand hygiene facilities and encourage good hygiene practices. Provide workers with appropriate PPE such as gloves, coveralls, and masks to protect against biological hazards. Implement regular cleaning and disinfection protocols for GTPs.
<b>Exposure of contaminants</b> – workers may be exposed to hazardous contaminants such as chemicals, oils, toxins, or hazardous materials that accumulate in the traps along with debris. This can lead to skin irritation, respiratory issues, or other health problems.	Wear appropriate PPE such as gloves, masks, goggles and coveralls. Provide proper training on handling hazardous materials and use of safety data sheets.
<b>Respiratory issues</b> - from inhaling dust, fumes, or mould present in the trap.	Use respiratory protection when dealing with dust, fumes or mould. Ensure adequate ventilation in the works area. Implement monitoring systems to detect the presence of biogases and ensure adequate ventilation of confined spaces. Establish procedures for safe entry into confined spaces, including atmospheric testing and the use of gas detectors. Provide workers with training on the

	hazards of biogases and the importance of proper ventilation and monitoring.
<b>Electric hazards</b> - shock from working near electrical equipment in or around the trap.	Inspect electrical equipment regularly for damage. Use ground fault circuit interrupters (GFCIs) and proper grounding techniques. Provide workers with training on electrical safety practices and procedures.
<b>Mechanical hazards</b> - workers may encounter mechanical hazards associated with the operation of machinery or equipment used for cleaning, maintaining, or servicing the traps, such as moving parts or pinch points.	Implement machine guarding and safety protocols to prevent workers from coming into contact with moving parts or pinch points. Provide training on the safe operation of machinery and equipment.
<b>Manual handling injuries</b> - musculoskeletal injuries from heavy lifting and manual handling of debris.	Provide training on safe lifting techniques. Use mechanical aids or equipment for lifting heavy debris/manual handling of equipment.
<b>Physical hazards</b> – workers may face slips, trips, or falls during maintenance due to the presence of wet surfaces or uneven terrain.	Wear appropriate health and safety gear to prevent against slips, trips and falls.
<b>Vehicle hazards</b> – workers using vehicles or heavy machinery to access or service the devices, there may be risks of rollovers or accidents associated with operating vehicles in close proximity to the traps or on uneven terrain.	Implement traffic management plans to control vehicle movement around work areas. Ensure operators receive proper training and certification for operating vehicles and machinery safely. Implement vehicle inspection and maintenance procedures to ensure equipment is in good working condition.

### 3.3. Outlet structure

The wetland outlet structure details can be found in It is noted that this are indicative sizes and will be finalised in detailed design stage.

Table 7. It is noted that this are indicative sizes and will be finalised in detailed design stage.

Table 7: Outlet details

	Wetland 2-2
Orifice	100mm Dia
Scruffy dome	1050mm
Outlet pipe	DN500

#### 3.3.1. Routine Maintenance

Key routine maintenance actions identified for the wetland outlet structure are summarised in Table 8 below.

Table 8: Outlet structure maintenance actions

Component	Recommended Action
Wetland outlets	Inspect wetland outlets for blockages caused by heavy sedimentation, floating debris, and rubbish.
	The areas around the outlet control structure should be free of blockages and dense vegetation to maintain an unobstructed flow path for stormwater.
	Inspect for evidence of leaky joints or soil seeping around outflow pipe barrel.

	Inspect outfall and water discharge areas for erosion (presence and severity within 30m of discharge point).
	Restore eroded areas and stabilise as necessary
	Erosion (washout, scouring) around outflow pipes can be caused by water flowing from the wetland and out along the outside of pipe, which can lead to embankment failure.
Erosion protection	<p>Inspect areas of erosion protection (rip rap, reno mattress, gabions) to identify any damage or loss of material.</p> <p>Identify any preferential flow paths forming through erosion protection that could be affecting function.</p> <p>Repairs should be carried out as required.</p>
Debris screen	<p>The debris screens should be inspected for the build-up of pollutants, leaves, sticks, branches, litter, and other debris.</p> <p>Accumulated debris can hinder stormwater flows and cause localised flooding, and these should be removed and properly disposed of at an appropriate disposal facility.</p> <p>Visually inspect the debris screens for signs of corrosion, repair or replace if necessary. Check lock and chain for any rust or damage.</p>
Valves	<p>If dewatering is required, inspect all installed valves through their full range of motion. Check for blockages and clear if necessary.</p> <p>If corrosion is present, repair or replace valve.</p>

### 3.3.2. Stream Outfall Maintenance Access Requirements

The wetland outlet is incorporated into a wingwall structure. Further details will be defined in detailed design stage.

