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Engineering

Working Beyond Expectations

Stormwater and Drainage Assessment

To accompany a Development Application for Stage 1 of Ivanhoe Estate - A State Significant Development

Property:
The land currently comprising Ivanhoe Estate, Herring Road, Macquarie Park as well as a portion of Shrimptons Creek and part of Lot 1 in DP 859537

Applicant:
Aspire Consortium on behalf of NSW Land and Housing Corporation

Date:
5th October 2018

Document Control Sheet

Issue No.	Amendment	Date	Prepared By	Checked By
A	DRAFT	23rd January 2018	BMY	IB
B	Modelling Updated	7th March 2018	BMY	IB
C	Appendix C added	16th March 2018	BMY	IB
D	Minor Wording	26th March 2018	BMY	IB
E	Minor Amendments	10th April 2018	BMY	IB
F	Amendments to C1	4th October 2018	BMY	IB
G	Image amended	5th October 2018	BMY	IB

Executive Summary

This report supports a Development Application for Stage 1 of the Ivanhoe Estate redevelopment, a State Significant Development (SSD) submitted to the Department of Planning and Environment (DPE) pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). It has been prepared for Aspire Consortium on behalf of NSW Land and Housing Corporation.

As a part of the Stage 1 development application, a Stormwater and Drainage Assessment of the proposed development is required. This report has undertaken an assessment of the proposed development to determine compliance with the requirements set out in both the Secretary's Environmental Assessment Requirements (SEAR's) and Ryde Council's DCP 2014 in regards to stormwater drainage.

The Stage 1 development application includes lots A1 and C1, along with the public road network for the entire development.

Ryde Council's DCP 2014 requires the development to comply with requirements for onsite detention, water sensitive urban design and flooding. This report considers both the onsite detention and water quality aspects with the flooding impact assessment been done by a third party.

As detailed in the previous submission for the Ivanhoe Estate Masterplan, onsite detention (OSD) and water sensitive urban design (WSUD) requirements only need to apply to areas within the site that are to remain in private ownership. As such, all OSD and WSUD control measures were provided on lot prior to flows entering the public drainage system. A concept drainage plan was developed on this basis and consisted of an on lot private system and a public drainage system located within the proposed public road reserves.

Using the XP-RAFTS software, an onsite detention model was created, using a combination of rainwater tanks and designated detention tanks to attenuate peak flows to meet Council's requirements. It was found that a total of 155m^3 of dedicated detention storage was required, along with 50m^3 of storage within the rainwater tanks to meet the requirements set out by Ryde Council.

A water quality model was created in the MUSIC software to determine the required water quality treatment measures to meet Council's water quality targets. A treatment train of rainwater tanks, gross pollutant traps and media filtration devices was proposed for the development. An analysis of the MUSIC model indicated that the proposed treatment train not only met but exceeded the targets set by Council.

A water balance model was developed to determine the reduction in potable water for each building within Stage 1 of the development. This development proposes to reuse captured stormwater for irrigation and car washing purposes.

Erosion and sedimentation control plans were developed for the likely construction staging, to ensure that during construction, runoff generated on the site was adequately treated prior to it entering the downstream receiving waters. Required temporary stormwater works are also detailed on the erosion and sedimentation control plans. The erosion and sediment control plans will need to be regularly updated to adjust to changes in the proposed development over the life of the project.

The adjoining development to the northwest of the subject site currently drains, under easement, through the site to the existing drainage system within Ivanhoe Place. It was found that the proposed development would impact on this connection, however through the design of building A1, it is shown that a new connection can be provided.

This report shows that from a stormwater management perspective, the proposed development can adequately meet the requirements set out by both Ryde City Council and the SEAR's and as such, should be approved.

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1.0 Introduction

This report supports a Development Application for Stage 1 of the Ivanhoe Estate redevelopment, a State Significant Development (SSD) submitted to the Department of Planning and Environment (DPE) pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). It has been prepared for Aspire Consortium on behalf of NSW Land and Housing Corporation.

1.1 BACKGROUND

In September 2015 the Ivanhoe Estate was rezoned by DPE as part of the Macquarie University Station (Herring Road) Priority Precinct, to transform the area into a vibrant centre that benefits from the available transport infrastructure and the precinct's proximity to jobs, retail and education opportunities within the Macquarie Park corridor.

The Ivanhoe Estate is currently owned by NSW Land and Housing Corporation and comprises 259 social housing dwellings. The redevelopment of the Ivanhoe Estate is part of the NSW Government Communities Plus program, which seeks to deliver new communities where social housing blends with private and affordable housing, with good access to transport, employment, improved community facilities and open space.

The Communities Plus program seeks to leverage the expertise and capacity of the private and non-government sectors. As part of this program, Aspire Consortium, comprising Frasers Property Australia and Mission Australia Housing, were selected as the successful proponent to develop the site in July 2017.

In September 2017, DPE issued the Secretary's Environmental Assessment Requirements for a comprehensive Masterplan application that will establish the framework for the staged redevelopment of the site. This Development Application for Stage 1 of the Ivanhoe Estate redevelopment represents the first stage of detailed works pursuant to the Ivanhoe Estate Masterplan.

1.2 SITE DESCRIPTION

The Ivanhoe Estate site is located in Macquarie Park near the corner of Epping Road and Herring Road within the Ryde Local Government Area (LGA). The site is approximately 8.2 hectares and currently accommodates 259 social housing dwellings, comprising a mix of townhouse and four storey apartment buildings set around a cul-de-sac street layout. An aerial photo of the site is provided at **Figure 1** below.

Immediately to the north of the site are a series of four storey residential apartment buildings. On the north-western boundary, the site fronts Herring Road and a lot that is currently occupied by four former student accommodation buildings and is likely to be subject to redevelopment. Epping Road runs along the south-western boundary of the site and Shrimptons Creek, an area of public open space, runs along the south-eastern boundary. Vehicle access to the site is via Herring Road.

Ivanhoe Estate comprised of 17 individual lots owned and managed by the NSW Land and Housing Corporation. The Masterplan site also incorporates adjoining land, being a portion of Shrimptons Creek and part of the commercial site at 2-4 Lyonpark Road. This land is included to facilitate a bridge crossing and road connection to Lyonpark Road.

Figure 1: Ivanhoe Estate Site

1.2.1 Site Topography

The site generally falls from the north western corner, at the intersection of Epping and Herring Roads towards Shrimpton's Creek in the south eastern corner. As indicated in **Figure 2** overleaf, there is approximately 30m of fall across the site at an average grade of 7.5%.

The topography of 2-4 Lyonpark Road is very gentle with the site generally falling towards Shrimpton's Creek at an average slope of 1-2%. This is also indicated in **Figure 2** overleaf.

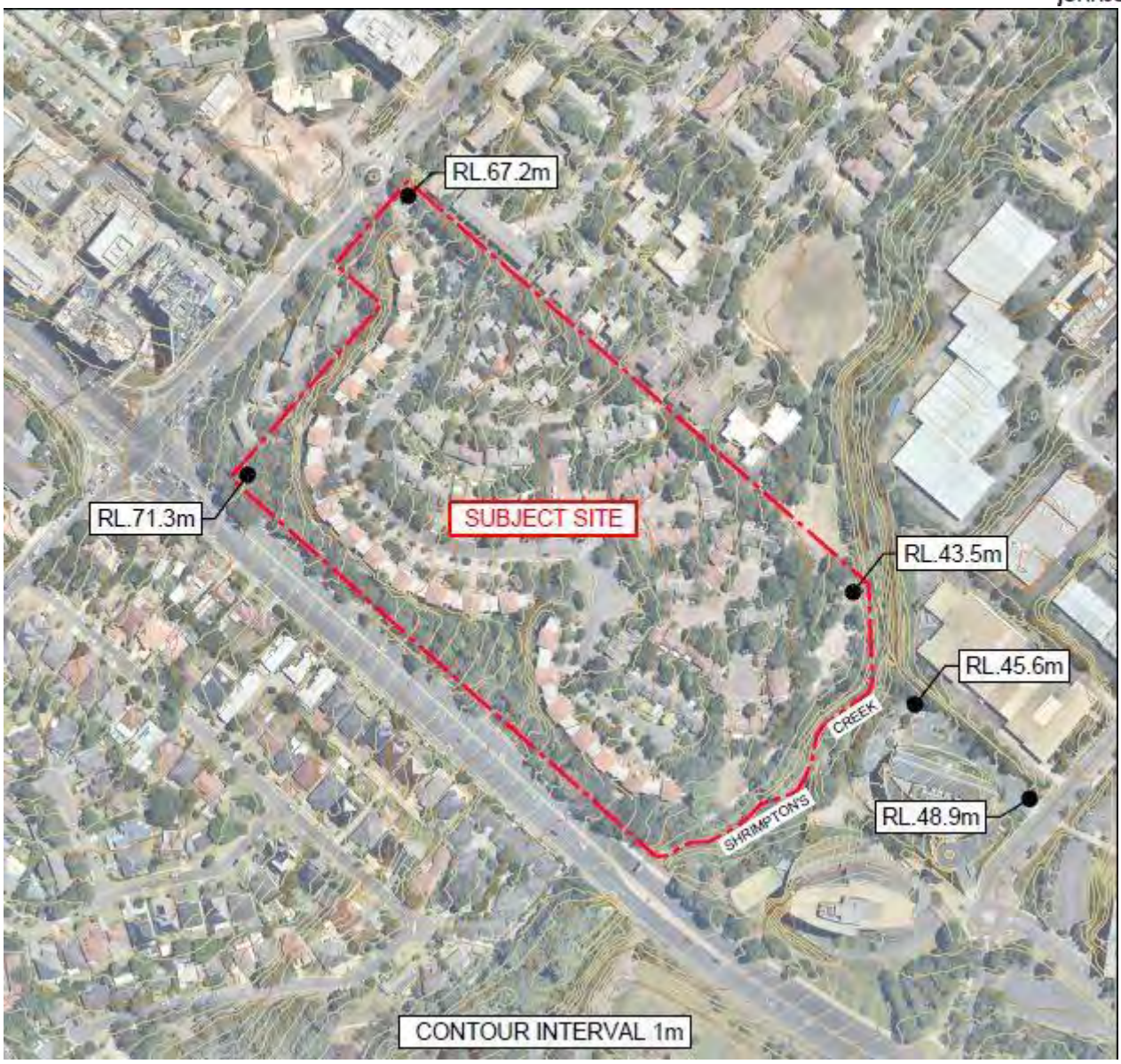


Figure 2: Existing Topography

1.2.2 Existing Stormwater Infrastructure

As mentioned in Section 1.2, the site currently consists of a mix of residential townhouses and apartment buildings set around a cul-de-sac street layout. Street drainage and interallotment drainage infrastructure currently drains runoff generated by the existing development south towards Shrimpton's Creek. There are currently three (3) outlet locations discharging into Shrimpton's Creek.

