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Urban Typologies and Stormwater Solutions

Western Parkland City

Sydney Water and all those who worked on this report acknowledge the traditional owners of the lands that include the Western Sydney Region and the living culture of the traditional custodians of these lands. We recognise that the traditional owners have occupied and cared for this Country over countless generations and celebrate their continuing contribution to the life of Western Sydney.

By adopting the urban typologies and stormwater solutions presented in this report, Western Sydney can be cool, green and liveable, with healthy waterways.

Bligh Tanner Pty Ltd.
ABN 32 061 537 666

blightanner.com.au

Architectus Australia Holdings Pty Ltd.
ABN 90 131 245 684

architectus.com.au

Sydney Water Corporation,
ABN: 49 776 225 038

www.sydneywater.com.au

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Project Team	Bligh Tanner: Alan Hoban, Himanthi Mendis Architectus: Jane Freeman, Oscar Stanish, Ivan Ip Aecom: Peter Gillam Sydney Water: Erin Saunders			
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Report contact	Sydney Water Phillip Birtles Program Lead, South Creek M: 0422 266 070 E: phillip.birtles@sydneywater.com.au			
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Contents

Glossary

Key terms, abbreviations and references
The following key terms and references are used throughout the report:

Catchment	Area of land that collects rainfall and contributes to surface water (streams, rivers, wetlands) or to groundwater
DPIE	Department of Planning, Industry and Environment
Groundwater	Sub-surface water in the soil or rock structure
GSC	Greater Sydney Commission
Impervious	A surface where the majority of rainfall becomes runoff and infiltration into the underlying soils is limited
Infiltration	The movement of water from the ground surface into the underlying soil profile
Receiving water	A water body that may receive runoff from the catchment under consideration and has some environmental value or beneficial use
Runoff	Surface overland flow of water resulting from rainfall or irrigation exceeding the infiltration capacity of the soil
Permeability	Describes the capacity of the surface to allow rainfall and runoff to absorb into the substrate
Stormwater Runoff	All surface water runoff from rainfall, predominantly in urban catchments
WSPP	Western Sydney Planning Partnership

Executive Summary

The NSW Government's aspirations for a cool and green Western City will require a change in current planning and design practice. Sydney Water is taking a active role in turning these aspirations into reality through contemporary, integrated water cycle planning for Western Sydney. This study sets out an integrated approach to delivering the Western Parkland City vision through:

- Designed built form typologies and precincts that deliver sustainable water management outcomes.
- Stormwater management and engineering solutions specifically identified for Western Sydney and tested across the identified building typologies and illustrative precincts.
- Recommendations and material that can be used towards implementation in new controls and guidelines.

Executive Summary

Background

Sydney Water is actively working with a range of government agencies to plan for the projected growth and development of Western Sydney in line with the government's vision for the Western Parkland City. The Western Parkland City is envisioned as a cool, green, city with South Creek representing the green spine and centre of amenity for the new community.

Purpose of this report

Sydney Water has been undertaking integrated water cycle management planning to service the Western Parkland City with water, wastewater and stormwater management. To align with broader NSW Government policy and objectives, Sydney Water is doing this planning in the context of the Parkland City vision for a cool, green urban neighbourhood centred on South Creek.

To inform this planning, Sydney Water required an understanding of likely urban development scenarios and stormwater management and its potential impacts on local waterways. The urban typologies and stormwater management work provides an integrated approach to land use planning and water cycle management to optimise outcomes in terms of efficiency, environmental health, liveability and sustainability.

The urban typologies can be applied through strategic land use planning to ensure that urban design and development considers stormwater management at the outset. The work can be applied by a range of stakeholders including planning authorities to inform planning and development controls, urban designers to shape master planning and developers, planners and engineers seeking to implement a contemporary and integrated approach to urban form and water management.

Objectives of the project

The objectives of Sydney Water Urban Typologies and Stormwater Management work are:

- To develop, test and refine a series of urban typologies which integrate land use planning and water cycle management;
- To use these typologies to document urban development scenarios for the Western Parkland City that are driven by sustainable water management as well as to inform Sydney Water modelling and service planning;
- To test these scenarios in the Sydney Water waterway health model to demonstrate the achievement of waterway health objectives (being finalised by DPIE); and
- To use these outputs to develop an efficient, sustainable and resilient water servicing strategy and inform design parameters for major water infrastructure for Western Sydney.

Consultation and collaboration

Delivery of the Western Parkland City requires a collaborative effort across all relevant government agencies and councils. Sydney Water has actively engaged with key stakeholders throughout the project including councils, WSPP, GSC, DPIE, and planning industry experts.

Outputs

The key outputs of the urban typologies and stormwater management work include:

- An evidence base for an alternative approach to urban stormwater management which integrates urban form and water management to optimise waterway health outcomes in the context of DPIE's Risk Based Framework (page 29);
- Principles and assumptions for use in modelling and water service planning for the Western Parkland City that are consistent with the Western Sydney Street Design Guidelines (page 17), provide excellence in urban design and have considered market feasibility and are implementable;
- Scalable planning tools which can be applied through strategic planning processes to ensure urban waterways are protected, water is used efficiently and streets are green and cool; and
- Recommended planning and development controls to facilitate delivery of the required water management outcomes.

Key findings and recommendations

1. Run-off from urban areas must be reduced from 3.9 megalitres / hectare / year to 0.9 megalitres / hectare / year – a reduction of 75%.

The 0.9 ML/ha/annum target is based on waterway health modelling developed by Sydney Water specifically for the South Creek Catchment.

2. Clear requirements for open space and streets are needed to achieve the overall targets.

Table 1 describes the recommended requirements for streets and open space on large masterplanned sites.

Table 1. Recommended open space and street percentages for South Creek

Typology	Minimum Dedicated public open space*	Minimum Streets*
Residential		
Low density	10%	30%
Medium density	15%	30%
High density	25%	30%
Mixed use centre	20%	30%
Employment		
Business Park	10%	20%
Industrial	5%	20%

* As a percentage 'urban typology' area excluding 1:100 flood prone land and any other regional open space and sporting fields

3. Four key technological solutions have been identified which can perform an important role in retaining stormwater in the urban environment.

These are:

- Bioretention 'Sponges' – 'raingardens' that treat stormwater by vertical percolation through a soil filter media
- Water Smart 'Wianamatta' street trees
- Permeable Pavements
- Rainwater Harvesting and Reuse.

Beyond this, to reduce runoff rates further relies primarily on reducing building footprints to allow greater deep soil and permeability on sites. These approaches must be managed in the context of land constraints and potential salinity risk. It is recommended that salinity risk is managed strategically through precinct planning or similar processes.

4. As a very simple rule of thumb, 50% of a development site for residential and 40% for employment uses needs to be pervious in order to reach the required level of stormwater retention water performance targets.

Precinct scale testing reveals that this, in combination with other measures, can reduce precinct runoff to approximately 0.9 megalitres / hectare / year which would allow for the protection of South Creek and its tributaries as urbanisation progresses.

However this is a step change from existing practice. Of several existing precincts tested only one came close to these targets (Newington with 42% permeability) while others were very distant (for example Macquarie Business Park at 28% permeability).

Executive Summary

5. A range of on-lot building typologies have been developed that achieve the desired outcomes however require some changes from current market practice.

This document includes detailed testing of a broad range of individual building typologies including:

- Employment: Office
- Employment: Industrial
- Apartments
- Attached housing
- Detached housing.

The building types have also been applied at a precinct scale for indicative residential and employment precincts.

Hydrologic performance testing including Mean Annual Runoff Volume and lot-scale MUSIC modelling has described the outcomes of these typologies.

