Stormwater Scheme Infrastructure Design Guideline DRAFT

Western Sydney

Version No. 2022-1.0

Sydney WATER

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Acknowledgement of Country

We acknowledge and pay our respects to the Traditional Custodians of Country within the Aerotropolis, the Dharug people. We extend that respect to many others who have custodial obligations for Country and have been connected to this place for many generations including the Dharawal and Gundungurra. We acknowledge other surrounding groups that came to this Country to do business including the Darkinjung, coastal Sydney, Wiradjuri and Yuin people. We recognise that the Gandangara, Deerubbin and Tharawal Local Aboriginal Land Councils have land holdings and responsibilities to communities within this area.

We also acknowledge and respect the vibrant and diverse Aboriginal population that call Western Sydney home. They have been established in the Western Parkland City for many generations and have strong cultural values associated with this Country.

Disclaimer

This handbook has been developed in good faith, after careful review and consultation.

While every care has been taken in compiling this handbook, we accept no liability whatsoever for any loss (including without limitation direct or indirect loss and any loss of profit, data, or economic loss) occasioned to any person nor for any damage, cost, claim or expense arising from reliance on this handbook or any of its content.

The handbook will be reviewed and updated periodically, and the updated version will be available on Sydney Water's website. Please ensure you are using the current version.

Revision History

Version No.	Section	Description of revision
2022-1.0	All	Document creation

Notes:

i. An electronic database stores and control the current electronic versions of this document.

ii. Relevant personnel will be notified of changes to the guideline.

iii. Holders of printed controlled copies will need to check the Sydney Water website to ensure they are using the latest copy.

iv. An electronic database manages the controlled printed copy distribution list for this document.

v. If printed controlled copies will cease to be a controlled copy.

1 Introduction

1.1 Background Context

The NSW Governments' statutory and planning documents for the Aerotropolis and Mamre Road Precincts have adopted a new land-use planning and urban design approach to achieve the Parkland City vision for Western Sydney. As part of this major shift, new waterway health objectives and targets for the Wianamatta South Creek Catchment have been set, based on the Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions.

In response to this planning change, Sydney Water developed an integrated water catchment management (**IWCM**) approach to meet the new stormwater flow and quality targets through large, regional scale infrastructure. This approach will be instrumental in achieving the Government's vision for a cool, green, liveable Western Sydney. In March 2022 NSW Government declared Sydney Water the Regional Stormwater Authority, in effect, accepting and endorsing the IWCM approach across the Aerotropolis Initial Precincts and Mamre Road Precinct. Sydney Water has since developed Stormwater Schemes and, in collaboration with Government, has been working through the strategic, technical, financial and operational changes necessary to implement them. This Draft Guideline is part of the technical development of the stormwater scheme infrastructure planning.

1.2 Document Purpose

Sydney Water is listening to the challenges that stakeholders are facing as we transition into a new era of water management in Western Sydney. This Draft Guideline is the first stage in addressing the need for design guidance around major infrastructure elements of the Stormwater Scheme.

To help development to proceed more rapidly, developers may deliver the stormwater infrastructure mapped on their property in step with their development. This Draft Guideline will assist developers and their design consultants to understand Sydney Water's expectations and technical requirements for the stormwater infrastructure and help to progress their site design with greater certainty to progress through the design approvals process.

Any requirements included in this Draft Guideline do not replace requirements specified in other Sydney Water standards, specifications (such as Technical Specifications - Civil) or other documents.

1.3 What's included?

The Draft Guideline includes Sydney Water's technical design guidelines and requirements and guideline drawings for major infrastructure elements of the stormwater scheme. These elements include:

- Gross pollutant traps (**GPTs**)
- Street Trees
- Naturalised trunk drainage channels (Constructed)
- Existing waterways
- Treatment wetlands
- Harvesting ponds

The level of detail in this document will assist primarily in the concept, masterplan, and DA phases of design. It is acknowledged that future revisions of this document will be required to provide detailed design and construction requirements. Sydney Water will review and update this document accordingly as more detailed design guidance and requirements are developed. This document is to be read in conjunction with other relevant Sydney Water standards, specifications (such as Technical Specifications - Civil).

For Sydney Water's role in the design approval and acceptance process, refer to *Drainage Management for Aerotropolis and Mamre Rd Precincts (Draft, Sydney Water, 2022).*

1.4 Vision, Objectives and Design Principles

1.4.1 Vision

The vision for the Stormwater Scheme is to preserve, protect and enhance the natural processes of Country in the Wianamatta-South Creek catchment while providing safe, sustainable and cost-efficient stormwater infrastructure to allow for urban development.

1.4.2 Objectives

The broad outcomes and design objectives for the Stormwater Scheme are summarised in Table 1-1. The subsequent sections describe design principles.

Table 1-1 General outcomes and objectives table for stormwater scheme plan infrastructure.

Outcomes	Design Objectives
Sustainable Assets	Maintain flood conveyance capacity Maintain channel stability Financial sustainability Maintainability
Health and Wellbeing	Safe access management Urban greening Localised cooling
Cultural connection to Country	Design to the existing topography and land features Enhance local ecological communities Maintain water in the landscape Flora and fauna connectivity Minimise soil profile disturbance
Waterway health	Achieve waterway health targets at downstream precinct boundaries Maximise length of waterways
Wildlife strike management	Minimise wildlife strike hazard from Western Sydney Airport
Social amenity	Opportunities for active transport Facilitate opportunities for passive recreation Facilitate public access to green, natural places
Multiple benefit outcomes	Balanced achievement of multiple objectives

1.4.3 Design for Sustainable Assets

TBC

1.4.4 Design for Health and Wellbeing

TBC

1.4.5 Design for Cultural Connection to Country

> *On 28 August 1826 a truly remarkable public meeting was held in Windsor Courthouse attended by notable local Aboriginal figures of the day. In this remarkable meeting it was resolved 'that the rivers be protected to the most insignificant jet', a poignant resolution still pertinent for the waters of the Wianamatta system.*
>
> *Water resources have important cultural, spiritual, and practical values for First Peoples. Waterways are crucial for cultural practices and knowledge transfers as part of a healthy, flowing, connected system. The Cannemegal and Wianamattagal peoples of the Dharug nation still care for the Country of Wianamatta and carry the stories and knowledges of that landscape. Dharug Elders describe Wianamatta as an interconnected system, formed through the Dreaming, this cultural landscape connects from beyond the mountains out to the sea. It is a particularly important place for pregnant women as the place of the mother creek – a female landscape relating to motherhood and creation. The floodplains of Wianamatta remain a significant place for Aboriginal communities. South, Ropes, Badgerys, and Thompsons Creeks form a major part of the Aboriginal infrastructure which has provided resources such as food, medicine, and recreation over thousands of generations of people. It is imperative to respect these waterways and their dynamic movements, and to learn from their capacity to find the path of least resistance. Allowing one part to become ill through pollution, mismanagement or overuse will cause the whole system to suffer. All the waters must be protected to ensure the health of the whole system – to the most insignificant jet.'*
>
> ***- Dr Danièle Hromek is a Budawang woman of the Yuin nation – she has spent some time yarning with the Aboriginal Elders in Wianamatta to help translate cultural values into land use planning.***

The NSW Government acknowledges the critical role of the waterways of the Wianamatta-South Creek catchment to culture, ecological health, and human mental and physical health. Design consideration for cultural values is captured in NSW Government planning documents including the Recognise Country Guidelines, and the Aerotropolis and Mamre Road Precinct DCPs. The task of designing to meet engineering, safety and functional guidelines, as well as to address Custodian values and knowledge is challenging and often poses contradictory objectives. Sydney Water have developed this IWCM approach and the technical design with close regard to the above planning documents as well as multiple consultations that have been undertaken with Custodians and endeavoured to reconcile the multiple objectives at every opportunity.

Recommendations and considerations for designing for Country are being collated based on consultations and will be attached as Appendix C of this document (TBC).

Plate 1 Image of Tributary of Little Creek - one of the few reference creeks in the region.

1.4.6 Design for Waterway Health

The objectives for stormwater management in the Precinct Plan include:

- Protect, maintain and/or restore waterways, riparian corridors, water bodies and other water dependent ecosystems.
- Provide a landscape-led approach to integrated stormwater management and water sensitive urban design
- Establish a network of multifunctional stormwater assets that support stormwater management and contribute to broader objectives for waterway health, biodiversity, urban greening and cooling, recreation and amenity.

The IWCM approach adopted and, in turn each of the Stormwater Scheme Plans has been designed to meet these multiple objectives.

1.4.7 Design for Wildlife Strike Management

The Western Sydney Aerotropolis (**SEPP**) requires consideration of the risk of wildlife likely to be present on land within 13km of the airport on the operation of the Airport. The SEPP sets out that consent must only be granted for relevant development providing the risk of wildlife to the Airport Operation has been mitigated with appropriate measures.

The Aerotropolis DCP (Section 2.10.3) which documents considerations for wildlife strike must also be considered in design of any relevant development.

The Stormwater infrastructure are potential risks to airport operation, and significant thought and consultation has been undertaken to provide design guidance and guidelines to minimise any increase to wildlife risks. These measures include design elements to minimise attraction of problematic species, careful plant palette selection and management protocol.

