Urban Stormwater Management Plan

Volume 2: Background Information

FINAL DRAFT FOR PUBLIC DISPLAY

June 2012

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PROJECT 12-004– BSC URBAN STORMWATER MANAGEMENT STRATEGIC PLAN

REV	DESCRIPTION	AUTHOR	REVIEW	APPROVAL	DATE
0	Draft issued for BSC review	R Campbell, K. Pratt	M Howland	M Howland	13 June 2012
1	Final draft for public display	R Campbell	S Smith	R Campbell	16/7/12

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1. INTRODUCTION

This Urban Stormwater Management Plan (USMP) brings together available information in order to identify the urban stormwater management issues within the urban areas of Ballina Shire and formulate management actions. The process used to develop the USMP is summarised in Figure 1. Volume 1 of the USMP provides an Implementation Plan for the priority management actions. Volume 2 (this document) provides background information and discusses the key issues.

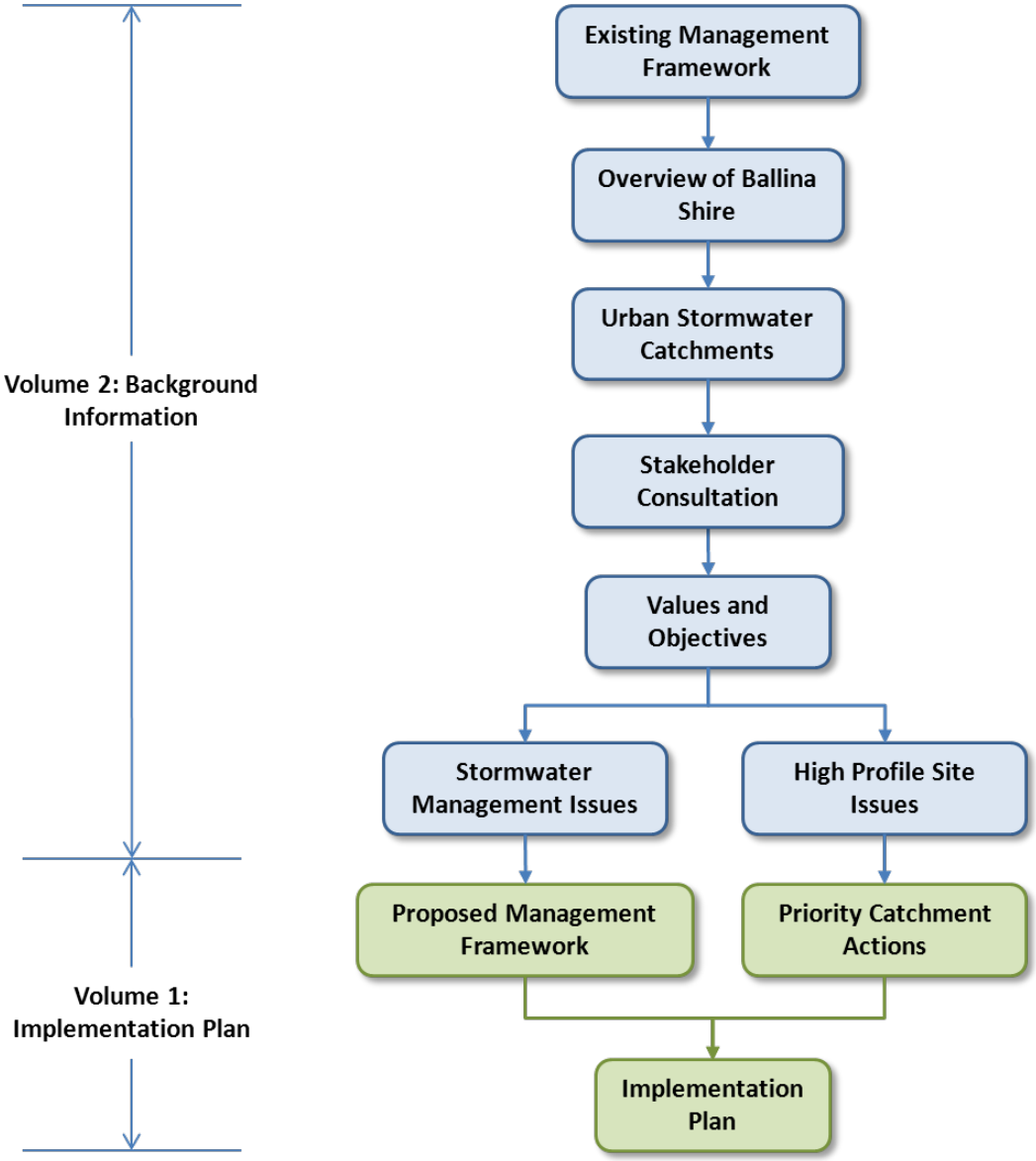
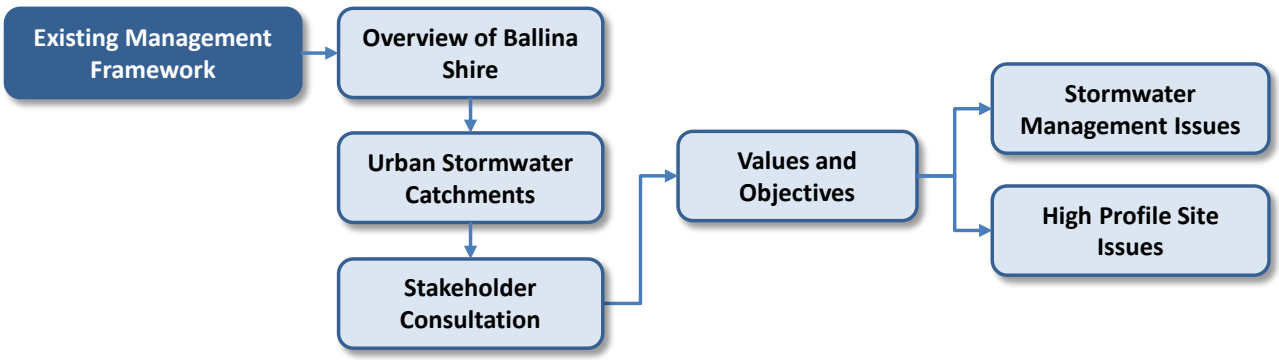


Figure 1: Structure of the USMP

2. EXISTING MANAGEMENT FRAMEWORK



The management of stormwater within Ballina Shire is influenced by the national, state, regional and local regulatory framework and guidelines. The development of management actions is consistent with the existing legislation, state and local government policies and strategic plans. Additional information on the planning framework is provided in Appendix 1.

2.1 Planning Context

2.1.1 National Context

Guidelines prepared as part of the National Water Quality Management Strategy promote nationally consistent approaches to urban stormwater management, based on best practice and the principles of ecologically sustainable development and integrated (or total) catchment management (ANZECC, 2000). The national guidelines recognise the shift of focus from traditional flood management to stormwater quality and ecosystem health considerations. The best-practice approaches focus on managing stormwater in the catchment, including Water Sensitive Urban Design (WSUD) approaches but also require consideration of community values, water quality objectives, public health and safety and economic sustainability.

The national WSUD Guidelines (JSCWSC, 2009) provide guidance on evaluating WSUD projects in Australia to promote the uptake of more sustainable urban water management. WSUD is discussed further in Section 6.3.

Commonwealth legislation relevant to stormwater management includes the *Environment Protection and Biodiversity Conservation (EPBC) Act, 1999*, which provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the *EPBC Act* as matters of national environmental significance.

2.1.2 State Context

In 1998 the NSW Environment Protection Authority (EPA) issued a legal direction under section 12 of the *Protection of the Environment Administration Act, 1991* requiring councils to prepare stormwater management plans as part of the State Government Waterways Package. Ballina Shire Council (BSC or "Council") prepared its Urban Stormwater Management Strategy (USMS) in 2000 and updated it in 2002 (refer Section 2.2.4).

The Stormwater Trust Scheme was implemented in 1997 to support projects that cost-effectively address common issues, knowledge gaps or impediments that councils face while implementing sustainable stormwater practices. Since the Stormwater Trust closed in 2003/04, the State government has prepared guidelines (Managing Urban Stormwater Series) for stormwater managers including stormwater harvesting

and reuse, erosion and sediment control on construction sites, stormwater education and environmental management on the urban fringe.

NSW Legislation

State legislation relevant to urban stormwater management is discussed below.

The *Local Government Act, 1993* gives local councils specific duties regarding natural resource management, land use allocation and development. Councils also have significant planning and development powers as a consent authority under the *Environmental Planning and Assessment Act (EP&A), 1979*.

The *EP&A Act* sets out the NSW system of land zoning and future planning through environmental planning instruments. It determines the requirements for development and use consents and gives the relevant authorities rights of enforcement to ensure compliance with the provisions of the Act. The Act also gives councils responsibility for considering conservation of biodiversity through the protection of ecological communities, and threatened species through reference to the *Threatened Species Conservation Act, 1995*.

State Environmental Planning Policy (Major Projects) 2005 (the Major Projects SEPP) provides a single planning instrument for the identification of projects for which the Minister for Planning is the approval authority under Part 3A of the *EP&A Act*. Recent developments within Ballina Shire that were assessed as Major Projects include residential subdivisions at Lennox Head, North Angels Beach, Pacific Pines Estate and Ferngrove. Planning reforms in 2011 amended the provisions of the SEPP relating to types of development that were previously assessed by the Minister and now will require council approval (such as residential subdivisions).

The *Protection of the Environment Operations (POEO) Act 1997* covers all forms of pollution. The EPA is the appropriate regulatory authority for the activities specified in Schedule 1 of the *POEO Act* (scheduled activities). In general, local councils can regulate non-scheduled activities through notice and enforcement powers. However, the EPA can issue a licence to regulate water pollution from a non-scheduled activity. If it does, it becomes the regulator for all environmental impacts from the activity under the *POEO Act* instead of the local council. The legislation also imposes a duty to notify 'relevant authorities' as specified in section 148(8) of the *POEO Act* (the EPA, local authority, Ministry of Health, WorkCover Authority and Fire and Rescue NSW) of pollution incidents where material harm to the environment is caused or threatened.

The *Fisheries Management Act, 1994* aims to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. In relation to stormwater management, the Act provides for the protection of aquatic habitats.

The *Soil Conservation Act, 1938* controls conservation of the soil resources of the State, mitigation of soil erosion and land degradation, and the conservation of water resources.

2.1.3 Local Government Context

Together with other government agencies and authorities, councils act as an interface between the community and state authorities. Local government is responsible for good governance and the care and protection of local communities within a framework of sustainable development. As managers of public land and land use planners, local government is responsible for policy development and implementation of land use planning as well as regulating a wide range of activities that may impact upon natural resource management. Local government also has a key role to play in translating the policies of Commonwealth and State governments into on-ground projects.

Local environmental plans guide planning decisions for local government areas. Through zoning and development controls, they allow councils to supervise the ways in which land is used. Ballina Shire has prepared a Draft LEP in accordance with the new standard instrument.

Development control plans, prepared in accordance with the *EP&A Act*, are also used to help achieve the objectives of the local plan by providing specific, comprehensive requirements for certain types of development or locations, e.g. for urban design, and heritage precincts and properties.

Local Government functions, powers and responsibilities related to urban stormwater management include:

- Strategic planning through land use zoning and statutory controls on all freehold land and locally managed public open space;
- Development control of activities and works on land as specified by council's LEP;
- Enforcement powers for development consent conditions, waste management and unauthorised land uses (e.g. land clearing, drainage and filling);
- Administrative responsibility for state agency coordination through integrated planning, licensing and development concurrence;
- Stormwater management and control, sewerage, drainage works and flood control;
- Pest, plant and animal risk control measures;
- Management of local open space to restore remnant vegetation and recreate habitat; and

Councils are also the primary advocate for and coordinator of local community groups and interests.

2.1.4 Other Stormwater Management Responsibilities

The Roads and Maritime Authority is responsible for stormwater and land management in the designated state highway corridors with the Shire.

The Northern Rivers Catchment Management Authority is responsible for natural resource management activities in non-urban areas of the Ballina Shire.

Richmond River County Council (RRCC) has been delegated the responsibility for flood mitigation activities within Ballina Shire, Lismore and Richmond Valley Councils. RRCC provides a coordination role in floodplain management, working with the constituent councils, State and Commonwealth agencies, university researchers, and floodplain industries to develop long-term natural resource management strategies for the Richmond River floodplain and estuary.

2.2 Council's Urban Stormwater Management Activities

2.2.1 Organisation Structure

Council's organisation structure comprises four groups - General Manager's Group, Regulatory Services Group, Strategic & Community Services Group and Civil Services Group. The responsibilities of each group that include aspects of urban stormwater management are shown below and discussed further in Section 2.2.2.

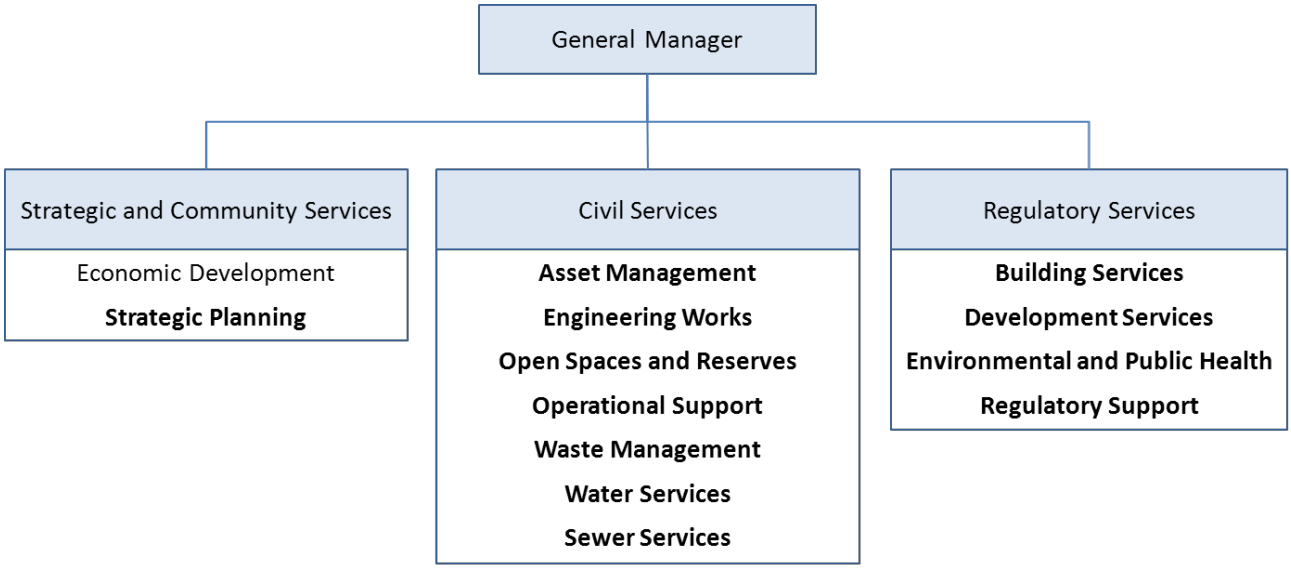


Figure 2: Council structure and responsibilities relevant to stormwater management

2.2.2 Integrated Planning and Reporting Framework

Community Strategic Plan and Delivery Program

As part of the Department of Local Government's Integrated Planning and Reporting (IPR) Framework, BSC prepared a Community Strategic Plan (CSP 2010-2025) from which a Delivery Program was developed. The Delivery Program provides a summary of the actions Council is undertaking to achieve the CSP Objectives and Outcomes over the next four years. The Delivery Program (2011/12 – 2014/15) actions relevant to stormwater management include:

- Implement environmental initiatives to improve development and infrastructure outcomes;
- Promote professionalism and skills of Council planning and building staff to ensure professional and contemporary services;
- Update Council planning instruments to improve built environment outcomes;
- Improve overall health of Richmond River;
- Provide a proactive approach to flood management to maximise community safety and knowledge;
- Provide contemporary stormwater management and infrastructure to minimise environmental impacts;
- Continue rezoning and urban design for the planned;
- Release Areas to allow development to proceed;
- Finalise LEP Renewal and review Ballina Shire;
- Combined Development Control Plan to provide a contemporary planning structure;
- Utilise land use controls to locate appropriately land uses that might impact negatively on water quality;
- Integrate climate change requirements into statutory planning to comply with legislation;
- Prepare and implement sports field maintenance and improvement program to provide an adequate level of service and to encourage increased use;

- Develop long term funding strategies for Council to ensure infrastructure is adequately maintained and delivered;
- Enhance development assessment services to improve service levels;
- Ensure development assessment and development engineering processes are efficient and effective;
- Improve and implement asset management strategy and plans to address funding shortfalls and to improve work practices;
- Progress resource sharing arrangements with other local government authorities to increase efficiencies; and
- Improve communication and consultation strategies to increase community involvement.

The delivery program includes a 4-year capital works program which identifies the major capital expenditure.

The actions, objectives and outcomes of the IPR process that are relevant to this USMP are discussed further in Section 6.1.

Operational Plan

The Operational Plan outlines the principal activities to be provided each year, along with the key measures that are recorded to identify whether the actions identified in the CSP and the Delivery Program are being achieved. As shown in Figure 2, urban stormwater management is not a currently principal activity area – instead responsibilities are spread across a number of activity areas within each of the services groups. The key functions within each of Council's principal activity areas relevant to stormwater management are shown in Table 1.

Table 1: Key Activities relevant to Stormwater Management (Operational Plan)

Functional Area	Relevant Activities
Asset Management	Survey and design for engineering works Infrastructure planning Engineering support for development Asset management Providing engineering advice and support for development proposals
Building Services	Assessment and issue of Development Applications Issuing Construction Certificates Undertaking building inspections Approval and inspection of on-site sewage management facilities Education and advice to the building industry Approvals and associated inspections regarding plumbing and drainage
Development Services	Implementation of Local Environmental Plan Determination of development applications Determination of Section 96 applications Determination of Section 82A Reviews of Determination Levying of developer contributions Issuing subdivision and Section 149 certificates Monitoring development control compliance Providing customer advisory services

Functional Area	Relevant Activities
Engineering Works	Maintenance and construction of roads Stormwater and drainage Flood mitigation
Environmental and Public Health	Responding to environmental incidents Monitoring mosquitoes Inspection of on-site sewage systems Management of overgrown private allotments
Open Spaces and Reserves	Managing and maintaining: • sporting fields • parks and reserves • cemeteries • public toilets and amenities • natural areas, including beaches
Strategic Planning	Environmental planning Section 94 planning (Developer Contributions) Combined Development Control Plan (DCP) State of the Environment reporting Managing the Growth Management Strategy

2.2.3 Urban Stormwater Management Revenue and Expenditure

The *Local Government Act, 1993* was amended in 2005 to allow councils the option to levy a stormwater management service charge on eligible residential or business rateable land for improved stormwater management. This change was made in recognition of councils' key role in stormwater management and their need for a sustainable funding source to support their stormwater services. Council is able to raise an annual stormwater charge of up to $25 per residential assessment and up to $25 per 350m^2 for urban business land (not indexed) for business properties where the service is provided.

In recent years, BSC has resolved to charge the maximum allowable residential stormwater charge ($25 per property) on residential properties and the equivalent charge for business properties. This represents an annual charge levied on all developed urban properties in the Shire. Funds raised by this charge must be spent on new stormwater and drainage projects.

The Operational Plan identifies the distribution of general purpose rate income. 3.2% of general purpose rate income was attributed to stormwater and environmental management in 2011/12 (2.8% in the draft 2012/13 Operational Plan). The annual budget provides details of Council's operating budgets on a program basis. The annual budget for the stormwater and environmental protection program (stormwater management, flood mitigation and environmental protection activities such as flood mitigation) includes an allocation for stormwater drainage maintenance ($164,000 or 32% of operating expenses in 2011/12 and $273,000 or 42% of operating expenses in 2012/13). These are funded through the stormwater levy (which was expected to provide $273,000 in 2011/12 and $285,000 in 2012/13) and any available grants, although no such grants were identified in 2011/12 or 2012/13.

Capital works for stormwater projects are funded through general revenue. In 2011/12, the capital works budget was $394,000. In 2012/13, a total of $290,000 is allocated to stormwater capital projects and $40,000 for asset data collection.

The Open Spaces and Reserves function was allocated 15.2% of the rate income in 2011/12 (13.1% in 2012/13) and this was used to fund all activities listed in Table 1. Vegetation management (coastal reserves, bushland reserves, weed control and environmental extension activities) accounted for $176,000 or 5% of the Open Spaces and Reserves operating expenses in 2011/12 ($150,000 or 4% in 2012/13).

Council's rates are subject to rate pegging and variations approved by the Minister for Local Government (6.1% in 2012/13 and 5.9% in 2013/14). The additional income from the special rate variation has not been allocated to stormwater projects.

Section 94 of the *EP&A Act* 1979 permits councils to require developers to pay monetary contributions and/or dedicate land in order to fund the increased demand for public amenities and public services generated by the carrying out of development. BSC's 2008 Contributions Plan authorises the collection of monetary contributions from residential and tourist developments in all parts of the Shire towards the provision of open space and community facilities and from development in the Wollongbar Urban Expansion Area for various road and access infrastructure. The existing Contributions Plans authorise the collection of monetary contributions from residential and tourist developments in all parts of the Shire towards the provision of open space and community facilities, from development in the Wollongbar Urban Expansion Area and for various road and access infrastructure but does not require contributions for stormwater infrastructure.

2.2.4 2002 Urban Stormwater Management Strategy

BSC prepared an Urban Stormwater Management Strategy (USMS) in 2000 in response to a direction by the EPA. The USMS was revised in 2002 (Gilbert and Sutherland and David Ardill & Associates, 2002). The USMS:

- Identifies stormwater management values;
- Derives objectives to protect these values;
- Identifies problems and issues; and
- Establishes a framework to guide present and future stormwater management planning in the Ballina Shire.

The USMS also provided a summary of water quality in the catchment including first flush effects, sediment transport and point sources of pollution. A review of the stormwater system existing at the time was also provided. Consultation with government agencies, business groups, Landcare and other Community groups was undertaken to identify concerns regarding stormwater management issues and management options.

