



Appendix P

P1 - BPO Device Selection

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Appendix P1 BPO Device Selection

Stormwater Management Devices Selection

The BPO approach was used to determine the most appropriate stormwater management devices from TP10 and the Transport Agency Stormwater Treatment Standard (2010). In this section, a brief description of the merits and constraints of different treatment devices which inform the choice of the BPO is provided. Site factors affecting the choice of BPO are highlighted where relevant. To understand the operation and maintenance requirements of different devices and to inform the assessment, input was sought from Peter Mitchell of the AMA and the AC Stormwater Unit was consulted. Chapter 4 of TP10, and in particular Tables 4-8 and 4-9, summarises the effectiveness of various treatment devices in removing contaminants and attenuating peak flows.

Rule E9.6.2 of the AUP, which contains controlled activity standards, requires compliance with TP10.

The BPO assessment has determined that constructed, off-line wetlands are the preferred means for providing stormwater quality and quantity control for the Project. The wetlands are described in more detail below together with a description of other treatment devices that were considered as part of the BPO process along with their benefits, performance and potential ecological impacts.

Wetlands

Wetlands are complex natural shallow water environments that are dominated by low lying vegetation. They are typically the preferred above ground devices used to provide both water quantity and quality control for large scale, linear motorway projects, where catchments are often of considerable size and length.

Wetlands are preferred to open water ponds because they provide better filtration of contaminants (including dissolved contaminants) due to densities of wetland plants, incorporation of contaminants in soils, adsorption, plant uptake, and biological microbial decomposition.

Wetlands also manage temperature increases better than ponds, mainly because the vegetation provides shade and protects the water from light penetration. Temperature affects the ability of water to hold oxygen (as temperature increases oxygen levels decrease), and changes in water temperature can provide direct stresses on aquatic species and also make nutrients in sediments more susceptible to algae growth.

Compared to other treatment devices, wetlands have low maintenance requirements, low whole-of-life costs, provide visual amenity and are a better habitat for wildlife. They are also considered to be safer to manage due to their shallow water levels, and as such they do not have the safety issues associated with the maintenance regimes for deeper water ponds.

For these reasons, the NZ Transport Agency, AC and iwi have indicated preference for shallow wetlands over wet ponds where practicable, which makes wetlands the BPO for stormwater management (treatment and attenuation) for the Project.



Swales

Engineered swales are effective devices for water quality treatment, however do not provide adequate volume storage for peak flow attenuation. Therefore engineered swales are not suitable to be used as a sole device for stormwater management for this Project due to the limited space and hydraulic constraints within the designation.

Although swales do not provide adequate volume storage for peak flow attenuation, they can be used to provide informal pre-treatment before discharging to wetlands or other dedicated other treatment devices. This treatment train approach is preferred and supported by Iwi.

There are locations within the Project area where it has been identified that planted swales can be practically constructed between the SUP and busway without impacting on the amount of land required or the retaining walls.

In these circumstances, swales are considered the BPO for this Project for:

- Full treatment to achieve 75% Total Suspended Solids (TSS) removal where space is available within the proposed designation footprint and wetlands are not practicable; and
- Conveyance of stormwater flow where space is available within the proposed designation footprint, which will provide informal pre-treatment of stormwater runoff prior discharging to dedicated treatment devices (i.e. wetlands).

Wet Stormwater Management Ponds

Wet ponds are a permanent storage device that have a standing pool of water. These ponds can, through their normal storage of water or in conjunction with extended detention, provide water quality treatment. They can, also in conjunction with extended detention, provide protection of downstream channels from frequent storms.

A wet pond has a smaller foot print when compared to wetlands, due to a deeper permanent pool of water. The permanent pool in ponds can often be up to 2m deep, so access and safety in maintenance is a key consideration when designing and specifying wet ponds.

Wet ponds are considered the BPO for areas of the Project where planted wetlands or swales cannot fit within the proposed designation footprint.

Dry Stormwater Management Ponds

Dry ponds are permanent storage device that temporarily store stormwater runoff to control the peak rate of discharges. They do not provide any dedicated water quality treatment benefits.

Dry ponds are often used in locations where attenuation is required but treatment is not. For example, dry ponds can be used downstream of swales or proprietary devices, and for attenuation of impervious areas that do not require treatment.

Off-line dry ponds that activate above a certain flow depth can be used for specific situations where attenuation is only required above a specified ARI storm event. This can minimise asset size, as stormwater may freely drain without taking up volume at the beginning of the storm.

Dry ponds are considered the BPO for areas of the Project where designation is constrained and a combined treatment / attenuation asset such as a wetland or wet pond cannot be provided.



Proprietary Filter Cartridges

Cartridge filters such as the Stormwater360 StormFilters are AC approved for water quality treatment for high traffic load applications. The filter medium used in the cartridges for highway applications is a porous material that removes particles through direct filtration and absorbs oil and grease via capillary action. They also remove hydrocarbons via adsorption.

These cartridges result in discharge stormwater quality that has been approved by the AC to meet TP10 Guideline requirements of 75% removal of TSS, as demonstrated in *Stormwater360 Stormfilter Interim Proprietary Device Evaluation Part 1 – Air, Land and Water Plan Evaluation (2015)*. A benefit of using StormFilters to treat runoff from motorway catchments is the targeted removal of metals and hydrocarbons, and the ability to locate them in discrete areas where larger, above ground devices such as wetlands and swales do not fit.

Cartridge filters are used for water quality treatment only and are not typically suitable where attenuation is required. An advantage of cartridge filters over other devices is the small space required for the device.