Prior to construction of the new development, all existing buildings, roads and associated infrastructure are to be demolished. As a part of this, the existing stormwater infrastructure is to be removed, with a new stormwater system to be constructed to cater for the new development.

It is noted that stormwater generated by the existing residential development to the North West of the subject site (Lot 1 D.P 609711) currently drains under easement through the site to the existing drainage system in Ivanhoe Place. Whilst the proposed development will impact on this connection, the design of building A1 has ensured that a connection will remain. This is discussed further in Section 6 of this report.

1.3 PROPOSED DEVELOPMENT

The proposed Stage 1 Development Application seeks consent for the first stage of detailed works within the Ivanhoe Estate, pursuant to the Ivanhoe Estate Masterplan under Section 4.22 of the EP&A Act. The Masterplan establishes the planning and development framework against which this Stage 1 Development Application will be assessed.

The Stage 1 Development Application seeks approval for:

- site preparation works, including tree removal, demolition of roads, services, and earthworks across the Ivanhoe Estate;
- the provision and augmentation of utilities and services infrastructure across the Ivanhoe Estate;
- the construction of all internal roads including public domain within the road reserves, and the bridge crossing and road connection to Lyonpark Road;
- the consolidation of existing lots and subdivision of the Ivanhoe Estate to reflect the revised road layout, open space, and provide superblocks corresponding to the Masterplan;
- the construction and use of Buildings A1 and C1 comprising residential uses (including social housing), a childcare centre, and retail / community spaces.

Despite the stage 1 development application seeking approval for works over the entire estate, it is proposed to deliver the works in accordance with the staging plan identified within the masterplan development application.

An image of the Masterplan, identifying Buildings A1 and C1 and illustrating the road network, is provided at **Figure 3** below.

Figure 3: Ivanhoe Estate Masterplan (Stage 1)

2.0 Authority Requirements

The proposed development is within the Ryde Council LGA and is therefore subject to the requirements of Ryde Council's Development Control Plan (DCP) 2014. Part 8.2 of Council's DCP contains specific information relating to the management of stormwater and contains the following documents:

- Stormwater Management Technical Manual;
- Water Sensitive Urban Design Guideline.

The proposed development is to satisfy the requirements of these documents and the broader Ryde Council DCP.

The development must also comply with the Secretary's Environmental Assessment Requirements (SEARs) provided by the NSW Department of Planning. A summary of the key SEARs requirements relating to this report can be seen below:

- *Prepare a Stormwater, Groundwater and Drainage Assessment;*
- *Detail Erosion, sediment and stormwater management controls during construction;*
- *Identify appropriate water quality management measures;*
- *Identify any water licensing requirements or other approvals;*
- *Prepare and integrated water management plan/drainage concept.*

The development is aiming to achieve a six (6) star Green Star communities rating and as such, is required to meet a number of stormwater objectives that are separate to the requirements of the SEAR's and Ryde Council's DCP 2014. As the Green Star communities rating is applied to the overall development, the requirements do not need to be considered in detail on a stage by stage basis. Details of the proposed measures to achieve the Green Star rating can be found in the Masterplan stormwater report.

2.1 STORMWATER QUANTITY

Ryde Council adopts a major/minor stormwater drainage philosophy for stormwater management throughout the LGA.

The minor drainage system is required to cater for runoff generated from all storm events up to and including the minor storm event without any surcharging within the system and minimising flow widths and ponding within the road carriageway. In accordance with the stormwater technical manual, the minor storm event for an urban residential development is the 20 year ARI storm event.

The road network and dedicated overland flow paths are to be provided to safely convey flows which exceed the capacity of the minor storm event up to and including the 100 year ARI storm event.

2.1.1 Onsite Detention (OSD)

Onsite detention systems are designed to minimise the effect of increased runoff from developments by attenuating peak stormwater flows leaving the site.

In accordance with Ryde Council's Stormwater Technical Manual, OSD systems are to be designed to ensure that the peak discharge in the **post developed 100 year ARI** storm event does not exceed the peak discharge in the **post developed 5 year ARI** storm event.

As outlined in the Stormwater and Drainage Assessment for the Ivanhoe Estate Masterplan development application submission, a meeting was held with Council to discuss the OSD requirements for the proposed development. Council advised that the detention requirements outlined within Ryde Council's Stormwater Technical Manual are only required to apply to the areas within the development that are to remain in private ownership.

Whilst the Stage 1 development application is for approval of the entire road network and lots A1 and C1 all OSD controls are to be applied to and contained within lots A1 and C1.

2.1.2 Shrimpton's Creek

As detailed in the Ivanhoe Estate Masterplan submission, Shrimpton's Creek is a second order watercourse which flows from west to east along the southern boundary of the proposed development site.

Shrimpton's Creek and its catchment has been analysed in the "Macquarie Park Floodplain Risk Management Study and Plan". This flood study, completed in 2011 considers the entire Shrimpton's Creek catchment on a regional scale and provides indicative flood extents within the Creek.

A further Study was undertaken as a part of the Ivanhoe Estate masterplan submission, detailing the impacts of the proposed development on Shrimpton's Creek and the surrounding areas. A copy of this report can be seen in **Appendix A.**

2.2 WATER SENSITIVE URBAN DESIGN

Through the management of potable water, wastewater and stormwater, water sensitive urban design (WSUD) aims to manage the effects of urban development on the water cycle. Ryde Council's "Water Sensitive Urban Design Guidelines" outline the requirements for WSUD within the Ryde LGA. This development aims to not only comply with the requirements set out by Council but exceed them.

2.2.1 Stormwater Quality

In order to comply with the WSUD requirements, the stormwater drainage system must effectively remove nutrients and gross pollutants from the site prior to runoff entering the downstream drainage infrastructure. The stormwater treatment objectives have been taken from the Ryde Council "Water Sensitive Urban Design Guidelines" document and can be seen below in **Table 1**.

Table 1 – Stormwater Treatment Objectives

Pollutant	Treatment Objective
Gross Pollutants	**90%** retention of the average annual load for particles and suspended solids
Suspended Solids	**85%** retention of the average annual load for particles and suspended solids
Total Phosphorus	**65%** retention of average annual pollutant load
Total Nitrogen	**45%** retention of average annual pollutant load

As outlined in the Stormwater and Drainage Assessment for the Ivanhoe Estate Masterplan development application submission, a meeting was held with Council to discuss the WSUD requirements for the proposed development. Council advised that the WSUD requirements outlined within Ryde Council's Stormwater Technical Manual are only required to apply to the areas within the development that are to remain in private ownership.

As with the OSD requirements, whilst the Stage 1 development application is for approval of the entire road network and lots A1 and C1 all WSUD controls are to be applied to and contained within lots A1 and C1.

2.2.2 Potable Water Conservation

The reduction of potable water usage can be achieved for a development through a number of methods, including the reuse of captured stormwater. This report details the requirements for stormwater reuse only, however it is noted that other methods may be used within the development.

Ryde Council requires that a water balance model be prepared to demonstrate how stormwater runoff from the site is reused. It should be noted that for a high-density development, as is proposed, it is extremely difficult to capture enough water to effectively reduce the extremely high potable water demand for internal uses. It has been decided at this stage for captured stormwater to be used for irrigation and car washing purposes only. It should be noted that other methods may be used within the development and these will be explored on a stage by stage basis as required.

This report will provide a water balance model to indicate how the captured stormwater is reused within the development.

3.0 Stormwater Quantity

As discussed in Section 2.0, this report will provide a drainage concept plan for Stage 1 of the Ivanhoe Estate project.

A concept stormwater drainage plan has been prepared to demonstrate how the stormwater runoff generated by the proposed development is captured and safely conveyed to Shrimpton's Creek.

As discussed in the Masterplan report, in order to achieve a six (6) star green star communities rating for the development, it is proposed to provide an end of line rain garden to cater for runoff generated by the public road reserves. It is noted that the Stage 1 development application includes the entire public road network, however as the Green Star requirements only need to be met for the entire development, the rain gardens will not be required in Stage 1. Despite this, in order to allow for the future rain gardens, the appropriate drainage pipework will be included within the Stage 1 development application.

As the Stage 1 development application is for the entire road network, along with lots A1 and C1, the concept stormwater plan has been developed for both the road network and the lots. It is noted however, that as Council do not require the roads to be detained or treated the public road network will not be included in the OSD or WSUD calculations found in this report.

The on lot drainage system has been designed to capture runoff from the lots and private access roads within the site, whilst the public drainage system has been designed to capture runoff generated by the public road network. The public drainage system will convey flows generated by both the lots and the road network to the receiving waters in Shrimpton's Creek.

The private system within the lots will capture and attenuate the flows generated within these lots before discharging to the public system. The private system consists of the following elements:

- Rainwater Tanks – Rainwater tanks will be used to capture and store runoff from roof areas for external reuse within the lots;
- OSD Tanks – OSD tanks will be used to attenuate peak flows before discharging into the public drainage system;
- Surface Drainage – Surface drainage pits will be provided to capture and convey runoff from both hardstand and pervious areas to the OSD tanks.

A plan showing the concept stormwater drainage system for the public road network can be seen in **Exhibit 1,** whilst a concept drainage plan for lots A1 and C1 can be seen in **Exhibit 2**.

3.1 ONSITE DETENTION

In accordance with Ryde Council's Stormwater Technical Manual, OSD systems are to be designed to ensure that the peak discharge in the **post developed 100 year ARI** storm event does not exceed the peak discharge in the **post developed 5 year ARI** storm event.

In accordance with the masterplan submission, it is proposed to use a series of rainwater tanks and dedicated OSD tanks located within the lots and under private roads to adequately attenuate the peak discharges generated by each lot. Runoff generated from the site is conveyed to the proposed tanks via the following systems:

- Roof Areas – Runoff generated from the building roofs is directed via the building hydraulics to rainwater tanks located within the basement of each building. Overflow from these rainwater tanks is then directed to an OSD tank.

  The most efficient rainwater tank sizes for each lot was provided by the building hydraulics engineer. A water balance model was performed on the rainwater tanks to determine the average volume available within the tanks at any given time. The average volume available within the tanks was adopted as available storage in the detention modelling. The water balance model is discussed further in Section 4.2.

- Remaining Lot Areas – Runoff generated from the remaining lot areas is captured in a series of surface drainage pits and conveyed to the detention tanks.

An XP-RAFTS model was created using the parameters outlined in the following sections in order to accurately model the proposed system.

3.1.1 Catchment Parameters

To ensure the runoff generated by each lot is accurately calculated the lots were split into subcatchments to reflect the conveyance systems discussed in Section 3.1 above.

The subcatchments areas were measured directly from the latest design plans for both A1 and C1 and can be seen in **Exhibit 2** and **Table 2** below**.**

Table 2. Catchment Areas

CATCHMENT AREA (ha)			
Catchment	**Roof**	**Remaining Lot (Captured)**	**Remaining Lot (Not Captured)**
A1	0.127	0.141	0.043
C1	0.298	0.224	0.113

In order to produce runoff hydrographs for each catchment, a number of hydrological parameters are required to be input into the XP-RAFTS model. These parameters include:

- Percentage of Impervious Area;
- Manning's 'n' – the Manning's 'n' coefficient is a measure of the surface roughness of a catchment;
- Average Catchment Slope.