The status of the USMS actions is discussed in Appendix 2. Many of the actions have been implemented but generally these were a result of other Council initiatives not specifically related to the USMS. Council staff identified the reasons for poor implementation of the 2002 USMS as lack of awareness of the strategy, its requirements and lack of identification of responsibilities.

The values and objectives documented in the 2002 USMS have been used to develop the revised objectives for this USMP (refer Section 5).

2.2.5 DCP Chapter 13 – Stormwater Management

Chapter 13 of the Ballina Shire Combined Development Control Plan was developed as a supplement to the 2002 USMS to address the issue of stormwater management for new developments within the Ballina Shire. This has resulted in more stringent stormwater management measures over time.

Based on the principles of Environmentally Sustainable Development (ESD) and the objectives of the 2002 USMS, Council has adopted the stormwater management objective for new urban developments which states that there shall be no net increase in the average annual load of key stormwater pollutants and peak

discharge flow rates, above that occurring under existing conditions. This condition is highlighted for all sites that have a sensitive receiving environment (National Parks and Nature Reserves, water catchment, scenic escarpment, habitat, coastal lands, SEPP 14 wetland, SEPP 26 Littoral rainforest). Pollutant treatment objectives are based on the NSW EPA recommendations (1997).

Urban subdivision development applications need to address stormwater management in order to comply with specific objectives and requirements for designated protection areas. Where necessary, evidence may be required to verify that the receiving environment will not be at risk of deterioration beyond existing levels. This may require baseline and construction/operational phase water quality monitoring and/or suitable computer simulation modelling of stormwater quality and peak stormwater flow discharges.

Issues with the application of DCP13 are discussed in Section 7.2.2.

2.2.6 Northern Rivers Local Government Development Design and Construction Manuals

The Northern Rivers Local Government Development Design and Construction Manuals have been adopted by Council to provide uniform design and construction standards for new infrastructure associated with developments within the Shire. The development industry is encouraged to utilise these guidelines before planning begins, enabling faster and more effective processing of developments through Council. The specifications are derived from the AUS-SPEC generic Development Specification Series – Design manual and include amendments required by the Northern Rivers Councils.

Relevant components include:

- Guidelines for Development and Subdivision of Land;
- D5 – Stormwater Drainage Design and supplement - Handbook of Stormwater Drainage Design;
- D6 – Site Regrading;
- D7 – Erosion Control and Stormwater Management; and
- D8 – Waterfront Development.

2.2.7 Erosion and Sediment Control

The NSW Department of Housing Blue Book “Managing Urban Stormwater – Soil and Conservation” outlines the general requirements for the preparation of a soil and water management plan. All works shall be conducted in accordance with a soil and water management plan that has been submitted and approved by Council prior to the commencement of works.

Council’s Erosion and Sedimentation and Control Policy EO1 was adopted in 1992 to increase awareness of environmental pollution and to help change traditional construction practices. The policy implementation process involved sending letters and pamphlets to tradespeople (i.e. builders, plumbers, earthmoving, landscapers, etc.), establishing model erosion and sediment measures, conducting drainage seminars and introduction of erosion and sediment control conditions for construction sites. The objective of the training was to raise participants’ awareness and develop their knowledge and skills in implementing effective erosion and sediment controls.

Subsequent to this training, Council’s Public & Environmental Health Section has implemented an Erosion and Sediment Control Education and Enforcement Program. The objective of this program is to protect the local waterways and environment by educating the community, builders and other trades people along with Council’s staff on the importance of erosion and sediment control on construction and development sites. Council continues to provide leaflets on sediment and erosion control guidelines for builders and developers.

A monitoring program of stormwater conduits and streams was also advocated in the Policy to allow Council's Environmental Health Section to determine the effectiveness of changes to traditional urban development practices in protecting the biological and chemical nature of the receiving waters. It appears, however, that this action has never been implemented.

2.2.8 Asset Management

Asset Management Strategy

BSC adopted an Asset Management Strategy in 2012 to describe how Council will meet its commitment to asset management as documented in its Asset Management Policy. The service delivery objective for stormwater is:

> *Effective primary treatment, temporary storage and distribution of stormwater to minimise complaints of flooding.*

Council currently does not have any viable condition data on any of its assets, asset valuations and determination of depreciation and remaining lives are based on design lives and recorded construction dates. The Strategy establishes a program of preparing for a condition based assessment approach to asset evaluation.

Council aims to achieve a number of tasks in order to narrow the existing gaps in data knowledge to allow Council to more efficiently understand, maintain and manage its asset base. Process Improvement Tasks specific to stormwater assets are:

- Authority Asset Management Software (AIM) – establish asset management system, staff training, maintain database regularly;
- Risk Definition – undertake risk management process, collect data, aged-based analysis of assets;
- Asset Register – develop work procedures and maintain regularly;
- Asset revaluations;
- Asset management plans – review and update regularly;
- GIS Implementation – set up MapInfo layer and maintain regularly;
- Asset design lives – review asset design lives/remaining lives; and
- Levels of service – review level of service and redefine key performance indicators

Stormwater Asset Management Plan

The draft 2007 Stormwater Assets Management Plan forms an annexure to the broader Ballina Council Asset Management Plan and encompasses the predicted costs and revenue raised from, the operation, maintenance and upgrading of Council's stormwater network over a 20-year period to achieve a defined level of service.

Council's stormwater assets have been grouped into three categories and several subcategories:

- Rural culverts: Man-made structures that allows free flowing water to travel underneath a road. They are generally found in rural areas and have been divided into three sub-categories - Reinforced Concrete Pipe (RCP), Reinforced Concrete Box Culvert (RCBC) and Other materials – e.g. Cast Iron;
- Urban reticulation: Gravity based stormwater reticulation that transports storm-water run-off from kerb and gutter (see Roads & Transport Asset Management Plan) to ocean or river outlets. They have been divided into 'Inter-allotment' and 'Road Reserve' sub-groups. Sub-categories include kerb inlets, pits, pipes, manholes, house connections and outlets;

- Flood protection schemes: Infrastructure with the purpose of minimising the effect of flooding on existing reticulation systems and property through the use of levee banks or retention and slow release of storm-water including retention areas (dams), open channels, stop banks and stormwater treatment devices.

The total replacement cost of Council's stormwater assets has been estimated in the order of $20 million. This figure is revised as more detailed information of the nature of the asset base is collected. Currently, these assets are being mapped onto Council's GIS.

2.2.9 Stormwater Quality Improvement Devices (SQIDs) Manual

Council has created a Stormwater Quality Improvement Devices (SQIDs) Manual, describing the locations, construction details and maintenance schedules for some of the SQID throughout the Shire. These include wetland systems, trash racks, ponds, sediment traps and detention tanks. New SQIDs are added to the manual as are identified or constructed.

2.2.10 Urban Water Management Strategy

In July 2003, Council adopted the Urban Water Management Strategy (UWMS), which provided a 'blueprint' for the management of water supplies, wastewater and stormwater in Ballina Shire. The strategy commits Council to actions that will result in progressive improvements in line with best practice in these areas. Although stormwater is referred to in the UWMS in broad terms, it has not been integrated into the broader water cycle management hierarchy, partly due to the segregation of stormwater from other water cycle elements within Council's management structure.

Relevant achievements of the UWMS include:

- Council commissioned the preparation of a Stormwater and Wastewater Wetlands Report. This report examined the potential benefits, constraints, characteristics and main issues surrounding the use of wetlands in different forms as a component of the stormwater management strategy. The report identified the need for stormwater management initiatives to target the following objectives:
    - reducing loads of contaminants at the source;
    - physically obstructing stormwater runoff; and
    - intercepting, retaining and transforming the contaminants.

  The report recommendation was for catchment management planning to involve an integrated treatment system utilising a combination of measures including gross pollutant traps, sedimentation ponds and wetlands.
- Reclaimed water is currently being used for irrigation on sporting fields, on the Ballina Golf Course, Ballina Race Track and the Wardell Turf Farm and other agricultural reuse purposes. This network will continue to be expanded to replace the need for drinking water for these purposes during dry weather.
- Council is continuing to facilitate the installation of dual reticulation in new residential estates in East Ballina, Ballina Heights, Cumbalum and Lennox Head.

2.2.11 CZMP for the Richmond River Estuary

The Coastal Zone Management Plan (CZMP) for the Richmond River Estuary provides a ten-year strategic plan for the implementation of key actions to address identified estuary issues. The primary goal is to achieve integrated, balanced, responsible methods to restore and maintain the ecological sustainability of the estuary as well as the recreational and commercial activities associated with it.

The CZMP is the culmination of the coastal zone management process for the Richmond River estuary. The Plan has been developed from the recommendations and outcomes reported in the Richmond River Estuary Management Study (EMS, Volume 2) and is supported by the scientific knowledge from the Estuary Processes Study (Hydrosphere Consulting, 2011).

Stormwater from urban areas can often discharge significant loads of pollutants to receiving water bodies. The CZMP reported that the impact of urban stormwater to overall estuarine water quality is a significant issue for the public and councils. The importance of managing urban stormwater will also become increasingly important as the extent of urban development increases to accommodate the increase in population within the study area.

The reduction of urban pollution such as nutrients and faecal coliforms is consistent with the aims of the estuary management program. The desired outcome of stormwater management actions is on-going improvements in stormwater management resulting in reduction of contaminants transported to the estuary. Tasks include:

- On-going review and update of council stormwater management plans;
- On-going review and update of Development Control Plans and development guidelines;
- Community education;
- Incorporating water sensitive urban design in new developments;
- Retrofitting stormwater/water quality controls to existing urban developments; and
- The State Government BASIX program.

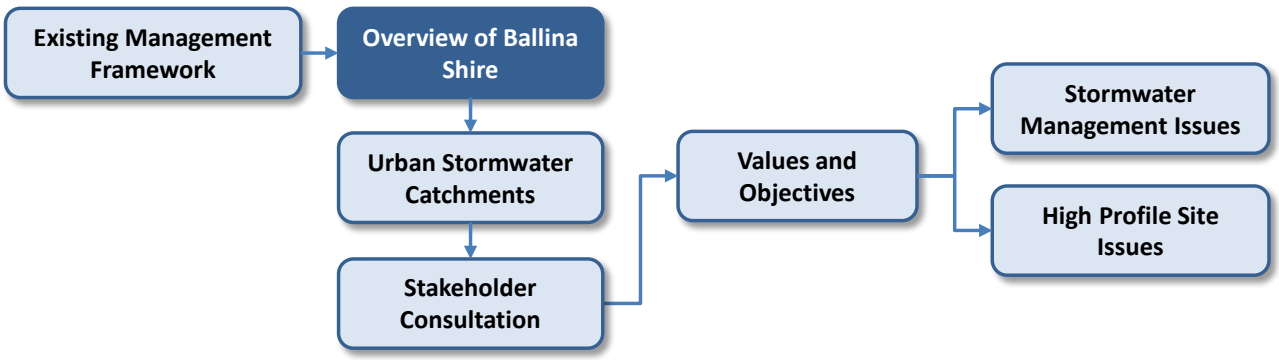
2.3 Comparison with Other Council Approaches to Urban Stormwater Management

The stormwater management strategies and activities of some other local government authorities were reviewed to identify current urban stormwater management practices (refer Appendix 3). Key findings from this review are summarised below:

- Lismore City Council (LCC):
    - The 2007 SMP divides the Lismore urban-zoned area into stormwater sub-catchments to simplify assessment of issues;
    - An adaptive implementation approach has been adopted where strategies will be incorporated into ‘action plans’ on an annual basis and integrated with longer-term plans in line with Council’s three-year management plans;
    - The Plan includes a framework for the expenditure of the stormwater management services charge and provides and overarching implementation process for strategies identified in the SMP;
    - Some key stormwater assets have been retrofit to improve stormwater quality, biodiversity, habitat and aesthetics. Examples are Browns Creek channel design and Rotary Drive headwall remediation. Many projects have been undertaken in partnership between LCC and EnviTE NSW; and
    - LCC is also working on finalising a service level agreement between Council departments to ensure maintenance requirements for stormwater are understood and carried out to a certain standard.

- Tweed Shire Council (TSC):
    - The Final Draft 2012 Urban Stormwater Quality Management Plan has a strong emphasis on achieving water quality objectives for downstream waterways;
    - The Management Plan refers to guidelines, resources and tools that should be used to implement best practice stormwater management, many of which have been developed by the Water By Design program for the South East Queensland Health Waterways Partnership;
    - Emphasises the development of SQIDs from design and approval to construction and maintenance stages; and
    - Includes a new approach of compensatory activities to offset residual and cumulative impacts of stormwater discharge into waterways;
- South East Queensland Healthy Waterways Partnership - The Water by Design program is part of the Health Waterways Partnership in south-east Queensland. Most local councils in the region are members of the partnership including Gold Coast City Council, Brisbane City Council and Sunshine Coast Regional Council. The program supports the management of the whole urban water cycle in order to achieve sustainable development, including protecting and restoring the natural water cycle. A number of tools and resources to assist practitioners design, construct and implement water sensitive urban design have been or are being developed by the Water by Design Program. The suite of tools, resources and guidelines represent one of the most comprehensive and integrated management approaches to urban stormwater management in Australia. While these tools and resources have been tailored to South East Queensland, they are relevant to the Far North Coast of NSW in terms of an effective overall management approach.
- Knox City Council (Victoria) - Council has recently completed their Water Sensitive Urban Design (WSUD) and Stormwater Management Strategy (2010). The main focus of the strategy is on implementing WSUD to disconnect impervious surfaces from waterways wherever possible. The Strategy follows detailed research by Knox in partnership with Melbourne Water that identified stormwater as a major source of degradation to downstream waterways. The program focuses on six priority areas:
    - Protection of high-value waterways;
    - Addressing identified “hotspots” with high pollution loads;
    - Integrating WSUD into Council retrofit and upgrade projects;
    - Planning program reform;
    - Maintenance of WSUD assets; and
    - Evaluation of effectiveness of WSUD.
- Derwent River (Tasmania) - The Derwent Estuary Stormwater Management Plan (2005) was prepared as a model for local governments in Tasmania. The SMP provides options to improve the management of stormwater, both in the catchment and within Council planning and development frameworks. The SMP focuses on three major areas:
    - “Retro-fitting” existing urban areas to improve stormwater quality – this includes wetlands, rainwater tanks, education signage, habitat rehabilitation (revegetation);
    - Proactive Council planning and development controls to minimise the impacts of future development on stormwater quality and quantity; and
    - Community and Council stormwater awareness programs.

3. OVERVIEW OF BALLINA SHIRE



This section discusses the major features of Ballina Shire including urban areas and waterway characteristics. This provides information on the Shire characteristics that have influenced land development and stormwater management. Specific information on the urban stormwater catchments is provided in Section 4.

3.1 Topography

Figure 3 provides an overview of the Shire's localities, topography and main waterways.

Major landform features within the Shire include the Alstonville Plateau crossed by a number of creeks, a large coastal floodplain associated with the Richmond River and a beach ridge plain associated with the coastline. A scenic escarpment runs through the Shire in a north/south direction separating the coastal plain from the Alstonville plateau to the west. The urban centres of Alstonville and Wollongbar are located along the Bruxner Highway in this region. To the south lies the relatively undisturbed Blackwall Range and the village of Wardell located by the Pacific Highway and the Richmond River. Coastal ridges between Ballina and Lennox Head interrupt the coastal floodplain.

Figure 3: Ballina Shire topography and waterways

3.2 Climate

The region experiences a mild subtropical coastal climate with moderate maximum and mild minimum temperatures and high intensity rainfall. The majority of rain falls in the summer and autumn months. Mean annual rainfall at Ballina is reported to be 1789 mm with an average of 122 rain days per year. March is the wettest month and September the driest. Average annual temperature varies from 19.6°C to 28.2°C (BOM, 2012).

3.3 Waterways

All main tributaries in the study area drain to the main river system - the Richmond River and eventually the Pacific Ocean (refer Figure 3). There is an extensive network of creeks, streams, watercourses and swamps draining the Alstonville Plateau and lowlands of the Shire. The coastal urban areas that drain towards the ocean have stormwater outlets on the beach (e.g. parts of Lennox Head and Shelly Beach). Lake Ainsworth has a small urban catchment area flowing directly to the freshwater lake.

The main waterways in the study area are:

- The Richmond River - the Richmond River catchment covers 6,864 square kilometres and incorporates a large coastal plain extending from south of Evans Head through almost to Byron Bay in the north. The Richmond River has an estimated length of 170km with headwaters in the foothills of the Border Ranges. The river runs past the towns of Kyogle, Casino, Coraki, Woodburn and Wardell before it meets the ocean at Ballina;
- North Creek - forms the north-east arm of the Richmond River estuary. Its upper reaches consist of the extensive freshwater floodplain of Newrybar Swamp west of Lennox Head, which has been largely modified by a system of drains and levees. Urban areas of Lennox Head (west-draining catchments) and Cumbalum drain to these upper reaches. North Creek passes through the upper estuarine swamps of the Ballina Nature Reserve and downstream to the marine dominated shoals adjacent to Ballina. North Ballina industrial and urban areas (North Lakes), Ballina Island (north-draining catchments) and the majority of East Ballina (including Angels Beach, Chickiba and Prospect areas) also drain to North Creek. There are several designated oyster lease areas situated along North Creek which is also valued for recreational pursuits and scenic amenity;
- Fishery Creek Canal - connects North Creek to the Richmond River. Parts of North Ballina (Ferngrove Estate), Ballina Island and West Ballina urban areas drain to this waterway;
- Emigrant Creek - has headwaters at Newrybar in the north of the Shire. Emigrant Creek Dam forms part of the town water supply catchment for Ballina and Lennox Head. The creek follows a meandering course south to join the Richmond River at West Ballina. The lower estuarine areas of Emigrant Creek are fringed with mangrove areas in good condition (Australian Wetlands, 2010);
- Maguires Creek - drains from the Teven Valley and part of the Alstonville Plateau and intersects with Emigrant Creek approximately 7.5kms upstream of the confluence with the Richmond River. Tributaries passing through upstream urban areas are Willowbank Creek, Pearces Creek and Branch Creek in Wollongbar and Alstonville; and
- Shaws Bay - a small tidal embayment located adjacent to the mouth of the Richmond River at Ballina. Stormwater from the Shaws Bay estate flows to this waterbody which is connected to the Richmond River by partial exchange through the northern river training wall.

3.3.1 Tidal Regime

The Richmond River is tidal from the mouth at Ballina past Lismore on the Wilson River, a major tributary of the Richmond, and past Tatham on the Richmond River, 110km from the ocean. Tidal range at Ballina varies from 0.65m on neap tides to 1.9m on some spring tides (Eyre and Twigg, 1997). King tides of over 2.0m

have been recorded in recent years. Tidal intrusion into stormwater pipes and flooding in some areas of Ballina Island have been associated with high tides.

3.3.2 Streamflow

Peak stream discharges correspond with high summer rainfall which is historically highest in March. Similarly, lowest river flows occur during September, corresponding with the driest month of the year.

Baseflow conditions exist in the Richmond River catchment from approximately July to December. Surface runoff during this period often ceases and streams in the upper Richmond catchment are fed by groundwater. Water tables drop in the floodplains of the lower catchment during this time due to evapotranspiration, reduced aquifer recharge and drainage to the river. During dry periods, tidal influence becomes stronger in floodplain waterways as the estuary migrates upstream (Ferguson and Eyre, 1995).

During the wet season (December to May) in the lower Richmond River catchment, ground water levels rise in response to high rainfall. Relatively small floods (1 in 2 year return) can flush the Richmond River estuary fresh to the mouth at Ballina (Ferguson and Eyre, 1995).

3.3.3 Flooding

There have been numerous occurrences of flooding in the low lying areas of the Ballina Shire. BSC has recently completed a Floodplain Risk Management Study (BMT WBM *et al*., 2012) with detailed modelling of potential flood events and incorporating various climate change scenarios. There are three main sources of flooding in the study area (WBM, 2012):

1. Richmond River flooding caused by a widespread storm system (with precipitation typically occurring over a few days) over the broader Richmond River catchment. These floods rise and fall relatively slowly at Ballina, with flood conditions lasting a few days;
2. Local catchment flooding caused by smaller storm systems in the local creek catchments with intense rainfall bursts typically lasting less than 12 hours. Flood waters rise and fall quickly. This form of flooding presents a high hazard due to short warning times and fast flowing water; and
3. Ocean storm surge flooding caused by low pressure systems, strong onshore winds and storm wave conditions, which lead to higher than usual ocean levels. This form of flooding is influenced by tides, and will typically occur in combination with one or two high tides.

Stormwater assets are affected by flooding and in turn, stormwater systems can also exacerbate flooding issues. One example is the tidal inflows of estuarine water through stormwater pipes during high tides. Periodic flooding of roadways in parts of Ballina Island is experienced during some high tides.

3.3.4 Water Quality

Water quality monitoring in the waterways subject to stormwater discharge is carried out primarily by Council at specific locations for a range of purposes including mandatory monitoring of licensed discharges (e.g. sewage treatment plans), State of the Environment reporting and 'Beachwatch' programs monitoring recreational water quality conditions. Other monitoring is carried out for specific projects or investigations by Council and other government agencies, or university studies. In the past these programs have generally been of short duration in response to specific issues or events.

There is generally a good understanding of the major water quality issues for the Richmond River estuary. A number of recent studies have investigated major issues associated with acid sulfate soils (ASS), flooding and associated blackwater events and subsequent fish kills in the mid and upper sections of the estuary. There are significant impacts from the Richmond River catchment upstream of the urban areas that can adversely impact water quality and the general health of the Richmond River especially during high flow events.

The Richmond River Processes Study (WBM, 2006) reported that during high flows the impacts from urban stormwater was negligible in comparison to the impact of diffuse loads from the catchment. Pollutant loads from urban inputs become relatively more important to water quality during the dry season when catchment inputs are low.

On a more local scale, some uncertainty remains regarding the sources of some water quality problems and the relative impact of various sources. One example is the periodic high levels of faecal coliforms measured at Beachwatch monitoring sites within the Shire. The Beachwatch Program reported the following results (OEH, 2011):

- The Serpentine (North Creek) and Shaws Bay: occasionally exceeded safe swimming levels in response to rainfall events over 10mm (monitoring carried out from 2002 to present);
- Lake Ainsworth (Lennox Head): Enterococci levels generally increased with increasing rainfall, often exceeding the safe swimming limit in response to rainfall events over 10mm;
- Shelly Beach: Microbial water quality has generally been of a high standard, with a small percentage of elevated enterococci results recorded in some years;
- Seven Mile Beach: monitored since 2002, microbial water quality has been of a generally high standard; and
- Lighthouse Beach: The site was monitored in 2002–03, and in 2009–10. Water quality has generally been of a very high standard.

