



Department for Housing and Urban Development

Sellicks Beach Growth Area

STORMWATER MANAGEMENT STRATEGY REPORT

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EXECUTIVE SUMMARY

WGA Engineers were engaged to prepare a Stormwater Management Strategy (SWS) to support a Code Amendment for the future Sellicks Beach Urban Growth Area. The SWS identifies risks, constraints and opportunities to manage stormwater generation from the future urban development and defines a framework to support appropriate strategies to respond to the proposed Structure Plan (2025).

The preparation of this SWS has been through engagement and collaboration with key Government Authorities, site investigation, and Civil Engineering assessment. The following key principles and objectives for the management of stormwater for the Growth Area were identified.

- Management of flood risk and attenuation of urbanised runoff condition to its equivalent current condition case for the major 1%AEP critical storm event.
- Management of urbanised runoff volumes to protect downstream environmental integrity, ecological and cultural values.
- Environmental remediation of degraded waterway corridors to recreate environmental values, improve public safety and amenity and manage flood risk.
- A Strategy with its focus on the protection of downstream receiving environmental and cultural values including Sellicks Creek, coastal waters and the Aldinga Washpool Lagoon.
- Consider climate change and potential risks through resilience in the strategic approach.
- A holistic and optimised design solution that considers constructability, maintenance and community wellbeing.

The SWS addressed the following key themes in the Growth Area:

Urban Hydrology

Urban development inherently changes the hydrological regime through increasing impervious areas, modifying and consolidating flow paths, and results in increased peak flow and volume of runoff discharged from the land. Management of potential flood and environmental risks resulting from changes in land use has been addressed through this stormwater management strategy. The strategy proposes a series of onsite detention storage basins with integrated wetland ponds to attenuate urban stormwater runoff. The detention basins will incorporate an ephemeral wetland within its base. This approach provides environmental value, stormwater treatment, and volume retention to manage major and minor rain event urban runoff.

Creeks and Waterway Corridors

Sellick Creek and the Southern waterways are highly degraded waterways within the subject land. These waterways provide little or no environmental value in their present condition and are a source of sediment load to the coastal waters. Sellicks Creek in particular presents a risk of life and health to both the environment and community in its current condition. As part of future urban development, there are significant opportunities to remediate these waterways to create dedicated biodiversity and blue green corridors, with safe community access for passive recreation, and mitigate continued source of sediment to the coastal waters. This strategy offers a best practice planning approach that will restore these waterways, vest them into dedicated open space corridors and recreate environmental value. This strategy adopts this approach through the adoption of natural waterway design principles while addressing flood risk and creating amenity.

Aldinga Washpool

The Aldinga Washpool lagoon is a highly valued environment of both cultural and ecological significance. It is protected as part of the coastal conservation park managed by the Department of Environment and Water. A catchment specific stormwater management strategy has responded to provide a focus on environmental protection. This strategy provides a viable solution that manages urban runoff to protect the intrinsic values of the Washpool and the systems it supports. The strategy integrates onsite retention through Managed Aquifer Recharge (MAR) to match the urbanised volumetric discharge to current conditions. MAR will also provide an opportunity for the sustainable reuse of this water resource and therefore delivers a multi objective approach to stormwater management. Stormwater treatment will be managed to comply with statutory requirements.

Water Sensitive Urban Design (WSUD)

A water sensitive urban design approach provides a focal point and underpins this strategy. It offers a holistic approach to managing risks and is cognisant of existing environmental values and accordingly offers protection and enhancement. WSUD supports existing ecological, environmental and cultural values and creates new opportunities the planned waterway remediation corridors, wetlands and retention of excess runoff. This strategy delivers a framework to support the Code Amendment; however, further opportunities can be considered as part of the future detailed master planning and design.

Stormwater Management Infrastructure

Infrastructure headworks and upgrades have been identified to facilitate and service the future development at a whole of catchment scale. The external infrastructure upgrades include

- Sellicks Beach Road culvert
- Sellicks Beach Road stormwater drainage network extension
- Culvert upgrades to internal roadways
- Justs Road – roadside swale

These upgrades do not include the functional stormwater infrastructure required within the Development area, such as wetlands, basins and waterway upgrades. A MAR scheme external to the site has been identified as forming part of the stormwater management scheme.

Conclusion

This report is provided to support the Code Amendment and presents a forward thinking and responsive approach to managing the risks associated with stormwater runoff from the future urban development. This SWS provides an opportunity to remediate degraded waterways, address current environmental issues and offers the ability to manage impacts to downstream environmental systems and protects cultural values. Key infrastructure upgrades and headworks have been identified to ensure responsible stormwater management outcomes can be achieved through the Development of the subject area.

1 INTRODUCTION

WGA was engaged by Department of Housing and Urban Development (DHUD), Growth and Infrastructure Coordination Unit (GICU) to prepare a Stormwater Management Strategy (SMS) for the Sellicks Beach Growth Area (SBGA). The SBGA is a part of the South Australian Government plan to deliver serviced residential land to the market to enable the development of more housing to meet the diverse needs of the State's growing population.

The proposed development sites are located at Sellicks Beach and have been identified as a location which will allow a mixture of housing types including affordable residential. The site under investigation is the Sellicks Beach Growth Area (SBGA) that is currently zoned Rural and Deferred Urban with the proposal approved to Initiate a Code Amendment to rezone the area to appropriate zone and policy framework to facilitate a new master planned community e.g. Master Planned Neighbourhood Zone; Suburban Neighbourhood Zone.

The location of the land subject to the Sellicks Beach Growth Area are shown in Figure 1.



Figure 1: Land Location

The stormwater management framework for the site covers key management criteria to support the proposed future development at the SBGA. These include:

- A general approach to stormwater management that aims to define the framework to enable the sites to be developed in the future. This encompasses the following key elements:
 - On site stormwater detention requirements to limit and attenuate off-site discharge.
 - On site stormwater treatment requirements to manage stormwater quality and protection of downstream receiving environments.
 - Flood risk management.
 - Opportunities for Water Sensitive Urban Design (WSUD) and the creation of a biodiversity waterway corridor along Sellicks Creek and other waterways.
 - Restoration of the highly degraded Sellicks Creek.
 - Protection to Sellicks Creek and other waterways and the receiving environmental values.
 - Adoption of a risk-based approach to avoid downstream impact to sensitive receiving environments, including the Aldinga Washpool and Sellicks Beach.

The SWS has been developed in parallel with the structure plan, through an integrated process including a broad range of consultation and engagement. The SMS and structure plan which forms a basis for the Code Amendment and an associated Infrastructure Scheme for the SBGA and adjoining areas to effectively and efficiently manage stormwater.

2 EXISTING INFORMATION

2.1 Existing Sites

2.1.1 Site Location and Area

The site is located 50kms south of Adelaide CBD, adjacent the coast and in proximity to the McLaren Vale region. The total area of the proposed land development is approximately 134ha in area.

The site can be divided into two primary catchments. The site to the north of Sellicks Beach Road on Justs Road grading to the north-west and to the coast via the Aldinga Washpool site. The site to the south of Sellicks Beach Road grades north-west to Sellicks Creek prior to discharge to the coast. This site is further broken down into further sub-catchments and local waterways.

Within this report, the two primary catchments are referred to as:

- Justs Road Catchment (JRC): Site area north of Sellicks Beach Road
- Sellicks Creek Catchment (SCC): Site area south of Sellicks Beach Road

Justs Road Catchment (JRC)

The JRC existing site condition consists of horticultural land use (olive orchard and vineyards) and open grass lands. The land falls in a north westerly direction at an average gradient of approximately 6%.

Sellicks Creek Catchment (SCC) including Southern Creeks (SCK)

Sellicks Creek flows through the northern portion of the site area within SCC land area. There are multiple smaller local waterways that traverse the southern portion of the land which create secondary sub-catchments and are referred to as the Southern Creeks (SCK). The Southern Creeks intersect prior to the north-western corner of the site boundary and flow along an existing drainage reserve through a residential area prior to discharging into Sellicks Creek, and the downstream remediated biodiversity corridor of Sellicks Creek.

Sellicks Creek Catchment and will drain into Sellicks Creek which flows west to the Gulf of St Vincent. Downstream of Sellicks Beach Road/Lurline Boulevard, Sellicks Creek has been environmentally remediated to feature a biodiversity corridor comprising of wetland ponds, rock chutes and trails. This length of creek was formally a highly degraded gully, which was remediated by the City of Onkaparinga in stages from 2006 to 2009.

Through the site area Sellicks Creek is highly degraded, in poor condition and severely eroded featuring a degraded gully measuring up to 8m deep x 15m wide. Sellicks Creek is actively eroding and presents a significant source of sediment to the downstream receiving environment. There have been efforts made by the land holder to revegetate the land adjacent to the creek gully to create a buffer. The creek is currently fenced to prevent animals falling into the gully.

The Southern Creeks exhibit some erosion in the upper reaches, however, due to flattening grade at the lower portion of the land they are somewhat undefined resulting in overland flow, shallow floodplains and braided creek. Part of this land is subject to an existing flood risk overlay. There are also pockets of remnant vegetation and habitat that could be considered for protection where possible.

The site consists of horticultural land use (predominately olive orchards) and open grass land. The site falls in a north westerly direction at an average gradient of approximately 6 to 8% to Sellicks Creek and 4 to 5% to the Southern Creeks.

Overall, the site is located amongst existing urban development (residential) both upstream of Justs Road and downstream of both catchments. The sites are located close to the coastal outfalls, and further to this the Justs Road catchment currently drains Northwest to Justs Road and out to the coastal Aldinga Washpool wetland area, which is a protected and highly valued for its cultural heritage and environmental value. The Southern Creeks consists of several minor waterways and overland flow paths at the southern portion of the site. These all drain to the north-west corner and along the existing drainage corridor into Sellicks Creek, just upstream of Sellicks Creek Road, and the downstream remediated biodiversity corridor of Sellicks Creek. Refer to Figure 2 and Figure 3 for aerial imagery for the site and indicating the existing stormwater networks and drainage corridors. For a more detailed existing infrastructure plan refer to Appendix A.



Figure 2: Site Aerial Imagery – Justs Road Catchment (JRC)

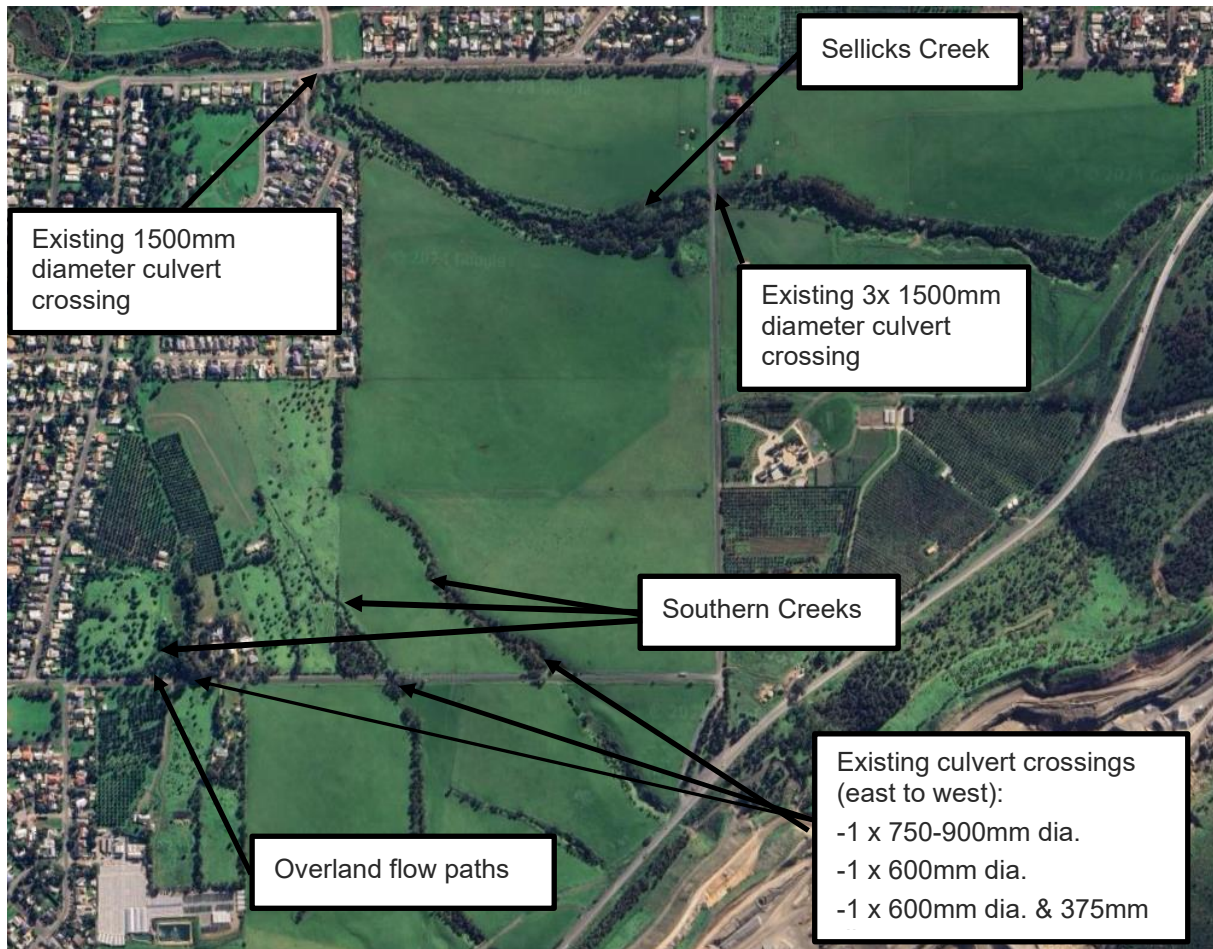


Figure 3: Site Aerial Imagery – Sellicks Creek Catchment (SCC) Including Southern Creeks (SCK)

2.1.2 Existing Site Infrastructure

Council's stormwater assets plan indicates limited stormwater infrastructure within the project boundary. Stormwater is conveyed overland and/or through the Sellicks Creek watercourse and Southern Creeks. Existing infrastructure in the vicinity of the proposed development includes:

- Sellicks Beach Road – stormwater drainage, roadside swale, and driveway culverts.
- Existing culvert crossing under Sellicks Beach Road.
- Culvert crossing and drop structure Sellicks Creek under Country Road.
- Existing 525mm diameter stormwater drain discharging to a swale in Justs Road (western road reserve).
- Driveway culverts along Justs Road drainage swale (eastern road reserve).
- Road culvert crossings on Gulf View Road.
- Existing retarding basins Greenoch Street to the north of the (Justs Road catchment).

Refer to Appendix A for a copy of Council GIS and collated information from discussion with Council and Department for Infrastructure and Transport (DIT).

2.1.3 Site Runoff Coefficient

WGA has calculated the coefficient of runoff for each site using conventional methods and the (DIT) Rational Method. A coefficient of runoff of the predeveloped condition for a 1% AEP event is estimated at 0.15 - 0.2 based on consideration of largely open space, horticultural uses, and land gradient. We have adopted this range of values as it also represents a conservative lower bound value given that the sites have a consistent 5 to 8% gradient.

2.1.4 Site Inspection

WGA undertook a site inspection on 4 October 2024 with representatives from GICU and Council. The inspection identified the key stormwater aspects of the site (i.e. existing drainage infrastructure, waterways and site conditions) and consider existing or potential risks in regard to stormwater management.

Key findings from the inspections are outlined below and have been considered in the development of the SMS.

Justs Road Catchment

- There is an existing open space area that integrates a detention basin, located in the north-east corner of the development area. This basin is servicing the existing upstream residential catchment (developed). Outflows from the basin appear to be overland in the north-west direction across existing farmland, however, overflow may enter the development site, therefore, an allowance for overland flow from the basin should be considered within the proposed structure plan. This would be located on the northern boundary of the Justs Road site.
- The existing site grading confirms that stormwater will runoff to the north-west corner of the site towards Justs Road and then ultimately to the Aldinga Washpool. It is acknowledged that there are constraints on discharges to the Aldinga Washpool due to cultural and environmental concerns.

Sellicks Creek Catchment

- Stormwater drainage in Sellicks Beach Road includes a roadside swale and below ground drainage servicing the length west of the Justs Road intersection. There is sufficient space within the road reserve to formalise drainage further if required.
- Sellicks Creek is significantly eroded up to 8m deep on the western side of Country Road (within the site boundary), there is also significant established vegetation within the channel most of which is exotic/non-natives. The state of the creek is noted as a key risk for the project and management/remediation of the creek a priority in the development of the SMS.
- There is notably less erosion of Sellicks Creek upstream of Country Road.
- Sellicks Creek directly upstream of Sellicks Creek Road/ Bluewater Boulevard is highly eroded and fenced off to protect public safety. This reach of the creek is outside of the project boundary, but upstream of the previously remediated channel. It is noted that any works within the site boundary will need to consider a transition into this reach, and it was also raised that this reach may be able to be integrated into the development if a suitable mutually beneficial outcome is achieved (i.e. use in flood detention storage or water quality management).

Southern Creeks Sub-catchment

- Two creeks cross Gulf View Road, these creeks are eroded directly downstream of the road crossing. Native vegetation is present along the creek corridor. Upstream of Gulf View Road the creeks have less erosion and are approximately 2m deep.
- North of Gulf View Road near the west boundary is low lying, flat and results in a braided waterway system. This appears to have historically been a flood plain.

2.2 Existing Vegetation

A vegetation survey has been undertaken by Umwelt (31560_R01_Sellicks_EcoReprot_V3, April 2025) to map the location and classification of existing vegetation across the site. The drainage strategy has considered the presence of existing vegetation and recommends sympathetic design approaches, where possible, to retain existing native vegetation or areas that are considered ecologically important habitat. It is envisaged that retention of vegetation may be achievable where it forms part of the wider waterway corridor. It is noted, however, that some vegetation will be impacted and may need to be offset. This will be managed as part of the environmental management strategy in future stages of the development.

2.3 Cultural Heritage

Consideration for environmental and cultural significance is an important element underpinning the principles for the strategy. It is understood there are significant cultural values associated with site located around the existing waterways, and at the downstream receiving water of the Aldinga Washpool. As part of the consultation process WGA has provided details of the concepts proposed to the GICU to engage with the Cultural Heritage advisors for the site. This is further discussed in Section 3.

2.4 Proposed Development

The Code Amendment will enable urban development comprising an estimated 1700 allotments with connected open spaces to be accommodated on the site. Whilst this is the expressed development outcome, the Code Amendment process does not represent a development application and is simply the process to change the zoning of the land. The use of the land as described is consistent with the current deferred urban zoning and lies within the 30-year urban growth boundary.

The indicative Draft Structure Plan is provided in Figure 4. This plan has been developed collaboratively with the SMS and represents the plan to support this document. The plan features open spaces and particularly with a focus on connected waterway corridors which offers the opportunity to preserve waterways and remediate them to create biodiversity corridors, allocated space for combined stormwater treatment, retention and detention basins and WSUD streetscape corridors.



Figure 4: Indicative Draft Structure Plan

2.5 Stakeholder Engagement

Stakeholder Engagement has been undertaken as part of the development of the SMS.

An initial Stakeholder Engagement workshop was held on the 10 October with City of Onkaparinga (CoO), Department for Environment and Water (DEW), GICU and the Urban Design team (Hansen Partnership).

The purpose of the workshop was to engage with key stakeholder and authorities to:

- Gain an understanding of local knowledge and feedback on the proposed development.
- Define risks, constraints, opportunities.
- Define objectives and parameters to inform the overarching framework for stormwater management.

The key points raised and items for consideration within the plan include:

- Key Risks:
 - Volume discharge and retention
 - Public Safety
 - Protection of the Washpool
 - Creek Restoration
 - Climate Change
 - Retention of character, culture and environment
- Key Opportunities:
 - WSUD
 - MAR and stormwater harvesting
 - Open spaces to provide co-benefit
 - Urban Design – protection of interface to existing residential

WGA also participated in the Urban Design team led project workshop which was attended by a wider range of stakeholders and agencies, the Sellicks Beach Growth Area Structure Plan Workshop on 12 November 2024.

The EPA were provided the initial frameworks for review and comment during the consultation phase

In this response the EPA confirmed in-principle:

- Support for the rehabilitation and bank stabilisation works along Sellick Creek to reduce erosion.
- Un-supportive of on-line basin structures due as a natural watercourse. Treatment of stormwater should be treated prior to discharge to the creek, in accordance with the stormwater quality treatment requirement.
- Clear definition of the function and contributing catchment to basins and wetlands.

This feedback has been integrated into the development of the framework.

Additional engagement between WGA, DEW and CoO (Council) occurred throughout the development of the strategy, along with input from engagement with other stakeholders that was led by GICU and is summarised in Table 1.

A key component of the additional consultation was engaging with DEW and Council to agree and determine a reasonable and practical stormwater management strategy for the Justs Road catchment that discharges to the Aldinga Washpool. The cultural and environmental sensitivity of the Aldinga Washpool requires a solution that considers and manages the increased peak flow, water quality and increased urban runoff volumes from the site. WGA in collaboration with the stakeholders undertook a number of workshops and technical reviews to develop a suitable strategy. These investigations included high-level concept development of a number of alternate stormwater management options, including use of land within the Aldinga Washpool to create a wetland through revegetation with native species to naturally treat, store, infiltration and evaporate pre-treated stormwater, diversion of stormwater to alternate Council outfalls bypassing the Washpool, diversion to Sellicks Creek and Managed Aquifer Recharge (MAR). The investigations and outcomes are further discussed in Section 3.4.

Table 1: Stakeholder Consultation

CONSULTATION	STAKEHOLDERS	DATE	KEY POINTS/OUTCOME
Initial Consultation Workshop led by WGA	GICU, DEW, CoO, Urban Design Team, WGA	10 October 2024	As above
Follow-up discussion DEW (Washpool) led by GICU and presentation of an alternate stormwater management option (wetland and infiltration)	GICU, DEW, WGA	4 November 2024	GICU initiated a workshop with DEW to discuss stormwater management solutions for urban stormwater discharging to the Washpool. This included the potential opportunity to use land within the Aldinga Conservation Park for management of stormwater volume, as identified during the initial consultation workshop. WGA presented an investigation into the use of the Aldinga Conservation Park, to create a wetland through revegetation with native species to naturally treat, store, infiltration and evaporate pre-treated stormwater. This concept was backed by preliminary modelling and considered water quality, water balancing and cultural and ecological values. Further consultation and review by DEW confirmed that this option was not supported.
Meeting with Council to workshop alternate discharge locations Justs Road led by WGA	CoO, GICU, WGA	December 2024 January 2025 February 2025	The workshop considered alternate options for the diversion and/or management of increased urban runoff volume from the Justs Road site. The options considered included, diversion of flows to alternate council drainage outfalls, diversion or pumping to Sellicks Creek and Managed Aquifer Recharge (MAR scheme), for onsite retention

CONSULTATION	STAKEHOLDERS	DATE	KEY POINTS/OUTCOME
			WGA reviewed and collated a summary of the risks and opportunities for each of the options investigated. Council reviewed and provided feedback on options. When considerations of all risks, constraints and opportunities (such as added environmental and sustainability outcomes) were addressed, Option 3 (MAR Scheme) was considered the option to proceed for further investigation.
Follow-up discussion with DEW on Washpool discharge constraints and alternate options led by WGA	DEW, GICU, WGA	February 2025	Further discussion was undertaken to seek in-principal feedback from DEW on the alternate options investigation undertaken with Council, as outlined above. DEW reviewed and provided feedback on all options and key considerations that should be addressed in regard to Option 3 MAR scheme.
Meeting with DEW to discuss the MAR scheme proposal for the Justs Road discharge	DEW, GICU, WGA, CoO	29 April 2025	This meeting allowed for engagement with DEW to understand the key risks, constraints and guiding principles to be considered in the proposal for a MAR scheme to manage stormwater and provide onsite retention. WGA presented further details and design scenario analysis for a MAR scheme, including water balance, seasonality, water quality and storage sizing to develop a concept that is reasonable and practical and comply with the objectives. DEW and WGA also reviewed the risks and additional investigations that would be needed as part of future feasibility assessments in regard to the construction and operation of a MAR scheme, including site investigations, water quality requirements, approvals and operational considerations.

Further details and correspondence have been documented in internal Technical Memorandums as part of the project consultation requirements.

2.6 Risk and Opportunities

A preliminary register was provided to document risks that have been discussed at the project inception meeting, from inspection of the site and through the stakeholder engagement process.

The risk register considers two types of risk:

- Project Delivery Risks - risks impacting delivery of the strategy i.e. lack of information, unresolved issues, items requiring external input or agreement.
- Design Risk- risks that need to be addressed within the strategy – technical risks relating to the site, to be address in design solutions.

This risk register is provided in Appendix B.

2.7 Stormwater Management Requirements

Following our risk and opportunities identification and stakeholder engagement process, the initial framework was reviewed and updated to integrate the feedback and determine the stormwater management requirements.

2.7.1 Authority Requirements

2.7.1.1 Council (City of Onkaparinga)

- The peak post-development 1% AEP (100yr ARI) discharge rate must not exceed the peak pre-development 1% AEP (100 Year ARI) discharge rate.
- The peak flows for the 4EY (3month ARI) and 1EY (one year ARI) events are to be mitigated to pre-development flows rate.
- On site stormwater treatment shall comply with the WSUD pollutant reduction targets as follows:
 - Total Suspended Solids (TSS) 80%
 - Total Phosphorus (TP) 60%
 - Total Nitrogen (TN) 45%
 - Gross Pollutants (GP) 90%

The adoption of WSUD principles and techniques, where can be practically achieved.

2.7.1.2 Department of Environment and Water (DEW)

- Post-development flow volume leaving the site must not be below pre-development flow volume leaving the site (Western Mount Lofty Ranges WAP requirement).
- Additional water to the Aldinga Washpool is not desirable, due to environmental and cultural significance.
- Seek to achieve no increase volume discharging to the Washpool, as a result of future urban development.
- Pre-development run-off based on the average annual rainfall used in the calculations in the WMLR WAP. As advised by DEW this is 530mm rainfall with a runoff coefficient of 0.03. This is an equivalent average annual volume discharge to the Washpool of 4.8ML.

2.7.1.3 Environmental Protection Agency (EPA)

For the purposes of defining the requirements for stormwater management, WGA utilised the following references and approach:

- Adoption of risk-based approach to manage stormwater to avoid harm to the environmentally high value receiving waters downstream from the Sites. This is consistent with ANZECC Guidelines (2000) for the protection of receiving fresh and marine waters, and environments.
- Utilising the local knowledge based on recent development undertaken in the region to appreciate its local attributes, sensitivities, and environmental values.
- The EPA adopts the framework and principles associated with the ANZECC Guidelines for stormwater quality, with a focus on a risk-based approach to minimise harm/impacts to receiving waters. EPA also adopts a WSUD management approach which essentially defines their requirements, which relate to management of both stormwater quantity and quality.
- The EPA's minimum requirements are as follows:
 - Run-off rates should not exceed the rate of discharge from the site that existed pre-development.
 - Water quality treatment reduction targets of the typical urban average annual load as follows.
 - Total Suspended Solids (TSS) 80%.
 - Total Phosphorus (TP) 60%.
 - Total Nitrogen (TN) 45%.
 - Retention of litter greater than 50mm for flows up to a three-month Average Recurrence Interval (ARI) peak flow.
 - No visible oils for flows up to a three-month ARI peak flow.

2.7.2 Reference and Guiding Principles

This stormwater management report is developed to encompass the principles in accordance with the following recognised references:

- Australian Rainfall and Runoff (2019)
- EPA Environment Protection Act (1993)
- Australian and New Zealand Environment and Conservation Council (ANZECC, 2000)
- City of Onkaparinga Stormwater Management Design Guide (November 2019)
- WSUD Engineering Procedures – Stormwater, Melbourne Water (2005)
- Australian Runoff Quality, Engineers Australia (2006)
- Water Sensitive Urban Design - Greater Adelaide Region Technical Manual (Dec 2010)
- South Australian MUSIC Modelling Guidelines (February 2021)

These handbooks and guidelines are considered as Australian and South Australian standards and cover all aspects of stormwater management. This includes the design for major and minor storm flow, and stormwater quality improvement. This report adopts the design standards, principles and practices covered by the handbooks.

The stormwater management framework was distributed to all stakeholders. The final agreed framework, and the basis for the strategy is outlined in Table 2.