### 3.3.3. Health and Safety Risks Associated with Wetland Outlet Structure Maintenance

There are a number of health and safety risks associated with working around waterbodies and inlet structures. Some of these potential risks are highlighted in Table 9 below.

Table 9: Health and safety risks associated with working around wetland outlet structures

Risk	Mitigation
Deep water (i.e. deeper than knee depth)	Do not enter the water, have rescue rope and second person available.
Removing blockage may generate high flow velocities	Lower water level before removing blockage.
Flow through wetland making work unsafe (i.e. >0.5 m/s)	Ensure no rainfall has occurred in the last 24 hours and non in forecast
Confined space within inlet pipe	Do not enter the confined space.
Fall Hazard	Avoid accessing close to steep drop offs, ensure safe site access



### 3.4. Emergency Spillway

The wetland emergency spillway details are shown in Table 10 below. It is noted that this are indicative sizes and will be finalised in the detailed design stage.

Table 10: Spillway details

	Wetland 2-2
Invert of Emergency Spillway	15m @RL 12.90m
Wetland embankment	12.33m RL

#### 3.4.1. Routine Maintenance

Key routine maintenance actions identified for wetland spillway structures are summarised in Table 11 below.

Table 11: Emergency spillway maintenance actions

Component	Recommended Action
Emergency spillway	<p>Inspect and maintain grass cover at 100 mm height. Ensure spillway is clear of trees and shrubs (only grass present).</p> <p>Inspect earth embankment for erosion, scour, slumping and any loss of soil.</p> <p>Cavities, erosion and scour should be repaired with engineered fill compacted to the earthwork's specifications.</p> <p>Check embankments for settlement, erosion, scouring, cracking, sloughing, separation, seepage, tomos, etc.</p>

#### 3.4.2. Health and Safety Risk Associated with Emergency Spillway Maintenance

There are a number of health and safety risks associated with working around the spillway. Some of these potential risks are highlighted in the Table 12 below.

Table 12: Health and safety risks associated with working around the spillway

Risk	Mitigation
Deep water (i.e. deeper than knee depth)	Do not enter the water, have rescue rope and second person available.
Steep and slippery banks	Take care and avoid wet soil conditions.
Erosion, scouring of spillway	Do not access unstable spillway. Stay away from edge of erosion/failure.
Drop offs	Do not mow close to drop off at downstream shoulder of spillway.

### 3.5. Waterbody

The waterbody area is susceptible to sediment deposition and aquatic weed growth (although aquatic weed growth is unlikely in the deeper areas of the wetland). Refer to the Auckland Council Pest Plants Search Database (Auckland Council, 2019) for identifying aquatic weeds (refer to the list of references in Section 5.0 for details). There is also a potential for algae blooms during summer months particularly as the water is unshaded.

### 3.5.1. Routine Maintenance

Key routine maintenance actions identified for the wetland waterbody are summarised in Table 13 below. The future catchment development and resulting sediment loads could change this frequency. Therefore, sediment accumulation rates should be monitored annually.

Table 13: Waterbody maintenance actions

Component	Recommended Action
Main Pond	<p>Probe sediment to check if sediment exceeds 50% of design water depth or if build-up is affecting the normal operation of the pond, such as vegetation dying or excessive odour. If this is the case, desilting is required.</p> <p>If desilting is required, sediments should be tested for relevant contaminants (e.g. heavy metals, PAHs) prior to removal to determine appropriate options for disposal of the sediment.</p> <p>Once sediment has been removed and dewatered, moisture content testing should be done to ensure that it meets the disposal requirements. If required, further dewatering or additives, such as sawdust, may be required.</p> <p>Rubbish and other floating debris need to be removed from the pond's surface and in areas where it collects.</p> <p>Inspect the pond for algal blooms or dead fish, which may signal eutrophication (a condition characterised by a combination of super-dense aquatic vegetation or algae growth and low dissolved oxygen levels in pond water), high nutrient or high contaminant levels in the stormwater runoff. Strong odours (such as rotten smells) can also be indicative of eutrophic conditions.</p> <p>Determine best method for addressing problem. Refer to TR2013/026 (de Winton et al., 2013). Could use flushing of pond if outlet can be blocked off.</p> <p>Check if barley straw bales need to be installed or replaced. Attach barley bales securely to marked stakes in October and remove by the following April.</p> <p>Check the waterbody for invasive aquatic weed species which can clog the flow of water through the pond. Refer to the Auckland Council Pest Plants Search Database (Auckland Council, 2019) and the Regional Pest Management Strategy (Auckland Regional Council, 2007) (refer to the list of references in Section 5.0 for details). Contact AC and the Auckland Council Biosecurity Team for further instruction (+64 9 301 0101).</p> <p>Control of aquatic weeds may require dewatering of the pond for chemical or mechanical management. Refer to TR2013/026 (de Winton et al., 2013) for more detail on control methods.</p> <p>Visually inspect for spills or pollution incidents (oil, paint, concrete etc.). This can affect vegetation growth, aesthetics, or cause other harmful or nuisance effects. Report contamination to Auckland Council Pollution Response team (+64 9 377 3107).</p>

### 3.5.2. Health and Safety Risks Associated with Waterbody

There are a number of health and safety risks associated with working around a waterbody. Some of these potential risks are highlighted in the Table 14 below.