However, it is noted that implementation of these typologies will require some changes from current design and building practice. These include:

- Delivery feasibility
  - Potential increased costs for technology
  - Insurance premiums for new products
- Maintenance and management
  - Management of additional green spaces
  - Some technologies with a lower life-cycle than established practice
- Planning constraints
  - State Environmental Planning Policy (Exempt and Complying Development) (Codes SEPP), SEPP (Sydney Region Growth Centres) and NSW Apartment Design guidelines permit much lower greening than desired
  - Implementation of the Western Sydney Planning Partnership (WSPP) Western Sydney Street Design Guidelines is required
- Divergence from the established market standards
  - The housing typologies propose larger open space areas than the market has delivered in recent development
  - Some typologies tested have focussed on community or strata title areas which are not typical practice
  - Car parking approaches will also vary significantly from business as usual.

6. Implementation of the typologies relies on the planning framework to ensure the targets are delivered.

Precinct planning is currently being led by the WSPP for the Aerotropolis Growth Area which lies at the heart of the South Creek Catchment. As a large greenfield area with minimal existing water infrastructure, it represents a significant opportunity to explore a different approach to water cycle management as proposed by the urban typology and stormwater management work. It is therefore critical that appropriate planning and development controls are enacted through the precinct planning process..

Implementation needs to be carefully managed to ensure that there is clear understanding of requirements for developers, property owners and Councils particularly over density, open space and maintenance/management.

Recommendations for planning implementation have been developed through this work, however these are expected to be refined and drafted by the relevant planning authorities.

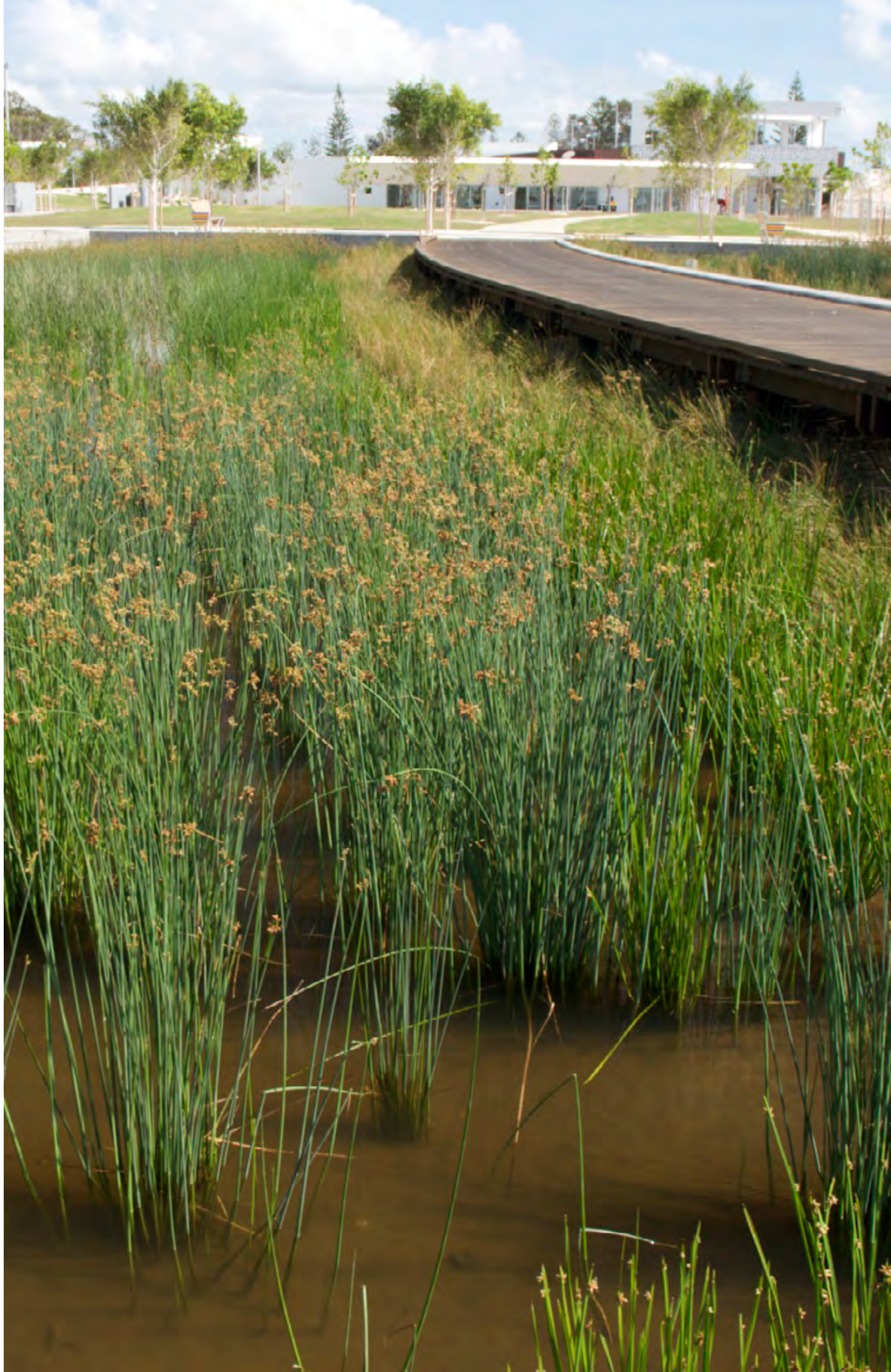


Figure 1. Illustrative precinct designs for residential (above) and employment (below) uses, used to assist in stormwater modelling

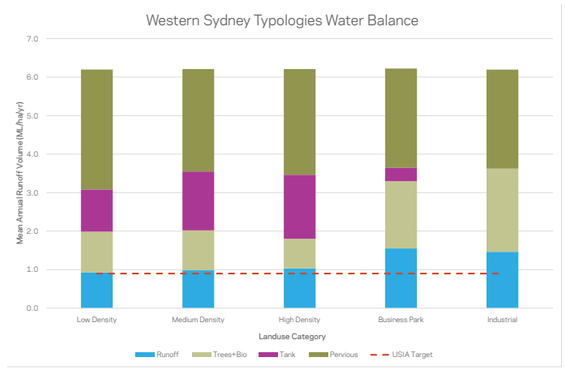
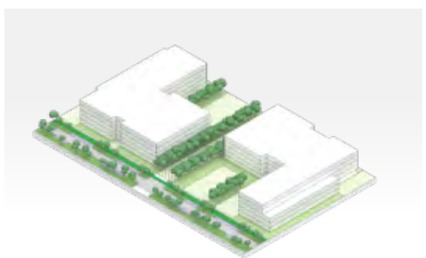
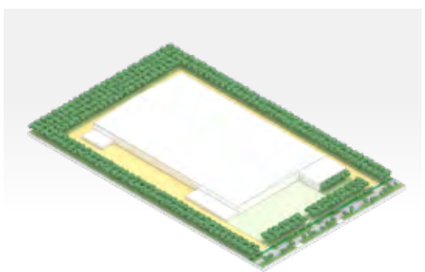


Figure 2. Result of MUSIC Water Balance Modelling – shows the combined impacts of creating more pervious surfaces and WSUD strategies which could significantly reduce surface runoff. Please note the results represent the average of the water balance for the typology variants of each land use category.