The percentage of impervious area, Manning's 'n' and average catchment slopes were all estimated based upon the latest design plans for A1 and C1 respectively.

A summary of the parameters for lots A1 and C1 can be seen below in **Table 3.**

Table 3. Hydrological Parameters

Hydrological Parameter			
Catchment	**Impervious %**	**Manning's 'n'***	**Slope (%)**
A1 – Lot Captured	25%	0.035/0.015	1%
A1 – Lot not Captured	80%	0.035/0.015	10%
A1 – Roof	60%	0.05/0.01	1%
C1 – Lot Captured	40%	0.04/0.015	1%
C1 – Lot not Captured	60%	0.04/0.015	3%
C1 – Roof	60%	0.05/0.01	1%

* Manning's 'n' values are for Pervious/Impervious

3.1.2 Detention Modelling

Detention modelling was undertaken using an XP-RAFTS model in order to determine the size of the proposed detention tanks within lots A1 and C1 to achieve the requirements set out by Council.

Rainwater tanks were used in the model to supplement the storage volume provided by the proposed detention tanks. The rainwater tanks have been modelled to have an orifice 300mm from the top of the tank and as such, only provide a small amount of detention storage. The storage below the orifice does however, buffer the peak discharge generated by the roof catchments to assist in reducing the overall lot peak discharge.

Ryde Council's Stormwater Management Technical Manual indicates that XP-RAFTS models are suitable for use in sizing detention structures, however it is required that the flow rates calculated are checked against another method. In accordance with this, a DRAINS model was set up to provide a check of XP-RAFTS flow rates. A comparison of 5 year and 100 year post developed flows for the A1 and C1 catchments can be seen in **Table 4** below.

Table 4. DRAINS vs RAFTS

	RAFTS (5 Yr ARI) (m^3/s)	DRAINS (5 Yr ARI) (m^3/s)	Difference (%)	RAFTS (100 Yr ARI) (m^3/s)	DRAINS (100 Yr ARI) (m^3/s)	Difference (%)
A1 Roof	0.038	0.039	3%	0.067	0.068	2%
A1 Lot	0.032	0.036	11%	0.06	0.067	11%
C1 Roof	0.086	0.093	7%	0.148	0.159	7%
C1 lot	0.056	0.062	10%	0.1	0.112	11%
Combined	0.21	0.226	7%	0.37	0.4	8%

It can be seen from **Table 4** above that the flows calculated by DRAINS compare well with those calculated by the RAFTS model. The RAFTS model was generally found to produce slightly lower flows than the DRAINS model.

Based on this comparison, it was concluded that the RAFTS model was suitable to use for the detention modelling. The results of the detention modelling can be seen below in **Table 5.**

Table 5. RAFTS Results

Catchment	5 Year ARI Flow (m3/s)	100 Year ARI Flow - Without Detention (m3/s)	100 Year ARI Flow - With Detention (m3/s)	Rain Water Tank Size (kL)#	Detention Tank Size (m^3)
A1	0.087	0.154	0.087	20	55
C1	0.182	0.313	0.180	30	100
Total	0.269	0.467	0.267	50	155

 # Only a percentage of the actual tank volume was used in the modelling

It can be seen from **Table 5** above that, through the use of rainwater tanks and dedicated detention tanks, the post developed 1 in 100 year ARI peak discharges can be adequately attenuated back to the post developed 1 in 5 year ARI peak discharges.

Indicative rainwater and detention tanks for each lot can be seen in **Exhibit 2.** A screenshot of the XP RAFTS model can be seen in **Appendix B**.

3.1.3 Detention Tank Parameters

To ensure the 1 in 100 year ARI peak discharge is attenuated back to the 1 in 5 year ARI peak discharge, discharge control structures have been designed for each tank. Each tank has been designed with a low flow outlet and a high flow weir.

The high flow weir has been designed to cater for the 1 in 100 year ARI peak discharge, however it is an emergency overflow weir only and as such, has been placed above the 1 in 100 year level in the detention tank.

The tank configuration and outlet controls for each tank are summarised below in **Table 6.**

Table 6. Detention Tank Parameters

Detention Tank	Volume (m^3)	Tank Depth (Excluding Emergency Weir*) (m)	Low Flow Orifice (mm)	Weir Length x Height (m)
A1	55	1.5	170	1m x 0.2m
C1	100	1.5	225	2m x 0.2m

** Tank volume is based on a depth of 1.5m. Emergency weir to be placed above this level.*

It should be noted that as the detention tanks are to be incorporated into the basements of the proposed buildings, the final configuration of the tanks will be subject to confirmation by the building hydraulics engineers.

The configuration of the rainwater tanks is discussed in section 4.1.4. An indicative sketch showing two potential tank configurations can be seen in **Appendix C.** It should be noted that these are indicative only and are subject to final design by the building hydraulics engineers.

4.0 Water Sensitive Urban Design

Through the management of potable water, wastewater and stormwater, water sensitive urban design (WSUD) aims to manage the effects of urban development on the water cycle. Ryde Council's "Water Sensitive Urban Design Guidelines" outline the requirements for WSUD within the LGA.

4.1 STORMWATER QUALITY

The proposed stormwater drainage system, as discussed in Section 3 above, will incorporate a number of water quality treatment devices to effectively treat runoff generated by Stage 1 of the development prior to it being discharged to the receiving waters in Shrimpton's Creek.

As discussed in Section 2.2.1, water quality devices are only required to treat runoff generated by the proposed lots. As such, all water quality devices will be provided within the lots to treat runoff prior to it discharging to the public drainage network.

It is noted that an end of line rain garden will be provided at a future stage in order to meet the requirements of the Green Star communities' guidelines.

4.1.1 Treatment Devices

It is proposed to use a combination of at source and conveyance controls to treat the runoff prior to it entering the public drainage system. The proposed treatment train has been modelled in the water quality software "Model for Urban Stormwater Improvement Conceptualisation" (MUSIC) to demonstrate compliance with Council's treatment targets.

The following devices are proposed within the development to achieve the required targets:

Rainwater Tanks

Rainwater tanks are proposed within each building to capture and store runoff generated from the roof area for reuse. Each rainwater tank will be fitted with a first flush system to provide pretreatment prior to runoff entering the tanks.

Gross Pollutant Traps

It is proposed to provide Stormwater 360 "Enviropods" or Council approved equivalent litter traps in all grated surface inlet pits within the private stormwater system to capture gross pollutants and coarse sediments. Further details of the Stormwater 360 "Enviropod" can be seen in **Appendix D.**

Media Filtration

It is proposed to provide Stormwater 360 'Stormfilter" or council approved equivalent system. The "Stormfilter" is a proprietary media filtration device consisting of multiple cartridges that will be housed within the proposed OSD tanks. Further details of the "Stormfilter" cartridges can be seen in **Appendix D.**

As all of the proposed treatment devices are to be provided within the private lots, maintenance of all devices will be the lot owners and as such no maintenance burden is placed on council. Details of the required maintenance of the system will be provided at the CC stage of the development.

A graphical representation of the treatment train can be seen in **Figure 4** below.

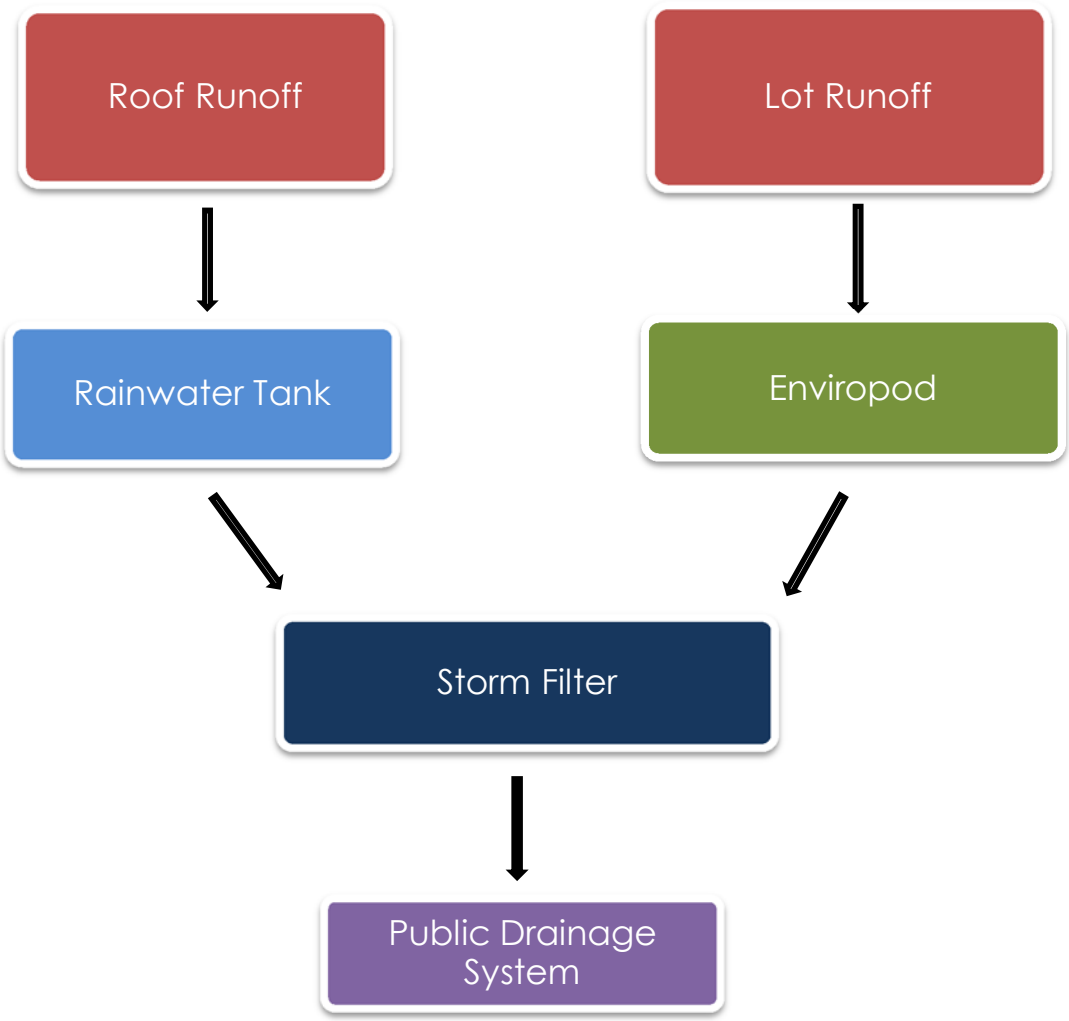


Figure 4: Proposed Treatment Train

4.1.2 MUSIC Parameters

The MUSIC model was set up in accordance with the "Using MUSIC in Sydney's Drinking Water Catchment" guidelines and Ryde Council's "Water Sensitive Urban Design Guidelines".