Table 14: Health and safety risks associated with working around waterbodies

Risk	Mitigation
Deep water (i.e. deeper than knee depth)	Do not enter the water, have rescue rope and second person available.
Steep and slippery banks	Take care and avoid wet soil conditions.
Deep sediment/silt	Avoid entering deep sediment. Probe sediment levels before proceeding.
Unstable banks	Avoid standing on unstable banks.
Flow through waterbody making work unsafe (i.e. >0.5 m/s)	Ensure no rainfall has occurred in the last 24 hours and none is forecast.
Contaminated sediment/water	Test sediment for relevant contaminants prior to desilting and take appropriate steps, such as wearing PPE, to avoid any harmful effects

### 3.6. Marsh Area

Wetland 2-2 has a marsh area around the edge. This area is planting that is permanently submerged. Around the wetland edges, vegetation is planted on the 3 m wide bench surrounding most of the pond. This area is susceptible to aquatic weed growth, as well as the loss of desirable wetland plant species.

Pest plants can affect the wetland's vegetation by outcompeting desirable native species. Due to the large number of pest plant species, refer to the Auckland Council Pest Plants Search Database (Auckland Council, 2019) and the Regional Pest Management Strategy for a comprehensive list of pest plants (Auckland Regional Council, 2007).

#### 3.6.1. Routine Maintenance

Key routine maintenance actions identified for the wetland marsh areas are summarised in Table 15 below.

Table 15: Marsh area maintenance actions

Component	Recommended Action
Marsh Areas (including the littoral zone)	<p>Inspect wetland plant health and any build-up of dead plant material. Remove debris as necessary.</p> <p>Inspect littoral zones for exotic and invasive/nuisance aquatic vegetation and remove accordingly.</p> <p>Control of invasive vegetation may be done manually or with appropriate herbicide, making sure to consider the proximity to the sensitive stream environment. Application of herbicides may need to be done by a properly licenced and registered professional. Refer to TR2013/026 (de Winton et al., 2013) for more detail on control methods.</p> <p>Inspection frequency may need to be increased during the growing season.</p>

#### 3.6.2. Health and Safety Risks Associated with Marsh Areas

There are a number of health and safety risks associated with working around a waterbody. Some of these potential risks are highlighted in the Table 16 below.

Table 16: Health and safety risks associated with working around marsh areas

Risk	Mitigation
Deep water (i.e. deeper than knee depth)	Do not enter the water, have rescue rope and second person available.
Deep sediment/silt	Avoid entering deep sediment. Probe sediment levels before proceeding.
Unstable banks	Avoid standing on unstable banks.
Flow through waterbody making work unsafe (i.e. >0.5 m/s)	Ensure no rainfall has occurred in the last 24 hours and none is forecast.
Contaminated sediment/water	Test sediment for relevant contaminants prior to desilting and take appropriate steps, such as wearing PPE, to avoid any harmful effects

### 3.7. Riparian Vegetation/Landscaping

The proposed wetland has large areas of riparian vegetation surrounding them. This area is susceptible to weed growth, as well as the loss of desirable native plant species.

Pest plants can affect the wetland's vegetation by outcompeting desirable native species. Due to the large number of pest plant species, refer to the Auckland Council Pest Plants Search Database (Auckland Council, 2019) and the Regional Pest Management Strategy for a comprehensive list of pest plants (Auckland Regional Council, 2007) (refer to the list of references in Section 5.0 for details).

#### 3.7.1. Riparian vegetation maintenance actions

Component	Recommended Action
Riparian Vegetation/ Landscaping	<p>Vegetation maintenance works including staking, trimming, lawn mowing, weed control, and replacement planting (only during planting season).</p> <p>Inspect riparian plant health and any build-up of dead plant material. Remove debris as necessary. Replace unhealthy or dead planting and undergo ongoing maintenance until established. When new planting is being carried out, exposed soil should be protected with mulch or organic matting such as coconut fibre to prevent soil erosion. Maintenance intervals will vary with growth rates and seasons.</p> <p>Identify weeds. Refer to the Auckland Council Pest Plants Search Database (Auckland Council, 2019) and the Regional Pest Management Strategy (Auckland Regional Council, 2007) (refer to the list of references in Section 5.0 for details). Notify AC and the Auckland Council Biosecurity Team if pest species present (+649 301 0101).</p> <p>Using appropriate control methods for the weed present, undertake weed control around the wetland and in the wider property using a combination of mechanical control, manual removal and herbicide. Specialist to be contacted if further weed inspection and removal is required. Where soil erosion is observed, repair as necessary. Soil can be eroded from wetland banks particularly after heavy rainfall and/or where vegetation cover is poor.</p>

### 3.7.2. Health and Safety Risks Associated with Riparian Vegetation

There are a number of health and safety risks associated with working around riparian vegetation. Some of these potential risks are highlighted in the Table 17 below.