Employment: Office
Urban Office: Deep soil setbacks and planting



Employment: Industrial
Large floorplate: Pervious paving and perimeter planting

Apartment buildings
Deep soil front setbacks

Attached housing
Large rear yards

Detached housing
Two storey dwelling on a regular lot

Figure 3. Example building typologies tested in this document (4 of 18 strategies shown)

1 Introduction

1.1 The need for a Western Parkland City development approach

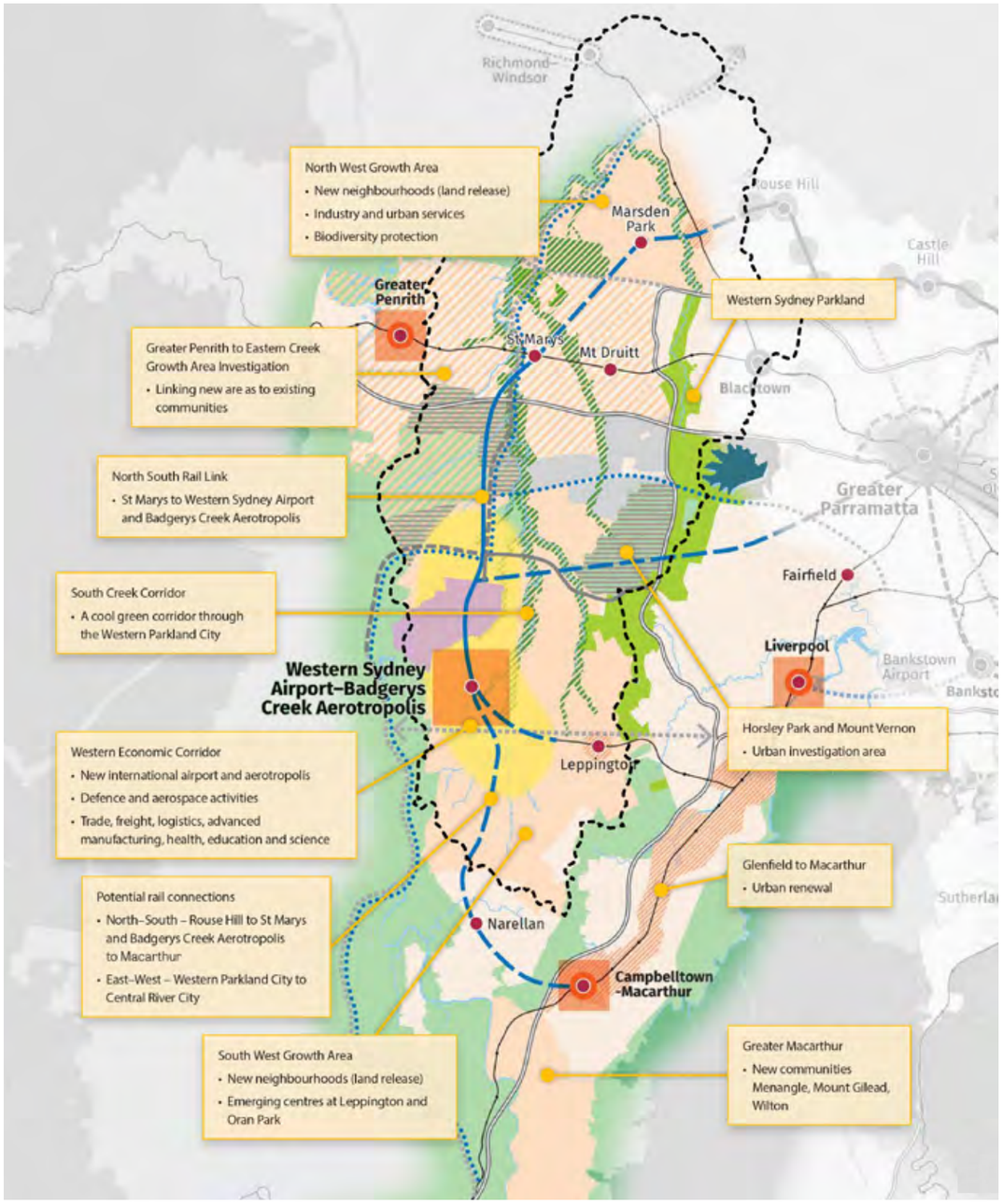


Figure 4. South Creek Catchment within the Western Parkland City

The site

Australian, State and Local Government have all committed to the Western Sydney City Deal which envisions a major new city – the 'Western Parkland City in Western Sydney. By 2056, South Creek Catchment, at the heart of the Parkland City, is planned to accommodate:

- 1.25 million people
- 500,000 jobs
- 500,000 homes.

It is expected to become Australia's third largest economy, and equivalent to a new city the size of Adelaide.

The Western City District Plan envisions the Western Parkland City to be "New cool and green neighbourhoods and centres with generous open spaces in a parkland setting to be developed along South Creek and its tributaries".

This planned new metropolis will be located in the hottest, driest and least 'treed' part of Greater Sydney, with temperatures commonly ten degrees higher than coastal suburbs.

Almost all of Western Sydney drains into South Creek (Wianamatta)—the longest freshwater creek system in Sydney—and then into the Hawkesbury Nepean.

All wastewater from the catchment would drain into the environmentally significant Hawkesbury Nepean system which is already approaching its capacity to assimilate nutrients.

The challenge

Sydney Water modelling has shown that 'business as usual' development – sprawling suburbs, large homes, small lots, land clearing and levelling would generate stormwater discharges that will destroy the banks and its natural systems and lead to the eventual local extinction of the Australian Bass and other wildlife in this catchment.

A business-as-usual approach to urbanisation of the catchment will produce business-as-usual outcomes:

- Hot urban areas.
- Poor physical and mental health outcomes, due to poor walkability and fewer opportunities for genuine social connection.
- Poor tree canopy (10% or less, significantly short of the 40% target for Metropolitan Sydney – Office of Government Architect targets).
- Poor sense of place and local identity.
- Destruction of the water ways, intact vegetation and biodiversity and indigenous history and connection.
- Erosion of the area's intrinsic landscape character and values.

How water-centric design can change our course

Embedding integrated water management into the planning and design for Western Parkland City enables innovative solutions for the responsible use of water resources for living, greening, amenity and the environment.

The key principles of this approach are:

- Protect the waterways and the floodplain, as a cool green spine of the City
- Manage waste water and floodwater in the urban areas passively through landscape, street and building design.

Key objectives for the Western Parkland City

The six key objectives below outline the breadth of the challenge in defining the future of the South Creek catchment.

Reduce infrastructure spend
A business as usual scenario would require significant infrastructure spend to capture and treat runoff

Keep Western Sydney cool and reduce energy demand
Western Sydney is commonly up to 10 degrees hotter than the east. Urban greening and cooling is required to deliver the Parkland City Vision.

Improve waterway health and habitat
South Creek is home to a variety of species that need protection around growth. One example is the native Australian Bass which is popular for fishing in the area.

Increase canopy cover and retain significant remnant vegetation
South Creek has been identified as having the potential for over 1.8million new canopy trees in line with the Government's 5 million trees for Sydney.

Increase parkland amenity
Greater local open space can provide more amenity

Reduce flood hazards
Reducing flood hazards can reduce risks to life as well as threats to water quality and infrastructure

1.2 Purpose of this Report

Background

Sydney Water is actively working with a range of government agencies to plan for the projected growth and development of Western Sydney in line with the government's vision for the Western Parkland City. The Western Parkland City is envisioned as a cool, green, city with South Creek representing the green spine and centre of amenity for the new community.

Strategic Options

Strategic Options for South Creek have been developed demonstrating the potential benefits of a new approach to urban development to the achievement of the Western Parkland City vision. Key to the achievement of these economic benefits is the delivery of an urban form which facilitates the desired water cycle management outcomes outlined in the Western City District Plan and modelled in the South Creek Sector Review.

Purpose of this report

Sydney Water has been undertaking integrated water cycle management planning to service the Western Parkland City with water, wastewater and stormwater management. To align with broader NSW Government policy and objectives, Sydney Water is doing this planning in the context of the Parkland City vision for a cool, green urban neighbourhood centred on South Creek.

To inform this planning, Sydney Water required an understanding of likely urban development scenarios and stormwater management and its potential impacts on local waterways. The urban typologies and stormwater management work provides an integrated approach to land use planning and water cycle management to optimise outcomes in terms of efficiency, environmental health, liveability and sustainability.