It is required that any design of the Stormwater Scheme infrastructure on behalf of Sydney Water be undertaken with consultation of a suitably qualified ornithologist/avian ecologist and landscape architect.

1.4.8 Design for Social Amenity

Sydney Water envisions the naturalised stormwater infrastructure providing high liveability values to the communities that they are established in; be those industrial, commercial or residential. Sydney Water is not able to fund and construct infrastructure required for social amenity however, design of these elements such as seating, shared paths, and areas for Custodians and other community members to spend time on Country beside water bodies is strongly encouraged in the vicinity of the Stormwater Scheme infrastructure assets.

Funding and ownership of these elements will need to be negotiated with the relevant local Council or provided and maintained privately. The stormwater scheme infrastructure is to be integrated into the surrounding landscape and any design of this infrastructure on behalf of Sydney Water is to be done in consultation with a qualified landscape architect to maximise it social amenity value potential.

1.4.9 Design for Multiple Benefit Outcomes

Sydney Water requires that design of the stormwater scheme is undertaken by a suite of relevant and suitably qualified consultants from multiple disciplines and in line with Sydney Water's Engineering Competency Standard. Sydney Water expects that the required consultant team for design of these infrastructure assets to include:

- Civil/environmental engineer with experience in large-scale Water Sensitive Urban Design and/or waterway design
- Structural engineer
- Geotechnical engineer
- Environmental scientist
- Landscape architect
- Indigenous design consultant
- Ecologist (with Avian specialty) or Ornithologist
- Access consultant

2 Stormwater Scheme Overview

The Stormwater Scheme Plans comprise of infrastructure from private lots, down to the floodplains of the larger waterways across the Precincts. The following outlines the main infrastructure elements that plays a role in management of stormwater throughout the scheme.

Private, on lot requirements include:

- Mandatory minimum **pervious surface areas** (as per the DCPs)
- **Gross Pollutant Traps (GPTs)**: On lot GPTs will be privately owned and maintained. Requirements for these privately owned GPTs are provided in Chapter 3 of the Technical guidance for achieving Wianamatta–South Creek stormwater management targets.
- **Onsite detention** - Onsite detention (**OSD**) is also a Council requirement on all lots within the Mamre Road Precinct and some areas of the Aerotropolis. OSD design is subject to DCP and Council design requirements and are not covered in this report.

Council/TfNSW owned streetscape requirements include:

- **Street Trees:** Street trees are an important element of the Stormwater Schemes. This guideline provides Sydney Water's requirements for street trees for them to fulfil their function in meeting the Waterway Health Targets. Note that street trees will remain a Council asset and engineering design is subject to Council approvals.

Sydney Water managed stormwater infrastructure includes

- Naturalised trunk drainage channels (predominantly along the alignment of 1st order creeks)
- Existing waterways (2nd order creeks and higher)
- GPTs
- Water quality treatment wetlands and
- Stormwater storage and harvesting ponds (and associated harvesting and recirculation infrastructure)

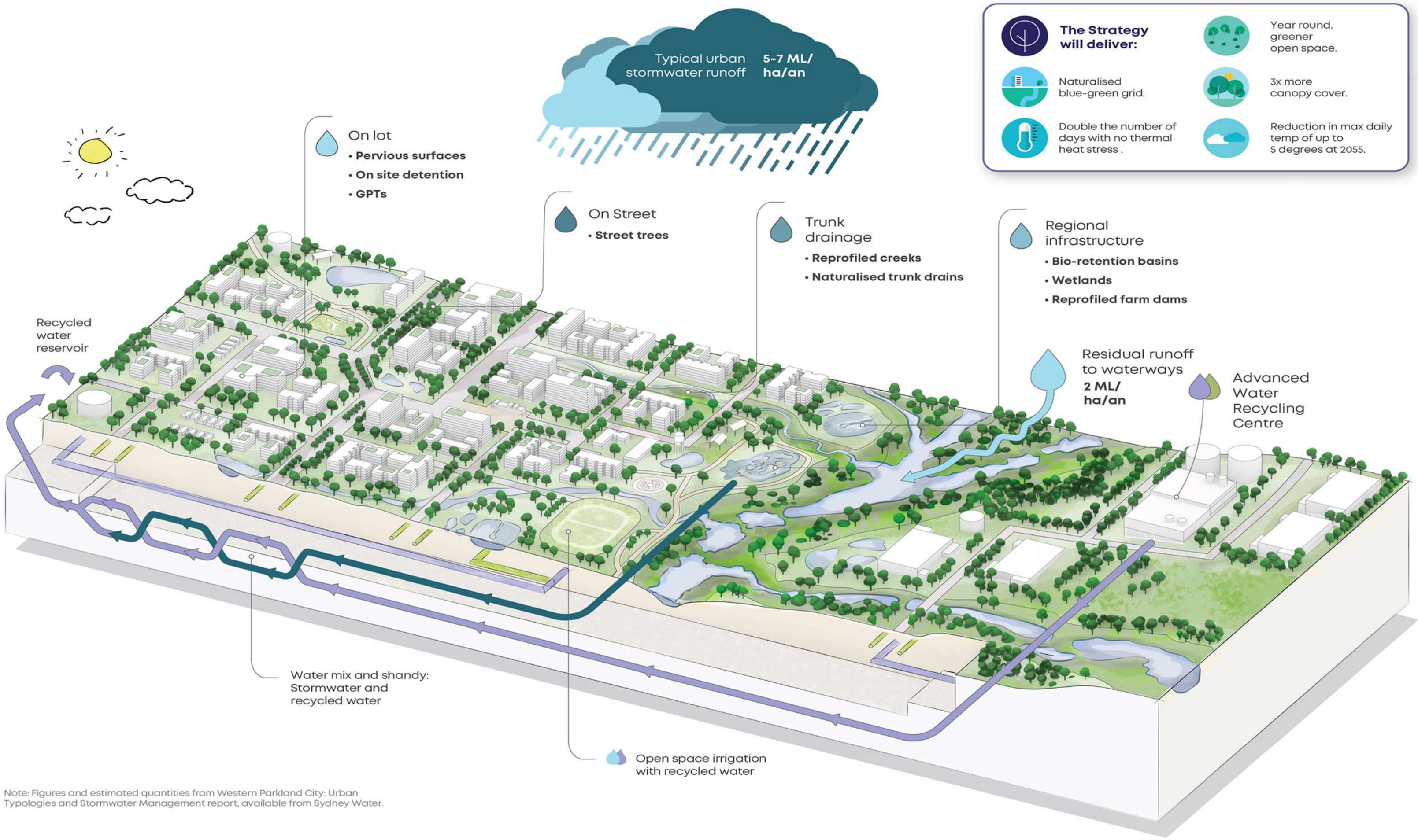


Figure 2-1: Diagram of Sydney Water's Stormwater Schemes.

3 Technical Guidelines

The following section provides background information and Sydney Water's technical requirements for designing the Stormwater Scheme infrastructure. The level of detail provided in this draft version is intended to be sufficient to help developers progress design to the Development Assessment or Masterplan stage where they may have stormwater scheme assets on their land holding. Further detailed design guidance will be released.

3.1 General Guidelines

- All development adjacent to the waterway shall be constructed with a minimum of 500mm freeboard to the top water level (TWL) of the 1% AEP flow event.
- For information regarding infrastructure close to Sydney Water's stormwater assets, refer to Building over or adjacent to our stormwater assets.

3.2 Street trees

3.2.1 Purpose and role in scheme

Street trees are to be designed as passively irrigated street trees. Passively irrigated street trees absorb a significant volume of road runoff and therefore provide an important component of the Stormwater Scheme wetland and pond infrastructure sizing. Design of street trees is to comply with Aerotropolis SEPP and DCP requirements as well as any Council requirements. These elements will ultimately be Council or TfNSW owned and maintained assets.

3.2.2 Design Requirements

IN1 Zoned Areas

The street trees act principally as a stormwater retention device as part of the wider stormwater infrastructure. To achieve the required stormwater retention objectives, the street tree system shall be designed to meet the following requirements:

Soil Filter Layer Volume of 126m^3 / 0.085 ha of road corridor (inclusive of shared path, tree planting/pervious verge and road carriageway, refer Notes 1, 2, 3 and 4)

- Soil Filter Layer to have a minimum hydraulic conductivity of 50mm/hr
- Extended detention depth of 0.01m across entire filter layer, which equates to 1.26m3/ 0.085ha of road (refer Note 5)

- Street tree spacing to achieve government canopy shading targets, nominally spaced at 8m centres.

Notes

1) It was assumed that the road corridor takes up 0.085 ha per 1 ha of development footprint. The soil filter layer volume should be factored accordingly to account for variations in road corridor.
2) The soil filter layer may include a higher organic content for improved soil health than a typical biofiltration street tree as the key function of the street tree is stormwater retention rather than stormwater filtration.
3) It is assumed that the soil filter layer extent is contained within the “tree planting” zone as documented within the Mamre Road DCP. The depth and extent of soil filter layer can be modified to achieve the required soil filter layer volume for each road type (and associated varying width).
4) 100% of road runoff from both the footpath and road carriageway must be directed towards either the surface or subsurface of the street trees.
5) Extended detention can be demonstrated through set down of street tree surface level (where flow is directed to top of street tree) or by providing extended detention within the void space within a drainage layer above the filter layer or within air space above filter layer within an inlet pit (where flow is directed to street tree via an inlet pit).
6) Where stormwater is directed into the street tree below the surface level (to a suitable drainage layer above filter layer), an inlet pit must be provided to capture sediment. To minimise the number of inlet pits, a connected / continuous trench of soil is recommended so one inlet pit can passively irrigate a number of trees. Inlet pits to be provided upstream of all stormwater drainage pits and nominally every 4 street trees (to be confirmed by designer).