Table 17: Health and safety risks associated with working around riparian vegetation

Risk	Mitigation
Deep water (i.e. deeper than knee depth)	Do not enter the water, have rescue rope and second person available.
Deep sediment/silt	Avoid entering deep sediment. Probe sediment levels before proceeding.
Unstable banks	Avoid standing on unstable banks.
Stinging insects	Wear long sleeved clothing and take care during summer months.
Pollen/Dust	Wear respirator while mowing during summer.

### 3.8. Wildlife

The proposed Wetland 2-2 will provide habitat for a large number of terrestrial and aquatic wildlife such as ducks and pukekos.

Mosquitos, pest animals such as rabbits, and stinging insects such as wasps can create health and safety hazards, which can negatively affect maintenance activities. For example, rabbit burrows can create a trip hazard for maintenance workers, or wasps can sting maintenance workers.

Pest fish can both physically affect the wetland itself and have negative effects on desirable native fish species. Common pest fish species that workers should be aware of include brown bullhead catfish, gambusia, gudgeon, koi, marron, orfe, perch, rudd and tench. For further details, refer to the Regional Pest Management Strategy (Auckland Regional Council, 2007).

#### 3.8.1. Routine Maintenance

Key routine maintenance actions identified for the wetland wildlife are summarised in Table 18 below

Table 18: Wildlife maintenance actions

Component	Recommended Action
Wildlife	Regular inspection is required to ensure that desirable species are not threatened, and pest species are controlled. Areas for mosquito controlling organisms (e.g. minnows) should be maintained.  A visual inspection of the wetland area to check for and the removal of dead or sick waterfowl (e.g. ducks) and fish (e.g. eels, grass carp) should be carried out. Record and provide number of dead animals removed to Council Operations team.
Pest Fish	Assess pest fish population numbers (from visual observations of pest fish surfacing in the wetland). Identify species, referring to the Regional Pest Management Strategy (Auckland Regional Council, 2007). Notify AC and the Auckland Council Biosecurity Team (+64 9 301 0101)
Waterfowl	Observe waterfowl population numbers and note problems.  If waterfowl numbers become unmanageable (when complaints are received or wetland condition is negatively affected), erect additional signage to prohibit public duck feeding and investigate other methods of control (e.g. predator decoys).

	When complaints are received or when maintenance activities are affected, excessive mosquito populations should be controlled by draining down the wetland to avoid stagnant water.
Perst	Infestation of rabbits or rodents should be dealt with by a suitably qualified professional.  Avoid contact with insects, such as wasps. If nests are on site, seek a suitably qualified professional to remove nests.

### 3.8.2. Health and Safety Risks associated with Wildlife

There are a number of health and safety risks associated with working around ecology. Some of these risks are highlighted in the Table 21 below.

Table 19: Safety risks associated with working around ecology

Risk	Mitigation
Steep and slippery banks	Take care and avoid wet soil conditions.
Unstable banks	Avoid standing on unstable banks.
Stinging insects	Wear long sleeved clothing and take care during summer months.
Pollen/Dust	Wear respirator while mowing during summer.

### 3.9. Access and Security

Wetland 2-2 is located west of Road 2 North. An access track off Flanagan Road is proposed to provide vehicular access to the wetland. The access track for the wetland is shown in Figure 3Figure 3: Wetland 2-2 Layout Plan, and can be referred to in drawing P24-447-01-3602-DR.

Further details regarding accessibility of the wetland structures will be provided during detailed design stage.



Figure 3: Wetland 2-2 Layout Plan

### 3.9.1. Routine maintenance

Key routine maintenance actions identified for the wetland maintenance access are summarised in Table 20 below.

Table 20: Maintenance actions

Component	Recommended Action
Maintenance Accessway	Vehicular access to wetlands, structural integrity, width sufficient for plant and machinery access. Check presence of weeds. Remove if present.
Fences/Handrails	Check condition of perimeter/safety fences and handrails.
Signage	Check signage for graffiti or damage.

