APPENDIX F | PDP Report - Stormwater Treatment

Stormwater Treatment – 535 Mill Road, Ohoka – Stormwater Management

Prepared for

Rolleston Industrial Developments Ltd

2022

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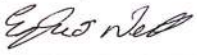
SIGNATURE 

Eoghan O'Neill

Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Rolleston Industries Developments Ltd [and] [others (not directly contracted by PDP for the work)], including [list]. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

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Executive Summary

Pattle Delamore Partners Ltd undertook a stormwater management assessment for the plan change request at 535 Mill Road, Ohoka. The site is approximately 156 ha and zoned as rural and located in Waimakariri District Council.

The proposed development consists of rural-residential, residential, business area and a possible retirement village / school area.

PDP considered the Canterbury Land and Water Regional Plan (ECan, Dec 2018) as well as the Waimakariri District Council Engineering Code of Practice (WDC, 2020) to assess the management of stormwater from the proposed development.

PDP have prepared separate flood assessment and ecological investigation reports.

The following conclusions were made:

- The management of stormwater quantity, including hydraulic continuity between the upstream and downstream catchments, can be managed by means of the following:
    - Formalised flow paths to be installed to connect the upstream and downstream catchments.
    - Attenuation and flood storage to be provided by basins, compensatory storage, and rain tanks.
- Water quality treatment can be provided as follows:
    - Residential and retirement village/school runoff to be treated by means of filtration via high infiltration rate raingardens or swales and bioscapes which includes storage of the first flush volume.
    - Rural-residential runoff to be treated by means of swales, high-infiltration raingardens and bioscapes.
    - Business areas runoff to be treated by means of proprietary filtration devices.
    - Limited catchment runoff will be treated by wetlands to limit potential water take within permitted activity status.

The following recommendations are made to support further development of the detailed stormwater solution :

- Flood model to be developed for the catchment to confirm required attenuation volumes.
- Monitor groundwater levels across the site to obtain a better understanding of the proximity of groundwater levels to the ground.

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1.0 Introduction

Pattle Delamore Partner Ltd (PDP) has been engaged by Rolleston Industrial Developments Ltd (Client) to complete an assessment of the stormwater effects of the proposed land use change for 535 Mill Road, Ohoka.

The site is located to the southwest of Ohoka township and is bordered by Bradleys Road and Whites Road. The current site consists of rural land with the proposed land change for a development consisting of business, residential, rural residential areas and potential retirement village / school area.

The site location is indicated in Figure 1 below:

Figure 1: Location of proposed development

The purpose of this study is to assess and report on the effect stormwater from the proposed development will have on the environment.

2.0 Existing Site Characteristics

2.1 Overview of site

The proposed site is zoned as rural and is approximately 156 ha in area. The existing land-uses on-site consist of:

- Large undeveloped paddock areas.
- Impervious areas limited to:
  - Unsealed roads
  - Buildings and sealed areas (< 1%)

The general fall across the site is northwest to southeast and elevation ranging between RL 29 m to RL 20 m. The average slope across the site is approximately 0.5% (1V:200H).

2.2 Existing stormwater

The existing site stormwater infrastructure consists of the following:

- The site has limited stormwater infrastructure and runoff drains via land drains or as sheet flow from the site.
- Existing land drains collect and drain stormwater and high groundwater away from the contributing catchment areas.
- Three prominent land drains intersect the proposed site.
    - South drain
    - Mid drain consisting of mid drain A and B
    - North drain
- Stormwater runoff, including baseflows present within the existing land drains, are discharged via culverts underneath Bradleys Road onto the proposed development from the upstream contributing catchment.
- Stormwater runoff, including baseflows present within the existing land drains, is collected by a drain running parallel to Whites Road with runoff discharged via culverts underneath Whites Road downstream of the proposed development.

Refer to the Figure 2 below indicating the existing stormwater infrastructure.

Figure 2: Existing stormwater infrastructure

2.3 Flood risk

Flooding information for the site was obtained from the Waimakariri District Natural Hazard website (https://waimakariri.maps.arcgis.com/) and the image below shows the current extent of the flooding for the 200-year event. Flood depths during the 200-year event is typically deeper (0.5 m to 0.75 m) along the existing drains (refer Figure 2) and shallow (0.10 m to 0.25 m) where sheet flow and localised ponding occurs.

Figure 3 shows the existing flood risk on the site.

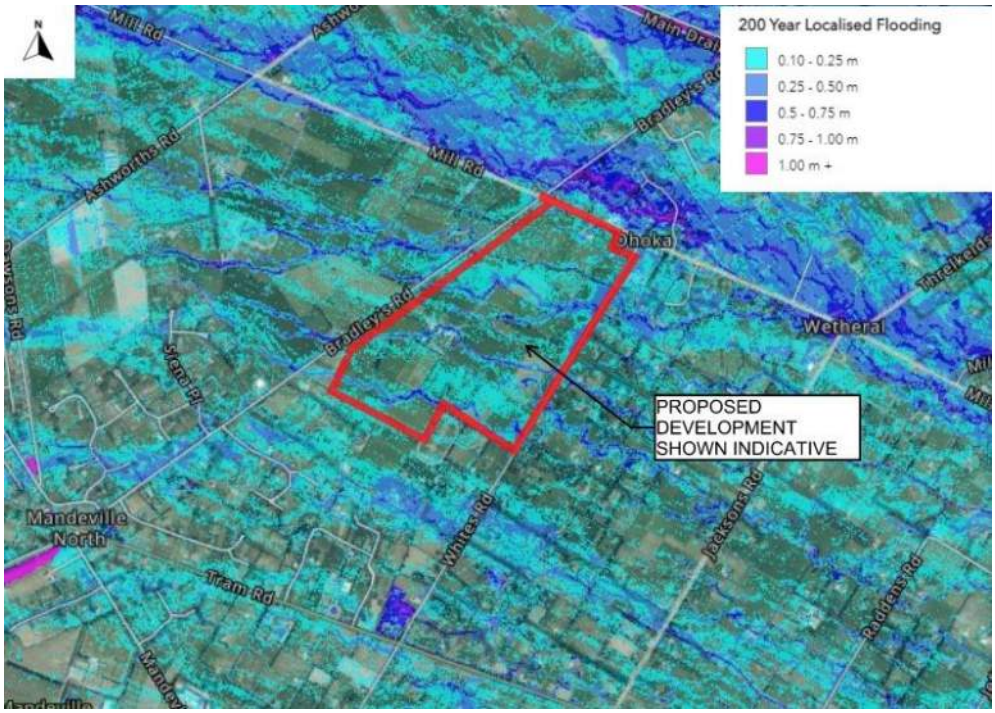


Figure 3: 200-year localised flood depth

2.4 Site Geology

The site is located on the northern Canterbury Plains (i.e., the Waimakiriri – Ashley Plains). The GNS geological map of the area maps the near-surface geology of the site as late Pleistocene brownish-grey river alluvium (Q2a). Previous geotechnical investigations undertaken at the site had encountered silt and clayey silt to a depth of 0.6 to 1.5 m below ground level (bgl), and sandy gravel below this.

A review of soil information available on S-map (Landcare Research) indicates that the soil types underlying the site consist of Ayreburn moderately deep clay. A small section on the northern and southern part of the site consists of Ayreburn deep clay and Leeston shallow clay, respectively.

The underlying soils are considered to be poorly drained.

2.5 Hydrogeology and Groundwater

On the Waimakariri-Ashley Plains, groundwater is dominantly sourced from infiltrating rainwater (i.e., land surface recharge) across the inland plains (to the north-west and upgradient of the site), together with some seepage losses from the Ashley River and Waimakiriri River. The groundwater flows to the southeast, towards the coast. Groundwater discharges into spring fed streams, including the Ohoka Stream and the Cam River/Ruataniwha.

The groundwater is typical shallow and subject to seasonal fluctuations. Groundwater is estimated to be average 0.64 m below ground level (bgl) with the highest recorded groundwater level at 0.14 m bgl (June 2018).

The occurrence of heavy soils and springfed waterways indicates that this site is located within a groundwater discharge zone, i.e., groundwater is discharging into surface waterways (land drains).

2.6 Discharge Environment

The downstream catchment has comparable properties to the pre-development site. The downstream catchment is undeveloped rural land (paddocks) with land drains collecting runoff and intersecting shallow groundwater. The downstream catchment drains towards the Ohoka Stream and eventually to the Kaiapoi River.

The site is in the Eyre Groundwater Allocation Zone, which has an allocation limit of 99,070,000 m^3 per year specified in Section 8.6 of the LWRP.
As of January 2022, this Allocation Zone is over-allocated, with a current allocation of 104%. The boundary with the Cust Groundwater Allocation Zone is adjacent to the site, along Mill Road. The Cust Allocation Zone is currently 29% allocated.

3.0 Proposed Development

The development is proposed to have the following land-use types:

Table 1: Proposed land-use types and areas

Land-use code	Description	Total area (ha)
Res 3	Residential	87.30
Res 4a	Rural-residential	60.87
Res 8	Retirement village / School	6.15
Business	Business / commercial	1.87
Total		**156**

Notes:

1. *Areas include proposed drainage corridors and open spaces.*

Refer to Appendix A for the current proposed development layout.

4.0 Design Considerations

4.1 References

The following documents and guidelines were referenced:

- Auckland City Council, Stormwater Management devices in the Auckland Region (AC, December 2017) (AC GD01)
- Environment Canterbury Regional Council, Canterbury Land and Water Regional Plan (ECan, December 2018) (CLWRP)
- Christchurch City Council, Waterways, Wetlands and Drainage Guide (CCC, February 2013) (WWDG)
- Waimakariri District Council, Engineering Code of Practice (WDC, July2020) (WDC CoP)

4.2 Design Standards

The following design criteria was used as the basis assessment of the stormwater effects.

Table 2: Design Criteria for Stormwater Treatment Devices

Item	Design Criteria	References
Primary flows	⁘ 5-year return event (20% AEP)	WDC CoP 2020
Secondary flows	⁘ 50-year return event (2% AEP)	WDC CoP 2020
Attenuation requirement	⁘ Post-development peak flows for all intensities to be less than pre-development flows	WDC CoP 2020
Rainfall	⁘ HIRDS V4 RCP 8.5 (2081 – 2100)	WDC CoP 2020
Runoff coefficient	⁘ As per Table 5.2 & Table 5.3 of WDC Engineering Code of Practice	WDC CoP 2020
Water Quality Flow	⁘ 10 mm/hr	AC GD01
First Flush Depth	⁘ 25 mm for greenfield developments	CCC WWDG Section 6

Notes:

1. *Type notes here*

4.3 Regional Plan Requirements

The following requirements applicable to the stormwater management for the proposed development has been identified in reference to the Canterbury Land and Water Regional Plan (ECan, Dec 2018).