Proprietary filter cartridges are the BPO for areas of the Project where space constrains the construction of, and safe access to wetlands.

Filter Strips

Grassed filter strips are uniformly graded and densely vegetated strips that are designed to treat stormwater runoff by filtration, infiltration, adsorption and biological uptake. Filter strips accept distributed or sheet flow and convey the runoff laterally from the roadside, meaning that runoff from the catchment is not collected and discharged at one point. Filter strips provide the following benefits (TP10):

- Effective at TSS concentration reduction;
- Can be used for vehicle recovery and sight lines;
- Aesthetically pleasing and incorporate low impact design principles;
- Do not provide quantity control;
- Low hydraulic head loss; and
- Eliminate need for capture and conveyance drainage network.

The main disadvantage of using filter strips in relation to this Project is that they do not provide any water quantity control and require a large area for the device immediately adjacent to the pavement surface (i.e. along the side of the carriageway). They are also not suitable for areas with moderate to steep slopes and areas where the area adjacent to the motorway is constrained

For these reasons, filter strips are not the BPO for water quality and quantity control for the Project due to space constraints within the Project area.

Rain Gardens

Rain gardens treat stormwater runoff by passing the water through a filter medium containing an organic component. The uniformly graded soil medium planting area and vegetated strip are designed to treat stormwater runoff by filtration, infiltration, adsorption and biological uptake. Rain gardens accept distributed or sheet flow and convey the runoff laterally from the roadside, collect the surface water in an extended detention zone, and through infiltration discharge it to a subsurface drainage layer.

To retain the filter media within the rain garden and aid drainage, one or more layers of filter medium are used at the bottom of the filter. The raingarden surface can be planted with a range of vegetation.



One of the advantages of rain gardens over other treatment devices is that piped reticulation and outfall structures may be reduced. Rain gardens provide similar benefits as described above for filter strips (TP10).

The disadvantages of using rain gardens within the motorway environment include:

- A large footprint is required;
- High maintenance costs;
- No quantity control; and
- High sediment loads lead to clogging.

Advice from Peter Mitchell of the AMA on recent motorway projects has been that filtration/infiltration type stormwater assets are not preferred by AMA due to their experiences with high rate of clogging and associated increased maintenance requirements (and safety concerns).

Accordingly, due to all the factors outlined above, rain gardens are not the BPO for any areas of the Project.

Sand Filters

Sand filters use filtration for treating stormwater runoff. They are similar to bio-filtration where contaminated flow passes through a filtering media such as sand, gravel, compost or peat to filter out contaminants. They are especially suited for small catchment areas and are primarily water quality treatment practices having little water quantity benefit.

The hydraulic head requirement through sand filters is larger than that through the proprietary filter devices and sand filters often require a large physical space for maintenance activities.

They are most commonly used in industrial settings, such as carparks of local service roads and are not typically considered as a practical means for treating stormwater runoff from large, longitudinal catchment on motorway projects. Sand filters do not provide any water quantity control.

For these reasons, sand filters are not the BPO for any area within the Project area.