The urban typologies can be applied through strategic land use planning to ensure that urban design and development considers stormwater management at the outset. The work can be applied by a range of stakeholders including planning authorities to inform planning and development controls, urban designers to shape master planning and developers, planners and engineers seeking to implement a contemporary and integrated approach to urban form and water management.

Objectives of the project

The objectives of Sydney Water Urban Typologies and Stormwater Management work are:

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- To use these typologies to document urban development scenarios for the Western Parkland City that are driven by sustainable water management as well as to inform Sydney Water modelling and service planning;
- To test these scenarios in the Sydney Water waterway health model to demonstrate the achievement of waterway health objectives (being finalised by DPIE); and
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Consultation and collaboration

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Outputs

The key outputs of the urban typologies and stormwater management work include:

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- Principles and assumptions for use in modelling and water service planning for the Western Parkland City that are consistent with the Western Sydney Street Design Guidelines (page 17), provide excellence in urban design and have considered market feasibility and are implementable;
- Scalable planning tools which can be applied through strategic planning processes to ensure urban waterways are protected, water is used efficiently and streets are green and cool; and
- Recommended planning and development controls to facilitate delivery of the required water management outcomes.

Focus of the project:

- Detailed design and testing of urban typologies, built form and corresponding stormwater solutions to optimise outcomes in terms of greening, cooling and amenity (i.e. test that the improvements in urban form are sufficient to deliver the required improvement to waterway condition, stormwater quality and volume, and urban performance).
- Translation and adoption of urban design and typology principles into planning policy and statutory plans to ensure parkland city outcomes are mandated and delivered through the development process.

1.3 Concurrent work

Western Sydney Street Design Guidelines

The Western Sydney Street Design Guidelines will guide the delivery of new streets in Western Sydney, as well as provide advice on the retrofitting of existing streets where needed. They aim to address some of the critical issues facing Western Sydney, with a focus on improved environmental, social and health outcomes for all street users. The Guidelines provide advice on a process for street design, typical cross-sections and design standards for a variety of street components. They will help ensure a consistent and standard approach for projects of all scales across the Local Government Areas of the partnering Councils.

The urban typologies and stormwater concepts outlined in this report adopt the relevant components of the Street Design Guidelines and could therefore be applied effectively alongside these.

Prepared by Aspect Studios for the Western Sydney Planning Partnership.

Engineering Design Manual for Western Sydney

The Western Sydney Uniform Engineering Manual will provide a consistent, local government engineering design specification for nine Western Sydney Councils. It aims to set clear expectations, simplify the development assessment process, and deliver better outcomes in relation to urban amenity and liveability for residents.

Specifically, the Manual seeks to deliver standards that:

1. Lead to high quality urban design outcomes and improve liveability.
2. Are achievable, constructible, cost effective and take into account local conditions.
3. Provide clarity and certainty to industry and the community, resulting in more efficient development assessments.
4. Are flexible, support innovation and emerging technology.
5. Contain maintenance and whole-of-life operating cost considerations.
6. Contribute to sustainability and desirable environmental outcomes.
7. Represent best practice for Western Sydney in the context of Government policy, in particular the Western City District Plan and the Planning Principles for the Western Parkland City.

Sydney Water has had input to the preparation of the Engineering Design Manual to ensure consistency with relevant components of the urban typologies and stormwater solutions defined in this report.

Prepared by Acor, Craig & Rhodes and others for the Western Sydney Planning Partnership.

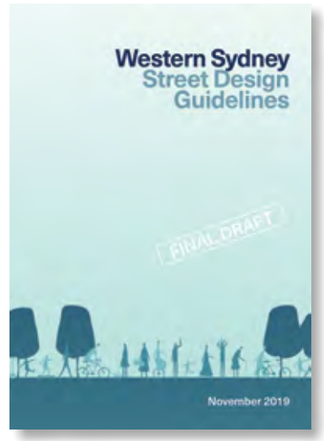
Western Sydney Aerotropolis Plan

Western Sydney Aerotropolis Growth Area is an 11,000 hectare greenfield release area set to accommodate some 200,000 jobs and 60,000 dwellings surrounding the new Western Sydney (Nancy-Bird Walton) International Airport.

The WSPP has the responsibility for delivering the strategic planning for this Growth Area, consisting of a Structure Plan (the Western Sydney Aerotropolis Plan (WSAP)), a State Environmental Planning Policy, a Development Control Plan and Precinct Plans for each of the nine precincts within the Growth Area.

Preliminary plans have been exhibited and the final plans are under preparation at the time of writing. The development of the urban typologies and stormwater management work has occurred in parallel with this planning process and in close consultation with the WSPP.

The intention is that the key principles and recommendations of this work are ultimately implemented through the planning framework to be established for the Aerotropolis initially, followed by wider adoption across Western Sydney.

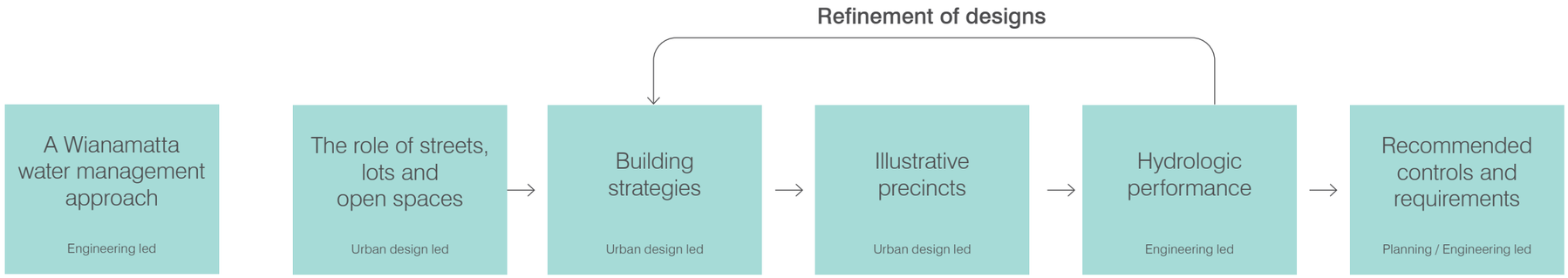


Draft Western Sydney Street Design Guidelines

Western Sydney Aerotropolis Plan

1.4 Project methodology and structure of this document

Project methodology



Structure of this document

1	2	3	4	5	6	
Introduction	A Wianamatta water management approach	The role of streets, lots and open spaces	Building typologies	Illustrative precincts	Conclusions and recommendations	References and Appendices
Providing background to South Creek, Sydney Water's Role and this document.	Investigating South Creek's catchment and a broad range of potential solutions before making recommendations on a range of key solutions to be implemented in the Western Parkland City.	Investigating how the desired outcomes for the broader South Creek catchment can be divided into lots, streets and open space as the key components of each urban typology. A framework is set out for dividing change between these components across different urban typologies or land uses.	Describing lot and building typologies that can achieve the Western City Parkland aspirations identified in earlier chapters. It includes approaches that are as close as possible to current practice as well as more innovative solutions. Each typology is described with technical metrics including density, greening and stormwater outcomes as well as being considered at a high level against issues such as cost, efficiency, social outcomes and impacts on streetscape.	Combining the building typologies with streets and open spaces to create a cohesive view of what a future precinct may look like.	Testing of the building typologies and precincts identified in Chapters 4 and 5 to understand outcomes for South Creek as a whole with their implementation. A summary of analysis and outcomes with recommendations towards controls and implementation.	Appendix A – Key assumptions Appendix B – Detailed water balance modelling results

South Creek Flood, 1949 (National Library of Australia Digital Collection)

2

A Wianamatta water management approach

Investigating South Creek's catchment and a broad range of potential solutions before making recommendations on a range of key solutions to be implemented in the Western Parkland City.