- ***Rule 5.93 The discharge of stormwater or construction-phase stormwater from a reticulated stormwater system onto or into land or into or onto land in circumstances where a contaminant may enter water, or into groundwater or a surface waterbody is a restricted discretionary activity, provided the following conditions are met:***
    - *1. For a discharge that existed at 11 August 2012, an application for a discharge permit is lodged prior to 30 June 2018, or at a later date as agreed between the reticulated stormwater system operator and the CRC; and*
    - *2. A stormwater management plan has been prepared to address the management of stormwater in the catchment and is lodged with the application; and*

- *3. The discharge will not cause a limit in Schedule 8 to be exceeded.*

- ***Rule 5.95 The discharge of stormwater, other than into or from a reticulated stormwater system, into a river, lake, wetland or artificial watercourse or onto or into land in circumstances where a contaminant may enter a river, lake, wetland, or artificial watercourse is a permitted activity, provided the following conditions are met:***

  - *1. The discharge is not from, into or onto contaminated or potentially contaminated land; and*
  - *2. The discharge is not into: (a) a water race, as defined in Section 5 of the Local Government Act 2002; and (b) a wetland, unless the wetland is part of a lawfully established stormwater or wastewater treatment system; and (c) a waterbody that is Natural State, unless the discharge was lawfully established before 1 November 2013; and*
  - *3. The discharge does not result in an increase in the flow in the receiving waterbody at the point of discharge of more than 1% of a flood event with an Annual Exceedance Probability of 20% (one in five year event); and*
  - *4. The discharge meets the water quality standards in Schedule 5 after reasonable mixing with the receiving waters, in accordance with Schedule 5; and*
  - *5. The concentration of total suspended solids in the discharge shall not exceed: (a) 50 g/m3 , where the discharge is to any spring-fed river, Banks Peninsula river, or to a lake except when the background total suspended solids in the waterbody is greater than 50 g/m3 in which case the Schedule 5 visual clarity standards shall apply; or Canterbury Land and Water Regional Plan Page | 122 (b) 100 g/m3 where the discharge is to any other river or to an artificial watercourse except when the background total suspended solids in the waterbody is greater than 100 g/m3 in which case the Schedule 5 visual clarity standards shall apply; and*
  - *6. The discharge to water is not within a Community Drinking-water Protection Zone as set out in Schedule 1; and*
  - *7. The discharge does not occur where there is an available reticulated stormwater system.*

ECan has provided the following interpretation of wet ponds (including wetlands) intersecting groundwater as follows:

- Wet ponds constructed into groundwater systems can allow additional flow loss (of groundwater) if the outflow is below groundwater-level at any time and can also allow for evaporation of groundwater.
- Wet ponds (including constructed wetlands) constructed into groundwater need to consider evaporation losses at the particular site to assess potential groundwater take due to loss of evaporation.

Wet ponds, including wetlands, intersecting groundwater could result in evaporation losses exceeding permitted activity volumes within the already over allocated groundwater zone. The following rule needs to be considered:

- **Rule 5.114 The taking and using of less than 5 L/s and more than 10 m3 but less than 100 m3 per property per day of groundwater on a property more than 20ha in area is a permitted activity, provided the following conditions are complied with:**
    - 1. The bore is located more than 20 m from the property boundary or any surface waterbody

If the aforementioned conditions cannot be met, Rules 5.128 to Rule 5.139 apply.

5.0 Catchment & Water Quality

5.1 Catchments

The upstream contributing catchment extends to the north of the site and consist of rural land and paddocks. The upstream contributing area discharges flows towards Bradleys Road with flow entering the site via two culverts underneath Bradleys Road. During significant storm events, runoff from the upstream contributing catchment breaches over Bradleys Road and discharges onto the proposed development area. The upstream contributing catchments is described and assessed as part of the flood risk assessment (PDP, Flood Risk Assessment – For Proposed Development by Rolleston Industrial Developments Ltd at Ohoka, May 2022).

The pre- and post-development catchments for the proposed development were delineated using the following information:

- Available LiDAR information.
- Existing stormwater infrastructure as per the WDC GIS.
- Flow paths as determined by the WDC 200-year flood modelling results.
- Proposed development plans (refer Section 3.0)

Refer to Appendix B for the pre- and post-development catchment drawings.

5.2 Catchment characteristics

The pre-development catchment characteristics are summarised in Table 3 below:

Table 3: Pre-development catchment characteristics.

Catchment	Land-use	Area (ha)	Runoff-coefficient (C)	Time of Concentration (min)
C1	⁘ Rural	30.68	0.3	85
C2	⁘ Rural	54.16	0.3	43
C3	⁘ Rural	51.6	0.3	36
C4	⁘ Rural	19.35	0.3	65
Total		155.80	N/A	N/A

The post-development catchment characteristic is summarised in Table 4 below.

Table 4: Pre-development catchment characteristics.

Catchment	Land-use	Area (ha)	Runoff-coefficient (C)	Time of Concentration (min)
C1	⁘ Rural-residential	41.5	0.47	39
C2	⁘ Residential ⁘ Rural-residential	53.89	0.60	39
C3	⁘ Residential ⁘ Business ⁘ Rural-residential ⁘ Retirement village / school	50.2	0.65	30
C4	⁘ Residential ⁘ Business	10.2	0.65	20
Total		155.80	N/A	N/A

The pre-development time of concentration was determined using the longest contributing flow path and using the WWDG nomograph for overland sheet flows

(refer WWDG Figure 21-1) and assumed stream velocity of 0.6 m/s for catchments with flat slopes (refer WWDG Table 21-4).

The post-development time of concentration was determined allowing for flow within roads based on the available development layout (refer Section 3.0) and assumed pipe velocities of 1.5 m/s (refer WWDG Table 21-3).

5.3 Runoff calculations

The catchments, with exception to catchment C4, exceed 15 ha in size. Runoff calculation from the catchments exceeding 15 ha will be subject to dynamic analyses and additional modelling, which includes the upstream contributing catchments, and to be completed at resource consent stage. The following is noted:

- There is an increase in impervious area in the post-development scenario which will result in an increase runoff which needs to be mitigated. The critical storm duration for the sizing of site runoff conveyance will be based on the sub-catchment time of concentration (refer Section 5.2).
- The critical storm duration for the sizing of site attenuation will be based on the larger contributing catchment critical storm duration.

5.4 Water Quality

Water quality runoff for the post-development catchments were calculated in accordance with WWDG document and AC GD01 as per the WDC Engineering Code of Practice. The first flush volume was based on the initial 25 mm rainfall depth as the site is a greenfield development. The first flush flow was calculated using the rational method for a storm intensity of 10 mm/hr (refer to Section 4.0).

Urban stormwater could contain the following contaminants (WWDG, May 2012):

- Suspended solids
- Nutrients (nitrogen and phosphorus)
- Hydrocarbons (oils, lubricants, fuels)
- Metals (particulate and dissolved)
- Microbes

Runoff from roads and business areas contain higher concentrations of metal and hydrocarbon contaminants. Roof runoff is assumed to not be contaminated and does not require treatment.

The first flush volume and flows were calculated based on smaller sub-catchments to allow for treatment close to source. Refer to Table 5 below for a summary of the water quality catchment characteristics and Appendix C for the delineated water quality catchments:

Table 5: Post-development water quality catchment summary

Catchment	Proposed Land-use	Total area (ha)	Composite FF Coefficient (C_{ff})	First flush volume (V_{ff}) (m^3)	First flush flow (Q_{ff}) (L/s)
WQ1	Residential	15.3	0.63	2,412	268
WQ2.1	Residential	8.8	0.63	1,383	154
WQ2.2	Business	2.1	0.81	435	48
WQ3	Residential & Rural Residential	10.8	0.61	1,651	184
WQ4	Retirement Village / School	6.2	0.63	969	108
WQ5	Residential	9.7	0.63	1,521	169
WQ6	Residential	9.3	0.63	1,461	162
WQ7	Residential	15.3	0.63	2,408	268
WQ8	Residential	4.8	0.63	755	84
WQ9	Residential & Rural Residential	8.4	0.57	1,191	132
WQ10	Residential & Rural Residential	26.9	0.54	3,658	407
WQ11	Residential & Rural Residential	8.2	0.63	1,298	144
WQ12	Rural Residential	15.0	0.53	1,994	222
WQ13	Rural Residential	15.4	0.53	2,042	227

Notes:

1. *Composite FF Coefficient based on WWDG Table 6-10*
2. *Rural Cff – 0.53*
3. *Business Cff – 0.81*
4. *Residential & Retirement Village Cff – 0.63*

6.0 Proposed Infrastructure

6.1 Conveyance

6.1.1 Hydraulic continuity

Hydraulic connectivity between upstream and downstream catchments of the proposed development will be provided by means of formalised flow path corridors through the proposed development. The flow path corridors will collect runoff from the upstream catchments discharging onto the proposed development via existing culverts underneath Bradleys Road, and direct flows towards the existing downstream culverts underneath Whites Road. Upstream flows breaching Bradleys Road will be intercepted by swales / cut-off drains and direct flow toward the flow path corridors.

The proposed flows paths will provide the following functions:

- Maintain hydraulic connectivity between the upstream and downstream catchments including baseflow.
- Collect and convey runoff from the proposed development catchments towards the downstream environment.
- Allow for attenuation in the following manner (refer to Section 6.2):
    - Instream attenuation volume.
    - Compensatory storage along the flow path corridor by flooding of low laying and depression areas.
    - Backflow into attenuation facilities during storm events exceeding the 2% AEP critical storm event.

The flow paths will be designed to capture and convey up to the 0.5% AEP event (200-year event) to reduce the impact of flooding on proposed flood levels within the development. The flow paths will be designed not to scour up to and including the 2% AEP event flows.

6.1.2 Primary flows

Primary flows will be collected along roads and/or swales either discharged into sumps and/or raingardens. A pipe network will direct flows towards the flow paths where end of pipe treatment (if required) and attenuation will be provided. Runoff is likely to be conveyed by means of swales along roads due to availability of space along road corridors.

Sustainable urban drainage will be utilised where feasible and consist of the following:

- Swales (rural-residential)
- Rainwater tanks (rural-residential)
- Raingardens / bio-infiltration along roads (residential, retirement village / school and business)
- Bioscapes at end of pipe discharge points (residential and retirement village / school)
- Soakage for roof runoff only and where feasible (residential, retirement village / school and rural-residential)

Infrastructure to be sized to capture and convey the 20% AEP design rainfall event.

6.1.3 Secondary flows

Secondary flows will be directed towards the formalised flow paths via roads and dedicated easements where there are no roads available to convey secondary flow.

6.2 Attenuation

Attenuation is to be provided across the development for management of the post-development runoff to not exceed the pre-development runoff. Formalised attenuation will be provided for up to the 2% AEP event by means of the following infrastructure:

- Attenuation basins located at the end of pipe for sub-catchments with controlled outlets discharging into the drainage corridors.
- Attenuation tanks to capture and attenuate roof runoff for rural-residential areas only.

The required attenuation volume for the proposed development is subject to the development of a flood model which takes into consideration the total contributing catchment, development, and downstream catchments. The critical storm duration for the wider contributing catchment is expected to be range between 6 hrs to 12 hrs, based on the catchment wide flood model results (DHI Kaiapoi Flood Modelling, 2020) and as reported in the flood risk assessment (PDP, Flood Risk Assessment – For Proposed Development by Rolleston Industrial Developments Ltd at Ohoka, May 2022).

Table 6 provides an estimate of the 2% AEP flood attenuation required for both the 6 hrs or 12 hrs critical storm duration within each of the delineated development catchments.

Table 6: 2% AEP attenuation volume		
Catchment	**Required attenuation volume (m^3) for 6 hrs event**	**Required attenuation volume (m^3) for 12 hrs event**
C1	9,850	13,250
C2	14,800	19,900
C3	16,350	21,950
C4	650	850
Total	41,650	55,950

Basins will be required to be shallow (≤ 0.5 m) to prevent interception of groundwater with outlet structures to managing discharge into the formalised flow paths. Overflow structures will allow both discharge of runoff exceeding the 2% AEP event from the contributing catchments as well as backflow from the formalised flow path.

Compensatory storage within the flow path corridors intersecting the site (refer to Section 6.1) will provide additional storage for events exceeding the 2% AEP event runoff. Storage could be provided as instream storage alongside controlled flooding of dry basins (depressions) within the flow path corridor.

The percentage area of the development estimated to provided attenuation is approximately 7% to 9% based on a basin depth of < 0.5 m. This estimated percentage includes area required for maintenances access. There is an opportunity to reduce attenuation volumes by utilising rain tanks at rural-residential properties to attenuate roof runoff from smaller rainfall events (i.e., 20% AEP and 10% AEP events).

6.3 Treatment

A summary of the potential treatment infrastructure sizing for each water quality catchment is included in Appendix D. The sizing was based on the following assumptions:

- Wetland and first flush basin were sized using the WWDG simplistic method including:
  - First flush to release water quality over 4 days.
  - Wetland hydraulic residence time of 2 days.
  - Wetland average depth of 0.25 m and vegetation porosity of 75%.
- Raingardens / biofiltration and bioscapes were sized assuming:
  - Soakage rates of 30 mm/hr for conventional raingardens.