Table 2: Stormwater Management Framework

	JUSTS ROAD CATCHMENT	SELICKS CREEK CATCHMENT
Stormwater attenuation (detention) requirements: Peak Flow	The peak post-development 1% AEP (100yr ARI) discharge rate must not exceed the peak pre-development 1% AEP (100 Year ARI) discharge rate. The peak flows for the 4EY (3month ARI) and 1EY (1 year ARI) events are to be mitigated to predevelopment flows.	The peak post-development 1% AEP (100yr ARI) discharge rate must not exceed the peak pre-development 1% AEP (100 Year ARI) discharge rate. The peak flows for the 4EY (3month ARI) and 1EY (1 year ARI) events are to be mitigated to predevelopment flows.
Stormwater attenuation (detention) requirements: Flow Volume	Post-development flow volume leaving the site must not be below pre-development flow volume leaving the site (Western Mount Lofty Ranges WAP requirement). Additional water to the Aldinga Washpool is not desirable, due to environmental and cultural significance. Department for Environment and Water (DEW) recommend a target of no increase in flow volume to the Washpool.	Post-development flow volume leaving the site must not be below pre-development flow volume leaving the site (Western Mount Lofty Ranges WAP requirement).
Online verses offline stormwater management	Online basin proposed due to site size and layout.	Preference for centralised design rather than multiple smaller basins that are harder to maintain. Basins are typically offline due to the large upstream catchment and to allow for water quality treatment prior to discharge to the waterway. A holistic and optimised design solution to be presented that considers constructability, maintenance and amenity value.
Stormwater treatment requirements	On site stormwater treatment shall comply with the WSUD pollutant reduction targets as follows: • Total Suspended Solids (TSS) 80% • Total Phosphorus (TP) 60% • Total Nitrogen (TN) 45% • Gross Pollutants (GP) 90% • Retention of litter greater than 50mm for flows up to a 3-month Average Recurrence Interval (ARI) peak flow • No visible oils for flows up to a 3-month ARI peak flow The adoption of WSUD principles and techniques, where can be practically achieved.	On site stormwater treatment shall comply with the WSUD pollutant reduction targets as follows: • Total Suspended Solids (TSS) 80% • Total Phosphorus (TP) 60% • Total Nitrogen (TN) 45% • Gross Pollutants (GP) 90% • Retention of litter greater than 50mm for flows up to a 3-month Average Recurrence Interval (ARI) peak flow • No visible oils for flows up to a 3-month ARI peak flow The adoption of WSUD principles and techniques, where can be practically achieved.

	JUSTS ROAD CATCHMENT	SELICKS CREEK CATCHMENT
Waterway management	N/A	All existing waterways/overland flow paths to be preserved and remediated and will form part of connected open space corridors. Sellicks Creek is highly degraded waterway and presents a high risk to the community and environment. The development will see the creek remediated to form a safe and sustainable connected corridor featuring a restored waterway environment. Discharge into waterways shall: • Prevent erosion and scour. • Be treated using stormwater treatment systems that comply with EPA requirements meeting pollutant reduction targets. • Adopt the framework and principles from ANZECC guidelines to address risk and environmental harm. • Sellicks Creek to be remediated utilising naturalistic waterway design principles to create a sustainable biodiversity waterway corridor. Consideration for environmental and cultural significance and sensitivity along the waterway corridors, particularly with regard to existing regulated and significant trees. Management of the existing floodplain and low-lying waterway corridors (southern waterways).
WSUD and integrated water management	The adoption of WSUD principles and techniques is encouraged. Opportunities for both diffuse and end-of-line initiative (i.e. Wetlands and streetscape WSUD). Consider integrated water management opportunities, such as MAR integrating stormwater harvesting. Stormwater management and assets to consider co-benefits (amenity, habitat, environment).	The adoption of WSUD principles and techniques is encouraged. Opportunities for both diffuse and end-of-line initiative (i.e. Wetlands and streetscape WSUD). Consider integrated water management opportunities. (MAR or stormwater harvesting). Currently there is limited reuse opportunities within the development, however, if future opportunities present this could be considered. Stormwater management and assets to consider co-benefits (amenity, habitat, environment).

	JUSTS ROAD CATCHMENT	SELICKS CREEK CATCHMENT
Climate resilience	Undertake a climate change sensitivity assessment considering a 'climate risk envelope', to assess the potential impacts from climate change on future upgrade/enhancements on both existing and new stormwater infrastructure assets. Consider climate change impacts in the stormwater response to provide climate resilience, i.e. support urban canopy cover, urban cooling, reduce impacts of erosion/sediment transfer, flood management.	Undertake a climate change sensitivity assessment considering a 'climate risk envelope', to assess the potential impacts from climate change on waterway corridors and future upgrade/enhancements on both existing and new stormwater infrastructure assets. Consider climate change impacts in the stormwater response to provide climate resilience, i.e. support urban canopy cover, urban cooling, reduce impacts of erosion/sediment transfer, flood management.
Management of environmental constraints with respect to stormwater management	Consideration for environmental and cultural significance, including: • Cultural heritage reports • Native vegetation survey Protection of the downstream receiving waters (coastal environment), through design solutions integrating erosion controls to manage sediment and reduce flow volumes. Protection of the Aldinga Washpool through management of stormwater discharge.	Consideration for environmental and cultural significance and sensitivity along the waterway corridors, including: • Cultural heritage reports • Native vegetation survey Protection of the downstream receiving waters (coastal environment), through design solutions integrating erosion controls to manage sediment and reduce flow volumes.
Risk Management	<i>Restrictions on discharge to the Aldinga Washpool is a key risk in the management of stormwater from this catchment.</i>	<i>Sellick's Creek is severely degraded this is a continuous source of sediment, and also a safety risk due to the eroded banks. This is a key design risk due to potential complexity linked to environmental, cultural and social connections to the creek.</i>
	<i>Sediment Management during construction must be carefully considered and addressed. The risk of sediment to both downstream receiving waters and potential impacts to the established waterbodies (wetlands, storages, MAR and WSUD elements) must be managed.</i>	<i>Sediment Management during construction must be carefully considered and addressed. The risk of sediment to both downstream receiving waters and potential impacts to the established waterbodies (wetlands, storages and WSUD elements) must be managed.</i>

3 STORMWATER MANAGEMENT

3.1 Internal Stormwater Management

The future urban land-use will alter the rainfall and runoff regimes within the development site area. The implementation of stormwater management infrastructure will be required to manage the changing site conditions and protect the downstream receiving waters.

The proposed internal stormwater management techniques include:

- On site detention basins to manage and attenuate urban peak flow rates.
- On site retention basins for to manage increased minor flow rate and flow volume.
- Onsite retention basin integrating MAR for management of site stormwater runoff rate and volume – Justs Road catchment only.
- Waterway design to provide flood protection and hydraulic capacity.

An overview of the design philosophy is provided below and further detailed in Sections 3.2-3.4.

Onsite Detention

The future urban development will utilise stormwater detention basins to ensure discharge in a 1% AEP post-development storm is restricted to the flows from a pre-development 1% AEP storm from each sub catchment. The excess stormwater runoff will need to be attenuated on site using several detention storage basins located to suit each sub catchment within the parcels of land. Flow estimates were undertaken for the pre and post development scenarios using several methods for comparison and illustration. The most critical approach that yields the highest storage volume was generally adopted.

Detention basins are located:

- Offline to the side of Sellicks Creek (outside the channel)
- Online at the confluence of the minor streams along the Southern waterways

The detailed design of the detention basin will accommodate two stage discharge controls to allow detention of the minor frequent flow events and major storm events. For the basis of the Code Amendment the detention basin size to manage major peak flows has been documented as the larger footprint and basin volume, as this will determine the land area required and inform costing.

These options are by no means considered to be definitive strategies for each site and instead aim to demonstrate feasible solutions/options for future detailed design development.

Refer to Section 3.2 and 3.3 for design and Appendix C for the sub-catchment plan and calculation.

Onsite Retention

On site retention is proposed to manage flow volume increase attributed to the urban land use change from rural to urban. On site retention will manage frequent minor storm events and is sized to retain the first 15mm of rainfall. This will offset the potential increase in volume discharged due to the increased impervious fraction, comparable to the permeable rural nature of the undeveloped site. This has been adopted for Sellicks Beach and Southern Creeks Catchments.

Onsite retention for the Justs Road catchment will be the primary form of stormwater management. This is due to the constraints on urban discharge to the downstream Aldinga Washpool. The proposal for the Just Rad Catchment is outlined separately in Section 3.4.2.

Waterway Design

In addition to peak flow management, there is a need for upgrade and environmental remediation of the waterways through the site to manage the conveyance of stormwater through the proposed development. Waterways are designed to manage the peak 1% AEP peak flow from the upstream catchments.

3.2 Catchment Hydrology

3.2.1 Upstream Catchment Hydrology

There is no significant upstream catchment influencing the JRC. There are existing detention basins servicing the urban development to the east, and these discharge to the south-west bypassing the site or flowing along the southern boundary. There is no allowance for upstream catchment flows into the JRC stormwater management system.

There are rural upstream catchments that flow through the SCC and SCk catchment site areas. An understanding of the existing upstream catchment flows is needed to determine the channel design and waterway corridors.

Sellicks Creek and Southern Creeks

The total area of the upstream Sellicks Creek catchment is 370ha. The southern waterways upstream catchment area of 150ha. The catchments are rural in nature, with steep slopes in the upper regions before flattening to approximately 6 to 8% on the western side of Main South Road.

Three methods were used to estimate the 1% Annual Exceedance Probability (AEP) flow rate:

- RORB Modelling
- DIT Rational Method
- DRAINS Modelling

Additionally, the Regional Flood Frequency Estimation (RFFE) tool has been considered for comparison. The results are summarised in Table 3A and Table 3B and detailed calculations and assumptions are provided in Appendix C.

Table 3A: Sellicks Creek and Southern Waterways 1% AEP Flow Estimates for Various Methods

Method	1% AEP PEAK FLOW (m ³ /s)		
	Sellicks Creek	Southern Waterway Upper	Southern Waterway Lower
RORB Analysis	15.08	4.90	1.83
DIT Rational Method*	14.59	8.0**	3.67**
DRAINS Modelling	8.42	4.37	1.99
RFFE#	0.44 - 6.26 (mean = 1.71)		0.06 - 0.88 (mean = 0.24)

*C value 1% AEP factor applied was the 1.2 (see spreadsheet)

RFFE lower and upper are for the lower confidence limit (5%) and upper confidence limit (95%) respectively.

** DIT Rational method flows considered an outlier for the Southern Creeks and excluded based on engineering review.

RFFE results for mean peak flows were excluded as they are considered too low.

The results outlined in Table 3A were reviewed to consider the best-fit assumptions on upstream catchment flows to inform the design assumptions. As outlined in Table 3B, significant outliers have been excluded, and conservatively the upper bound values have been used in the determination of peak flows for the channel and culvert design.

Table 3B: Sellicks Creek and Southern Waterways 1% AEP Flow Assumption

Method	1% AEP PEAK FLOW (m³/s)		
	Sellicks Creek	Southern Waterway Upper	Southern Waterway Lower
Channels and culverts design (upper bound)	15.08	4.90	1.99
	RORB Analysis	RORB Analysis	DRAINS

3.2.2 Internal Catchment Hydrology - Pre-development Runoff

The pre-development runoff assumptions for the project area are based on the existing condition. The land use across the project area currently are open space, horticultural uses, and varying land gradient. The pre-development catchment assumptions are summarised in Table 4 for each of the internal sub-catchments (refer Appendix C). The time of concentration has been calculated using the kinematic wave equation for overland travel time.

Table 4: Pre-development Catchment Assumptions – Internal Sub-catchments

SITE AREA	TYPICAL SLOPE	TC	AREA (ha)	% PAVED	% SUPPLEMENTARY	% PERVIOUS
A	6.5 %	42	30.5	0%	0%	100%
B1	4.4 %	52	28	0%	0%	100%
B2	3.6 %	44	16	0%	0%	100%
B3	9.0 %	26	13	0%	0%	100%
C1	4.2 %	34	8	0%	0%	100%
C2	4.0 %	61	29	0%	0%	100%
C3	6.2 %	25	10	0%	0%	100%

3.2.3 Internal Catchment Hydrology - Post-development Flows

The post-development flows are based on the understanding of urban densities and the land uses outlined within the proposed Structure Plan. The key land uses within the Structure Plan influencing runoff rate are:

- Residential Land
- Commercial/Mixed Use (Town Centre)
- Open Space

Table 5 below outlines the catchment parameters used across the development area for these land uses. These have been used in the hydrological model (DRAINS) proportionate to the land use area. These assumptions align with DIT Master specification RK DK-D1 Road Drainage Design Table 8-1, based on the proposed lot size as provided by the GICU.

Table 5: Surface Parameter Assumptions

LAND USE	DETAILS	% PAVED	% SUPPLEMENTARY	% PERVIOUS
Residential Land typical (Lot size – 300 - 500m²)	Residential zones	70%	10%	20%
Retail/Mixed use	Activity Centre	90%	0%	10%
Open Space	Waterway corridors, parks, reserves, basins and wetlands	0%	5%	95%

3.2.4 Summary of Pre to Post-development Peak Flows

The pre and post-development assumptions were applied to the DRAINS model to generate comparable 1% AEP pre-development and post-development flows are summarised in Table 6.

Table 6: Pre to Post-development Peak Flows

CATCHMENT	AREA	1% AEP PRE-DEVELOPMENT (m ³ /s)	1% AEP POST-DEVELOPMENT (m ³ /s)
A*	30.5	<i>Justs Road Catchment is excluded and has been design based on onsite retention requirements.</i>	
B1	28	0.59	4.42
B2	16	0.76	2.77
B3	13	0.40	2.28
C1	8	0.28	1.34
C2	29	0.74	4.78
C3	10	0.40	1.75

The results of the DRAIN modelling have been compared to rational method calculations to provide a comparable method of assessment. The most critical approach that yields the highest storage volume was generally adopted. A full breakdown of assumptions, and comparable rational method calculations is provided Appendix C.

3.3 On Site Detention Requirements

Due to the need to restrict outflows from the site to a 1% AEP pre-development flow, it will be necessary to incorporate a detention storage into the on-site stormwater management systems for each sub-catchment. The detention storage will be provided using a storage basin located within the site designed to retain up to the major 1% AEP event. A high-level detention assessment was undertaken based on the flow estimates obtained in Section 3.1. The site detention storage requirement varies depending on the calculation method adopted, however the most critical result was adopted for each site. The detention basin storage requirements are summarised in Table 7.

Table 7: Stormwater Detention Storage Volumes

SITE	BASIN LOCATION AND VOLUME (m ³)		
A - Justs Road Catchment	Basin A	N/A	<i>Justs Road Catchment is excluded and has been design based on onsite retention requirements – Refer to Section 3.4.</i>
B – Sellicks Creek Catchment	Basin B1	10,100	Basins 2, 3 and 4 are located offline from the Sellicks Creek channel.
	Basin B2	4,500	
	Basin B3	3,900	
C – Southern Creeks	Basin C1	4,250	Basins 5 and 6 are located online within the southern creeks waterway corridors.
	Basin C2	15,350	

Refer to Appendix E Stormwater Management Strategy for the locations of each detention basin.

3.4 Onsite Retention

3.4.1 Management of Minor Frequent Flows and Onsite Retention

The basins will be designed to accommodate a combination of onsite retention and two stage discharge controls to facilitate detention and retention of the minor storm event (to manage peak flows for the 4EY (three month ARI) and 1EY (one year ARI) events to their equivalent pre-development runoff rate). Given the rural nature of the site currently, it is expected that runoff will be minor from the catchment during frequent minor rainfall events.

To manage the increase in frequent event runoff from the catchment that will result from the urban development, it is proposed to provide onsite retention resulting from a 15mm rain event from the urban catchment. This runoff volume is proposed to be retained (without discharge) within wetlands that will be integrated within the base/footprint of the proposed major flow detention basins. The retention wetland component will be unlined with no low-flow discharge, it will provide retention prior to evaporation and infiltration and will also support WSUD and water quality improvement.

The required wetland storage based on 15mm retention is outlined in Table 8.

Table 8: Retention Volumes (Minor Events)

CATCHMENT	AREA (ha)	C AVERAGE (POST DEVELOPMENT)	VOLUME (m ³)
A	<i>Not applicable refer to Section 3.4.2</i>		
B1	28	0.75	3,150
B2	16	0.75	1,800
B3	13	0.75	1,460
C1 & C2	37	0.75	3,265
C3	10	0.75	1,125

It is assumed that the retention storage will be achieved within the wetland/treatment portion of the basin. This retention volume is additional to the detention storage requirement, it is assumed to be integrated into the base of the detention storage, with the footprint of the retention wetland within the larger On-site Detention (OSD) basin footprint.

3.4.2 Onsite Retention for Reduction of Flow Volume to the Aldinga Washpool

Stormwater management for the Justs Road catchment (sub-catchment A) has been primarily focused on volume reduction through onsite retention. This objective has been defined by DEW due to the specific cultural and ecological constraints on the downstream receiving water of the Aldinga Washpool. The approach to stormwater management has, therefore, been specifically adapted to the objectives set by DEW as outlined below:

DEW Objectives

DEW advised the following objectives for stormwater discharging to the Aldinga Washpool:

- Seek to achieve no increase volume discharging to the Washpool, as a result of future urban development.
- For modelling and assessment, the assumption of Pre-development run-off must be based on the average annual rainfall used in the calculations in the Western Mount Lofty Ranges (WMLR) Water Allocation Plan (WAP). As advised by DEW this is 530mm rainfall with a runoff coefficient of 0.03. This is an equivalent average annual volume discharge to the Washpool of 4.8ML.
- Minimise any additional discharge to the Washpool, including in winter months.

Proposed Stormwater Management Approach

Initially, a high-level options assessment was undertaken to review various stormwater discharge options that would divert urban stormwater away from the Aldinga Washpool. These options considered opportunities to use land within the Aldinga Washpool to create a wetland through revegetation with native species to naturally treat, store, infiltration and evaporate pre-treated stormwater diversion to local Council's local drainage network in proximity of the site, diversion and/or pumping back to Sellicks Creek and onsite retention supported by Managed Aquifer Recharge (MAR). The assessment considered the risks and opportunities associated with each option and included consultation with authorities.

The outcome of the investigation and associated consultation concluded that the preferred option for management of flow volume for this catchment would be on-site retention integrating MAR. MAR was recognised as a stormwater discharge solution that could enhance sustainable design outcomes through the retention of stormwater at site, recharge of local groundwater systems and be integrated into future stormwater reuse schemes to support urban greening and water security. It also provides a suitable basis to achieve the objectives associated with stormwater runoff volume reductions.

Further consultation and assessment were undertaken by WGA to develop high-level concepts, considering a range of scenarios and potential constraints to determine a concept that is reasonable and practical, complies with the objectives, and provides a suitable basis to support the Code Amendment process. A summary of the findings and assumptions are provided below.

Proposed Concept

Preliminary water balance modelling was undertaken to determine the conceptual sizing of stormwater basin within the Justs Road development site, to manage the volumes in-line with DEW objectives. The key outcome to inform the Code Amendment is to understand the order of magnitude of the basins and associate open space to provide storage and retention based in the post-development scenario.

On site retention relies on discharge through evaporation, infiltration, reuse and/or Managed Aquifer Recharge (MAR), a number of sensitivity assessment were undertaken to consider these variables and develop concept that is practical and complies with the objectives. Key assumptions are outlined in Table 9 and Table 10 and further details of the sensitivity assessment is provided Appendix E.

Table 9: MAR Scheme Concept - Key Assumptions

ASPECT	ASSUMPTION	BASIS
Hydrogeology – Injection rate	10L/s discharge to MAR based on 2 x 5L/s bores. A maximum of 10hrs pumping/day.	Conservative assessment based on an understanding of the existing hydrogeology but noting there is limited bore data in the region.
Hydrogeology – Target aquifer	Port Willunga Formation	
Water Quality	Primary Treatment within wetland with additional mechanical treatment plant to provide redundancy.	Noting risks associated with reduced residence time in the wetland and the potential increased sediment loads during the construction phase.
Contributing Urban Catchment Area	30.5ha	Based on the proposed development area on the corner of Justs Road and Sellicks Beach Road

ASPECT	ASSUMPTION	BASIS
Urban runoff coefficient	0.75	Based on City of Onkaparinga (CoO) development guidelines and conservative assumption adopted as the full site area at 0.75. (Realistically, a weighted coefficient would be reasonable and would reduce the volume discharge).
Rainfall Data (mm)	Daily Rainfall Data 1924-2024 Station 023753 Willunga	Based on Willunga historical rainfall data (considered conservative)
Infiltration Rate (mm/hr)	24mm/day	Based on Clayey Sand
Evaporation (mm)	Average monthly evaporation data Bureau of Meteorology (BOM)	
Average Annual Volume Discharge to Washpool (Pre-development Condition)	4.8ML/a	Pre-development run-off based on WMLR WAP. As advised by DEW this is 530mm rainfall with a runoff coefficient of 0.03.
Additional Flow Volume to Washpool (post-development scenario)	Limited to spill event only. Limit total spill volume to match the average annual flow volume in pre-development condition.	

Table 10: MAR Scheme Concept and Basin Size

MAR SCHEME – JUSTS ROAD CATCHMENT	
Basin Storage Volume:	30,000m ³
Basin Surface Area:	20,000m ²
Surface Area with Provision for Batter/Site Grading:	2.5ha
DEW Targets	Total volume of runoff to the Washpool (i.e. spill volume) <= to the pre-development volume based on average annual runoff over 100-year data set. Spill frequency per 100 years, average 1.5 per year. With only 4 summer spill events. <i>(Average annual injection approx. 70ML to aquifer)</i>

Sensitivity Assessment and Design Optimisation Opportunities

It is understood that there are a number of variables that may influence, and potentially optimise, the operation of a MAR retention scheme in this location. These include the viability of the MAR and bore injection rates, spill allowances and the potential for allowance of low-flow discharge in winter months to draw-down storage.

The proposed concept is based on a conservative assessment of likely aquifer conditions and limitations, historical rainfall data, considered a manageable scheme size, and limits discharge to existing volumes. There are, however, potential opportunities to optimise this scheme based on the outcomes of aquifer testing (injection rates), refined water balancing, and further engagement with DEW to understand limitations and opportunities to allow winter discharge at low-flow trickle feed. The key benefit of this optimisation could be reduced basin volume and surface area (increasing land value and reducing infrastructure costs), reduced number of bores or injection rate (reducing operation costs). These should be considered in detail as design proceeds.

In contrast to this there is a risk that the MAR is determined to be unfeasible based on detailed assessment. In this case the basin sizing will need to be increased to account for increased onsite retention volume, and/or the water balance modified to allow low-flow winter discharge to the Aldinga Washpool.

Two scenarios have been considered, and a sensitivity water balances assessment reviewed to consider the potential variation impacts on the basin size and land required to accommodate a modified scheme, the key takeaways are summarised below.

Retention Storage Size if MAR Determined Not Viable:

- If MAR was considered non-viable the basin size will result in a considerable storage increase as the basin would rely on infiltration and evaporation for draw-down.
- The basin size would increase to balance the reduced discharge (limited to infiltration and evaporation only). The expected increase is a doubling in volume and surface area increase of 2.5 times the proposed. This is a surface area of up to 5-6ha of a 30ha development.
- The increase basin size would have a significant impact on the urban development outcomes and would likely compromise the objectives of the development.
- Winter discharge offers an opportunity to offset the loss in MAR discharge and storage, the basin size would still see an increase in storage, however in the order of a 25%.

Optimisation with 'Winter Discharge':

- Allowing winter discharge (low-flow/trickle) will provide an opportunity to reduce the number of 'spill' events (which would be higher flow event) to the Washpool. The results indicate 'spill' discharges will decrease as shown from 1- 2 per year to < 1 per year (approx. 0.5 times a year), if low flows are allowed in winter. In this scenario there will be an increase in total annual volume of water discharging to the Washpool. However, the additional winter flow volume will be at a low flow rate and not due to a large 'spill' events. A rate of 5L/s constant rate has been adopted for this example scenario.
- Allowing winter discharge may allow the basin size and volume to be reduced by 30% while still retaining the target spill frequency (based on no winter discharge) or alternatively reduce the number of spill events if basin volume and size was retained as documented.
- The benefits of low-flow discharge increase the optimisation (reduced basin size and summer spills) in the event MAR was not viable.
- It is important to note that while the Aldinga Washpool is full during winter periods, an additional low flow release from the catchment provides an opportunity to improve the inherent water quality with the lagoon itself with no impacts to cultural, ecological and function of the washpool itself. This premise is supported by virtue that the lagoon receives catchment inflow from untreated, uncontrolled horticultural land use and a degraded Sliver Sands Water. This opportunity should be considered on the merits of the environmental benefits it provides and is discussed further in Section 4.

3.5 Stormwater Management Basin Sizing

The proposed combined basin sizing, integrating onsite detention storage, retention and wetland design for water quality management are outlined in Table 11. The surface area assumptions are based on a maximum water storage depth on 1.2m compliant with the City of Onkaparinga Guideline and additional contingency has been applied to allow safe batters and landscape design.

Table 11: Combined Storage Size (Detention and Retention)

CATCHMENT/BASIN	ON SITE DETENTION 1% AEP (m ³)	STORAGE BASIN SURFACE AREA (m ²)	RETENTION STORAGE (m ³)	COMBINED VOLUME (m ³)
A	N/A	20,000	30,000	30,000
B1	10,100	8,417	3,150	13,250
B2	4,500	3,750	1,800	6,300
B3	3,900	3,250	1,463	5,363
C1	4,250	3,542	2,025	6,257
C2	15,350	12,792	3,263	18,613

Further to this consideration for Climate Change and the influence this will have on peak flow and basin sizing has been undertaken, refer to Section 5.

3.6 Waterway Design

3.6.1 Waterway Corridors

For the purposes of the Code Amendment, a notional cross section has been prepared for each of the primary waterway corridor which considers the following:

- The requirement to accommodate the 1% AEP peak storm flow (including freeboard).
- Climate change risk assessment/sensitivity.
- To optimise the remediation approach, which will include filling in, and reshaping the existing degraded eroded gully. This is most relevant to Sellicks Creek, where this approach aims to reduce the existing gully's depth from approximately 8m down to approximately 3m. A 3m deep channel allows for suitable batter gradients to enable a balance between planting and passive recreation. Refer to Section 4.2 for further discussion about the Sellicks Creek remediation strategy.

All waterways/overland flow paths will be preserved within waterway corridors, as shown in the structure plan. This is by way of the provision of open space corridors to accommodate waterways along with open space amenity, shared user paths and WSUD feature. These waterways will be revegetated and may include remedial works to control erosion and restore stream function.

Manning's equation was used to fundamentally check the proposed channel dimensions; the peak flow assumptions have been based on conservative upper bound flows when considering the upstream rural catchment as outlined in Table 12. A further assessment of potential climate change impacts is addressed in Section 5.

Table 12: Waterway Capacity and Design Assumptions

WATERWAY	SELICK CREEK	SOUTHERN WATERWAY UPPER	SOUTHERN WATERWAY LOWER
Peak 1% AEP - Upstream Catchment	16m ³ /s	10 m ³ /s	5 m ³ /s
Hydrology assumptions	Based on upper-bound result from RORB modelling and allowance for flow from the development.		
Channel top width	15m	11m	
Channel base width	2m (min.)	2m (min.)	
Channel flow depth	1.0m 1.3m (with freeboard)	0.9m (max) 1.2 m (with freeboard)	
Extended waterway corridor	20-30m	15-20m	

The typical sections of the waterways are shown below as shown in Figure 5A & Figure 5B. Refer to Appendix C for calculation.