Other studies have detected periods of poor water quality in waterways of the Shire including high levels of nutrients, sediment and faecal coliforms. While a number of potential sources have been identified such as agricultural and urban runoff or treated sewage, the specific source of contaminants in many cases has not been established. There is no dedicated stormwater quality monitoring program across the Shire to assess impacts of stormwater on receiving waterways.

3.3.5 Estuarine Flora and Fauna

The Richmond River estuary is a significant contributor to the Australian east coast fishery through a range of mechanisms including direct contribution to catches, provision of nursery habitats, spawning stock and nutrients for offshore fisheries.

Estuarine vegetation (mangrove, saltmarsh and seagrass) occurs primarily in the lower reaches of the Richmond River, North Creek and Emigrant Creek. Many of these areas are conserved as SEPP 14 Wetlands and provide habitat and nursery grounds for a variety of aquatic and terrestrial species. These estuarine wetlands provide habitat for a large number of migratory waders including federally listed threatened species. Significant areas of sclerophyll forest, heathland, littoral rainforest and estuary and wetland exist within the Shire. These areas support a number of wildlife habitat areas.

The Richmond River is the seventh largest (by surface area) estuary in NSW, with the fifth largest finfish catch in the region (ABER, 2007). In addition to the high fisheries/productivity value of the estuary, the estuary supports species, habitats and communities of conservation concern. These include:

- Rare and threatened communities, as defined under the *Threated Species Conservation Act, 1995* (refer WBM, 2006), namely:
    - Coastal Saltmarsh;
    - Swamp Oak Floodplain Forest;
    - Swamp Sclerophyll Forest On Coastal Floodplains;
    - Freshwater Wetlands On Coastal Floodplains;

- Littoral Rainforest;
- Lowland Rainforest on Floodplains; and
- Ripple-leaf Muttonwood (*Rapanea* species A Richmond River).

- Wetlands of conservation significance: SEPP 14 wetlands (4964ha) and Zone 7(a) Environmental Protection (Wetlands) or E2 (Environmental Conservation) under the new LEP instrument; and
- SEPP 26 Littoral rainforest.

3.3.6 Riparian and Foreshore Vegetation

Riparian land is any land that is next to, or directly influences a body of water. It includes areas adjacent to creeks and rivers, gullies which sometimes run water, wetlands or areas surrounding dams and lakes.

Riparian and foreshore vegetation provides a number of important ecological functions including fisheries habitat, terrestrial habitat, bank stability and maintenance of soil structural integrity, land use buffering, water quality filtering, lowering water temperature and reducing aquatic weeds as well as providing scenic amenity. There are some notable areas of good quality riparian vegetation within the BSC study area that have been protected by environmental zoning, national parks or nature reserves including tracts along North Creek (Ballina Nature Reserve) and the lower Richmond River (Richmond River Nature Reserve). However, there are many riparian areas that are degraded as a result of clearing, development, weed encroachment and disturbance.

3.3.7 Land Use

A breakdown of the Ballina Shire land area by zones defined in the BSC Draft Local Environmental Plan 2010 (LEP) zones is provided in Table 2.

Table 2: Ballina Shire Land use

Urban Zoning	**Area (km^2)**
Low Density Residential	10.16
Medium Density Residential	7.37
Neighbourhood Centre	0.14
Local Centre	0.23
Private Recreation	0.43
Public Recreation	3.33
Commercial Core	0.44
Enterprise Corridor	0.24
General Industrial	1.57
Infrastructure	1.41
Mixed Use	0.06
Total Urban Area:	**25 (5%)**

Rural Zoning	**Area (km^2)**
Primary Production	241.23
Rural Landscape	57.03
Total Rural Area:	**298 (61%)**

Environmental Zoning:	**Area (km^2)**
Environmental Conservation	81.34
Environmental Management	55.32
National Parks and Nature	14.52
Natural Waterways	14.40
Recreational Waterways	2.76
Total Environmental Area:	**168 (34%)**

Rural Land Use

Ballina Shire contains a variety of land uses and natural resources. Nutrient-rich soils combined with high rainfall and a temperate/sub-tropical climate provides conditions suitable for a diverse range of land uses. Major primary industries within the Shire include:

- sugar cane;
- dairy and beef cattle;
- horticultural crops (macadamias, bananas, stone fruit vegetables, etc.);
- tea tree;
- aquaculture (oysters and prawns); and
- quarries.

In addition, several areas throughout the Shire have been developed as rural residential urban developments.

Environmental Land Use

The other major land use attracting tourists to the region is the environmental use of land in national parks, and reserves. Approximately 34% (168km^2) of the Shire falls within Environmental Protection Zones under the Draft LEP (BSC, 2012). These areas include:

- 2,740 ha of Wetlands;
- 4,780 ha of Water Catchment Zoning;
- 1,400 ha of identified Scenic and/or Escarpment Lands;
- 1,240 ha of Coastal Lands;
- 640 ha of Urban Buffer Lands;
- 1,590 ha of zoned Habitat Lands; and
- 940 ha of National Parks and Nature Reserves.

Urban Land Use

Ballina Shire's main commercial centre is located within the Ballina Township. The main commercial and retail area is in River Street and the Ballina Fair and Ballina Central shopping complexes adjacent to Kerr Street. Alstonville, Wollongbar and Lennox Head each have relatively small commercial areas, while Wardell has a small village centre.

Industrial land in the Ballina Shire is concentrated in two major areas. The Southern Cross Industrial Estate is on the northern side of Ballina and the smaller Russelton Industrial Estate is located at Wollongbar. Three smaller industrial zoned land areas exist in West Ballina: Kalinga Street, Clark/Hogan Street and Smith Drive.

New Development Areas

In recent years new urban subdivisions have proceeded between Lennox Head and East Ballina and north of Ballina at Cumbalum. Areas including the Pacific Pines, Aspect and Elevation estates continue to be developed. New development areas are also proceeding in Wollongbar (residential development) and the industrial estate in North Ballina will provide additional employment lands. The Cumbalum Ridge area, north of Ballina and inland of Lennox Head represents the largest future urban release parcel in the Shire covering approximately 1,450ha.

3.4 Geology and Soils

Ballina Shire occurs on Mesozoic sediments of the Clarence-Moreton Basin, mostly overlain by Tertiary volcanics of the Mt Warning shield volcano. Quaternary (Pleistocene) alluvium is associated with the Richmond River alluvial plain, delta and estuary and similar features on smaller catchments within the Shire. Quaternary quartz sands occur on past and present beaches (Gilbert and Sutherland and David Ardill & Associates, 2002)

Coastal areas include deep Siliceous and Calcareous Sands on the beaches, Podzols and Humus Podzols with the predominantly Pleistocene and Holocene dune systems with Acid Peats in swales. Estuarine areas within the coastal zone contain Solonchaks, Humic Gleys, Dense Clays, as well as Siliceous and Calcareous Sands. Humic Gleys are common in the swamp areas with Prairie Soils and Structured Alluvial Clays occurring on deltaic and back barrier sediments. Potential acid sulfate soils occur through much of the Coastal Plain.

The major soil types throughout the Richmond River Alluvial Plain area include deep, cracking Grey and Brown Clays, Black Earths, Weisenboden, Humic Gleys, Alluvial Clays, Structured Plastic Clays and Alluvial Krasnozems. Earthy sands are also reported to occur within historical stream channels.

The Alstonville Plateau is dominated by krasnozem soils with some Chocolate Soils and Prairie Soils occurring on basalt (Gilbert and Sutherland and David Ardill & Associates, 2002).

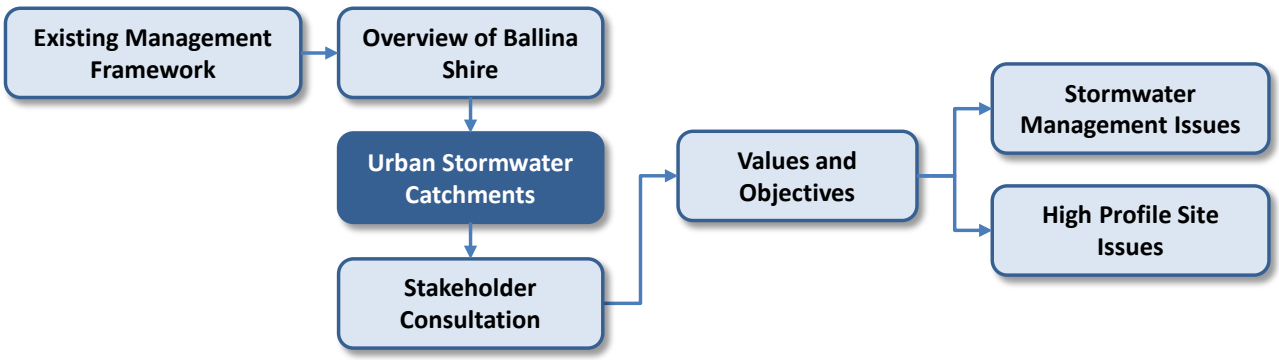
3.5 Cultural Heritage

The Shire contains many sites of spiritual and cultural significance for local communities. Both European and Aboriginal heritage sites and items exist in and around the urban areas and their recognition and protection are important to the local community.

Given the long period of Aboriginal use of the land there are numerous sites that are of Aboriginal heritage significance (e.g. art sites, camp sites, middens, fishing and hunting areas, caves and rock shelters, burial sites, mythological sites and scarred trees).

The study area also contains a wide variety of European cultural heritage items due to the rapid changes in key industries such as forestry and agriculture and the associated transportation networks developed to support the industries, i.e. shipping and then rail. There are many listed heritage items, which occur around the urban centres, e.g. heritage buildings.

4. URBAN STORMWATER CATCHMENTS



This section provides a summary of the major features of the urban stormwater catchments.

4.1 Urban Stormwater Catchments and Management Areas

For the purposes of this USMP, the study area was divided into urban stormwater management areas based on urban stormwater catchments. The management areas serve to break the large study area down into smaller units, and to visualise at a suitable scale the location of stormwater assets in relation to receiving environments and any identified problem areas.

Stormwater sub-catchments were initially defined based on topographic contours. Stormwater assets were then overlain and boundaries of the catchment adjusted accordingly. For example, a stormwater pipe connecting two topographic catchments forms a single stormwater catchment. A total of sixty topographic sub-catchments were identified. These were then grouped into stormwater management areas based on geographic location, land use and receiving environment. Figure 4 provides an overview of all urban stormwater management areas within the Ballina Shire based on the draft 2012 LEP urban zones. Further urban development is expected to occur in the future including the expansion of Cumbalum (Precinct A and B). The outcomes of this USMP should also apply to future (rezoned) urban areas.

The following section presents a map for each stormwater management area and a summary table of key attributes of each area including:

- Location/suburb/estate names;
- Number of topographic sub-catchments within the management area;
- Total area (ha);
- Receiving environments;
- Special features/values;
- Current percentage of urban and non-urban land;
- LEP Zoning (Draft LEP 2012);
- Potential pollution sources;
- SQIDs; and
- Stormwater issues identified.

Stormwater pipes are included on the mapping where available, however, at the time of this report stormwater asset mapping was incomplete and the following maps may not include all stormwater assets in the Shire.

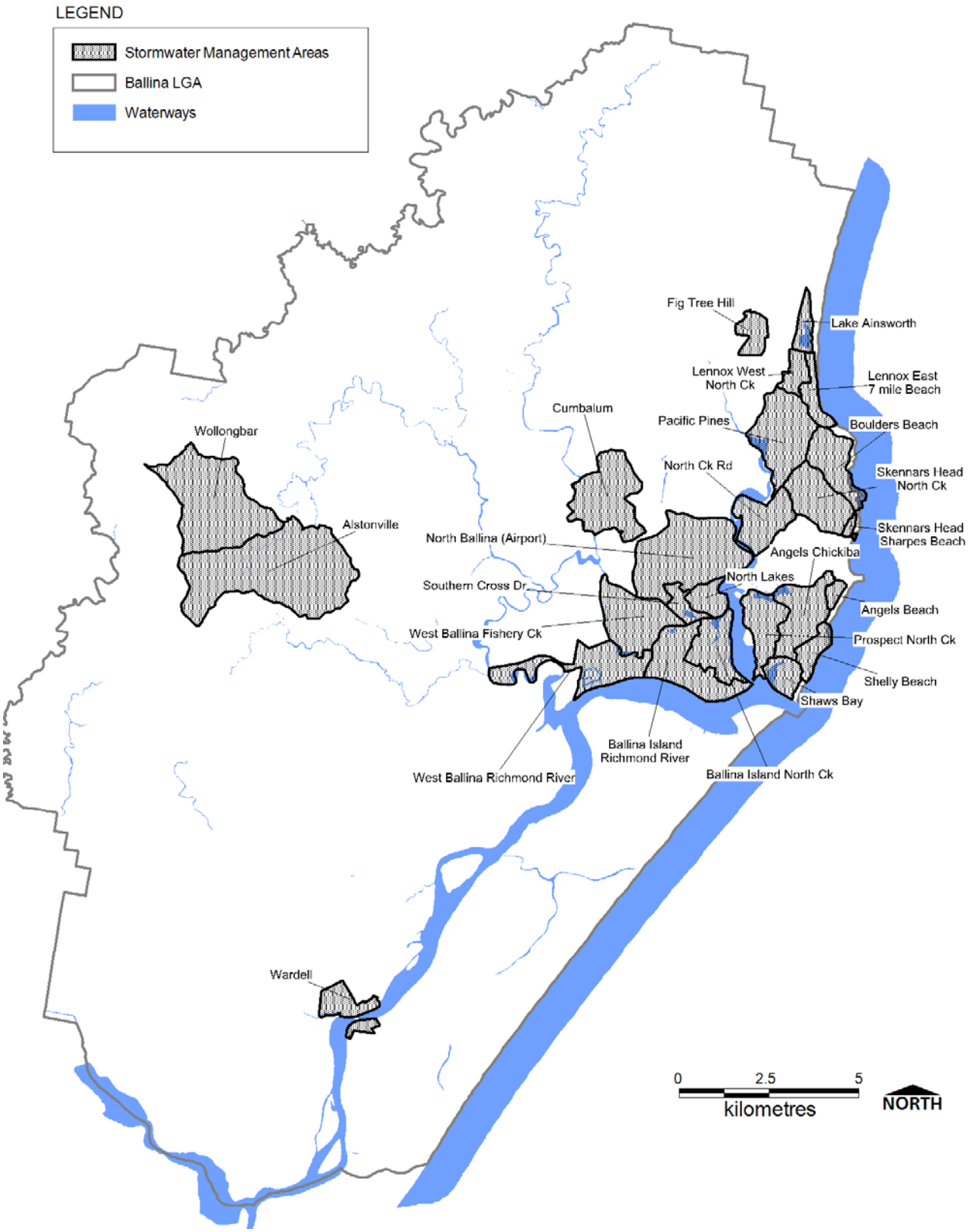


Figure 4: Stormwater Management Areas

Table 3: Wollongbar stormwater management area - summary of key attributes

Stormwater Management Area:	**Wollongbar (ID no. WO01)**
Location/suburb/Estates:	Wollongbar, Alstonville Plateau. Wollongbar Park Estate, Avalon, Kays Lane Industrial Estate
Number of sub-catchments:	2
Total Area:	589 ha
Receiving Environments:	Willowbank Creek, Maguire's Creek, Pearces Creek, Richmond River.
Special features/values:	Urban development areas currently under construction (2011/2012). HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	25% urban, 75% non-urban
LEP Zoning (%)	37% Environmental Management, 21% Primary Production, 16% Low Density Residential, 16% Medium Density Residential, 6% General Industrial, 3% Public Recreation.
Potential pollution sources:	Urban runoff, construction site runoff, agricultural runoff, road runoff, industrial estate
SQIDs:	Mapped: CDS Unit (1),Filter Bag Pit Inserts (20), Sediment Sump (1) From inspection of Avalon: litter baskets, rock-lined swales, rock-lined/grassed detention basin and gabion wall outlet
Stormwater issues identified:	• Stormwater system functioning well overall. Some minor wash out of mulch observed at Avalon from between rock and some weed encroachment.

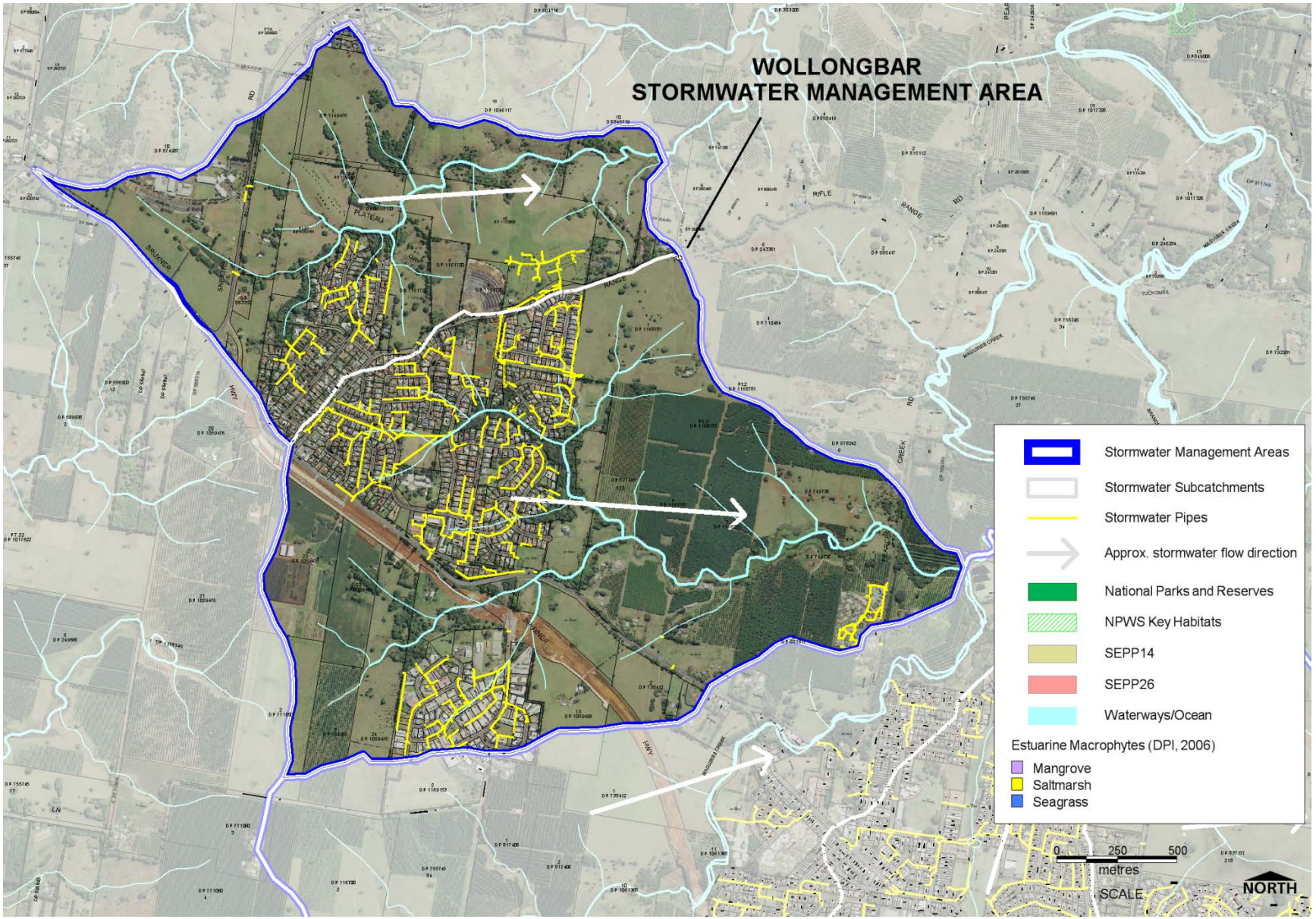


Figure 5: Wollongbar stormwater management area

Table 4: Alstonville stormwater management area - summary of key attributes

Stormwater Management Area:	**Alstonville (ID no. AL01)**
Location/suburb/Estates:	Alstonville Plateau.
Number of sub-catchments:	2
Total Area:	876 ha
Receiving Environments:	Maguire's Creek, Branch Creek, Richmond River
Special features/values:	HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	40% urban, 60% non-urban
LEP Zoning (Draft LEP 2012) (%)	37% Environmental Management, 26% Primary Production, 24% Low Density Residential, 5% Medium Density Residential, 1% General Industrial, 6% Public Recreation, 1% Local Centre, 1% Infrastructure.
Potential pollution sources:	Urban runoff, agricultural runoff, road runoff (bypass)
SQIDs	Mapped: Filter Bag Pit Inserts (4), Sediment Sump (2)
Stormwater Issues identified:	• Tanamera drain historical issues and maintenance difficulties increasing flooding risk to adjacent properties. Possibly exacerbated by bypass detention ponds upstream.