- Soakage rates of 1,000 mm/hr (including a safety factor 2) based on proprietary filter media for raingardens / biofiltration and bioscapes.
- Minimum raingarden depth of 750 mm including 600 mm media depth.

- Proprietary filter devices (i.e., Stormfilter®) treats a maximum of 1.4 L/s flow per filter unit.

Treatment of water quality flows from catchments are proposed to be managed as follows:

6.3.1 Residential areas, retirement village / school & rural-residential areas

Treatment of the water quality runoff from the residential and retirement village / school is proposed to be provided by means of both raingardens / biofiltration and bioscapes. To minimise the required footprint of the bioscape and raingarden treatment area, it is proposed that proprietary filter media with a high infiltration rate in excess of 2,000 mm/hr is used. Similar systems have been utilised in both small scale (development lots) and larger scale projects (residential sub-divisions). Refer to Appendix E for more information regarding the high infiltration rate proprietary filter media. Treatment by high-infiltration raingardens and bioscapes are proposed to be as follows:

- Swales will collect runoff from the lots and roads and provide pre-treatment of the water quality flows.
- Swales will direct runoff towards high infiltration raingardens and/or bioscapes where further treatment of the water quality flows will be provided by means of filtration through proprietary filter media (i.e., Filtera®). First flush volume storage to be provided in rain gardens and as part of bioscape basin.
- Treated runoff will be collected by subsoil drains and discharged into conventional pipe infrastructure which will discharge the treated runoff into the downstream stormwater infrastructure (flow path corridors and/or attenuation infrastructure).
- Flows exceeding the water quality flow will either be:
  - Captured by sumps and discharged into the conventional stormwater network; or
  - Overflow directed towards the flow path corridors and/or attenuation infrastructure.

It is expected that some of the raingardens and bioscapes are likely to intersect the groundwater. The following is proposed to manage the risk of high groundwater:

- The proposed raingardens and bioscapes will be lined (HDPe or concrete surrounds) to prevent water quality runoff to discharge directly into ground and for groundwater to enter the stormwater network.
- Lined raingarden and bioscape inverts can be lower than the groundwater levels with filter media operating under partial saturated conditions with a submerged subsoil outlet to the conventional pipe infrastructure.

A total wetland area of approximately 2 ha (based on average evaporation of 50 m^3/day/ha) to 0.6 ha (based on a maximum evaporation of 150 m^3/day/ha) can be incorporated into the treatment network without exceeding the maximum water take of 100 m^3/day for it to be a permitted activity. The water take is due to evaporation loss of groundwater as a result of the wetlands intercepting the groundwater. It is anticipated that wetland treatment, including first flush, could be provided as end of pipe treatment solutions for larger residential water quality catchments (i.e., WQ1 and WQ10).

6.3.2 Business areas

The business areas are considered a small catchment, but likely to have a significant contribution to the contaminant load due to increased vehicle activity in the area. To reduce the amount runoff to be treated, it is proposed that roof runoff is separated from road, parking, and other sealed areas.

Treatment can be provided as follows:

- Gross pollutants to be captured at sumps by means of submerged outlets and/or proprietary devices within the sumps (i.e., LittaTrap™ or TetraTrap®).
- Water quality flows are to be directed to a proprietary filter system (i.e., Stormfilter®) to treat runoff by removing total suspended solids, hydrocarbons, and heavy metals. The treatment device will consist of the following:
    - Approx. 36 filter units, in total, to treat 50 L/s water quality runoff (inclusive of roof runoff).
    - Proprietary device treats 1.4 L/s water quality flow per filter.
    - Filters to be fitted in a chamber and outlet to drain to downstream stormwater infrastructure.
    - Flows exceeding the water quality flows will be diverted upstream of the treatment chamber.

Presence of high groundwater can be mitigated by installed filters in a shallow chamber (< 1 m deep) and filters which operate under low head conditions. Refer to Appendix F for more information on the proposed proprietary devices.

6.3.3 Summary of treatment

Table 7 is a summary of the proposed treatment for each of the water quality catchments.

Table 7: Summary of proposed treatment options

Catchment	Land-use	Treatment	Infrastructure size
WQ1	Residential	⁘ End of pipe first flush basin and wetland	⁘ First flush basin – 2,450 m^3 ⁘ *Wetland – 6,450 m^2
WQ2.1	Residential	⁘ Pre-treatment through swales ⁘ High-infiltration raingardens ⁘ End of pipe bioscape with first flush volume	⁘ Raingardens – 580 m^2 ⁘ First flush basin – 1,450 m^3 ⁘ Bioscape area – 48 m^2
WQ2.2	Business	⁘ Pre-treatment through in-sump installations ⁘ Proprietary filters	⁘ Proprietary filter units (Stormfilter®) – 35 (off)
WQ3	Residential & Rural-residential	⁘ Pre-treatment through swales ⁘ Pre-treatment through gross pollutant trap ⁘ High-infiltration raingardens ⁘ End of pipe bioscape with first flush volume	⁘ Raingardens – 661 m^2 ⁘ First flush basin – 1,651 m^3 ⁘ Bioscape area – 55 m^2
WQ4	Retirement Village / School		⁘ Raingardens – 388 m^2 ⁘ First flush basin – 969 m^3 ⁘ Bioscape area – 32 m^2
WQ5	Residential		⁘ Raingardens – 609 m^2 ⁘ First flush basin – 1,521 m^3 ⁘ Bioscape area – 51 m^2
WQ6	Residential		⁘ Raingardens – 585 m^2 ⁘ First flush basin – 1,461 m^3 ⁘ Bioscape area – 49 m^2
WQ7	Residential		⁘ Raingardens – 964 m^2 ⁘ First flush basin – 2,408 m^3 ⁘ Bioscape area – 80 m^2
WQ8	Residential		⁘ Raingardens – 302 m^2

			⁘ First flush basin – 755 m^3 ⁘ Bioscape area – 25 m^2
WQ9	Residential & Rural-residential		⁘ Raingardens – 477 m^2 ⁘ First flush basin – 1,191 m^3 ⁘ Bioscape area – 40 m^2
WQ10	Residential & Rural-residential	⁘ End of pipe first flush basin and wetland	⁘ First flush basin – 3,658 m^3 ⁘ *Wetland – 9,753 m^2
WQ11	Residential & Rural-residential	⁘ Pre-treatment through swales ⁘ Pre-treatment through gross pollutant trap ⁘ High-infiltration raingardens ⁘ End of pipe bioscape with first flush volume	⁘ Raingardens – 520 m^2 ⁘ First flush basin – 1,298 m^3 Bioscape area – 43 m^2
WQ12	Rural-residential		⁘ Raingardens – 798 m^2 ⁘ First flush basin – 1,994 m^3 ⁘ Bioscape area – 66 m^2
WQ13	Rural-residential		⁘ Raingardens – 817 m^2 ⁘ First flush basin – 2,042 m^3 ⁘ Bioscape area – 68 m^2

Notes:

1. *Pending assessment of evaporation rate and losses not to exceed 100 m^3/day

7.0 Alternatives Considered

The following alternative were considered as part of the assessment:

- **Soakage to ground**: Option is limited due to the presence of high groundwater and poor draining soils.
- **Provide treatment and attenuation by means of wetlands with first flush basins**: Although wetland is proposed as part of a hybrid solution, providing treatment by means of wetlands for the total development is not considered feasible due to the potential groundwater take due to evaporation likely to exceed 100 m^3/day for average evaporation rates.
- **Provide treatment and attenuation by means of wetponds**: Although wetponds could be incorporated as part of a hybrid solution, providing treatment by means of wetponds for the total development is not considered feasible due to the potential groundwater take due to evaporation likely to exceed 100 m^3/day for average evaporation rates.

- **Pump water quality flow to wetlands not intersecting the groundwater**: The option could be feasible for some or all the catchment but will be subject to pumping of water quality flows as well as base flows to sustain plant growth within the wetlands.
- **Treat fully water quality flow by means of filter type proprietary devices only**: A total number of 1,840 filter units would be required to treat the estimated water quality flow of 2.6 m^3/s.

8.0 Conclusion

The management of stormwater quantity, including hydraulic continuity between the upstream and downstream catchments, can be managed by means of the following:

- Formalised flow paths to be installed to connect the upstream and downstream catchments.
- Attenuation and flood storage to be provided by:
    - Attenuation basins located at the end of pipe for sub-catchments with controlled outlets discharging into the drainage corridors.
    - Compensatory storage within the flow path corridors intersection the site (refer to Section 6.1). Storage could be provided instream and controlled flooding of dry basins (depressions) within the drainage corridor.
    - Rain tanks to capture and attenuate roof runoff for rural-residential areas only.

Water quality treatment can be provided as follows:

- Residential, rural-residential and retirement village / school runoff to be treated by means of swales, filtration via high infiltration rate raingardens and bioscapes which includes storage of the first flush volume.
- Business areas runoff to be treated by means of proprietary filtration devices.
- Limited catchment runoff will be treated by wetlands to limit potential water take.

Stormwater Treatment Wetlands would typically be used for such a large development. However, due to potential groundwater take exceeding the current limit of 100 m^3/day to be considered a permitted activity as a results of potential evaporation loss across the total required wetland area, wetlands alone are considered not feasible to provide treatment.

The potential impact on stormwater quantity and quality could be mitigated through the aforementioned stormwater management concepts.

The following recommendations are made to support further development of the detailed stormwater management solution:

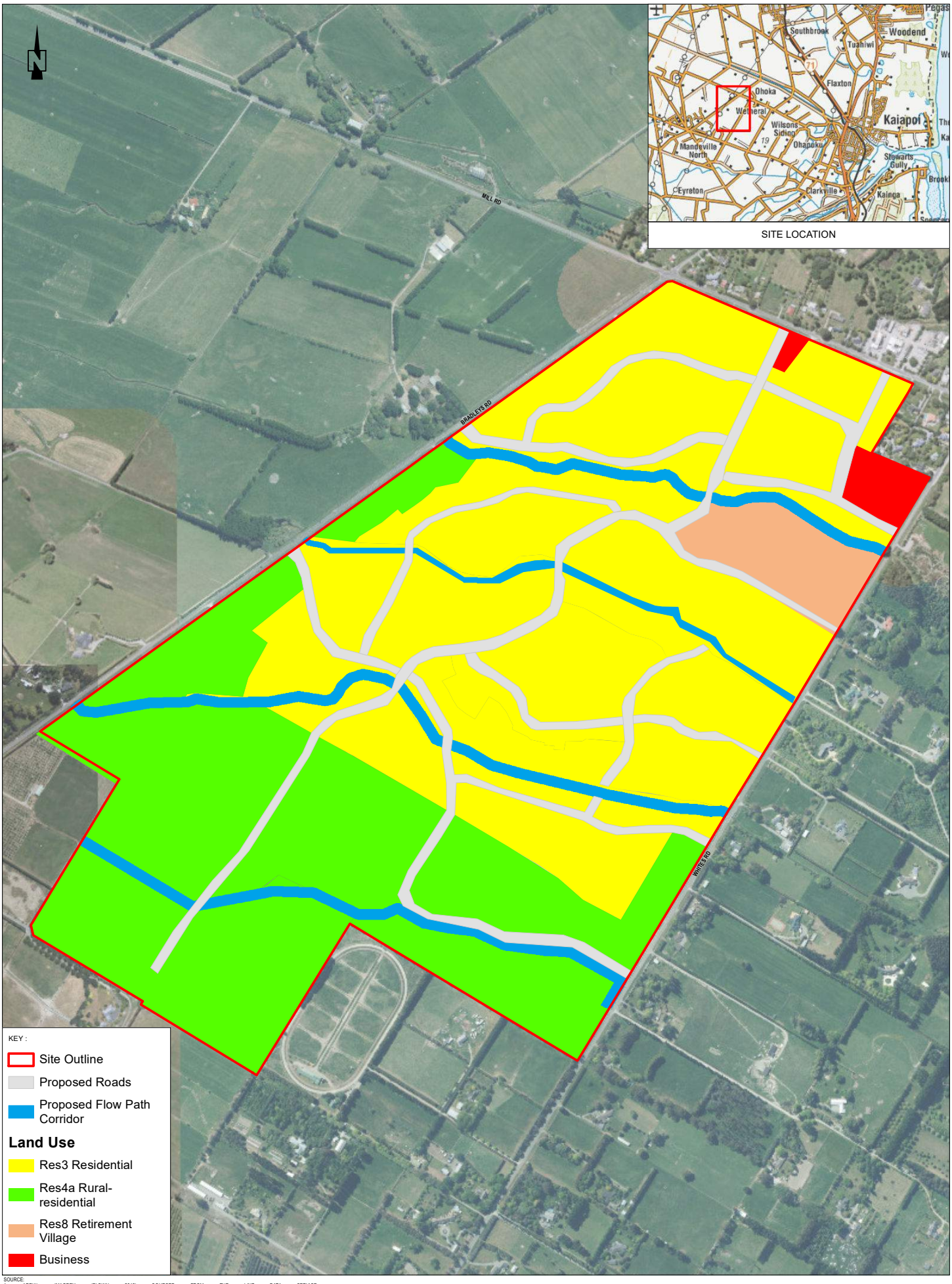
- Flood model to be developed for the catchment to confirm required attenuation volumes.
- Monitor groundwater levels across the site to obtain a better understanding of the proximity of groundwater levels to the ground.