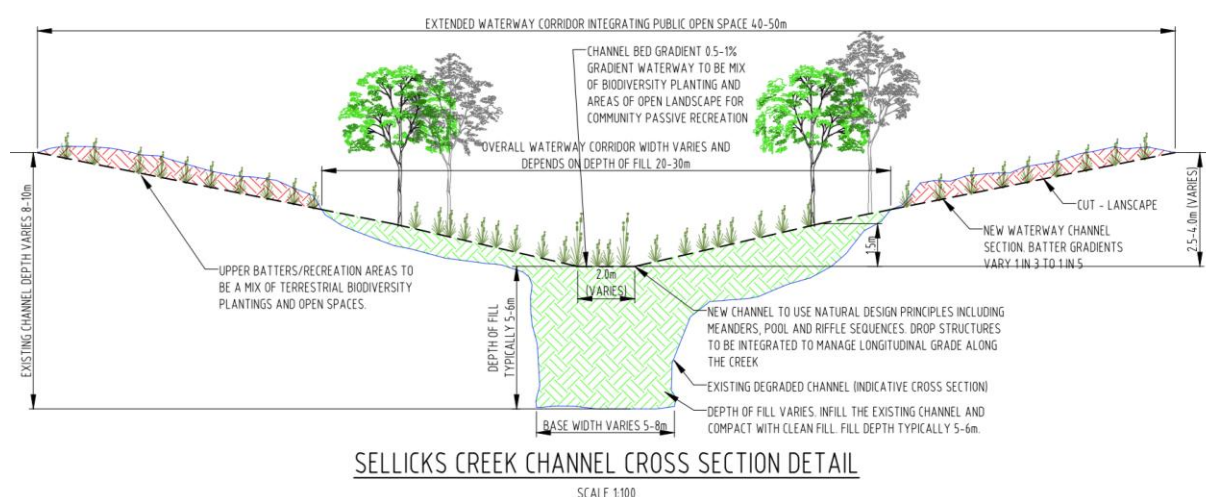
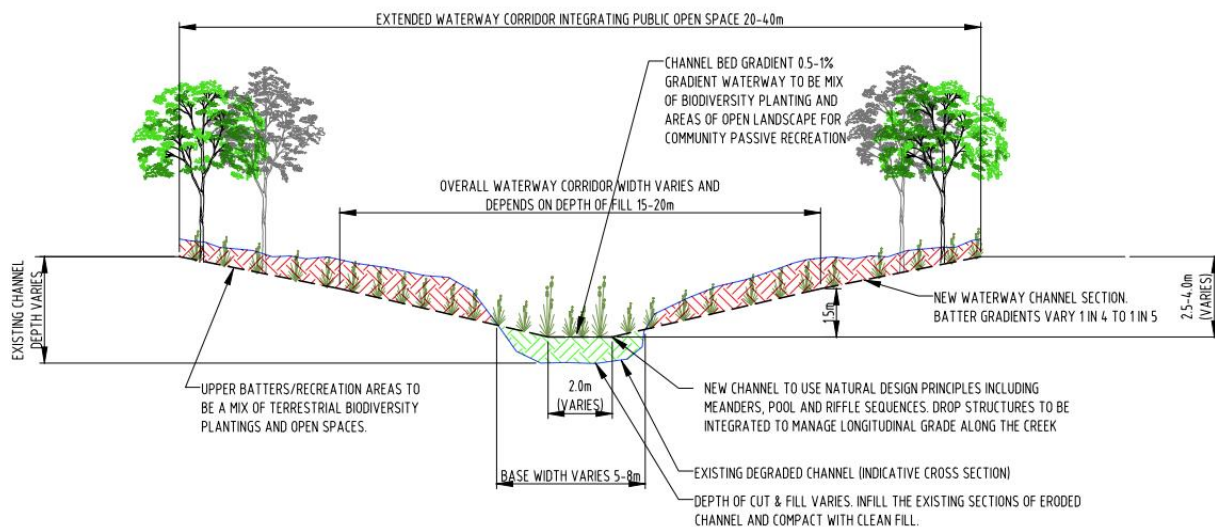


Figure 5A: Sellicks Creek – Channel Remediation Cross Section



SOUTHERN CREEK CHANNEL CROSS SECTION DETAIL

SCALE 1:100

LEGEND:

- NEW CHANNEL BED
- EXISTING CREEK PROFILE (INDICATIVE)
- FILL - INFILL CHANNEL
- CUT - LANDSCAPE

Figure 5B: Southern Creeks – Channel Remediation Cross Section

3.6.2 Waterway Culvert Capacity

Sellicks Creek

An existing 1500 diameter Reinforced Concrete Pipe (RCP) culvert crosses Sellicks Beach Road approximately 50m downstream of the Site. Based on the hydrology modelling and peak flow assumptions as outlined in Table 3 this culvert is insufficient to cater for the peak 1% AEP storm flow from the existing catchment in its pre-developed condition.

To demonstrate this, an assessment using Hy-8 was undertaken to assess its hydraulic capacity, Refer to Appendix C for the calculations. These calculations demonstrate that the existing culvert capacity of approximately 9m³/s does not meet the 1% AEP peak flow of up to approximately 16m³/s. Therefore, the culvert will need to be upgraded to prevent flooding within the site and to existing properties downstream of the site.

It is noted that the proposed Code Amendment would not result in an increased flood risk downstream of, nor to existing properties, based on the implementation of onsite detention storages (refer to Section 3.3) that would form part of the requirements to develop the land. The upgrade is to manage the existing risk and capacity issue.

There were stub connections for the future installation of an additional 2 x 1500mm diameter RCP, as part of earlier works that upgraded the downstream Sellick Creek channel. Upgrade works to extend the existing stub culverts would upgrade capacity to meet the pre-development flow condition. Note, this assumption, does not provide contingency for future increase due to climate change within the upper catchment (Refer to Section 5). A detailed hydraulic assessment will be required to assess the risk and confirm the requirements for upgrade.

Southern Creeks

Should there be a need for an internal road to cross the southern creeks to provide connection between collector road to Gulf View Road, new bridge crossings/culverts will be required. These culverts will form part of the internal development works, the estimated sizing for this culvert structures are 1x 1050mm diameter RCP at each bridge structure based conservatively on adopting a Manning's equation assumption and a peak 1% AEP flow 2m³/s within the channels.

The existing drainage culvert at the southern end of Gulf View Road, 1 x 300mm diameter RCP and 1 x 600mm diameter RCP will not meet the capacity to convey the post-development peak flows, due to the proposed increased urban development upstream of the culvert crossing. It is recommended that this crossing is upgrade to 1 x 1200mm diameter RCP or an additional duplicate 1 x 600mm diameter RCP is installed to manage increased urban discharge.

3.7 Flood Hazard

On review of Plan SA, South Australian Property and Planning Atlas (SAPPA) planning overlays, Flood Hazard overlays, exist over some of the project site area. There are two overlays in effect, as outlined in Table 13 and Figure 6.

Table 13: Flood Hazard Overlays

HAZARD OVERLAY	DEFINITION	KEY CONSIDERATIONS*	LOCATION
Hazard (Flooding)	Medium- High – within this overlay a 1% AEP in areas of highest risk may cause structural damage to buildings and may be unsafe for persons to escape through floodwaters and would not be safe for vehicles.	- Development is not suitable in high-risk areas and developed areas, where intensification should be minimised. - Ensure that flood ways are not obstructed. - Development in this overlay is expected to be performance assessed. - Development should only occur where it can be sited and designed to minimise exposure of people and property to unacceptable flood risk. And, where evacuation is possible and emergency services can gain access during a 1% AEP flood event. - Building must be constructed above the flood plain plus a free board of 300mm may be considered appropriate by the relevant authority. - Buildings that house vulnerable people, community services, key infrastructure and emergency services should be sited away from areas within this overlay.	Sellicks Creek Catchment (waterway only) Southern Creeks Catchment (partial)
Hazard (Flooding – Evidence Required)	Unknown flood risk is applied to those areas where no detailed flood study data is available.	- The overlay seeks to adopt a precautionary approach to mitigate potential impact on people, property, infrastructure and the environment through the appropriate siting and design of development. - This Overlay is applied as an interim measure until flood studies can be undertaken to determine the extent of the flood hazard. - The Deemed-to-Satisfy (DTS) criteria requires habitable buildings, commercial and industrial buildings, and buildings used for animal keeping to incorporate at least 300mm free board above: a. The highest point of the top of kerb of the primary street; or b. The highest point of natural ground level at the primary street boundary where there is no kerb	Justs Road Catchment Sellicks Creek Catchment (partial) Southern Creeks Catchment (partial)

**Refer to Appendix D for a copy of SAPPA Flood Overlay Reference document.*

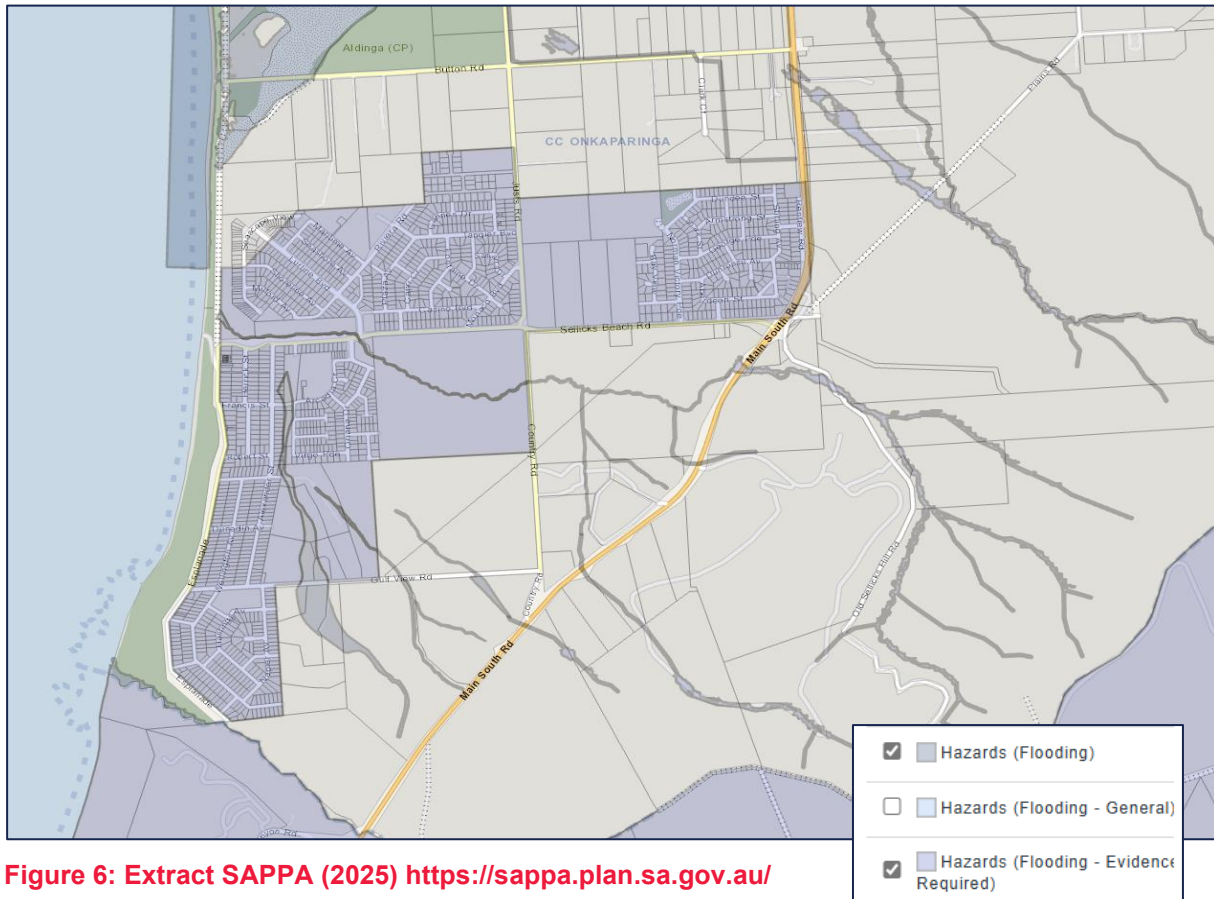


Figure 6: Extract SAPPA (2025) <https://sappa.plan.sa.gov.au/>

In respect to the SWS, the following has been considered in regard to Flood Hazard:

Hazard (Flooding)

These areas are typically not suitable for development, however, extents of the overlay are generally limited to the waterway corridors throughout the site, as outlined below:

- **Sellicks Creek Waterway**

The SWS includes remediation of Sellick Creek. The capacity of the creek adopted as part of the remediation design will accommodate:

- Post-development peak 1% AEP flow (noting that the development proposes offline OSD basins to manage peak flow to pre-development rate).
- Freeboard of 300mm minimum.
- Climate change risk assessment/sensitivity.

The creek is located within a wider waterway corridor that is the equivalent or greater than the overlay extents. Therefore, there is no expected impact to the development area.

- **Southern Creeks Waterway and Surround**

The SWS includes remediation of the southern waterways. It is understood that this land is currently low-lying and flat and with poorly defined waterways. This results in overland flow spreading across this low-lying areas. Typically, the capacity of the creek adopted as part of the remediation design will accommodate:

- Post-development peak 1% AEP flow
- Freeboard of 300mm minimum
- Climate change risk assessment/sensitivity

Generally, the flood extents are located within a wider waterway corridor. Therefore, there reducing the potential impact to the development area.

The SWS also proposes to define waterway corridors and upgrade the channel capacity where required, to manage flood risk across the portion of the site impacted by the flood overlay and where this extends beyond the waterway corridor. Such modifications will need to be considerate of existing vegetation and ecological values that may have established in select areas due to natural flow paths. There may also be scope to consider pocket parks and waterway corridor widening to manage any locations of significant value.

Any development proposed within in this location will be subject to further investigate and flood modelling to confirm compliance with development conditions, flood overlay and flood risk. Where residual flood risk occurs appropriate consideration of land use will be required, i.e. avoidance of high-risk development (vulnerable people, key infrastructure).

Hazard (Flooding – Evidence Based)

- **All Zones:**
 - It is understood that this overlay is applied as an interim measure until flood studies can be undertaken to determine the extent of the flood hazard. Therefore, the overlay is proposed to be removed from the Code once studies are completed via the Code Amendment process. This overlay is not expected to impact development opportunities, and the requirements for a Deemed-to-Satisfy criteria would be considered as part of the detailed design phases and development approvals.

3.8 Ecological and Cultural Heritage Considerations

The stormwater management strategy recognises that consideration of ecological values and cultural and heritage within the waterway design is important. The following initiatives and design principles are recommended for the future design development.

Remediate the waterways through extensive earthworks in an environmentally and culturally sensitive manner. The aim is to integrate remediated areas with open space/recreation areas with biodiversity via blue green corridors following a best practice planning approach. The Strategy is cognisant of respecting existing environmental and cultural values, while also seeking opportunities to restore degraded areas.

Waterway remediation will adopt natural design principles that follow meandering patterns of waterways and natural flow path, and revegetate these corridors, bringing in features that would enhance environmental value, manage erosion and opportunity for cultural connections through naturalistic treatments. This approach would aim to create living ecological corridors and essentially replicate the environmental remediation completed downstream. All waterway open space corridors are proposed to be considerably wider remediated waterway conveyance channel. This corridor will support the desired buffer zone around the culturally sensitive waterway.

On site retention (integrating MAR) is proposed as the primary approach for stormwater management of the Justs Road catchment, to manage the volume of water discharged to the Aldinga Washpool. This is based on consultation with DEW and an understanding that there is significant cultural value in the Aldinga Washpool that may be impacted through unrestricted increase in additional urban flow. MAR also provide opportunities for stormwater harvesting and reuse, which will support sustainable water management and opportunities to enhance urban greening and provide integration into wider regional water supply networks to improve water security in the region.

4 WATER SENSITIVE URBAN DESIGN

4.1 Opportunities

It is recognized that Water Sensitive Urban Design (WSUD) embraces a range of measures that form part of ecologically sustainable development (ESD). WSUD can be designed into the future development, to mitigate the impacts of urban development, creating sustainable and resilient green spaces to improve stormwater quality, reduce runoff and peak flow rates. It also plays a significant role towards enhancing environmental values, biodiversity and ecosystems services in an urban realm context.

The vision for the project encapsulates the following key principles:

- Integration of green infrastructure strategically placed within the site to create zones suitable to establish medium to large sized trees.
- Creation of places for people that are comfortable and provide an element of protection and shelter from heat generated from hard surfaces as well as softening the hard-built form.
- Opportunities to integrate stormwater design as part of landscape architecture to create visual interest and interactive space.
- Utilise WSUD techniques that demonstrate sustainable outcomes to the local community and to integrate sustainable stormwater management outcomes.
- Utilise practices that are, practical, and maintainable and that are proven to be cost effective and delivering multiple outcomes as they relate to landscaping and stormwater management.
- Use green infrastructure to attenuate stormwater flows, while also provide an appropriate level of treatment.
- Protection of waterway corridors and vesting these into the public open spaces and biodiversity corridors.
- Environmental remediation of the degraded waterways.
- Recognition of cultural values associated with waterways and downstream receiving waters and environments. WSUD will provide a focus on environmental protection of downstream environments.
- Opportunities for placemaking integrating WSUD, such as pocket parks integrating bioswales or strategic locations of smaller scale WSUD within the waterway.
- Water quality treatment at-source, and upstream of sensitive waterways.

The strategy for WSUD is based on delivering the principles set out above. As part of this investigation, key WSUD opportunities were identified to be suitable for this type of urban development proposal. Further opportunities can be considered as part of an integrated planning process when the concept for the site is further developed.

For this purpose, the following WSUD opportunities have been included in this Strategy to support the Code Amendment:

- Waterway corridors – to be protected, restored, revegetated, and vested into continuous open space corridors, establishing biodiversity pathways and integrated passive recreation networks.
- Sellicks Creek environmental remediation – create a sustainable, biodiversity waterway corridor employing naturalistic waterway design principles as part of its remediation.
- Southern Creeks waterways – create a sustainable, biodiversity waterway corridor employing naturalistic waterway design principles as part of its remediation.
- Detention basins with integrated retention wetland ponds – to attenuate stormwater inflows from urban development. The detention basins can be designed to incorporate an ephemeral pool and wetland plantings within its base. This approach can provide retention of urban flows, environmental value, enhance biodiversity and stormwater treatment.
- Streetscape WSUD to be integrated on main collector roads and where achievable across the development subject to road grading and site constraints. This will enhance treatment and retention of urban runoff at-source and provide benefits of urban greening, cooling and shade.

The above approaches should be explored further during the master planning phase for the urban development areas subject of the Code Amendment. The best outcomes can be achieved if WSUD is taken into consideration while planning for the development layout is being undertaken.

4.2 Sellicks Creek and Southern Waterways Remediation

Sellicks Creek is in a highly degraded condition and undergoing active gully erosion. It presents an ongoing risk to the community and environment. Through the Code Amendment and by facilitating development of this land, offers an opportunity to remediate the creek channel and corridor. The following principles can be considered in environmental remediation of Sellicks Creek:

- Starting with a vision to recreate a living creek system with ecosystem values to sustainably manage urban stormwater and rural catchment inflows.
- Improve water quality, trap sediment loads entering from the upper rural catchment, improve urban stormwater using a connected series of vegetated wetland pools and riffles to control gradients so that the watercourse is stable and does not contribute sediment downstream.
- Transform the corridor into a connected public land reserved for mixed uses. Including passive recreation, trails, flora and fauna, and biodiversity.
- Create a corridor that is safe, engaging to the community through social wellbeing, and enjoyment of the restored natural creek setting.
- Reduction in ongoing erosion and protection of public safety through softening of batters and reduction in depth of channel.
- Consider opportunities to protect cultural value and vegetation.

Refer to Figure 5A and Figure 5B for a typical cross section that is provided to display fundamental channel form. It is noted that the Southern Creeks adopt the same principles as described above.

4.3 Onsite Greening and Environmental Considerations

State Planning policies are geared towards achieving tree canopy, rewilding and biodiversity targets under the Greater Adelaide Regional Plan (GARP). In this regard, dedicated deep soil zones to accommodate tree canopy cover suited for medium to large trees should be considered and integrated into the urban development as part of the future planning where possible.

The open space corridors planned within the development and along the waterway corridors, will form part of the future urban development. This can offer an opportunity to coordinate waterway corridors, environmental remediation and stormwater management while aiming to integrate enhanced tree canopy and greening. In addition, supporting opportunities to increase local biodiversity along these waterways. Biodiversity can be achieved through careful selection of upper storey, mid level and ground cover species particularly along the waterways to enhance and contribute towards environmental values and ecological function. Such opportunities will be explored during the site planning and concept design phase.

4.4 Stormwater Treatment

This section summarizes the stormwater quality simulation carried out using MUSIC software and compares the outcomes to the pollutant reduction targets as defined in the South Australian MUSIC Guidelines, February 2021, Water Sensitive SA.

MUSIC modelling is utilised to conceptually confirm the required surface areas of the treatment systems to ensure that the treatment requirements can be met for the overall development. MUSIC version 6.4 has been used to assess the performance of the conceptual strategy. The model layout has been shown in Figure 7 and shows notional development parameters have been included in the model so that these can be assessed against the treatment requirements for this urban development.

4.4.1 Modelling Input Parameters – MUSIC

MUSIC model uses climatic data comprising of daily rainfall interval and evaporation data from Adelaide Kent Town (Station No 023090) from 1983 to 1992. This rainfall data was used based on South Australian MUSIC Guidelines (2021), as the site is located within the rainfall region 'Adelaide Wet and Foothills' which recommends the climate template based on 23090 Adelaide Kent Town. This data is used to simulate the rainfall and runoff on site and the subsequent treatment performance for the development strategy. The results and outcomes are presented in this Section 4.4.2.

The input parameters for the source and treatment nodes are summarised in Table 14 is not intended to provide all parameters for nodes within the model; instead, it provides a general overview of the typical parameters used for the source and treatment nodes. In this case the source nodes are represented by "urban nodes", and the treatment nodes are represented by detention basin with ephemeral wetland. A screen copy of the model and indicating the locations where results have been reported is provided in Figure 7.

The surface area of wetland treatment nodes has been sized based on the basin surface areas of the urban directly connected impervious fraction.

MUSIC modelling has been undertaken to comply with the South Australian Music Modelling Guidelines (2021).



Figure 7: MUSIC Model Layout

Table 14: MUSIC Model Parameters

NODE TYPES	PARAMETERS				
Source Water Node: Urban	Soil storage capacity 40mm	Rainfall Threshold 1 mm/day	Typical directly connected impervious fraction 75%	Stochastically generated pollutants	Initial storage capacity % of soil capacity 30%
TREATMENT NODES	PARAMETERS				
Bioretention System	Surface area based on 2% of road surface area	Unlined filter media perimeter 0.01m	Infiltration loss 0.36mm/hr	Filter Depth of 0.3 m	Detention time is approximately 72 hours
Wetland System	Surface area based on 2.5% of sub-catchment areas	Permanent pool volume based on constant 0.225m depth	Extended detention depth 0.5 m	Infiltration loss 0.36mm/hr	Detention time is approximately 72 hours

4.4.2 MUSIC Modelling Results

The results presented in this section demonstrate water quality compliance in accordance with the target values specified. The results have been reported at the downstream outlet from each of the proposed land parcels (Sites) as shown in Table 15 to Table 16.

Table 15: Stormwater Treatment Results Compared to WSUD (2013) Targets – JRC Catchment

POLLUTANT TYPE	TP	TN	TSS	GROSS POLLUTANTS	ANNUAL FLOW
Target Percentage Reduction	60%	45%	80%	90%	Not Specified
Resultant Percentage Reduction	79%	53%	89%	100%	23%

Table 16: Stormwater Treatment Results Compared to WSUD (2013) Targets – Sellicks Creek Catchment

POLLUTANT TYPE	TP	TN	TSS	GROSS POLLUTANTS	ANNUAL FLOW
Target Percentage Reduction	60%	45%	80%	90%	Not Specified
Resultant Percentage Reduction	77%	50%	86%	100%	20%

The results summarised in Table 15 and Table 16 demonstrate that the TSS, TP and TN reductions will meet the required performance criteria.

5 CLIMATE CHANGE

Australian Rainfall and Runoff (AR&R) has recently released revised guidance for incorporating considerations of climate change into drainage design. One of the key messages is that there is now sufficient certainty that increases in global temperatures are, and will continue to, result in increases in rainfall intensities. While there is certainty that rainfall intensities will increase under a warming climate, there is still considerable uncertainty as to the magnitude of the changes and this somewhat complicates the application to drainage design and flood modelling. There is no 'one-size-fits all' approach to selecting climate change design parameters and a risk-based approach is required.

For the purpose of the SWS, a risk-based approach to assessing potential climate change influences on key stormwater infrastructure has been adopted by WGA. The following scenarios have been reviewed to consider the impact to key assets such as stormwater storage basins and channel upgrades.

Table 17: Climate Change Scenarios

DESIGN SCENARIO	STORMWATER ASSET	CLIMATE CHANGE PROJECTION SCENARIO	TIMEFRAME	RAINFALL AND LOSS FACTOR ADJUSTMENT
Short-term scenario	- Onsite Detention - Waterway Channel Capacity	SSP2 – 4.5	2030	12-18% increase in rainfall intensity. - Loss factor adjustment - IL (Initial Loss): 5% increase - CL(Continuing Loss):7% increase.
Long-term scenario	- Onsite Detention - Waterway Channel Capacity	SSP3 – 7.0	2070	28-42% increase in rainfall intensity. - Loss Factors - IL: 12% increase - CL:15% increase

5.1 Risk-Based Approach

The risk-based approach adopted reviews the impacts of the above climate change scenarios on the preliminary design and proposed basin size and waterway design capacity. WGA have undertaken preliminary modelling in DRAINS using projected rainfall data and adjusted loss factors. The outputs from the modelling have been reviewed to consider the risk and potential impact to the development.

A full climate risk assessment should be undertaken as part of future design stages. This assessment must engage with key stakeholders to consider and assess the level of risk, with key aspects for assessment to include, potential impacts of public health and safety, critical infrastructure and damage to private property, and determine climate change mitigations and adaptation to be adopted in final designs. A more detailed modelling and assessment will be required as part of the detail design phase, however, the results below are provided for initial review and consideration by stakeholders.

5.1.1 Sensitivity Assessment

Detention basin sizing will be influenced by climate change resulting in reduction in acceptable design standards (i.e. reduced freeboard) or potential increase in storage capacity of the basin.

WGA have undertaken a high-level assessment to consider the potential reduction in design standard in the two scenarios, and an order of magnitude increase in storage capacity.

It is important to note that due to the rural nature of the pre-development catchments, that in the even in the absence of any development, peak discharge from the catchment is expected to increase due to the climate change factors. The preliminary assessment has considered the pre-development runoff rates based on the equivalent future scenario in the assessment of impacts to onsite detention basin sizing. However, the downstream stormwater network capacity may also be impacted by climate change factors, independent of the proposed development. Therefore, this should also be considered as part of a wider assessment on the impacts of climate change on the regional network.

Table 18: Climate Change Scenario Results – On Site Detention

DESIGN SCENARIO	ASSESSMENT	MODELLING RESULTS	INTERPRETATION
Short-term scenario (SSP2 - 4.5 / 2030)	Sensitivity modelling in DRAINS. Modelling with future rainfall and loss factors to consider the capacity of the proposed basins under short-term climate change scenario.	- In most catchments storage still is contained within the proposed basin size but with reduced freeboard, or minimal freeboard. - The peak outflow from the basin is greater than pre-development discharge (based on current climatic conditions) but are equal or less than the pre-development outflow in the equivalent design scenario (i.e. SSP2). - Onsite detention storage volume to meet the equivalent pre-development discharge rate are 10-20% greater than current.	- The reduction in freeboard increases the risk of overtopping in major events. - In some catchments (generally the Southern Creek catchments) there is an increased outflow from the basin, however, it is < 10%. - In a 'like to like' scenario. The detention to pre-development condition is typically met, with reduced freeboard. However, if the downstream network capacity is not upgraded to meet increase flows under climate change conditions, there is a risk to downstream capacity.
Long-term scenario (SSP3 – 7.0 / 2070)	Sensitivity modelling in DRAINS. Modelling with future rainfall and loss factors to consider the capacity of the proposed basins under short-term climate change scenario.	- The basin capacity (current climatic conditions) will be exceeded, and spill / overflow will occur. - The peak outflow from the basin is greater than pre-development discharge (based on current climatic conditions), and up to 10% greater than the equivalent pre-development outflow in the equivalent design scenario (i.e. SSP7). - The onsite detention storage volume required to meet the equivalent pre-development discharge rate, are 20-40% greater than current.	- Basin capacity is exceeded, resulting in spill. This is a potential risk that needs to be considered. - There is an increased outflow from the basin, however, it is < 10% greater than the equivalent pre-development flow). - If the downstream network capacity is not upgraded to meet increase flows under climate change conditions, there is a risk to downstream capacity.

Table 19: Climate Change Scenario Results – Waterway Corridor

DESIGN SCENARIO	ASSESSMENT	PRELIMINARY RESULTS	INTERPRETATION
Short-term scenario (SSP2 - 4.5 / 2030)	Assessment of capacity of waterway/waterway corridor with increase upstream peak flow through the site.	Increased flows due to climate change would be contained within the proposed waterway with reduced freeboard.	The waterway design has capacity to convey future flow, however, with reduced freeboard. The overall waterway corridor provides suitable capacity to: • Increase capacity in the waterway to achieve required freeboard. • Adapt the design in future as required. • Provides a buffer between private property or key assets that are at risk.
Long-term scenario (SSP3 – 7.0 / 2070)	Assessment of capacity of waterway/waterway corridor with increase upstream peak flow through the site.	Increased flows due to climate change would be contained within the proposed waterway with reduced or limited freeboard.	The waterway design has capacity to convey future flow, however, with reduced or limited freeboard. The overall waterway corridor provides suitable capacity to: • Increase capacity in the waterway to achieve required freeboard. • Adapt the design in future as required. • Provides a buffer between private property or key assets that are at risk.