### 3.9.2. Health and Safety Risks

There are a number of health and safety risks associated with working around a waterbody. Some of these potential risks are highlighted in the Table 21 below.



Table 21: Health and safety risks associated with working around a waterbody

Risk	Mitigation
Steep and slippery banks	Take care and avoid wet soil conditions.
Unstable banks	Avoid standing on unstable banks.
Public	Have a plan if an unwanted encounter occurs.

## 4. Wetland Plans

### 4.1. Fast Track Consent Plans

Please refer to the Fast Track Consent Plans:

- P24-447-01-3000-DR Overall Stormwater Layout Plan
- P24-447-01-3001-DR to 3004-DR Stormwater Layout Plan Sheets
- P24-447-01-3103-DR Stormwater Treatment Catchment Plan
- P24-447-01-3200-DR Proposed Overland Flowpath Plan
- P42-447-01-3602-DR Wetland 2-2 Layout Plan
- P24-447-01-3604-DR Wetland 2-2 Cross Section Plan



# Raingarden 2-1 Operations and Maintenance Manual

**Drury Centre**

Stage 2

Kiwi Property Group Ltd

14/03/2025

DRAFT

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## Document Control

<b>Project Number</b>	P24-447
<b>Project Name</b>	Drury Centre
<b>Client</b>	Kiwi Property Group Ltd
<b>Date</b>	14/03/2025
<b>Version</b>	V0
<b>Issue Status</b>	DRAFT
<b>Originator</b>	Jasmin Moll – 3 Waters Engineer
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## 1. Introduction

The operations and maintenance (O&M) manual details the proposed Raingarden 2-1 at Stage 2 of the Drury Centre Precinct development by Kiwi Property No. 2 Limited ("Kiwi Property"). The raingarden location is shown in Figure 1.