2.1 South Creek analysis

The South Creek catchment covers an area of 625 km^2, which represents nearly 30 per cent of the Greater Sydney region. The catchment is a typical example of a peri-urban catchment with significant urban development surrounded by peri-urban agriculture activities, such as market gardens, cut flowers, greenhouses, nurseries, orchards, turf farming and improved pastures.

Rapid urbanisation of the catchment is expected to continue to occur over the next 20 years. There are five sewage treatment plants which discharge treated effluent into the South Creek and its main tributary, Eastern Creek. The majority of rural residential dwellings in the upper parts of the catchment are serviced with potable water supply, but not with the centralised sewer system. Generally these dwellings have onsite wastewater systems and discharge their effluent locally through on-site septic tanks.

Sydney Water supplies potable water to non-residential properties, and also supplies water to irrigate recreation spaces (parks and golf courses) and some intensive agriculture activities, such as market gardens, hydroponics, greenhouses and nurseries.

Properties also extract water from surface water and groundwater sources mainly for irrigation purposes. The South Creek Catchment drains in and has a major influence on water quantity and quality of the Hawkesbury River, downstream of Windsor (CRC Irrigation Futures, 2009).

2.1.1 South Creek Water Balance Interactions

South Creek Water Balance Interactions

The South Creek catchment faces a number of major water cycle challenges, including how water supply, wastewater management, flooding and waterway health are all managed in an integrated and sustainable way.

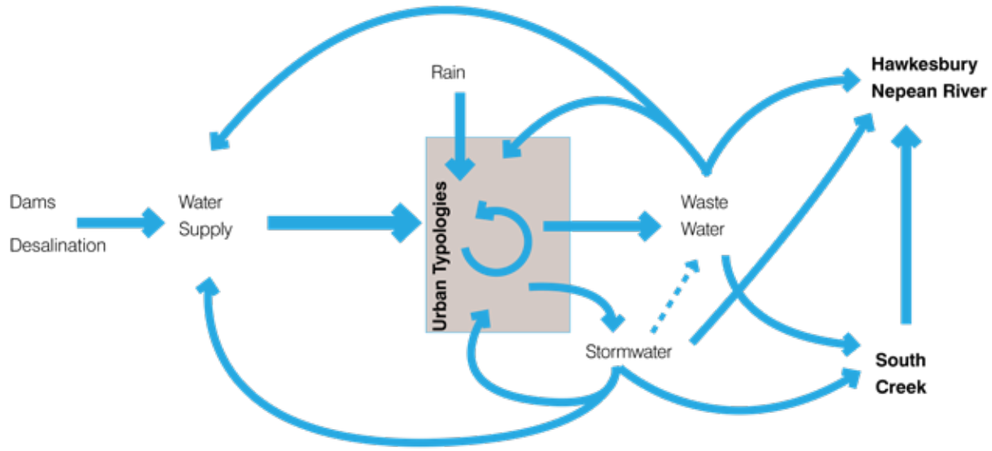


Figure 5. South Creek water cycle interactions

Urbanisation results in significant increases in the amount of stormwater runoff reaching surrounding waterways and changes the hydrological pattern of flow. This changes flood behaviour and can adversely impact the ecological health of waterways. To achieve effective flood management, urban cooling, greening and waterway health outcomes in South Creek, stormwater must be managed 'at source', within the urban environment through contemporary water sensitive urban design measures.

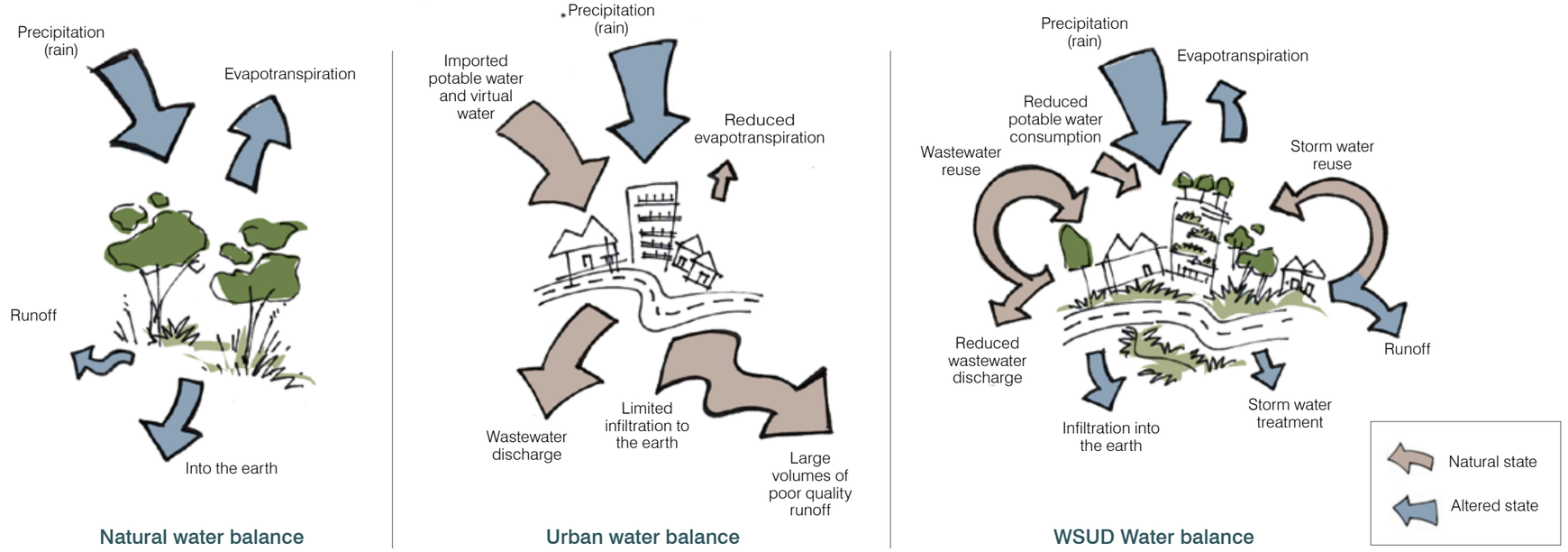


Figure 6. Hydrological changes through urbanisation

2.1.2 Waterway Health

The waterways of South Creek Wianamatta are essential for the realisation of the Western Parkland City and provide the main landscape feature to orientate the urban form narrative and identity. Along with the green bankside corridors, the creek lines provide the linking of local destinations, alignment of recreational activities and the ecological core of the natural environment.

The waterways in the South Creek Catchment currently have a range of ecological values. Populations of native birds, fish, turtles, reptiles and mammals still thrive within the wild parts of the catchment. Existing residential communities identify with the creeks and there are many bushcare, bird watching and angling groups active.

Modelling undertaken in 2015 showed that the projected urbanisation of the catchment will drastically increase the flow of stormwater into the waterways after rainfall events. In the long term, this will destabilise the creeklines causing ongoing erosion, degrading waterway health. In a business as usual urban development scenario, the creeks will become drains stabilised by concrete or other hard structures.

High Ecological Value mapping from the Department of Planning Industry and Environment provides a snapshot of the extent of waterway and floodplain habitats that could be protected and improved. This mapping compiles data on groundwater dependent ecosystems, floodplain vegetation communities and recorded native fauna.

Sydney Water has also undertaken field surveys through the Aerotropolis area to identify the current extent of iconic species such as the Australian Bass and the Myotis microbat.

As a minimum, the current hydrologic (water flow) regimes serve as useful waterway objectives to maintain the current higher ecological value outcomes. The baseline hydrology in those reaches should be maintained to ensure those values persist into the future.

The hydrology of these reaches provides the basis for waterway flow targets that could be applied to poorer ecological areas where the same outcomes are desired for vegetation, prey species, hydrologic regimes and instream habitat.