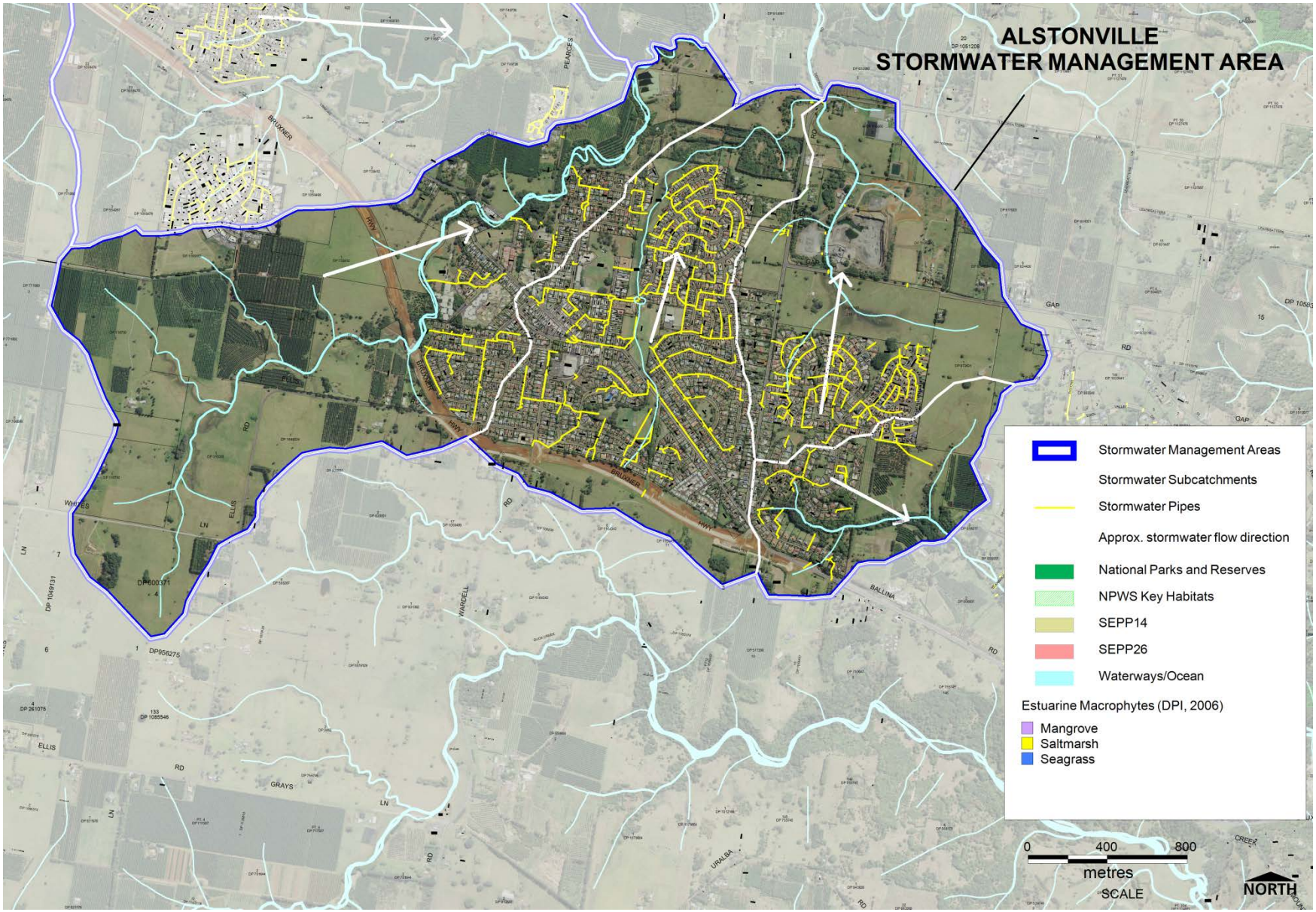


Figure 6: Alstonville stormwater management area

Table 5: Fig Tree Hill stormwater management area - summary of key attributes

Stormwater Management Area:	**Fig Tree Hill (ID no. LE01)**
Location/suburb/Estates:	Ross Lane, Lennox Head. Fig Tree Hill, Sanctuary Village
Number of sub-catchments:	4
Total Area:	80 ha
Receiving Environments:	Cane drains, North Creek, coastal heath (SEPP14) to the east
Special features/values:	SEPP14 wetlands, NPWS Key Habitat, HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	20% urban, 80% non-urban
LEP Zoning (%)	37% Environmental Conservation, 36% Primary Production, 27% Rural Landscape
Potential pollution sources:	Urban runoff, agricultural runoff, road runoff
SQIDs:	None mapped
Site inspection notes	None mapped. Site inspection- curb and guttering, SW drains on north side of estate, none on southern side.
Stormwater Issues identified:	• No stormwater assets on southern side of estate. Some minor erosion observed on roadside and private property.

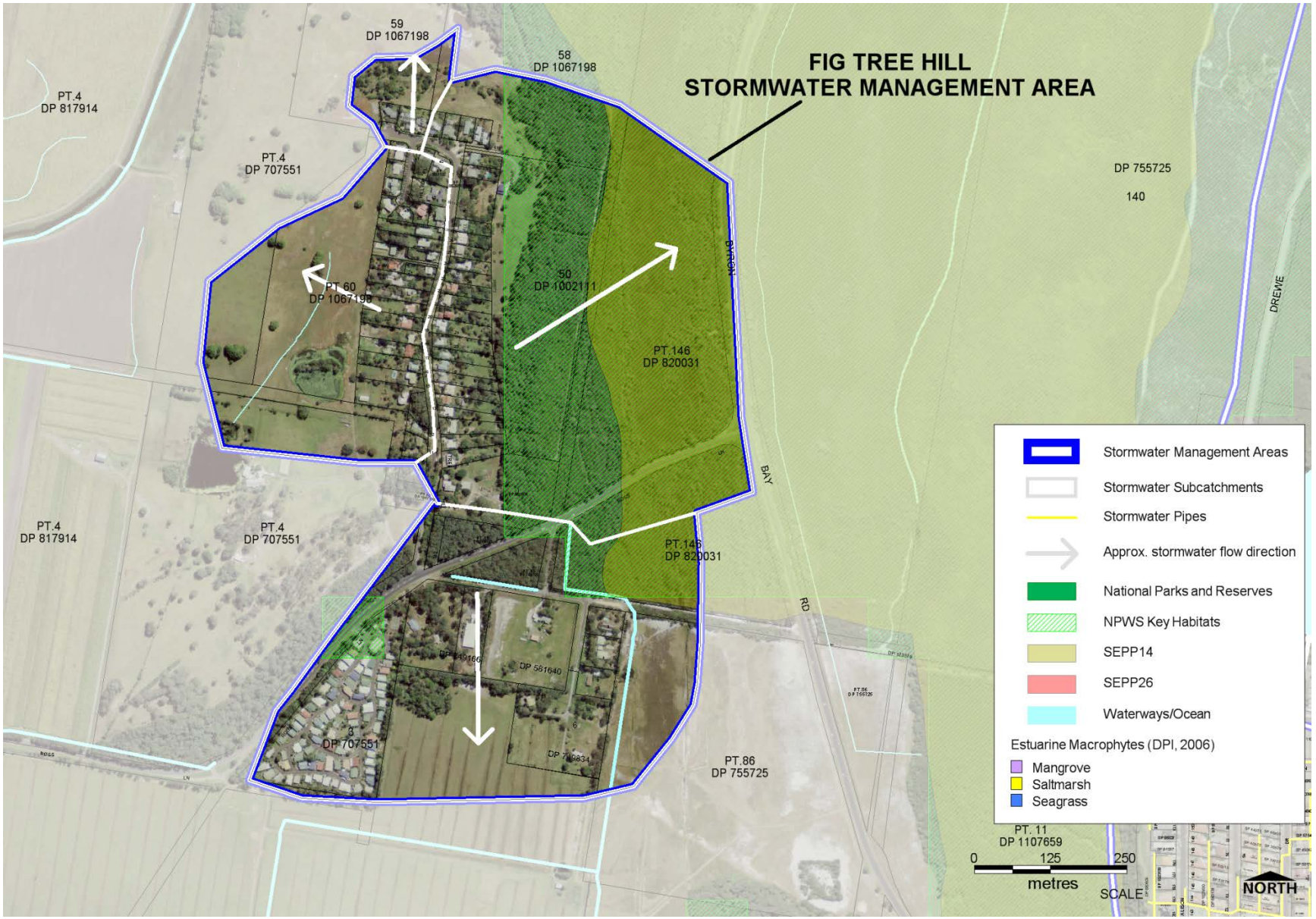


Figure 7: Fig Tree Hill stormwater management area

Table 6: Lake Ainsworth stormwater management area - summary of key attributes

Stormwater Management Area:	**Lake Ainsworth (ID no. LE02)**
Location/suburb/Estates:	North Lennox Head. Includes: Lennox Head Caravan Park, Surf Club and Sports and Recreation Centre
Number of sub-catchments:	1
Total Area:	63 ha
Receiving Environments:	Lake Ainsworth (freshwater, tannin stained lake)
Special features/values:	Recreational swimming, boating, fishing, scenic amenity, tourism, NPWS Key Habitat, HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	10% urban, 90% non-urban
LEP Zoning (%)	91% Environmental Conservation, 9% Public Recreation.
Potential pollution sources:	Urban runoff, road runoff, litter
SQIDs:	None mapped
Stormwater Assets:	None mapped. Inspection: grassed swales, pits/grates, outlets covered by vegetation
Stormwater Issues identified:	• On-going water quality issues in lake including nutrient enrichment and periodic blue green algae blooms. • Runoff from the Caravan Park identified as potential source of pollutants to Lake.

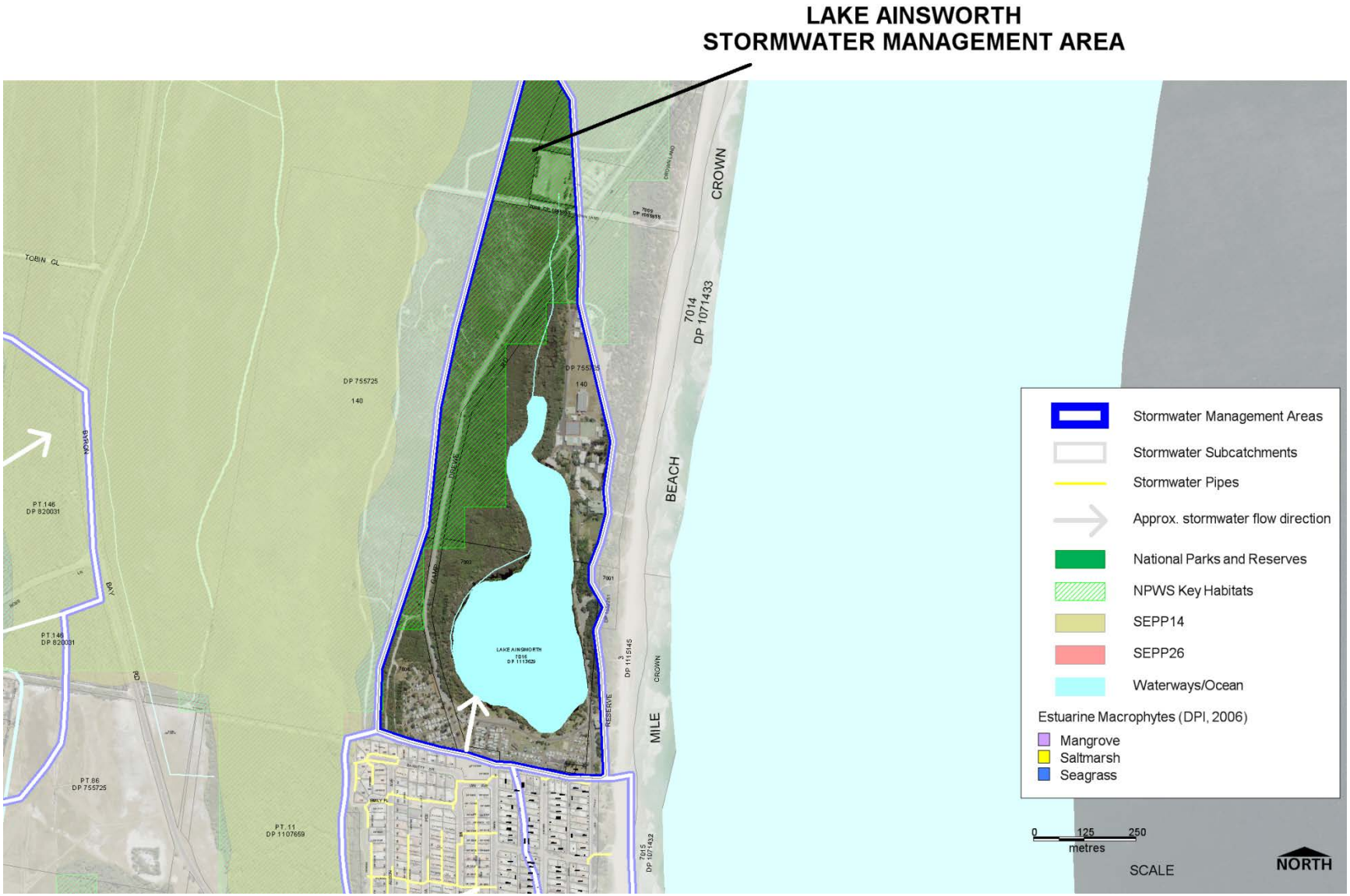


Figure 8: Lake Ainsworth stormwater management area

Table 7: Lennox Head Seven Mile Beach stormwater management area - summary of key attributes

Stormwater Management Area:	**Lennox East Seven Mile Beach (ID no. LE03)**
Location/suburb/Estates:	Lennox Head draining to Seven Mile Beach, Town Centre
Number of sub-catchments:	1
Total Area:	77 ha
Receiving Environments:	Seven Mile Beach, Pacific Ocean, Cape Byron Marine Park
Special features/values:	Cape Byron Marine Park: The Mote/Bream Hole Sanctuary Zone, and the Seven Mile Beach Habitat Protection Zone. Lennox Head Surfing Reserve (from Lennox Surf Club to Flat Rock), scenic amenity, recreational swimming, boating, fishing, walking, tourism. Coastal erosion. HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	25% urban, 75% non-urban
LEP Zoning (%)	5% Environmental Management, 34% Environmental Conservation, 1% Low Density Residential, 46% Medium Density Residential, 8% Local Centre, 7% Public Recreation.
Potential pollution sources:	Urban runoff, road runoff.
SQIDs:	Mapped: Filter Bag Pit Inserts (3), Sediment Pit (2), Sock on 450mm Discharge Pipe (6), Sock on 600mm Discharge Pipe (1)
Stormwater Issues identified:	• Stormwater drains contributing to erosion at beach front, unsightly drains on beach. • Outlets on beach cracked and leaking, causing further destabilization and erosion • Stormwater ponding at back of dunes at end of Rutherford St. • Stormwater impacts on The Mote/Bream Hole Sanctuary Zone and the Seven Mile Beach Habitat Protection Zone. • Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall.

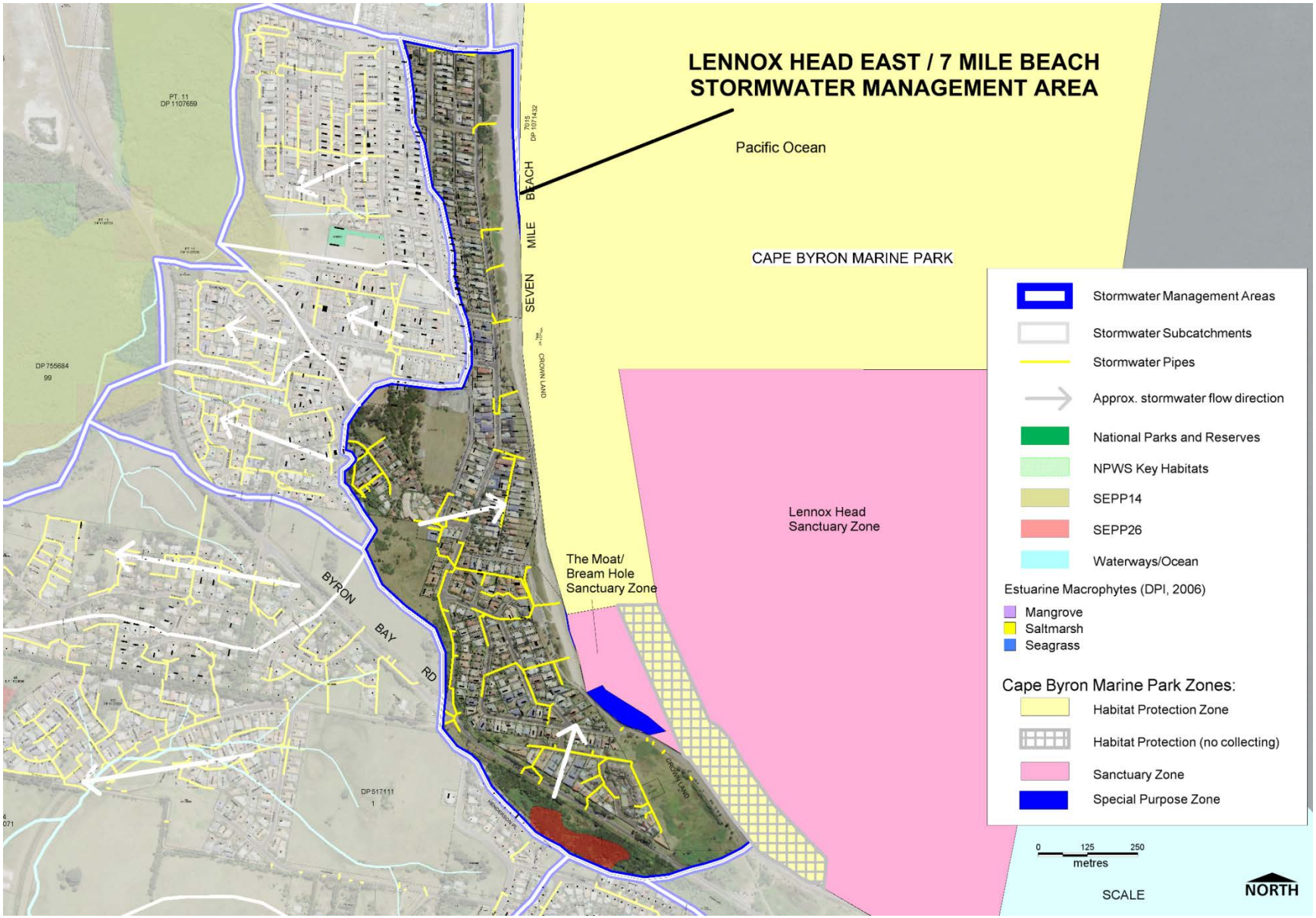
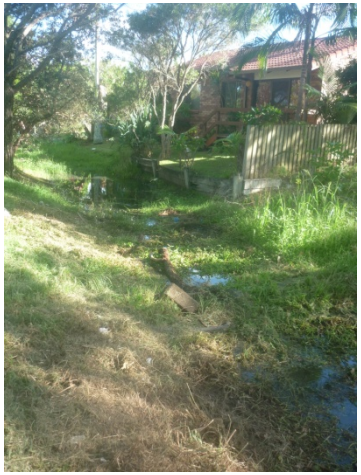


Figure 9: Lennox Head East stormwater management area

Table 8: Lennox Head West North Creek stormwater management area - summary of key attributes

Stormwater Management Area:	**Lennox West North Creek (ID no. LE04)**
Location/suburb/Estates:	Lennox Head draining west
Number of sub-catchments:	4
Total Area:	68 ha
Receiving Environments:	Coastal Wetlands, North Creek
Special features/values:	SEPP14, NPWS Key Habitat, Aboriginal Bora Ring Reserve, HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	90% urban, 10% non-urban
LEP Zoning (%)	10% Environmental Conservation, 1% Environmental Management, 28% Low Density Residential, 54% Medium Density Residential, 4% Private Recreation, 2% Rural Landscape.
Potential pollution sources:	Urban runoff, road runoff
SQIDs:	Mapped: Filter Bag Pit Inserts (1), Sediment Basin (1), Trash Racks (4)
Stormwater Issues identified:	• Ponding of stormwater after heavy rainfall at Lennox St. and Park Lane (inadequate drainage) • Some stormwater drains overgrown with vegetation (due to lack of regular maintenance) and now has habitat values and/or mapped SEPP14 requiring environmental assessment (e.g. REF) before maintenance work can be done. • Williams Reserve drain receives stormwater discharge and ponding occurs here. Places properties at risk, and risk to public safety. • Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall.