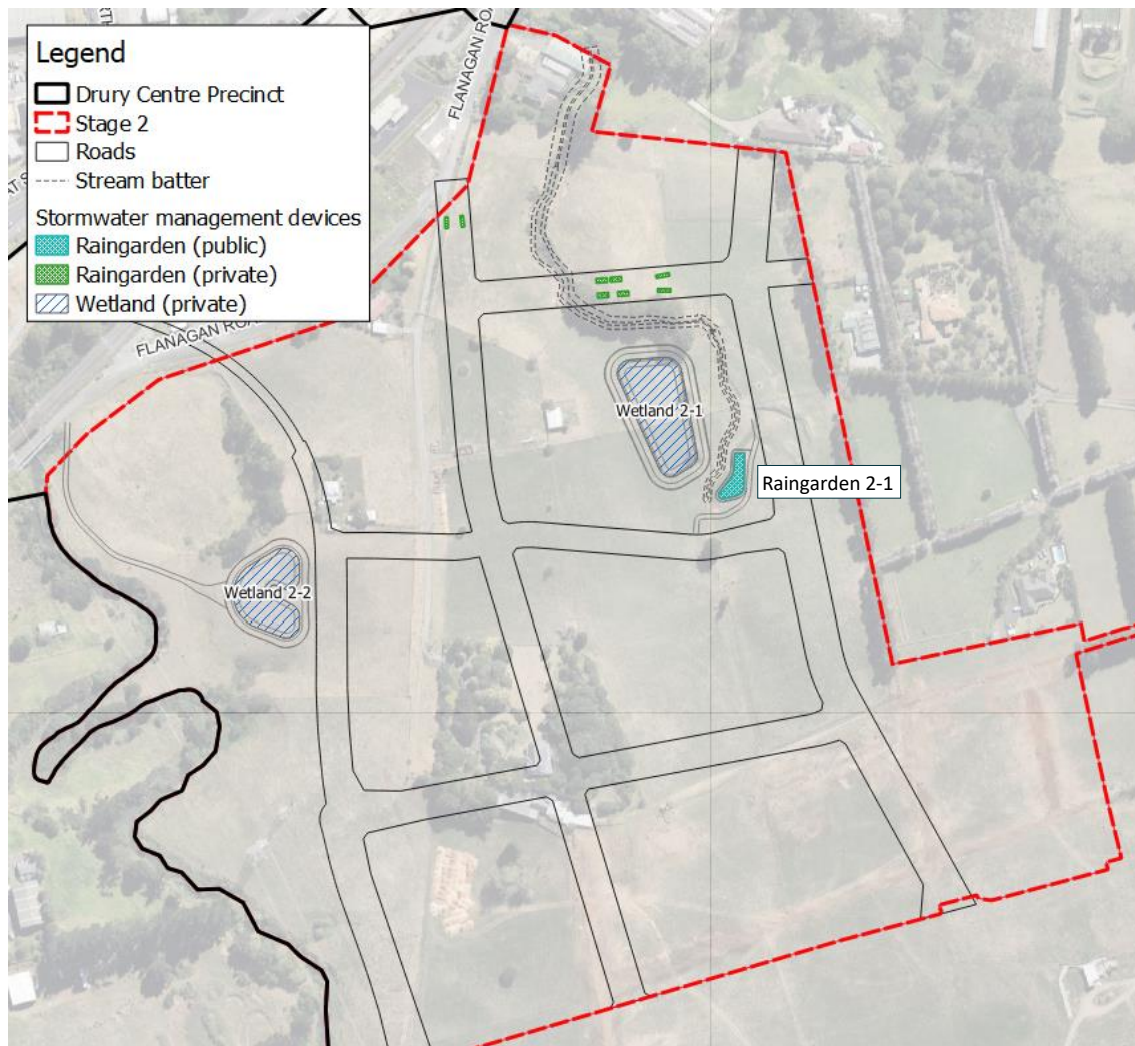


Figure 1: Proposed stormwater management

It is intended that this O&M manual provides:

- Background information on the stormwater treatment and detention facilities at Raingarden 2-1,
- Basic background information on the contributing stormwater catchment,
- Design details for the stormwater treatment and detention system: and
- O&M details.

This manual excludes information on the stormwater reticulation system within the contributing catchment area.

The manual is to be updated following consent and construction with final O&M to be provided with CCC.

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### 1.1. Contact information

A summary of the contact information relating to the ownership, maintenance manager and designer for the raingarden are included in Table 1.

Table 1: Contact Information

Asset ID		Resource Consent Number	
Location:		Development Name / Legal Description:	
<b>Asset Owner Details:</b>			
Name:		Adress:	
Telephone Number:			
Email:			
<b>Maintenance Manager Emergency Contact Details:</b>			
Name:			
Telephone Number: (Daytime)			
Telephone Number: (Out of Hours)			
Email:			

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<b>Design Details:</b>			
Name:			
Telephone Number:			
Email:			
<b>Applicant Details:</b>			
Name:			
Telephone Number:			
Email:			
<b>Landowner Details:</b>			
Name:			
Telephone Number:			
Email:			
Notes / Restrictions / Access			



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## 2. System Description

### 2.1. Catchment Description

Raingarden 2-1 provides stormwater treatment and detention for a 0.54ha stormwater catchment, as detailed in Table 2

Table 2: Contributing catchment to Raingarden 2-1

	<b>Total impervious area (ha)</b>	<b>Total pervious area (ha)</b>	<b>Total contributing catchment area (ha)</b>
Catchment contributing to Raingarden 2-1	0.49	0.05	0.54

### 2.2. Design Philosophy

The purpose of the proposed Raingarden is to provide stormwater treatment and detention for the contributing catchment. The raingarden was designed to improve water quality by removing particulate and dissolved contaminants as runoff is filtered through a vegetated filtered bed. Additional function is the reduction of runoff temperature. This raingarden also performs a hydrological function by reducing runoff volume (through retention) and detaining runoff flows.

#### 2.2.1. Key Features

The raingarden was designed to meet the following design requirements

- Water Quality: Provide water quality treatment equivalent to runoff volume generated from the catchment for 90<sup>th</sup> percentile storm event.
- Hydrology Mitigation:
  - Retention – Provide retention of at least 5mm runoff depth
  - Detention – Provide detention and a drain-down period of 6 to 24 hours, through low infiltration rate media for the difference between the pre- and post-development runoff volume from the 95<sup>th</sup> percentile, 24-hour rainfall event minus 5mm retention.

#### 2.2.2. Timeline

Construction not yet completed. This section will be completed after the raingarden is constructed and vested

#### 2.2.3. Critical Levels as per approved Design and As-built Data

The design has not yet been approved. This section will be completed once the design of the raingarden has been approved

### 2.3. As-Built Information

To be provided following consent and construction

### 2.4. Design Standards and Assumptions

The proposed Raingarden 2-1 is designed to provide SMAF1 hydrology mitigation and water quality treatment.

The raingarden has been designed in accordance with GD01 guideline.

## 2.5. Stakeholder consultation

A session was held with Healthy Waters to discuss the stormwater management approach for Drury Stage 2 development as part of the Fast-Track application. During the ongoing planning process, further engagements will be held.

## 2.6. Ground conditions

The raingarden shall be built as per the recommendations of the geotechnical report.

## 2.7. Consent information

To be provided following consent approval

## 3. System Components

Details of the proposed Raingarden 2-1 design are shown in Figure 2.