Stream flow gauges across the upper and mid catchment have been measuring creek flow for decades. There are eight flow gauges that provide a valuable basis for characterising predevelopment hydrologic regimes. Sydney Water has used this data to calibrate and validate a suite of very detailed waterway health models specifically for the Wianamatta South Creek Catchment.

These models help match the pattern of pre development flows via combination of metrics that define the frequency, magnitude and duration of flow events.

The mean annual runoff streamflow or mean annual runoff volume (MARV) is one of these metrics and represents the shear quantum of change in catchment runoff volumes. Preserving this metric is the most challenging for the Wianamatta South Creek catchment. To keep this indicator at the same level requires aggressive approaches of retaining stormwater within urban developments or finding another use for the water within the urban context.

Flow gauges in the vicinity of the WSA show that the average contribution of stream flow from the catchment is approximately 0.9ML/Ha/yr under current development conditions.

As an initial target for preserving waterway health, the residual stormwater runoff from urban areas that enters creeks should aim to achieve a mean annual runoff volume of 0.9 ML/Ha/yr to ensure that waterway health is preserved and the iconic species are maintained.

The **Risk Based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions** (the Framework) was released by the State Government in 2017 to improve the management of waterways in NSW.

The outcome being sought by the initiative is improved water quality and health of waterways in the coastal catchments of NSW, through the reduced risk of threats from urban stormwater discharges on waterways. The Framework is based on existing policies and strategies and is referred in a range of strategic planning instruments across the State, as well as being identified as the preferred assessment process in the Western District Plan.

The Framework provides a pragmatic approach for determining appropriate stormwater, wastewater and catchment management actions given a set of values, drivers and community aspirations for coastal waterways. Applying the Framework allows for the development of tailored catchment management solutions and encourages the testing and demonstration of those solutions to ensure measures are cost effective and sustainable.

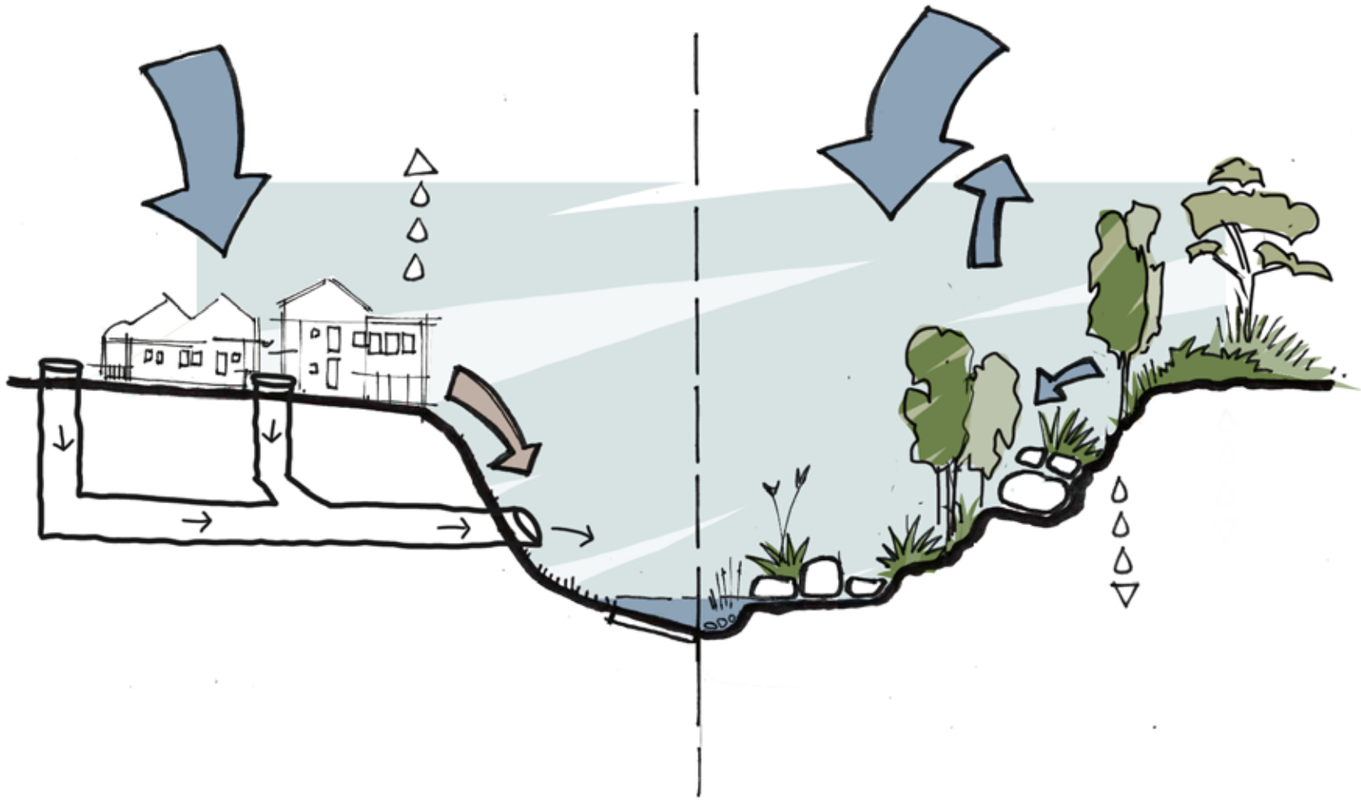
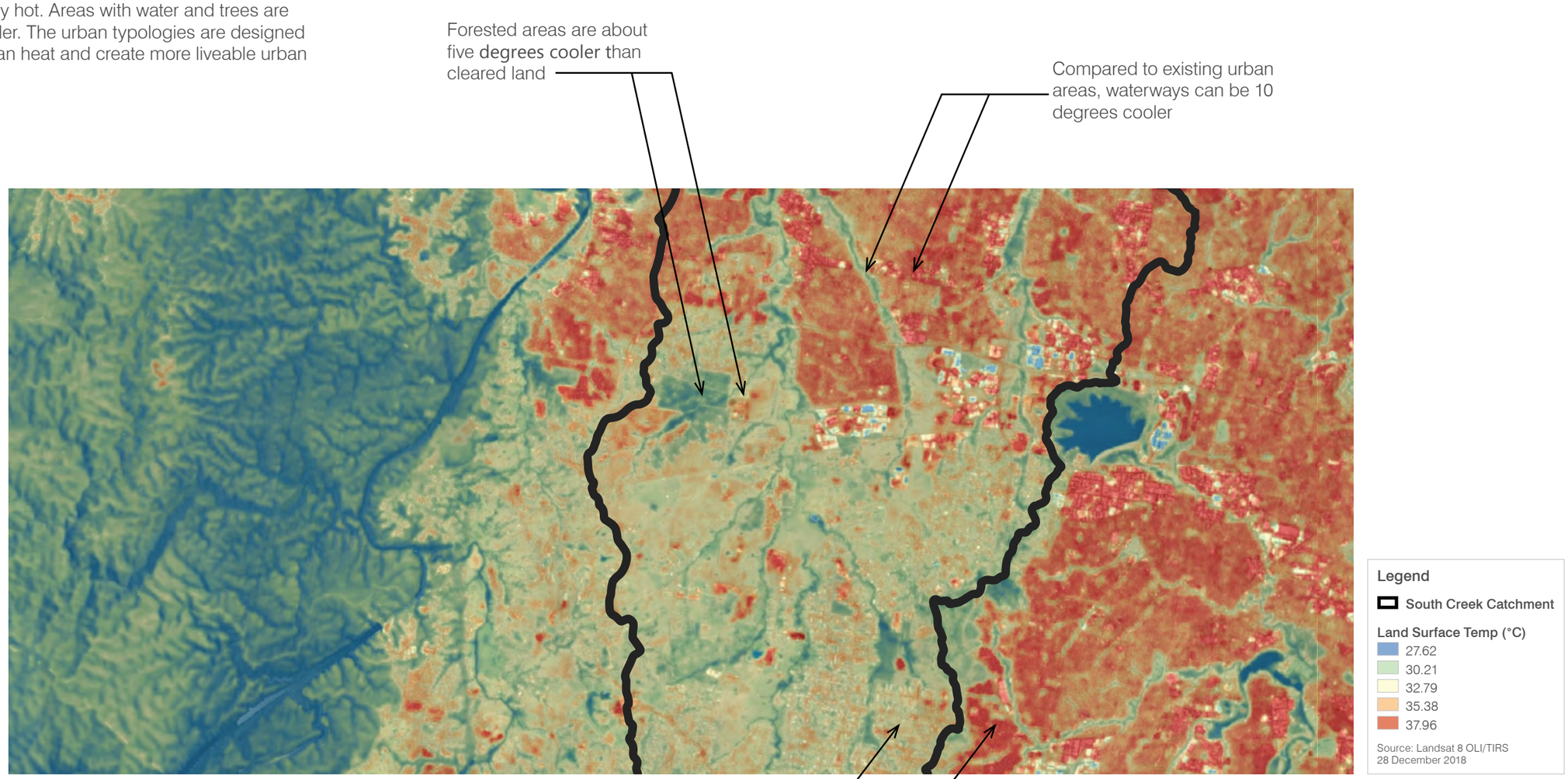