5.2 Risks and Future Design Considerations

The results of the climate change sensitivity outline that stormwater infrastructure will be impacted by future climate change scenario. Key aspects for future consideration are outlined below:

- Independent of the development there will be an increase in runoff from the site due to climate change impacts (increased rainfall intensity).
- Increasing basin storage to meet the future scenarios will result in an order of magnitude increase of 10-20% for SSP2 and 20-40% for SSP3. Noting, that these increases may result in basins been overdesigned for part of the design life.
- Provision of sufficient open space around the basins will allow for scope to review and accommodate an acceptable storage volume based on detailed modelling and a risk based approach that considered stakeholder and requirements.
- Where a reduction in freeboard is agreed, review of proximity of the basins to private property or sensitive land use (key infrastructure, schools) must be considered and sufficient protection be provided or suitable for future adaptation. The location of basins is typically within or adjacent the waterway corridor and as such this may be scope for future adaptations to manage risk into the future.
- Where basin capacity is likely to be exceeded in future climates, provision for safe overland flow paths that will convey flows to the waterway corridors need to be integrated into the design.

- The stormwater onsite detention basins are key assets that manage peak flows from the site and manage flood risk downstream. These are proposed to be constructed online or within a wider open space corridor. Where this occurs, the corridor can provide a flood mitigation buffer, and capacity to upgrade capacity in future as part of a climate change adaptation plan.
- Where basins are located outside of the waterway corridor (i.e. Justs Road) the basin will be located within an open space. It is recommended that additional open space is allocated so provision for adaptive design is within the site planning, and risk to private property or public safety can be managed.
- The stormwater channels are proposed to be constructed within a wider open space corridor. This corridor will provide a flood mitigation buffer, and capacity to upgrade capacity in future as part of a climate change adaptation plan. This will provide capacity to potential manage risk to property and or public safety through adaptive design and controls.

6 INFRASTRUCTURE REQUIREMENTS

6.1 Impacts on Existing Stormwater Infrastructure

The status of impacts to the stormwater infrastructure that exists within and at the perimeter of the site boundaries is outlined below.

6.1.1 Justs Road Catchment

- **Existing Justs Road Drainage**

- The existing land parcel discharges to the north-west corner and into Justs Road. The design intent is to retain flow onsite to prevent additional urban flow volumes discharging from the site to the Washpool. On this basis there will be limited impact to the existing drainage network. However, the proposed retention system will have on average 1 -2 events annually which will exceed the retention basin capacity and overflow to Justs Road and north towards Silver Sands Creek and the Aldinga Washpool. There is no formal stormwater infrastructure along Justs Road available for connection. Justs Road is a rural roadway that drains via a roadside table drain. The table drain will not provide a suitable drainage capacity for spill event and as such upgrades to the Justs Road drainage swale will be required by formalisation of the roadside channel and driveway culvert upgrades.

6.1.2 Sellicks Creek Catchment Including Southern Creeks

- **Existing Sellicks Beach Road/Sellick Creek Culvert**

- There is an Existing 1500 RCP culvert crossing where Sellicks Creek crosses over Sellicks Beach Road. This culvert does not meet the current capacity requirement of the 1% AEP peak storm flow from the catchment. Whilst the development will not exacerbate the flood risk, the culvert is currently undersized and will need to be upgraded irrespective of development.
There are 2 x 1500mm diameter RCP stubs that have been constructed as part of the creek remediation works undertaken previously downstream from Sellicks Beach Road. The provision of 3 x 1500mm diameter RCP at this crossing would increase the capacity to an equivalent of the upstream road crossing (Country Road 3 x 1500mm). This should be sufficient to provide 1% AEP capacity based on current pre-development flow rates, however, consideration for the impacts of climate change would need to be assessed as part of the detailed design or construction. Post-development flows from the development site are to be detained and managed onsite as outlined in Section 3.

- **Existing Sellicks Beach Road Drainage**

- Sellicks Beach Road east of Justs Road is not serviced by stormwater infrastructure. The roadway drains via table drains which is typical of a rural roadway. The table drain will not provide a suitable drainage connection from the development. Formalisation of the drainage from Sellicks Beach Road will be required to drain the proposal to upgrade Sellicks Beach Road. Additional urban flows within the development are proposed to be manage within the Development via a new drainage network and downstream OSD basin.
Sellicks Beach Road east of Justs Road is serviced by an existing 525mm diameter drain and roadside swale. This drainage will have capacity to manage the existing flows and roadside drainage. The additional urban flows contributing from the development will exceed the capacity of this network. The development will be required to manage urban flows within the boundary via a new networks and connection to the proposed online detention basin/wetland.

- **Existing Sellicks Creek**
 - The creek is in a highly degraded state, with active gully erosion. It presents an ongoing environmental risk as it is a source of sediment that makes its way downstream to the beach. The majority of SCC will drain into Sellicks Creek and there is significant upstream catchment that is conveyed along the creek. The creek line will need to undergo extensive environmental remediation which includes earthworks, filling, reshaping and revegetation, as discussed in Section 4.2 to provide a safe and environmentally sustainable waterway corridor.
- **Existing Southern Creeks - Waterways/Overland Flow Paths**
 - The Southern Creek features several minor waterways and overland flow paths. Some remediation of these waterways will be required to ensure capacity of the waterways and reduce erosion. These will be protected by a proposed network of waterway corridors. Stormwater drainage from the urban development will be connected to a proposed online detention basin/wetland which will protect and attenuate flows into the downstream waterway.
- **Existing Culvert Crossing Country Road**
 - The existing drainage crossing of Sellicks Creek and Country Road has been upgraded in recent years. The existing 3 x 1500mm diameter culverts are sufficient to convey the 1% AEP peak design flow. No upgrade to these culverts is required.
- **Existing Culvert Crossing Gulfview Road**
 - The existing drainage crossing of Upper Southern Creek and Gulfview Road is 1 x 300 diameter RCP and 1 x 600 diameter RCP culvert. There is urban development proposed upstream of this culvert crossing that will not be detained under downstream of the road crossing within Basin C2. Upgrade of this road crossing convey the 1% AEP peak design flow post-development is required, via 1 x 1200mm diameter RCP or an additional duplicate 1 x 600mm diameter RCP is installed to manage increased urban discharge.

6.2 Proposed Infrastructure Requirements

Development of the site will require augmentation of existing stormwater infrastructure within and adjacent the development. New internal infrastructure will form part of the provisions for stormwater management and discharge arrangement from the future urban development. Major trunk infrastructure has been detailed below, with detailed and minor drainage elements to be designed as part of future development planning and design.

6.2.1 External Infrastructure Upgrade

As noted above in Section 6.1 there will be impacts to the existing adjacent drainage infrastructure in and adjacent the site. The proposed external infrastructure upgrades are summarised below.

- Formalization of the eastern side Justs Road drainage/roadside swale.
- Upgrade the existing Sellicks Beach Road/Sellicks Creek culvert crossing, to meet the 1% AEP flow capacity of Sellicks Creek. Upgrade from 1 x 1500mm dia. to 3 x 1500mm dia.
- Formalise the Sellicks Creek Road roadside drainage east of the junction with Justs Road.
- Upgrade to the existing culvert crossing on Gulf View Road.

6.2.2 New Internal Infrastructure

The following regional/truck stormwater infrastructure is required to support the development of the site.

Justs Road Catchment

- Discharge to MAR and onsite retention, with infrequent overflow to Silver Sands Creek/Aldinga Washpool via Justs Road:
 - Discharge to a combined retention and detention basin with integrated MAR scheme and wetland proposed as part of the urban development. The basin will primarily retain and treat stormwater prior to injection/discharge to the underlying aquifer as part of a Managed Aquifer Recharge (MAR) scheme.
 - The basin will spill on average 1 – 2 times per year typically in winter or major events. Overflow via controlled outflow will be directed to the roadside swale on the eastern side of Justs Road. Formalisation of this channel to provide sufficient capacity will be required including upgrade of driveway culverts and reshaping.

Sellicks Beach Catchment (including Southern Creeks)

- Discharge to Sellicks Creek:
 - Discharge to detention basins with integrated wetland proposed as part of the urban development. The detention basins will release controlled outflow into Sellicks Creek.
 - Depending on how the urban development this planned to occur, approximately 3 detention basins with wetlands would be required as part of the urban development.
- Discharge to Southern waterways:
 - Discharge to detention basins with integrated wetland proposed as part of the urban development. The detention basins will release controlled outflow into the waterway downstream of the urban development. Two detention basins with wetland would be required as part of the southern part of this urban development. The basin could be constructed in line with the watercourse and form part of its environmental restoration.
 - Should there be a need for an internal road to cross the southern creeks to provide connection between collector road to Gulf View Road, new bridge crossings/culverts will be required. Provision for a 1050mm diameter culvert per bridge structure for flow conveyance is recommended.
- Discharge to Sellicks Creek via Sellicks Beach Road:
 - Discharge to Sellick Beach Road will be limited to properties fronting Sellick Beach Road, due to the capacity limitations on the existing infrastructure. Drainage infrastructure will be constructed within the site to service the development.

6.2.3 Proposed Infrastructure Requirement Summary

The proposed infrastructure requirements are shown on Figure 8.

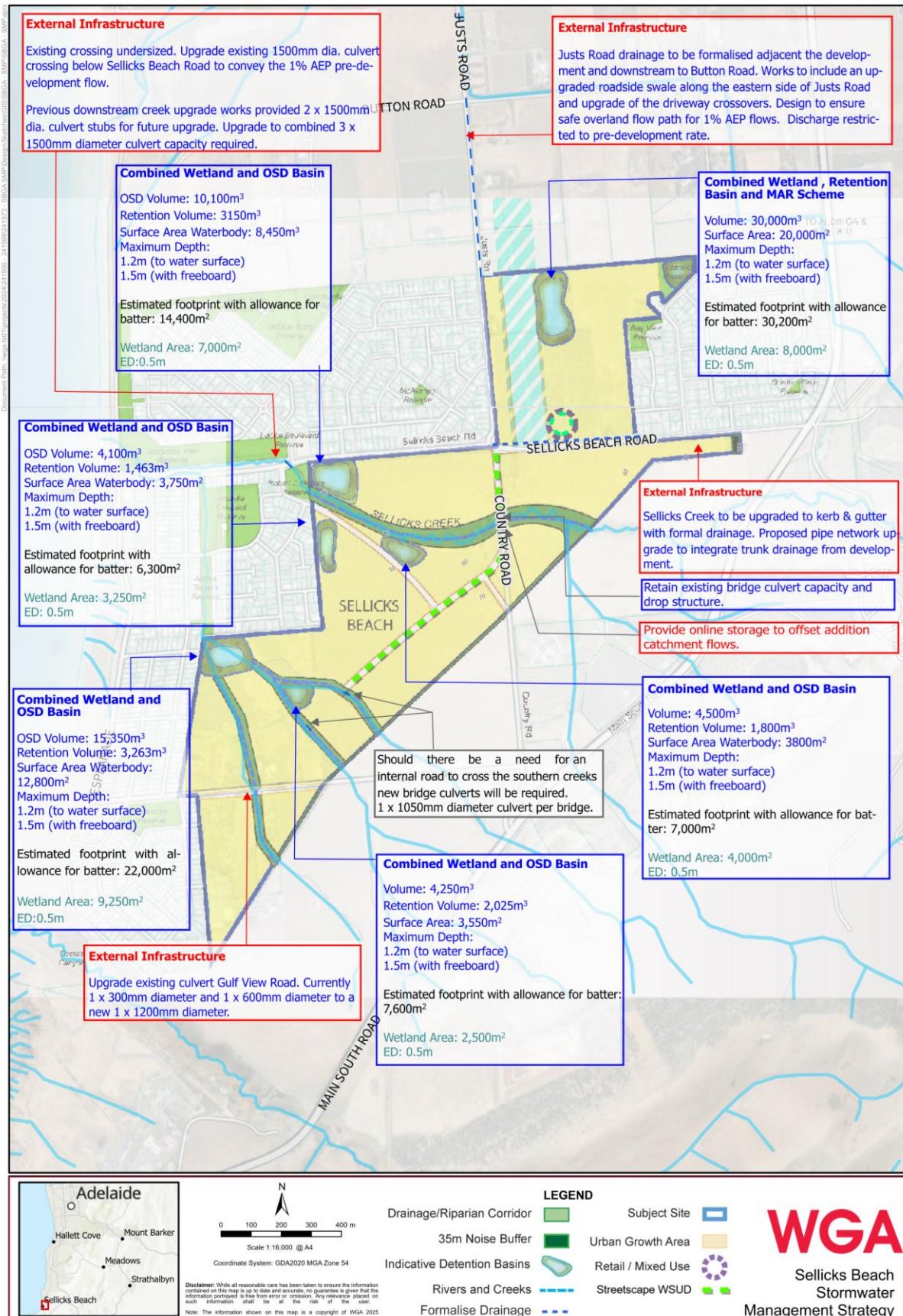


Figure 8: Stormwater Management Strategy - Infrastructure Requirements

7 STORMWATER MANAGEMENT FRAMEWORK

This report illustrates a stormwater management strategy to support the Code Amendment process to enable the Sellicks Beach Growth Area to be zoned for urban development. This strategy is based on the following key requirements being met:

- The stormwater management strategy is consistent with the indicative Draft Sellicks Beach Structure Plan (2025) and the City of Onkaparinga Stormwater Management Guidelines (2019). Attenuation of the peak post 1% AEP (100-year ARI) stormwater discharge from the pre-developed site for the 1% AEP (100-year ARI) peak flow rate. Detention basins are proposed for this purpose.
- Stormwater treatment shall comply with pollutant reduction targets as defined by the City of Onkaparinga, Environment Protection Authority and Industry Standards. This is via urban constructed wetlands that are integrated into each detention basins. This strategy facilitates a focus on environmental protection and remediation. WSUD opportunities at streetscapes scale could be explored as part of master planning. This strategy uses a risk-based approach with utilising an environmental strategy to manage stormwater to address impacts to the downstream receiving waters. Waterway corridors to be environmentally remediated, revegetated, and vested into continuous open space corridors, establishing biodiversity pathways and integrated passive recreation networks. This includes Sellicks Creek and Southern Waterways. Waterway corridors to be environmentally remediated, revegetated, and vested into continuous open space corridors, establishing biodiversity pathways and integrated passive recreation networks. This includes Sellicks Creek and Southern Waterways.
- Detention basins with integrated wetland ponds will be used to attenuate stormwater inflows from urban development. The detention basins will incorporate an ephemeral wetland within its base for water quality and onsite retention. This approach can provide environmental value, enhance biodiversity and stormwater treatment, along with management of urban stormwater volumes in frequent minor events.
- Site tree canopy and greening targets should be considered along with biodiversity plantings particularly along waterway corridor.
- Protection of the Aldinga Washpool through a site-specific stormwater management strategy for the Justs Road catchment based on on-site retention integrating MAR. Opportunity to support regional water security through the stormwater harvesting scheme linked to MAR.
- Protection of environmental, social and cultural values linked to the site.
- Rehabilitation of Sellick Creek for improved public safety, ecological restoration and sediment management

7.1 Future Considerations

This report is provided to support the Code Amendment process. Further calculations and detailed design will be necessary to confirm the sizing and spatial requirements of the stormwater management and WSUD elements recommended. It is recommended that an integrated planning process should be undertaken as part of a future development application to enable the stormwater management requirements to be integrated into a functional site layout. Climate change risk assessment assessing climate-related risks, prioritizing adaptive measures to mitigate potential deficiencies in performance and capacity, and engaging with the key stakeholders should also be further considered and appropriately integrated into final design. It is acknowledged that further investigations and detailed design is required as part of the land development process. This report demonstrates that appropriate and sustainable stormwater management solutions are achievable, and details the external infrastructure that will be required to service the future development.

APPENDIX A

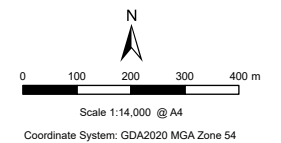
CATCHMENT EXTENTS & EXISTING STORMWATER ASSETS





LEGEND

- Pits
- GPT
- Drains
- Culverts
- Water Courses
- Open Drains
- Storages
- Parcel



WGA

Figure 2

Sellicks Beach Master Plan

Existing Infrastructure

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.
Note: The information shown on this map is a copyright of WGA 2025

APPENDIX B

RISK REGISTER



Likelihood and Consequence Matrix

LIKELIHOOD	CONSEQUENCE		
	Low Minor adverse social or environmental impact	Medium Measurable adverse environmental or social impact. Will result in annoyance or nuisance to community	High Significant damage or impact on environmental systems and local community
Low The event could occur only rarely, or is unlikely to occur	Low Risk	Low Risk	Medium Risk (could be high)
Medium The event will occur occasionally or could occur	Low Risk	Medium Risk	High Risk
High The event will occur often or is most likely to occur	Medium Risk	High Risk	High Risk

Preliminary Risk Register

The preliminary register is provided to document risks that have been discussed at the project inception meeting, from inspection of the site and through the stakeholder engagement process. This risk matrix will be revised and updated throughout the strategy development.

The risk register considers two types of risk:

- Project Delivery Risks - risks impacting delivery of the strategy ie. lack of information, unresolved issues, items requiring external input or agreement.
- Design Risk- risks that need to be addressed within the strategy – technical risks relating to the site, to be address in design solutions.

KEY RISKS							
ID	Issue	Potential Impact	Likelihood	Consequence	Level of Risk	Proposed Response/Management Measure	Risk Category
A	Aldinga Washpool – cultural and environmental values	Restrictions on discharge to the Aldinga Washpool are a key risk in the management of this stormwater catchment. If urban stormwater runoff cannot be discharged to the Aldinga Washpool then alternate solutions (pumping, reuse, MAR) will be needed. This is a key risk that needs to be confirmed and agreed with the key stakeholders.	High	Medium	High	Stakeholder consultation to understand the constraints and opportunities will be undertaken as part of the development of the strategy. An agreed principle for management of discharge from the Justs Road catchment is needed to allow the strategy to be developed by WGA. Design assumptions will be documented in the final report along with any residual risks, data gaps and/or recommendations. A collaborative approach is needed to consider all stakeholders.	Project Delivery
B	Sellicks Creek – cultural and environmental value	Impacts to design solutions due to the complexity linked to environmental, cultural and social connections to the creek.	Medium	Medium	Medium	GICU have commissioned a number of additional investigations that will be used to inform the risks and opportunities. The development of the strategy is to consider the findings of additional investigations into environmental and cultural constraints. WGA are to review and consider the relevant findings from these reports, and design solutions are to be sensitive to the constraints. Design assumptions will be documented in the final report along with any residual risks, data gaps and/or recommendations. A collaborative approach is needed to consider holistic solutions.	Project Delivery and Design

KEY RISKS							
D	Climate Change	The impact of climate change should be considered in modelling and design solutions. Increases in rainfall intensity and patterns may impact sizing and design of stormwater systems (basins, waterways and WSUD). Other factors such as decrease in annual rainfall, increased evaporation and temperature extremes must also be considered.	Medium	Medium	Medium	A risk-based approach to considering the impacts of climate change will be undertaken as part of the development of the strategy. WGA will engage with GICU to review the finding of the risk assessment and agree to an appropriate level of mitigation and/or residual risk to be adopted in the stage. The strategy will adopt stormwater management requirements, framework and principles (draft for review) as summarised below. • Undertake a climate change sensitivity assessment considering a 'climate risk envelope', to assess the potential impacts from climate change on the sizing of stormwater assets and waterway corridors. • Consider climate change impacts in the stormwater response to provide climate resilience, ie. support urban canopy cover, urban cooling, reduce impacts of erosion/sediment transfer, flood management	Project Delivery and Design
C	Sellicks Creek – highly degraded state	Sellick's Creek is severely degraded this is a continuous source of sediment and presents a high risk to the community and environment.	High	High	High	The strategy will adopt stormwater management requirements, framework and principles (draft for review) as summarised below. • The strategy will address the creek remediated to form a safe and sustainable connected corridor featuring a restored waterway environment. • Discharge into waterways shall: – Prevent erosion and scour. – Be treated using stormwater treatment systems that comply with EPA requirements meeting pollutant reduction targets. – Adopt the framework and principles from ANZECC guidelines to address risk and environmental harm. Sellicks Creek to be remediated utilising naturalistic waterway design principles to create a sustainable biodiversity waterway corridor.	Design

KEY RISKS							
D	Flood Risk	Increased flooding potential due to increase impervious areas and flatter downstream gradients.	Medium	High	High	The strategy will adopt stormwater management requirements, framework and principles (draft for review) as summarised below. • The peak post-development 1% AEP (100yr ARI) discharge rate must not exceed the peak pre-development 1% AEP (100 Year ARI) discharge rate. • The peak flows for the 4EY (3month ARI) and 1EY (1 year ARI) events are to be mitigated to predevelopment flows.	Design
E	Erosion at outlets/ waterways and sediment.	Scouring and erosion associated with increase velocities, peak, volume of water. Increase sediment transfer will have impacts on the downstream receiving environments.	Medium	Medium	Medium	The strategy will adopt stormwater management requirements, framework and principles (draft for review) as summarised below. • Discharge into waterways shall be designed to prevent erosion and scour. • The peak flows for the 4EY (3month ARI) and 1EY (1 year ARI) events are to be mitigated to predevelopment flows. • Creek and channel upgrade to consider naturalisation and remediation to prevent increased erosion and sediment transfer. • The adoption of WSUD principles and techniques is encouraged. Opportunities for both diffuse and end-of-line initiative (ie. Wetlands and streetscape WSUD).	Design
F	Waterway function	Changes in waterway function due to changes to hydrological regimes, sedimentation, erosion, water quality.	Medium	Medium	Medium	The strategy will adopt stormwater management requirements, framework and principles (draft for review) as summarised below. • The peak flows for the 4EY (3month ARI) and 1EY (1 year ARI) events are to be mitigated to predevelopment flows. • Post-development flow volume leaving the site must not be below pre-development flow volume leaving the site (Western Mount Lofty Ranges WAP requirement) • Discharge into waterways shall: – Prevent erosion and scour. – Be treated using stormwater treatment systems that comply with EPA requirements meeting pollutant reduction targets.	Design

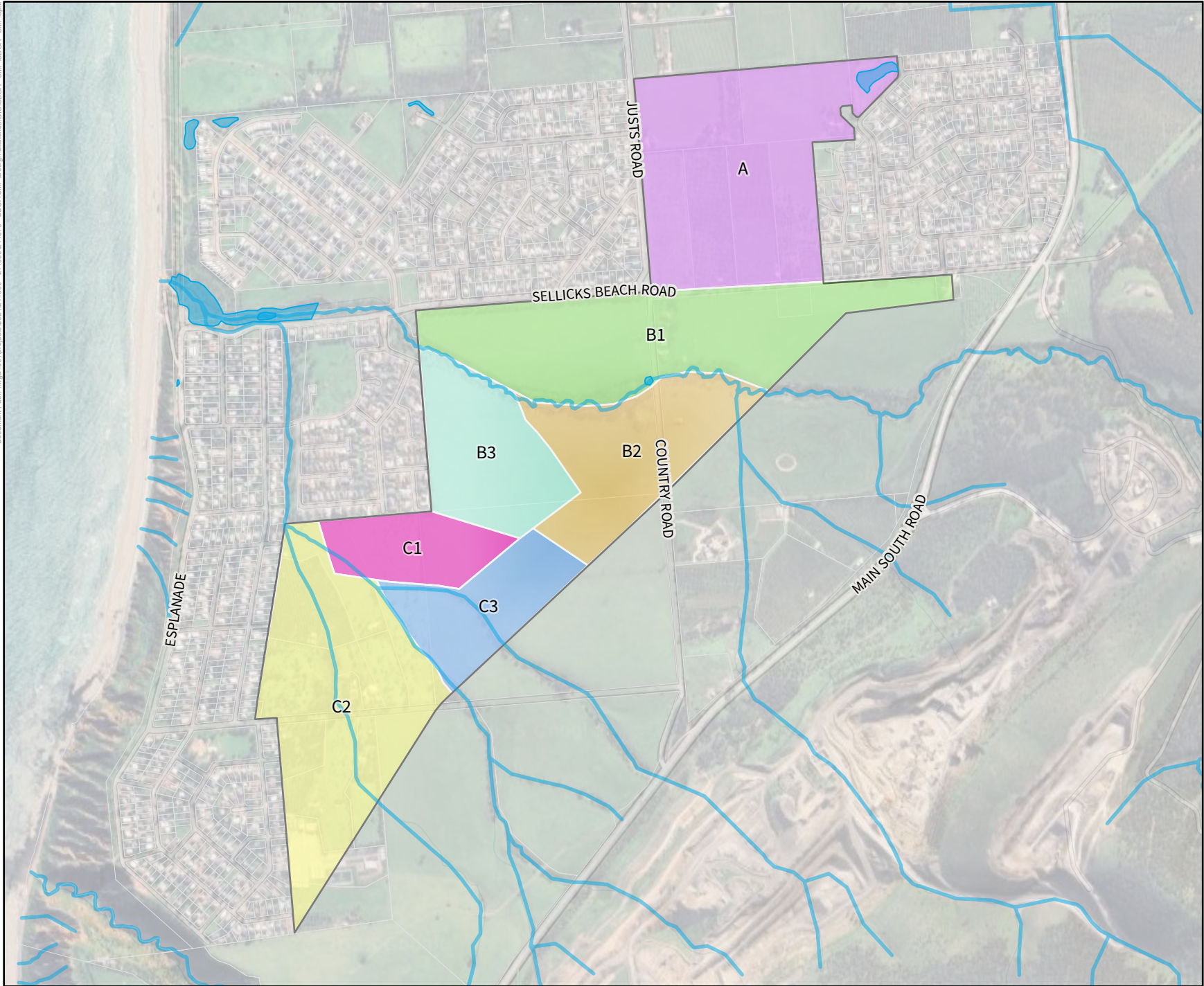
KEY RISKS							
F	Waterway function (Cont.)					– Adopt the framework and principles from ANZECC guidelines to address risk and environmental harm. – Sellicks Creek to be remediated utilising naturalistic waterway design principles to create a sustainable biodiversity waterway corridor.	
G	Impacts to downstream coastal environment	Increase urban stormwater volumes and erosion contributing to increased sediment loads.	Medium	Medium	High	The strategy will adopt stormwater management requirements, framework and principles (draft for review) as summarised below. • The peak flows for the 4EY (3month ARI) and 1EY (1 year ARI) events are to be mitigated to pre-development flows. • Post-development flow volume leaving the site must not be below pre-development flow volume leaving the site (Western Mount Lofty Ranges WAP requirement) • Discharge into waterways shall: – Prevent erosion and scour. – Be treated using stormwater treatment systems that comply with EPA requirements meeting pollutant reduction targets. – Adopt the framework and principles from ANZECC guidelines to address risk and environmental harm. – Sellicks Creek to be remediated utilising naturalistic waterway design principles to create a sustainable biodiversity waterway corridor.	Design
H	Increased runoff volumes due to increased impermeable surfaces	Impact to flow regimes and function of receiving waters.	High	Medium	High	The strategy will adopt stormwater management requirements, framework and principles (draft for review) as summarised below. • Using WSUD techniques to slow rate of runoff through swales, soakage systems and on-site retention. • The peak flows for the 4EY (3month ARI) and 1EY (1 year ARI) events are to be mitigated to predevelopment flows	Design

KEY RISKS							
I	Water Quality - Water Sensitive Urban Design	Runoff quality leads to long term water quality impacts to receiving environments.	Medium	Medium	Medium	The strategy will adopt stormwater management requirements, framework and principles (draft for review) as summarised below. - On site stormwater treatment shall comply with the WSUD pollutant reduction targets as follows: - Total Suspended Solids (TSS) 80% - Total Phosphorus (TP) 60% - Total Nitrogen (TN) 45% - Retention of litter greater than 50mm for flows up to a 3-month Average Recurrence Interval (ARI) peak flow - No visible oils for flows up to a 3-month ARI peak flow The adoption of WSUD principles and techniques is encouraged.	Design

APPENDIX C

STORMWATER CALCULATIONS





LEGEND

Water Courses

Storages

Parcel

Sub-Catchment Areas

A

B1

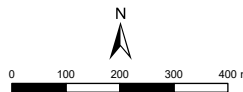
B2

B3

C1

C2

C3



Scale 1:14,000 @ A4

Coordinate System: GDA2020 MGA Zone 54

WGA

Figure 1

Sellicks Beach Master Plan

Sub-catchment Areas

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.

