East Darling Harbour Development
Water Sensitive Urban Design Strategy

SUMMARY REPORT

20 September 2006

ECOLOGICAL ENGINEERING

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1 INTRODUCTION

Water Sensitive Urban Design (WSUD) reflects a new paradigm in the planning and design of urban environments that is 'sensitive' to the issues of water sustainability and environmental protection. It pertains to the synergies within the urban built form (including urban landscapes) and the urban water cycle (as defined by the conventional urban water streams of potable water, wastewater, and stormwater), integrating the holistic management of the urban water cycle into the planning and design of the built form in an urban environment.

This report has been prepared on behalf of the Sydney Harbour Foreshore Authority for the East Darling Harbour (EDH) urban renewal project. It provides an assessment of the water management issues for the site, and identifies WSUD opportunities for the EDH development. The WSUD strategy developed for the EDH development is underpinned by the following principles:

1. Demand for potable mains water to be reduced within the development through water efficient fixtures and appliances, and using alternative sources of water based on matching water quality to uses on a "fit-for-purpose" basis;

2. Wastewater disposal to be minimised through a combination of potable mains water demand management initiatives, water efficient processes and wastewater reuse;

3. Urban stormwater to be treated to meet national stormwater quality objectives for reuse and/or discharge to the harbour.

4. Stormwater to be used within the urban landscape to maximise visual and recreational amenity of developments, and where appropriate influence the micro-climate of the area.

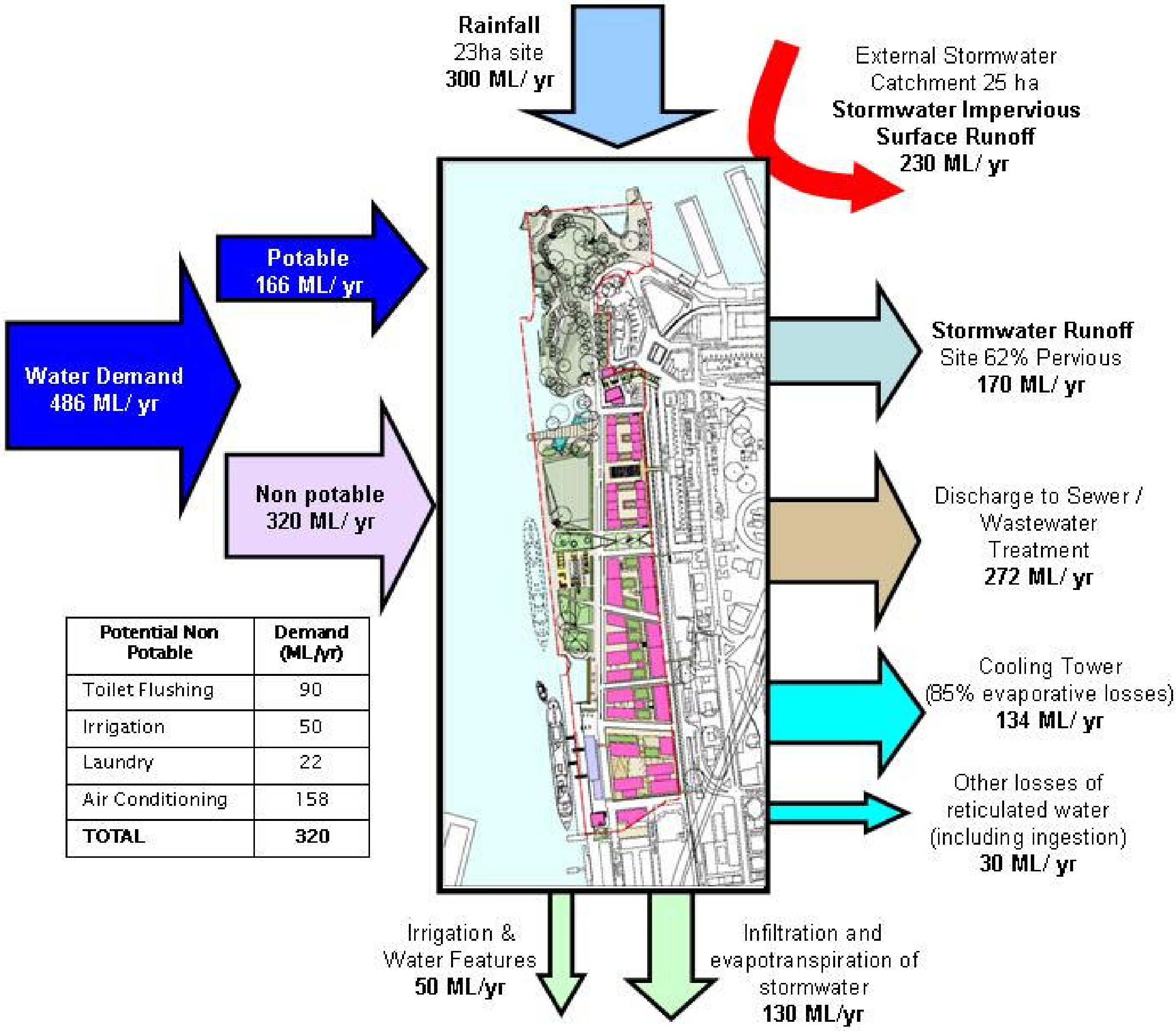
The EDH development has the opportunity to be a flagship for environmental protection and the conservation of our precious water resources by establishing infrastructure and development controls that will set new sustainability standards for urban redevelopment projects.