Catchment areas for the MUSIC modelling were adopted to correspond with those used within the detention model. Similar to the detention model, the overall catchments were broken down into smaller subcatchments in order to accurately determine the pollutant loads.

A summary of the catchment areas and parameters can be seen in Tables 2 and 3 in Section 3.1.1 above.

4.1.3 Water Quality Modelling

The MUSIC model was created using the parameters outlined above to determine compliance with council's water quality targets. The results of the water quality modelling can be seen in **Table 7** below.

Table 7. MUSIC Modelling Results

	Pollutant Load Reduction			
Catchment	**Gross Pollutants**	**Total Suspended Solids**	**Total Phosphorus**	**Total Nitrogen**
A1	100.0%	86.8%	67.1%	59.6%
C1	100.0%	86.5%	65.2%	56.7%

From **Table 7** above, it can be seen that the proposed treatment train of rainwater tanks, gross pollutant traps and media filtration devices not only meets, but exceeds the targets set by Council.

A screenshot of the MUSIC model can be seen in **Appendix E** whilst further details of the proposed treatment devices can be seen in section 4.1.4 below.

4.1.4 Treatment Device Parameters

The A1 and C1 catchments, as described in Section 3.1.1 above, have different characteristics and as such, require different configurations of the proposed treatment devices.

The treatment devices modelled for each catchment were chosen to achieve the required targets whilst also providing the most efficient solution for each catchment. The treatment device parameters for the rain water tanks and stormfilters can be seen below in **Tables 8 & 9,** whilst each catchment is to have Enviropods in all surface drainage pits.

Table 8. Rain water Tank Parameters

	Tank Parameter			
Catchment	**Volume (kL)**	**Surface Area (m^2)**	**Depth Above Overflow (m)**	**Overflow Pipe Diameter (mm)***
A1	20	13	0.3	270
C1	30	20	0.3	400

***** *Overflow pipe diameter is an equivalent diameter.*

Table 9. Stormfilter Parameters

	Tank Parameter				
Catchment	**Chamber Surface Area (m^2)**	**Extended Detention Depth (m)**	**Overflow Weir Width (m)**	**Overflow Pipe Diameter (mm)***	**Number of Cartridges**
A1	8.6	0.77	2	49	2
C1	8.6	0.77	2	49	5

***** *Overflow pipe diameter is an equivalent diameter.*

A sketch showing two potential tank configurations can be seen in **Appendix C.**

4.2 POTABLE WATER CONSERVATION

The reduction of potable water usage can be achieved for a development through a number of methods, including the reuse of captured stormwater. This report considers stormwater reuse only, however it is noted that other methods may be used throughout the development.

A water balance model was prepared for Stage 1 to determine the reduction in potable water consumption achieved through the reuse of stormwater captured within the rainwater tanks for irrigation purposes. Whilst the development will ultimately use captured stormwater for both irrigation and car washing purposes, the water balance model will only consider irrigation as the demand for car washing is unknown at this stage.

4.2.1 Water Balance Model Parameters

To accurately determine the potable water reduction for the development, a daily water balance model was set up for each individual building. In order to create the water balance model, the following parameters were required for each building:

- Catchment Area – As with the detention and water quality models, it was assumed that 50% of the roof catchment is a rooftop garden. Due to the expected low runoff from the rooftop garden (in the order of 4-5 l/s in the 1 year ARI event), it has been assumed for the water balance model that only 50% of the roof catchment reaches the tank.

- Water Demand – To determine the amount of water used each day within the lots a water demand is required. An irrigation rate for each catchment was provided by the landscape architects. A demand of **10,200 l/day** was adopted for catchment A1, whilst a demand of **15,400 l/day** was adopted for catchment C1.

- Daily Rainfall – To ensure consistency between models, the same rainfall data adopted within the MUSIC model was adopted for the water balance model.

The most efficient rainwater tank size for each lot was provided by the building hydraulics engineers and combined with the above parameters were used to perform a water balance model. The results of the water balance model can be seen in **Table 10** below.

Table 10. Water Balance Model Results

Block	Tank Size (kL)	Reduction in Potable Water *	Average Volume Available in tank (kL)#
A1	20	16.6%	17.2
C1	30	21.6%	24.0

***** *Reduction in potable water used for irrigation purposes only.*
#The average volume available in the tank was adopted in the OSD modelling as available storage.

It should be noted that reduction in potable water demand in **Table 10** above is for irrigation purposes only and does not consider car washing or internal building uses.

Table 10 also indicates that the average volume (empty space) available within the tanks. These volumes have been adopted within the OSD model as described in Section 3.1.2

5.0 Erosion and Sedimentation Control

Erosion and sedimentation control are an important part of any development to ensure downstream receiving waters are not adversely affected during construction.

The Stage 1 development application is for the entire public road network, along with lots A1 and C1, however it is likely that construction of the road network will be split into multiple stages.

As such, to ensure that there are no impacts to the downstream receiving waters at any stage during construction, detailed erosion and sediment control plans have been prepared for the likely construction staging of the development.

As the likely construction staging starts at the upstream end of the sites catchment, temporary stormwater works will be required to convey flows to the receiving waters in Shrimpton's Creek.

The likely construction staging can be seen in **Exhibit 3**, whilst the erosion and sediment control plans and required temporary works can be seen in **Exhibits 4-6**.

It should be noted that the erosion and sediment control plans contained within this report are provided as an indicative plan only and all erosion and sediment controls should be constantly updated during construction to ensure adequate protection is provided at all times.

6.0 Adjoining Development Drainage

As mentioned in Section 1.2.2, the existing development to the northwest of the site (Lot 1 D.P 609711) currently drains under easement through the proposed development site to the existing drainage system in Ivanhoe Place. The location of the existing stormwater line can be seen in **Figure 7** below.

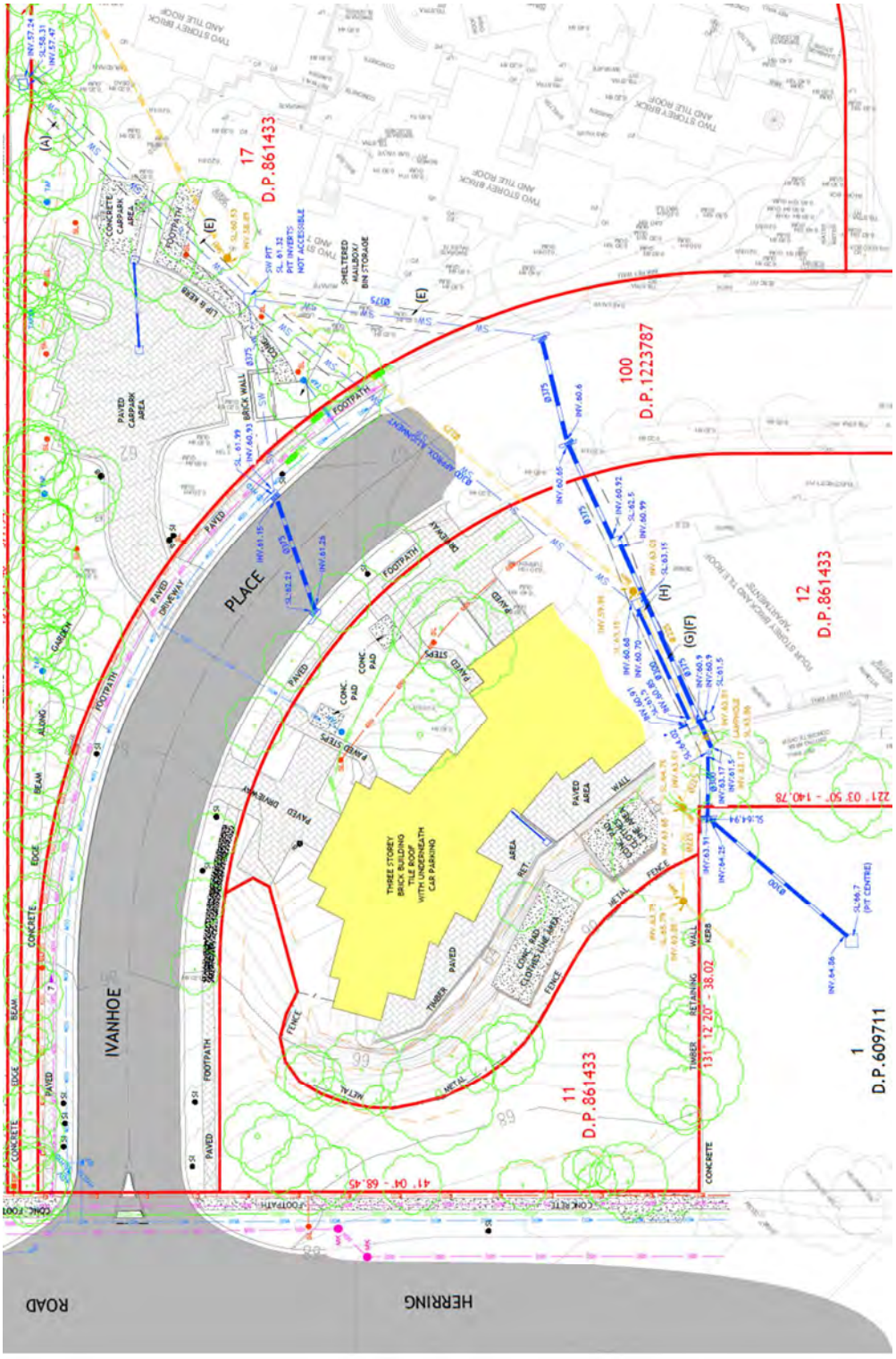


Figure 7: Adjoining Development Drainage

It can be seen from **Figure 7** that the adjoining site is currently drained via a 375mm dia stormwater pipe under the existing buildings and into the drainage system within the existing Ivanhoe Place. It is noted that Ivanhoe Place was never dedicated as public road and therefore the easement benefitting lot 1 DP 609711 does not extend to an existing public drainage system.

Based upon the proposed location and levels of building A1, it was found that the existing drainage infrastructure will need to be removed as a part of the proposed development.

In order to allow Lot 1 D.P. 609711 to continue to drain through Ivanhoe Estate, it is proposed to provide a piped stormwater system through the basement of building A1. This pipe system will drain through the basement of A1 and connect into the public drainage network located within the proposed road reserve.

This pipe system will be designed to cater for the 1 in 100 year ARI storm event, with an overland flow path to be provided on the podium level of building A1 to cater for emergency overland flows.

The final configuration of the proposed piped connection and overland flow path is subject to negotiation with the adjoining landowner and as such final details of the proposed system will be provided at the CC stage of the development.

Whilst final details are unavailable at this time, it is noted that a connection **will** be provided and as such, this issue will not pose a constraint to the development.