Figure 7. Streamflow in urbanised scenarios compared to natural streamflow

2.1.3 A Cooler Western Sydney

Evidence is clear that urban areas in Western Sydney get very hot. Areas with water and trees are noticeably cooler. The urban typologies are designed to mitigate urban heat and create more liveable urban environments.



Source: Satellite thermal image 28 Dec 2018, Landsat_8 OLI/TRS USGS

In the neighbouring city of Parramatta, somes streets are currently baking in +40 degree heat, whilst other streets do not suffer so acutely. Increased tree cover in urban streets leads to cooler streets, and studies have shown significant improvement in property values for treed streets.

Research by the CRC Low Carbon Living on cooling strategies for Western Sydney shows permeable paving and tree canopy cover are two most effective urban design measures. Sydney Water's own research demonstrates that applying the Parkland typologies across a precinct can result in significant cooling benefits over a business as usual approach, as detailed in Section 4.

These two Western Sydney streets are completely different temperatures — here's why

By Mridula Amin

Updated 21 Nov 2019, 7:00am

PHOTO: Christelle Dardagos and her son Ashton cool down on the hot streets outside St Monica's Primary School in North Parramatta. (ABC News: Mridula Amin)

These two western Sydney streets are only 1 kilometre apart, but when it comes to temperature there's a lot that separates them.

Last summer, Galloway Street in North Parramatta experienced five days of temperatures above 40 degrees.

People on Daking Street — which is a short walk north — sweated through 13 days above 40 degrees.

It's the hottest street in the City of Parramatta's municipality.

LOCAL CLIMATE		RECORD TEMPERATURE	AVERAGE RAINFALL (MM/Y)	COOL PAVING			COOL ENVELOPE		GREEN ENVELOPE		TREE CANOPY	EVAPORATIVE COOLING		SHADING STRUCTURES
SUMMER: HOT SUBTROPICAL	WINTER: MILD			HIGH ALBEDO PAVING	HIGH EMITTANCE PAVING	PERMEABLE PAVING	HIGH ALBEDO ENVELOPE TREATMENTS	HIGH EMITTANCE ENVELOPE TREATMENTS	GREEN ROOF	GREEN WALL		SURFACE WATER AND EVAPORATIVE COOLING	MISTING FAN	
		Min 2.3°C Max 43.2°C	1149	1	3	3	R-3 W-1	RW-3	3	3	3	1	2	3

Effectiveness
High = 3 Low= 1
Medium = 2

W = Wall
R = Roof

COOLING STRATEGIES DURING SUMMER

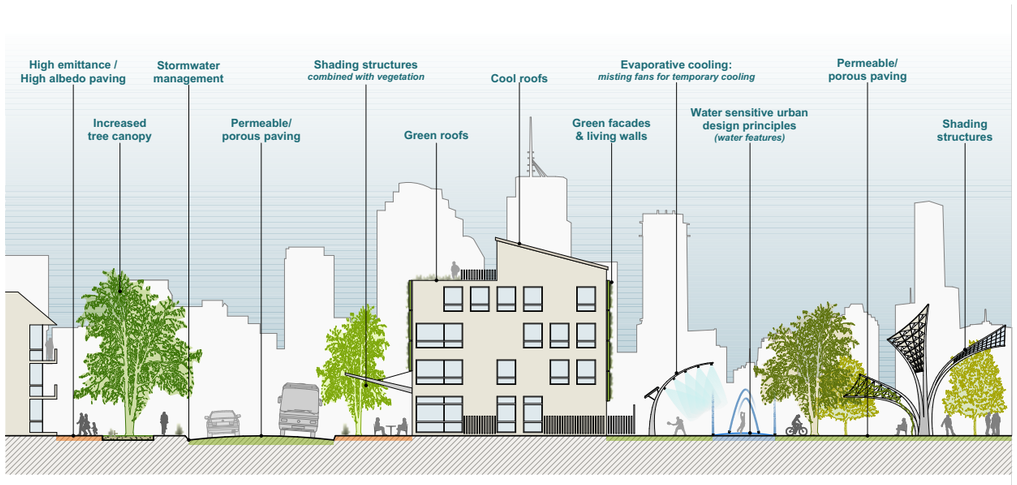


Figure 8. Cooling Strategies during summer

2.1.4 Urban Salinity

Salinity occurs when salts naturally found in soil or groundwater mobilise, allowing capillary rise and evaporation to concentrate the salt at the ground's surface. Such movements are caused by changes in the natural water cycle. In these areas, activities, infrastructure and resources on and above the soil surface may be affected.

In urban areas the processes which cause salinity are intensified by the increased volumes of water added to the natural system in urban areas. Additional water comes from the irrigation of gardens, lawns and parks, from leaking underground pipes and pools and from the concentrated infiltration of stormwater. Urban salinity can also be related to sub-surface water flows being impeded by structures such as roads and by poor drainage conditions on a site.

The surface impacts of urban salinity may include damage to vegetation similar to that observed in rural areas. It may affect lawns, playing fields and private and public gardens. Potentially salinity in urban areas could also place additional stress on remnant natural areas such as bushland, wetlands, rivers and creeks.

Urban salinity affects built infrastructure, due to the chemical and physical impact of salt on concrete, bricks and metal. The salt moves with water into the pores of bricks and concrete when they are exposed to damp, salt-laden soils. As the water is evaporated from the material, the salt concentrates and over time this can be substantial enough to cause corrosion and damage the material's structure. This is seen as crumbling, eroded or powdering mortar or bricks, the flaking of brick facing and the cracking or corrosion of concrete. The salt within the material can also have a corrosive effect on steel reinforcing. The long-term consequences can be structural damage.
Source: Western Sydney Salinity Code of Practice

NSW Government salinity and Hydrogeological Landscape (HGL) mapping for provides a broad scale characterisation of the potential presence of salinity risks and impacts. These broad scalemapping tools identify the South Creek catchment as a moderate to high risk area. Traditionally, infiltration and uncontrolled discharge of stormwater is not a recommended practice in saline landscapes because it creates a mechanism for existing salts to be mobilised and transported to sensitive receptors such as built infrastructure, waterways or ecological communities sensitive or intolerant to salt.

However, the impact of urban stormwater on the hydrology of waterways is being increasingly recognised as a critical factor that can contribute to the degradation of their ecological values. In the context of South Creek, avoidance of stormwater infiltration is highly likely to result in poor waterway health outcomes.