Other Zoned Areas

Street Tree design requirements for other zoned areas are provided in Table 3-1.

Table 3-1 Street Tree Sizing Requirements

Land use	Required soil filter layer volume / ha of development [1]	Assumed footprint of road corridor per ha of development [1]
Low Density	144 m^3	0.29 ha
Medium Density	144 m^3	0.31 ha
High Density	144 m^3	0.38 ha
All other Industrial and Commercial land uses	126 m^3	0.085 ha

[1] Soil filter volume to be factored accordingly to account for variations in road corridor extent

[2] Notes 2, 4, 5 and 6 above in relation to IN1 Zoned Areas are applicable across all land uses in other precincts.

3.3 Naturalised trunk drainage channels

3.3.1 Purpose and role in scheme

Trunk drainage commences where stormwater catchments reach an area of 15 hectares within a **declared catchment area**. The purpose of trunk drainage is to collect, control and convey stormwater runoff resulting from development. Trunk drainage must be sized adequately to receive stormwater run-off from its catchment area, prevent overflowing and causing damage to property or loss of life.

The Aerotropolis and Mamre Road DCPs both have objectives of IWCM with an emphasis on stormwater management through naturalised water assets and the capacity to maintain water in the landscape. In response to this, all trunk drainage will be in the form of naturalised, open channels that adhere to the design guidance in this section. The use of naturalised trunk drainage channels also supports the NSW Government's vision of the Parkland City by keeping water in the landscape, adding to the cooling of the environment and provision of safe conveyance of peak overland flows while adding to the visual amenity and connection to Country of the surrounding development.

This section addresses constructed naturalised trunk drainage channels which will be implemented where:

a) There is a requirement for trunk drainage and no defined existing waterway

b) There is a requirement for trunk drainage but the existing waterway does not have sufficient capacity to convey the required flows

c) An existing waterway re-alignment has been approved by NSW Department of Natural Resources Access Regulator (**NRAR**)

3.3.2 Design Requirements

Design flow rates of interest

Naturalised trunk drainage channels are required to safely convey the 1% **AEP** pre-development flow event entirely within the high flow channel. Addition flows, 0.2% AEP and **PMF** are required to consider failsafe operation of the trunk drainage system and the potential impacts of climate change (0.2% AEP).

At a minimum, the peak flow magnitude for the 12**EY**, 1EY, 5% AEP, 1% AEP, 0.2% AEP and PMF flow events must be determined through the design process.

Frequent events (12EY and 1EY flow events) are important for designing the low flow channel geometry and diversions to the GPT (refer section 3.5). Less frequent events including 5% AEP and 1% AEP are important to provide flood planning controls and erosion control in the trunk drainage channels and confirm the total channel geometry.

Compound waterway geometry is Sydney Water's preferred approach. Compound waterways are required to have a low flow channel with sufficient capacity to convey at least 50% of the 12EY flow event (selected to enable the low flow channel to have room to meander). Flows exceeding the low flow channel capacity will engage the adjacent banks and other surfaces as flows spill across the base of the high flow channel.

All designers shall model a range of flows to consider the shear stresses within the channel and maintain velocities of less than 1.4m/s within the low flow channel.

Recommended Flow Rates

As a general guide, channels will convey the following flowrates:

- 20m corridor 2 – 4.5 m^3/s
- 25m corridor 4 – 11 m^3/s

- 30m corridor 11 – 20 m^3/s

Note these flowrates are a general guide and do not replace appropriate hydraulic modelling. Hydraulic modelling requirements are included in Section 6.

Mannings 'n' values

The channels shall be designed to a Mannings roughness (n) of 0.08 with sensitivity testing of 0.03 and 0.10 to assess the impacts of flows on newly constructed channels where vegetation is in its establishment phase, and the potential for overgrown channels.

Note that planting palette and density guidelines to achieve a 0.08 Mannings roughness are provided in Appendix B.

Connections to trunk drainage

All stormwater connections to the naturalised trunk drainage channels shall be made in a manner to preserve the amenity and stability of the channel while effectively and safely conveying minor to major flows. All proposed connection points to naturalised trunk drainage channels will be subject to approval by Sydney Water.

General requirements for connections to constructed trunk drainage channels are documented in Stormwater Connections to Natural Waterways. Note that this document serves as interim guidance for connections to waterways but may be updated to reflect any additional guidance or requirements specific to the Aerotropolis and Mamre Rd Precincts.

Channel Corridor Width

Where the channels are to be constructed as part of site development, they shall be designed to fit the corridor widths and locations as shown in the planning instruments. Typically, the widths are 20m, 25m and 30m for constructed naturalised trunk drainage.

Channel cross-section

Sydney Water has developed two typical concept sketches for trunk drainage channels. Trunk Drainage Channel Design Typical 1 is for a compound channel geometry which is the preferred design approach. A rendered graphic of this design is shown in Figure 3-1, more detailed concept sketches are provided in Appendix A.

Only where flow or grade constraints exclude the feasibility of a compound channel should Trunk Drainage Channel Design Typical 2 be considered. An example of such a situation may be in the transition reach between frequent drop structures. A meander in the channel base must still be achieved in this design through continuous variation of the channel bank grades.

Figure 3-1: Rendered Plan (left) and Cross Section (right) of Typical Naturalised Trunk Drainage Channel Design (Typical 1).

Channel long section

Typically streams in western Sydney have a longitudinal slope of 0.4% - 0.8%. It is understood that in the upper reaches the grades may be steeper but where grades exceed 1%, with a maximum allowable grade of 2% then appropriate energy dissipation will be required, and calculations undertaken to ensure that shear forces generated are suitable for the soils and vegetation.

Drop Structures

Drop structures will be required in steeper gradients to allow the typical vegetated channel grades to be maintained as described above. Key design criteria for drop structures are as follows:

- Drop structures are to be designed to withstand all events up to a 1% AEP flood event. Drop structure designs are to be supported by hydraulic modelling and/or appropriate hydraulic calculations.
- Preference is for the use of rock chutes or near vertical rock drop structures constructed of sandstone logs. Wood drop structures and grouted rock structures will generally not be accepted. All drop structures shall include appropriate scour protection and dissipation to protect the upstream and downstream channel. The frequency of drop structures shall aim to maximise the extent of vegetated channel and minimise rock. Where the length of drop structure and associated rock lined channel exceeds the length of vegetated channel or the length of the typical vegetated channel is <10m between drop structures, consultation with Sydney Water is required.
- Vertical drop structures are to have a recommended drop across the system of 500mm. Larger drops up to a maximum of 900mm may be accepted subject to local constraints and safety in design protocol.
- Rock chutes are to generally be 1V:5H or flatter and have a maximum height of 1.2m from chute crest level to base level (excluding pool depth). Vertical drop structures are preferred where these criteria do not suit local conditions.
- All drop structures are to be designed with consideration for the potential for dispersive in-situ soils. A geotechnical engineer is to assess the need for additional treatment for dispersive soils. This will typically require the placement of a layer of non-dispersive soil at the interface with underlying in-situ soils for the full length of the drop structure and associated scour protection.
- Where fish passage is required within natural waterway realignments or rehabilitation works and grades are unsuitable for vegetation, pool and riffle systems which comply with fish passage requirements are to be used to provide grade control.

- Safety in design protocol as described in section 4 must be followed when designing all drop structures.

Planform (sinuosity)

Sinuosity is the term used to describe the repetitive, though variable, curvature of a watercourse channel or low flow channel. In natural, dry bed streams, meanders or sinuosity occurs in both the main channel and the low flow channel.

In urban waterways, however, where the space available for waterways is constrained by development footprint requirements and urban infrastructure assets, natural waterway processes of erosion and deposition are required to be controlled. The constructed form of the waterway is designed to remain fairly constant over time. Though sinuosity is encouraged for the form of the main channel, the focus of designed sinuosity for constructed naturalised trunk drainage channels is aimed at the low flow channel.

The required minimum radius of constructed bends is 3 times the bankfull width. Tighter bends may be considered but shall be discussed with Sydney Water prior to commencing design. Tighter bends are likely to require additional protection to the bed and banks to avoid excessive erosion.

Design for sinuosity should avoid perfectly smooth and repetitive 'sine curve' meander as shown in Figure 3-2. Irregularity in channel meanders is the desired outcomes and achieves significantly greater stream diversity and ecological outcomes.