9.0 Limitations

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Rolleston Industrial Development Ltd and others (not directly contracted by PDP for the work), including Inovo Projects and Land Information New Zealand. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Rolleston Industrial Developments Limited for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Appendix A: Development Plan



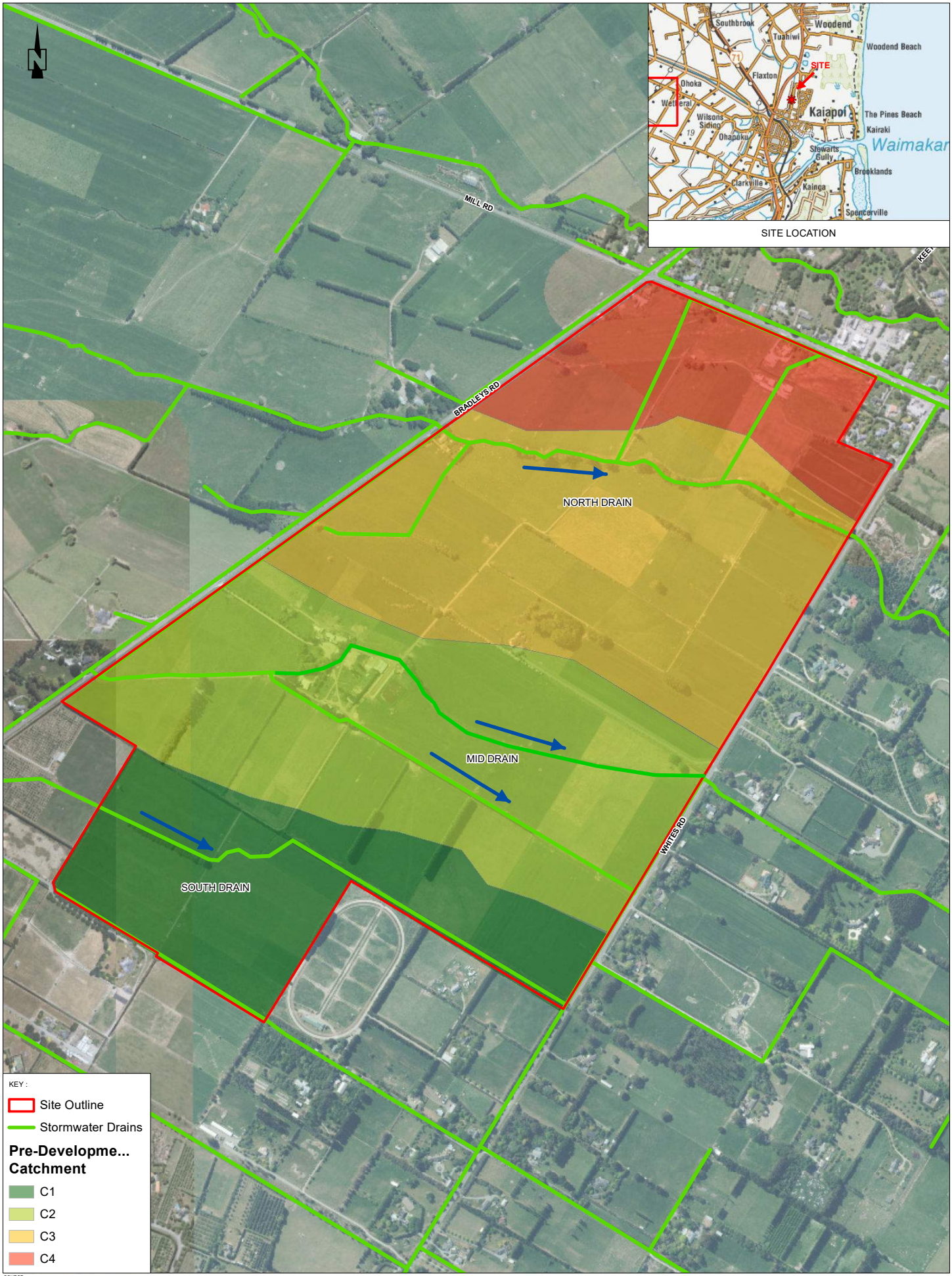
SOURCE:
1. AERIAL IMAGERY (FLOWN 2016) SOURCED FROM THE LINZ DATA SERVICE [https://services.arcgisonline.co.nz/arcgis/rest/services/Imagery/newzealand/MapServer/0] AND LICENCED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.
2. CADASTRAL LOT LAYOUT PROVIDED BY ROLLESTON INDUSTRIAL DEVELOPMENTS.
3. LAND USE INFORMATION PROVIDED BY ROLLESTON INDUSTRIAL DEVELOPMENTS.
4. FLOW PATH CORRIDOR SOURCED FROM ???

FIGURE 1 : PROPOSED DEVELOPMENT LAYOUT

SCALE : 1:7,000 (A3)

0 50 100 200 300
METRES

Appendix B: Catchment Plans



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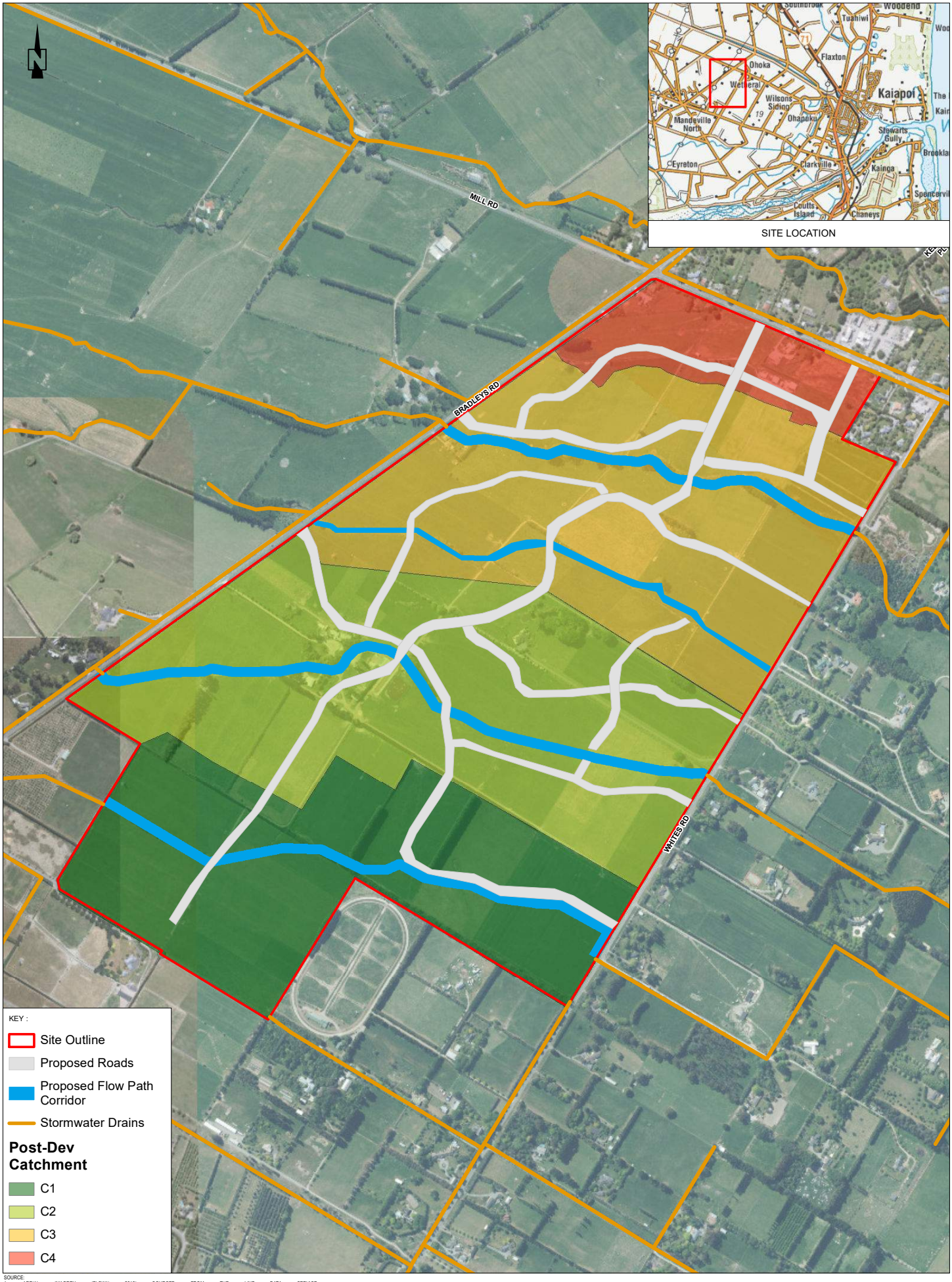
3. LAND USE INFORMATION PROVIDED BY ROLLESTON INDUSTRIAL DEVELOPMENTS.
4. FLOW PATH CORRIDOR SOURCED FROM ???