Note: The information shown on this map is a copyright of WGA 2025

Time of Concentration

RORB Area

367.977 ha

t_c - Bransby-Williams formula

Catchment 1

Upper Sthn Creeks

Lower Sthn Creeks

	F		F		F
	58.5		58.5		58.5
	A (km²)		A (km²)		A (km²)
RORB	3.680		1.175		0.329
	L (m)		L (m)		L (m)
	3431.00		1420.00		628.00
	L (km)		L (km)		L (km)
	3.431		1.420		0.628
	H_1 (m AHD)		H_1 (m AHD)		H_1 (m AHD)
	340		232		126
	H_2 (m AHD)		H_2 (m AHD)		H_2 (m AHD)
	74		68		70
	ΔH (m)		ΔH (m)		ΔH (m)
	266		164		56
	S (m/km)		S (m/km)		S (m/km)
	77.5		115.5		89.2
	Se (m/km)		Se (m/km)		Se (m/km)
	99.1		90		73.1
	t_c (min)		t_c (min)		t_c (min)
	70		33		17

T_c Check using 0.5A^0.65	t_c		t_c	t_c
	1.20	Hours	0.38	0.11
	71.76	mins	22.91	6.41

Summary Table

	Sellick Creek	Southern Creeks Upper	Southern Creeks Lower	Justs Road
Area (km ²)	3.68	1.17	0.33	0.32
Length (km)	3.431	1.420	0.628	700.000
Se (m/km)	99.1	90	73.1	6.67%
t _c (mins)	70	33	17	42
Rational Method Q(m ³ /s)	14.6	8.0	3.7	2.1

DIT Rational Method

Sellicks Creek	Southern Creeks Upper
Runoff Coefficient, C (-)	Runoff Coefficient, C (-)
Step 1 - Base Coefficient (10% AEP)	Step 1 - Base Coefficient (10% AEP)
0.20For Dairy Farming, Orchards/Vineyards, and Horticulture Catchment Terr	0.20For Dairy Farming, Orchards/Vineyards, and Horticulture Catchment Terrains
Step 2 - Slope Adjustment	Step 2 - Slope Adjustment
+ 0.03Se > 50 m/km	+ 0.03Se > 50 m/km
0.23C	0.23C
Step 3 - Catchment Area Adjustment	Step 3 - Catchment Area Adjustment
0.32C = (100/A)^0.10 <= 0.4, A in km^2	0.36C = (100/A)^0.10 <= 0.4, A in km^2
Step 4 - Location Adjustment	Step 4 - Location Adjustment
0.38C(1% AEP)	0.41C(1% AEP)
Step 5 - Average Recurrence Interval (ARI) adjustment	Step 5 - Average Recurrence Interval (ARI) adjustment
1.2	1.2
ARI (Years)Factor (-)	ARI (Years)Factor (-)
50.7	50.7
101.00	101.00
201.15	201.15
1001.6	1001.6

Interpolation of IFD intensity	
Input from IFD intenisty table from data hub (for tc that is between two durations)	
Durations	Intensities
60	40.3
90	31.1
calculated tc being used to interpolate to get the intenisty at this duration.	
70.272	

Intenisty
37.15calculated

Rational Method Flow calculation	
k	0.278Area in km ²
C _y	0.38Calculated using DIT method
I	37.15From IFD table/ Tc calc
A	3.68km ²
Q _y	14.59Calculated

1%

Southern Creeks Upper	Southern Creeks Lower
Runoff Coefficient, C (-)	Runoff Coefficient, C (-)
Step 1 - Base Coefficient (10% AEP)	Step 1 - Base Coefficient (10% AEP)
0.20For Dairy Farming, Orchards/Vineyards, and Horticulture Catchment Terrains	0.20For Dairy Farming, Orchards/Vineyards, and Horticulture Catchment Terrains
Step 2 - Slope Adjustment	Step 2 - Slope Adjustment
+ 0.03Se > 50 m/km	+ 0.03Se > 50 m/km
0.23C	0.23C
Step 3 - Catchment Area Adjustment	Step 3 - Catchment Area Adjustment
0.36C = (100/A)^0.10 <= 0.4, A in km^2	0.41C = (100/A)^0.10 <= 0.4, A in km^2
Step 4 - Location Adjustment	Step 4 - Location Adjustment
0.41C(1% AEP)	0.46C(1% AEP)
Step 5 - Average Recurrence Interval (ARI) adjustment	Step 5 - Average Recurrence Interval (ARI) adjustment
1.2	1.2
ARI (Years)Factor (-)	ARI (Years)Factor (-)
50.7	50.7
101.00	101.00
201.15	201.15
1001.6	1001.6

Interpolation of IFD intensity	
Input from IFD intenisty table from data hub (for tc that is between two durations)	
Durations	Intensities
30	62.4
45	48.4
calculated tc being used to interpolate to get the intenisty at this duration.	
33.235	

Intenisty
59.38calculated

Rational Method Flow calculation	
k	0.278Area in km ²
C _y	0.41Calculated using DIT method
I	59.38From IFD table/ Tc calc
A	1.17km ²
Q _y	8.00Calculated

1%

Southern Creeks Lower	Justs Road
Runoff Coefficient, C (-)	Runoff Coefficient, C (-)
Step 1 - Base Coefficient (10% AEP)	Step 1 - Base Coefficient (10% AEP)
0.20For Dairy Farming, Orchards/Vineyards, and Horticulture Catchment Terrains	0.20For Dairy Farming, Orchards/Vineyards, and Horticulture Catchment Terrains
Step 2 - Slope Adjustment	Step 2 - Slope Adjustment
+ 0.03Se > 50 m/km	+ 0.03Se > 50 m/km
0.23C	0.23C
Step 3 - Catchment Area Adjustment	Step 3 - Catchment Area Adjustment
0.41C = (100/A)^0.10 <= 0.4, A in km^2	0.41C = (100/A)^0.10 <= 0.4, A in km^2
0.4	0.4(1% AEP)
Step 4 - Location Adjustment	Step 4 - Location Adjustment
0.46C	0.46C
Step 5 - Average Recurrence Interval (ARI) adjustment	Step 5 - Average Recurrence Interval (ARI) adjustment
1.2	1.2
ARI (Years)Factor (-)	ARI (Years)Factor (-)
50.7	50.7
101.00	101.00
201.15	201.15
1001.6	1001.6

Interpolation of IFD intensity	
Input from IFD intenisty table from data hub (for tc that is between two durations)	
Durations	Intensities
15	94.2
20	79.7
calculated tc being used to interpolate to get the intenisty at this duration.	
17.404	

Intenisty
87.23calculated

Rational Method Flow calculation	
k	0.278
C _y	0.46
I	87.23
A	0.33
Q _y	3.67Calculated

Justs Road	Justs Road
Runoff Coefficient, C (-)	Runoff Coefficient, C (-)
Step 1 - Base Coefficient (10% AEP)	Step 1 - Base Coefficient (10% AEP)
0.20For Dairy Farming, Orchards/Vineyards, and Horticulture Catchment Terrains	0.20For Dairy Farming, Orchards/Vineyards, and Horticulture Catchment Terrains
Step 2 - Slope Adjustment	Step 2 - Slope Adjustment
+ 0.03Se > 50 m/km	+ 0.03Se > 50 m/km
0.23C	0.23C
Step 3 - Catchment Area Adjustment	Step 3 - Catchment Area Adjustment
0.41C = (100/A)^0.10 <= 0.4, A in km^2	0.41C = (100/A)^0.10 <= 0.4, A in km^2
0.4	0.4(1% AEP)
Step 4 - Location Adjustment	Step 4 - Location Adjustment
0.46C	0.46C
Step 5 - Average Recurrence Interval (ARI) adjustment	Step 5 - Average Recurrence Interval (ARI) adjustment
1.2	1.2
ARI (Years)Factor (-)	ARI (Years)Factor (-)
50.7	50.7
101.00	101.00
201.15	201.15
1001.6	1001.6

Interpolation of IFD intensity	
Input from IFD intenisty table from data hub (for tc that is between two durations)	
Durations	Intensities
30	62.4
45	48.4
calculated tc being used to interpolate to get the intenisty at this duration.	
42.000	

Intenisty
51.20calculated

Rational Method Flow calculation	
k	0.278
C _y	0.46
I	51.20
A	0.32
Q _y	2.10Calculated

Summary Table

	Sellick Creek	Southern Creeks Upper	Southern Creeks Lower
Area (km ²)	3.68	1.17	0.33
Length (km)	3.431	1.42	0.63
Se (m/km)	99.1	90.00	73.10
t_c (mins)	70	33.24	17.40
Rational Method Q(m ³ /s)	21.2	11.3	4.9

Sellicks Creek

Time of Concentration

F	58.5 factor for km ²
L	3.431 km
A	3.68 km ²
S _a	99.10 From Se
T _c	70.3 mins (Calculated)

Interpolation of IFD intensity

that is between two durations)	
Durations	Intensities
60	14.6
90	11.3

calculated tc being used to interpolate to get the intenisty at this duration.

70.272

Intenisty

13.47 calcuated

(C) 8.0410375

Catchment Relief 5 Hilly to steep slopes 4–15%

Catchment storage 10 Well defined water courses, negligible storage

Ground characteristics 30 Agricultural land

C50 0.530410375

Adjustment 0.556930894

Rational Method Flow calculation

k	0.278 Area in km ²
C _y	0.56 Calculated using DIT method
I	37.15 From IFD table/ Tc calc
A	3.67977 km ²

Q _y	21.16538288 Calculated
----------------	------------------------

Southern Creeks Upper

Time of Concentration

F	58.5 factor for km ²
L	1.420 km
A	1.17 km ²
S _a	90.00 From Se
T _c	33.2 mins (Calculated)

Interpolation of IFD intensity

durations)	
Durations	Intensities
30	22.4
45	17.4

calculated tc being used to interpolate to get the intenisty at this duration.

33.235

Intenisty

21.32 calcuated

(C) 10.39648352

Catchment Relief 5 Hilly to steep slopes 4–15%

Catchment storage 10 Well defined water courses, negligible storage

Ground characteristics 30 Agricultural land

C50 0.553964835

Adjustment 0.581663077

Rational Method Flow calculation

k	0.278 Area in km ²
C _y	0.58 Calculated using DIT method
I	59.38 From IFD table/ Tc calc
A	1.17484 km ²

Q _y	11.28077563 Calculated
----------------	------------------------

$$Q_y = k \times C_y \times I_{t_c,y} \times A$$

3

where

- Q_y = Flow rate, Q (m³/s) for an ARI of Y years
- k = A conversion factor, k = 0.278 when A is in km² and 0.00278 when A is A hectares (ha) and for smaller catchments (i.e. urban) when A is m², k = 0.278 × 10⁻⁶
- C_y = Run-off coefficient, C (dimensionless) for an ARI of Y years
- $I_{t_c,y}$ = Average rainfall intensity, I (mm/h) for design duration of t_c (time of concentration, see Section 6.6.2 – Time of Concentration) and ARI of Y years
- A = Area of catchment either hectares, km² or m²

$$t_c = \frac{F \times L}{A^{0.3} \times S_a^{0.2}}$$

where

- t_c = Time of concentration (min)
- F = A conversion factor. F = 58.5 when A is in km² and 92.7 when A is hectares (ha)
- L = Length of mainstream(km) from the outlet to the catchment divide
- A = Area of catchment (either km² or hectares)
- S_a = Equal area slope (m/km) as defined in Figure 6.4

Southern Creeks Lower

Time of Concentration

F	58.5
L	0.628
A	0.33
S _a	73.10
T _c	17

Interpolation of IFD intensity

between two durations)	
Durations	Intensities
15	33.5

20 28.5

duration.

17.404

Intenisty

31.10 calcuated

(C) 13.32876406

Catchment Relief 5 Hilly to steep slopes 4–15%

Catchment storage 10 Well defined water courses, negligible storage

Ground characteristics 30 Agricultural land

C50 0.583287641

Adjustment 0.612452023

Rational Method Flow calculation

k	0.278
C _y	0.61
I	87.23
A	0.33

Q _y	4.881718695 Calculated
----------------	------------------------

Pre-development

	Area (m^2)	Area (ha)	Pre-development Flow Path (m)
A	305000	30.50	700
BB1	280000	28.00	800
BB2	160000	16.00	560
BB3	130000	13.00	447
CC1	80000	8.00	433
CC2	290000	29	890
CC3	100000	10	353
1a	142390	14.2	514

AEP (%)
1

k
0.000000278

C
0.2 Table RD-DK-D1-8-5: Mixed Farming

n* (-)
0.1 Table 6.12: Short grass paddock

Sub-catchment #	H_1 (m AHD)	H_2 (m AHD)	ΔH (m)	S (m/m)	Assumed T_c (mm/h)	I (mm/h)	T_c (min)	Q (m^3/s)	Q (L/s)
A	86	40	46	0.0657	42	50.5	42	0.856	856
BB1	75	35	40	0.0500	52	44.1	52	0.686	686
BB2	74	54	20	0.0357	44	49.1	44	0.436	436
BB3	78	38	40	0.0895	26	68.1	26	0.492	492
CC1	60	42	18	0.0416	34	57.7	34	0.256	256
CC2	78	42	36	0.0404	61	40.0	61	0.644	644
CC3	76	54	22	0.0623	25	69.7	25	0.387	387
1a	114	78	36	0.0700	25	69.7	30	0.551	551
Duration (min)	I (mm/h)								
1	251								
2	217								
3	194								
4	176								
5	162								
6	150								
7	140								
8	131								
9	124								
10	117								
11	112								
12	107								
13	102								
14	97.9								
15	94.2								
16	90.8								
17	87.7								
18	84.8								
19	82.2								
20	79.7								
21	77.5								
22	75.3								
23	73.4								
24	71.5								
25	69.7								
26	68.1								
27	66.5								
28	65.1								
29	63.7								
30	62.4								
31	61.1								
32	59.9								
33	58.8								
34	57.7								
35	56.7								
36	55.7								
37	54.7								
38	53.8								
39	52.9								
40	52.1								
41	51.3								
42	50.5								
43	49.8								
44	49.1								
45	48.4								
46	47.7								
47	47.1								
48	46.4								
49	45.8								
50	45.3								
51	44.7								
52	44.1								
53	43.6								
54	43.1								
55	42.6								
56	42.1								
57	41.6								
58	41.2								
59	40.7								
60	40.3								
61	40.0								
62	39.7								
63	39.4								
64	39.1								
65	38.8								
66	38.5								
67	38.2								

68	37.8
69	37.5
70	37.2
71	36.9
72	36.6
73	36.3
74	36.0
75	35.7
76	35.4
77	35.1
78	34.8
79	34.5
80	34.2
81	33.9
82	33.6
83	33.2
84	32.9
85	32.6
86	32.3
87	32.0
88	31.7
89	31.4
90	31.1
120	25.9
180	20
270	15.5
360	12.9
540	9.85
720	8.11
1080	6.08
1440	4.91
1800	4.13
2160	3.56
2880	2.8
4320	1.96
5760	1.5
7200	1.22
8640	1.03
10080	0.891

Pre-development	Area (m²)	Area (ha)	Pre-development Flow Path (m)										
A	305000	30.50	700										
BB1	280000	28.00	1216										
BB2	160000	16.00	560										
BB3	130000	13.00	447										
CC1	80000	8.00	433										
CC2	290000	29	890										
CC3	100000	10	353										
1a	142390	14.2	514										
AEP (%)													
1													
	PA (%)	RIA (%)	EIA (%)	*Table RD-DK-D1 8-1 Acceptable surface parameters									
Residential allotments 300 - 500 m2	10	20	70										
C	1	0.9	0.2										
Weighted Average	0.83												
Roof Drainage Travel time	5 Guide to Road Design Part 5: Drainage												
k													
0.000000278													
C													
0.2	Table RD-DK-D1-8-5: Mixed Farming												
n* (-)													
0.013	Table 6.12: Concrete or Asphalt												
0.1	Table 6.12: Short grass paddock												
Sub-catchment #	H_1 (m AHD)	H_2 (m AHD)	ΔH (m)	S (m/m)	Assumed T_c (mm/h)	I (mm/h)	Road T_c (min)	Pipe T_c (min)	Paved T_c (min)	Supplementary T_c (min)	Grassed T_c (min)	Q (m³/s)	Q (L/s)
BB1	88	34	54	4.44%	15	94.2	5	4	14	19	24	6.081	6081
BB2	74	54	20	3.57%	9	124.0	5	2	12	17	22	4.574	4574
BB3	78	38	40	8.95%	5	162.0	5	1	11	16	21	4.856	4856
CC1	60	42	18	4.16%	7	140.0	5	2	12	17	22	2.582	2582
CC2	78	42	36	4.04%	12	107.0	5	3	13	18	23	7.154	7154
CC3	76	54	22	6.23%	5	162.0	5	1	11	16	21	3.735	3735
A	86	40	46	6.57%	5	162.0	5	2	12	17	22.0		
Duration (min)	I (mm/h)												
1	251												
2	217												
3	194												
4	176												
5	162												
6	150												
7	140												
8	131												
9	124												
10	117												
11	112												
12	107												
13	102												
14	97.9												
15	94.2												
16	90.8												
17	87.7												
18	84.8												
19	82.2												
20	79.7												
21	77.5												
22	75.3												
23	73.4												
24	71.5												
25	69.7												
26	68.1												
27	66.5												
28	65.1												
29	63.7												
30	62.4												
31	61.1												
32	59.9												
33	58.8												
34	57.7												
35	56.7												
36	55.7												
37	54.7												
38	53.8												
39	52.9												
40	52.1												
41	51.3												
42	50.5												
43	49.8												
44	49.1												
45	48.4												
46	47.7												
47	47.1												
48	46.4												
49	45.8												
50	45.3												
51	44.7												
52	44.1												
53	43.6												
54	43.1												
55	42.6												
56	42.1												
57	41.6												
58	41.2												
59	40.7												
60	40.3												
61	40.0												
62	39.7												
63	39.4												
64	39.1												
65	38.8												
66	38.5												
67	38.2												
68	37.8												
69	37.5												
70	37.2												
71	36.9												
72	36.6												
73	36.3												
74	36.0												
75	35.7												
76	35.4												
77	35.1												
78	34.8												
79	34.5												
80	34.2												
81	33.9												
82	33.6												
83	33.2												

84	32.9
85	32.6
86	32.3
87	32.0
88	31.7
89	31.4
90	31.1
120	25.9
180	20
270	15.5
360	12.9
540	9.85
720	8.11
1080	6.08
1440	4.91
1800	4.13
2160	3.56
2880	2.8
4320	1.96
5760	1.5
7200	1.22
8640	1.03
10080	0.891

IFD Design Rainfall Intensity (mm/h)

Issued: 25-Mar-25

Location Label:

Requested Latitude -35.33 Longitude 138.455

Nearest grid Latitude 35.3375 (S) Longitude 138.4625 (E)

		Annual Exceedance Probability (AEP)						
Duration	Duration in	63.20%	50%	20%	10%	5%	2%	1%
1 min	1	79.8	89.9	124	150	178	218	251
2 min	2	71.2	79.8	109	131	155	189	217
3 min	3	63	70.8	97.1	117	138	168	194
4 min	4	56.7	63.7	87.7	106	125	153	176
5 min	5	51.7	58.2	80.2	96.8	114	140	162
10 min	10	37.1	41.8	57.8	69.9	82.8	102	117
15 min	15	29.8	33.5	46.4	56.1	66.5	81.5	94.2
20 min	20	25.3	28.5	39.3	47.6	56.3	69	79.7
25 min	25	22.2	25	34.5	41.7	49.3	60.4	69.7
30 min	30	19.9	22.4	30.9	37.3	44.1	54	62.4
45 min	45	15.5	17.4	24	29	34.3	41.9	48.4
1 hour	60	13	14.6	20.1	24.2	28.6	35	40.3
1.5 hour	90	10	11.3	15.5	18.7	22.1	27	31.1
2 hour	120	8.35	9.38	12.9	15.6	18.4	22.5	25.9
3 hour	180	6.43	7.22	9.94	12	14.2	17.4	20
4.5 hour	270	4.93	5.54	7.64	9.23	10.9	13.4	15.5
6 hour	360	4.08	4.59	6.33	7.65	9.06	11.1	12.9
9 hour	540	3.11	3.5	4.83	5.84	6.93	8.51	9.85
12 hour	720	2.56	2.88	3.97	4.8	5.7	7	8.11
18 hour	1080	1.94	2.17	2.99	3.61	4.28	5.26	6.08
24 hour	1440	1.59	1.78	2.43	2.93	3.47	4.25	4.91
30 hour	1800	1.36	1.51	2.06	2.48	2.93	3.58	4.13
36 hour	2160	1.19	1.33	1.8	2.16	2.54	3.1	3.56
48 hour	2880	0.968	1.08	1.44	1.72	2.02	2.44	2.8
72 hour	4320	0.722	0.798	1.05	1.24	1.44	1.73	1.96
96 hour	5760	0.586	0.645	0.841	0.984	1.13	1.34	1.5
120 hour	7200	0.499	0.547	0.707	0.821	0.937	1.1	1.22
144 hour	8640	0.437	0.48	0.615	0.71	0.804	0.931	1.03
168 hour	10080	0.392	0.43	0.549	0.63	0.709	0.812	0.891

Key Assumptions

RORB Analysis

ARR1987 method as outlined in DIT’s Road Drainage Design Master Spec and Kemp & Hewa (2019).

Initial Loss:	24 mm
Continuing Loss:	4.60 mm/h
Kemp (1993) method (also for catchments in SA with a mean average rainfall greater than 500 mm) to calculate kc	
Sellicks Creek kc:	1.91
Southern Creeks kc:	1.11
M value	0.8
Class of streams:	Natural
Impervious Area:	0%

DIT Rational Method

Runoff Coefficient0.2 (dairy farming, orchards / vineyards and horticulture)

Runof coefficient adjusted using the DIT Rational Method.

Time of Concentration(calculated from the Bransby-Williams formula for rural catchments)

Sellicks Creek	70
Upper Southern Creeks	33
Lower Southern Creeks	17

DRAINS Modelling

Rural Catchments(Aerial imagery has shown that all upstream catchments consist of approximately 5% roads and additional supplementary paved.)

Roads	5%
Supplementary	5%
Grassed	90%

Adopted using the ILSAX model

RORB

		1% AEP					Design Storm Duration (h)	Peak Flow Time (h)
		k_c Method	k_c (-)	IL (mm)	CL (mm/h)	Q (m^3/s)		
Sellicks Creek Upstream	ARR1987 and ARR Data Hub	SA MAR > 500 = 0.89A^0.55	1.91	24.0	4.6	15.0815	6	1.75
Southern Creeks Upstream (upper)	ARR1987 and ARR Data Hub	SA MAR > 500 = 0.89A^0.55	1.11	24.0	4.6	4.8989	1.5	1.08
Southern Creeks Upstream (lower)	ARR1987 and ARR Data Hub	SA MAR > 500 = 0.89A^0.56	1.11	24.0	4.6	1.8288	1.5	1



C (-)	r	l	p	Weighted Average C (-)	
Pre-development (%)	1.0	0.9	0.2	-	AS 3500.3
Post-development (%)	0	0	100	0.2	Table RD-DK-D1-9-5: Mixed Farming
	70	10	20	0.83	Table RD-DK-D1-7-1

Sub-catchment #	Area (m ²)	Area (ha)	Pre-development Flow Path (m)	Post-development Flow Path (m)
A	320000	32	700	700
BB1	280000	28	1216	1216
BB2	160000	16	560	560
BB3	130000	13	447	447
CC1	80000	8	433	433
CC2	290000	29	890	890
CC3	100000	10	353	353
CC1 and CC3	180000			

$$Q_p = R \times C_p \times I_{A,p} \times A$$

where

Q_p = Flow rate, Q (m³/s) for an ARI of Y years

R = A conversion factor ($R = 0.278$ when A is in km² and 0.00278 when A is hectares (ha)) and for smaller catchments (i.e. urban) when A is m², $R = 0.278 \times 10^6$

C_p = Run-off coefficient, C (dimensionless) for an ARI of Y years

$I_{A,p}$ = Average rainfall intensity, i (mm/h) for design duration of t_c (time of concentration, see Section 6.6.2 - Time of Concentration) and ARI of Y years

A = Area of catchment either hectares, km² or m²

$$T_c = \frac{6.94(L \times n^*)^{0.6}}{I^{0.4} \times S^{0.3}}$$

AEP (%)
1

k
0.00000278

Pre-development

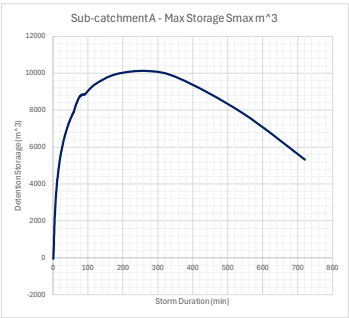
n* (-)
0.1
Table 6.12: Short grass paddock

Sub-catchment #	H_1 (m AHD)	H_2 (m AHD)	ΔH (m)	S (m/m)	Assumed T_c (mm/h)	I (mm/h)	T_c (min)	Q (m ³ /s)	Q (L/s)	pre-dev (DEW)
A	86	40	0.066	46	42	50.5	42	0.898	898	0.135
BB1	88	34	0.044	54	76	35.4	76	0.551	551	
BB2	74	54	0.036	44	44	40.1	44	0.436	436	
BB3	78	38	0.089	40	26	68.1	26	0.492	492	
CC1	60	42	0.042	18	34	57.7	34	0.256	256	
CC2	78	42	0.040	36	61	40.0	61	0.644	644	
CC3	76	54	0.062		25	69.7	25	0.387	387	

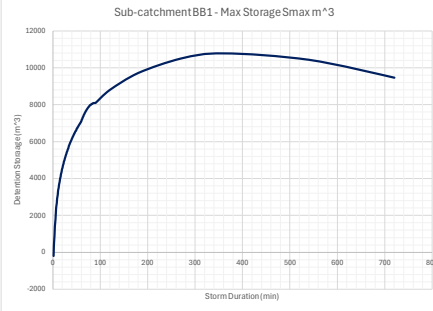
Detention Storage Assessment

Sub-catchment A S_max (m ³)					Sub-catchment BB1 S_max (m ³)					Sub-catchment BB2 S_max (m ³)				
10122					10786					4395				
Duration (min)	I (mm/h)	Inflow Volume (L/s)	Inflow Volume (m ³ /s)	Max Storage (m ³)	Duration (min)	I (mm/h)	Inflow Rate (L/s)	Inflow Volume (m ³ /s)	Max Storage (m ³)	Duration (min)	I (mm/h)	Inflow Rate (L/s)	Inflow Volume (m ³ /s)	Max Storage (m ³)
1	251	18518	1111	-47	1	251	16203	972	-186	1	251	9259	556	-34
2	217	16010	1921	736	2	217	14009	1681	393	2	217	8005	961	358
3	194	14213	2576	1364	3	194	12254	2254	949	3	194	7156	1268	673
4	176	12985	3116	1877	4	176	11362	2727	1405	4	176	6492	1558	930
5	162	11952	3586	2320	5	162	10458	3137	1800	5	162	5976	1793	1151
6	150	11067	3984	2691	6	150	9683	3486	2132	6	150	5533	1992	1337
7	140	10329	4338	3018	7	140	9038	3796	2425	7	140	5164	2169	1501
8	131	9665	4639	3292	8	131	8457	4059	2672	8	131	4832	2320	1639
9	124	9148	4940	3567	9	124	8005	4323	2919	9	124	4574	2470	1776
10	117	8632	5179	3779	10	117	7553	4532	3111	10	117	4316	2590	1883
11	112	8263	5454	4026	11	112	7230	4772	3335	11	112	4132	2727	2007
12	107	7894	5684	4229	12	107	6907	4973	3520	12	107	3947	2842	2109
13	102	7525	5870	4388	13	102	6536	5136	3666	13	102	3763	2935	2189
14	97.9	7223	6067	4559	14	97.9	6320	5309	3822	14	98	3611	3034	2274
15	94.2	6950	6255	4720	15	94.2	6081	5473	3970	15	94	3475	3127	2355
16	90.8	6431	6699	5011	16	90.8	5662	5627	4108	16	91	3350	3216	2430
17	87.7	6470	6600	5141	17	87.7	5662	5775	4239	17	88	3235	3300	2501
18	84.8	6255	6757	5141	18	84.8	5474	5912	4360	18	85	3128	3378	2567
19	82.2	6065	6914	5271	19	82.2	5306	6049	4480	19	82	3032	3457	2632
20	79.7	5880	7056	5386	20	79.7	5145	6174	4588	20	80	2940	3528	2690
21	77.5	5718	7204	5508	21	77.5	5003	6304	4702	21	78	2859	3602	2751
22	75.3	5555	7333	5609	22	75.3	4861	6417	4798	22	75	2778	3667	2802
23	73.4	5415	7473	5722	23	73.4	4736	6539	4904	23	73	2708	3737	2859
24	71.5	5275	7596	5819	24	71.5	4616	6647	4995	24	72	2638	3798	2908
25	69.7	5142	7713	5909	25	69.7	4500	6749	5081	25	70	2571	3857	2953
26	68.1	5024	7838	6006	26	68.1	4396	6858	5173	26	68	2512	3919	3002
27	66.5	4906	7948	6090	27	66.5	4293	6955	5253	27	67	2453	3974	3044
28	65.1	4803	8069	6184	28	65.1	4200	7050	5343	28	65	2401	4034	3092
29	63.7	4700	8179	6265	29	63.7	4112	7155	5421	29	64	2350	4089	3133
30	62.4	4604	8287	6348	30	62.4	4028	7251	5500	30	62	2302	4143	3174
31	61.1	4508	8385	6418	31	61.1	3944	7336	5569	31	61	2254	4192	3210
32	59.9	4419	8485	6492	32	59.9	3867	7424	5641	32	60	2210	4243	3247
33	58.8	4336	8570	6570	33	58.8	3796	7516	5695	33	59	2169	4295	3287
34	57.7	4257	8684	6637	34	57.7	3725	7599	5782	34	58	2128	4342	3321
35	56.7	4183	8785	6711	35	56.7	3660	7687	5853	35	57	2092	4392	3358
36	55.7	4109	8876	6776	36	55.7	3596	7767	5917	36	56	2055	4438	3391
37	54.7	4036	8959	6831	37	54.7	3531	7839	5973	37	55	2018	4480	3419
38	53.8	3969	9050	6886	38	53.8	3473	7919	6036	38	54	1985	4525	3451
39	52.9	3903	9133	6951	39	52.9	3415	7991	6092	39	53	1951	4566	3480
40	52.1	3844	9225	7017	40	52.1	3363	8072	6156	40	52	1922	4613	3513
41	51.3	3785	9311	7075	41	51.3	3312	8147	6214	41	51	1892	4655	3542
42	50.5	3726	9389	7127	42	50.5	3260	8215	6266	42	51	1863	4694	3568
43	49.8	3674	9479	7190	43	49.8	3215	8274	6329	43	50	1837	4730	3601
44	49.1	3622	9563	7247	44	49.1	3170	8368	6386	44	49	1811	4762	3629
45	48.4	3571	9641	7298	45	48.4	3124	8436	6438	45	48	1785	4821	3655
46	47.7	3519	9713	7343	46	47.7	3079	8499	6484	46	48	1760	4856	3678
47	47.1	3475	9789	7402	47	47.1	3041	8574	6543	47	47	1737	4900	3708
48	46.4	3432	9859	7455	48	46.4	2997	8657	6597	48	46	1712	4939	3725
49	45.8	3379	9934	7483	49	45.8	2957	8697	6628	49	46	1690	4967	3749
50	45.3	3342	10026	7549	50	45.3	2924	8773	6692	50	45	1671	5013	3782
51	44.7	3298	10091	7587	51	44.7	2886	8830	6732	51	45	1649	5046	3802
52	44.1	3254	10151	7619	52	44.1	2847	8882	6768	52	44	1627	5076	3819