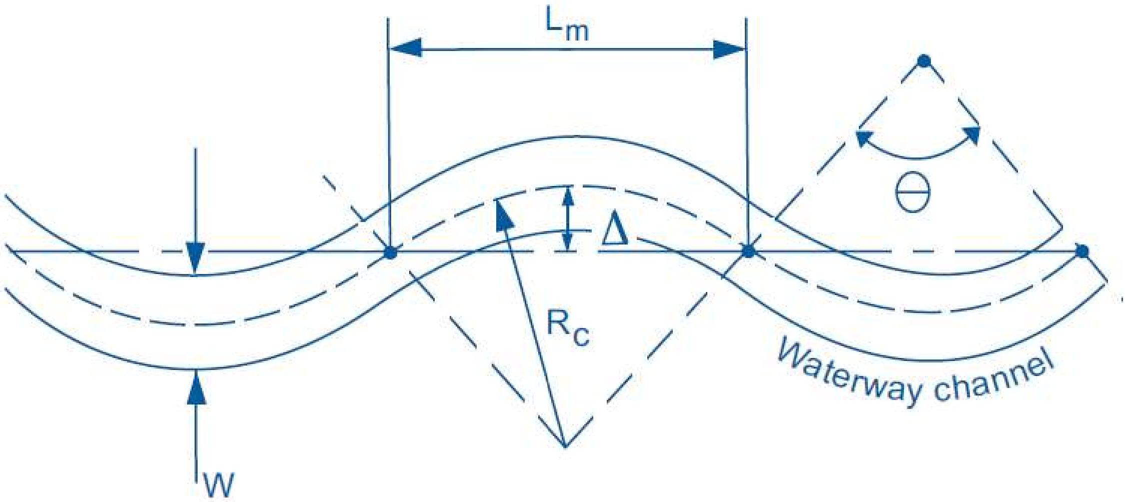


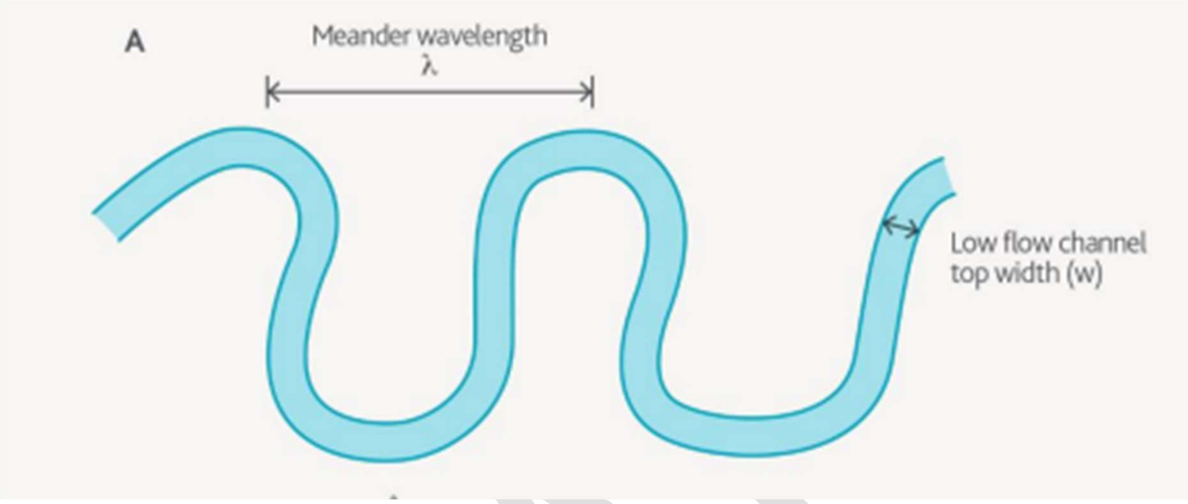
Figure 3-2: Sinuosity diagram (Brisbane City Council, 2000)

The preferred sinuosity design criteria are as follows:

- Average wavelength (λ, refer Figure 3-3) of 10 x Low Flow Channel Top Width

- Minimum sinuosity of 1.05 (see Figure 3-3).
- Minimum radius of curvature (Rc, refer Figure 3-2) of 3 x Low Flow Channel Top Width (W)

It may not be feasible to achieve the above sinuosity criteria where a Trunk Drainage Channel Design Typical 2 is required for flow or grade constraints. In this instance the sinuosity of the low flow channel should be maximised as much as practical.



$$Sinuosity = \frac{Low\ flow\ channel\ length\ (m)}{Corridor\ length\ (m)}$$

Figure 3-3 Sinuosity wavelength (Melbourne Water, 2019)

Access

All corridors will require a 3.5m wide maintenance/access track suitable for light vehicle access. A 1m planted buffer is required adjacent to the access track. The access track arrangement is shown in the Trunk Drainage Channel Typical Plan and Sections (see Appendix A).

Access ramp connections between local roads and the trunk drainage corridor access track are to be provided at every road crossing. The ramp connection is to have a maximum grade of 1V6H. Designer is to confirm an appropriate surface treatment for ramps. Removable bollards or a locked access gate shall be provided at all access points.

Where drop structures are required, the access track grade is to be set at a grade which minimises steep changes in grade instead providing a more continuous grade which caters for the periodic drops, subject to local constraints.

Bed and bank surface treatment

Surface treatment of constructed trunk drainage channels must be appropriate for the modelled velocities and sheer stresses expected in the channel. Refer to Table 3-2 for suitable surface treatments for different sheer stress and velocities.

Table 3-2 Acceptable stream stress values (Melbourne Water, 2019)

BOUNDARY CATEGORY	BOUNDARY TYPE	SHEAR STRESS EROSION THRESHOLD (N/M2)
Soils	Fine colloidal sand	1.5
	Alluvial silt and silty loam (non-colloidal)	3
	Firm loam and fine gravels	4
	Stiff clay and alluvial silts (colloidal)	12
Gravel/Cobble	25 mm, 51 mm, 152 mm, and 305 mm	16, 32, 96, and 192 respectively
Vegetation	Turf	45 to 177
	Long native grasses	80
	Short native and bunch grass	45

With consideration to natural character of Cumberland Plains waterways, rock armouring should be avoided wherever possible, instead, design should focus on minimising sheer stresses and velocities through shallow longitudinal grades, stream meanders and containing required elevation changes through drop structures (refer Drop Structures).

Where rock armouring in-stream is required, consideration should be given to using of rock material relevant to the local geological landscape.

3.4 Existing waterways

3.4.1 Purpose and role in scheme

Existing waterways and their riparian zones are an integral part of maintaining the ecological health of the Wianamatta catchment. By rehabilitating these waterways, the health and structure of the receiving waters are protected by mitigating erosion impacts, flows can be slowed to a more natural state and the ecological environment protected while offering cooling to the surrounding area. All existing waterway treatment shall be referred to NRAR and shall comply with their publication Guidelines for controlled activities on waterfront land – Riparian corridors. Other document that may be helpful are Good practices in riparian rehabilitation.

For areas covered by Wianamatta South Creek Catchment Flood Study Existing Conditions (Advisian, 2022), rehabilitation concept designs should be referred to INSW and the appropriate local government authority to ensure compliance with the floodplain management plan and controls. For areas outside this study, hydraulic modelling will be required to ensure that floodplain management controls can be met. Hydraulic modelling requirements for these areas are provided in Section 6.

3.4.2 Design Requirements

Connections to natural waterways

All stormwater connections to the existing waterways shall be made in a manner to preserve the amenity and stability of the channel while effectively and safely conveying minor to major flows. All connection points to existing waterways will be subject to Sydney Water approval.

Requirements for connections to natural waterways are documented in Stormwater Connections to Natural Waterways.

Corridor width

The corridor width for existing waterways will be in line with the waterways Strahler order and the riparian width requirements documented in the Guidelines for controlled activities on waterfront land – Riparian corridors. The designer must also confirm that the critical 1% AEP flows are contained within the riparian corridor.

Note that the design flows (based on the rural peak flowrates) must consider the impact of OSD requirements provided in the Mamre Road and Aerotropolis DCPs respectively. If OSD is not provided on a site, then the corridor width may need to be increased to accommodate the additional flow. Designers will need to assess these constraints prior to commencing design.

3.5 Gross pollutant traps

3.5.1 Purpose and role in scheme

The purpose of the GPTs is to protect trunk drainage channels and wetlands from impacts of high sediment, hydrocarbon and litter loads. GPTs play a critical role in the treatment train to managing water quality risk that is fundamental to a stormwater harvesting and reuse scheme.

There are two locations in the Stormwater Scheme treatment train where GPTs are to be provided:

- Immediately upstream (with the exception of an OSD basin, which may be downstream of the GPT) of each legal point of discharge from private property. Sometimes this will occur as a direct connection to a trunk drainage channel. These GPTs will not be managed by Sydney Water. Requirements for these GPTs are stipulated in the DCPs and the Technical guidance for achieving Wianamatta South Creek stormwater management targets.

- at the diversion point from trunk drainage channels to wetlands

3.5.2 Design Requirements

The following design requirements apply to the design of GPTs at the diversion point from trunk drainage channels to wetlands. These will be owned and maintained by Sydney Water.

Design Event and Treatable Flow Rate

A GPT upstream of the wetland shall be designed to treat all flows diverted into the wetland. This will prevent the need for the GPT to have its own high flow bypass arrangement. Bypass weirs are to be set at the full height of the diversion chamber.

Access to the GPT for an eductor truck of minimum 9m length and 150mm ground clearance shall be provided.

Pollutant Removal Targets

Pollutant removal is to be verified through MUSIC modelling (see modelling requirements for GPTs below). GPTs shall be designed to remove:

1) 45% of Total Suspended Solids (**TSS**) incoming loads from all private and public land draining to the GPT (which can exclude the residual TSS load from tree pits).
2) Hydrocarbons through the inclusion of oil baffles.
3) 90% of gross pollutants where gross pollutants are defined as particles larger than 3mm in diameter.