This report has been prepared in consultation with the landscape designers and architects of the successful design competition; Philip Thalis, Paul Berkemeier and Jane Irwin. Communication with Sydney Water has been initiated with an overall briefing of the WSUD principles being adopted and possible initiatives for sustainable urban water management at the site. Information on infrastructure from Sydney Water has been requested to facilitate further detail analyses of the WSUD initiatives identified. Discussions have identified opportunities for a collaborative approach with Sydney Water in undertaking these analyses.

This report has been prepared for use within a Concept Plan to be prepared in accordance with Part 3A of the Environmental Planning and Assessment Act 1979. As the project is at Concept Plan stage, the specific WSUD strategies to be implemented on the EDH site have not been resolved and this report provides general principles for WSUD with detailed design proposals to flow from future project stages.

East Darling Harbour ~ Water Balance

Climate Data, Modelling
Rainfall data from the Sydney Observatory Hill BOM Site for the period 1963 – 1993.
*Average Rainfall - 1273 mm/yr
*Average Evapo-Transpiration – 1261 mm/yr



Potential Non Potable	Demand (ML/yr)
Toilet Flushing	90
Irrigation	50
Laundry	22
Air Conditioning	158
TOTAL	**320**

	Water Usage (ML/yr)	Potential Non Potable (ML/yr)	Details
Residential (1600 people)	92	33	Toilet (10), Laundry (14), Cooling Tower (9)
Commercial etc (283,460 m²)	256	200	Toilet (60), Cooling Tower (140)
Hotels (481 rooms)	88	37	Toilet (20), Laundry (8), Cooling Tower (9)
Irrigation & Water Features	50	50	50 (irrigation and water features)
TOTAL	**486 ML/yr**	**320 ML/yr**	

Updated 20 Sept 2006
20% site GFA residential

2 EDH Water Cycle Balance Analysis

A water cycle balance for the proposed EDH development was undertaken which estimates the potable water demand, and quantities of waste water and stormwater likely to be generated from the proposed development. Figure 1 presents an overview of the water demands (potable and non-potable), wastewater generation and stormwater discharge from within the site and from external catchments. The figures presented include demand management initiatives associated with the use of water efficient appliances and fixtures, based on equivalent best practice potable water demand of 0.9 $kL/m^2/yr$ (an equivalent NABERS[1] rating of 3.5 for commercial buildings), and demand management with water efficient appliances and fittings for residential apartments in line with BASIX[2].

It is evident from the analysis that two-thirds of the water demand is associated with non-potable use and significant conservation of potable water can be achieved if alternative sources of water can be found to meet this demand. Sources of alternative water may come from treated wastewater (approximately 272 ML/yr from the site, but considerably more wastewater is available from external sewer catchments) or from stormwater (total of 400 ML/yr if external stormwater catchments are included).