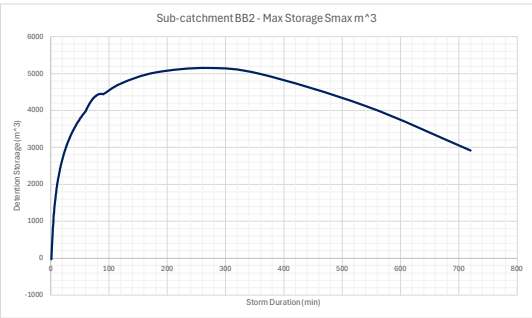
53	43.6	3217	10229	7670
54	43.1	3180	10303	7717
55	42.6	3143	10372	7759
56	42.1	3106	10436	7797
57	41.6	3069	10497	7830
58	41.2	3040	10578	7885
59	40.7	3003	10630	7909
60	40.3	2973	10704	7956
61	40.0	2951	10799	8025
62	39.7	2928	10892	8091
63	39.4	2905	10982	8154
64	39.1	2883	11070	8215
65	38.8	2860	11154	8273
66	38.5	2837	11236	8328
67	38.2	2815	11316	8380
68	37.8	2792	11392	8430
69	37.5	2770	11466	8477
70	37.2	2747	11537	8521
71	36.9	2724	11606	8562
72	36.6	2702	11672	8601
73	36.3	2679	11735	8637
74	36.0	2656	11795	8671
75	35.7	2634	11852	8701
76	35.4	2611	11907	8729
77	35.1	2589	11959	8754
78	34.8	2566	12009	8777
79	34.5	2543	12056	8797
80	34.2	2521	12100	8814
81	33.9	2498	12141	8828
82	33.6	2475	12179	8840
83	33.2	2453	12215	8849
84	32.9	2430	12248	8855
85	32.6	2408	12279	8858
86	32.3	2385	12307	8859
87	32.0	2362	12332	8857
88	31.7	2340	12354	8852
89	31.4	2317	12373	8845
90	31.1	2294	12390	8835
120	25.9	1911	13758	9395
180	20	1476	15936	9957
270	15.5	18526	10122	1144
360	12.9	952	20557	9730
540	9.85	727	23545	7870
720	8.11	598	25848	5325



53	43.6	2815	8950	6820
54	43.1	2762	9015	6868
55	42.6	2750	9075	6912
56	42.1	2718	9132	6952
57	41.6	2686	9184	6988
58	41.2	2660	9256	7042
59	40.7	2627	9301	7071
60	40.3	2602	9366	7119
61	40.0	2582	9449	7187
62	39.7	2562	9531	7251
63	39.4	2542	9610	7314
64	39.1	2522	9686	7374
65	38.8	2503	9760	7431
66	38.5	2483	9832	7487
67	38.2	2463	9901	7539
68	37.8	2443	9968	7590
69	37.5	2423	10033	7638
70	37.2	2404	10095	7684
71	36.9	2384	10155	7727
72	36.6	2364	10213	7768
73	36.3	2344	10268	7807
74	36.0	2324	10320	7843
75	35.7	2305	10371	7877
76	35.4	2285	10419	7908
77	35.1	2265	10464	7937
78	34.8	2245	10508	7964
79	34.5	2225	10549	7988
80	34.2	2206	10587	8010
81	33.9	2186	10623	8030
82	33.6	2166	10657	8047
83	33.2	2146	10688	8062
84	32.9	2126	10717	8075
85	32.6	2107	10744	8085
86	32.3	2087	10768	8092
87	32.0	2067	10790	8098
88	31.7	2047	10810	8101
89	31.4	2027	10827	8101
90	31.1	2008	10841	8100
120	25.9	1672	12038	8801
180	20.0	1291	13944	9716
270	15.5	1001	16210	10495
360	12.9	833	17988	10786
540	9.9	636	20602	10428
720	8.1	524	22617	9470



53	44	1608	5115	3845
54	43	1590	5151	3868
55	43	1571	5186	3890
56	42	1553	5218	3909
57	42	1535	5248	3926
58	41	1520	5289	3953
59	41	1501	5315	3966
60	40	1487	5352	3990
61	40	1475	5400	4025
62	40	1464	5446	4058
63	39	1453	5491	4090
64	39	1441	5535	4121
65	39	1430	5577	4150
66	38	1419	5618	4178
67	38	1407	5658	4205
68	38	1396	5696	4230
69	38	1385	5733	4254
70	37	1373	5769	4276
71	37	1362	5803	4297
72	37	1351	5836	4317
73	36	1340	5867	4335
74	36	1328	5897	4352
75	36	1317	5926	4368
76	35	1306	5954	4382
77	35	1294	5980	4395
78	35	1283	6004	4407
79	34	1272	6028	4417
80	34	1261	6050	4426
81	34	1249	6070	4434
82	34	1238	6090	4440
83	33	1226	6108	4445
84	33	1215	6124	4448
85	33	1204	6139	4450
86	32	1192	6153	4451
87	32	1181	6166	4451
88	32	1170	6177	4449
89	31	1159	6187	4445
90	31	1147	6195	4441
120	26	955	6879	4732
180	20	738	7968	5035
270	16	572	9263	5151
360	13	476	10279	4989
540	10	363	11773	4126
720	8	299	12924	2921



Sub-catchment BB3 S_max (m^3)

5339

Duration (min)	I (mm/h)	Inflow Rate (L/s)	Inflow Volume (m^3)	Max Storage (m^3)
1	251	7523	451	53
2	217	6504	780	367
3	194	5815	1047	619
4	176	5275	1266	823
5	162	4856	1457	999
6	150	4496	1619	1146
7	140	4196	1762	1275
8	131	3926	1886	1383
9	124	3717	2007	1491
10	117	3507	2104	1573
11	112	3357	2216	1670
12	107	3207	2309	1748
13	102	3057	2385	1809
14	98	2934	2465	1875
15	94	2823	2541	1936
16	91	2721	2613	1993
17	88	2629	2681	2047
18	85	2542	2745	2096
19	82	2464	2809	2145
20	80	2389	2867	2188

Sub-catchment CC1 S_max (m^3)

2885

Duration (min)	I (mm/h)	Inflow Rate (L/s)	Inflow Volume (m^3)	Max Storage (m^3)
1	251	7523	278	9
2	217	6503	600	323
3	194	5815	920	605
4	176	5275	1240	974
5	162	4856	1560	1280
6	150	4496	1880	1560
7	140	4196	2200	1820
8	131	3926	2520	2070
9	124	3717	2840	2300
10	117	3507	3160	2510
11	112	3357	3480	2700
12	107	3207	3800	2870
13	102	3057	4120	3020
14	97.9	2934	4440	3150
15	94.2	2823	4760	3260
16	90.8	2721	5080	3350
17	87.7	2629	5400	3420
18	84.8	2542	5720	3470
19	82.2	2464	6040	3500
20	79.7	2389	6360	3510

Sub-catchment CC2 S_max (m^3)

10492

Duration (min)	I (mm/h)	Inflow Rate (L/s)	Inflow Volume (m^3)	Max Storage (m^3)
1	251	16782	1007	192
2	217	14509	1741	523
3	194	12971	2335	1098
4	176	11768	2824	1568
5	162	10832	3249	1974
6	150	10029	3611	2315
7	140	9361	3931	2617
8	131	8759	4204	2870
9	124	8291	4477	3124
10	117	7823	4694	3321
11	112	7488	4942	3551
12	107	7154	5151	3740
13	102	6820	5319	3889
14	97.9	6546	5498	4049
15	94.2	6298	5668	4199
16	90.8	6071	5828	4340
17	87.7	5864	5981	4473
18	84.8	5670	6123	4595
19	82.2	5496	6265	4719
20	79.7	5329	6395	4829

Sub-catchment CC3 S_max (m^3)

2615

Duration (min)	I (mm/h)	Inflow Rate (L/s)	Inflow Volume (m^3)	Max Storage (m^3)
1	251	5787	347	45
2	217	5003	600	287
3	194	4473	905	480
4	176	4058	1211	637
5	162	3735	1457	772
6	150	3458	1696	885
7	140	3228	1936	984
8	131	3020	2166	1066
9	124	2859	2392	1149
10	117	2698	2619	1212
11	112	2562	2845	1266
12	107	2467	3061	1313
13	102	2352	3267	1354
14	97.9	2257	3464	1393
15	94.2	2172	3651	1433
16	90.8	2093	3828	1470
17	87.7	2022	4000	1503
18	84.8	1955	4167	1533
19	82.2	1895	4329	1575
20	79.7	1838	4486	1612

21	78	2323	2927	2233	21	77.5	1787	2251	1828	21	77.5	5182	6529	4944	21	77.5	1787	2251	1717
22	75	2257	2979	2271	22	75.3	1736	2292	1861	22	75.3	5035	6646	5041	22	75.3	1736	2292	1746
23	73	2200	3026	2313	23	73.4	1692	2335	1897	23	73.4	4983	6772	5172	23	73.4	1692	2335	1778
24	72	2143	3086	2348	24	71.5	1648	2374	1928	24	71.5	4781	6884	5241	24	71.5	1648	2374	1805
25	70	2089	3134	2381	25	69.7	1607	2410	1957	25	69.7	4660	6990	5328	25	69.7	1607	2410	1830
26	68	2041	3184	2417	26	68.1	1570	2449	1988	26	68.1	4553	7103	5421	26	68.1	1570	2449	1857
27	67	1993	3229	2447	27	66.5	1533	2484	2014	27	66.5	4446	7203	5502	27	66.5	1533	2484	1880
28	65	1951	3278	2481	28	65.1	1501	2522	2045	28	65.1	4351	7312	5592	28	65.1	1501	2522	1906
29	64	1909	3322	2511	29	63.7	1469	2555	2071	29	63.7	4259	7411	5671	29	63.7	1469	2555	1928
30	62	1870	3366	2540	30	62.4	1439	2590	2097	30	62.4	4172	7510	5751	30	62.4	1439	2590	1951
31	61	1831	3406	2565	31	61.1	1409	2620	2120	31	61.1	4085	7598	5820	31	61.1	1409	2620	1970
32	60	1795	3447	2591	32	59.9	1381	2652	2144	32	59.9	4005	7690	5902	32	59.9	1381	2652	1989
33	59	1762	3489	2619	33	58.8	1357	2684	2169	33	58.8	3921	7784	5967	33	58.8	1357	2684	2010
34	58	1729	3528	2643	34	57.7	1330	2714	2191	34	57.7	3858	7870	6034	34	57.7	1330	2714	2028
35	57	1699	3569	2669	35	56.7	1307	2745	2214	35	56.7	3791	7961	6105	35	56.7	1307	2745	2048
36	56	1669	3606	2691	36	55.7	1284	2774	2235	36	55.7	3724	8044	6169	36	55.7	1284	2774	2065
37	55	1639	3640	2710	37	54.7	1261	2800	2254	37	54.7	3657	8119	6225	37	54.7	1261	2800	2079
38	54	1613	3677	2732	38	53.8	1240	2828	2274	38	53.8	3597	8201	6289	38	53.8	1240	2828	2096
39	53	1586	3710	2751	39	52.9	1220	2854	2292	39	52.9	3537	8276	6343	39	52.9	1220	2854	2110
40	52	1562	3748	2774	40	52.1	1201	2883	2314	40	52.1	3483	8360	6408	40	52.1	1201	2883	2128
41	51	1538	3782	2794	41	51.3	1183	2910	2333	41	51.3	3430	8438	6466	41	51.3	1183	2910	2143
42	51	1514	3814	2811	42	50.5	1164	2934	2349	42	50.5	3376	8509	6518	42	50.5	1164	2934	2156
43	50	1493	3851	2833	43	49.8	1146	2962	2370	43	49.8	3330	8591	6580	43	49.8	1146	2962	2172
44	49	1472	3885	2852	44	49.1	1132	2989	2388	44	49.1	3283	8667	6637	44	49.1	1132	2989	2187
45	48	1451	3917	2869	45	48.4	1116	3013	2405	45	48.4	3236	8737	6688	45	48.4	1116	3013	2200
46	48	1430	3946	2884	46	47.7	1100	3035	2420	46	47.7	3189	8802	6734	46	47.7	1100	3035	2211
47	47	1412	3981	2904	47	47.1	1086	3062	2439	47	47.1	3149	8881	6793	47	47.1	1086	3062	2226
48	46	1391	4005	2913	48	46.4	1070	3081	2450	48	46.4	3102	8935	6828	48	46.4	1070	3081	2233
49	46	1373	4036	2929	49	45.8	1056	3104	2466	49	45.8	3062	9003	6877	49	45.8	1056	3104	2245
50	45	1358	4073	2952	50	45.3	1044	3133	2487	50	45.3	3029	9086	6941	50	45.3	1044	3133	2262
51	45	1340	4100	2964	51	44.7	1031	3154	2500	51	44.7	2989	9145	6980	51	44.7	1031	3154	2271
52	44	1322	4124	2973	52	44.1	1017	3172	2511	52	44.1	2949	9200	7015	52	44.1	1017	3172	2278
53	44	1307	4156	2990	53	43.6	1005	3197	2527	53	43.6	2915	9270	7067	53	43.6	1005	3197	2291
54	43	1292	4185	3005	54	43.1	994	3220	2543	54	43.1	2882	9337	7114	54	43.1	994	3220	2302
55	43	1277	4213	3018	55	42.6	982	3241	2556	55	42.6	2848	9399	7157	55	42.6	982	3241	2312
56	42	1262	4240	3030	56	42.1	971	3261	2569	56	42.1	2815	9458	7196	56	42.1	971	3261	2320
57	42	1247	4264	3040	57	41.6	959	3280	2580	57	41.6	2781	9512	7232	57	41.6	959	3280	2328
58	41	1235	4297	3058	58	41.2	948	3295	2598	58	41.2	2755	9566	7266	58	41.2	950	3295	2336
59	41	1220	4318	3064	59	40.7	938	3322	2606	59	40.7	2721	9633	7314	59	40.7	938	3322	2346
60	40	1208	4348	3079	60	40.3	929	3345	2622	60	40.3	2695	9700	7361	60	40.3	929	3345	2357
61	40	1199	4387	3104	61	39.99333333	922	3375	2644	61	39.99333333	2674	9787	7429	61	39.99333333	922	3375	2376
62	40	1189	4425	3126	62	39.68666667	915	3404	2665	62	39.68666667	2653	9871	7493	62	39.68666667	915	3404	2393
63	39	1180	4462	3148	63	39.38	908	3432	2686	63	39.38	2633	9953	7556	63	39.38	908	3432	2410
64	39	1171	4497	3169	64	39.07333333	901	3459	2705	64	39.07333333	2612	10032	7616	64	39.07333333	901	3459	2425
65	39	1162	4532	3189	65	38.76666667	894	3486	2724	65	38.76666667	2592	10109	7673	65	38.76666667	894	3486	2440
66	38	1153	4565	3207	66	38.46	887	3511	2742	66	38.46	2571	10183	7728	66	38.46	887	3511	2454
67	38	1144	4597	3225	67	38.15333333	880	3536	2759	67	38.15333333	2551	10255	7781	67	38.15333333	880	3536	2467
68	38	1134	4628	3241	68	37.84666667	873	3560	2775	68	37.84666667	2530	10324	7831	68	37.84666667	873	3560	2480
69	38	1125	4658	3256	69	37.54	866	3583	2791	69	37.54	2510	10391	7878	69	37.54	866	3583	2491
70	37	1116	4687	3271	70	37.23333333	858	3605	2805	70	37.23333333	2489	10456	7923	70	37.23333333	858	3605	2502
71	37	1107	4715	3284	71	36.92666667	851	3627	2819	71	36.926667	2469	10518	7966	71	36.926667	851	3627	2512
72	37	1098	4742	3296	72	36.62	844	3647	2832	72	36.62	2448	10577	8006	72	36.62	844	3647	2521
73	36	1088	4767	3306	73	36.31333333	837	3667	2844	73	36.31333333	2428	10634	8044	73	36.31333333	837	3667	2529
74	36	1079	4792	3316	74	36.00666667	830	3686	2855	74	36.006667	2407	10689	8079	74	36.006667	830	3686	2536
75	36	1070	4815	3325	75	35.7	823	3704	2865	75	35.7	2387	10741	8112	75	35.7	823	3704	2542
76	35	1061	4837	3332	76	35.39333333	816	3721	2875	76	35.39333333	2366	10791	8143	76	35.39333333	816	3721	2548
77	35	1052	4859	3339	77	35.08666667	809	3737	2883	77	35.086667	2346	10838	8171	77	35.086667	809	3737	2552
78	35	1042	4879	3344	78	34.78	802	3753	2891	78	34.78	2325	10883	8196	78	34.78	802	3753	2556
79	34	1033	4898	3348	79	34.47333333	795	3767	2898	79	34.47333333	2305	10925	8210	79	34.47333333	795	3767	2559
80	34	1024	4915	3351	80	34.16666667	788	3781	2904	80	34.166667	2284	10965	8240	80	34.166667	788	3781	2561
81	34	1015	4932	3353	81	33.86	781	3794	2909	81	33.86	2264	11003	8258	81	33.86	781	3794	2563
82	34	1006	4948	3354	82	33.55333333	774	3806	2914	82	33.55333333	2243	11038	8273	82	33.55333333	774	3806	2563
83	33	996	4962	3354	83	33.24666667	767	3817	2917	83	33.246667	2223	11070	8287	83	33.246667	767	3817	2563
84	33	987	4976	3353	84	32.94	759	3828	2920	84	32.94	2202	11100	8297	84	32.94	759	3828	2561
85	33	978	4988	3350	85	32.63333333	752	3837	2922	85	32.63333333	2182	11128	8305	85	32.63333333	752	3837	2559
86	32	969	5000	3347	86	32.32666667	745	3846	2923	86	32.326667	2161	11153	8311	86	32.326667	745	3846	2556
87	32	960	5010	3342	87	32.02	738	3854	2923	87	32.02	2141	11175	8315	87	32.02	738	3854	2553
88	31	951	5019	3337	88	31.71333333	731	3861	2922	88	31.71333333	2120	11196	8315	88	31.71333333	731	3861	2548
89	31	941	5027	3330	89	31.40666667	724	3867	2920	89	31.406667	2100	11213	8314	89	31.406667	724	3867	

Summary DRAINS results

Sub-Catchment Flows

Catchment	Area	Pre Development	Post Development
B1	28	0.592	4.42
B2	16	0.761	2.77
B3	13	0.4	2.28
C1	8	0.276	1.34
C2	29	0.744	4.78
C3	10	0.401	1.75

Basin Sizing * 1.2 m depth of water

Basin	OSD Volume	Surface Area	Retention Storage	Combined Volume	OSD Calcs
B1	10100	8417	3150	13250	10800
B2	4500	3750	1800	6300	4400
B3	3900	3250	1463	5363	3400
C1	4250	3542	2025	6275	16000
C2	15350	12792	3263	18613	

*combined for C1 and C2

Catchment Flows

Catchment	Pre Development	Post Development
B1	0.592	4.42
B2	0.761	2.77
B3	0.400	2.28
C1	0.276	1.34
C2	0.744	4.78
C3	0.401	1.75

Creeks	Flow (m3/s)
Downstream Sellicks	15.8
Downstream Southern Upper	10
Downstream Southern Lower	5

Pre Development - Sellicks Creek Model

DRAINS results prepared from Version 2025.01.9147.24925

PIT / NODE DETAILS							Version 8
Name	Max HGL	Max Pond HGL	Max Surface Flow (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
B1 Upstream	77			0			
B2 Upstream	62.17			1.561			
N3	46.18			1.547			
Site B downstream	34.17			3.213			

SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
P_BB1	0.592	0	0.592	5	52		2 1% AEP, 4.5 hour burst, Storm 9
P_BB2	0.381	0	0.381	5	44		2 1% AEP, 4.5 hour burst, Storm 5
P_BB3	0.4	0	0.4	5	26		2 1% AEP, 3 hour burst, Storm 6
1a Catchment	0.38	0	0.38	5	30		2 1% AEP, 3 hour burst, Storm 6

PIPE DETAILS					
Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS				
Name	Max Q (cu.m/s)	Max V (m/s)		Due to Storm
Sellicks Creek	0	0		1% AEP, 4.5 hour burst, Storm 5
Sellicks Creek	0.692	1.81		1% AEP, 4.5 hour burst, Storm 5
Sellicks Creek	0.69	1.75		1% AEP, 4.5 hour burst, Storm 5

OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF01	0.592	0.592	0.998	0.04	0.09	10.62	2.17	1% AEP, 4.5 hour burst, Storm 9
OF04	0.381	0.381	0.455	0.046	0.05	11.27	1.11	1% AEP, 4.5 hour burst, Storm 5
OF05	0.4	0.4	0.455	0.047	0.05	11.39	1.12	1% AEP, 3 hour burst, Storm 6
OF03	0.38	0.38	0.455	0.046	0.05	11.27	1.11	1% AEP, 3 hour burst, Storm 6

DETENTION BASIN DETAILS					
Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level

Run Log for DRAINS v2025.01.9147.24925 - Sellicks Beach_PreDev
Run Log for DRAINS v2025.01.9147.24925 - Sellicks Beach_PreDev.drn run at 15:06:07 on 13/5/2025

Flows were safe in all overflow routes.

Post Development - Sellicks Creek Model

DRAINS results prepared from Version 2025.01.9147.24925

PIT / NODE DETAILS							Version 8
Name	Max HGL	Max Pond HGL	Max Surface Flow (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
BB3.1	32.48			2.756			
Downstream	31.74			0.861			
BB2.1	63.08			3.491			
Sc.1	62.11			0			
N8623	46.1			0.861			
Sellicks Up	77			0			
BB1.1	32.52			4.992			

SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
BB3	2.28	2.28	0.138	11	21		16 1% AEP, 30 min burst, Storm 5
BB2	2.765	2.765	0	12	22		17 1% AEP, 30 min burst, Storm 3
BB1	4.417	4.417	0.247	14	24		19 1% AEP, 30 min burst, Storm 9

PIPE DETAILS					
Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
BB3.Basin3	2.28	2.57	32.48	32.464	1% AEP, 30 min burst, Storm 5
Outlet2	0.384	2.29	32.071	31.744	1% AEP, 3 hour burst, Storm 8
BB2.Basin	2.765	3.13	63.076	63.058	1% AEP, 30 min burst, Storm 3
B2-Sc	0.761	2.72	62.611	62.407	1% AEP, 2 hour burst, Storm 10
BB1.Basin1	4.417	3.86	32.516	32.508	1% AEP, 30 min burst, Storm 9
B1 outlet	0.588	2.57	32.061	31.812	1% AEP, 3 hour burst, Storm 9

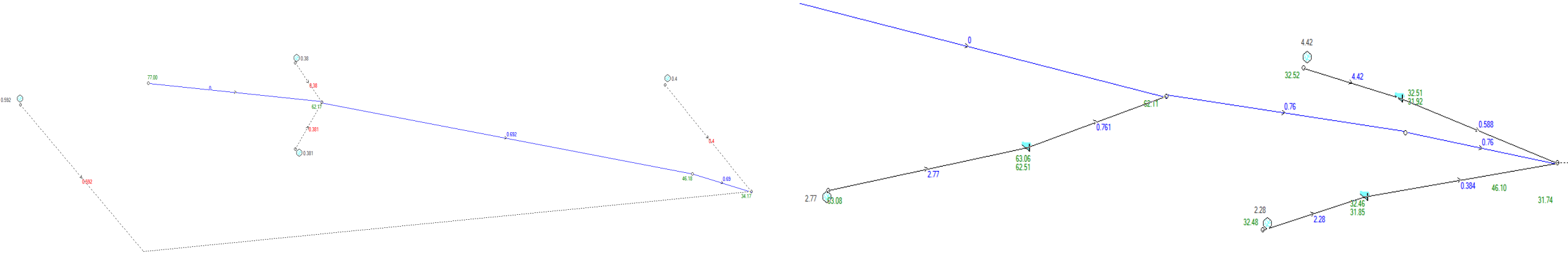
CHANNEL DETAILS				
Name	Max Q (cu.m/s)	Max V (m/s)		Due to Storm
Sc2	0.76	1.45		1% AEP, 2 hour burst, Storm 10
Sc3	0.76	1.45		1% AEP, 2 hour burst, Storm 10
Sc1	0	0		1% AEP, 2 hour burst, Storm 10

OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
Sellicks DS	1.746	1.746	0.921	0.346	0.57	5.15	1.65	1% AEP, 3 hour burst, Storm 1

DETENTION BASIN DETAILS					
Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin 3	32.46	3856.1	0.384	0.384	0
Basin2	63.06	4404.6	0.761	0.761	0
Basin1	32.51	10079.3	0.588	0.588	0

Run Log for DRAINS v2025.01.9147.24925 - PostDev_SellicksCreek_FINAL
Run Log for DRAINS v2025.01.9147.24925 - PostDev_SellicksCreek_FINAL.drn run at 10:46:42 on 19/5/2025

The maximum flow in these overflow routes is unsafe: Sellicks DS



Pre Development - Southern Creek Model

DRAINS results prepared from Version 2025.01.9147.24925

PIT / NODE DETAILS							Version 8
Name	Max HGL	Max Pond HGL	Max Surface Flow Arrivin (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N21	70.57		9.602				
Site C Down	50.57		9.679				
C2 Upstream	68.35		5.409				
N55616	40.39		15.67				
N55617	38.4		15.618				

SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
CC3	0.401	0	0.401	5	25		2 1% AEP, 9 hour burst, Storm 7
CC2	0.744	0	0.744	5	61		2 1% AEP, 9 hour burst, Storm 7
CC1	0.276	0	0.276	5	34		2 1% AEP, 9 hour burst, Storm 7
Cat186221	4.372	0.437	4.083	10	33		30 1% AEP, 3 hour burst, Storm 6
Cat186224	1.993	0.228	1.861	10	17		30 1% AEP, 2 hour burst, Storm 4

PIPE DETAILS					
Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS				
Name	Max Q (cu.m/s)	Max V (m/s)		Due to Storm
Crk20115	4.648	2.88		1% AEP, 3 hour burst, Storm 6
Southern C	2.331	2.64		1% AEP, 2 hour burst, Storm 4
Crk15955	6.658	6.63		1% AEP, 2 hour burst, Storm 4

OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF162415	4.648	4.648	0.911	0.107	0.41	17.36	3.83	1% AEP, 3 hour burst, Storm 6
OF38	0.401	0.401	0.455	0.047	0.05	11.39	1.13	1% AEP, 9 hour burst, Storm 7
OF40	0.744	0.744	0.455	0.062	0.09	12.91	1.37	1% AEP, 9 hour burst, Storm 7
OF162405	0.276	0.276	0.455	0.04	0.04	10.68	0.99	1% AEP, 9 hour burst, Storm 7
OF211580	4.372	4.372	0.455	0.143	0.33	20.56	2.3	1% AEP, 3 hour burst, Storm 6
OF211585	1.993	1.993	0.455	0.099	0.18	16.6	1.84	1% AEP, 2 hour burst, Storm 4

DETENTION BASIN DETAILS					
Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level

Run Log for DRAINS v2025.01.9147.24925 - Southern_PreDev

Run Log for DRAINS v2025.01.9147.24925 - Southern_PreDev.drn run at 13:07:41 on 20/5/2025.