Hydraulic grade line requirements

Hydraulic grade line (**HGL**) requirements for GPT design includes:

Ensuring the HGL upstream of the GPT does not rise above the diversion weir for the design event. This will require GPTs to have low friction loss coefficients and that are capable of storing sediment and collected gross pollutants below outlet screens. Note:

- GPTs which store gross pollutants in line with screens are not acceptable due to the reduction in conveyance capacity when full.
- Ensuring that downstream extended detention depths are considered when sizing and designing the GPT (i.e., have a submerged or drowned outlet) or alternatively locating the

GPT outlet pipe level so that it remains above the extended detention depth (plus weir flow depth at the outlet).

Sizing of the GPT Storage Sump

The storage sump for GPTs shall be designed to store the gross pollutant and sediment load assuming maintenance twice per annum. The designer shall assume a minimum sediment and GPT loading rate of 1 m^3/ha/annum.

Design Life

GPTs shall be designed to achieve a main structure 100- year design life. It is accepted that the screen or other degradable parts will need to be replaced during the period of asset ownership. The GPT shall be warranted for a minimum of 10 years.

Access

Where a proposed GPT is located within 5m of a public road, an indented parking bay adjacent to the GPT lid and long enough to accommodate a 9m service vehicle shall be provided. The parking bay shall be designed so that the GPT lid can align with the rear of the eductor truck where the suction hose is located (Access arrangement drawing TBC).

Where a proposed GPT cannot be located with the lid within 5m of a public road, a dedicated concrete access track and level concrete standing pad next to the GPT lid shall be provided. Adequate provision for turning for a 9m service vehicle must be provided. It is permissible for an eductor truck to reverse in achieving this manoeuvre.

Modelling Requirements

To demonstrate compliance with the above requirements, the following modelling methodologies shall be adopted:

- Flow rates shall be modelled using DRAINS software (see Section 6).
- The GPT model proposed shall have a manufacturer nominated treatable flow rate greater than the 4EY. A MUSIC model is required to demonstrate compliance with the need to retain 45% of TSS. These GPT node parameters shall be included in the standard MUSIC

nodes available for download from within MUSIC-Link. An example of a generic GPT node configuration in MUSIC is shown below in Figure 3-4.

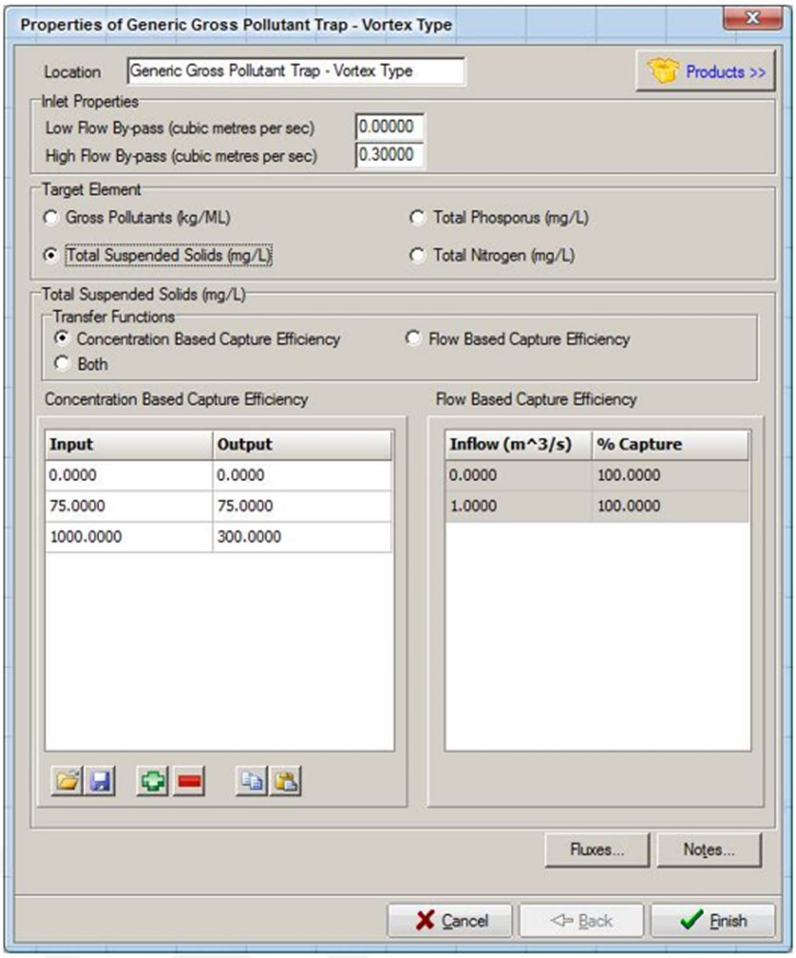


Figure 3-4: Standard MUSIC GPT node.

3.6 Constructed wetlands

3.6.1 Purpose and role in scheme

Constructed wetlands are a widely recognised and mainstream water management technology. The Constructed Wetlands Manual (DLWC, 1998) was published over 20 years ago and there are a considerable number of well designed and constructed, wetlands across the developing areas of western Sydney which has helped to pioneer their use for managing urban stormwater.

Constructed wetlands play a critical role in meeting the Wianamatta South Creek stormwater targets set in the Mamre Road Precinct and Aerotropolis DCPs. Firstly, they have a traditional role in treating urban stormwater quality to help make it fit for non-potable reuse (there is a multiple barriers approach demanded by the National Water Quality Management Strategy in its publication titled Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (phase 2) Stormwater harvesting and reuse (July 2009).

Secondly, the proposed constructed wetlands provide an opportunity to enhance evaporative losses which will help in meeting the flow-based stormwater targets by helping to reduce the Mean Annual Runoff Volume (**MARV**) through evaporative losses.

EDD above the normal surface water level of the wetlands will also help to slow down and detain flows long enough to help meet other specific flow percentile targets such as the 90th percentile flow target.

Constructed wetlands are proposed to be located generally at the end of naturalised trunk drainage channels or along existing waterways where they will provide end-of-line treatment to diverted stormwater flows from the upstream development. Many of the wetlands have been placed partially if not completely within the 1% AEP flood extent but clear of the mapped 1% AEP floodway. Infrequent inundation of the wetland and pond basins is considered acceptable however the basins levels must be elevated as much as practically possible to avoid inundation impacts from smaller events (without impacting on flooding).

The wetland basins have also been located and sized relative to the modelled runoff from their upstream catchment (defined in most cases by natural catchment boundaries). Therefore, any changes to catchment boundaries, or trunk drainage alignments have an impact on the function of the wetlands.

Stormwater runoff will first be diverted from the naturalised trunk drainage channel into a GPT. These GPTs, will protect the wetland from gross pollutants, coarse sediment exported from the trunk drainage channel and to some extent hydrocarbons.

After flowing through the wetland, the treated stormwater will be discharged into a storage pond (which is described below in Section 3.7). Treated stormwater will be harvested from the pond for regional reuse. Regional reuse is another critical mechanism of the Stormwater Scheme used to meet the NSW State Government's Wianamatta South Creek flow targets.

In addition, the proposed wetlands will significantly reduce the potential for algal outbreaks during hot dry periods. It is proposed to circulate water from downstream ponds back into the wetland where the water will be reoxygenated and further filtered to reduce nutrients which are necessary for algal growth.

3.6.2 Design requirements

A conceptual sketch of a typical storage pond arrangement is shown Figure 3-5. More detailed concept typical sketches are shown in Appendix A.

Diversion Weirs

Trunk Drainage Channels (constructed or existing waterways) will convey stormwater runoff into the wetlands via diversion weirs. The elevation of diversion weirs is to be set to convey the design flow (TBC by Sydney Water on a case-by-case basis) into the wetlands. The diversion weirs effectively form a high flow bypass and protect the wetlands from excessively high flows which may scour the wetlands and reduce water quality.

Sydney Water will develop detailed design specifications for the diversion structures to maintain as much uniformity as possible in diversion structure design across the many wetlands in the declared catchments. This is important to the success of ongoing maintenance of these assets.

Low Flow Bypass Structure

The diversion weirs may be required to be designed to allow for very low flows to be conveyed downstream through a non-blocking structure. This requirement is subject to supporting modelling and designers are required to confirm low flow bypass requirements with Sydney Water on a case-by-case basis.

GPT

Refer to section 3.5 for GPT requirements.

Sediment Basin and Inlet Volume

All wetlands are to have a sediment basin at the inlet zone. The purpose of the sediment basin is to settle out very fine sand to prevent smothering and rapid accretion/deposition of the macrophyte zone which would reduce its life and mean time between maintenance events.

The maximum allowable depth of the sediment basin is 2.0m.