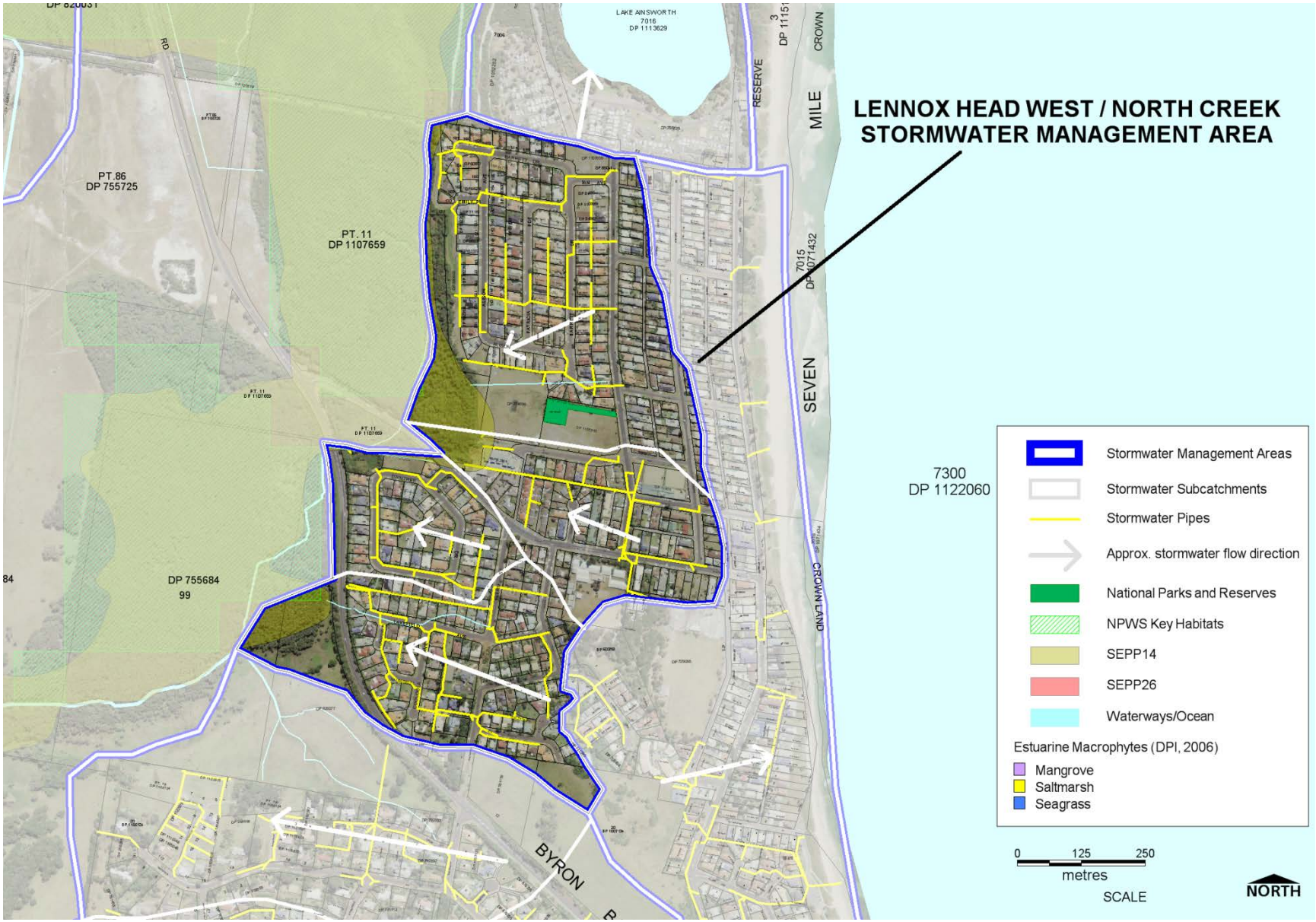


Figure 10: Lennox Head West North Creek stormwater management area

Table 9: Boulders Beach stormwater management area - summary of key attributes

Stormwater Management Area:	**Boulders Beach (ID no. LE05)**
Location/suburb/Estates:	Lennox Head east of North Creek Rd and draining to Boulders Beach. Includes Blue Seas Parade, Survey St, Amber Dr, Sandstone Crescent and Coastal Grove development area.
Number of sub-catchments:	2
Total Area:	170 ha
Receiving Environments:	Coastal Wetlands, Boulders Beach, Pacific Ocean
Special features/values:	SEPP26, NPWS Key Habitat, Lennox Head Surfing Reserve, scenic amenity, recreational swimming, boating, fishing, walking, tourism. HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	15% urban, 85% non-urban
LEP Zoning (%)	57% Environmental Conservation, 16% Environmental Management, 1% Primary Production, 24% Low Density Residential, 2% Public Recreation.
Potential pollution sources:	Urban runoff, construction site runoff, road runoff.
SQIDs:	None mapped
Stormwater Issues identified:	• Coastal Grove development approved under Infrastructure SEPP

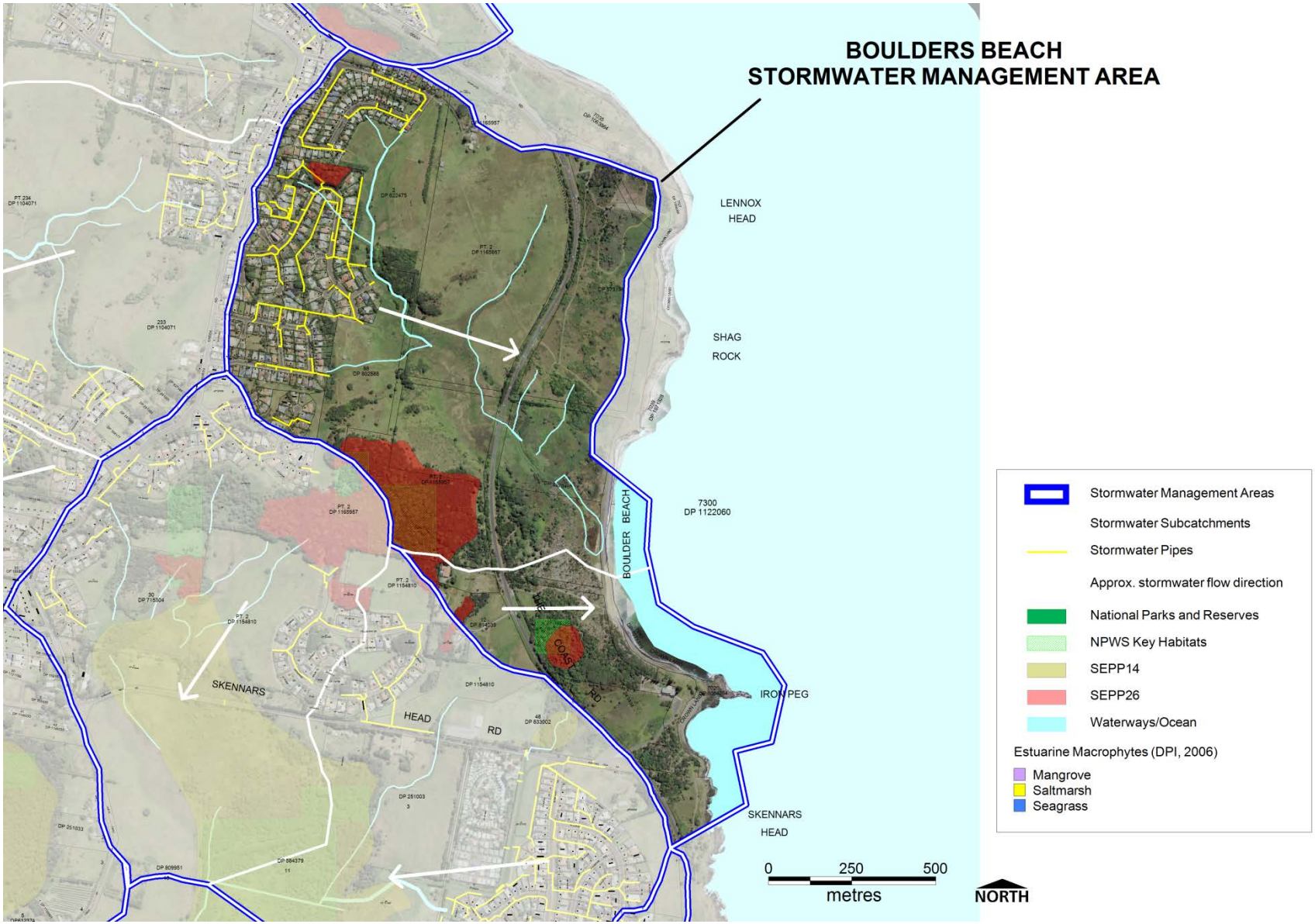


Figure 11: Boulders Beach stormwater management area

Table 10: Pacific Pines stormwater management area - summary of key attributes

Stormwater Management Area:	**Pacific Pines (ID no. LE06)**
Location/suburb/Estates:	Lennox Head estates west of North Creek Rd including: The Meadows, Pacific Pines and Aspect
Number of sub-catchments:	4
Total Area:	314 ha
Receiving Environments:	North Creek
Special features/values:	SEPP14, SEPP26, Mangroves, NPWS Key Habitat, HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	50% urban, 50% non-urban
LEP Zoning (%)	4% Environmental Conservation, 2% Environmental Management, 16% Primary Production, 33% Low Density Residential, 30% Medium Density Residential, 4% Public Recreation, 4% Rural Landscape, 6% National Parks and Nature, 1% Neighbourhood Centre.
Potential pollution sources:	Urban runoff, construction site runoff, road runoff
SQIDs:	None mapped From inspection of Aspect: Litter baskets/pits, small wetland area Pacific Pines: Water quality control pond
Stormwater Issues identified:	• Algal blooms and poor water quality episodes at Pacific Pines pond

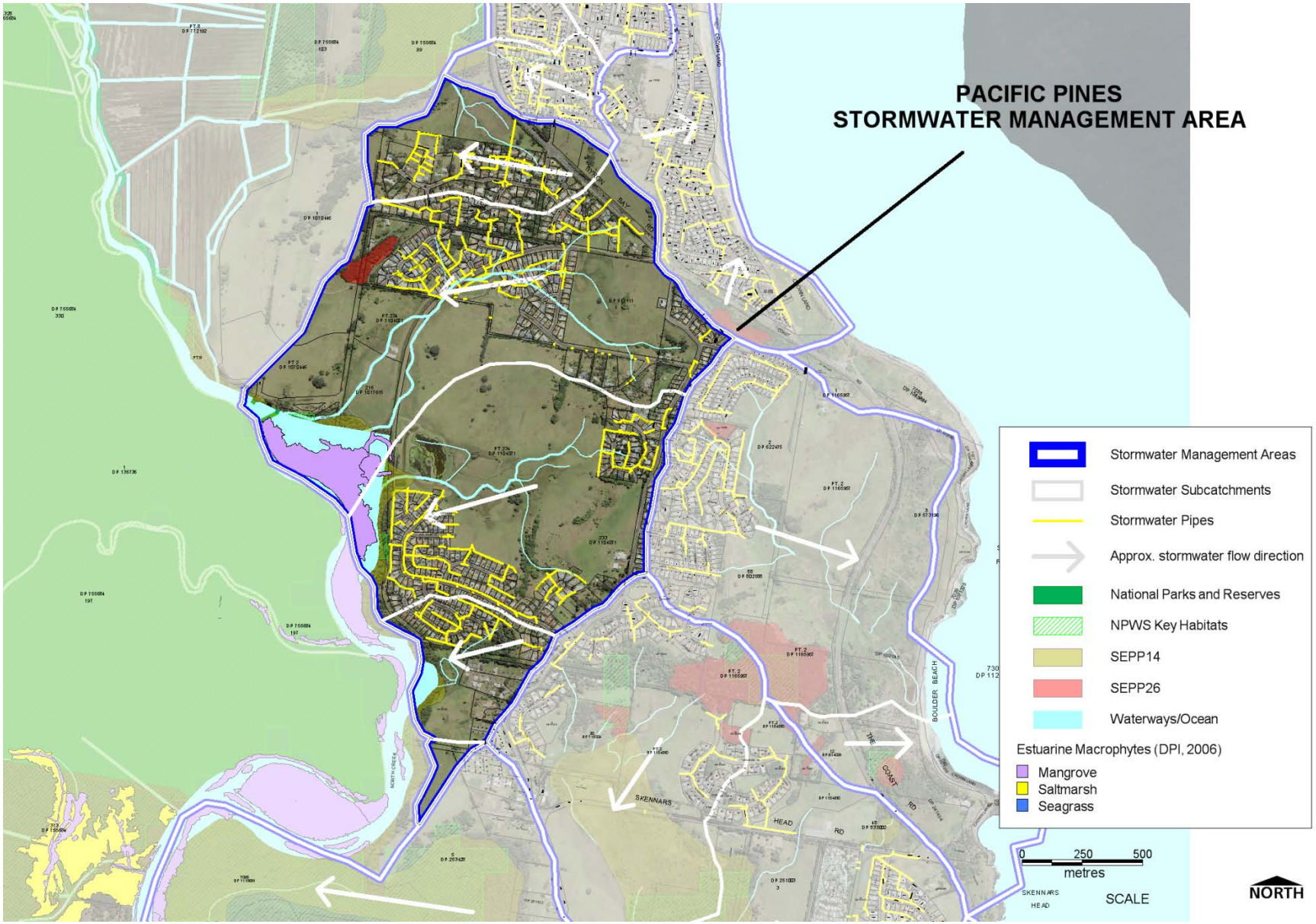


Figure 12: Pacific Pines stormwater management area

Table 11: Skennars Head stormwater management area summary of key attributes

Stormwater Management Area:	**Skennars Head (ID no. LE07)**
Location/suburb/Estates:	Tara Downs, Castle Dr, Palisade Way, Headlands Estate draining SW
Number of sub-catchments:	2
Total Area:	223 ha
Receiving Environments:	Coastal Wetlands, North Creek
Special features/values:	SEPP14, SEPP26, NPWS Key Habitat, Headlands Leisure Park, HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	40% urban, 60% non-urban
LEP Zoning (%)	35% Environmental Conservation, 4% Environmental Management, 17% Primary Production, 27% Low Density Residential, 4% Medium Density Residential, 8% Rural Landscape, 4% Public Recreation.
Potential pollution sources:	Urban runoff, construction site runoff, road runoff
SQIDs:	Mapped: Filter Bag Pit Inserts (6)
Stormwater Issues identified:	• Phragmites blocking open drain adjacent to Headlands Leisure Park exacerbating localized flooding issues. Maintenance of the drain difficult and bush hen habitat now established (Vulnerable species under TSC Act 1995) requiring environmental assessment (e.g. REF) before maintenance work can be done.

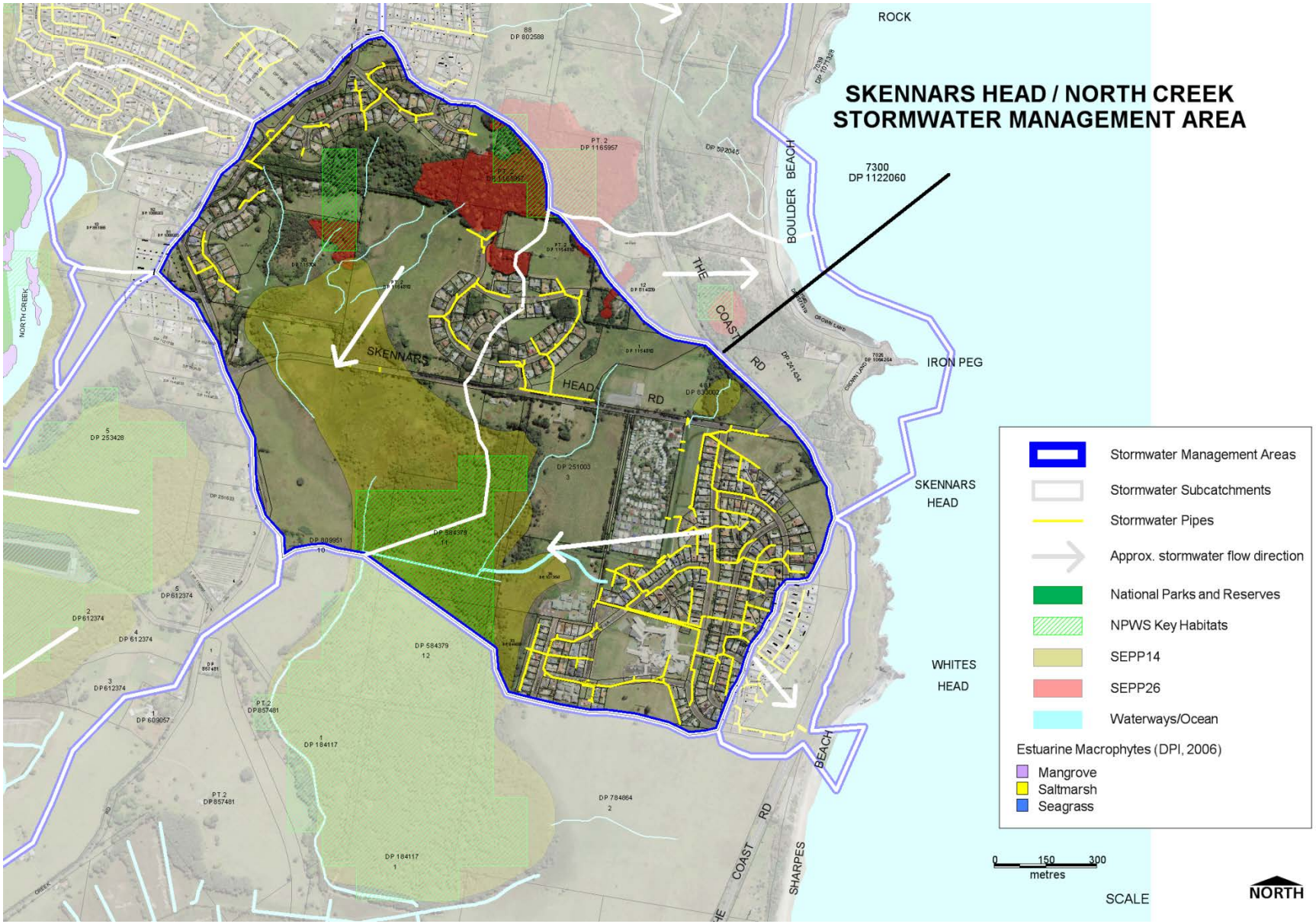


Figure 13: Skennars Head / North Creek stormwater management area

Table 12: Skennars Head, Sharpes Beach stormwater management area - summary of key attributes

Stormwater Management Area:	**Skennars Head, Sharpes Beach (ID no. LE08)**
Location/suburb/Estates:	Headlands Estate draining to Sharpes Beach
Number of sub-catchments:	1
Total Area:	15 ha
Receiving Environments:	Sharpes Beach, Pacific Ocean
Special features/values:	Lennox Head Surfing Reserve, scenic amenity, recreational swimming, boating, fishing, walking, tourism. HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	25% urban, 75% non-urban
LEP Zoning (%)	45% Environmental Management, 20% Environmental Conservation, 1% Primary Production, 27% Low Density Residential, 7% Medium Density Residential
Potential pollution sources:	Urban runoff, road runoff
SQIDs:	None Mapped
Stormwater Issues identified:	• No issues identified

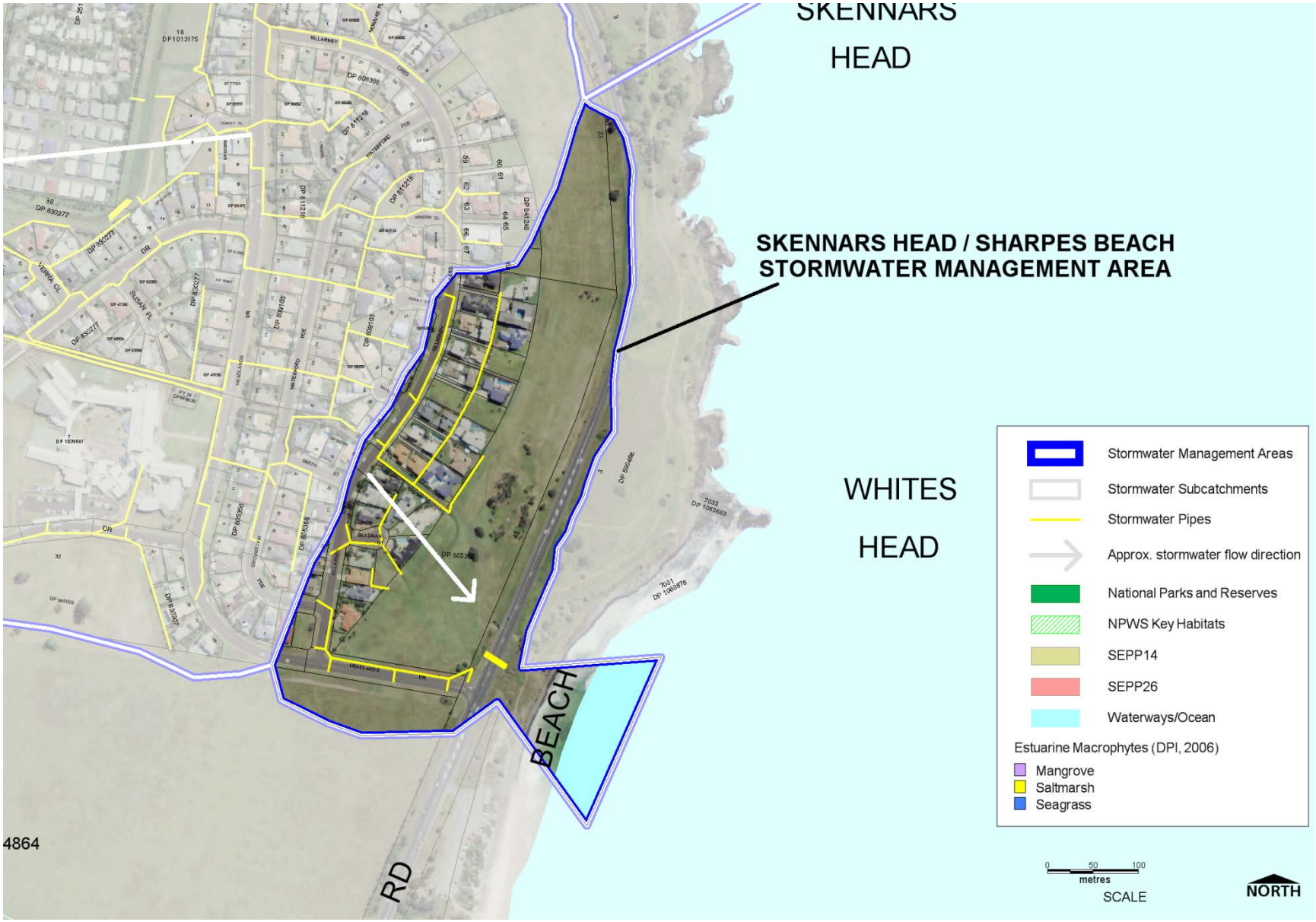


Figure 14: Skennars Head / Sharpes Beach stormwater management area

Table 13: North Creek stormwater management area - summary of key attributes

Stormwater Management Area:	**North Creek Rd (ID no. LE09)**
Location/suburb/Estates:	West of North Creek Road including small areas of urban estates (Elevation) and Lennox Head Reclaimed Water Facility.
Number of sub-catchments:	1
Total Area:	192 ha
Receiving Environments:	North Creek
Special features/values:	SEPP14, NPWS Key Habitat, mangroves, saltmarsh, scenic amenity, recreational swimming, boating, fishing, walking, tourism, designated oyster lease areas downstream. HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	5% urban, 95% non-urban
LEP Zoning (%)	57% Environmental Conservation, 1% Environmental Management, 27% Primary Production, 5% Infrastructure, 5%Local Centre, 4% Natural Waterways, 1% National Parks and Nature
Potential pollution sources:	Urban runoff, construction site runoff (Elevation), agricultural runoff, road runoff
SQIDs:	None mapped From inspection at Elevation: Litter baskets/pits, detention basin with energy dissipater, gabion wall weir.
Stormwater Assets:	
Stormwater Issues identified:	• Resident complaint (in survey) about stormwater holding pond at Elevation being polluted by construction activities and odour issues. • Impacts of stormwater on oyster lease areas directly downstream