The maximum flow in these overflow routes is unsafe: OF211585, OF211580, OF162415, OF40

Post Development - Southern Creek Model

DRAINS results prepared from Version 2025.01.9147.24925

PIT / NODE DETAILS							Version 8
Name	Max HGL	Max Pond HGL	Max Surface Flow Arrivin (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N74535	68.61		7.213				
N74527	50.52		12.946				
N74525	38		10.271				
1	70.7		5.397				
N3...	66.62		7.708				
N74542	50.63		7.199				
N3.	52.56		1.581				
CC3.1	68.49		2.12				
N417044	68.48		7.202				
N417045	70.34		2.906				

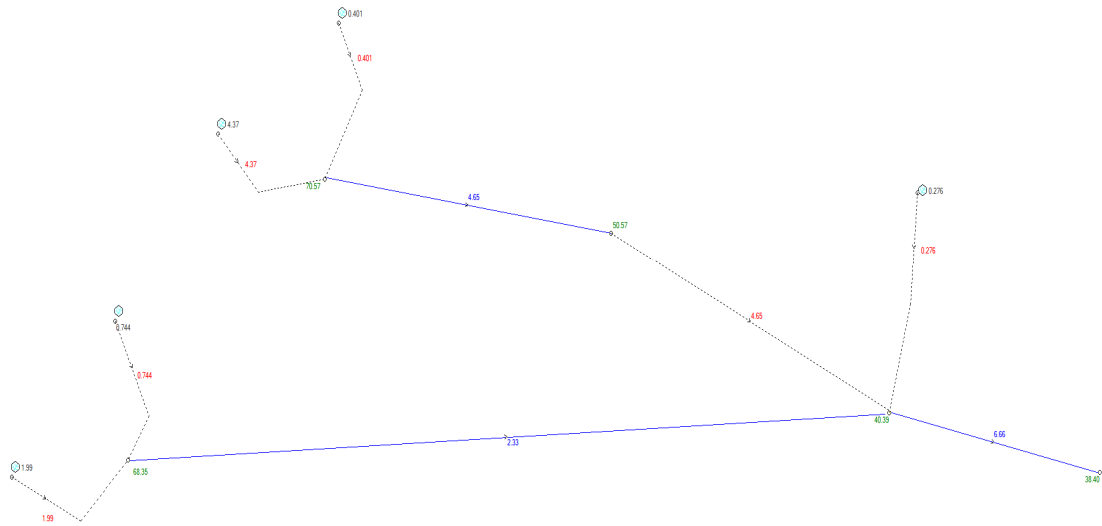
SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
CC2	4.784	4.784	0.274	13	23		18 1% AEP, 30 min burst, Storm 9
CC1	1.354	1.354	0.082	12	22		17 1% AEP, 30 min burst, Storm 3
CC3	1.754	1.754	0.106	11	21		16 1% AEP, 30 min burst, Storm 5
Upper	4.372	0.437	4.083	10	33		30 1% AEP, 3 hour burst, Storm 6
LowerUpstream	1.993	0.228	1.861	10	17		30 1% AEP, 2 hour burst, Storm 4

PIPE DETAILS					
Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Outlet3	1.08	2.85	41.132	41	1% AEP, 3 hour burst, Storm 6
Outlet	0.407	1.88	51.02	50.631	1% AEP, 2 hour burst, Storm 4

CHANNEL DETAILS				
Name	Max Q (cu.m/s)	Max V (m/s)		Due to Storm
Southern Creek	5.048	2.81		1% AEP, 30 min burst, Storm 10
Crk20089	9.205	2.55		1% AEP, 2 hour burst, Storm 4
Southern Crk :	4.796	2.79		1% AEP, 2 hour burst, Storm 3

OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF199334	5.975	5.975	1.442	0.211	1.61	4	7.64	1% AEP, 3 hour burst, Storm 6
OF1	4.784	4.782	0.326	0.598	1.06	8.17	1.8	1% AEP, 30 min burst, Storm 9
OF199331	4.287	4.287	1.442	0.174	1.17	4	6.74	1% AEP, 3 hour burst, Storm 6
OF38950	4.66	4.674	0.206	0.785	1.04	10.42	1.79	1% AEP, 3 hour burst, Storm 6
OF3.	1.345	1.342	0.326	0.44	0.45	6.27	1.39	1% AEP, 30 min burst, Storm 3
OF162333	1.753	1.755	0.326	0.384	0.54	5.61	1.47	1% AEP, 30 min burst, Storm 5
OF198764	4.372	4.373	1.446	0.377	1.14	4	3.03	1% AEP, 3 hour burst, Storm 6
Lower	1.993	1.992	1.446	0.235	0.53	4	2.27	1% AEP, 2 hour burst, Storm 4

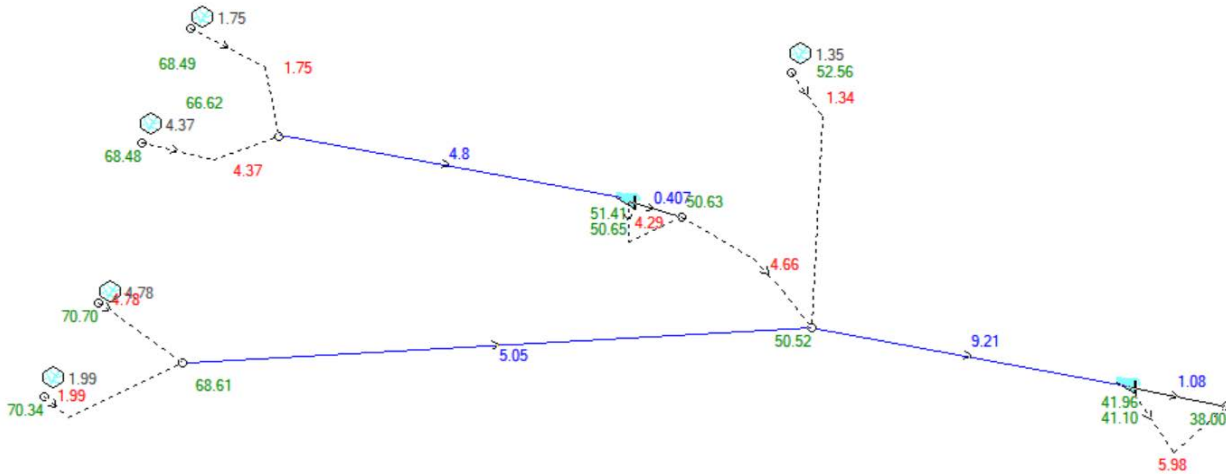
DETENTION BASIN DETAILS					
Name	Max WL	MaxVol	Max Q	Max Q	Max Q



		Total	Low Level	High Level
Southern2	41.96	15329.4	7.056	1.08
Southern 1	51.41	4235.1	4.693	0.407

Run Log for DRAINS v2025.01.9147.24925 - PostDev_SouthernCreeks_CREEKS_EH
Run Log for DRAINS v2025.01.9147.24925 - PostDev_SouthernCreeks_CREEKS_EH.drn run at 09:55:51 on 16/5/2025.

The maximum flow in these overflow routes is unsafe: OF199334, OF199331, Lower, OF198764, OF162333, OF3., OF38950, OF1



Pre-development Flows

Upstream Catchments	6.2
Development	1.421
TOTAL	7.621 m3/2

Combined downstream flow in above model (pipe + spill)

7.06 m3/2

therefore, suitably maintain the pre-development flow at the outfall from the site (including u/stream flows)

Mannings for Typical flow depth and profile

1% AEP Flow Creek Profile

Sellicks Creek
Channel top width 15m

Southern Creeks
Channel top width 11m

Slope of channel 0.03

Slope of channel 0.01

Depth of 1m + 0.5m freeboard

Depth of 0.9m + 0.5m freeboard

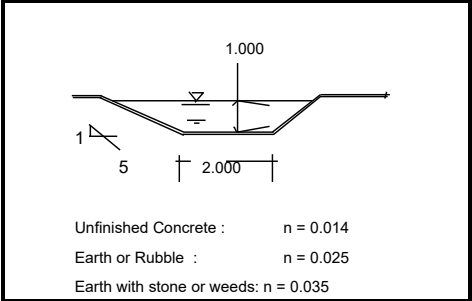
2m base, 1.5m, 1:5

2m base, 1.4m, 1:5

20-30m Extended waterway corridor

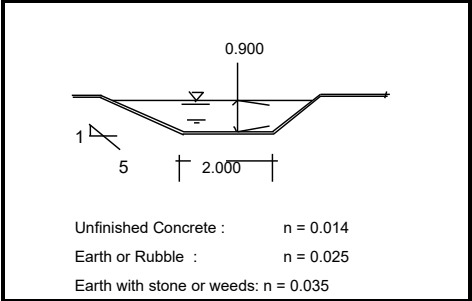
15-20m Extended waterway corridor

Mannings Formula for Trapezoidal Channels		
n	0.035	
Channel Slope,	0.0300	
Depth, y (m)	1.000	
Slope of side, 1:	5.000	
Base Width (m)	2.000	
Area (m2)	7.000	
Wetted Perimet	12.198	
Flow, Q	23.923	m3/s
Velocity,V	3.418	m/s *



* <u>Maximum Recommended Velocities</u>		
Coarse Gravel	1.3 - 1.8	m/s
Grass Covered Surfaces	1.8	
Stiff Sandy Clay	1.3 - 1.5	

Mannings Formula for Trapezoidal Channels		
n	0.035	
Channel Slope,	0.0100	
Depth, y (m)	0.900	
Slope of side, 1:	5.000	
Base Width (m)	2.000	
Area (m2)	5.850	
Wetted Perimet	11.178	
Flow, Q	10.855	m3/s
Velocity,V	1.856	m/s *



* <u>Maximum Recommended Velocities</u>		
Coarse Gravel	1.3 - 1.8	m/s
Grass Covered Surfaces	1.8	
Stiff Sandy Clay	1.3 - 1.5	

APPENDIX D

FLOOD HAZARD OVERLAYS



Frequently Asked Questions



Understanding the Flood Hazard Overlays in the Planning and Design Code

Introduction

Land use planning plays an important role in ensuring that new developments avoid or mitigate impacts from flood hazard. The planning system does this by setting parameters around buildings in areas of known high risk and requiring that developments meet certain standards so that they are exposed to acceptable levels of risk. It is also important that the impact from new development on downstream users and watercourses is considered.

A \$3 million COVID Stimulus Grant was received to undertake a project to update flood hazard mapping for the State and enhance the Planning and Design Code's policies.

The Flood Hazard Mapping and Assessment Project will look at extending flood hazard mapping coverage, developing consistent flood hazard mapping, applying current national best practice and enhancing overlay policies.

There are three stages to this project:

- Stage 1 – *Flood Hazards Mapping Update Code Amendment*: the Chief Executive of the Department for Trade and Investment has initiated this Code Amendment. This Code Amendment seeks to reduce the spatial extent of the existing Hazards (Flooding - Evidence Required) Overlay, in 12 local government areas and several Outback Area townships where more recent flood hazard mapping has demonstrated that there is minimal risk of flooding

The Code Amendment will also seek to apply the Hazards (Flooding - Evidence Required) Overlay to a portion of the Port Adelaide Enfield Council area as a precautionary measure until the flood hazard mapping, being prepared in Stage 2 of the Project, can be implemented into the Code.

- Stage 2 – *Preparation of Mapping Products*: the Department is commissioning updated and new flood hazard mapping across the State to better identify flood risk using improved data and more consistent modelling.
- Stage 3 – *State-wide Flooding Hazards Code Amendment*: the State Planning Commission (Commission) will initiate a State-wide amendment to the Code to include the new mapping and updated policy.

About this FAQ

This FAQ addresses how the Planning and Design Code (the Code) manages new development in areas exposed to flood hazard via three overlays:

- Hazards (Flooding) Overlay
- Hazards (Flooding - General) Overlay
- Hazards (Flooding - Evidence Required) Overlay

The policies applying to each overlay are designed to respond to flood risk and to provide the degree to which new development must consider the flood hazard.

The FAQ also assists with understanding each flood hazard overlay and how they provide policies for development subject to flooding within a 1% Annual Exceedance Probability (AEP)¹ event.

Frequently asked questions

Q – What kinds of flooding are covered by the Flood Hazard Overlays?	3
Q – What about flood hazard along the coast and River Murray?	3
Q – The Code says that I am in the ‘Hazard (Flooding) Overlay’, what does this mean if I want to undertake development?	3
Q – The Code says that I am in the ‘Hazard (Flooding - General) Overlay’, what does this mean if I want to undertake development?	4
Q – The Code says that I am in the ‘Hazard (Flooding - Evidence Required) Overlay’, what does this mean if I want to undertake development?	4
Q – My house is not included in a Flood Overlay. Does this mean I am not at risk of flooding?	5
Q – I have never experienced flooding before, so why has my property been identified?	5
Q – Only a small proportion of my allotment is covered by the flooding overlay, does that mean that the whole allotment is assessed against the overlay policy?	5
Q – Why am I required to build 300mm above the 1% AEP flood event?	5
Q – What should be done when two flood hazard overlays apply?	6
Q – Where can I get information on...	6
Q – Where can I find more information about this Project?	6
Flood Hazard Mapping and Assessment Project Information Series	6

¹ **Annual Exceedance Probability (AEP)** is a term used to express the percentage of likelihood of a flood of a given size or larger occurring in a given year. If a flood has an AEP of 1%, it has a one in 100 likelihood of occurring in any given year.

Frequently asked questions

Q – What kinds of flooding are covered by the Flood Hazard Overlays?

A – The overlays cover riverine (flooding of water courses and spilling onto adjoining areas) and surface water flooding (rainfall events that exceed stormwater infrastructure capacity and flood areas) at a 1% AEP event.

An annual exceedance probability (AEP) is the probability of an event occurring in any given year. For example, a 1% AEP indicates that there is a 1% change in any given year if the event occurring, which means that on average one event of this size or larger will occur every 100 years.

It is important to note however, that the occurrence of a 1% AEP event in a year does not reduce the chance that another event will occur the next year.

Q – What about flood hazard along the coast and River Murray?

A – Flooding along the coast and River Murray is addressed via overlays that apply to specific locations. The Coastal Areas Overlay and Coastal Flooding Overlay deal with coastal hazard risk. Flooding along the River Murray is addressed in the River Murray Flood Plain Protection Area Overlay.

Q – The Code says that I am in the ‘Hazard (Flooding) Overlay’, what does this mean if I want to undertake development?

A – The Hazard (Flooding) Overlay covers areas of highest flood hazard or where flood depth has been modelled at 300mm or greater above ground level for a 1% AEP flood. It seeks to minimise impact on people, property, infrastructure and the environment by avoiding development in high risk areas.

What does this mean for development?

- Development is not suitable in high-risk areas and developed areas, where intensification should be minimised.
- To ensure that flood ways are not obstructed, minor development such as fencing and small outbuildings require approval where located in this overlay.
- Development in this overlay is expected to be performance assessed and it is likely that an engineer’s report will be required to determine the extent of hazard risk for that property.
- Development should only occur where it can be sited and designed to minimise exposure of people and property to unacceptable flood risk (including adjoining properties); also, where evacuation is possible and emergency services can gain access during a 1% AEP flood event.
- After detailed consideration of the above listed factors, building above the flood plain plus a free board of 300mm may be considered appropriate by the relevant authority.
- Buildings that house vulnerable people, community services, key infrastructure and emergency services should be sited away from areas within this overlay.

- Buildings that house hazardous materials must be suitably designed to ensure there is no leakage into flood waters.
-

Q – The Code says that I am in the ‘Hazard (Flooding - General) Overlay’, what does this mean if I want to undertake development?

A – The Hazard (Flooding-General) Overlay covers areas of lower flood hazard or where flood depth has been modelled at less than 300mm above ground level for a 1% AEP flood. The overlay seeks to minimise impact on people, property, infrastructure and the environment through the appropriate siting and design of development.

What does this mean for development?

- Habitable buildings, commercial and industrial buildings, and buildings used for animal keeping should be sited and designed to prevent the entry of floodwaters (where the entry of floodwaters is likely to result in undue damage to or compromise ongoing activities within the building).
 - A Deemed-To-Satisfy (DTS) criteria of 300mm free board above 1% AEP flood event applies for development assessment.
 - If a flood depth cannot be provided, the development authority may require an engineer’s report on the flood depth.
 - Buildings that house vulnerable people, community services, key infrastructure and emergency services should be sited away from areas within this overlay.
 - Buildings that house hazardous materials must be suitably designed to ensure there is no leakage into floodwaters.
-

Q – The Code says that I am in the ‘Hazard (Flooding - Evidence Required) Overlay’, what does this mean if I want to undertake development?

A – The Hazard (Flooding-Evidence Required) Overlay applies to areas where there is no flood hazard data, making the flood risk unknown.

The overlay seeks to adopt a precautionary approach to mitigate potential impact on people, property, infrastructure and the environment through the appropriate siting and design of development.

This Overlay is applied as an interim measure until flood studies can be undertaken to determine the extent of the flood hazard. Therefore, the overlay is proposed to be removed from the Code once studies are completed via the Code Amendment process.

What does this mean for development?

The Deemed-to-Satisfy (DTS) criteria requires habitable buildings, commercial and industrial buildings, and buildings used for animal keeping to incorporate at least 300mm free board above:

- (a) the highest point of the top of kerb of the primary street; or
 - (b) the highest point of natural ground level at the primary street boundary where there is no kerb.
-

Q – My house is not included in a Flood Overlay. Does this mean I am not at risk of flooding?

A – Flooding is dependent on many different aspects, there are limitations in predictability, and this is increasing with the occurrence of climate change. The modelling and associated mapping provides an indication of flooding from river, creek or stormwater flows during a 1% AEP event.

It is possible that your land may be affected by a larger event than the 1% AEP. It is also possible that your land may flood in a more frequent event due to infrastructure failures, such as pipes being blocked or levee failures. In addition, changes to the catchment may have occurred after the flood study data was collected, which could increase your flood risk.

Roadways are designed to accommodate excess stormwater. It is also possible that gardens, driveways and sheds in properties which are not included in the overlay may experience shallow flooding. This scenario is called 'nuisance flooding' as the impact and costs associated with the flooding is relatively low.

It is also common for local roads in metropolitan Adelaide to flood in more frequent events as most council underground stormwater systems cater for a 20% to 10% AEP.

Q – I have never experienced flooding before, so why has my property been identified?

A – Although your property has never been flooded before, it cannot be assumed that land is free from flood risk. Climate change and increased stormwater run-off from increasing hard surfaces from urban development—will increase chances of flooding in the future. Flood studies use rainfall patterns and topography amongst other factors to determine flood hazard areas.

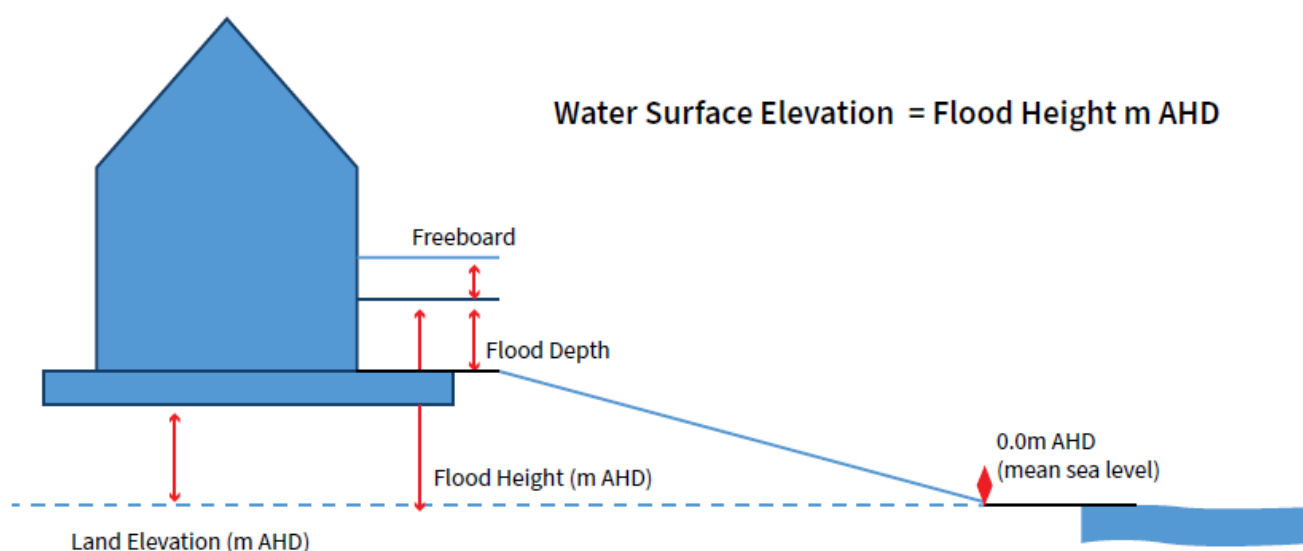
Q – Only a small proportion of my allotment is covered by the flooding overlay, does that mean that the whole allotment is assessed against the overlay policy?

A – No, only that part of the development within the specific overlay needs to be assessed against the overlay policy.

Q – Why am I required to build 300mm above the 1% AEP flood event?

A – The 300mm above the 1% AEP flood event is called the freeboard. A freeboard is added to flood height as the minimum flood level to provide reasonable certainty of achieving the desired level of protection of property. The freeboard takes into account:

- Uncertainties in the estimates of flood level from flood modelling including local factors, impact of infill and climate change.
- Wave action models assume flat surfaces and do not consider waves from either wind, or boats and vehicles in the flood areas.



Q – What should be done when two flood hazard overlays apply?

A – When more than one of the flood overlays apply to a parcel of land, the overlay that addresses the higher flood hazard risk will apply. However, the planning authority may take into consideration how the different flood overlays affect the land when undertaking a performance assessment of a proposed development (e.g. if a new building is not located where the flood overlay applies, the overlay may not be considered relevant to assessment of that development).

Q – Where can I get information on...

- 1% flood depth at my property?
- 5% flood depth at my property?
- Whether my allotment is subject to high flood hazard?

A – Contact your local council and request the information; alternatively, visit the Water Connect Website and look up [Flood Awareness Maps](#).

An engineer's report on the flood risk and/or flood depth can be requested from the relevant decision-making authority for performance assessed developments.

Q – Where can I find more information about this Project?

A – Visit the [Flood Hazard Mapping and Assessment Project](#) page on the PlanSA portal and/or refer to the Project Information Series (below).

Flood Hazard Mapping and Assessment Project Information Series

- [Flood Hazard – Project Overview](#)
- [Flood Hazard – Understanding the Flood Hazard Overlays in the Planning and Design Code](#)
- [Flood Hazard – Understanding and Using Flood Maps](#)

APPENDIX E

WATER QUALITY MODELLING



MUSIC modelling

	Site Area	Road Areas	House Areas
A	30.5	1.57	28.931
B1	28		28
B2	16	0.94	15.065
B3	13		13
C1	8		8
C2	29	0.55	28.45
C3	10	0.95	9.0496

Bioretention Basin		
2% of road surface area		
A	0.03138	313.8
B2	0.0187	187
C2	0.011	110
C3	0.019008	190.08

Wetland Volume		Permanent pool volume
based on constand 0.225m depth		
A	8000	1800
B1	7000	1575
B2	4000	900
B3	3250	731
C1	2500	563
C2	9250	2081

Catchment Details	
Timestep: 6 Minutes	
Start Date: 1/01/1983	
End Date: 31/12/1992	
Rainfall Station: 023090 ADELAIDE	
ET Station: User-defined monthly PET	
Mean Annual Rainfall (mm): 585	
Mean Annual ET (mm): 1143	

Node Types	Parameters				
Source Water Node: Urban	Soil storage capacity 40mm	Rainfall Threshold 1 mm/day	Typical directly connected impervious fraction 75%	Stochastically generated pollutants	Initial storage capacity % of soil capacity 30%
Treatment Nodes	Parameters				
Bioretention System	Surface area based on 2% of road surface area	Unlined filter media perimeter 0.01m	Infiltration loss 0.36mm/hr	Filter Depth of 0.3 m	Detention time is approximately 72 hours
Wetland System	Surface area based on 2.5% of sub-catchment areas	Permanent pool volume based on constant 0.225m depth	Extended detention depth 0.5 m	Infiltration loss 0.36mm/hr	Detention time is approximately 72 hours

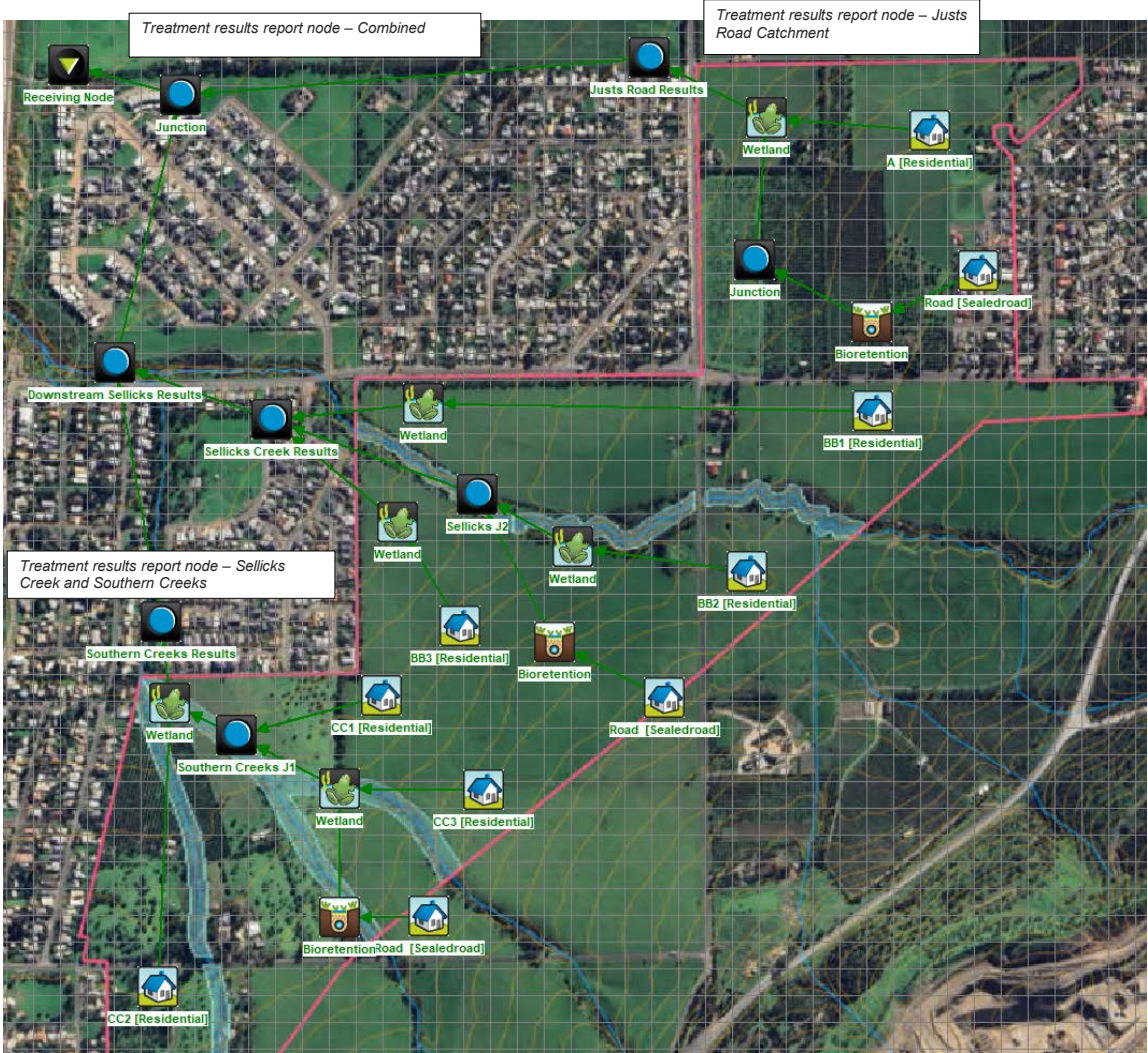
Pollutant Type	TP	TN	TSS	Gross Pollutants	Annual Flow
Target Percentage Reduction	60%	45%	80%	90%	Not Specified
Resultant Percentage Reduction	79%	53%	89%	100%	23%
Resultant Percentage Reduction	77%	50%	86%	100%	20%