7.0 Groundwater Assessment

A groundwater assessment of the subject site has been undertaken by Douglas Partners and is detailed within their report.

8.0 Water Licensing Requirements and Other Approvals

Potable water for use within the site will be provided via the Sydney Water Corporation's existing carrier water mains, with this being supplemented by captured stormwater for reuse within buildings. No other permanent water sources are proposed to be utilised by the development and accordingly an ongoing water license for the site is not required.

Based upon the results of the geotechnical testing, it is likely that groundwater will be encountered in basement excavations and therefore dewatering will be required. The appropriate dewatering licenses will be obtained prior to construction commencing.

9.0 Conclusion

This report supports a Development Application for Stage 1 of the Ivanhoe Estate redevelopment, a State Significant Development (SSD) submitted to the Department of Planning and Environment (DPE) pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). It has been prepared for Aspire Consortium on behalf of NSW Land and Housing Corporation.

This report considered the stormwater drainage aspects of the proposed development, with specific focus on onsite detention and Water Sensitive Urban Design. Flood modelling within the adjacent Shrimpton's Creek was considered in a separate report.

In accordance with the Stormwater and Drainage Assessment for the Ivanhoe Estate Masterplan, OSD and WSUD requirements outlined within Ryde Council's Stormwater Technical Manual would only apply to the areas within the development that are to remain in private ownership. A concept drainage plan was developed on this basis and consisted of an on lot private system and a public drainage system located within the proposed public road reserves.

Through the use of rainwater tanks and dedicated detention tanks, it was shown that the private stormwater system could adequately attenuate peak flows generated by the proposed development and comply with the OSD requirements set out by Ryde Council. Similarly, through the use of rainwater tanks, gross pollutant traps and filtration devices, it was shown that the proposed development complies with the WSUD requirements set by Council.

In accordance with Council's requirements, a water balance model was developed to demonstrate how captured stormwater was reused within the site to reduce the demand on potable water. Whilst the development proposes to reuse captured stormwater for both irrigation and car washing purposes, only irrigation has been considered in the water balance model due to the car washing demand being unknown at this stage.

An erosion and sedimentation control plan was developed for the likely construction staging to ensure that during construction runoff generated on the site was adequately treated prior to it entering the downstream receiving waters. This plan will be regularly updated to adjust to changes in the proposed development over the life of the project.

The adjoining development to the northwest of the subject site currently drains, under easement, through the site to the existing drainage system in Ivanhoe Place. It was found that based upon the proposed location and level of building A1 that this connection would need to be removed. A new piped connection is to be provided through the basement of building A1 with an emergency overland flow path being provided on the podium level.

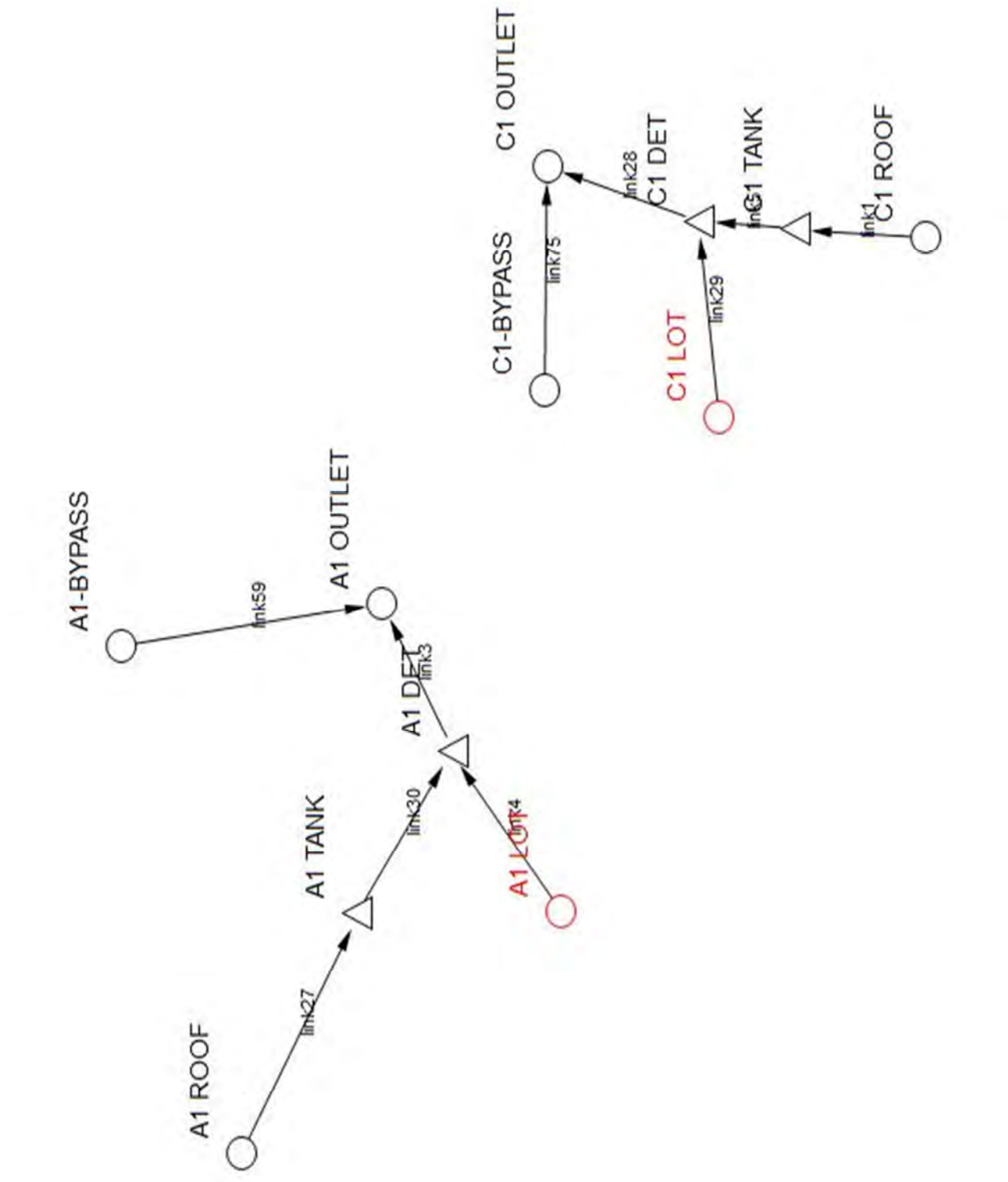
This report shows that from a stormwater management perspective, the proposed development can adequately meet the requirements set out by both Ryde City Council and the SEAR's and as such should be approved.

Appendix A

BMT WBM FLOODING REPORT

Appendix B

XP-RAFTS MODEL

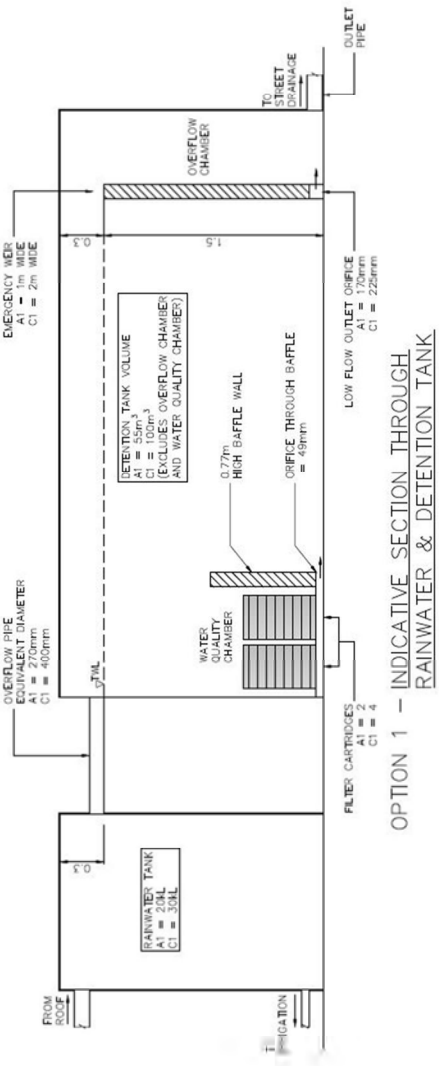


Appendix C

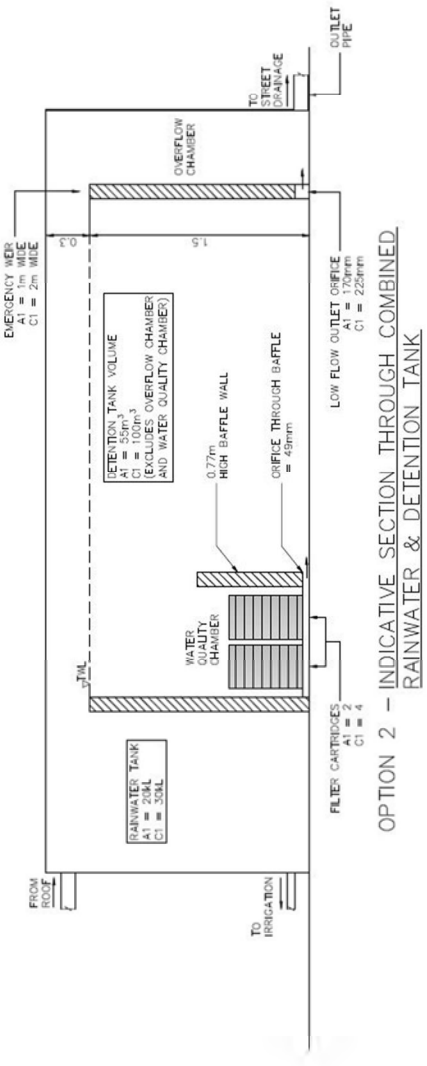
TANK DETAILS

NOTES:-

1. TANK DESIGNS ARE INDICATIVE ONLY AND ARE SUBJECT TO DETAILED DESIGN.
2. FINAL TANK CONFIGURATION SUBJECT TO BUILDING HYDRAULICS AND ARCHITECTURAL DESIGN.
3. OUTLET TO STREET DRAINAGE MAY BE PUMPED OR DRAINED VIA GRAVITY.
4. REFER TO STORMWATER 360 BROCHURE FOR STORMFILTER DETAILS



OPTION 1 – INDICATIVE SECTION THROUGH RAINWATER & DETENTION TANK



OPTION 2 – INDICATIVE SECTION THROUGH COMBINED RAINWATER & DETENTION TANK

Appendix D

STORMWATER 360 INFORMATION

EnviroPod®

Cost-effective, easily maintained gullypit insert

The EnviroPod is a proven gullypit insert that's been designed for easy retrofitting into new and existing stormwater gullypits, requiring no construction or land take. It removes a significant portion of sediment, litter, debris and other pollutants from water entering the stormwater system, and can be installed in either kerb inlet, standard pre-cast gullypits or manhole gullypits. Using low-cost passive screening and optional oil-adsorbent media, the EnviroPod can be customised to meet site-specific requirements with interchangeable polyester mesh screens ranging from 200 to 1600 micron pore size. Unless specified otherwise, 1600 micron filter mesh screening bags are supplied as standard.