FIGURE 2: PRE-DEVELOPMENT CATCHMENT PLAN

SCALE : 1:7,500 (A3)

0 50 100 200 300
METRES



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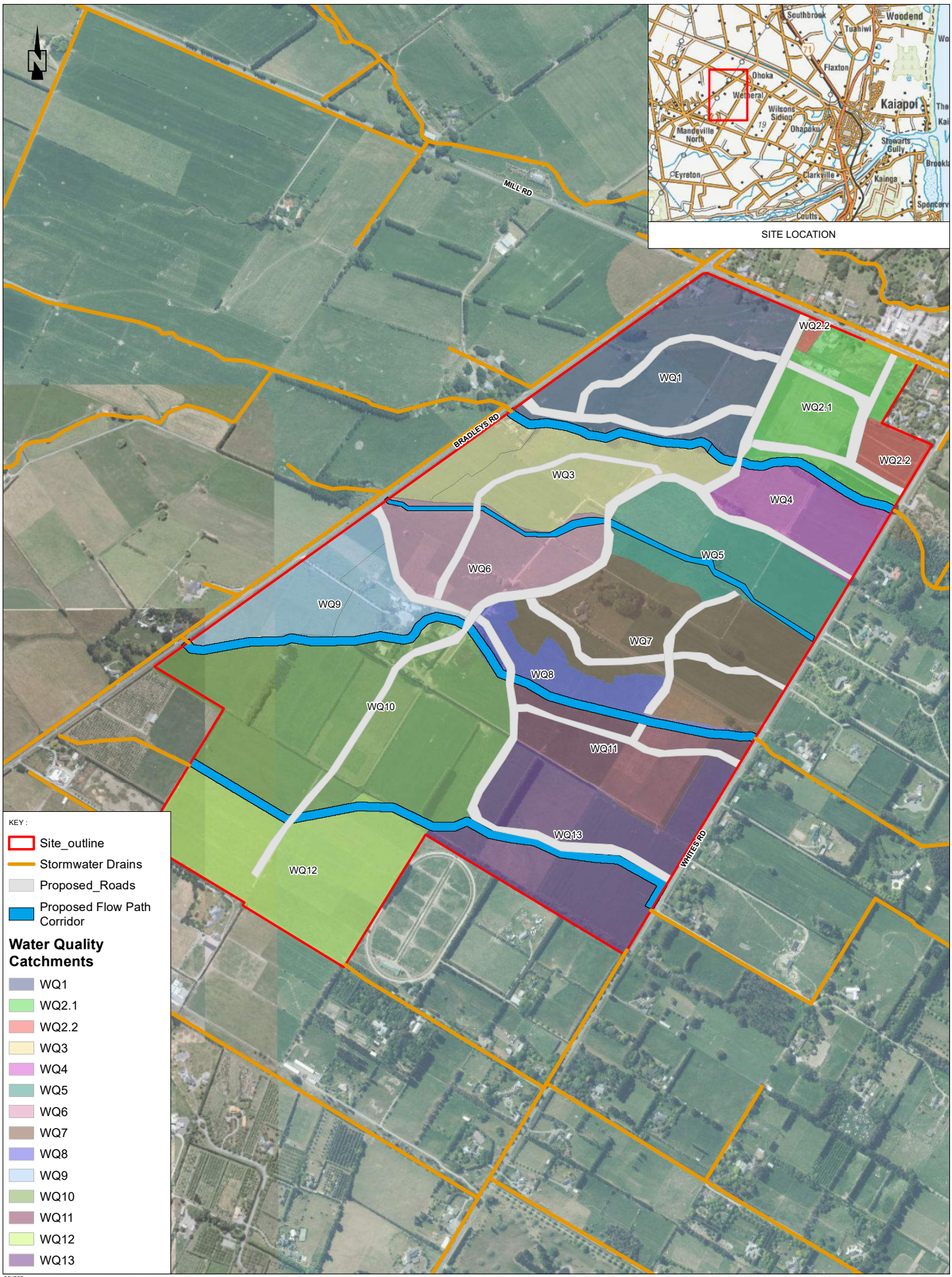
4. FLOW PATH CORRIDOR SOURCED FROM ???

FIGURE 3: POST-DEVELOPMENT CATCHMENT PLAN

SCALE : 1:7,500 (A3)

0 50 100 200 300
METRES

Appendix C: Water Quality Catchments



SITE LOCATION

SOURCE.
1. AERIAL IMAGERY (FLOWN 2016) SOURCED FROM THE LINZ DATA SERVICE [https://services.arcgisonline.co.nz/arcgis/rest/services/Imagery/newzealand/MapServer/0] AND LICENCED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.
2. CADASTRAL LOT LAYOUT PROVIDED BY ROLLESTON INDUSTRIAL DEVELOPMENTS.
3. LAND USE INFORMATION PROVIDED BY ROLLESTON INDUSTRIAL DEVELOPMENTS.
4. FLOW PATH CORRIDOR SOURCED FROM ???

FIGURE 4: WATER QUALITY CATCHMENT PLAN

SCALE : 1:8,000 (A3)

0 50 100 200 300
METRES

Appendix D: Water Quality Treatment Sizing

Table 8: High-level sizing of treatment devices							
Catchment	**Land-use**	**First Flush Basin (m^3)**	**Wetland area (m^2)**	**High infiltration Bioscape (m^2)**	**High infiltration raingarden (m^2)**	**Conventional raingarden (m^2)**	**Proprietary filter units (no.)**
WQ1	Residential	2,412	6,433	80	966	2,681	192
WQ2.1	Residential	1,383	3,688	46	554	1,537	110
WQ2.2	Business	435	1,160	15	174	483	35
WQ3	Residential & Rural Residential	1,651	4,402	55	661	1,834	131
WQ4	Retirement Village / School	969	2,584	32	388	1,077	77
WQ5	Residential	1,521	4,056	51	609	1,690	121
WQ6	Residential	1,461	3,896	49	585	1,624	116
WQ7	Residential	2,408	6,421	80	964	2,675	191
WQ8	Residential	755	2,014	25	302	839	60
WQ9	Residential & Rural Residential	1,191	3,177	40	477	1,324	95
WQ10	Residential & Rural Residential	3,658	9,753	122	1,464	4,064	291
WQ11	Residential & Rural Residential	1,298	3,461	43	520	1,442	103
WQ12	Rural Residential	1,994	5,316	66	798	2,215	158
WQ13	Rural Residential	2,042	5,445	68	817	2,269	162
Total		**23,165**	**61,772**	**772**	**9,273**	**25,740**	**1,840**

Appendix E: High infiltration media details

FILTERRA®

The Next Generation in Rain Gardens

filterra® Bioretention Systems

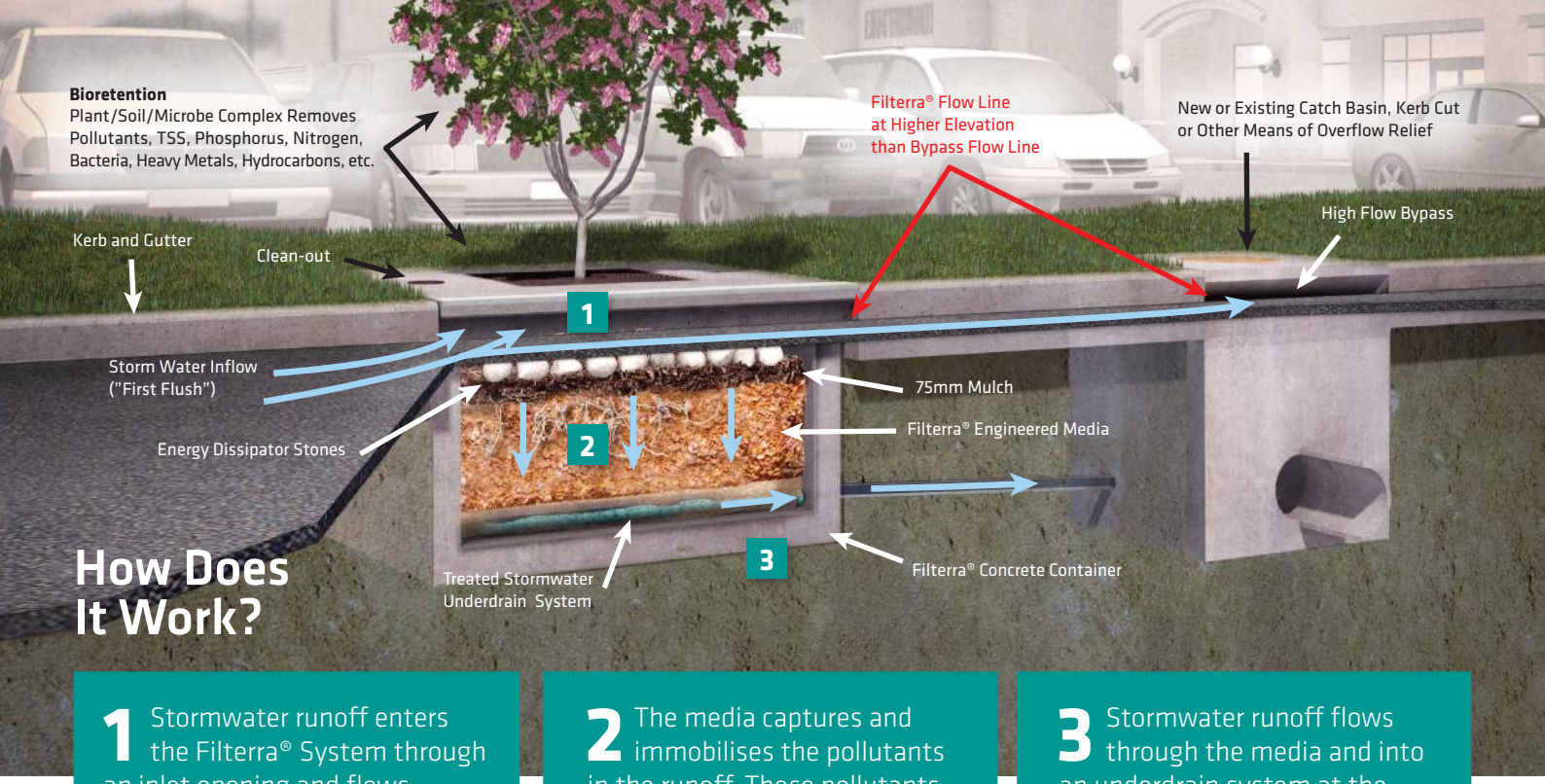
Filterra® from Stormwater360 is a pre-engineered and manufactured Stormwater Bioretention Treatment System that has been optimised for high volume/flow treatment and high pollutant removal.

The latest technology and advancements in bioretention allow the Filterra® system to work **as efficiently as a traditional bioretention system but in a footprint a fraction of its size.**

Filterra® is a revolutionary micro bioretention system with high performance, enhanced pollutant removal, low operating costs, easy to install and simple to maintain.

www.stormwater360.co.nz

Stormwater360® BETWEEN SKY AND SEA



How Does It Work?

1 Stormwater runoff enters the Filterra® System through an inlet opening and flows through the filter media mixture contained in a landscaped concrete container.

2 The media captures and immobilises the pollutants in the runoff. Those pollutants are then decomposed, volatilised and incorporated into the biomass of the Filterra®.

3 Stormwater runoff flows through the media and into an underdrain system at the bottom of the container, where the treated water is discharged.

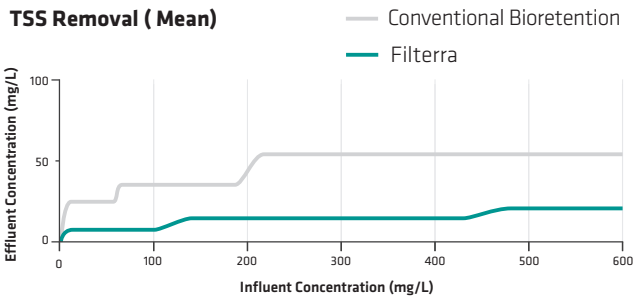
WHY USE FILTERRA® OVER TRADITIONAL SYSTEMS?