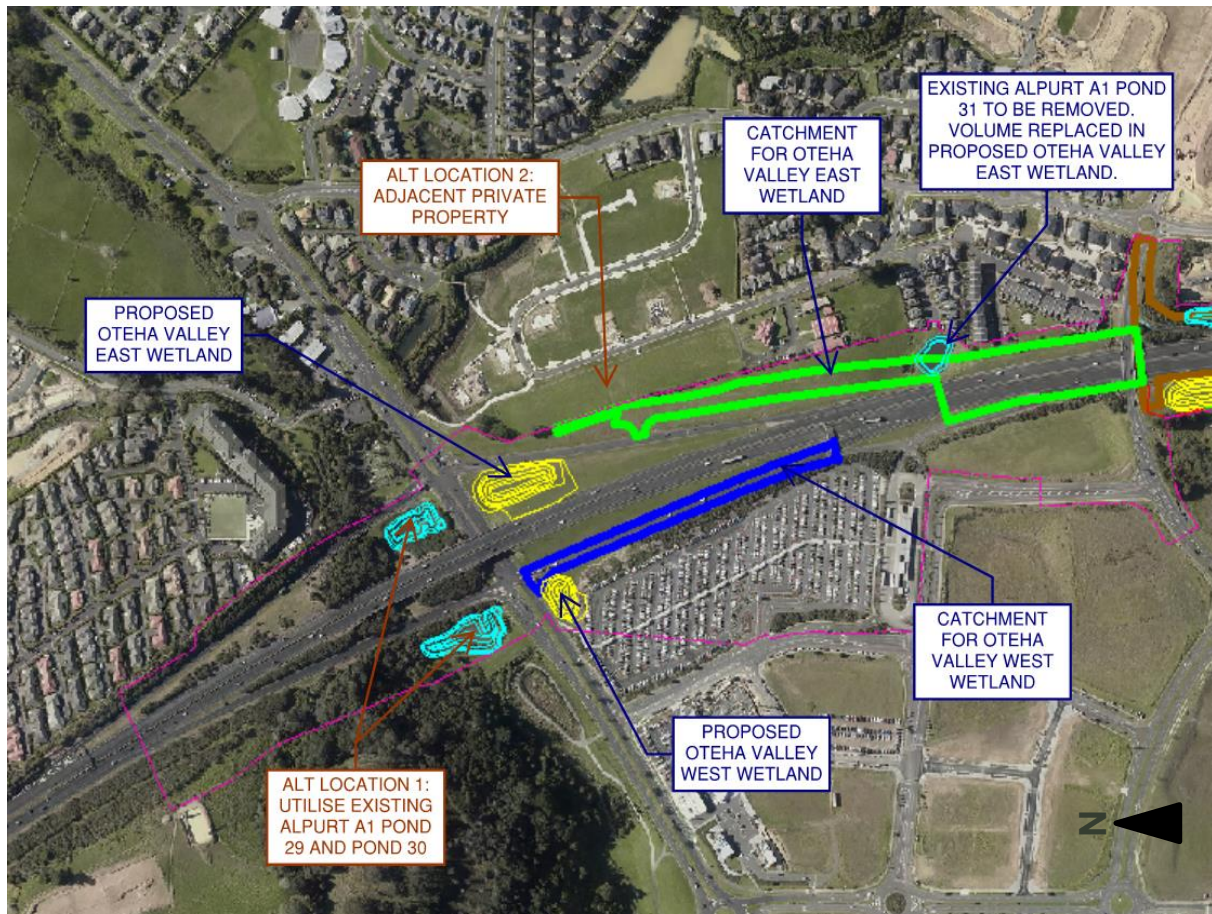


Appendix P2 BPO Assessment – Alternatives Considered

Oteha Valley to McClymonts (OV2M) Catchment

Alternative locations considered for stormwater management is identified in Figure A7.

Figure A7 BPO and alternatives for OV2M sub-catchment



Alternative Location 1: Utilising existing Alpur A1 Ponds

The option to utilise existing Alpur A1 ponds as identified in Figure A7 has been considered. This would involve enlarging existing ponds to serve the new impervious areas and providing mitigation for the removal of Alpur A1 Pond 31. However, this option was discarded for the following reasons:

- There is limited space at the existing pond locations to upsize the ponds to provide adequate treatment and detention performance and replacement for Alpur A1 Pond 31;
- Modifying the existing ponds adjacent to Lucas Creek would increase the risk of potential adverse environmental effects during construction;
- Modifying existing ponds requires works within Significant Ecological Areas, which can be avoided with the BPO;
- The existing ponds were renewed within the last year so do not need any further maintenance or upgrade work at this time; and



- As the ponds serve an existing stormwater function, taking them offline for upgrading is impracticable.

Alternative Location 2: Locate wetland on adjacent private property

The option of locating one wetland on an adjacent property as shown in Figure A7 has also been considered. However, this option was discarded because:

- It would require land acquisition of private property; and
- The adjacent property is at a higher level than the motorway and would require significant cuttings to achieve the hydraulic levels required.

Alternative Stormwater Devices Considered

Alternative devices considered for stormwater management for the OV2M catchment are summarised in **Table A6** below.

Table A6 Stormwater Management Device Comparison for OV2M

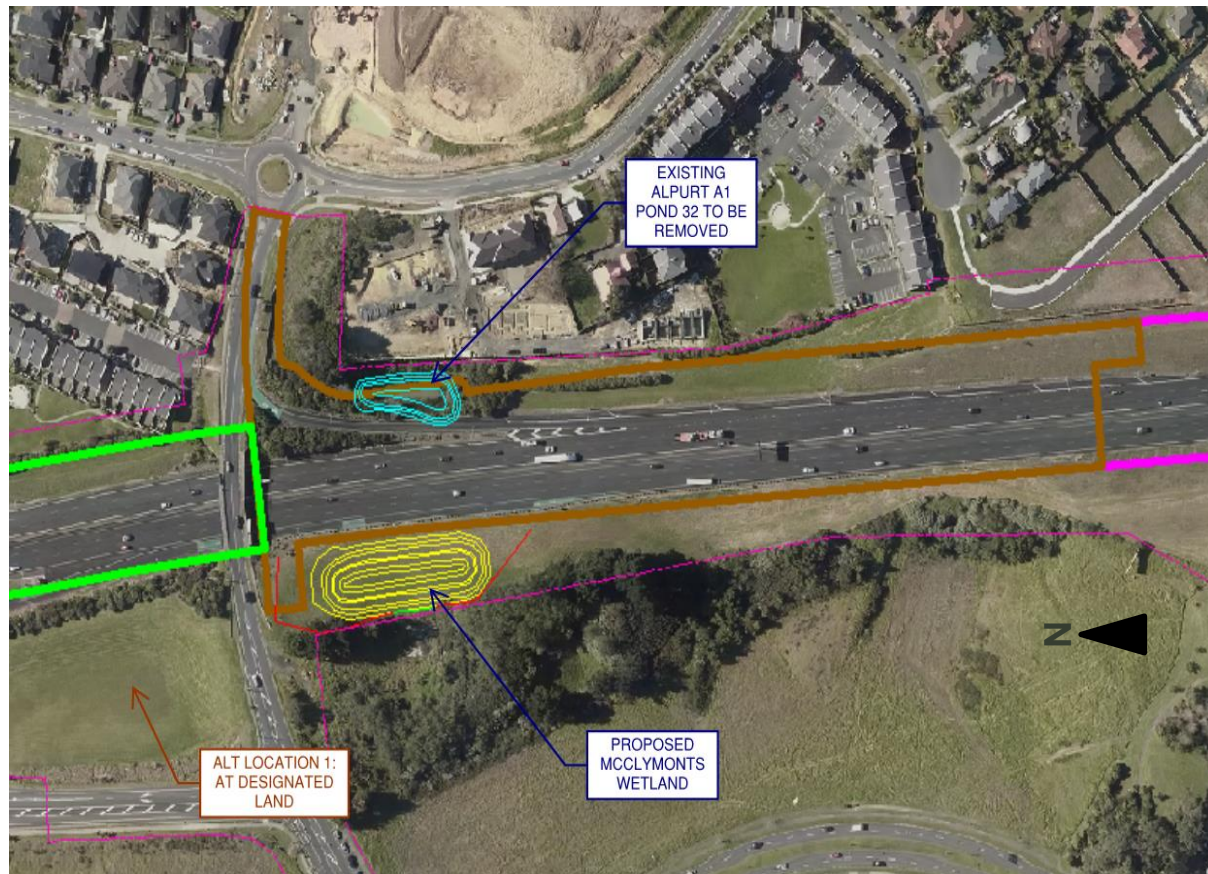
Stormwater Management Device	BPO for Catchment (Y/N)	Comment
Swales	Yes	Proposed for conveyance between busway and SUP. No treatment swales required as there is adequate space for wetlands.
Proprietary Filter Cartridges	No	There is adequate space within the designation for wetlands.
Dry Stormwater Management Ponds	No	Stormwater treatment is required for the catchment.
Wet Stormwater Management Ponds	No	There is adequate space within the designation for wetlands.
Wetlands	Yes	Preferred option for providing water and quantity management as space is adequate.