3 WSUD Principle #1 – Reduction in demand of Potable Water

Under the NSW government's requirement, the BASIX Scheme dictates new residential developments use 40% less potable mains water than dwellings of the same type. This target can be achieved through the installation of water saving appliances and fittings. No such requirement yet applies to commercial buildings or for public open space, however the NSW Government's Metropolitan Water Plan for Sydney identifies the need for 'fit for purpose use' where alternative water sources can reduce potable water demands.

Demand management measures can be stipulated through building design guidelines and are critical for potable water conservation. These measures include the use of water saving devices and fittings such as flow regulators on taps, low flow showerheads, dual flush toilets, front loading washing machines and water efficient dishwashers to achieve a BASIX rating of 40% for residential units and an equivalent NABERS[3] rating of 3.5 for commercial buildings.

Opportunities have been identified to surpass the 35% to 40% reduction in potable water demand in the development and to implement sustainable water management for development in line with Sydney's Metropolitan Water Plan.

Provision of a dual water supply pipeline to residential and commercial buildings will facilitate a significant further reduction in potable water consumption into the future. Provision of non potable water through a dual reticulation water supply scheme is considered an essential element that fundamentally underpins and locks in the sustainability outcomes associated with potable water conservation in the private and public domain for the EDH development.

Further reductions in water demand for air conditioning could be achieved through the use of alternative cooling technologies such as harbour heat rejection.

[1] National Australian Building Environment Rating System

[2] BASIX - Building Sustainability Index, NSW Government requirement for new residential developments to use 40 per cent less potable mains water than similar dwellings of the same type, related to the benchmark of 256.6 L/p/d.

[3] National Australian Building Environment Rating System

4 WSUD Principle #2 – Wastewater Minimisation

Demand management initiatives minimise wastewater generation from the development.

Further reductions in wastewater discharge from the site can be advanced through reuse to meet non-potable demands. Options include sewer mining or a local sewage treatment plant for the EDH site with treated wastewater reticulated through the development. Reuse of treated wastewater provides added benefits for the surrounding infrastructure by reducing the volumetric load on the sewer, potentially reducing the incidence and volume of sewer overflows and thereby protecting Sydney Harbour.

Wastewater in East Darling Harbour is currently transported via local pumping stations to the Bondi Ocean Outfall Sewer (BOOS) via the Kent Street branch. The capacity limitations of this network have been identified by Sydney Water, the network has been specifically noted for its contribution to sewage overflows to Sydney Harbour during wet weather. The opportunity exists to incorporate infrastructure for with the EDH development that would alleviate some of the current environmental problems associated with Sydney's ageing sewerage infrastructure. Sewage from additional catchments which drain to pumping stations at the EDH site can be treated to produce recycled water. This supply of non-potable water could be used to irrigate foreshore parks, linked through a reuse pipeline. Treated wastewater can be provided via sewer mining or a local sewage treatment plant.

4.1 Sewer mining

Sewer mining involves the extraction of waste water from the sewer system and onsite treatment using reliable and robust technologies to deliver high quality water for non-potable reuse. A localised treatment plant can be established to extract water from the sewer and return solid wastes for centralised processing at the Bondi treatment plant. A modular system can be set up with the option to increase its capacity in the future to potentially provide water for use at other locations along the foreshore. A suitable extraction point can be selected such as the sewage pumping station SPS1129 which lies within the EDH site. The pumping station is a central collection point for sewage from the EDH development and external sewage catchments making available a reliable source.

4.2 Local sewage treatment plant

An onsite sewage treatment plant treats wastewater (blackwater) onsite with solids handling and no discharge to the existing sewer.

Onsite blackwater treatment requires a self-contained wastewater treatment system that can treat wastewater to a high standard. Water is separated and treated for re-use and biosolids are dewatered onsite before transportation for reuse in forestry or agriculture. The process is also suitable for treating kitchen waste, and has an added benefit of producing biogas which can be harvested for energy production in the development's energy recovery systems. This option would set the benchmark in Australia for sustainable management of the nutrient cycle within an urban setting. Odour generation from sewage sludge and biosolids handling will require treatment utilising biofiltration technologies that can be incorporated within landscape features such as garden beds or playing fields.