Small footprint

- **Fraction of the size of traditional rain gardens**
- Filterra® is typically less than 1% of drainage area. This contrasts to 3%-10% for standard bioretention cells
- Full use of land
- Ideal for urban retrofit and highly developed sites
- Can be located around underground services
- Ideal for coastal areas

Proven Pollutant Removal

- Filterra filter media has been optimised to operate under high flow rates while maintaining high pollutant removal performance
- Approved for TSS, Phosphorus, Enhanced Dissolved Metals, Nitrogen and Oil



Modified from:
FILTERRA EQUIVALENCY ANALYSIS AND DESIGN CRITERIA; GeoSyntec Consultants August 2015

Proven Performance

- 10 years field monitoring
- Equivalent or better performance than traditional rain gardens
- **No other product in NZ has Enhanced Removal certification from Washington Dept. of Ecology**
- Approved by over 500 regulatory agencies worldwide
- Maintained hydraulic conductivity

Maintenance

- First year maintenance included**
- Easy access – no confined space
- No specialised equipment needed
- **Minimal cost**
- Smaller and fewer treatment devices = less time to undertake maintenance

** Conditions apply

Prefabricated solution

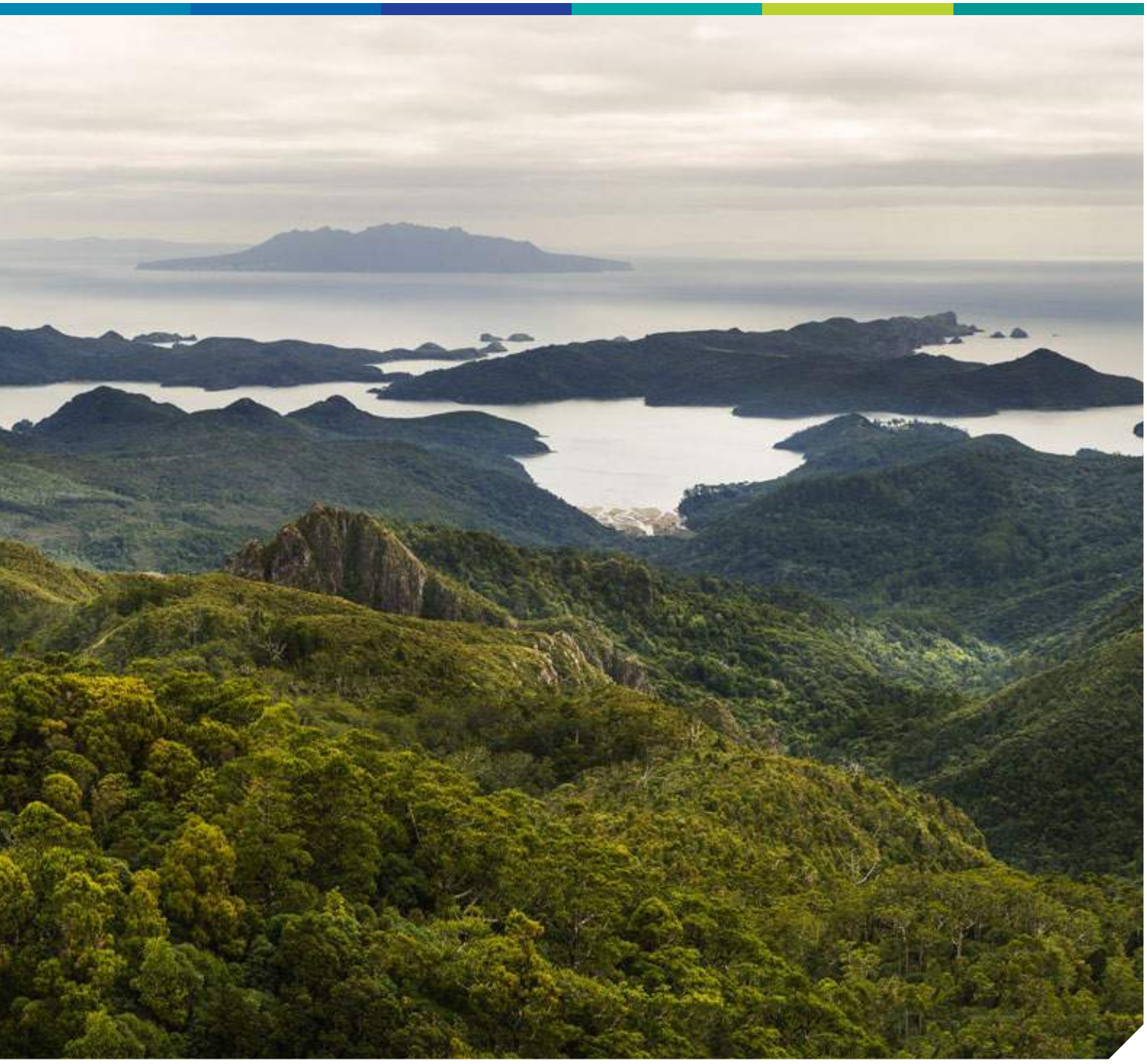
- **Delivered as a Plug and Play Solution**
- 25 x Quality Assurance tests deliver consistent media and performance every time
- Available in open top or tree pit configuration
- Commissioning and hydraulic conductivity testing by Stormwater360
- Plant selection guidance
- Design assistance

www.stormwater360.co.nz
Freephone **0800 STORMWATER** (0800 786769)

Stormwater360®
BETWEEN SKY AND SEA

Appendix F: Summary of proprietary devices

Stormwater Management and Green Infrastructure Solutions



PRODUCT OVERVIEW 2018

Stormwater360®
BETWEEN SKY AND SEA

Stormwater360 is New Zealand's only specialist stormwater technology company with over 25 years' experience and expertise in managing every aspect of stormwater management.

Our company's products address the impacts of urban growth with a range of natural and engineered stormwater solutions.

By screening plastic and other gross pollutants, filtering sediment, absorbing heavy metals, enhancing evapotranspiration and increasing infiltration, we can reduce the impact of stormwater runoff on our environment.

We are passionate about our waterways and are committed to delivering stormwater solutions that preserve and protect the future of our rivers, lakes and oceans.

www.stormwater360.co.nz

Stormwater360®
BETWEEN SKY AND SEA

Stormwater Filters

HEAVY METALS / NUTRIENTS / FINE SEDIMENT

Our filtration devices have been developed to remove an array of contaminants, including sediment, heavy metals and nutrients to meet the most stringent regulatory authority requirements.

Oil and Water Separators

DIESEL / PETROL / HYDROCARBON / SPILL CONTROL

Separate and divert oil, hydrocarbons and other contaminants from stormwater discharges.

Gross Pollutant Traps

PLASTIC / GROSS POLLUTANT / SEDIMENT

Gross Pollutant Traps separate sediment, litter and debris from stormwater. Ideal for pre-treatment or retrofit application.

Catchpit Inserts

PLASTIC / GROSS POLLUTANT / SEDIMENT

Screening and sediment device which uses existing infrastructure. Low cost stormwater treatment.

Detention/ Retention Structures

RUNOFF REDUCTION / FLOW CONTROL

Underground structures that promote infiltration and store water.

Permeable Surfaces

RUNOFF REDUCTION

Surface infiltration allows runoff to slowly seep into soil or substrate where it is filtered and can be reduced through evapotranspiration and infiltration.

BioFilter

HEAVY METALS / NUTRIENTS / FINE SEDIMENT

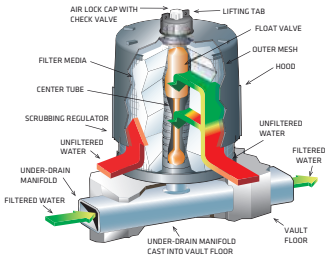
Engineered modular biofiltration systems with a small footprint. Effective at removing dissolved contaminants.

Stormwater Filters

Our stormwater treatment filtration devices have been developed to remove an array of contaminants, including sediment, heavy metals and nutrients to meet the most stringent regulatory authority requirements.

STORMFILTER™

The Stormwater Management StormFilter® cleans stormwater through a patented passive filtration system, effectively removing pollutants to meet the most stringent regulatory requirements. Easy to install and maintain, and proven performance over time, the StormFilter® contains rechargeable , media-filled cartridges that remove a variety of pollutants, such as sediments, oil and grease, metals, organics, and nutrients. These systems come in variable configurations to match local conditions and come with prolonged maintenance periods to ensure long-term performance and reduce operating costs.



Easy maintenance and low life cycle costs

Can be configured in any drainage structure.

Customised media options including ZPG, Perlite and Phosphosorb® target TSS, phosphorus, heavy metals, and hydrocarbons

Multiple cartridge heights give design solutions for site restraints

High Sediment Removal

MAINTENANCE

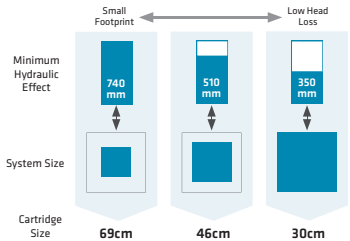
- Only needs to be maintained every 1-3 years
- Cartridge Exchange Service
- Lifetime Warranty on StormFilter cartridges (conditions apply)

APPROVALS

- ARC TP10 approval for removal of greater than 75 percent TSS
- Auckland Council Approved for use on Public and Private Sites
- Christchurch City Council Approved for use on Public and Private Sites

SUPERIOR HYDRAULICS

Multiple cartridge heights give design solutions for site restraints.



USE OUR ONLINE PROJECT CALCULATOR
for instant DIY sizing, drawings and technical specifications.

Visit www.stormwater360.co.nz

JELLYFISH®

This revolutionary stormwater quality device is the latest in filtration technology and uses gravity, flow rotation, and up-flow membrane filtration to provide stormwater treatment in an underground compact stand-alone system. Using unique filtration cartridges, each Jellyfish® Filter has a large membrane surface area, resulting in high flow rates and pollutant removal capacity. The filter has a number of 'tentacles' that catch and remove floatables, litter, oil, debris, TSS, silt-sized particles (as small as 2 microns), and a high percentage of particulate-bound pollutants; including phosphorus, nitrogen, metals and hydrocarbons.

The Jellyfish® Filter has a much smaller footprint than other best-management practices (BMPs), greater design flexibility and no replaceable media.

Jellyfish® Filter

For JellyFish models and sizing visit
www.stormwater.co.nz

High surface area, high flow rate membrane filtration

Highest design treatment flow rate per cartridge (up to 80 gpm (5 L/s))

150- 457mm headloss @5L/S

Lightweight cartridges with passive backwash

Ideal for flat land areas with low hydrologic grade

High to Very High Sediment Removal

MAINTENANCE

- Low maintenance costs
- Reusable cartridges
- No replaceable media

APPROVALS

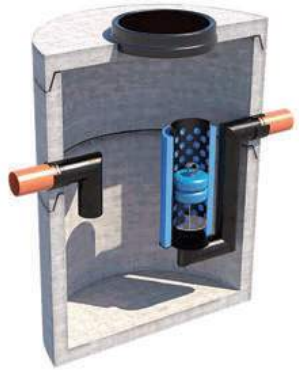
- Auckland Council Approved for use on Public and Private Sites
- Christchurch City Council Approved for use on Public and Private Sites

Oil & Water Separators

Stormwater360 offers a range of solutions for industrial sites and trade-waste applications. Our products help you meet regulations by capturing oil in stormwater, keeping it on-site and away from the environment.

ESK™ Oil Management System

The ESK™ is a passive high efficiency coalescing separator that removes free oil from contaminated stormwater runoff and has a built-in shutoff valve to prevent spills and storage capacity excess exiting the device. The device is ideally suited for sites where specific effluent targets are specified, or for sites where removal of oil and grease is the greatest concern e.g. fuel stations, fuel distribution stations, car servicing workshops, etc. It is typically sized to remove oil droplets as small as 10 microns and achieve an effluent concentration of 5 mg/L or less.



- Easy to install and maintain
- Reusable and washable media
- Optional alarm system, sensor control, remote control
- Small footprint

APPLICATIONS

- Refuelling stations
- Farms
- Petrol Stations
- Industrial Sites
- High contaminating activities

MAINTENANCE

- Easy to install and maintain
- Reusable and washable media

in cooperation with ecol-unicon

TREATMENT TRAIN

With industrial sites, often the runoff is highly contaminated and cannot be managed through source control measures. In such instances, several treatment devices can be used in a "treatment train". Each device in the treatment train targets a different contaminant. Often a treatment train is required to lower the concentration of contaminants to a suitable level for safe discharge. In many cases a treatment train is used to lower operational costs.

AVAILABLE MODELS

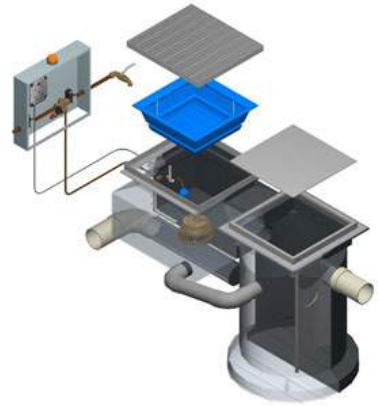
ESK	Chamber Diameter	Treatment Flow	Recommended Inlet/Outlet Pipe Size
	m	L/s	mm
ESK10	1050	10	150
ESK20	1200	20	200
ESK40	1500	40	300
ESK100	1800	100	300

Our standard ESK coalescing separator range is designed and manufactured for treatment flows starting at 1.5L/s up to 100L/s.