McClymonts to Spencer (M2S) Catchment

An alternative location considered for stormwater management is labelled in **Figure A8**.

Figure A8 BPO and alternatives for M2S sub-catchment



Alternative Location 1: Wetland on AT designated open space

The option to construct a wetland in this open space has been considered. The benefit of this option over the BPO is that no retaining wall is required. However, this option has been discarded due to the following reasons:

- Land acquisition would be required;
- This location would hinder development on land designated for use by AT – potentially for bus station extension;
- Not preferable hydraulically, as outlet needs to be extended further south near basin adjacent to the BPO wetland; and
- An emergency spillway cannot be provided at this location, as it is surrounded by the motorway and local roads.

Alternative Stormwater Devices Considered

Alternative devices considered for stormwater management is summarised in **Table A7**. Devices that are not considered appropriate for the Project, as discussed in **Section 8.2** are not included for further discussion below.



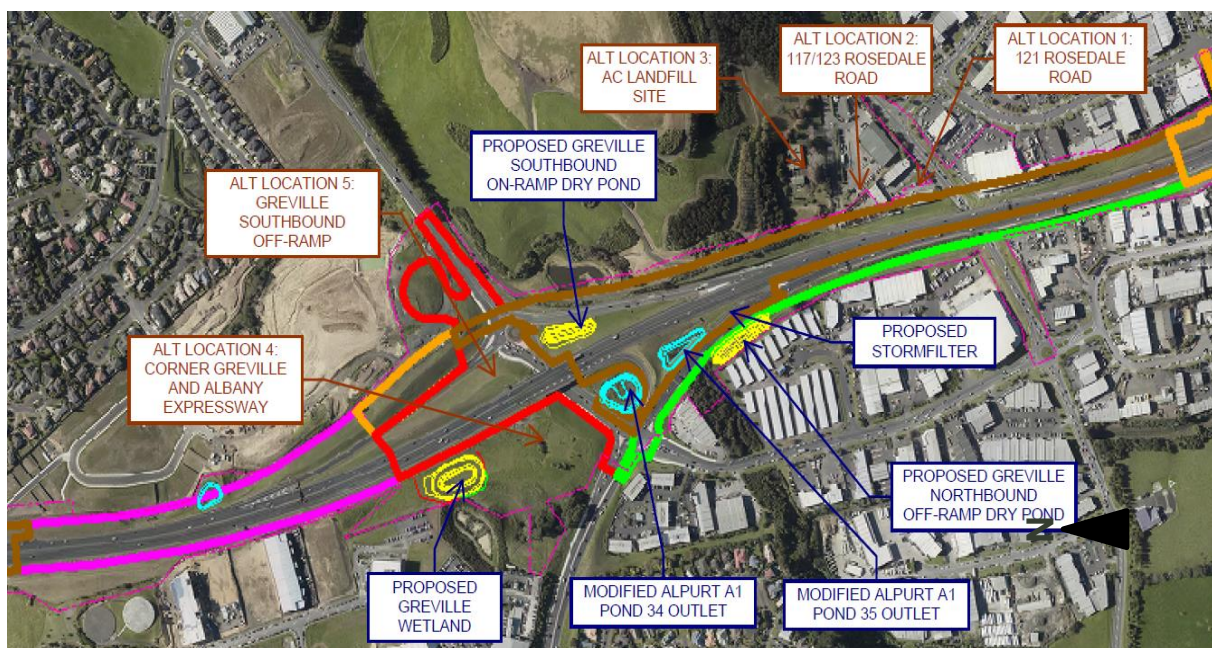
Table A7 Stormwater Management Device Comparison for M2S

Stormwater Management Device	BPO for Catchment (Y/N)	Comment
Swales	No	Space is constrained within designation.
Proprietary Filter Cartridges	No	There is adequate space within the designation for a wetland.
Dry Stormwater Management Ponds	No	Stormwater treatment is required for the catchment.
Wet Stormwater Management Ponds	No	There is adequate space within the designation for a wetland.
Wetlands	Yes	Preferred option for providing water and quantity management as space is adequate.

Spencer to Rosedale (S2R) Catchment

Alternative locations considered for stormwater management are identified in **Figure A9**.