This is the context within which planning for the Western Parkland City must be undertaken. Current investigations indicate that the ecological value of South Creek will degrade unless surface runoff volumes are limited significantly under an urban development scenario. It is neither realistic nor effective for the assessment and management of urban salinity in the Western Parkland City to be undertaken in isolation, with an 'avoid at all costs' approach. The likelihood, consequence and mitigation costs of urban salinity must be evaluated against the costs, risks and benefits associated with the preservation and enhancement of South Creek and establishment of a sustainable, cool, green, liveable city. Notwithstanding, there are very real constraints and risks associated with any attempt to infiltrate and transmit stormwater through the subsurface environments within South Creek.

Precinct planning offers a valuable opportunity to develop evidence based, subcatchment / landscape scale strategies for adequately managing salinity. Site and landscape specific evidence can used to develop meaningful and measurable controls to ensure salinity risk is effectively managed.

Importantly, an opportunity also exists to ensure accurate and appropriate monitoring data is collected on the effectiveness of the salinity management strategies.

Salinity has been a key consideration in the development of the typologies. There are several responses embedded:

- According to the Western Sydney Salinity Code of Practice, the cumulative effects of vegetation loss in a catchment contribute to a changed water cycle, which can result in a salinity problem. Trees are a proven way of drawing down water tables, and the 40% canopy target will be critical to managing salinity.
- The runoff targets are to preserve existing catchment characteristics and maintain pre-development streamflow by mimicking the natural water balance of the catchment • The street trees will need access to water to thrive. To provide irrigation water without contributing excess water to groundwater, the proposed sub-soil wicking beds will have impervious liners. This approach means significant volumes of stormwater are 'lost' to evapotranspiration.
- The use of harvested rainwater is prioritised for irrigation use over recycled water to help alleviate any issues associated with mild salinity levels in recycled water.
- For low density development, suspended floors are advocated which can help alleviate some of the issues induced by slab-on-ground housing which can cause rising damp (refer Western Sydney Salinity Code of Practice Section 8.8).
- Conventional civil engineering infrastructure, such as subsoil drains under roads and gravel backfill around sewer pipes, provide good drainage and act as protective measures to stop groundwater tables rising too close to the surface.
- Permeable pavements and bioretention systems have been fo und to provide a valuable capacity for reducing the potentially disruptive effects of saline water on soil structure in the bioretention basin or downstream (Kazemi et al., 2018).

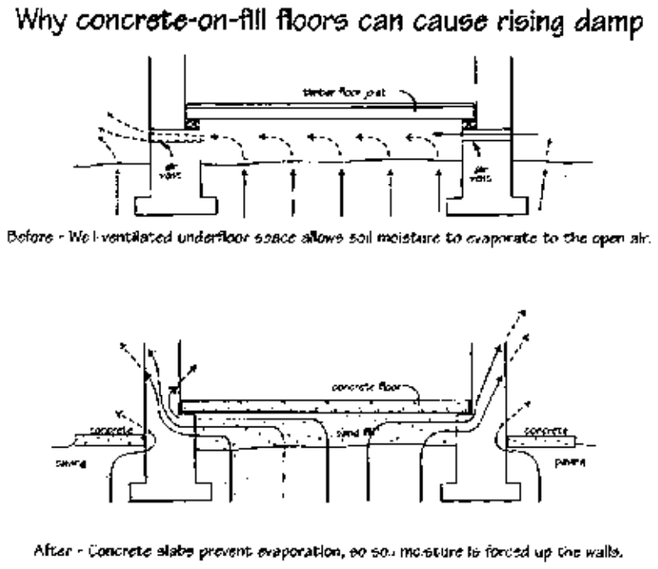


Figure 9. Salinity and Slab on ground construction. Source: Western Sydney Salinity Code of Practice

2.1.5 Urban Streamflow Impact Assessment and the Risk Based Framework

The Risk Based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions (the Framework) was released by the State Government in 2017 to improve the management of waterways in NSW.

The outcome being sought by the initiative is improved water quality and health of waterways in the coastal catchments of NSW, through the reduced risk of threats from urban stormwater discharges on waterways. The Framework is based on existing policies and strategies and is referred in a range of strategic planning instruments across the State, as well as being identified as the preferred assessment process in the Western District Plan.

The Framework provides a pragmatic approach for determining appropriate stormwater, wastewater and catchment management actions given a set of values, drivers and community aspirations for coastal waterways. Applying the Framework allows for the development of tailored catchment management solutions and encourages the testing and demonstration of those solutions to ensure measures are cost effective and sustainable. The 'Urban Streamflow Impact Assessment' (USIA) which assesses the role of streamflow in degrading waterways in urban catchments has been applied to two case study precincts in the South Creek catchment, as part of the urban typology and stormwater testing document in this report. The report concludes that conventional WSUD approaches are unable to adequately mitigate streamflow to achieve low risks to most creek values.

Nine streamflow metrics have been identified during development of the USIA method which are relevant to urban settings, and can be linked to social, ecological or geomorphic values:

1. Annual flow volume
2. Mean duration of zero flow periods
3. Total duration of zero flow periods
4. Baseflow index (ratio of baseflow to total flow volume)
5. Frequency of freshes (flows > 3 times median flow)
6. Total duration of freshes (flows > 3 times median flow)
7. Total duration of flows above channel erosion threshold
8. Frequency of floodplain engagement flows
9. Total duration of floodplain engagement flows.

Due to the complexity of applying all nine metrics to all of the typologies, the design focus has been on the first and most holistic metric: annual flow volume. Preliminary waterway health modelling indicated that, to protect the ecological values of South Creek and its tributaries, the mean annual runoff volume (MARV) would need to be no greater than 0.9 megalitres/hectare/annum. This is a reduction of approximately 75% when compared to the MARV of typical urbanised areas.

Prepared by Streamology and CTENVIRONMENTAL for Sydney Water

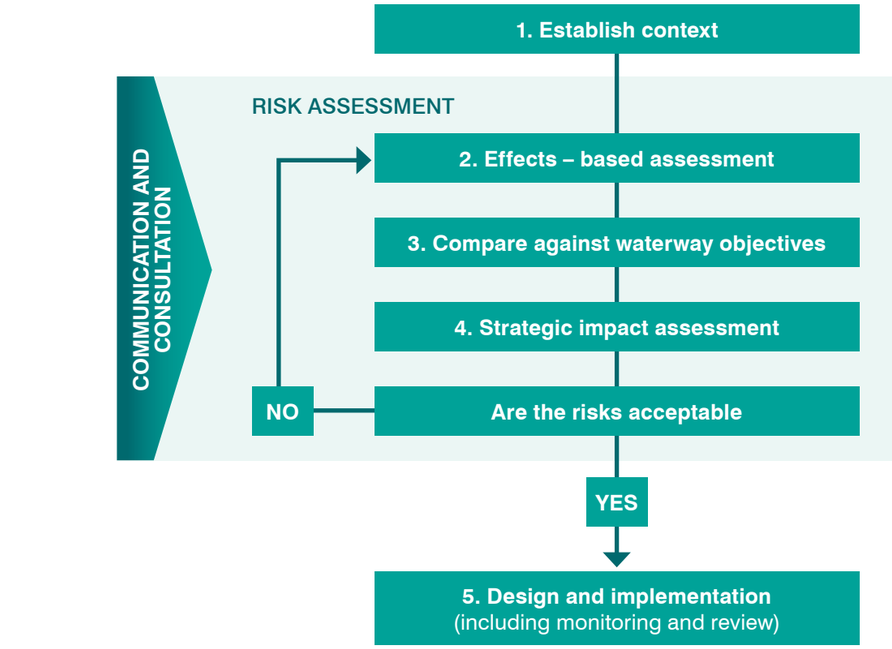


Figure 10. Application of the Risk Based Framework for Waterway Health - South Creek