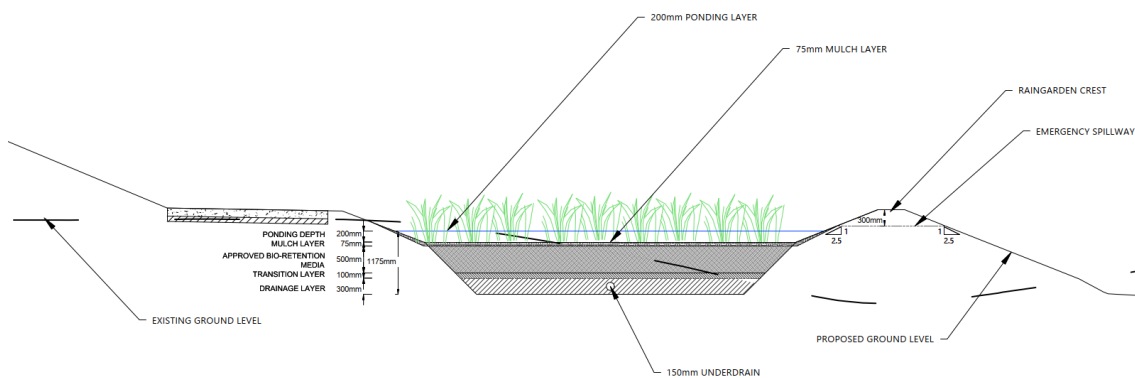


Figure 2: Raingarden 2-1 Detail, DWG No. P24-447-01-3605-DR

## 4. Raingarden Operation & Maintenance Requirements

This maintenance document and schedule has been developed in accordance with Stormwater Management Devices in the Auckland Region GD01.

Raingardens require some regular maintenance to ensure they continue to perform as stormwater management devices and as attractive landscape features

With the maintenance of the raingardens it is important that special care is taken around the trees onsite in order to prevent damage and unnecessary removal of trees. This care is particularly important in the removal of top layer of the soils, silt removal and general maintenance.

A barrier should be placed around the trees when working near them, it is recommended that when operating machinery in or around trees, exhaust is to be directed away from trees and shrubs. Machinery is not to be placed under the dripline of trees and all excavation work.

### 4.1. Traffic Management

A traffic management plan will need to be submitted if the work will prevent:

- Normal use of a vehicle driving or parking lane
- Normal pedestrian access along a path.

A suitable traffic management plan for maintenance will be provided by traffic contractors at the time of maintenance.

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## 4.2. Harvesting

Like any soil area that includes grasses or woody plant materials, harvesting and pruning of excess or diseased growth will need to be done occasionally. Trimmed materials may be recycled back in with replenished mulch material, composted elsewhere on the site, or taken to landfill if necessary.

Trees may also be pinched, pruned, thinned or dead-headed for shape or to maximize fruit or flower production. Pruning of trees should occur before bud-break in the late winter.

## 4.3. Watering

Typically, watering of the raingarden garden will not be necessary once plants have become established, except during drought conditions. However, watering will be needed during the plant establishment stage

## 4.4. Weeding

Weeding of the facilities is not absolutely necessary for the proper functioning of the raingarden facility. However, unwanted plants can be invasive, consuming the intended planting and destroying the aesthetic appeal and biodiversity benefits of the raingarden. Therefore, weeding is encouraged to control the growth of unwanted plants. Non-chemical methods (hand pulling and hoeing) are preferable.

## 4.5. Pest damage

Trees and shrubs should be monitored for the appearance of pests and/or damage caused by pests or disease.

It is important to keep in mind that insects and soil micro-organisms perform a vital role in maintaining soil structure. Therefore, the use of pesticides should be avoided so as not to harm beneficial organisms. An alternative approach is to use a combination of biological, physical, and chemical controls.

## 4.6. Mulching

The mulch materials placed in the facility will decompose and blend with the soil medium over time.

Mulch layers should not exceed 75mm in depth around trees and shrubs and should be placed away from the base of trunks. Mulch can be spread to 50mm depths around perennials.

Avoid blocking inflow entrance points with mounded mulch. Mulch material should be re-applied once every 6 months during the first three growing seasons. Once a full groundcover is established, re-mulching can be programmed annually, with the mulch scraped off and removed every 5 years.

## 4.7. Standing Water Problems

Raingarden facilities are designed to have water standing for up to 24 hours. If this period is routinely exceeded, the facility may not be functioning properly. Should standing or pooling water become a maintenance burden, minor corrective action can usually correct it. Pooling water is usually caused by clogging or blockage of the surface layer. The surface blockage problem may be corrected by removing the mulch layer and using a flat-bottomed shovel and skim off the top 50mm of media, and then replace the mulch. If this is done several times, then additional media may be needed in the future.