Figure A9 BPO and alternatives for S2R sub-catchment



Alternative Location 1: 121 Rosedale Road

The option to locate a wetland within 121 Rosedale Road has been considered. This would require land acquisition of private property and demolition of existing buildings. This option has been discarded based on the following reasons:

- Additional land acquisition of private property and building demolition required
- Owner wishes to continue using the existing buildings



Alternative Location 2: 117/123 Rosedale Road

This site is ideal in terms of hydraulics as it is close to the motorway low point and is situated close to an existing culvert that can be used for discharge. However, this option has been discarded based on the following reasons:

- Wetland location located in a floodplain, which would adversely impact existing flood levels; and
- Additional land acquisition of private property required.

Alternative Location 3: AC Landfill Site

The option to locate a wetland in AC's Landfill site has been considered. This option requires removal of existing plant and buildings owned by AC. Upon consultation with AC's Landfill team, it has been confirmed the existing plant and buildings are required for future operations. Therefore, this option has been discarded for the following reasons:

- Wetland would require demolition of existing AC landfill plant and buildings. It has been confirmed that these buildings are required for future operations.

Alternative Location 4: Corner Greville Road and Albany Expressway

This location is better suited for management of motorway runoff. Due to its location further downstream in the motorway sub-catchment, a wetland at this location would allow more stormwater runoff from the motorway to be managed. However, this area has been proposed to be used as a construction yard, hence the BPO location for the wetland in this location was moved further north. This option has been discarded based on the following reason:

- Land reserved for other uses – construction yard

Alternative Location 5: Greville Southbound Off-Ramp

This option to locate a wetland between the Greville Road southbound off-ramp and the motorway on-ramp has been considered. It appears on plan that there is adequate space available. However, upon consideration of the existing ground profiles, it was found that the slope between the motorway and ramp is already quite steep. Therefore, this option has been discarded based on the following reasons:

- The existing slope between the motorway and the ramp is steep (> 1V:2.5H). Therefore, a wetland in this location has been discounted due to the significant retaining structures required for construction.

Alternative Stormwater Devices Considered

Alternative devices considered for stormwater management is summarised in **Table A8**. Devices that are not considered appropriate for the Project, as discussed in **Section 8.2**, are not included for further discussion below.

Table A8 Stormwater Management Device Comparison for S2R

Stormwater Management Device	BPO for Catchment (Y/N)	Comment
Swales	Yes	Proposed for conveyance between busway and SUP. Proposed for treatment and informal pre-treatment prior to discharge to dry ponds and wetlands.
Proprietary Filter Cartridges	Yes	Provides treatment prior to discharging to existing undersized Alpur A1 Pond 35.
Dry Stormwater Management Ponds	Yes	Required for providing additional attenuation in narrow locations.

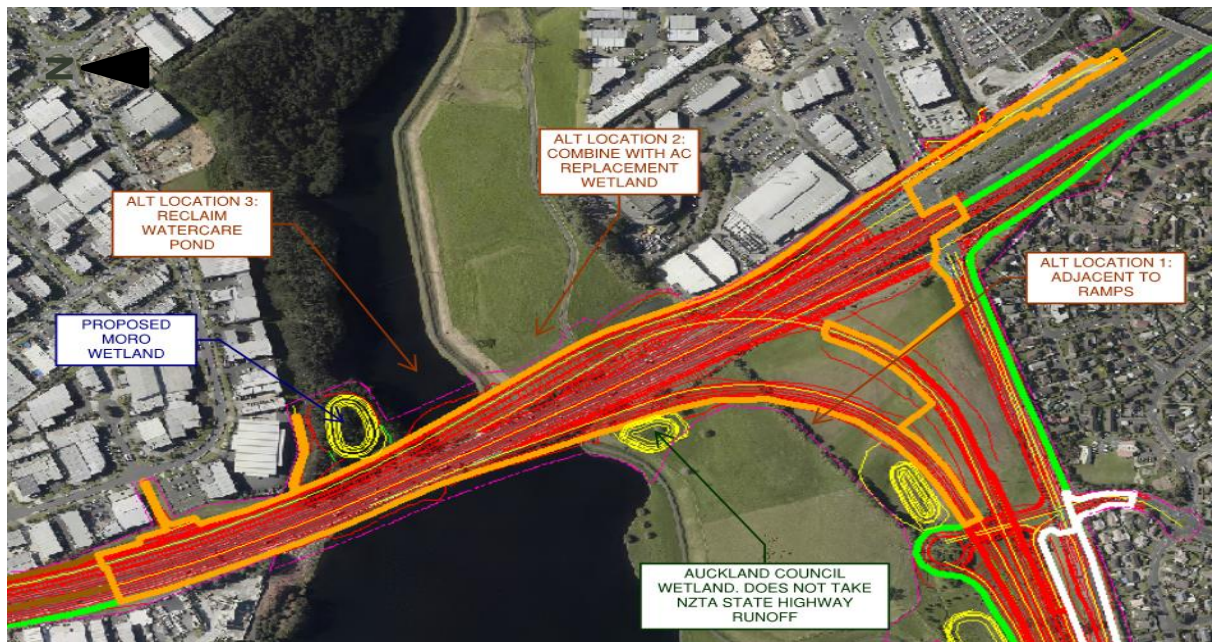


Stormwater Management Device	BPO for Catchment (Y/N)	Comment
Wet Stormwater Management Ponds	No	There is adequate space within the designation for wetlands.
Wetlands	Yes	Preferred option for providing water and quantity management as space is adequate.