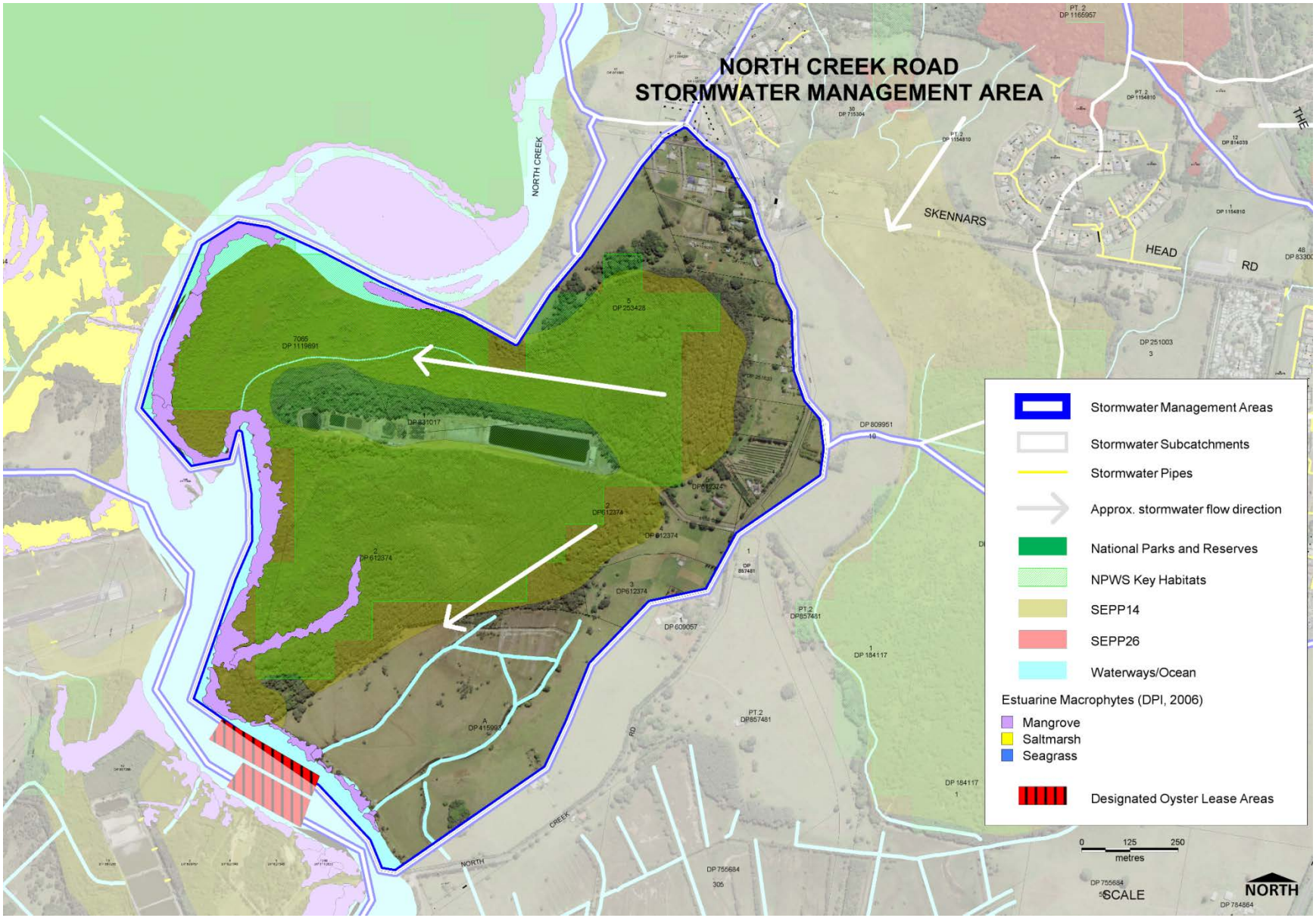


Figure 15: North Creek Road stormwater management area

Table 14: North Ballina stormwater management area - summary of key attributes

Stormwater Management Area:	**North Ballina (Airport) (ID no. NO01)**
Location/suburb/Estates:	Part of Southern Cross Drive Industrial Estate draining to North Creek including Harvey Norman Centre, Ballina Airport, Rubbish Tip.
Number of sub-catchments:	1
Total Area:	142 ha
Receiving Environments:	North Creek
Special features/values:	SEPP14, NPWS Key Habitat, Mangroves, Seagrass, Saltmarsh, Ballina Aquaculture area (now closed?). Scenic amenity, recreational swimming, boating, fishing, walking, tourism. Designated oyster lease areas downstream. HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	5% urban, 95% non-urban
LEP Zoning (%)	27% Environmental Conservation, 1% Environmental Management, 4% Low Density Residential, 1% Medium Density Residential, 7% General Industrial, 22% Infrastructure, 1% Public Recreation, 35% Rural Landscape, 2%Natural Waterways.
Potential pollution sources:	Urban runoff, construction site runoff, road runoff, industrial estate
SQIDs:	None Mapped Inspection Harvey Norman Centre: Open drain/infiltration basin, rock-lined outlet.
Stormwater Issues identified:	• Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall. • RTA borrow pit water quality issues • Harvey Norman Centre open drain/infiltration basin has never drained completely when it is designed to drain. Litter and weeds accumulate and it's difficult to maintain. • Concerns about safety due to open water pond with no fencing at Harvey Norman drain • Impacts of stormwater on oyster lease areas directly downstream

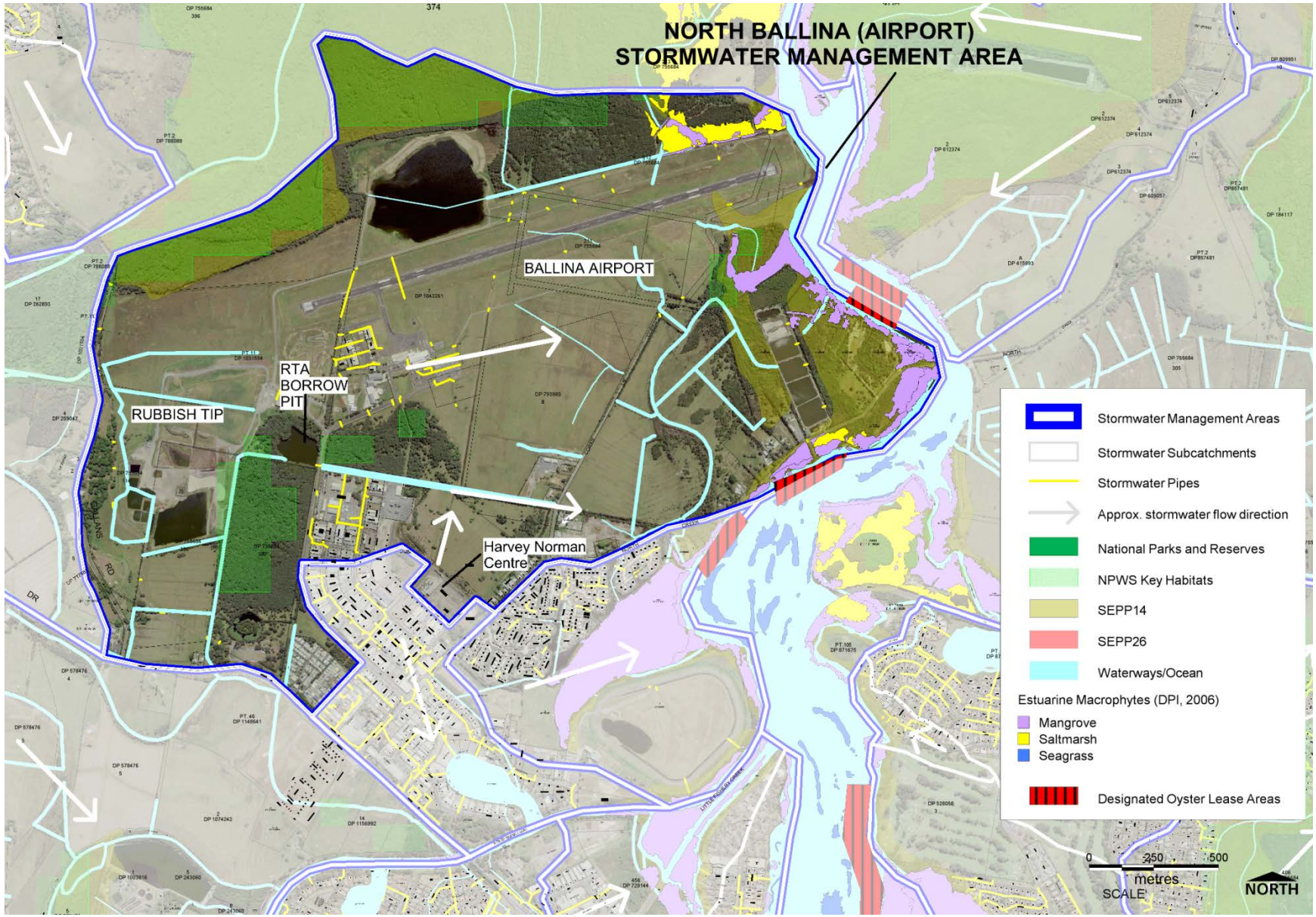


Figure 16: North Ballina (Airport) stormwater management area

Table 15: North Lakes / Ballina Racecourse stormwater management area - summary of key attributes

Stormwater Management Area:	**North Lakes / Ballina Racecourse (ID no. NO02)**
Location/suburb/Estates:	North Lakes housing estate, Ballina Racecourse
Number of sub-catchments:	1
Total Area:	85 ha
Receiving Environments:	North Creek, Fishery Creek
Special features/values:	SEPP14, Mangroves, Seagrass, scenic amenity, recreational swimming, boating, fishing, walking, tourism, designated oyster lease areas downstream
Current % urban to non-urban land	75% urban, 25% non-urban (approx.)
LEP Zoning (%)	27% Environmental Conservation, 15% Low Density Residential, 3% Medium Density Residential, 4% General Industrial, 38% Public Recreation, 8% Rural Landscape, 5% Natural Waterways. HCV Vegetation (BSC Mapping)
Potential pollution sources:	Urban runoff, road runoff, industrial estate
SQIDs:	None Mapped. Man Plan: Grassed swales conveying stormwater to a series of interconnected stormwater ponds/lakes. An embankment wall with constructed weir overflow and reverse flow gate allow interaction with adjoining wetland and creek. One trash rack/GPT is installed.
Stormwater Issues identified:	• On-going water quality issues, including algal blooms and odours, fish kills, red spot disease etc. The management plan attributes water quality issues to lack of adequate water exchange between lakes and North Creek (tidal exchange). • Maintenance difficulties of grassed swales and around lake itself. Access issues around the lake prevent adequate maintenance occurring. • Grass swales have very low grade and do not drain adequately, often being water logged and unable to be mowed. • Weeds and bank erosion around lakes. • The North Lakes Water Quality Management Plan provides management actions but needs funding to implement. • Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall. • Impacts of stormwater on oyster lease areas directly downstream

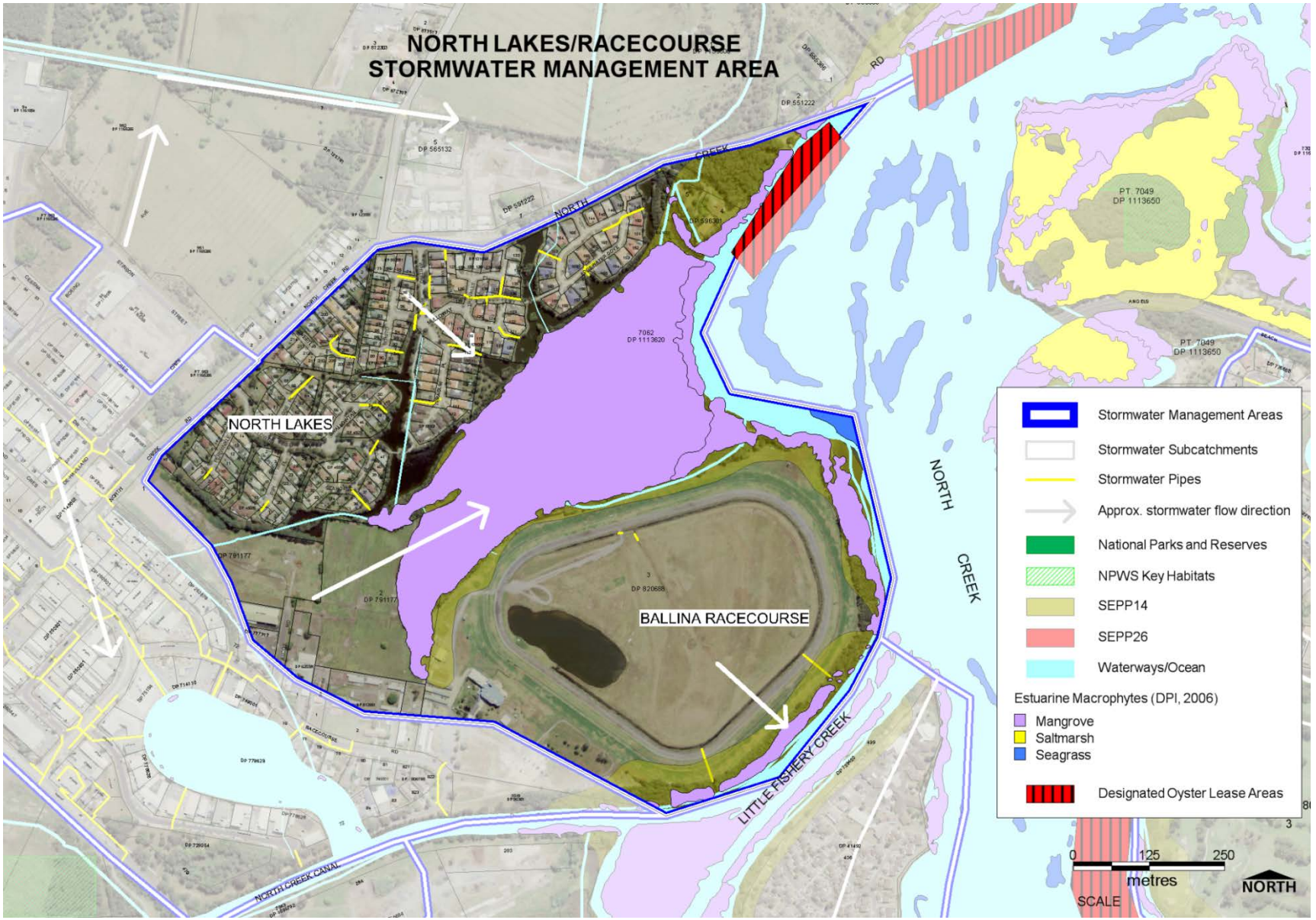


Figure 17: North Lakes / Racecourse stormwater management area

Table 16: Southern Cross Drive stormwater management area - summary of key attributes

Stormwater Management Area:	**Southern Cross Drive (ID no. NO03)**
Location/suburb/Estates:	Southern Cross Drive Industrial Estate
Number of sub-catchments:	1
Total Area:	63 ha
Receiving Environments:	Fishery Creek Canal, North Creek
Special features/values:	Industrial Estate / Commercial hub. Scenic amenity, recreational swimming, boating, fishing. Small area SEPP14. Downstream environments include designated oyster lease areas, Mangroves and Seagrass areas.
Current % urban to non-urban land (approx.)	85% urban, 15% non-urban
LEP Zoning (%)	5% Environmental Conservation, 8% Medium Density Residential, 67% General Industrial, 7% Public Recreation, 2% Rural Landscape, 9% Recreational Waterways, 1% Neighbourhood Centre
Potential pollution sources:	Urban runoff, road runoff, industrial estate
SQIDs:	None Mapped
Stormwater Issues identified:	• Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall. • Impacts of stormwater on oyster lease areas

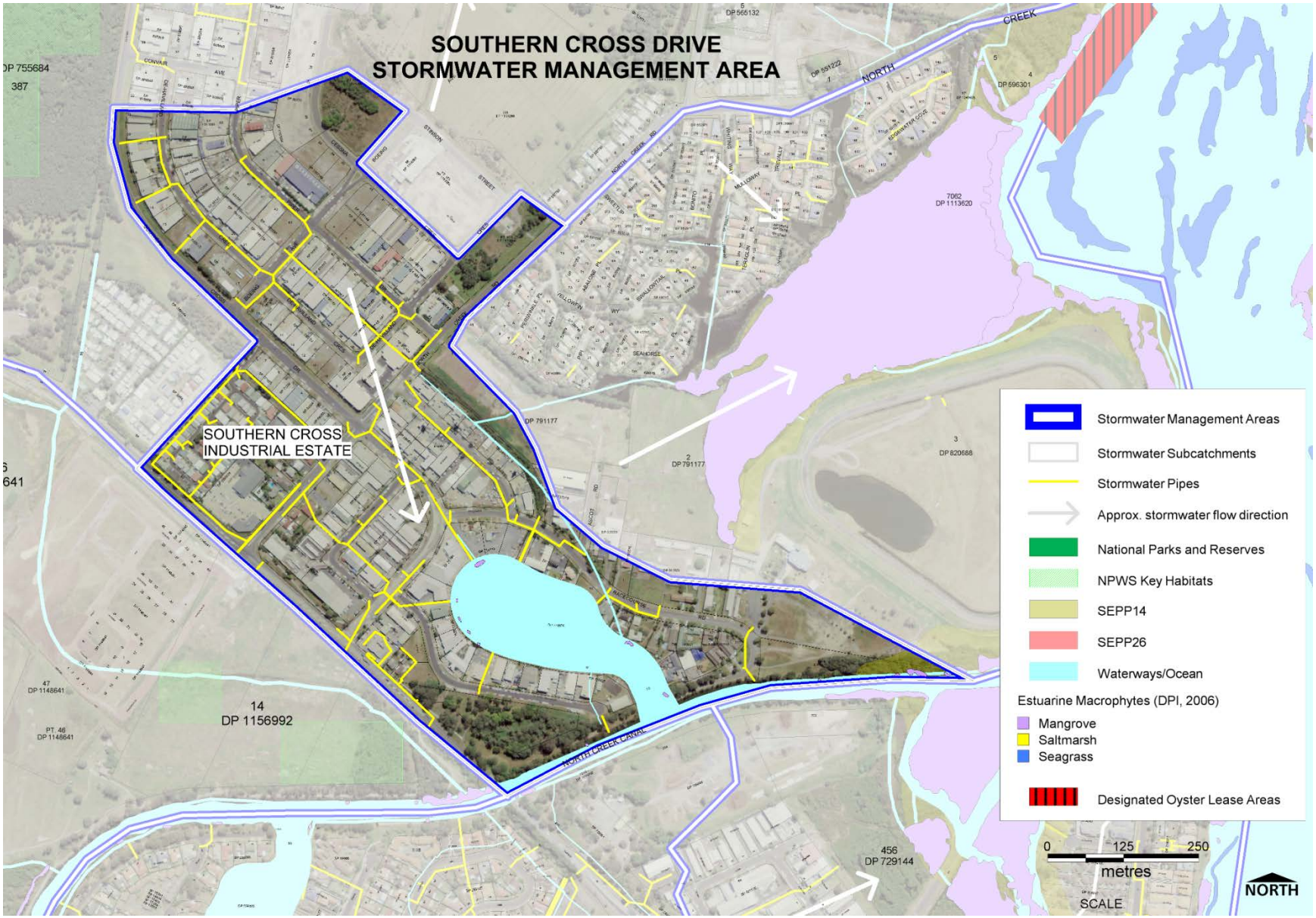


Figure 18: Southern Cross Drive stormwater management area

Table 17: Cumbalum stormwater management area - summary of key attributes

Stormwater Management Area:	**Cumbalum (ID no. CU01)**
Location/suburb/Estates:	Cumbalum
Number of sub-catchments:	3
Total Area:	589 ha
Receiving Environments:	Draining East and South: Roberts Creek, Deadmans Creek, Newrybar Swamp. Draining North and South: Emigrant Creek, Richmond River.
Special features/values:	Ballina Nature Reserve/Newrybar Swamp, SEPP14, NPWS Key Habitat. HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	20% urban, 80% non-urban
LEP Zoning (%)	5% Environmental Conservation, 30% Primary Production, 11% Low Density Residential, 33% Medium Density Residential, 1% Public Recreation, 2% Local Centre, 15% Rural Landscape, 2% Natural Waterways
Potential pollution sources:	Urban runoff, construction site runoff, agricultural runoff, road runoff
SQIDs:	Filter Bag Pit Inserts (110), pools, riffles and swales (some rock-lined), Water quality control pond
Stormwater Issues identified:	• Weeds observed in rock-lined channels. Maintenance difficult due to access slopes and rocks.