Justs Road

Treatment Train Effectiveness - Justs Road Results			
	Sources	Residual Load	% Reduction
Flow (ML/yr)	128	99.2	22.7
Total Suspended Solids (kg/yr)	28700	3430	88.1
Total Phosphorus (kg/yr)	55.8	11.7	79
Total Nitrogen (kg/yr)	269	126	53.1
Gross Pollutants (kg/yr)	5210	0	100

Sellicks + Southern Creeks

Treatment Train Effectiveness - Downstream Sellicks Results			
	Sources	Residual Load	% Reduction
Flow (ML/yr)	415	330	20.4
Total Suspended Solids (kg/yr)	91000	12900	85.8
Total Phosphorus (kg/yr)	181	41.2	77.2
Total Nitrogen (kg/yr)	872	438	49.7
Gross Pollutants (kg/yr)	16800	0	100



MUSIC SUMMARY REPORT

Location,A,BB2,BB1,Road ,BB3,CC3,CC2,Road,Road ,CC1

ID,6,16,17,18,19,20,21,22,24,26

Node Type,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode

Zoning Surface Type,Residential,Residential,Residential,Sealedroad,Residential,Residential,Residential,Sealedroad,Sealedroad,Residential

Total Area (ha),30.431,15.1,28.0,94.13,9.05,28.45,1.569,1.5,ε

Area Impervious (ha),22.8993275,11.36275,21.07,0.94,9.7825,6.810125,21.408625,1.569,1.5,6.0:

Area Pervious (ha),7.5316725,3.73725,6.93,0,3.2175,2.239875,7.041375,0,0,1.9ε

Field Capacity (mm),30,30,30,80,30,30,30,80,80,30

Pervious Area Infiltration Capacity coefficient - a,200,200,200,200,200,200,200,200,200,200

Pervious Area Infiltration Capacity exponent - b,1,1,1,1,1,1,1,1,1,1

Impervious Area Rainfall Threshold (mm/day),1,1,1,1,1,1,1,1,1,1

Pervious Area Soil Storage Capacity (mm),40,40,40,120,40,40,40,120,120,40

Pervious Area Soil Initial Storage (% of Capacity),30,30,25,25,30,30,30,25,30

Groundwater Initial Depth (mm),10,10,10,10,10,10,10,10,10

Groundwater Daily Recharge Rate (%),25,25,25,25,25,25,25,25,25

Groundwater Daily Baseflow Rate (%),5,5,5,5,5,5,5,5,5

Groundwater Daily Deep Seepage Rate (%),0,0,0,0,0,0,0,0,0

Stormflow Total Suspended Solids Mean (log mg/L),2.18,2.18,2.18,2.43,2.18,2.18,2.18,2.43,2.43,2.1ε

Stormflow Total Suspended Solids Standard Deviation (log mg/L),0.39,0.39,0.39,0.32,0.39,0.39,0.39,0.32,0.32,0.3ε

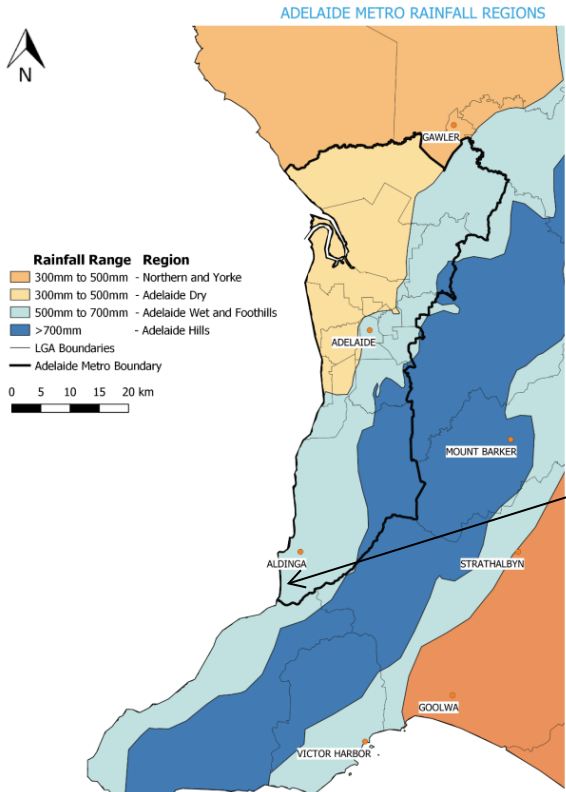


Figure 3.3 Rainfall regions for the Adelaide metropolitan area

Table 3.1 Climate templates for Adelaide region

Region	Rainfall band (mm)	Rainfall station	Period	Period mean annual rainfall (mm)	Mean annual PET (mm)
Adelaide Dry	300–500	23013 Parafield Airport	1979–1988	450	1,159
Adelaide Wet and Foothills	500–700	23090 Adelaide Kent Town	1983–1992	585	1,143
Adelaide Hills	700+	23875 Parawa (Second Valley AWS)	2001–2010	866	1,132
Northern and Yorke	300–500	23122 Roseworthy AWS	2001–2010	404	1,145

Site Location: Within Adelaide Wet and Footlands

Stormflow Total Suspended Solids Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic

Stormflow Total Suspended Solids Serial Correlation,0,0,0,0,0,0,0,0,0

Stormflow Total Phosphorus Mean (log mg/L),-0.47,-0.47,-0.47,-0.3,-0.47,-0.47,-0.47,-0.3,-0.3,-0.47

Stormflow Total Phosphorus Standard Deviation (log mg/L),0.32,0.32,0.32,0.25,0.32,0.32,0.32,0.25,0.25,0.32

Stormflow Total Phosphorus Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic

Stormflow Total Phosphorus Serial Correlation,0,0,0,0,0,0,0,0,0

Stormflow Total Nitrogen Mean (log mg/L),0.26,0.26,0.26,0.34,0.26,0.26,0.26,0.34,0.34,0.26

Stormflow Total Nitrogen Standard Deviation (log mg/L),0.23,0.23,0.23,0.19,0.23,0.23,0.23,0.19,0.19,0.23

Stormflow Total Nitrogen Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic

Stormflow Total Nitrogen Serial Correlation,0,0,0,0,0,0,0,0,0

Baseflow Total Suspended Solids Mean (log mg/L),1,1,1,1.2,1,1,1,1.2,1.2,1

Baseflow Total Suspended Solids Standard Deviation (log mg/L),0.34,0.34,0.34,0.17,0.34,0.34,0.34,0.17,0.17,0.34

Baseflow Total Suspended Solids Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic

Baseflow Total Suspended Solids Serial Correlation,0,0,0,0,0,0,0,0,0

Baseflow Total Phosphorus Mean (log mg/L),-0.97,-0.97,-0.97,-0.85,-0.97,-0.97,-0.97,-0.85,-0.85,-0.97

Baseflow Total Phosphorus Standard Deviation (log mg/L),0.31,0.31,0.31,0.31,0.31,0.31,0.31,0.19,0.31,0.31

Baseflow Total Phosphorus Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic

Baseflow Total Phosphorus Serial Correlation,0,0,0,0,0,0,0,0,0

Baseflow Total Nitrogen Mean (log mg/L),0.2,0.2,0.2,0.11,0.2,0.2,0.2,0.11,0.11,0.2

Baseflow Total Nitrogen Standard Deviation (log mg/L),0.2,0.2,0.2,0.12,0.2,0.2,0.2,0.12,0.12,0.2

Baseflow Total Nitrogen Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic

Baseflow Total Nitrogen Serial Correlation,0,0,0,0,0,0,0,0,0

Flow based constituent generation - enabled,Off,Off,Off,Off,Off,Off,Off,Off,Off,Off

Flow based constituent generation - flow file, , , , , , , , ,

Flow based constituent generation - base flow column, , , , , , , , ,

Flow based constituent generation - pervious flow column, , , , , , , , ,

Flow based constituent generation - impervious flow column, , , , , , , , ,

Flow based constituent generation - unit, , , , , , , , ,

OUT - Mean Annual Flow (ML/yr),121,60.0,111,4.49,51.6,35.9,113,7.49,7.16,31.8

OUT - TSS Mean Annual Load (kg/yr),26.1E3,12.8E3,23.9E3,1.57E3,11.3E3,7.74E3,24.3E3,2.61E3,2.51E3,6.85E3

OUT - TP Mean Annual Load (kg/yr),51.4,25.9,47.7,2.64,22.3,15.4,48.5,4.43,4.25,13.8

OUT - TN Mean Annual Load (kg/yr),251,125,235,10.8,107,74.7,237,18.1,17.3,65.8

OUT - Gross Pollutant Mean Annual Load (kg/yr),4.91E3,2.43E3,4.51E3,180,2.10E3,1.46E3,4.59E3,300,287,1.29E3

Rain In (ML/yr),177.833,88.2416,163.627,5.4932,75.9698,52.8866,166.257,9.16895,8.76573,46.7501

ET Loss (ML/yr),57.1319,28.3494,52.5686,1.00349,24.4068,16.9908,53.413,1.67496,1.60132,15.0191

Deep Seepage Loss (ML/yr),0,0,0,0,0,0,0,0,0

Baseflow Out (ML/yr),5.09766,2.52948,4.69043,0,2.1777,1.51602,4.76582,0,0,1.34012

Imp. Stormflow Out (ML/yr),109.01,54.0914,100.302,4.48971,46.5688,32.419,101.914,7.49399,7.16442,28.6571

Perv. Stormflow Out (ML/yr),6.74228,3.34555,6.20367,0,2.88028,2.00511,6.30337,0,0,1.77241

Total Stormflow Out (ML/yr),115.753,57.437,106.506,4.48971,49.449,34.4241,108.217,7.49399,7.16442,30.4301

Total Outflow (ML/yr),120.85,59.9664,111.196,4.48971,51.6268,35.9401,112.983,7.49399,7.16442,31.7701

Change in Soil Storage (ML/yr),-0.149173,-0.0740204,-0.137256,0,-0.0637261,-0.0443632,-0.139462,0,0,-0.0392161

TSS Baseflow Out (kg/yr),69.0887,34.2551,63.4961,0,29.5183,20.5511,64.5673,0,0,18.2101

TSS Total Stormflow Out (kg/yr),26061.3,12733.8,23823.8,1570.46,11267.4,7723,24280,2608.33,2509.16,6833.81

TSS Total Outflow (kg/yr),26130.3,12768.1,23887.3,1570.46,11296.9,7743.55,24344.6,2608.33,2509.16,6852.1

TP Baseflow Out (kg/yr),0.703289,0.349003,0.646558,0,0.300502,0.209463,0.657594,0,0,0.185041

TP Total Stormflow Out (kg/yr),50.6969,25.5575,47.0617,2.63897,21.9583,15.2099,47.8634,4.42533,4.25316,13.6121

TP Total Outflow (kg/yr),51.4002,25.9065,47.7082,2.63897,22.2588,15.4193,48.521,4.42533,4.25316,13.7971

TN Baseflow Out (kg/yr),8.98556,4.45477,8.26768,0,3.84431,2.67377,8.40534,0,0,2.36301

TN Total Stormflow Out (kg/yr),241.529,120.532,226.379,10.837,102.877,71.9816,228.718,18.1098,17.2832,63.4751

TN Total Outflow (kg/yr),250.514,124.987,234.646,10.837,106.721,74.6553,237.124,18.1098,17.2832,65.8381

GP Total Outflow (kg/yr),4917.87,2440.27,4525,179.814,2100.89,1462.55,4597.73,300.136,286.937,1292.81

No Imported Data Source nodes

USTM treatment nodes

Location,Wetland,Wetland,Wetland,Wetland,Wetland,Wetland,Wetland,Bioretentention,Bioretentention,Bioretentior

ID,7,8,9,10,11,12,15,23,25

Node Type,WetlandNode,WetlandNode,WetlandNode,WetlandNode,WetlandNode,WetlandNode,BioRetentionNodeV4,BioRetentionNodeV4,BioRetentionNodeV4

Lo-flow bypass rate (cum/sec),0,0,0,0,0,0,0,0

Hi-flow bypass rate (cum/sec),100,100,100,100,100,100,100,100

Inlet pond volume,0,0,0,0,500, , ,

Area (sqm),4000,8000,7000,3250,2500,9250,180,310,300

Initial Volume (m^3),900,1800,1575,731,563,2081, , ,

Extended detention depth (m),0.5,0.5,0.5,0.5,0.5,0.5,0.3,0.3,0.3

Number of Rainwater tanks, , , , , , , ,

Permanent Pool Volume (cubic metres),900,1800,1575,731,563,2081, , ,

Proportion vegetated,0.5,0.5,0.5,0.5,0.5,0.5,0.5,0.5, , ,

Equivalent Pipe Diameter (mm),70,98,90,63,55,105, , ,

Overflow weir width (m),3,3,3,3,3,2,2,2

Notional Detention Time (hrs),68.8,70.2,72.9,69.0,69.7,70.7, , ,

Orifice Discharge Coefficient,0.6,0.6,0.6,0.6,0.6,0.6,0.6, , ,

Weir Coefficient,1.7,1.7,1.7,1.7,1.7,1.7,1.7,1.7,1.7

Number of CSTR Cells,4,4,4,4,4,3,3,3

Total Suspended Solids - k (m/yr),1500,1500,1500,1500,1500,1500,8000,8000,8000

Total Suspended Solids - C* (mg/L),6,6,6,6,6,20,20,20
Total Suspended Solids - C** (mg/L),6,6,6,6,6, , ,
Total Phosphorus - k (m/yr),1000,1000,1000,1000,1000,1000,6000,6000,6000
Total Phosphorus - C* (mg/L),0.06,0.06,0.06,0.06,0.06,0.06,0.13,0.13,0.13
Total Phosphorus - C** (mg/L),0.06,0.06,0.06,0.06,0.06,0.06, , ,
Total Nitrogen - k (m/yr),150,150,150,150,150,150,500,500,500
Total Nitrogen - C* (mg/L),1,1,1,1,1,1,4,1.4,1.4
Total Nitrogen - C** (mg/L),1,1,1,1,1,1, , ,
Threshold Hydraulic Loading for C** (m/yr),3500,3500,3500,3500,3500,3500, , ,
Horizontal Flow Coefficient, , , , , ,3,3,3
Reuse Enabled,Off,Off,Off,Off,Off,Off,Off,Off,Off
Max drawdown height (m), , , , , , , ,
Annual Demand Enabled,Off,Off,Off,Off,Off,Off,Off,Off,Off
Annual Demand Value (ML/year), , , , , , , ,
Annual Demand Distribution, , , , , , , ,
Annual Demand Monthly Distribution: Jan, , , , , , , ,
Annual Demand Monthly Distribution: Feb, , , , , , , ,
Annual Demand Monthly Distribution: Mar, , , , , , , ,
Annual Demand Monthly Distribution: Apr, , , , , , , ,
Annual Demand Monthly Distribution: May, , , , , , , ,
Annual Demand Monthly Distribution: Jun, , , , , , , ,
Annual Demand Monthly Distribution: Jul, , , , , , , ,
Annual Demand Monthly Distribution: Aug, , , , , , , ,
Annual Demand Monthly Distribution: Sep, , , , , , , ,
Annual Demand Monthly Distribution: Oct, , , , , , , ,
Annual Demand Monthly Distribution: Nov, , , , , , , ,
Annual Demand Monthly Distribution: Dec, , , , , , , ,
Daily Demand Enabled,Off,Off,Off,Off,Off,Off,Off,Off,Off
Daily Demand Value (ML/day), , , , , , , ,
Custom Demand Enabled,Off,Off,Off,Off,Off,Off,Off,Off,Off
Custom Demand Time Series File, , , , , , , ,
Custom Demand Time Series Units, , , , , , , ,
Filter area (sqm), , , , , ,180,310,300
Filter perimeter (m), , , , , ,0.01,0.01,0.01
Filter depth (m), , , , , ,0.3,0.3,0.3
Filter Median Particle Diameter (mm), , , , , , , ,
Saturated Hydraulic Conductivity (mm/hr), , , , , ,100,100,100
Infiltration Media Porosity, , , , , ,0.35,0.35,0.35
Length (m), , , , , , , ,
Bed slope, , , , , , , ,
Base Width (m), , , , , , , ,
Top width (m), , , , , , , ,
Vegetation height (m), , , , , , , ,
Vegetation Type, , , , , ,Vegetated with Effective Nutrient Removal Plants,Vegetated with Effective Nutrient Removal Plants,Vegetated with Effective Nutrient Removal Plants
Total Nitrogen Content in Filter (mg/kg), , , , , ,800,800,800
Orthophosphate Content in Filter (mg/kg), , , , , ,55,55,55
Is Base Lined?, , , , , ,No,No,No
Is Underdrain Present?, , , , , ,Yes,Yes,Yes
Is Submerged Zone Present?, , , , , ,No,No,No
Submerged Zone Depth (m), , , , , , , ,
B for Media Soil Texture,-9999,-9999,-9999,-9999,-9999,13,13,13
Proportion of upstream impervious area treated, , , , , , , ,
Exfiltration Rate (mm/hr),0,0.36,0.36,0.36,0.36,0.36,0.36,0.36,0.36
Evaporative Loss as % of PET,125,125,125,125,125,125,100,100,100
Depth in metres below the drain pipe, , , , , , , ,
TSS A Coefficient, , , , , , , ,
TSS B Coefficient, , , , , , , ,
TP A Coefficient, , , , , , , ,
TP B Coefficient, , , , , , , ,
TN A Coefficient, , , , , , , ,
TN B Coefficient, , , , , , , ,
Sfc, , , , , ,0.61,0.61,0.61
S*, , , , , ,0.37,0.37,0.37
Sw, , , , , ,0.11,0.11,0.11
Sh, , , , , ,0.05,0.05,0.05
Emax (m/day), , , , , ,0.008,0.008,0.008
Ew (m/day), , , , , ,0.001,0.001,0.001
IN - Mean Annual Flow (ML/yr),60.0,128,111,51.6,42.5,178,4.49,7.49,7.1E
IN - TSS Mean Annual Load (kg/yr),12.8E3,26.2E3,23.9E3,11.3E3,7.78E3,32.4E3,1.57E3,2.61E3,2.51E3
IN - TP Mean Annual Load (kg/yr),25.9,52.3,47.7,22.3,16.3,66.5,2.64,4.43,4.2E
IN - TN Mean Annual Load (kg/yr),125,256,235,107,80.0,345,10.8,18.1,17.3
IN - Gross Pollutant Mean Annual Load (kg/yr),2.43E3,4.91E3,4.51E3,2.10E3,1.46E3,5.88E3,180,300,287
OUT - Mean Annual Flow (ML/yr),54.8,99.2,86.2,40.0,33.6,145,4.11,6.84,6.5E
OUT - TSS Mean Annual Load (kg/yr),1.95E3,3.43E3,3.54E3,1.77E3,1.23E3,5.66E3,22.8,37.9,35.3
OUT - TP Mean Annual Load (kg/yr),6.33,11.7,10.8,5.19,4.21,18.3,0.546,0.908,0.86E

OUT - Mean Annual Flow (ML/yr),58.9,185,99.2,145,429,429,65.3,6.84,330
OUT - TSS Mean Annual Load (kg/yr),1.98E3,7.28E3,3.43E3,5.66E3,16.4E3,16.4E3,8.09E3,37.9,12.9E
OUT - TP Mean Annual Load (kg/yr),6.88,22.9,11.7,18.3,52.9,52.9,18.0,0.908,41.2
OUT - TN Mean Annual Load (kg/yr),75.3,247,126,191,564,564,108,5.65,438
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,1.29E3,0.00,0.00
% Load Reduction,8.65,18.5,22.7,22.7,21.0,21.0,12.8,8.70,20.4
TSS % Load Reduction,86.2,85.3,88.1,86.3,86.3,86.3,52.7,98.5,85.8
TN % Load Reduction,44.5,48.1,53.1,51.7,50.5,50.5,31.4,68.8,49.7
TP % Load Reduction,75.9,76.8,79.0,77.7,77.6,77.6,46.2,79.7,77.2
GP % Load Reduction,100,100,100,100,100,100,57.5,100,100

Links

[illegible]

Source node ID,9,10,3,13,8,12,11,14,6,15,1,16,17,18,19,20,21,22,24,7,26,23,27,25,4,2,28

Target node ID,2,2,13,5,3,4,14,12,8,1,2,7,9,15,10,11,12,23,25,1,14,27,8,11,28,28,13

[illegible]

Muskingum K,,,,,,,,,,,,,

Muskingum theta,,,,,,,,,,,,,

IN - Mean Annual Flow (ML/yr), 86.2, 40.0, 99.2, 429, 99.2, 145, 33.6, 65.3, 121, 4.11, 58.9, 60.0, 111, 4.49, 51.6, 35.9, 113, 7.49, 7.16, 54.8, 31.8, 6.84, 6.84, 6.53, 145, 185, 33

IN - ISS Mean Annual Load (kg/yr),3.54E3,1.77E3,3.43E3,16.4E3,3.43E3,5.66E3,1.23E3,8.09E3,26.1E3,22.8,1.98E3,12.8E3,23.9E3,1.57E3,11.3E3,7.74E3,24.3E3,2.61E3,2.51E3,1.95E3,6.85E3,37.9,37.9,35.3,5.66E3,7.28E3,12.9

IN - TP Mean Annual Load (kg/yr), 10.8, 5.19, 11.7, 32.9, 11.7, 18.3, 4.21, 18.0, 51.4, 0.546, 6.88, 25.9, 47.7, 2.64, 22.3, 15.4, 48.5, 4.43, 4.25, 6.33, 13.8, 0.908, 0.908, 0.868, 18.3, 22.9, 41.

IN - TN Mean Annual Load (kg/yr), 116,54.5, 126,564, 126,191, 42.4, 108,251, 3.39, 75.3, 125,235, 10.8, 107,74.7, 237,18.1, 17.3, 71.9, 65.8, 5.65, 5.65, 5.39, 191,247,43

IN - Gross Pollutant Mean Annual Load (kg/y), 0.00,0.00,0.00,0.00,0.00,0.00,0.00,1.29E3,4.91E3,0.00,2.43E3,4.31E3,180,2.10E3,1.40E3,4.39E3,300,287,0.00,1.29E3,0.00,0.00,0.00,0.00,0.00,0.00

OUT - TSS Mean Annual Load (kg/ha) 3.5152 3.7752 3.4852 3.1552 3.1852 5.3352 1.3352 3.3352 33.152 33.3 1.3352 13.352 33.352 1.5752 11.352 7.7152 3.1352

OUT-TSS Mean Annual Load (kg/yr): 3.34E3, 1.77E3, 3.43E3, 1.04E3, 3.43E3, 3.00E3, 1.23E3, 6.09E3, 2.01E3, 22.6, 1.96E3, 12.0E3, 23.9E3, 1.37E3, 11.5E3, 3.77E3, 1.74E3, 2.24E3, 2.01E3, 1.95E3, 0.83E3, 37.9, 37.9, 33.3, 3.00E3, 1.72E3, 12.9E3

OUT TN Mean Annual Load (kg/yr) 118 54 5 126 564 126 101 42 4 108 251 2 20 75 2 125 225 10 8 107 74 7 227 18 1 17 2 71 0 65 8 5 65 5 65 5 20 101 247 42

OUT Gross Pollutant Mean Annual Load (kg/yr) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 1.39E3 1.01E3 0.00 0.00 3.43E3 1.51E3 180 3.10E3 1.46E3 1.59E3 300 387 0

DOI: 10.1002/for

Catchment Details

Catchment Name,Sellicks Creek Updated

Timestep, 6 Minutes

Start Date,1/01/1983

End Date,31/12/1992 11:54:00 PM

Rainfall Station, 023090 ADELAIDE

EI Station, User-defined monthly PEI

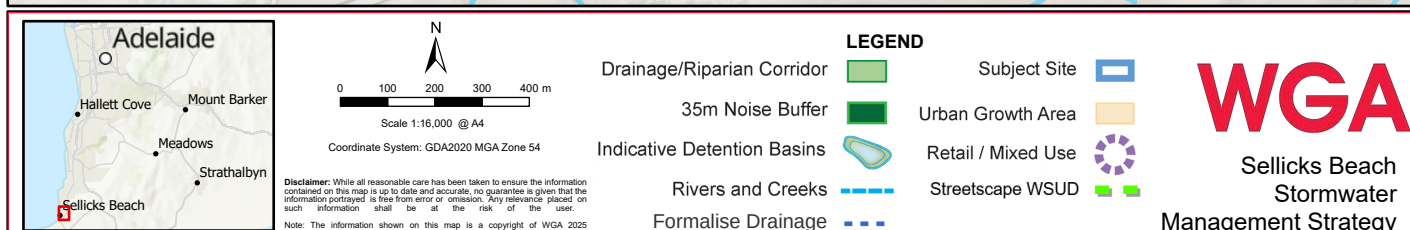
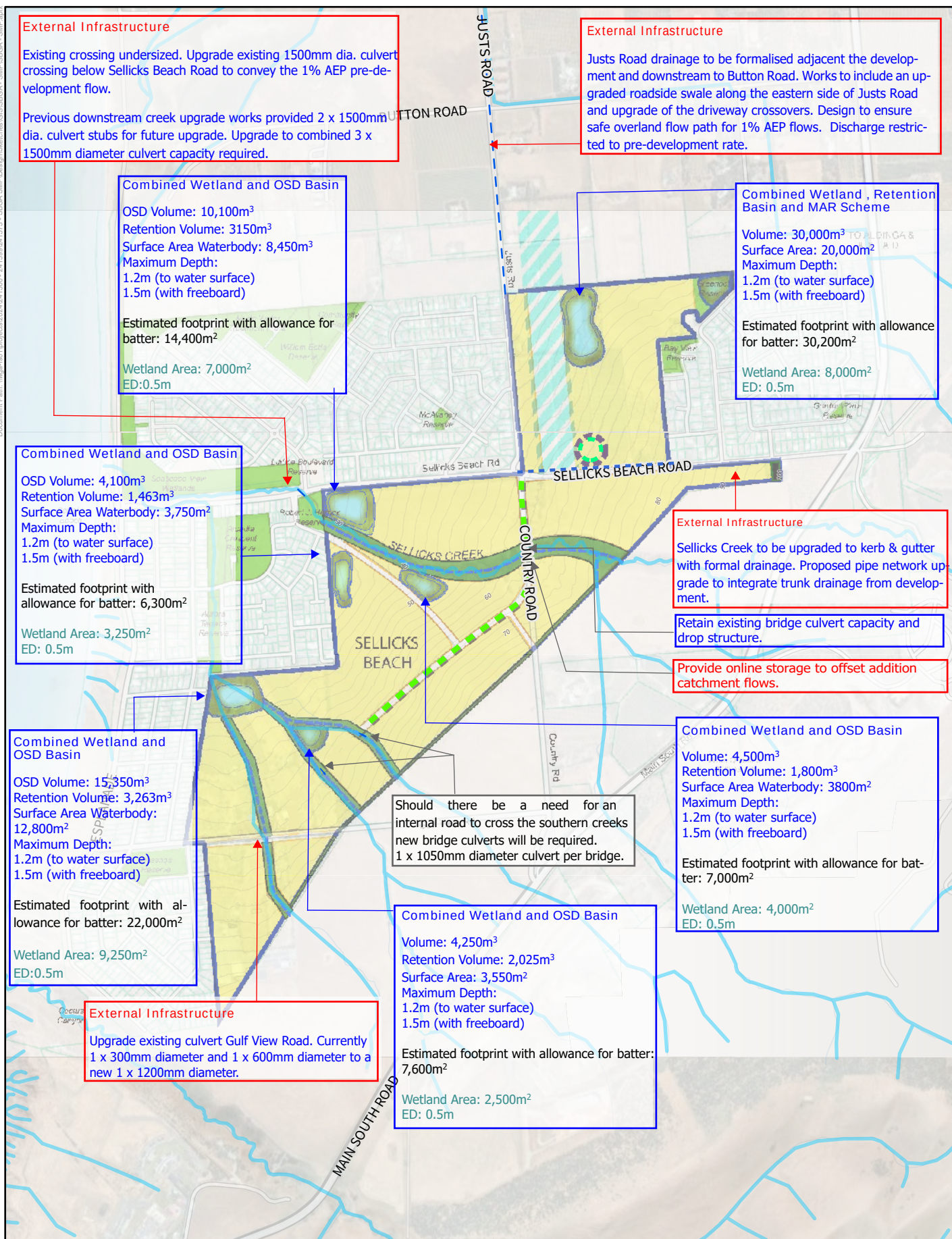
Mean Annual Rainfall (mm), 585

Mean Annual EI (mm), 1143

APPENDIX F

STORMWATER MANAGEMENT STRATEGY







FOR FURTHER INFORMATION CONTACT:

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