Rosedale to Constellation (R2C) Catchment

Three alternative locations considered for stormwater management is labelled in **Figure A10**.

Figure A10 BPO and alternatives for R2C sub-catchment



Alternative Location 1: Open space adjacent to proposed SH18 to SH1 ramps

The space adjacent to the proposed ramps have been considered to be used for locating a stormwater management device. However, this option has been discarded based on the following reasons:

- The serviceable catchment is very small, as this location is near the high-point; and
- The land adjacent north to the ramps is proposed to be used by Watercare for future plant expansion.

Alternative Location 2: Combining runoff with AC Wetland replacement

The option to combine motorway and AC catchment runoff and manage within one device has been considered. However, this option has been discarded based on the following reason:

- This option results in an asset receiving stormwater runoff from public (AC) and private (the NZ Transport Agency) catchments. The design philosophy is to avoid this type of arrangement, as it requires third party approval (AC) with regards to agreements on operation and maintenance responsibilities;
- This alternative requires land acquisition from Watercare, which opposes a device at this location as it restricted future plant and commercial development potential; and
- This location is not located at the motorway low point, which restricts the catchment area able to be managed.



Alternative Location 3: Reclamation of Watercare Wastewater Treatment Ponds

The space adjacent to the proposed ramps has been considered to be used for locating a stormwater management device. However, this option has been discarded for the following reason:

- The required wetland size can be accommodated above ground at the proposed BPO location, hence it is not considered necessary to undertake additional reclamation for stormwater management.

Alternative Stormwater Devices Considered

Alternative devices considered for stormwater management is summarised in **Table A9**. Devices that are not considered appropriate for the Project, as discussed in **Section 8.2**, are not included for further discussion below.

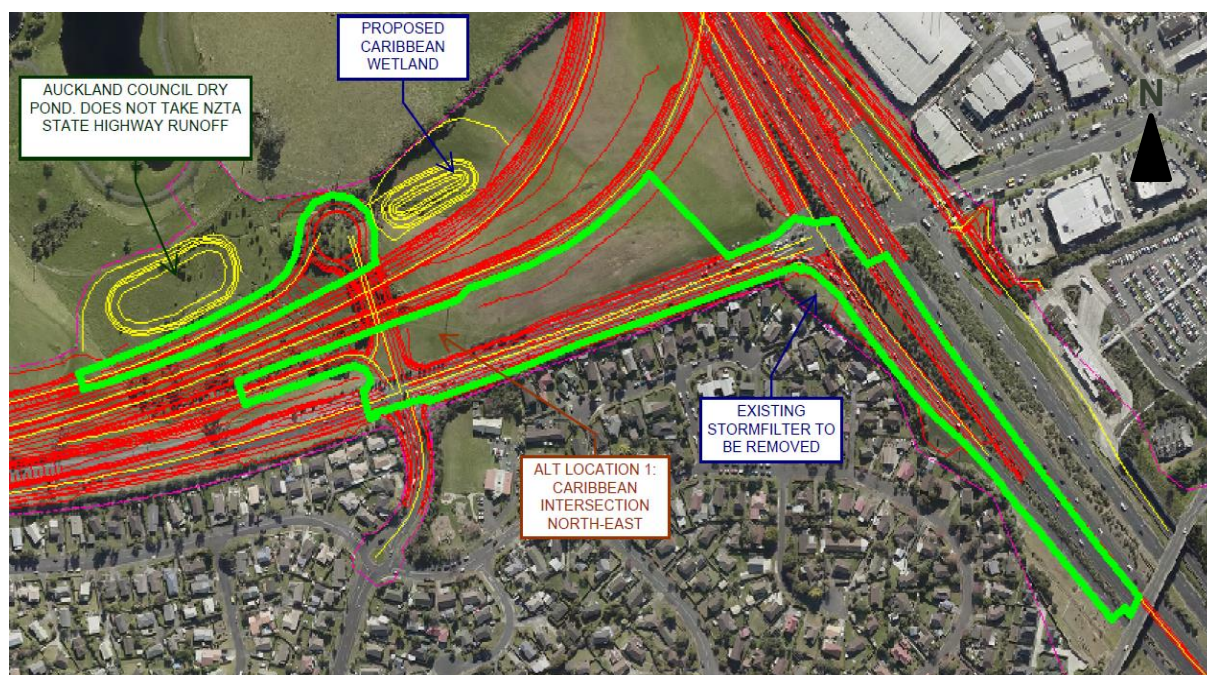
Table A9 Stormwater Management Device Comparison for R2C

Stormwater Management Device	BPO for Catchment (Y/N)	Comment
Swales	Yes	Proposed for conveyance between busway and SUP. Proposed for informal pre-treatment of motorway and ramps.
Proprietary Filter Cartridges	No	There is adequate space within the designation for a wetland.
Dry Stormwater Management Ponds	No	Stormwater treatment is required for the catchment.
Wet Stormwater Management Ponds	No	There is adequate space within the designation for a wetland.
Wetlands	Yes	Preferred option for providing water and quantity management as space is adequate.

Constellation to Paul Matthews (C2PM) Catchment

An alternative location considered for stormwater management is labelled in **Figure A11**.

Figure A11 BPO and alternatives for C2PM sub-catchment





Alternative Location 1: North-east of Caribbean Drive intersection

This option was previously considered as it enables a more compact overall Project footprint with less earthworks volume. However, this option has been discarded based on the following reasons:

- It would intercept existing underground Transpower cable, which would likely be cost prohibitive to relocate; and
- The serviceable catchment is significantly less than the preferred option – runoff from the SH18 off-ramp and roundabout link cannot be managed by a device in this alternative location due to hydraulics.