The sediment basin is to be sized using MUSIC, by selecting the “Estimate Inlet Volume” option within the wetland node adopting the following parameters:

Table 3-3 Sediment basin sizing parameters to be adopted in MUSIC

Parameter	Value to be adopted
Particle Size	Very fine sand (125 micron)
Design flow	is set equal to the high flow bypass rate
Sediment Loading Rate	0.5 m^3/ha/year (assumes GPT will remove nominally 45% TSS load)
Capture Efficiency	90%
Clean out frequency	10 years

Turbulence	1 CSTR

Wherever possible, sediment basin inlet zones shall include a high flow bypass weir that would restrict flows allowed to travel through the macrophyte zone to the 4EY and direct them into the pond without further treatment in the wetland. This will limit scour and peak velocities and help designers to comply with the maximum velocity requirements included above. In some locations there may be insufficient gradient to allow for diversion of high flows into the ponds. In this instance, the design must allow for protection of the macrophyte zone.

The following parameters, (taken largely from the Melbourne Water, Wetland Design Manual, 2019) are to be adopted:

- The surface area of the macrophyte zone and the sediment basin shall be nominally 300m^2 per hectare of contributing catchment.
- The depth of the macrophyte zone shall be 300mm but allow for 100mm accretion (rise in the bed level) to reduce maintenance frequency.
- The macrophyte zone EDD must be ≤ 350 mm.
- The macrophyte zone must provide nominally 30 hours residence time. Where the outlet control for the wetland is not an overflow pipe invert set to the NWL such as a submerged orifice in an overflow pit with protective screen, then the residence time can be assessed using a program such as DRAINS and modelling the wetland as a detention basin.
- Provide a system to create a sinuous flow path within the wetland to increase residence time and avoid short circuiting, i.e. to maximise the number of continuously stirred tank reactor (CSTR) cells. The top of the wetland is to be a minimum of 200 mm above the wetland extended detention depth. Larger wetlands are to use internal clay/soil berms or sandstone blocks or similar as required to achieve the minimum flow path requirements. Timber baffle walls will not be permitted.
- The length of the macrophyte zone must typically be ≥ 4 times the average width of the macrophyte zone.
- Velocities within the macrophyte zone must not exceed 0.05 m/s at the EDD during 4EY inflow events. Consider the flow area as the EDD plus 0.3 multiplied by the narrowest width of the macrophyte zone at normal water level (NWL).
- The velocity through the macrophyte zone is ≤ 0.5 m/s during the peak 1% AEP flow
- Maintain a minimum 200 mm depth at the edge of the macrophyte zone via a rock or hard edge to reduce the risk of mosquito breeding during dry periods when the water levels drop.

- Dense vegetation bands and flat bathymetry orientated perpendicular to the flow path are required for even flow distribution and to reduce short-circuiting through the macrophyte zone.

Plate 2 Macrophyte zone densely planted at Blacktown International Sports Park stormwater harvesting wetland

Connections between zones

For the wetlands to function as intended it is necessary to ensure that incoming flows are spread evenly across the wetland. This ensures maximum hydraulic residence time, avoidance of scour at flow concentration points and optimal water quality outcomes.

To achieve this flow spreaders are required between the inlet zone and the macrophyte zone and the macrophyte zone and outlet zone.

Macrophyte growing media

Macrophyte zones shall include placement of 300mm depth of growing media.

Wildlife management

Wetlands are to be designed to reduce the risk of bird strike at the Western Sydney Airport. While an adaptive management approach is to be adopted, a number of risk management measures can be implemented through design.

Key design considerations include:

- Avoiding open water/deep water zones within macrophyte zones (water quality ponds do have open water but will have separate management strategies)
- Avoid placement of bird prey habitat features in banks and bunds (e.g. logs, rocky features)
- Avoiding the creation of migratory bird wading habitat such as clay pans – edge treatments to wetlands are critical in this respect and appropriate treatment of basin edges has been shown in the wetland typical concept sketch drawings (Appendix A)
- additional management measures to be advised by Sydney Water.

Consideration has been given to managing wildlife attraction risk in the preparation of the Concept Sketch drawings for wetlands and ponds (see Appendix A).

Outlet Structure

Sydney Water will develop detailed design specifications for the wetland outlet structures to maintain as much uniformity as possible in across the many wetlands in the declared catchments. This is important to the success of ongoing maintenance of these assets (Detail TBC).

3.7 Storage ponds

The constructed wetlands would discharge into end of line storage and harvesting ponds located as the most downstream treatment element.

Plate 3 Julluck Pond at The Ponds, image courtesy Urban Growth NSW

3.7.1 Purpose and role in scheme

End of line water quality ponds are required to:

1) Further enhance water quality prior to regional reuse. Additional hydraulic retention times will see further decay of contaminants and improvements in water quality. Large open areas of water exposed to UV light would typically see some effective sterilisation of pathogens and enhanced sedimentation. Collectively the system would achieve a minimum of 3 days hydraulic retention time to achieve a log reduction in pathogens.

2) Retain water over an extended period to ensure its availability as a water supply for the regional non-potable reuse scheme. Retained water would be gradually drawn down through regional reuse to create the storage volume needed to retaining runoff from the

next storm event and so on. The ponds therefore play a critical role in meeting both the water quality and quantity targets, especially the Mean Annual Runoff Volume (MARV) target of less than 2 ML/ha/annum through retention.

3) Help meet water quantity targets, other than MARV, through the creation of air space (extended detention) above the low flow spill level of the pond. This air space, used for detention of very frequent storm events (as opposed to onsite stormwater detention which is focussed on rarer storm events) helps to meet the Wianamatta South Creek, 90th percentile flow targets.

3.7.2 Design Requirements

A conceptual sketch of a typical harvesting pond arrangement is shown Figure 3-5. More detailed concept typical sketches are shown in Appendix A.

Key elements

The storage ponds shall include the following elements:

1) A high flow inlet from the sediment basin – this will operate in very large events and allow high flows to bypass the macrophyte zones and be directed into the ponds
2) A normal flow inlet from the macrophyte zone
3) Have a storage volume of not less than 600m^3/ha
4) A maximum depth of 1.5m to prevent thermal stratification
5) Incorporate a macrophyte / safety bench at the pond edge of not less than 2.4m width
6) A low flow outlet (orifice) which affords nominally 20 hours of extended detention depth
7) A high flow overflow weir with a weir width sufficient to afford 300mm freeboard to the lowest elevation of any embankment wall that forms and retains the pond.
   - Note: Sydney Water will develop detailed design specifications for the pond outlet structures to maintain as much uniformity as possible in across the many ponds in the declared catchments. This is important to the success of ongoing maintenance of these assets (Detail TBC).
8) A recirculation system described further below. This will require hydraulic efficiency to limit short circuiting and maximise the effectiveness of recirculation in turning over the pond volume

Recirculation system

The pond shall include a recirculation system that would turn over the volume of the pond, when full, not longer than every 14 days. This conservative approach aims to prevent exponential algal cell growth out to 15,000 cells (Australian Runoff Quality, 2006, Chapter 12, by Wong, Breen and Lawrence).

The recirculation system shall draw water off from near the pond outlet and return it to the sediment basin upstream of the macrophyte zone.

Harvesting infrastructure

TBC

Wildlife management

Ponds are to be designed to reduce the risk of bird strike at the Western Sydney Airport. While an adaptive management approach is to be adopted, a number of risk management measures can be implemented through design.

Key design considerations include:

- Avoid placement of bird prey habitat features in banks and bunds (e.g. logs, rocky features)
- Avoiding the creation of migratory bird wading habitat such as clay pans – edge treatments to wetlands are critical in this respect and appropriate treatment of basin edges has been shown in the wetland typical concept sketch drawings (Appendix A)
- additional management measures to be advised by Sydney Water.

Consideration has been given to managing wildlife attraction risk in the preparation of the Concept Sketch drawings for wetlands and ponds (see Appendix A).