> "Designed for easy fit into new or existing gully pits, the EviroPod® is a simple and effective solution for preventing gross pollutants from entering the stormwater system.

The EnviroPod is also effective as a pre-treatment device for use in a treatment train with hydrodynamic separators, filtration devices, ponds and wetlands. In many cases, it is often the most practical solution for retrofits.

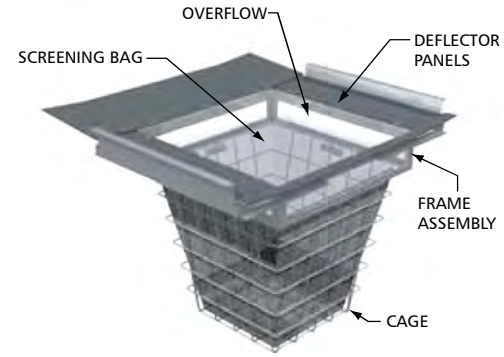
Independently trialled and tested by city councils throughout Australia and New Zealand, and with installation of over 15,000 units including North America, the EnviroPod filter is the premier gully pit insert.

How does it work?

As stormwater enters a storm grate or gullypit, it passes over the oil adsorbent pillows (optional) and into the screening bag. Litter, debris, and other pollutants larger than the screening bag aperture are captured and retained, while the oil adsorbent pillows reduce oil and grease. If the screening bag is full, or during high flows, overflow is released through the overflow apertures in the frame assembly.

Design and operation

The EnviroPod consists of a screening bag supported by a filter box and structural cage. Modular plastic deflector panels attach to the filter box and guide the flow of water to the screening bag. The screening bag captures pollutants and allows the water to pass through to the outlet pipe. Optional absorbent material inside the screening bag captures oil and grease. Openings in the filter box allow water to bypass the screening bag during high flow conditions to prevent surface flooding.



Capabilities

- Captures sediment, litter, debris and other pollutants before they enter the drainage system
- Fits a range of gullypit sizes – ideal for retrofits
- Easy access – maintenance friendly design, generally no confined space entry required
- Bypasses high flows with no moveable parts
- Adjustable panels allow fine-tuning during installation for a perfect fit

Configurations

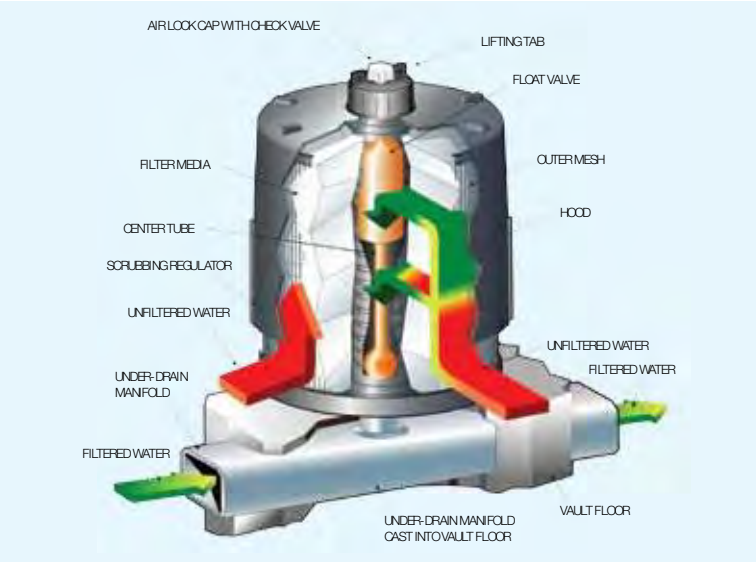
The kerb entry EnviroPod is inserted through the pit access cover and is supported by aluminium arms fixed to the kerb channel/pit wall.

The Drop-In EnviroPod is designed to simply insert into the gullypit below the grate, again supported by aluminium arms fixed to the kerb channel/wall pit. Plastic deflector panels seal against the pit walls and direct flow into the filter box and through the mesh screens. There are two standard sizes to fit most pre-cast regular and kerb entry gullypits. Custom designs can be fabricated for non-standard pits.

Installation, inspection and maintenance

Traffic control must be well planned when installing, inspecting or maintaining EnviroPod Filters. All standard rules and regulations governing traffic control and safety while working on the road must be rigidly followed at all times. All potential hazards must be identified and control methods put in place prior to installing, inspecting or maintaining filters.

The Stormwater Management StormFilter



Removing the most challenging target pollutants

The Stormwater Management StormFilter is a best management practice (BMP) designed to meet stringent regulatory requirements. It removes the most challenging target pollutants – including fine solids, soluble heavy metals, oil, and total nutrients (inc. soluble) – using a variety of media. For more than two decades, StormFilter has helped clients meet their regulatory needs and through product enhancements the design continues to be refined for ease of use.

Why StormFilter is the best filter available

Superior hydraulics

- External bypass – protects treatment chamber from high flows and ensures captured pollutants are not lost during low frequency, high intensity storm events
- Multiple cartridge heights – minimises head loss to fit within the hydraulic grade line and shrink system size, reducing installation costs
- Multiple StormFilter configurations in use across the country

Reliable longevity

- One-of-a-kind self-cleaning hood – prevents surface blinding, ensures use of all media, and prolongs cartridge life
- Customised maintenance cycles – fewer maintenance events compared to similar products, which reduces costs over the lifetime of the system
- 12 years of maintenance experience – predictable long-term performance comes standard

Proven performance

- Only filter on the Australian market tested within Australia achieving best practice guidelines, for TSS, TP and TN
- Qualifies for a minimum 2 EMI 5 Green star credits
- Achieve water quality goals with confidence – easy approval speeds development assessment process
- 8th generation product – design refined and perfected over two decades of research and experience

Maximising your land use and development profitability

StormFilter systems are utilised in below ground systems. The advantages this offers over above ground systems includes:

- Land space saving that enable an increase in development density and reduce sprawl
- The potential to add car parking, increase building size, and develop out parcels

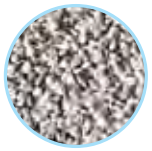
In addition, StormFilter's compact design reduces construction and installation costs by limiting excavation.

Media options

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.

PhosphoSorb™ is a lightweight media built from a Perlite-base that removes total phosphorus (TP) by adsorbing dissolved-P and filtering particulate-P simultaneously.

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



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.

	PhosphoSorb	Perlite	ZPG	Zeolite	GAC
Sediments	•	•	•		
Oil and Grease	•	•	•		
Soluble Metals	•		•	•	
Organics			•	•	•
Nutrients	•	•	•	•	•
Total Phosphorus	•		•		

Note: Indicated media are most effective for associated pollutant type. Other media may treat pollutants, but to a lesser degree.

ZPG™ media, a proprietary blend of zeolite, perlite, and GAC.

Cartridge options

With multiple cartridge heights available, you now have a choice when fitting a StormFilter system onto your site.

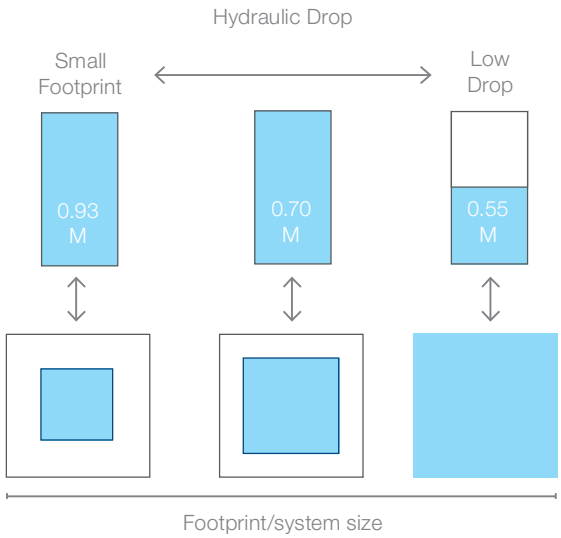
The 69cm cartridge provides 50% more treatment than the previously standard 46cm cartridge, which enables you to meet the same treatment standards with fewer cartridges, and via a smaller system.

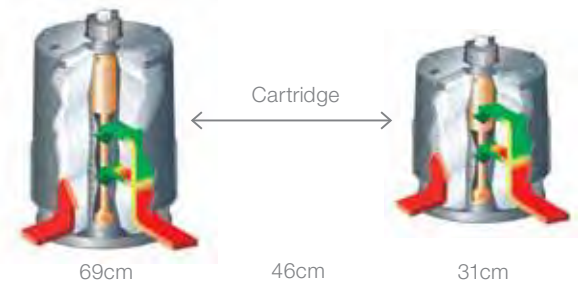
If you are limited by hydraulic constraints, the low drop cartridge provides filtration treatment with only 0.55m of headloss.

Cartridge flow rates

Cartridge Type	Hydraulic Drop	Treatment Capacity (l/sec)	
		0.7 l/s/m²	1.4 l/s/m²
StormFilter 69cm	0.93 m	0.71	1.42
StormFilter 46cm	0.70 m	0.47	0.95
StormFilter Low Drop	0.55 m	0.32	0.63

Selecting cartridge height





Configurations and applications

The StormFilter technology can be configured to meet your unique site requirements. Here are a few of the most common configurations, however many other configurations are available. A Stormwater360 engineer can assist you evaluate the best options for your site or you can find out more by downloading the StormFilter Configuration Guide from www.stormwater360.com.au

Upstream treatment configurations

The following suite of StormFilter configurations are easily incorporated on sites where WSUD is recommended. These low-cost, low-drop, point-of-entry systems also work well when you have a compact drainage area.

GullyPit StormFilter

Combines a gullypit, a high flow bypass device, and a StormFilter cartridge in one shallow structure.

- Treats sheet flow
- Uses drop from the inlet grate to the conveyance pipe to drive the passive filtration cartridge
- No confined space required for maintenance

Gully inlet

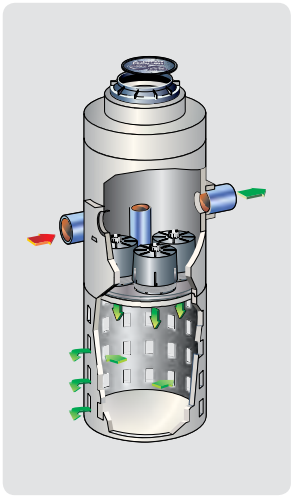
- Accommodates kerb inlet openings from 900 to 3000mm long
- Uses drop from the kerb inlet to the conveyance pipe to drive the passive filtration cartridges

Linear grate

- Can be designed to meet volume based sizing requirements
- Can be installed in place of and similar to a typical gullypit
- No confined space entry required for maintenance
- Accommodates up to 29 StormFilter cartridges

Infiltration/retrofit configuration infiltration

- Provides treatment and infiltration in one structure
- Available for new construction and retrofit applications
- Easy to install
- Re-charge groundwater and reduces run-off



Roof runoff treatment configuration

Down pipe

- Easily integrated into existing gutter systems to treat pollution from rooftop runoff
- Fits most downpipe configurations and sizes; single or dual-cartridge models available
- Treats up to 1300m^2 of rooftop area per dual-cartridge system

Downstream treatment configurations

Conventional stormwater treatment involves collecting, conveying and treating stormwater runoff with an end-of-pipe treatment system before discharging off-site. StormFilter configurations suitable for these applications are listed below and can be engineered to treat a wide range of flows.