## 4.8. Rubbish and Debris

Runoff flowing into raingardens may carry litter and debris with it. Rubbish and debris should be removed regularly both to ensure that inlets do not become blocked and to keep the area from becoming unsightly. Inspect raingardens areas after rainstorms to ensure drainage paths are free from blockages

## 4.9. Sediment runoff

During earthworks and construction works sediment laden runoff needs to be prevented from entering the stormwater network utilising prescribed Sediment and Erosion control methods. Any sediment laden runoff entering into a raingarden device can affect the soakage quality of the media mix and may cause replacement to be required. It is essential therefore, that sand filled socks remain over raingarden inlets until construction works within their catchment are complete and stabilised. The socks must be of a diameter to allow free flow of water through the Road channel

## 4.10. Mechanical components

The mechanical components within the raingarden devices are scour protection, end boards, liners, pipe work and overflow pits in some cases, as shown in the attached drawings. Each time the raingardens are inspected these components should be checked for damage and fixed/replaced as necessary. Pipe work within the raingarden devices is designed to be accessible by CCTV if required. All pipe work replaced must be to Council standards.

## 4.11. Maintenance Schedule

Effective long-term operation of raingardens requires dedicated and routine maintenance tasks performed to a consistent timetable as summarised in Table 3.

Table 3: Raingarden Maintenance Schedule

Maintenance Activity	Monthly	6 Monthly	12 Monthly	5 Yearly
<b>Remove weeds and replace dead plants. Eradicate noxious/pest weeds and undesirable growth.</b> This shall be completed by competent workmen who have landscape experience. A hoe and weed knife will be required and other weed removal equipment.	✓			
<b>Litter removal.</b> Litter removal will require low skilled workman. Equipment includes a pickup tool claw, rubbish bags and other equipment suitable for the removal of litter.	✓			
<b>Inflow, overflow/outlets – check overflow for clogging. Remove accumulated sediment. Check overflow spillway.</b> This will require specialist materials and competent labour	✓			
<b>Summer-monitor and water vegetation in extended dry periods.</b> Low skilled labour and watering tools will be required	✓			
<b>Visually check for damage or missing components of devices such as inspection chamber caps, edge beams and scour protection. Replace/fix as required.</b> Workmen who are competent at identifying broken equipment will be required as well as a site checklist, and other equipment deemed appropriate.	✓			
<b>Pruning or thinning.</b> Low skilled labour and pruning tools are required and other equipment deemed appropriate.		✓		
<b>Compost/Mulch replenishment (first 3 growing seasons).</b> Low skilled labour and safety gear is		✓		

required, and other equipment deemed appropriate				
<b>Remove accumulated sediments. Reinstate plants, soil and mulch. Check for ponding/clogging and blockage of filter media.</b> Workers who are competent at unblocking filter media are required, and equipment deemed appropriate is required		✓		
<b>Inspect trees and shrubs and replace any dead or severely diseased vegetation.</b> A shovel, weed knife, hoe and other equipment deemed appropriate may be required to carry out work.		✓		
<b>Scour/erosion evident: check for erosion signs. Check dams/capping system areas and correct as required.</b> Labourers who are competent in checking for erosion are required and other equipment that are deemed appropriate for job may be required.		✓		
<b>Sump-accumulated sediments not more than 50% full.</b> Labour who are competent in identifying sump accumulation of sediments are required and other tools that are deemed appropriate may be required.		✓		
<b>Outlet manholes – check and remove silt from manhole sumps.</b> Competent Labourers and a sucker truck. Equipment that is deemed appropriate maybe required.		✓		
<b>Pre-treatment, inspection and silt removal as required.</b> Low skilled labour is required and a sucker truck required. Equipment that is deemed appropriate maybe required.		✓		
<b>Compost/Mulch replenishment (after first 3 growing seasons).</b> Competent workers and compost tools are required			✓	
<b>Check for restrictions/clogging/failures in pipes.</b> Competent workers and pipe work tools are required.			✓	
<b>Scrape off top 100mm of soil and mulch, dispose to landfill, replace.</b> Competent workers are required and the appropriate gardening tools are required.				✓
<b>Replace transition layer if warranted.</b> Competent workers are required, small digger and the appropriate gardening tools are required.				✓

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## 5. Raingarden Plans

### 5.1. Fast Track Consent Plans

Please refer to the Fast Track Consent Plans:

- P24-447-01-3000-DR Overall Stormwater Layout Plan
- P24-447-01-3001-DR to 3004-DR Stormwater Layout Plan Sheets
- P24-447-01-3103-DR Stormwater Treatment Catchment Plan
- P24-447-01-3200-DR Proposed Overland Flowpath Plan
- P42-447-01-3601-DR Wetland 2-1 Layout Plan
- P24-447-01-3605-DR Raingarden 2-1 Cross Section-E