FOX™ Diversion Valves

The Fox™ Valve system is a stormwater/ tradewaste diversion system designed to divert washdown and/or first flush stormwater runoff to trade waste to prevent pollution of downstream waterbodies.

Stormwater360 can supply different models depending on application and contaminant of concern.



- Plug and play – however needs on site calibration for 'First Flush Volume'
- Designed for sites over 5m²
- Operates at 20 L/ sec.
- Trafficable – Heavy Duty CLASS D grate

APPLICATIONS

- Aviation/Airports
- Earthmoving
- Armed Forces
- Ports
- Marinas
- Fuel/Gas Stations
- Mining
- Slipways
- Trucking/Transport
- Vehicle Dealerships

FOX ENVIRONMENTAL SYSTEMS

AVAILABLE MODELS

UNIT	DESCRIPTION	APPLICATIONS	NEED POWER	LITRE/SEC
FOX DD600	DEMAND DRIVEN - this system relies on the work area being left free from pollutants after the washdown activity has ceased	Machine washdown, small wash areas that can be kept clean after use, car wash areas etc.	No	20 l/sec choke is silt tray - restricting to 5 l/sec
FOX FF600	FIRST FLUSH - for washpads where the area may be left polluted after the wash down operation ceases.	All washpads that are dirty and can't always be left clean	Yes (240v 10 amp)	20 l/sec choke is silt tray - restricting to 5 l/sec
FOX SCS600	SPILL CONTROL SYSTEM - provides total protection for pollutants "on the water"	Liquid sites such as Service Stations and re-fueling areas	Yes (240v 10 amp)	20 l/sec choke is silt tray - restricting to 5 l/sec
FOX CMS600	CONSTANT MONITORING SYSTEM - provides total protection where pollutant is water soluble	Milk Depots, Wineries and Chemical Plants.	Yes (240v 10 amp)	20 l/sec choke is silt tray - restricting to 5 l/sec

Gross Pollutant Traps

Gross pollutant control plays an important role in stormwater management. From targeting visual contaminants such as plastic, litter, leaves or oils, to pre-treatment of sediments prior to filtration devices, ponds or wetlands, Gross Pollutant Traps (GPT's) are a cost-effective way to reduce your site's contaminant loadings and extend system maintenance frequencies.

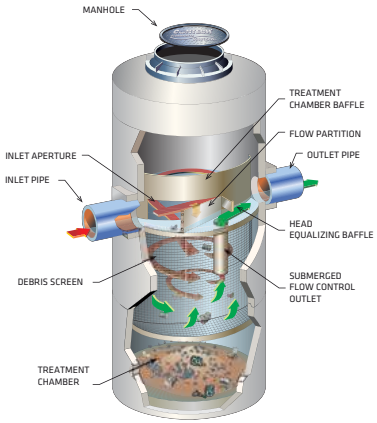
VORTCAPTURE™

VortCapture™ is a full capture, high-capacity litter, debris & sediment solution designed to remove all particles greater than 5mm in size. The system combines the proven sediment removal capability of hydrodynamic separation with superior litter and organic debris capture. The result is a stormwater treatment system that effectively captures and retains a broad range of pollutants.

- Integrated high flow diversion
- Flexible, compact design ideal for congested sites
- Provides unobstructed access to stored pollutants, making it easy to maintain
- Integrated screen to remove neutral buoyant debris.

APPLICATION

- Ideal for pretreatment – Reduce maintenance costs on downstream stormwater devices



Moderate Sediment Removal

AVAILABLE MODELS

VORTCAPTURE™	Swirl Chamber Diameter	Typical Depth Below Invert	Max. Pipe Size Inlet/Outlet	Water Quality Flow Rate	Debris Storage Capacity	Sediment Storage
	mm	m	mm	L/s	m^3	m^3
VC40	1200	2.0	450 (900[1])	39	0.9	0.5
VC50	1500	2.3	450 (1050[1])	69	1.5	0.8
VC60	1800	2.6	600 (1200[1])	109	2.3	1.2
VC70	2050	2.8	750 (1500[1])	185	3.4	1.6
VC80	2300	3.1	750 (1500[1])	283	4.7	2.1

Custom design on request for high flow solutions. Contact sales@stormwater360.co.nz

VORTSENTRY HS™

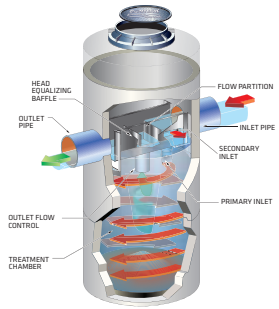
The VortSentry HS™ system employs a helical flow pattern that enhances containment of pollutants and provides effective removal of settleable solids and floating contaminants from urban runoff.

APPLICATIONS

- Stormwater quality control and hydrocarbon removal
- Inlet and outlet protection
- Ideal pretreatment for other stormwater management products

Moderate Sediment Removal

- Compact footprint
- Helical flow pattern enhances trapping and containment of pollutants
- High treatment and bypass capacities
- Compact footprint ideal for congested sites
- Lightweight design easy to install
- Available in both inline and grate inlet configurations
- Quick manufacturing turnaround time



VORTECHS™

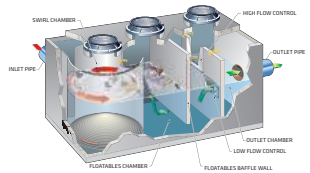
The Vortechs™ system is a high-performance gross pollutant trap that effectively removes fine sediment, oil and grease, and floating and sinking debris. Its swirl concentrator and flow controls work together to minimise turbulence and provide stable storage of captured pollutants. The design also allows for easy inspection and unobstructed maintenance access. With comprehensive lab and field testing, the system delivers proven results and site-specific solutions.

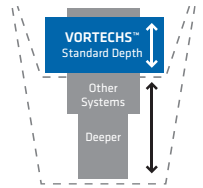
APPLICATIONS

- Ideal for larger projects

Moderate to High Sediment Removal

- High removal rate of fine sediments.
- Compact design to reduce cost and sprawl
- Largest treatment zone surface area of any hydrodynamic system available
- Easy maintenance – unobstructed access to stored pollutants
- Proven performance verified through third-party testing
- Shallow system profile and unique horizontal design makes installation easier and cost-effective
- Flexible design fits site constraints and accommodates a wide range of treatment options





Catchpit Inserts

A low-cost solution that involves inserting a screening and sedimentation device into new or existing catchpits. Capturing pollutants at source allows hotspot targeting and can reduce maintenance costs for downstream stormwater treatment devices and infrastructure.

Detention & Retention

Stormwater chambers allow both retention and detention of stormwater so they can be used as either a traditional stormwater management tool or a green infrastructure device. In detention applications, the chambers can be sealed with an impermeable membrane to create an underground waterproof tank structure, and is ideal to maximise storage capacity in a shallow footprint.

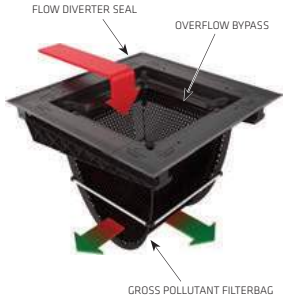
LITTATRAP™

The LittaTrap™ is a cost effective, innovative catchpit insert designed to be easily retrofitted into new and existing stormwater drains to specifically target litter, plastic and gross pollutants over 5mm.

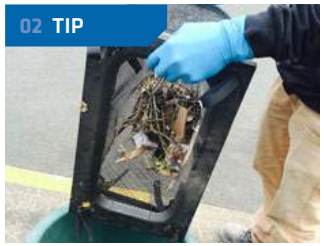
The LittaTrap™ has patented flow modifying components that dissipate energy, promote Total Suspended Solids (TSS) capture in sumped catchbasins, and provide full capture of gross solids.

Moderate Sediment Removal

- Easy hand maintenance
- Easy to install
- Lightweight for easy handling
- Various sizes available and can be custom designed
- Ideal for pretreatment – reduce maintenance costs on downstream stormwater devices
- Optional liners for targeted contaminants e.g. sediment. plastic pellets



LittaTrap™



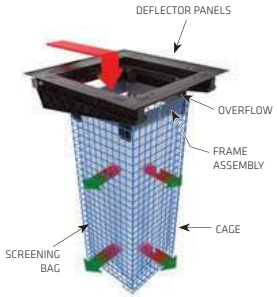
LITTATRAP EASILY MAINTAINED BY HAND

ENVIROPOD®

The EnviroPod® is an effective, easily maintained catchpit insert that captures and retains litter, debris and other pollutants as runoff enters the storm drain system. This catchpit insert can be installed in either a curb inlet or drop-in catch basin and can be customised to meet site-specific requirements. The EnviroPod® is effective as a pre-treatment device in a treatment train and is often the most practical solution for retrofits.

Moderate to High Sediment Removal

- High performance catchpit insert
- No construction required resulting in low costs
- Various sizes available and can be custom designed
- Can be used to easily target heavily polluted areas
- Fine precision woven screen to capture smaller particles e.g. sediment, plastic pellets, turf rubber



ENVIROPOD™

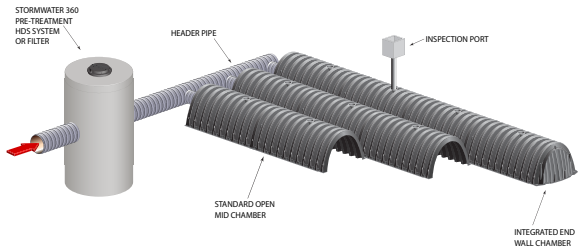
CHAMBERMAXX™

The ChamberMaxx™corrugated, open-bottom plastic infiltration chamber system allows you to meet stormwater runoff reduction requirements and maximise available land space by providing economic infiltration below ground. ChamberMaxx™ maximises storage volume in a small footprint, and its low profile shape is ideal for sites with shallow footprints or where land is at a premium.

APPLICATIONS

- Detention
- Retention
- Soakage
- Rainwater Harvesting
- Install under raingardens for reduced footprint in volume reduction regulated areas

- 2.1m³ of storage per chamber
- Easy installation - no heavy lifting equipment required
- Lightweight, low profile shape (770mm rise)
- Exceeds New Zealand Heavy Traffic Loading (HN-HO-72) standards
- Modular configuration with flexible layout options



Reduce Auckland Council SMAF zone raingarden size

Permeable Surfaces

Engineered permeable surfaces are an "at source" Water Sensitive Design (WSD) feature to reduce stormwater runoff volumes via infiltration and evapotranspiration.

BioFilter

Biological treatment system that will remove the majority of contaminants, reduce stormwater flows and blend in to the urban environment.

GRASSCRETE™

Grasscrete™ from Stormwater360 is a cast-on-site cellular reinforced concrete permeable paving system that is an effective Water Sensitive Design (WSD) solution to reduce impervious surfaces and promote infiltration.

Stormwater regulation limits the number of impermeable surfaces on a property; Grasscrete is considered permeable by many city councils allowing for a greater building footprint.

- Easy to install
- Reduce impervious areas
- Withstands heavy vehicle loadings
- Tested in flow rates in excess of 8 metres per second
- Increase building footprint and functional space

LIVEROOF®

LIveRoof® is New Zealand's only pre-vegetated modular green roof system, specifically designed to grow plants in a rooftop environment. With plants already grown before installation, establishment and maintenance costs are reduced as the roof is fully-grown when installed. The LiveRoof® modular green roof system uses Stormwater360's compliant green roof soil media and has numerous New Zealand native or sedum/ succulent planting options.

APPROVALS

- Acceptance of compliance with New Zealand Building Code (Auckland Council)

- Pre-vegetated before install ensuring maximum visual impact immediately
- Reduced establishment costs
- Low ongoing maintenance costs
- Full design services using a complete range of native and succulent greenroof plants
- Designed for roof pitches up to 30 degrees
- Ideal for both residential and commercial builds

LiveRoof®

FILTERRA®

Filterra® is an advanced biofiltration system. With components that make it similar to bio retention in pollutant removal and application, the system has been optimised for high volume/flow treatment and high pollutant removal. The high flow rate media allows a small footprint and the biological treatment mechanisms remove and store pollutants mimicking nature.