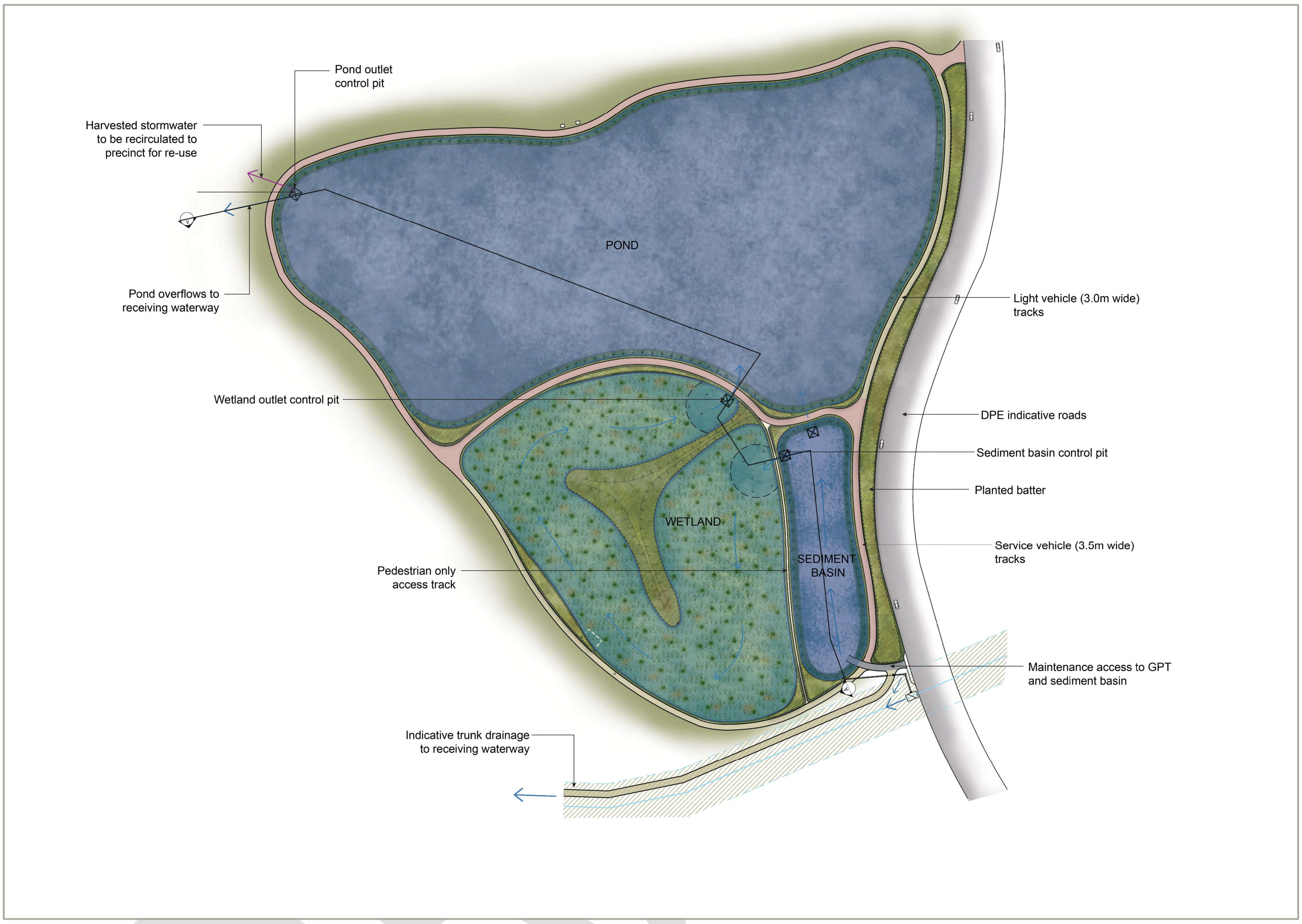


Figure 3-5 General Arrangement Plan of Sediment Basin Wetland and Pond.

4 Safety in design

4.1 The safety in design process

4.1.1 What is safety in design?

Safety in Design is a risk management process that integrates control measures early in the design process to eliminate or, of this is not reasonably practicable, minimise risks to health and safety throughout the life of the asset being designed.

4.1.2 When do you need to follow the safety in design procedure?

The procedure is to be used during each design phase of all projects involving the creation of Sydney Water assets. It applies to both permanent and temporary works.

A designer must follow the risk management process described in the Safety in Design procedure or an alternative equivalent process that meets the intent of the *Work Health and Safety Act*.

4.1.3 Is a design safety review workshop required at both concept and detailed design stages?

We expect there to be a balance between the required effort and the benefit derived from the process. Therefore, for simple designs, a design safety review workshop would not be required at both concept and detailed design stages.

Designers should understand that Safety in Design is more than just holding a workshop, such as a HAZOP at a specific point in the design process. Considering the safety aspects of a design by adopting a risk management approach should be part of the entire design process.

4.1.4 When is a safe design report required?

A Safe Design Report is only required for designs that have unusual or atypical features that present hazards and risks that are unique to the design.

The *WHS Act* requires that the designer transfer safety related information to those that will carry out the design. This should include key information about identified hazards and action taken or required to control risks related to the design.

4.1.5 What are designers' duties under the *Work Health and Safety Act*?

Under the *Work Health and Safety Act*, designers must ensure that designs of Sydney Water infrastructure are without risk, so far as reasonably practicable, to those that will construct, use or be exposed to them.

Designers must also give adequate information communicating any risks that may be inherent in the design.

4.1.6 What are project managers responsible for in relation to safety in design?

Project managers must provide designers with any information in relation to the hazards and risks at the site where the construction work is to be carried out.

Project managers are also required to consult with designers about how to ensure that health and safety risks arising from the design are eliminated or minimised during construction.

4.1.7 What is 'reasonably practicable'?

Deciding what is 'reasonably practicable' to protect people from harm requires considering all relevant matters including:

- the likelihood of the hazard or risk occurring
- the degree of harm that might result from the hazard or the risk
- knowledge about the hazard or risk
- ways of eliminating or minimising the risk
- the availability and suitability of ways to eliminate or minimise the risk.

4.1.8 Do you need to follow the Codes of Practice issued by SafeWork NSW?

No, it is not mandatory to follow the Codes of Practice. SafeWork NSW issues Codes of Practice to provide practical guidance on how a person can achieve the requirements of the *Work Health and Safety Act and Regulation*.

However, Codes of Practice may be used in court to determine what is 'reasonably practicable' in the circumstances to which the code relates. It is recognised that equivalent or better ways of achieving the required work health and safety outcomes may be possible. For that reason, compliance with Codes of Practice is not mandatory providing that any other method used provides an equivalent or higher guideline of work health and safety.

4.2 Summary of risks identified in design

The purpose of the safety in design process is to eliminate hazards, or if this is not possible within a reasonable time and cost, to mitigate such hazards to a level of risk that is as low as reasonably practicable. It is the view of the designers that the multi-step safety in design process employed for this project has identified the atypical hazards for construction, operation, maintenance and demolition activities relevant to this project.

Please refer to Appendix D for the actions and minutes related to the safety in design workshops held during the design. This will provide more information on the relevant hazards and their risk levels (TBC).

Major risks associated with this project, identified during this process, are documented below.

Risk which are OPEN and have not been closed out during design shall be considered carefully by the project team and constructor.

Table 4-1 Major Risks

ID	Risk	Proposed Control Measures	Action By	Status
1	TBC			
2				
3				
4				
5				

5 Maintenance requirements

(TBC)

6 Modelling requirements

6.1 Hydrological modelling

All sites shall prepare suitably refined hydrologic models to represent the catchments of the proposed development as well as any upstream catchments. An accurately drawn catchment plan shall be prepared that clearly defines the proposed catchment and is superimposed on the existing natural catchments. Note, catchment splitting is not supported, unless directed by the Regional Stormwater Authority, and large building pads may be required to drain to their natural discharge points when crossing natural catchment boundaries.

Acceptable digital hydrologic methods are runoff routing, storage routing and time area models such as XP-Rafts, RORB, WBNM, ILSAX and Drains. Use of the Rational Method is <u>not</u> appropriate. Where the time of concentration is required, for developed sites, the minimum time is 5 minutes with a maximum of 20 minutes, noting that times over 14 minutes will require justification. Use of the Kinematic Wave equation is limited to flow paths no longer than 30m and shall be over surfaces that are homogeneous in finish and grade.

Appropriate rainfall data shall be obtained from the Bureau of Meteorology (BOM). Recent studies have used ARR 1987 or ARR 2019 data, either data set is acceptable and shall be modelled using methods appropriate to the data. A full range of storms for each chosen event shall be run to establish the critical peak flowrate for that event. This is particularly important when establishing storage requirements for OSD and assessing the coincident timing of adjacent OSD flows.

Initial/continuing loss methods have been adopted in existing regional studies. Adopted values are as follows:

- Pervious areas IL – 37.1 mm CL – 0.94 mm
- Impervious areas IL – 1.0 mm CL – 0.0 mm

For Rafts style models a Bx value of 1.3 has typically been adopted.

Critical hydrographs shall be provided for the site. These shall include upstream (where flows enter the site) and downstream with existing catchment flows superimposed over the developed catchment flows.

Results shall be provided in a tabular form showing all modelling parameters used with justification provided for any outlying values.

6.2 Hydraulic modelling

The hydraulic operation of the trunk drainage system is important for the safety of the area being developed as well as the environmental, cultural and stream health benefits. Current best practice is a prerequisite to achieving sustainable and effective trunk drainage.

All flow paths and channels shall be modelled using industry standard 1D/2D models refined to a suitable resolution to define flood flow extents and provide accurate shear force representations. Acceptable hydraulic modelling software is TUFLOW, HEC-RAS 2D and Mike-21. Other software may be permissible but should be referred to the Regional Stormwater Authority before establishing the model.

As a minimum the existing catchment shall be modelled using 5%, 1%, 0.2% AEP and PMF critical flows and the developed catchment shall additionally include the 12EY and 1EY flows to assess shear forces within the low flow channels. Shear flow modelling is only required for the developed case.

Drop structures must be supported by hydraulic modelling or calculations. Sydney Water's preferences are as follows:

- Chutes – Chute (eWater), Hec-Ras (1D) or industry standard rock sizing calculations for chutes.
- Vertical drop structures - Hec-Ras (1D)

Mapping for the existing catchment shall show existing flow extents and velocities for all the mentioned critical flow cases and developed catchment mapping shall show:

- flood extents and velocities for 1%, 0.2% AEP and PMF flood extents
- flood planning area i.e. the area below the flood planning level
- flood hazard and the flood constraints that apply to the land – utilising ARR 2019 hazard definitions
- climate change design flood modelling sensitivity analysis comparing the 0.2% AEP flood event as a proxy for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change
- model topographical roughness mapping

Additional mapping that supports the application can also be provided. Geo-referenced mapping files shall be provided that can be read in waterRIDE or a GIS format. Alternatively full model output files, that can be converted to be read in waterRIDE, shall be provided.