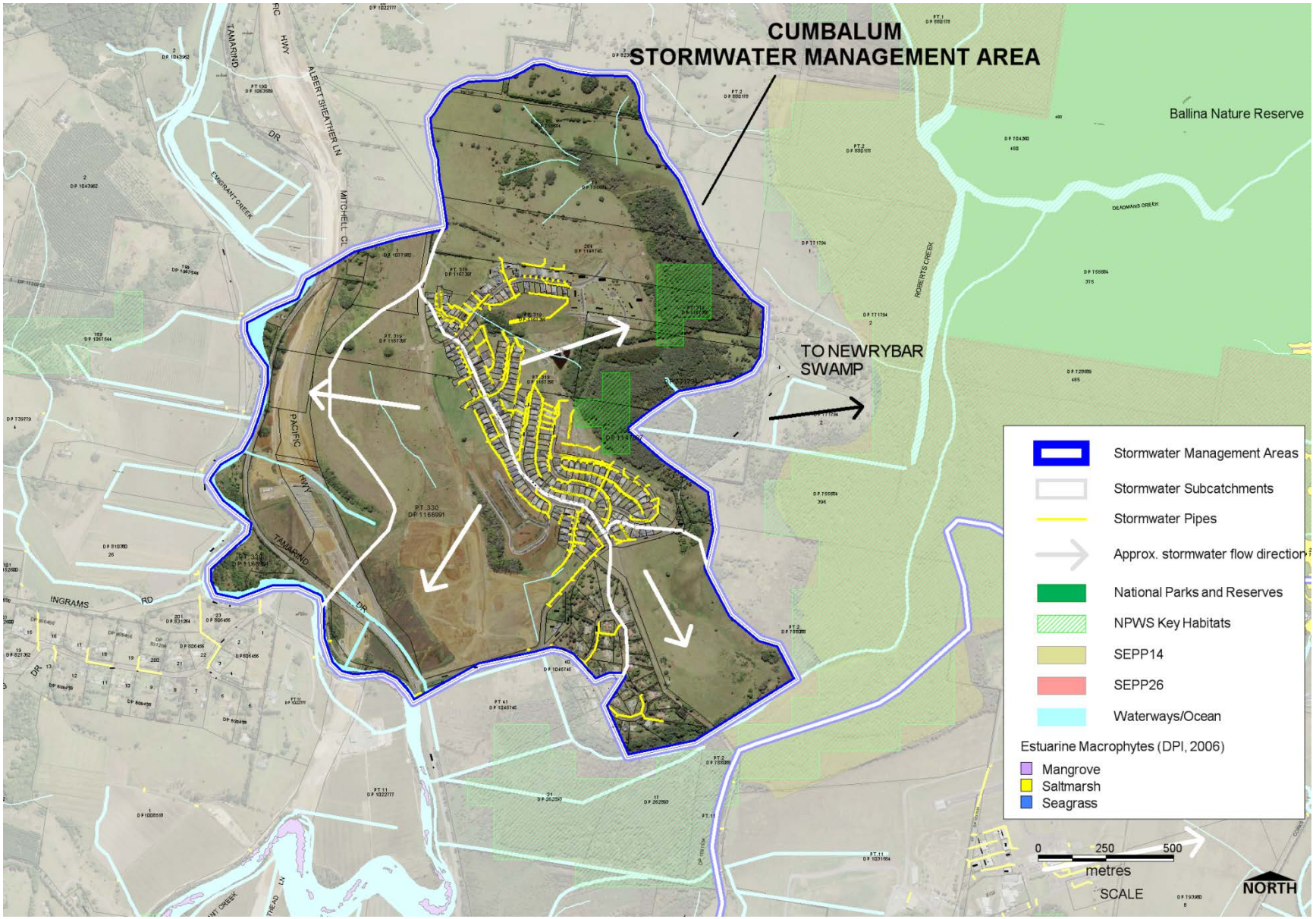


Figure 19: Cumbalum stormwater management area

Table 18: Angels Beach Chickiba stormwater management area - summary of key attributes

Stormwater Management Area:	**Angels Beach Chickiba (ID no. EA01)**
Location/suburb/Estates:	East Ballina including Angels Beach North, Silvergull Dr, Chickiba, Bel Air and Rainforest Ridge estates
Number of sub-catchments:	5
Total Area:	299 ha
Receiving Environments:	Chickiba Wetlands, Chickiba Lake, North Creek
Special features/values:	SEPP14, NPWS Key Habitat, Mangroves and Saltmarsh downstream, Bird habitat/roosting area at Chickiba Lakes, scenic amenity, recreational swimming, boating, fishing, walking, tourism, designated oyster lease areas downstream. HCV Vegetation (BSC Mapping)
Current % urban to non-urban land	45% urban, 55% non-urban (approx.)
LEP Zoning (%)	54% Environmental Conservation, 25% Low Density Residential, 14% Medium Density Residential, 5% Public Recreation, 1% Rural Landscape.
Potential pollution sources:	Urban runoff
SQIDs:	Filter Bag Pit Inserts (30) Gross Pollutant Trap (2)
Stormwater Issues identified:	• Construction of Chickiba wetland at outlet near Angels Beach drive prevents proper drainage and can cause flooding. High water levels identified as cause of *M. quin* dieback and general wetland health decline. Tidal inflows to Chickiba Wetlands • Chickiba Sports fields inappropriately located. They interfere with stormwater flows to detriment of field and surrounding environment • Water-borne pollutants (including roadside rubbish and chemical runoff) from urban land is frequently washed into natural bushland areas via stormwater (either uncontrolled or via drains without pollutant traps) • Endangered Swamp Orchid *Phaius Australia* believed to be under threat from contamination due to pollutant runoff from urban areas. • Transport of weed propagules (seeds, roots, tubers etc.) via stormwater to receiving environments. • Creation of conditions suitable for weed growth at stormwater outlets (frequently watered and fertilised environment) • Many sites experience scouring, erosion, gullying and sedimentation from uncontrolled runoff during heavy rainfall events from urban areas to bushland sites.

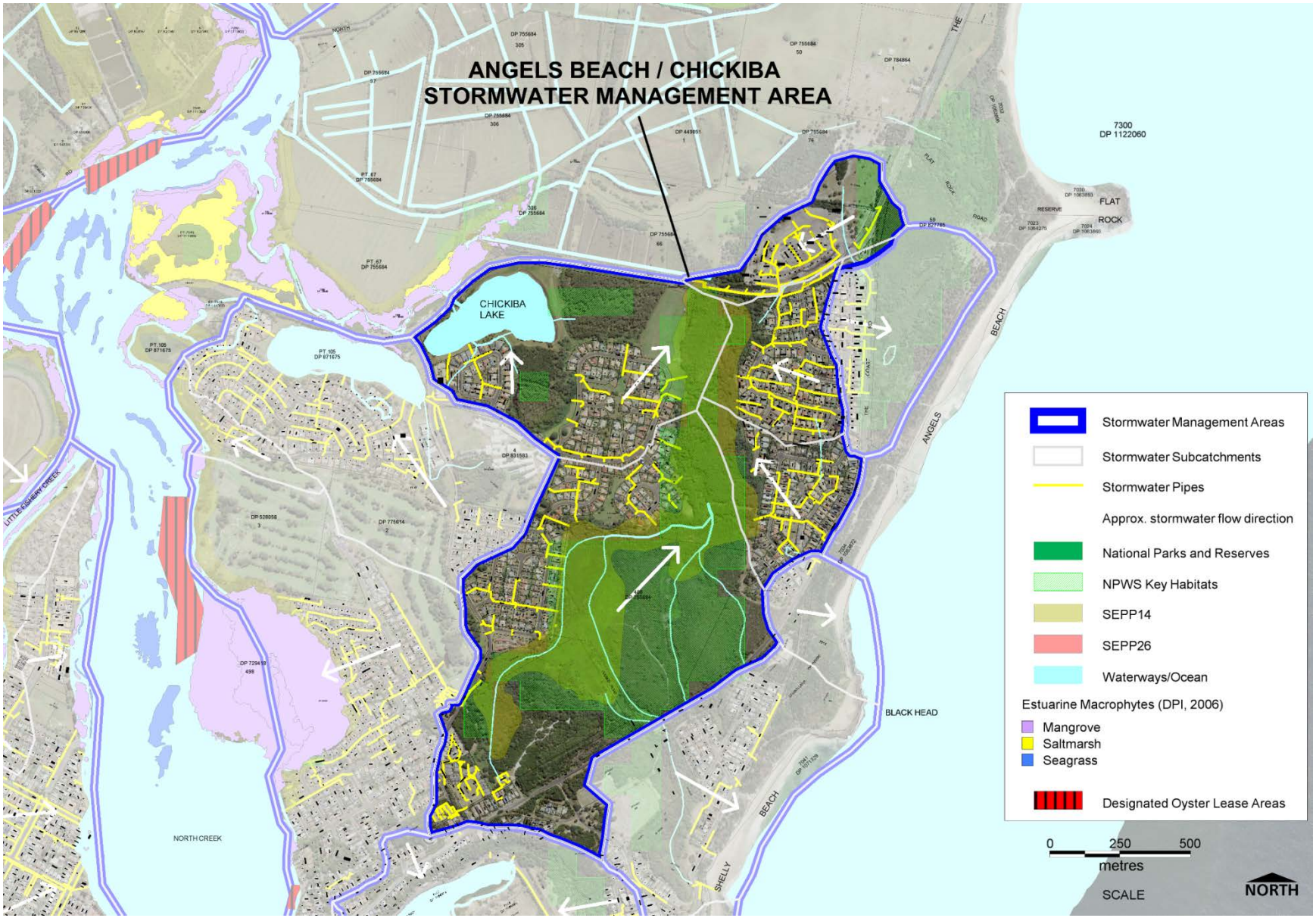


Figure 20: Angels Beach / Chickiba stormwater management area

Table 19: Angels Beach stormwater management area - summary of key attributes

Stormwater Management Area:	**Angels Beach (ID no. EA02)**
Location/suburb/Estates:	Angels Beach
Number of sub-catchments:	1
Total Area:	29 ha
Receiving Environments:	Angels Beach coastal wetlands
Special features/values:	NPWS Key Habitat, HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	20% urban, 80% non-urban
LEP Zoning (%)	79% Environmental Conservation, 13% Low Density Residential, 8% Medium Density Residential
Potential pollution sources:	Urban runoff, road runoff
SQIDs:	None mapped
Stormwater Issues identified:	• Water-borne pollutants (including roadside rubbish and chemical runoff) from urban land is frequently washed into natural bushland areas via stormwater (either uncontrolled or via drains without pollutant traps) • Transport of weed propagules (seeds, roots, tubers etc.) via stormwater to receiving environments. • Creation of conditions suitable for weed growth at stormwater outlets (frequently watered and fertilised environment) • Many sites experience scouring, erosion, gullying and sedimentation from uncontrolled runoff during heavy rainfall events from urban areas to bushland sites. Results in disturbance to vegetation and habitat and undesirable visual impact.

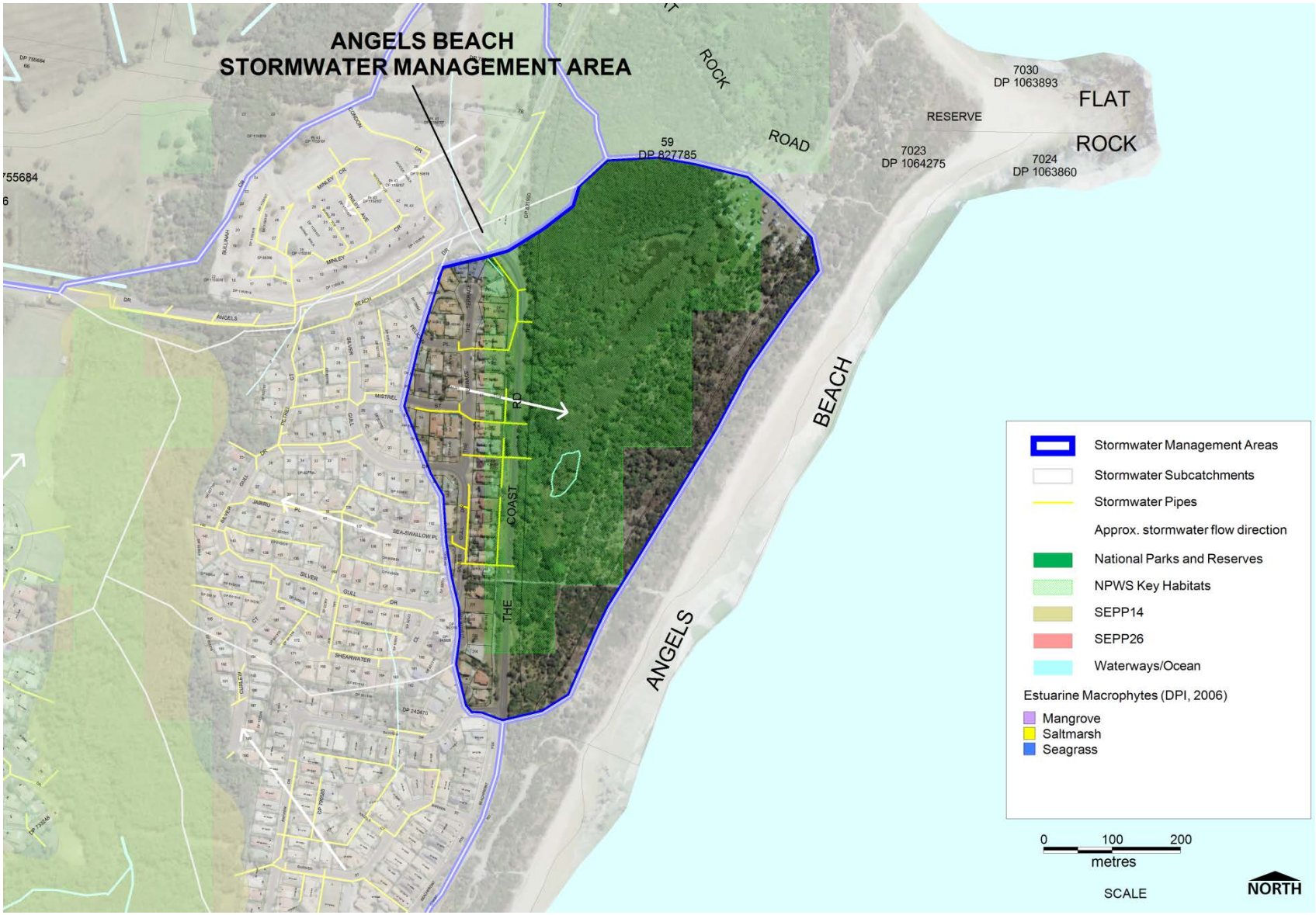


Figure 21: Angels Beach stormwater management area

Table 20: Prospect North Creek stormwater management area - summary of key attributes

Stormwater Management Area:	**Prospect North Creek (ID no. EA03)**
Location/suburb/Estates:	Prospect, Northumberland Drive, Ballina Golf Course, Serpentine Area
Number of sub-catchments:	4
Total Area:	175 ha
Receiving Environments:	Prospect Lake, North Creek, Richmond River
Special features/values:	SEPP14, NPWS Key Habitat, Mangrove and seagrass habitat areas, scenic amenity, recreational swimming, boating, fishing, walking, tourism, designated oyster lease areas downstream. HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	75% urban, 25% non-urban
LEP Zoning (%)	11% Environmental Conservation, 43% Low Density Residential, 5% Medium Density Residential, 13% Public Recreation, 24% Private Recreation, 1% Recreational Waterways, 2% Natural Waterways, 1% Neighbourhood Centre.
Potential pollution sources:	Urban runoff, Golf Course, road runoff
SQIDs:	None Mapped
Stormwater Issues identified:	• Northumberland drain now mapped as SEPP14 and council needs to do an REF to do maintenance works • Impacts of stormwater on oyster lease areas directly downstream

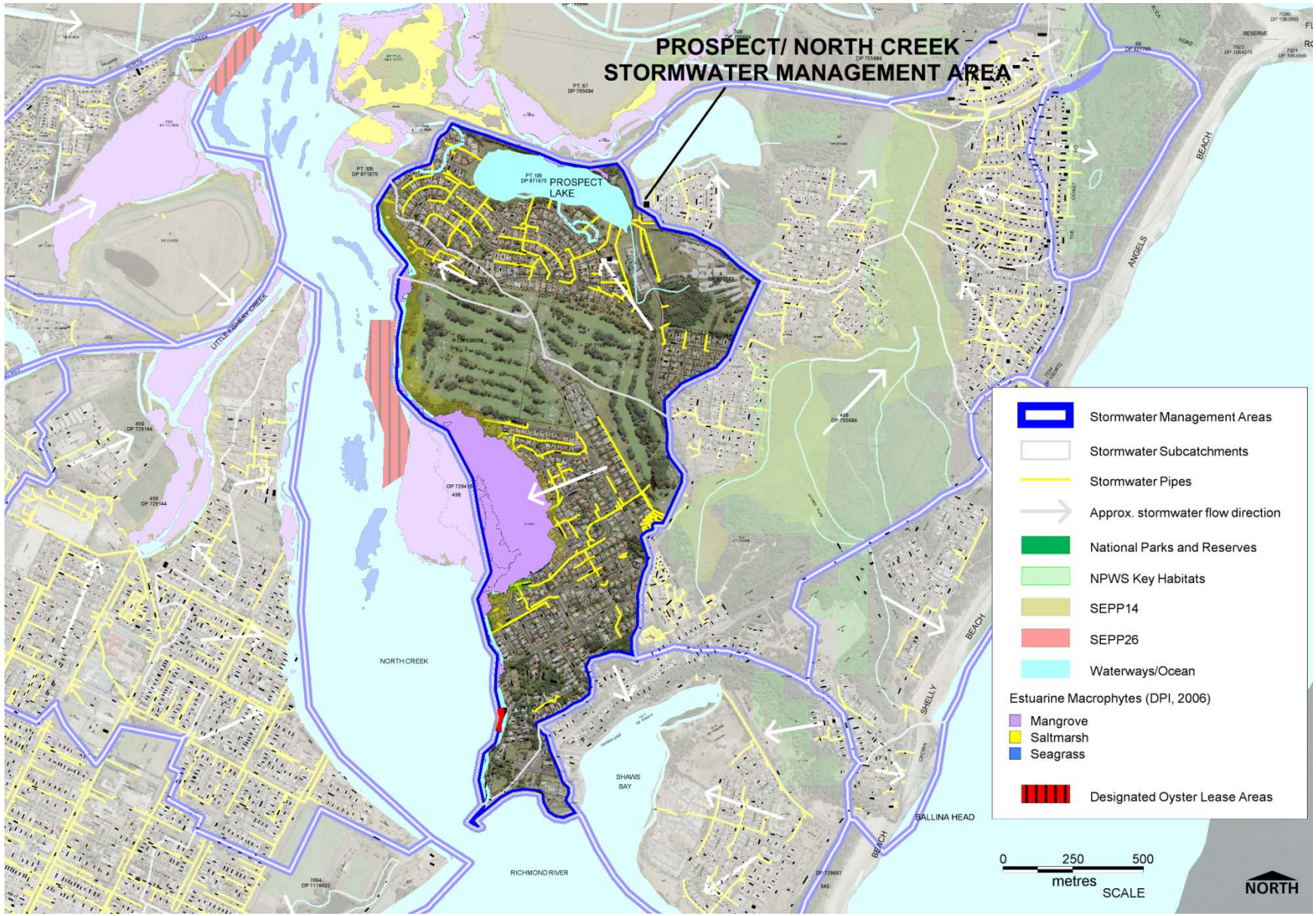


Figure 22: Prospect / North Creek stormwater management area

Table 21: Shelley Beach / Black Head stormwater management area - summary of key attributes

Stormwater Management Area:	**Shelley Beach / Black Head (ID no.EA04)**
Location/suburb/Estates:	Shelly Beach, East Ballina
Number of sub-catchments:	3
Total Area:	73 ha
Receiving Environments:	Shelly Beach, Pacific Ocean
Special features/values:	NPWS Key Habitat, scenic amenity, recreational swimming, boating, fishing, walking, tourism. HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	40% urban, 60% non-urban
LEP Zoning (%)	67% Environmental Conservation, 5% Low Density Residential, 16% Medium Density Residential, 11% Public Recreation.
Potential pollution sources:	Urban runoff, road runoff
SQIDs:	Butt Catcher (1) Standard Stormwater Pit (1)
Stormwater Issues identified:	• Stormwater pipe on beach cracked, unsightly. • Water-borne pollutants (including roadside rubbish and chemical runoff) from urban land is frequently washed into natural bushland areas via stormwater (either uncontrolled or via drains without pollutant traps) • Transport of weed propagules (seeds, roots, tubers etc.) via stormwater to receiving environments. • Creation of conditions suitable for weed growth at stormwater outlets (frequently watered and fertilised environment) • Many sites experience scouring, erosion, gullying and sedimentation from uncontrolled runoff during heavy rainfall events from urban areas to bushland sites. • No drainage to distribute stormwater from Beachfront Parade and Bayview Dr. This results in stormwater funnelling through pedestrian underpass and into adjacent bushland causing erosion/sedimentation etc. • “Showcase” stormwater trap at Ballina lighthouse headland not maintained

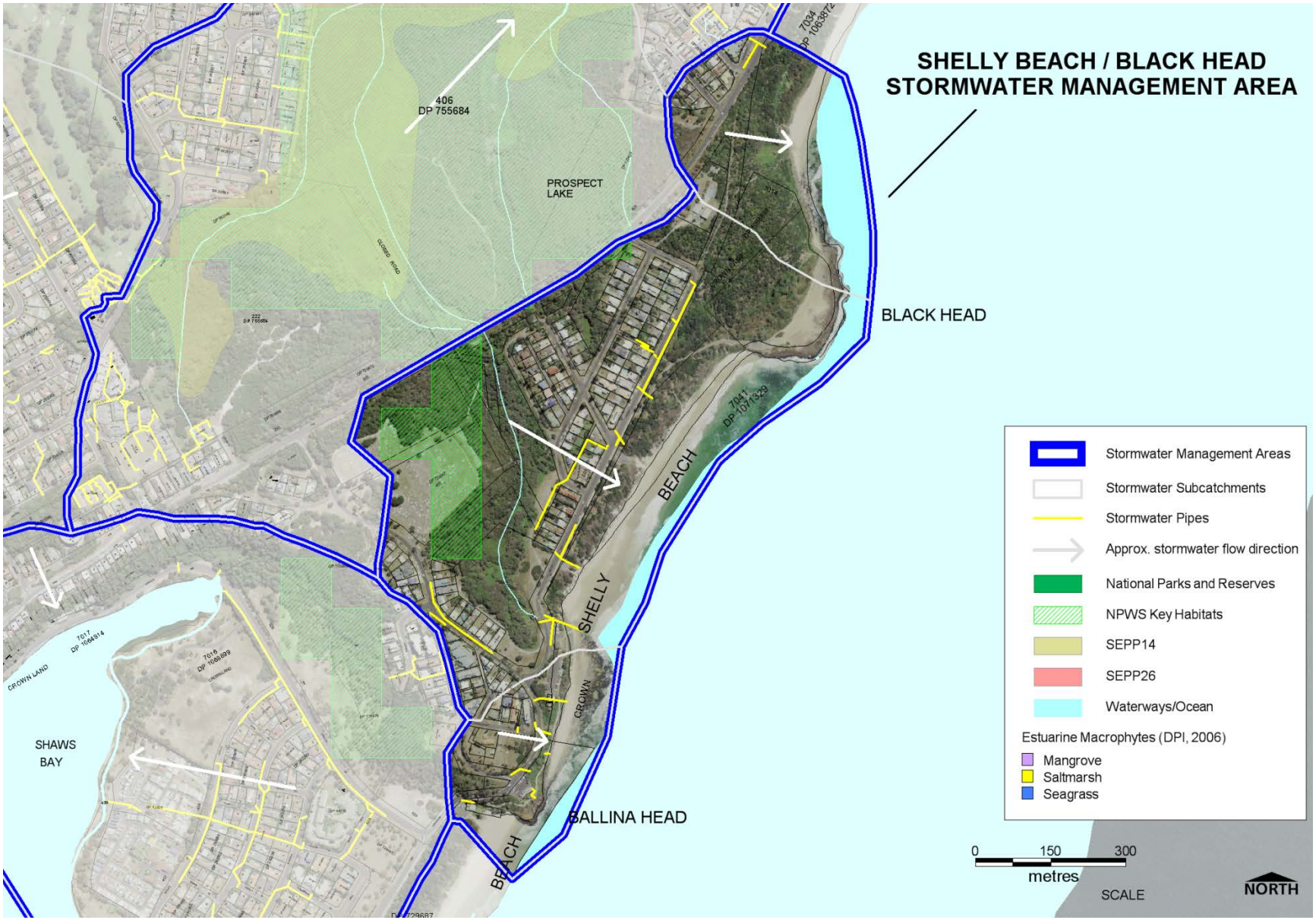


Figure 23: Shelley Beach / Black Head stormwater management area

Table 22: Shaws Bay stormwater management area - summary of key attributes

Stormwater Management Area:	**Shaws Bay (ID no. EA05)**
Location/suburb/Estates:	Pine Avenue, Short St and Shaws Bay, East Ballina
Number of sub-catchments:	1
Total Area:	87 ha
Receiving Environments:	Shaws Bay, Richmond River, Pacific Ocean
Special features/values:	NPWS Key Habitat, scenic amenity, recreational swimming, boating, fishing, walking, tourism. HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	75% urban, 25% non-urban
LEP Zoning (%)	11% Environmental Conservation, 23% Low Density Residential, 4% Medium Density Residential, 32% Public Recreation, 18% Recreational Waterways, 2% Neighbourhood Centre
Potential pollution sources:	Urban runoff, road runoff
SQIDs:	Filter Bag Pit Inserts (87), Gross Pollution Trap (2), Standard Stormwater Pit (2)
Stormwater Issues identified:	• Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall. • Mangroves allowed to grow in stormwater drains (lack of regular maintenance), now needs REF to remove.