4.3 Wastewater treatment technology selection

The selection of appropriate, sustainable and suitable water treatment technologies is dependent on economic, environmental and social considerations, as well as the development scale, water balance, space available and surrounding infrastructure. In some cases, competing issues must be evaluated.

The footprint of a 'package treatment plant' is typically less than 200m^2 and can fit within a twenty foot shipping container. Storage tanks are also required both for balancing the variable inflow of wastewater and to provide a reliable supply of non potable water. These storage volumes will be in the order of 2000 m^3 and can be located underground.

5 WSUD Principle #3 – Management of Urban Stormwater as a Resource and for Environmental Protection

5.1 Stormwater for Non-Potable Uses

Stormwater can be harvested from local and external catchments, treated, stored and reticulated to provide a reliable source of non-potable water for demands including irrigation, toilet flushing and air conditioning. Stormwater pollutant levels are significantly less than those in wastewater and thus simpler technologies and less energy is required in the treatment process.

A mean annual stormwater flow of 400 ML/yr could potentially be harvested. These flows are however seasonal and intermittent, and storages will be required to provide a reasonable level of water supply reliability. Stormwater storages can be integrated into landscape design. A combined local and external catchment stormwater harvesting scheme could provide up to 50% of the total non-potable demand of the development with a storage requirement of 5000 m^3. The storage required will need to be located at a central location where stored water can be pumped into a dual reticulation water supply pipeline.

5.2 Stormwater Quality

All stormwater will be treated to improve water quality prior to their reuse or discharge into Sydney Harbour. The strategy for stormwater quality treatment is based on a three-tier framework, ie.

1) In the public domain constructed wetlands will be used to treat the external stormwater catchments. These freshwater wetlands will protect the Harbour from pollutants that are carried in the stormwater from the old areas of Millers Point. Intercepting the external catchments buffers the Harbour from stormwater pollution, which can include sewage contamination from ageing infrastructure in the oldest parts of Sydney.

2) Street-scale water quality elements will include bioretention street trees and central median strips as well as raingardens. These elements will be used to meet best practice targets to reduce suspended solids and the nutrient load of the stormwater runoff from road surfaces and the site itself.

3) Within the private domain building guidelines identify opportunities to incorporate WSUD into the building architecture and management practices to provide source control of stormwater pollutants.

5.3 Combined treated wastewater and stormwater scheme

Non potable demands may be met with a combined wastewater and stormwater scheme. If treated wastewater is to be reticulated throughout the site as the primary alternative source of non-potable water, stormwater harvesting could be dedicated to open space irrigation and water features as treatment of stormwater suitable for these uses can often be undertaken through landscape features alone.

An advantage of this option is that stormwater harvesting storages do not need to be located at a central location but could be distributed through the open space and parkland in EDH. Computer modelling of landscape watering demand show that at least 50% of the landscape irrigation demand can be attained from harvesting local stormwater runoff with a small storage of 500 m^3. As much as 90% of this demand can be provided where stormwater from the external catchment is also harvested and a total storage volume of 3000 m^3 storage is provided.

6 WSUD Principle #4 – Stormwater to be used within the urban landscape to maximise visual and recreational amenity

Best practice management of stormwater within the Headland Park will include bioretention systems, integrated with the landscape and public art water features. Stormwater treatment measures and storages can be integrated into landscape design through the use of constructed wetlands, bioretention swales and raingardens. Stormwater treatment elements can also be integrated into building design and associated open space in the private and public domains.

7 Conclusion

The EDH development has the opportunity to be a flagship for environmental protection and conservation of precious water resources. A commitment to sustainability can be demonstrated through appropriate stormwater management and the central provision of critical infrastructure: dual reticulation and a non potable water source. This infrastructure is the critical element and fundamentally underpins and locks in the sustainability outcomes associated with potable water conservation in the private and public domain for the EDH development. There are significant opportunities for the WSUD Strategy for EDH to alleviate the pressures on existing, ageing sewerage infrastructure servicing the western sector of Sydney's CBD and to protect Sydney Harbour from stormwater pollution generated from this sector.

The expectations from the community are high for the EDH site in terms of delivering on ecological sustainability for urban renewal projects. The site can illustrate the vision required, the planning and the provision of infrastructure needed to address the critical issue of urban water management in Australia.