Rainfall on grid is acceptable but will require that peak flowrates at critical points in the model compare favourably to flowrates from a hydrologic model as described in Section 6.1.

For full 2D models a grid size shall be chosen that adequately models the complexities of any compound channels.

6.3 MUSIC modelling

Where developments are integrating with the stormwater treatments, proposed by Sydney Water, then there is no requirement to undertake MUSIC modelling. For all developments that are outside the proposed stormwater scheme or where Master Planning proposes alternate treatments then MUSIC modelling is required to demonstrate how the targets are achieved. MUSIC modelling should follow the guidance provided in this DPE's publication Technical guidance for achieving Wianamatta-South Creek stormwater management targets (DPE 2022), and for parameters outside the scope of this guide follow Blacktown City Council's WSUD developer handbook MUSIC modelling and design guide 2020 (BCC, 2020).

The DPE's guide provides ranges of acceptable parameters to use for specific elements of a MUSIC model. This is supported by data sets that can be downloaded as part of a MUSIC modelling toolkit. A spreadsheet for post-processing daily modelled flow data to generate and assess whether the flows from the site of development achieves the stormwater quantity (flow) targets is also available in the toolkit.

Note that a divergence from the Technical guidance for achieving Wianamatta-South Creek stormwater management targets (DPE 2022) is the demand assumption used in Sydney Water's modelling. The demand assumptions for the scheme have a significant impact on sizing of the wetlands and ponds. The demand assumptions adopted by Sydney Water have been balanced for acceptable risk to the Stormwater Scheme's compliance with the Waterway Health Targets and Capex of the Scheme. Sydney Water can provide demand values on request if required.

Commissioning, inspection and testing requirements

TBC

7 References

The following documents were referred to in the development of this guideline (TBC)

Title	Description
Brisbane City Council (2003) *Natural Channel Design – Guidelines*. Brisbane City Council, Queensland.	
DPIE, 2021. Performance criteria for protecting and improving the blue grid in the Wianamatta – South Creek catchment, NSW Department of Planning, Industry and Environment, Parramatta	
Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions	
Recognise Country: Guidelines for Development in the Aerotropolis	
Mamre Road Precinct Development Control Plan 2021	
Western Sydney Aerotropolis Development Control Plan 2022	
State Environmental Planning Policy (Precincts—Western Parkland City) Amendment (Miscellaneous) 2022	
Technical guidance for achieving Wianamatta South Creek stormwater management targets (Department of Planning and Environment, 2022)	
Stormwater connections to natural waterways (Sydney Water, 31 July 2014)	
Constructed Waterways Design Manual, Melbourne Water, 2019	
NRAR, 2018. Guidelines for controlled activities on waterfront land - Riparian corridors (NRAR, 2018)	
Good practices in riparian rehabilitation - Benchmarks for Environmental Trust funded projects (Department of Planning, Industry & Environment and Natural Resources Commission, 2020)	
Wianamatta South Creek Catchment Flood Study Existing Conditions (Advisian, 2022)	

The Constructed Wetlands Manual (DLWC, 1998) - Department of Land and Water Conservation (DLWC, NSW) (1998)
Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (phase 2) Stormwater harvesting and reuse (July 2009)
Wetland Design Manual A1: Design, Construction and Establishment of Wetlands Manual (Melbourne Water, December 2020)
Australian Runoff Quality – A guide to Water Sensitive Urban Design (2006)
Safety in Design Procedure (Sydney Water 2017)
Work Health and Safety Act
MUSIC Modelling Toolkit – Wianamatta NSW Department of Environment and Heritage - https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Water/Water-quality/Wianamatta-South-Creek-documents/technical-guidance-for-achieving-wianamatta-south-creek-stormwater-management-targets-220503.pdf

8 Acronyms and Abbreviations

Acronyms / Glossary

Acronym	Definition
1% AEP	A flood that has a 1% chance of occurring in any given year within a 100-year cycle.
Annual Exceedance Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. e.g. if a peak flood discharge of $500m^3/s$ has an AEP of 5% it means there is a 5% chance (i.e. one in 20 chance) of a $500m^3/s$ or larger events occurring in any one year.
ARR2019	Australian Rainfall and Runoff 2019 Guidelines
EY	EY
Bioretention systems	Vegetated sunken garden bed areas that collect and treat stormwater as it percolates through a sandy loam soil media. They can be a range of sizes and located in private allotment or local parks and support a wide range of vegetation types.
Bioretention street trees	Bioretention systems associated with a single street tree located in road verges that collect and treat stormwater from the road kerb. These systems come in a number of different engineering and landscape forms.
Blue-Green (natural)	A network of waterways, water bodies, wetlands, groundwater ecosystems, and vegetation that are water dependent (this includes the riparian vegetation in the Wianamatta-South Creek catchment).
Blue-Green Grid	A network of high-quality green areas and waterways, from regional natural assets to local natural assets, that connect to centres, public transport and public spaces.
Blue-Green Infrastructure Framework	Blue-green infrastructure is the interconnected network of natural and semi-natural landscape elements. For example, blue includes water bodies, creeks and dams. Green includes trees, parks and native vegetation.
Coarse sediment	Particles larger than 0.125mm transported in stormwater

Consent Authority	The same meaning as in Section 4.5 of the Environmental Planning and Assessment Act 1979.
Construction phase	Construction period during a development until at least 80% of the allotment buildings are complete – with occupation certification
Certified Professional in Erosion and Sediment Control (CPESC)	Individuals who demonstrate an established minimum level of competence through the application review process and an examination process will be certified in erosion and sediment control.
DCP	Development Control Plan – precinct planning instrument
Declared Catchment Area	this is the area where Sydney Water can charge customers a stormwater charge, and developers a contribution under the DSP. In the Aerotropolis area, the declared catchments are aligned to the precinct borders and were declared 18 March 2022 under the Sydney Water (Stormwater Drainage Areas) Order 2011. The maps can be viewed on the NSW legislation website.
EDD	Extended detention depth – the depth of water allowed to pond above the normal water level (NWL) in a pond or wetland.
EY	This is a reference to very frequent design rainfall events as Exceedances per Year (EY). For example, 2 EY is equivalent to a design event with a 6 month recurrence interval when there is no seasonality in flood occurrence
Green roof	Roof areas that are covered with soil and vegetation. They act to capture rainwater, promote evaporation, reduce runoff volumes and cool the buildings
GPT	Gross pollutant trap – a device that intercepts litter, coarser sediments and hydrocarbons in stormwater systems and stores them for removal.
Irrigated street trees	Street trees that are irrigated form a reticulated supply (can be recycled water supply)
MARV	Mean annual runoff volume
NRAR	NSW government department - Natural Resources Access Regulator
O&M	Operation and Maintenance
OSD	On-site stormwater detention

Operational phase	Period when development is complete – with occupation certification
Passively irrigated street trees	Stormwater diverters installed in kerbs to direct small amounts of stormwater into soils around street trees for irrigation (not bioretention)
PMF	Probable Maximum Flood
Practitioners	An individual actively engaged in a profession – in this context – these are individuals such as stormwater engineers, flood engineers or landscape architects
Proponent (development)	A person or entity who puts forward a proposition or proposal for an urban development.
REF	Review of Environmental Factors
Stormwater Infrastructure	Refers to stormwater infrastructure under the care and control of the Regional Stormwater Authority i.e. natural trunk drainage, wetlands and harvesting ponds etc.
SEPP	State Environmental Planning Policy – a regional planning instrument.
Storages	Storage for water reuse systems to collect treated stormwater and store it until it is required. They can be open water storages (dam or lakes) or in enclosed tanks that are either above or below ground.
TSS	Total Suspended Solids
Water and Stormwater Management Plan	A document that addresses urban stormwater from a management perspective to ensure that the stormwater management targets and other related controls are achieved.
Waterway	The whole or any part of a watercourse, wetland, waterbody (artificial) or waterbody (natural).
Waterway health objectives	The community environmental values and long-term goals for managing waterways. The objectives consisting of three components i) values and uses of waterway, and ii) indicators and iii) numerical criteria needed to protect the values and uses. In this context, they are the environmental guidelines for delivering healthy waterways, riparian corridors and other water dependent ecosystems

Wetlands (for stormwater management)	Shallow vegetated waterbodies that are intended for stormwater treatment. They can be a variety of scales and are generally configured to capture an initial volume of stormwater and slowly release it over two to three days.
WSUD	Water sensitive urban design (WSUD) is an approach to planning and designing urban areas to make use of stormwater and reduce the harm it causes to waterways.
WSUD measures	Built structure or landscape feature that is designed to slow and disperse runoff from storm events by promoting onsite retention, infiltration or evapotranspiration while cleaning the runoff of pollutants including litter and harmful chemicals
WSUD strategy/strategies	Method (strategy) of delivering WSUD measures are various scales – allotment, precinct, catchment/regional
WH&S	Work Health and Safety

9 Appendices

ID	Title	Revision	Format	Comment
A	Typical Concept Sketches	A	PDF	DRAFT
B	Planting Palette Draft	A	PDF	DRAFT
C	Indigenous Design Considerations	TBC	TBC	TBC
D	Safety in Design Workshop – Actions and Minutes	TBC	TBC	TBC

Appendix A – Typical Concept Sketches

Appendix B – Planting Palette Draft

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