Pre-engineered and manufactured – the system is easy to install and maintain, and with a range of planting design options , the Filterra® can enhance any urban landscape.

- Delivered as a Plug and Play Solution
- Low life cycle cost
- Small footprint
- Proven and verified performance
- Fraction of the size of traditional raingardens
- **Enhanced dissolved heavy metal removal**

Very High Sediment Removal

APPROVALS

- Auckland Council Approved for use on Public and Private Sites
- Christchurch City Council Approved for use on Public and Private Sites

MAINTENANCE

- Easy maintenance with no confined space access
- First year maintenance included

Based on a comparison of a traditional designed raingarden (k=0.3-0.75m/d) and the Filterra® (k=2.5m/d).

Talk to us about Filterra Bioscape® : an option for the large scale drainage projects.

filterra® Bioretention Systems


Filterra® with internal bypass


Filterra® and ChamberMaxx providing treatment, detention and retention


Street Tree Filterra®

Device Selection Guide

Stormwater can have a range of contaminants entrained in the runoff. Stormwater360 treatment devices target these different contaminants in their different forms.

The below table is a guide to the types of contaminants removed by our devices.

STORMWATER360 TREATMENT PRODUCTS PERFORMANCE MATRIX

	Floatable Gross Pollutants	Neutrally Buoyant Gross Pollutants	Heavy Metals/ TSS				Dissolved Contaminants
			Free Oil	Moderate	High	Very High	
StormFilter (Perlite)	✓	✓	✓		✓		
StormFilter (Phosphorb)	✓	✓	✓		✓		✓
StormFilter (ZPG)	✓	✓	✓		✓		✓
Jellyfish	✓	✓	✓			✓	
ESK			✓				
VSHS	✓		✓	✓			
VortCapture	✓	✓		✓			
VorTechs	✓		✓	✓			
Enviropod	✓	✓		✓			
LittaTrap	✓	✓		✓			
Filterra	✓	✓	✓			✓	✓

OPERATION AND INSTALLATION CONSIDERATIONS

Often operational considerations influence the decision as to which treatment devices should be used.

	Installation Cost	Maintenance Cost	Shallow Install	Replaceable media	Hydraulic Requirement
StormFilter	Medium	Medium	✓	✓	0.35 m - 0.9 m
Jellyfish	Low	Medium			0.15 m - 0.45 m
VSHS	Low	Low – Medium			0.25m - 1m
VortCapture	Medium	Low – Medium			0.25m - 1m
VorTechs	Low	Low – Medium	✓		0.25m - 1m
LittaTrap	Low	Low	✓		Min (pipe cover)
Enviropod	Low	Medium	✓		Min (pipe cover)
Filterra	Low	Low	✓	✓	Min (pipe cover)

To work out which solution is right for your project talk to the Stormwater360 team or use our online design calculator

Visit www.stormwater360.co.nz

360Maintenance

Stormwater360 offers comprehensive maintenance services for our complete product range, ensuring optimal performance of all devices and ongoing regulatory compliance.

WHY IS MAINTENANCE ESSENTIAL?

Stormwater structures or storage facilities can become clogged with debris or sediment, leading to reduced flow or storage capacity, which in turn may result in flooding of the site and damage to stormwater assets.

A reduction in the ability of stormwater treatment devices to efficiently and effectively remove and prevent pollutants from entering waterways.

A failure to comply with local authority regulations relating to stormwater quality standards, which may result in penalties for the site's owners or property managers.

The likelihood of costly repairs, increased ongoing maintenance costs and the potential of damage to other infrastructure or drainage assets.

An erosion of the asset's capital value.

HOW IS MAINTENANCE CARRIED OUT?

Stormwater360 has developed a systematic maintenance approach to inspecting, cleaning and repairing our stormwater systems. We utilise approved maintenance contractors who are familiar with the characteristics of each type of system, and the processes required to optimise its efficiency and performance.

Our maintenance experts design a site-specific maintenance plan for each system and provide documentation and reporting to meet regulatory compliance.

CARTRIDGE EXCHANGE SERVICE

Stormwater360 offer a cartridge exchange service on StormFilter cartridges. Refurbished cartridges are filled with the appropriate approved filter media and swapped with emptied exhausted cartridges from your site.

Stormwater360 recommend that StormFilter cartridges are inspected once per annum.

LEARN MORE

Talk to us about a maintenance option and more detailed technical information about Stormwater360 products and solutions.

Contact **maintenance@stormwater360.co.nz** or **Freephone 0800 STORMWATER** for more information.

0800 STORMWATER (0800 786769)
www.stormwater360.co.nz

Stormwater360®
BETWEEN SKY AND SEA

S360 Product Brochure 2018 [1183]

STORMFILTER™

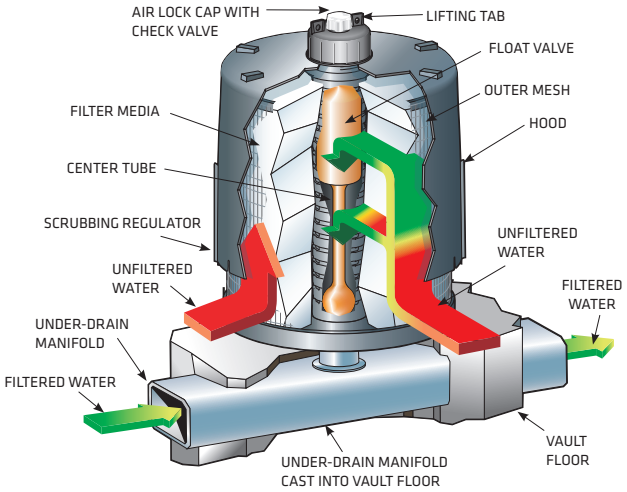
High efficiency / low maintenance stormwater filter.

SIPHON-ACTUATED FILTRATION The Stormwater Management StormFilter® cleans stormwater through a patented passive filtration system, effectively removing pollutants to meet the most stringent regulatory requirements. Highly reliable, easy to install and maintain, and proven performance over time, StormFilter products are recognised as a versatile BMP for removing a variety of pollutants, such as sediments, oil and grease, metals, organics, and nutrients. These systems come in variable configurations to match local conditions and come with prolonged maintenance periods to ensure long-term performance and reduce operating costs.

HOW DOES IT WORK?

During a storm, runoff passes through the filtration media and starts filling the cartridge center tube. Air below the hood is purged through a one-way check valve as the water rises. When water reaches the top of the float, buoyant forces pull the float free and allow filtered water to drain.
After the storm, the water level in the structure starts falling. A hanging water column remains under the cartridge hood until the water level reaches the scrubbing regulators. Air then rushes through the regulators releasing water and creating air bubbles that agitate the surface of the filter media, causing accumulated sediment to drop to the vault floor. This patented surface-cleaning mechanism helps restore the filter's permeability between storm events.

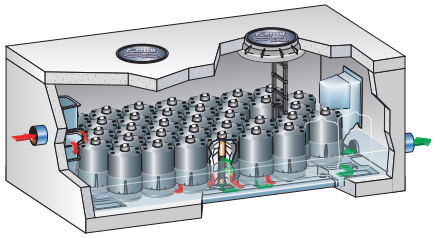
STORMFILTER CARTRIDGE



PROVEN PERFORMANCE

- New Zealand's only independently verified filter by Washington Department of Ecology, New Jersey Department of Environmental Protection and USEPA's Environmental Technology Verification program).
- Approved Auckland Council >75% TSS removal and approved on high trafficked roads (>20,000 V.P.D)
- Over 550 x StormFilter's installed throughout New Zealand-treating over 3.7 million m^2 of catchment area
- 8th generation of the product. Design refined and perfected over two decades of research and experience

STORMFILTER VAULT



STORMFILTER BENEFITS

UNDERGROUND SYSTEMS MAXIMISE PROFITABILITY

- Save land space allowing denser developments reducing sprawl
- Add parking spaces and increase building size, increasing profitability
- Compact design reduces construction and installation costs by limiting excavation

RELIABLE LONGEVITY & LOWER MAINTENANCE COSTS

- Self cleaning hood prevents surface blinding, ensures use of all media and prolongs cartridge life
- 1-3 year maintenance cycles
- 8 years maintenance experience – 1-5 year contracts with cost guarantees
- Minimal or no standing water. Lower disposal costs

CONTACT DETAILS

Stormwater360

FREEPHONE:
0800 STORMWATER
(0800 786769)

www.stormwater360.co.nz

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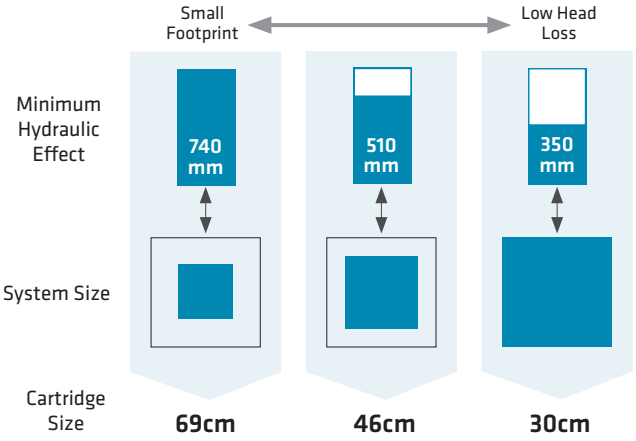
SUPERIOR HYDRAULICS

Multiple cartridge heights gives design solutions for site restraints.



Other hydraulic benefits

- Low hydraulic effect as low as 350 mm head loss
- Zero surcharge of inlet pipe unlike upward flowing filters
- Can be operated with tail water e.g tidal conditions
- Online and offline configurations can limit hydraulic effects

MEDIA CHOICES

Our filtration products can be customised using different filter media to target site-specific pollutants. A combination of media is often recommended to maximise pollutant removal effectiveness.

Perlite is naturally occurring puffed volcanic ash. Effective for removing TSS, oil and grease.

ZPG™ is a multi-purpose media option approved for highly trafficked sites or sites with high metal loadings. ZPG is a mixture of Zeolite, Perlite and GAC (granular activated carbon). ZPG is ideal for removing soluble metals, TSS, oils and grease, organics and ammonium.

Zeolite is a naturally occurring mineral used to remove soluble metals, ammonium and some organics.

GAC (Granular Activated Carbon) has a micro-porous structure with an extensive surface area to provide high levels of adsorption. It is primarily used to remove oil and grease and organics such as PAHs and phthalates.

CONFIGURATION

Stormfilter's can be configured in any drainage structure. Please contact SW360 for a customised design.

PRECAST VAULT

- Treats medium sized sites
- Simple installation – arrives on-site fully assembled

DRYWELL/SOAKAGE

- Provides treatment and infiltration in one structure
- Available for new construction and retrofit applications
- Easy installation
- Shallow and Rock soakage models available

HIGH FLOW

- Treats flows from large sites
- Consists of large, precast components designed for easy assembly on-site
- Several configurations available, including: Panel Vault, Box Culvert, or Cast-In-Place

DETENTION

- Meets volume-based stormwater treatment regulations
- Captures and treats site specific Water Quality and Quantity Volume
- StormFilter cartridges provide treatment and control the discharge rate
- Can be designed to capture all, or a portion, of the WQv
- Detention vault configured to provide pre-treatment

CATCHPIT/ CURB-INLET

- Provides a low cost, low drop, point-of-entry configuration
- Treats sheet flow from small sites
- Accommodates curb inlet openings from 1 to 3 metres long

PRECAST MANHOLE

- Provides a low drop, point-of-entry configuration
- Uses drop from the curb inlet to the conveyance pipe to drive the passive filtration cartridges
- No crane required (Hi-AB lifting for most sizes)
- 1050-2400mm diameter sizes available