Alternative Stormwater Devices Considered

Alternative devices considered for stormwater management is summarised in **Table A10**. Devices that are not considered appropriate for the Project, as discussed in **Section 8.2**, are not included for further discussion below.

Table A10 Stormwater Management Device Comparison for C2PM

Stormwater Management Device	BPO for Catchment (Y/N)	Comment
Swales	Yes	Proposed for treatment of stormwater runoff from existing Upper Harbour Highway.
Proprietary Filter Cartridges	No	There is adequate space within the designation for a wetland.
Dry Stormwater Management Ponds	No	Stormwater treatment is required for the catchment.
Wet Stormwater Management Ponds	No	There is adequate space within the designation for a wetland.
Wetlands	Yes	Preferred option for providing water and quantity management as space is adequate.

Paul Matthews to Albany Highway (PM2AH) Catchment

The other alternative locations identified that could potentially be used for stormwater management are the:

- Bluebird Reserve;
- Abandoned Caltex service station; and
- Abandoned Z Service service station ramp.

Alternative locations considered for stormwater management are labelled in **Figure A12**.



Figure A12 BPO and alternatives for PM2AH sub-catchment



Alternative Location 1: Bluebird Reserve

The location identified for the wetland during the preliminary design phase was a grassed location adjacent to the UHH within Rook Reserve, to the north of Rook Place. AC Parks recently expressed concern about the potential loss of functionality that locating a wetland would have on this reserve. In response, two alternative sites were investigated, both within the Bluebird Reserve: one site within the grassed open area north of the children's playground, and another in an area of bush within the same reserve.

All options would require the use of a proprietary device to filter the stormwater prior to discharge into the local streams. In all other aspects, the Bluebird Reserve options would provide a comparably suitable area to the Rook Reserve option for a stormwater management wetland that would also provide an amenity feature, accessible by the public.

An MCA process was undertaken in conjunction with AC Parks on all three sites, with the Rook Reserve site being selected as the preferred location for the following reasons:

- The Rook Reserve option performs better from a stormwater functionality perspective, with the least increase in downstream flood flows, the avoidance of the need to fill in a floodplain and the avoidance of the use of culverts to convey the stormwater to the filter before discharging; and
- While all three locations would result in a reduction in the functionality of each reserve, the Rook Reserve is larger and therefore has greater opportunities to enhance the reserve's recreational value following the construction of the wetland, including opportunities to integrate the wetland as a community asset.

At the time of writing, a decision from the Local Board (as manager of the reserves) as to its preferred option has not been made (partly due to the timing of the local body elections and the new meeting schedule for the Local Board). The NoRs and consent applications, therefore, include both the Rook and Bluebird Reserve options. Once the position of the Local Board is known, the NZ Transport Agency will confirm which option will proceed and the designation line can be drawn back in the location of the discarded option.



Due to the location of the Bluebird Reserve being some 300m west of the SH18 low point (CH1725), the Bluebird Wetland location is only able to manage stormwater runoff from the existing impervious areas (and a small area of new impervious area) from Bluebird Reserve to the motorway crest just west of Albany Highway. The Project only proposes minor widening of the existing State Highway over this area (little new HUR pavement areas), so the majority of stormwater management provided by the Bluebird Wetland is of existing impervious areas. No treatment, detention or attenuation is currently provided in relation to this area.

To provide treatment new HUR areas to the east of the Bluebird Wetland, a proprietary treatment device (StormFilter of similar approved) would be required at the abandoned Z Energy service Station ramp (CH1700).

The Bluebird Wetland discharges via the tributary west of Bluebird Reserve, through a culvert under SH18 and then into Alexandra Stream downstream of the motorway.

To summarise, the merits and disadvantages for this alternative are as follows:

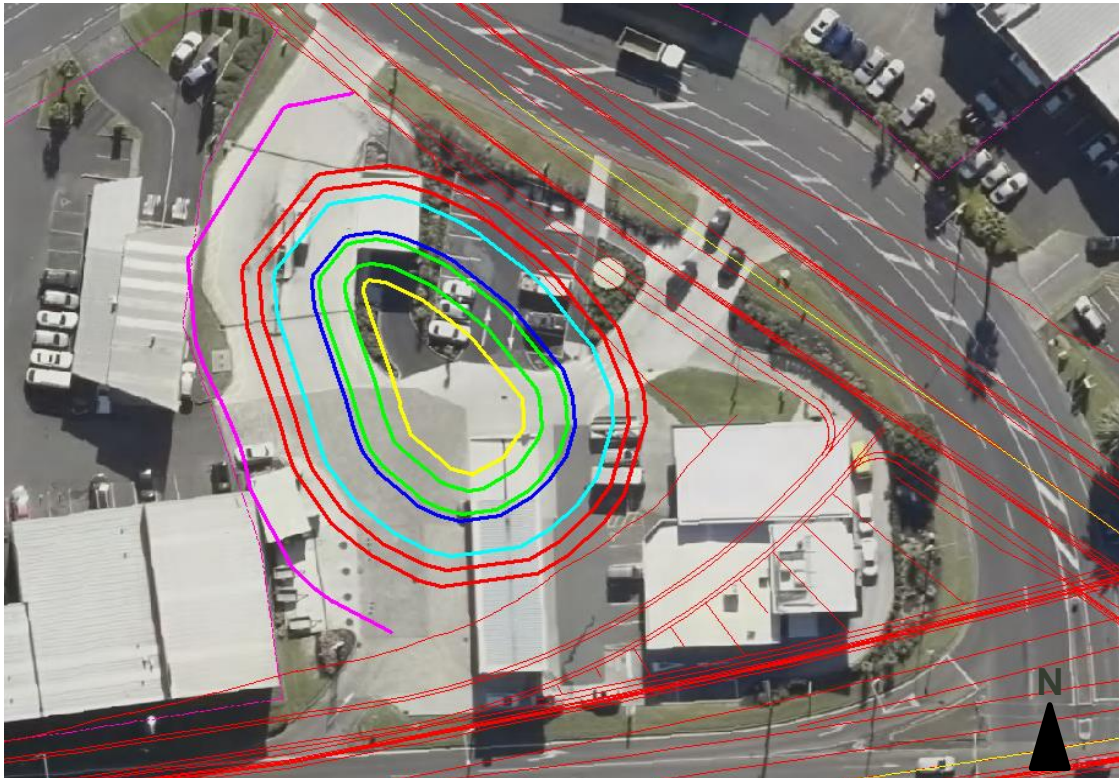
- Merits:
 - Achieves treatment of new and existing HUR areas in this sub-catchment; and
 - The Bluebird Wetland can be safely accessed from Bluebird Crescent.
- Disadvantages:
 - Results in wider increased flooding downstream of the Alexandra Stream crossing compared with the preferred option;
 - A proprietary cartridge device (StormFilter or similar approved) is required at the abandoned Z Energy service station ramp for treatment of new impervious areas east of Alexandra Stream; and
 - The Bluebird Wetland will impact on existing open space in the Bluebird Reserve.

Alternative Location 2: Caltex Service Station Site

The Caltex Station site is required to construct the SUP and associated access on Paul Matthews Road. This provides an opportunity to locate a wetland within the property boundary. **Figure A13** illustrates extents of a wetland located within the Caltex Station site.



Figure A13 Alternative wetland location within Caltex service station



This level of the existing surface at the service station is considerably higher than the motorway adjacent. Further, the westbound carriageway alignment is proposed to be lowered an additional 3.5m. The level of the existing ground is at approx. 46.3mRL, while the westbound carriageway is at approx. 42.9mRL. Therefore, a wetland located at the service station requires significant cut to function hydraulically. This option requires retaining walls up to 4.5m high adjacent to Paul Matthews Road and the proposed SUP as a minimum.

This location is further upstream from the motorway low point than the preferred location at Rook Reserve, which results in a smaller catchment that can be managed. A wetland located at the Caltex service station could service an impervious catchment area of 2.2ha, while the preferred location at Rook Reserve can service an impervious area of 2.8ha. In the PM2AH sub-catchment, an additional 2.1ha of HUR pavement area and 0.5ha of SUP is proposed. A wetland located at the Caltex station could still be expected to provide adequate treatment, detention and attenuation performance.

Due to the depressed location of a wetland at this location, an emergency spillway cannot be provided for this option and would increase flood risks.

There is also a risk that the ground under the Caltex service station is contaminated (refer to the Assessment of Land Contamination Effects for further details).

To summarise, the merits and disadvantages for this alternative are as follows:

- Merits:
 - Hydraulically acceptable;
 - No additional land acquisition associated with stormwater management required;
- Disadvantages:
 - Less impervious area catchment served when compared with the preferred option;



- Significant cut into existing ground;
- Retaining walls up to 4.5m high required;
- No emergency spillway can be provided, resulting in increased flood risks;
- Potential dam considerations due to depth of wetland; and
- Potential land contamination issues associated with the service station.

Alternative Location 3: Z Service Station ramp

The existing ramp from SH18 to the Z Energy service station is removed as part of the works. This location has been considered as an option to provide stormwater management devices.

This sub-catchment requires attenuation of stormwater runoff up to the 10-year ARI event. To achieve this a volume of approx. 1,500m³ is required. This is most practically achieved with an above ground device such as wetland. The option to provide an underground tank has been considered, but due to volume required and long-term maintenance safety and operation considerations, an underground tank is impractical.

Due to the limited space available, it has been found that adequately sized above ground devices, such as wetlands and ponds, cannot be located within this area. To maximise the attenuation volume, a dry pond has been modelled and can only provide 700m³, which is not adequate for attenuating the 10-year ARI peak flows for the sub-catchment.

To summarise, the merits and disadvantages for this alternative are as follows:

- Merits:
 - Located adjacent to motorway low point;
 - Opportunity to provide proprietary device (StormFilter or similar approved);
 - No additional land acquisition associated with stormwater management required;
- Disadvantages:
 - Inadequate space for a suitably sized above ground device for stormwater quantity control.

Alternative Stormwater Devices Considered

Alternative devices considered for stormwater management is summarised in **Table A11**. Devices that are not considered appropriate for the Project, as discussed in **Section 8.2**, are not included for further discussion below.

Table A11 Stormwater Management Device Comparison for PM2AH

Stormwater Management Device	BPO for Catchment (Y/N)	Comment
Swales	No	Space is constrained within designation.
Proprietary Filter Cartridges	Yes	Required for treatment of new and existing HUR pavement areas in the sub-catchment
Dry Stormwater Management Ponds	No	Stormwater treatment is required for the catchment.
Wet Stormwater Management Ponds	No	There is adequate space within the designation for a wetland.
Wetlands	Yes	Preferred option for providing water and quantity management as space is adequate.