Peak diversion

- Provides off-line bypass and treatment in one structure
- Eliminates material and installation cost of additional structures to bypass peak flows
- Reduces the overall footprint of the treatment system, avoiding utility and right-of-way conflicts
- Internal weir allows high peak flows with low hydraulic head losses
- Accommodates large inlet and outlet pipes (up to 900mm) for high flow applications

Vault / manhole

- Treats small to medium sized sites
- Simple installation – arrives on-site fully assembled
- May require off-line bypass structure

High flow

- Treats flows from large sites
- Consists of large, precast components designed for easy assembly on-site
- Configurations available, include, Panel Vault and Cast-In-Place

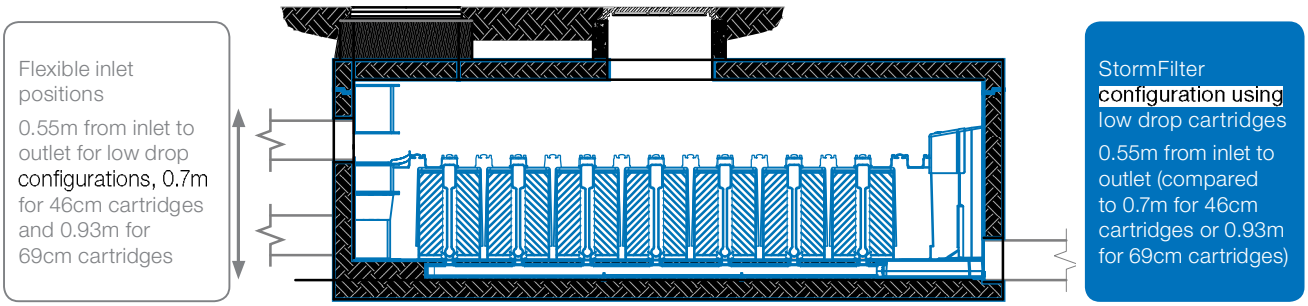
Volume

- Meets volume-based stormwater treatment regulations
- Captures and treats specific water quality volume (WQv)
- Provides treatment and controls the discharge rate
- Can be designed to capture all, or a portion, of the WQv

Filtration for low drop sites

Designing for limited drop

In some cases, site constraints limit the hydraulic drop that is available to drive the passive filtration cartridges. Following are a variety of solutions to either create the required drop or work around the limited drop without impacting the performance of the system.



Solutions for Low Drop Sites

Site modfications

Reduce pipe slope

Use an alternate pipe material with a lower Manning's n value for a portion of the site and reduce the pipe slope.

Reduce pipe cover

Use controlled density fill (CDF) at the front-end of the conveyance system to minimise pipe cover and raise the conveyance system. CDF, a method of pouring concrete with fine aggregate (sand vs. gravel) around pipe, allows the use of most pipe materials with limited cover.

Drain inlet treatment

Substitute several shallow inlet configurations for the single end-of-pipe system. Shallow options include the Catchpit/Gullypit StormFilter, CurbInlet StormFilter, Manhole StormFilter and the Linear StormFilter. These systems still require the normal drop (0.7m for 46cm cartridges) but utilise the drop into the conveyance system to drive the cartridges.

Provide pumping system

Stormwater360 offers the Integrated Pumping System (IPS), which can be designed in tandem with filtration system sizing.

Treatment system modfications

Use low drop cartridges

The StormFilter can be configured with low drop cartridges that activate at 31cm, reducing the overall head loss to only 0.55m, compared to 0.7m for the 46cm cartridge or 0.93m for the 69cm cartridge.

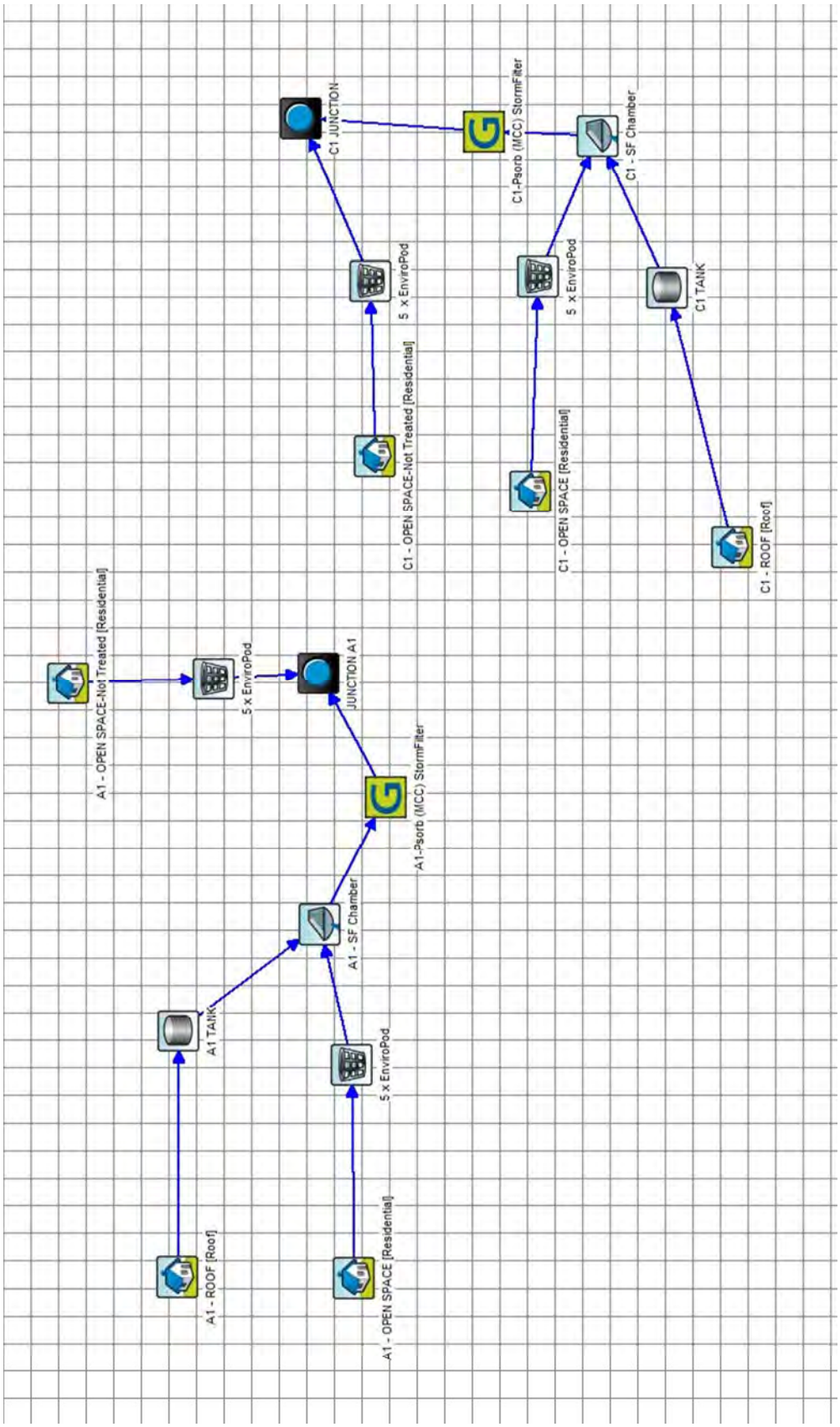
Surcharge the inlet pipe

Backing-up water into the conveyance system can create the necessary drop to drive the StormFilter cartridges. This will affect the HGL and increase the volume of water required to activate the cartridges, which could have a detrimental effect on system longevity. The following design modifications mitigate these risks:

- Confer with a Stormwater360 design engineer before surcharging the inlet pipe
- Verify this is an acceptable practice in your local jurisdiction
- Modify the overall system design to accommodate the increased HGL
- Calculate the additional treatment volume and consider using more cartridges

Appendix E

MUSIC MODEL



Exhibits

NOTE:
1. OUTLETS TO SHRIMPTONS CREEK SUBJECT TO DETAILED DESIGN

LEGEND

- SITE BOUNDARY
- STAGE 1 DA BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- PROPOSED KERB
- PROPOSED STORMWATER
- FUTURE STORMWATER
- PROPOSED STORMWATER OUTLET
- PROPOSED LINTEL
- PROPOSED GSIP
- INDICATIVE FUTURE RAIN GARDEN

HERRING ROAD

LYON PARK RO

EPPING ROAD

CREEK

SHRIMPTONS

FUTURE LOT B1.1

FUTURE DRIVEWAY No.5

FUTURE LOT B1.2

FUTURE DRIVEWAY No.3

FUTURE LOT B2

FUTURE LOT B3

LOT A1

ROAD No.1

FUTURE LOW FLOW BYPASS TO RAIN GARDEN

INDICATIVE FUTURE RAIN GARDEN LOCATION. TO BE CONFIRMED BY LANDSCAPE ARCHITECT

FUTURE LOT A2

ROAD No.2

LOT C1

FUTURE LOT C2

FUTURE LOT C3

ROAD No.3

FUTURE LOT C4

FUTURE DRIVEWAY No.4

FUTURE LOW FLOW BYPASS TO RAIN GARDEN

FUTURE DRIVEWAY No.1

FUTURE DRIVEWAY No.2

FUTURE LOT D2

FUTURE LOT A3

FUTURE LOT D1

FUTURE LOT D3

FUTURE LOT D4

CONCEPT STORMWATER PLAN

SCALE 1:1500

ver.	date	comment	drawn	pm	level information	scale (A3 original size)	notes
C	04.10.18	ISSUED FOR APPROVAL	KT	BM	DATUM: N/A CONTOUR INTERVAL: 1.0m	0 30 60 75m SCALE: 1:1500 (FULL)	

drawing title:

STAGE 1 - CONCEPT STORMWATER PLAN

location: HERRING RD & EPPING RD, MACQUARIE PARK

council: RYDE CITY COUNCIL

dwg ref: 300001(1)-EX-001

client: ASPIRE

adw johnson

central coast office ph: (02) 4305 4300
hunter office ph: (02) 4978 5100
sydney office ph: (02) 8046 7411

www.adwjohnson.com.au

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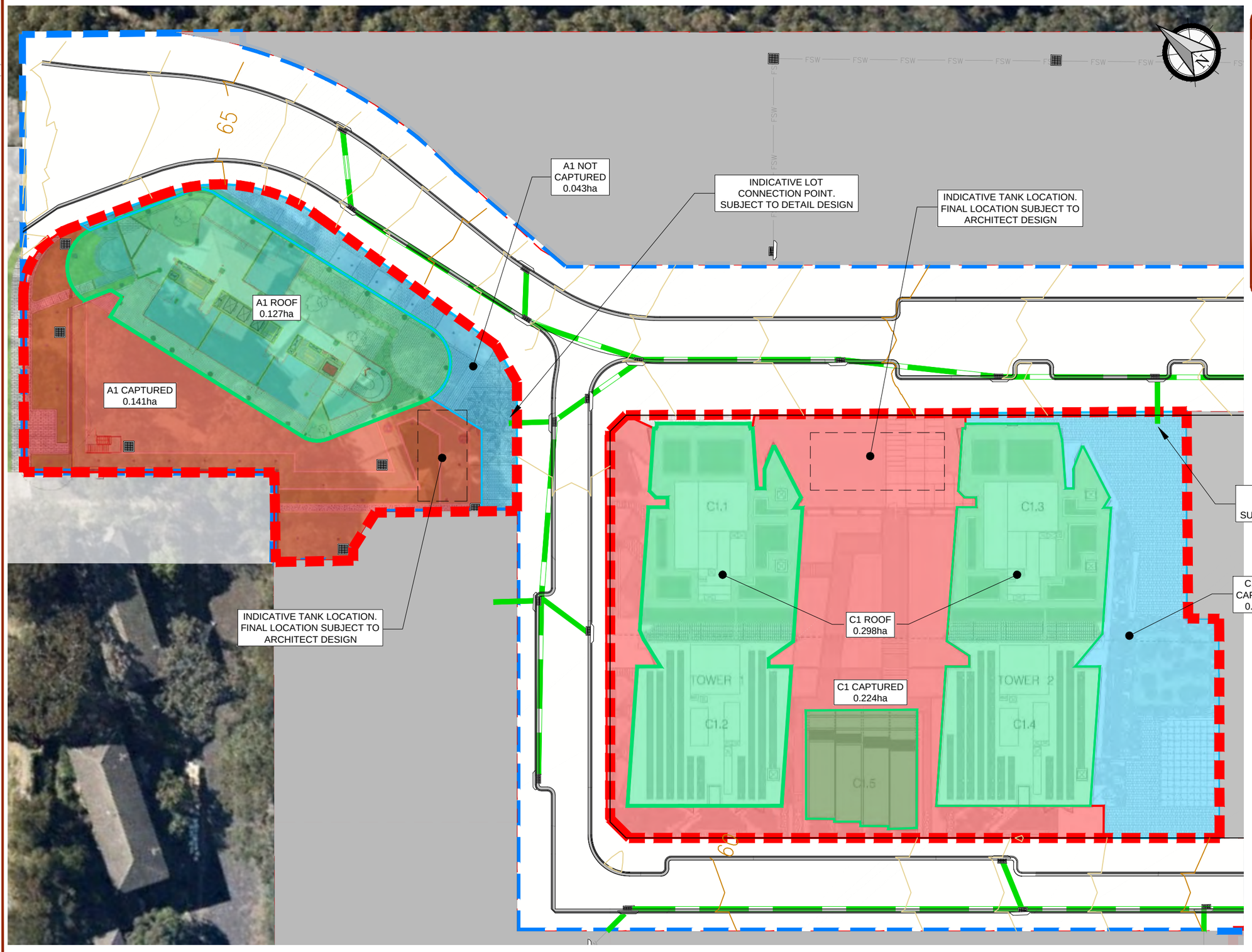

LEGEND

- OVERALL CATCHMENT AREA
- ROOF CATCHMENT AREA
- LOT AREA NOT CAPTURED
- LOT AREA CAPTURED
- INDICATIVE TANK LOCATION
- PROPOSED KERB
- PROPOSED STORMWATER
- PROPOSED LINTEL
- PROPOSED GSIP

NOTE:
1. STORMWATER PITS WITHIN LOTS SHOWN INDICATIVELY ONLY. FINAL LOCATION SUBJECT TO ARCHITECT DESIGN.

ver.	date	comment	drawn	pm	level information	scale (A3 original size)	notes
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drawing title:

STAGE 1 - CATCHMENT PLAN

location: HERRING RD & EPPING RD MACQUARIE PARK

council: RYDE CITY COUNCIL

dwg ref: 300001(1)-EX-002

client: ASPIRE

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sydney office ph: (02) 8046 7411
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300001(1)-EX-002-C

*image source: Nearmap (20/11/2017)

STAGING PLAN

SCALE 1:1500

ver.	date	comment	drawn	pm	level information	scale (A3 original size)	notes
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drawing title:

CONSTRUCTION STAGING

location: HERRING RD & EPPING RD, MACQUARIE PARK

council: RYDE CITY COUNCIL

dwg ref: 300001(1)-EX-003

client: ASPIRE

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• project management • civil engineering • infrastructure • superintendency • economic analysis • social impact • town planning • surveying • development feasibility • visualisation • urban design

300001(1)-EX-003-C

NOTE:
1. DETAILED EROSION AND SEDIMENT CONTROLS PLANS TO BE PROVIDED STAGE BY STAGE.
2. EROSION AND SEDIMENT CONTROLS TO SUIT THE SITE AT TIME OF CONSTRUCTION
3. FURTHER DETAILS AROUND TEMPORARY WORKS TO BE PROVIDED AT CC STAGE.

LEGEND

- SITE BOUNDARY
- STAGE BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- PROPOSED KERB
- PROPOSED STORMWATER
- PROPOSED STORMWATER OUTLET
- SEDIMENT/SILT FENCING
- NO-GO FENCING
- DIVERSION DRAIN
- TEMPORARY SWALE
- STRAWBALES
- GRAVEL/SAND BAGS
- SITE ACCESS/SHAKER RAMP
- TEMPORARY SEDIMENT BASIN

HERRING ROAD
LOT A1
TIE INTO SALES SUITE LEVELS
ROAD No.1
TEMPORARY BASIN
LOT C1
ROAD No.2
TEMPORARY TURNING HEAD
ROAD No.3
TEMPORARY BASIN
FUTURE RAIN GARDEN TO BE USED AS TEMPORARY SEDIMENT BASIN
CREEK
LYON PARK ROAD
SHRIMPTONS
EPPING ROAD
FSW
65
60

STAGE 1A - EROSION AND SEDIMENT CONTROL/TEMPORARY WORKS PLAN

SCALE 1:1500

ver.	date	comment	drawn	pm	level information	scale (A3 original size)	notes
C	04.10.18	ISSUED FOR APPROVAL	KT	BM	DATUM: N/A CONTOUR INTERVAL: N/A	0 30 60 75m SCALE: 1:1500 (FULL)	

drawing title:
STAGE 1A - EROSION & SEDIMENT CONTROL/TEMPORARY WORKS PLAN

location: HERRING RD & EPPING RD, MACQUARIE PARK
council: RYDE CITY COUNCIL
dwg ref: 300001(1)-EX-004
client: ASPIRE

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300001(1)-EX-005-C

NOTE:
1. DETAILED EROSION AND SEDIMENT CONTROLS PLANS TO BE PROVIDED STAGE BY STAGE.
2. EROSION AND SEDIMENT CONTROLS TO SUIT THE SITE AT TIME OF CONSTRUCTION
3. FURTHER DETAILS AROUND TEMPORARY WORKS TO BE PROVIDED AT CC STAGE.

LEGEND

- SITE BOUNDARY
- STAGE BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- PROPOSED KERB
- PROPOSED STORMWATER
- PROPOSED STORMWATER OUTLET
- SEDIMENT/SILT FENCING
- NO-GO FENCING
- DIVERSION DRAIN
- TEMPORARY SWALE
- STRAWBALES
- GRAVEL/SAND BAGS
- SITE ACCESS/SHAKER RAMP
- TEMPORARY SEDIMENT BASIN

HERRING ROAD

LYON PARK ROA

EPPING ROAD

ROAD No.1

ROAD No.2

ROAD No.3

TEMPORARY BASIN

TEMPORARY BASIN

TEMPORARY BASIN

FUTURE RAIN GARDEN TO BE USED AS TEMPORARY SEDIMENT BASIN

CREEK

SHRIMPTONS

FSW

65

60

STAGE 1B - EROSION AND SEDIMENT CONTROL/TEMPORARY WORKS PLAN

SCALE 1:1500

ver.	date	comment	drawn	pm	level information	scale (A3 original size)	notes
C	04.10.18	ISSUED FOR APPROVAL	KT	BM	DATUM: N/A CONTOUR INTERVAL: N/A	0 30 60 75m SCALE: 1:1500 (FULL)	

drawing title:
STAGE 1B - EROSION & SEDIMENT CONTROL/TEMPORARY WORKS PLAN

location: HERRING RD & EPPING RD, MACQUARIE PARK

council: RYDE CITY COUNCIL

dwg ref: 300001(1)-EX-005

client: ASPIRE

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300001(1)-EX-006-C

NOTE:
1. DETAILED EROSION AND SEDIMENT CONTROLS PLANS TO BE PROVIDED STAGE BY STAGE.
2. EROSION AND SEDIMENT CONTROLS TO SUIT THE SITE AT TIME OF CONSTRUCTION
3. FURTHER DETAILS AROUND TEMPORARY WORKS TO BE PROVIDED AT CC STAGE.

LEGEND

- SITE BOUNDARY
- STAGE BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- PROPOSED KERB
- PROPOSED STORMWATER
- PROPOSED STORMWATER OUTLET
- SEDIMENT/SILT FENCING
- NO-GO FENCING
- DIVERSION DRAIN
- TEMPORARY SWALE
- STRAWBALES
- GRAVEL/SAND BAGS
- SITE ACCESS/SHAKER RAMP
- TEMPORARY SEDIMENT BASIN

HERRING ROAD

LYON PARK ROAD

ROAD No.1

ROAD No.2

ROAD No.3

TEMPORARY BASIN

TEMPORARY BASIN

TEMPORARY BASIN

TEMPORARY BASIN

FUTURE RAIN GARDEN TO BE USED AS TEMPORARY SEDIMENT BASIN

CREEK

SHRIMPTONS

EPPING ROAD

FSW

65

60

STAGE 1C - EROSION AND SEDIMENT CONTROL/TEMPORARY WORKS PLAN

SCALE 1:1500

ver.	date	comment	drawn	pm	level information	scale (A3 original size)	notes
C	04.10.18	ISSUED FOR APPROVAL	KT	BM	DATUM: N/A CONTOUR INTERVAL: N/A	0 30 60 75m SCALE: 1:1500 (FULL)	

drawing title:

STAGE 1C - EROSION & SEDIMENT CONTROL/TEMPORARY WORKS PLAN

location: HERRING RD & EPPING RD, MACQUARIE PARK

council: RYDE CITY COUNCIL

dwg ref: 300001(1)-EX-006

client: ASPIRE

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