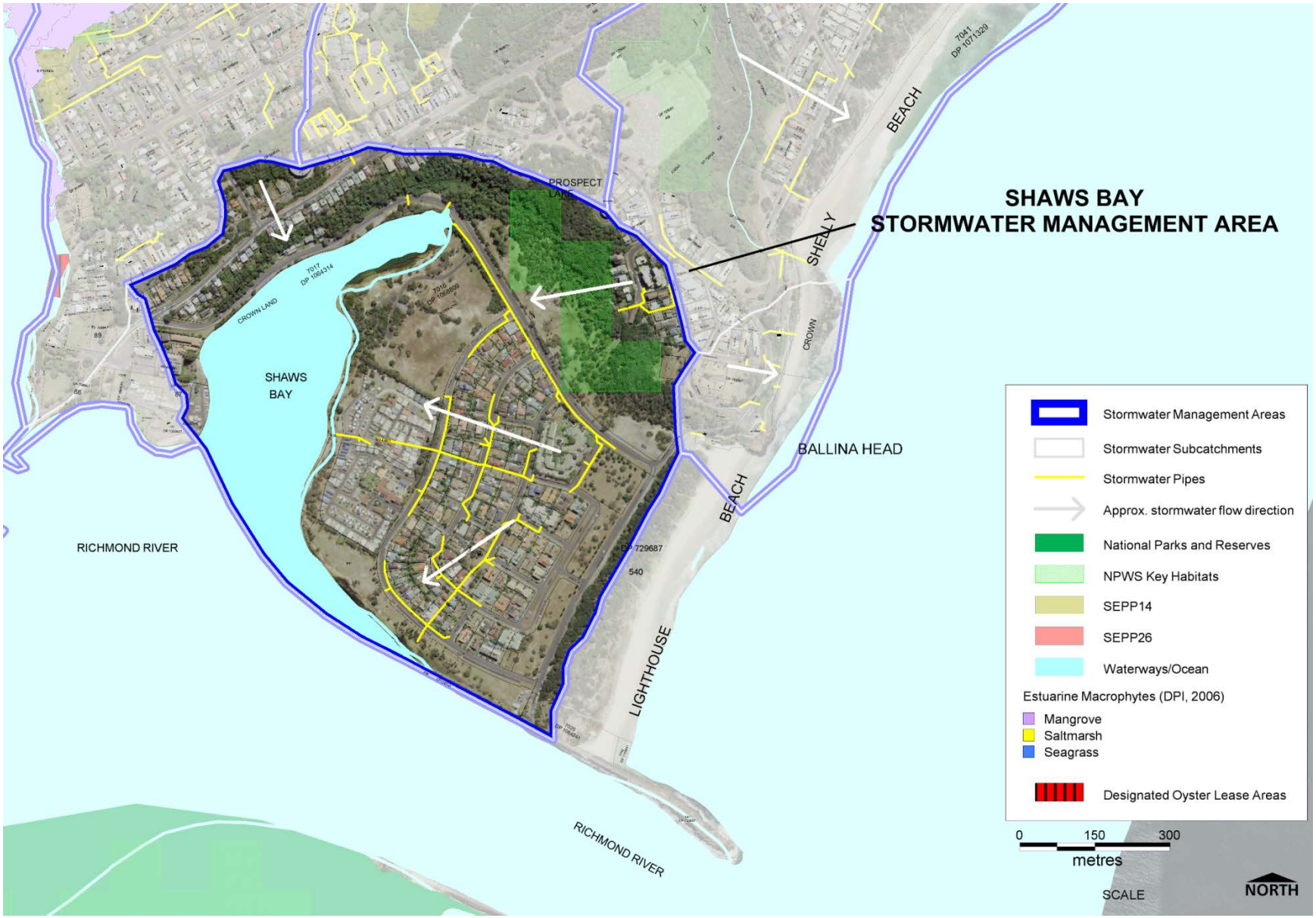


Figure 24: Shaws Bay stormwater management area

Table 23: Ballina Island North Creek stormwater management area - summary of key attributes

Stormwater Management Area:	**Ballina Island North Creek (ID no. BA01)**
Location/suburb/Estates:	Ballina Island urban areas draining to North Creek
Number of sub-catchments:	5
Total Area:	181 ha
Receiving Environments:	North Creek
Special features/values:	SEPP14, mangroves, seagrass, scenic amenity, recreational swimming, boating, fishing, walking, tourism, designated oyster lease areas downstream. HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	90% urban, 10% non-urban
LEP Zoning (%)	13% Environmental Conservation, 19% Low Density Residential, 41% Medium Density Residential, 4% General Industrial, 8% Public Recreation, 2% Rural Landscape, 5% Natural Waterways
Potential pollution sources:	Urban runoff, road runoff, industrial estate
SQIDs:	None mapped
Stormwater Issues identified:	• Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall. • Poor stormwater drainage during heavy rainfall due to low grade. • Ageing assets need replacing/ repairing • Impacts of stormwater on oyster lease areas directly downstream

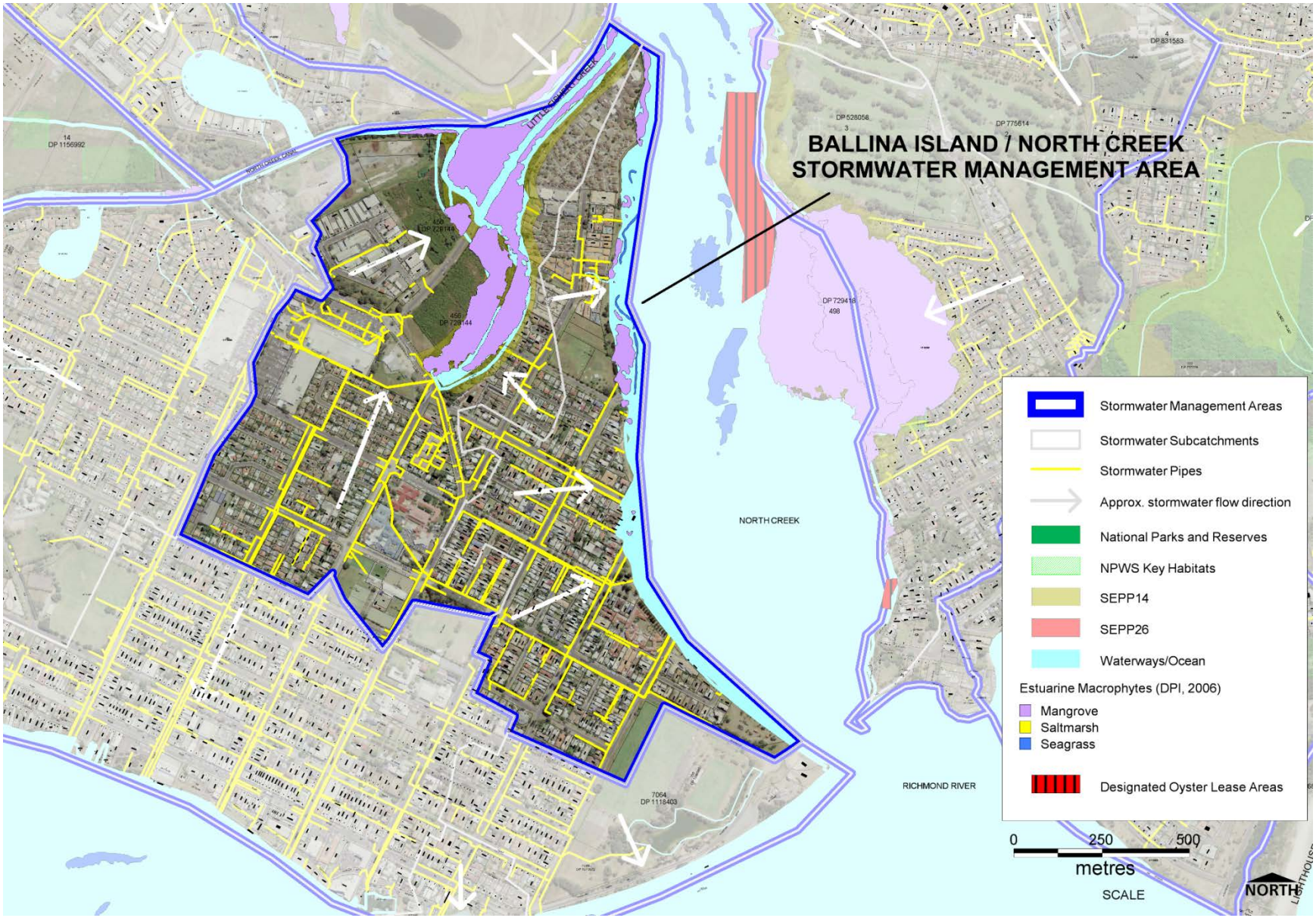
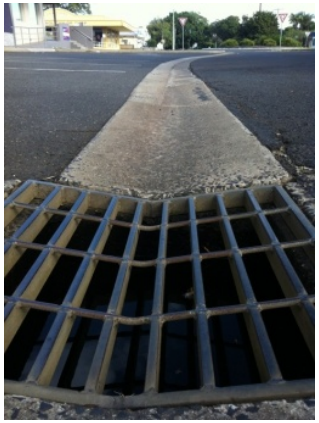


Figure 25: Ballina Island / North Creek stormwater management area

Table 24: Ballina Island Richmond River stormwater management area - summary of key attributes

Stormwater Management Area:	**Ballina Island Richmond River (ID no. BA02)**
Location/suburb/Estates:	Ballina Island draining to Richmond River and Fishery Creek
Number of sub-catchments:	3
Total Area:	275 ha
Receiving Environments:	Fishery Creek, Richmond River.
Special features/values:	Main street commercial hub, community infrastructure (hospitals, library, schools, churches etc.). Scenic amenity, recreational swimming, boating, fishing, walking, tourism. Seagrass in Richmond River, mangrove areas in Fishery Creek Canal
Current % urban to non-urban land (approx.)	98% urban, 2% non-urban
LEP Zoning (%)	23% Low Density Residential, 36% Medium Density Residential, 17% Public Recreation, 13% Commercial Core, 7% Recreational Waterways, 2% Mixed Use, 2% Rural Landscape
Potential pollution sources:	Urban runoff, road runoff
SQIDs:	Filter Bag Pit Inserts (5)
Stormwater Issues identified:	• Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall. • Tidal ingress along stormwater drains during very high tides causing flooding of streets (e.g. Tamar, Crane and Owen Streets). • Poor stormwater drainage during heavy downpours due to low grade. • Ageing assets need replacing/ repairing



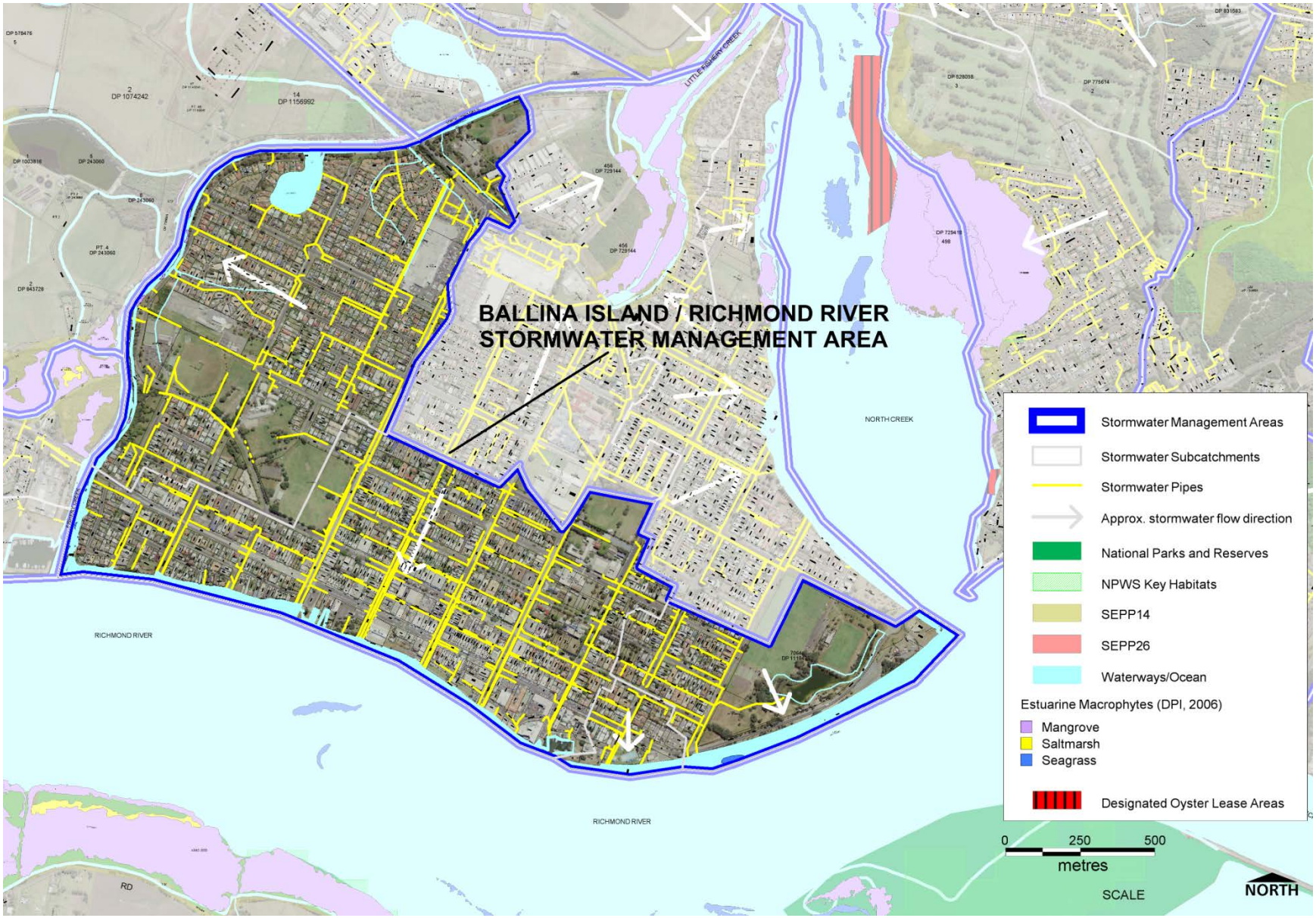


Figure 26: Ballina Island / Richmond River stormwater management area

Table 25: West Ballina Richmond River stormwater management area - summary of key attributes

Stormwater Management Area:	**West Ballina Richmond River (ID no. WE01)**
Location/suburb/Estates:	West Ballina (west of Fishery Creek), Ballina Quays, Smith Drive
Number of sub-catchments:	3
Total Area:	273 ha
Receiving Environments:	Emigrant Creek, Fishery Creek, Richmond River.
Special features/values:	SEPP14, mangroves, seagrass, scenic amenity, recreational swimming, boating, fishing, walking, tourism, designated oyster lease areas downstream. HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	25% urban, 75% non-urban
LEP Zoning (%)	10% Environmental Conservation, 36% Low Density Residential, 6% Medium Density Residential, 9% General Industrial, 4% Public Recreation, 14% Rural Landscape, 8% Recreational Waterways, 4% Natural Waterways, 1% Neighbourhood Centre, 9% Enterprise Corridor
Potential pollution sources:	Urban runoff, construction site runoff (bypass), agricultural runoff, road runoff, industrial estate
SQIDs:	None mapped
Stormwater Issues identified:	• Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall. • Tidal ingress along stormwater drains during very high tides causing flooding of streets (e.g. Riverview Ave). • Impacts of stormwater on oyster lease areas directly downstream

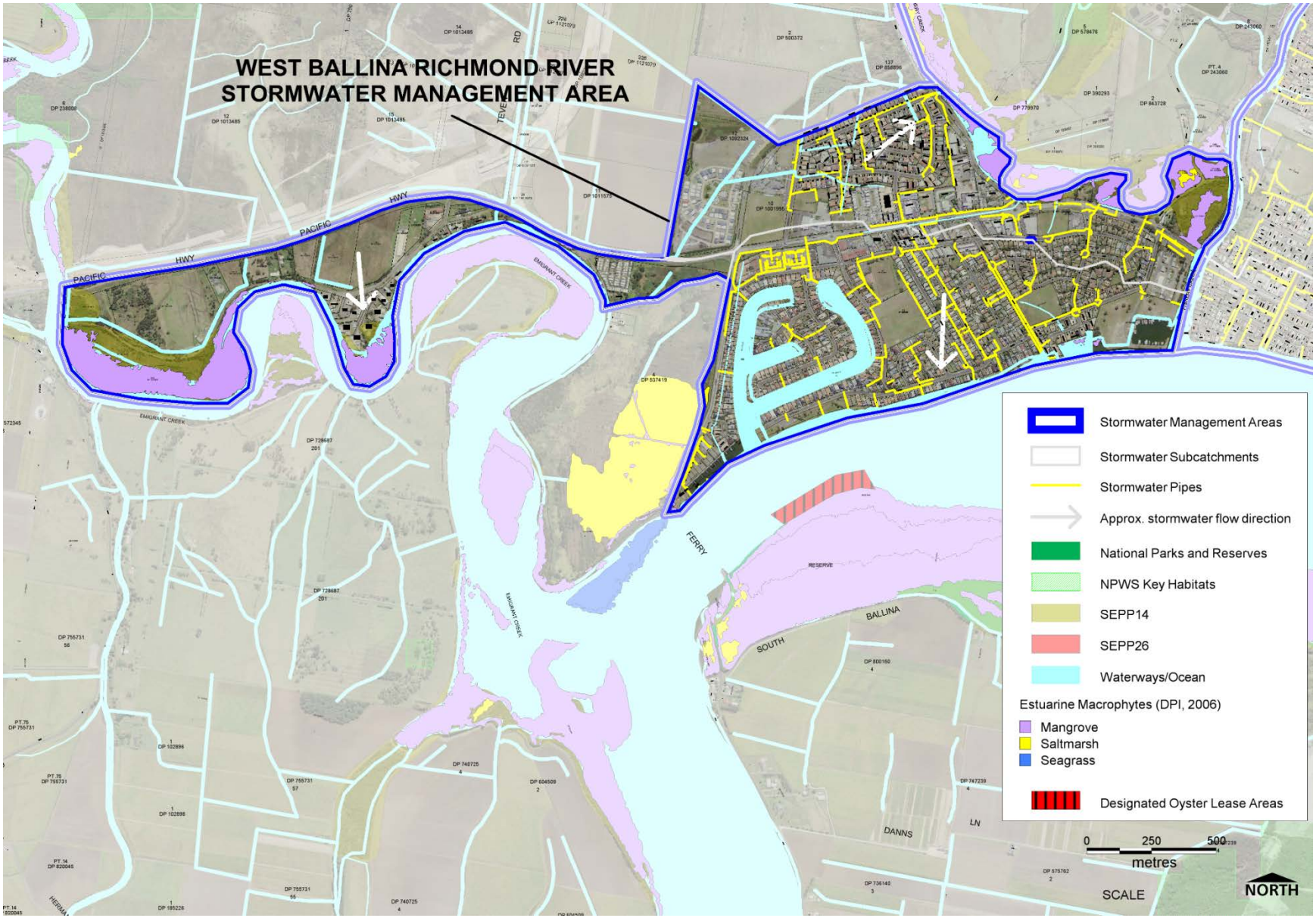


Figure 27: West Ballina Richmond River stormwater management area

Table 26: West Ballina Fishery Creek stormwater management area - summary of key attributes

Stormwater Management Area:	**West Ballina Fishery Creek (ID no. WE02)**
Location/suburb/Estates:	West Ballina agricultural land draining to Fishery Creek. Includes Ballina WWTP and Ferngrove Estate
Number of sub-catchments:	1
Total Area:	280 ha
Receiving Environments:	Fishery Creek, North Creek, Richmond River.
Special features/values:	SEPP14, NPWS Key Habitat, mangroves, saltmarsh, scenic amenity, recreational swimming, boating, fishing, walking, tourism. HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	10% urban, 90% non-urban
LEP Zoning (%)	18% Environmental Conservation, 12% Medium Density Residential, 65% Rural Landscape, 1% Recreational Waterways, 3% Infrastructure.
Potential pollution sources:	Urban runoff, construction site runoff, agricultural runoff, road runoff, WWTP discharge/overflows.
SQIDs:	Mapped: Sock on 375mm Discharge Pipe (6) From inspection at Ferngrove: Stormwater filtration unit, vegetated swale, detention basin, gabion wall
Stormwater Assets:	
Stormwater Issues identified:	• Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall. • Ferngrove Estate: stormwater assets (vegetated swale and basin) overgrown with weeds and difficult to maintain – residents feel this looks unsightly and it chokes up flow. • Ferngrove Estate grade of stormwater not adequate to achieve suitable stormwater conveyance.

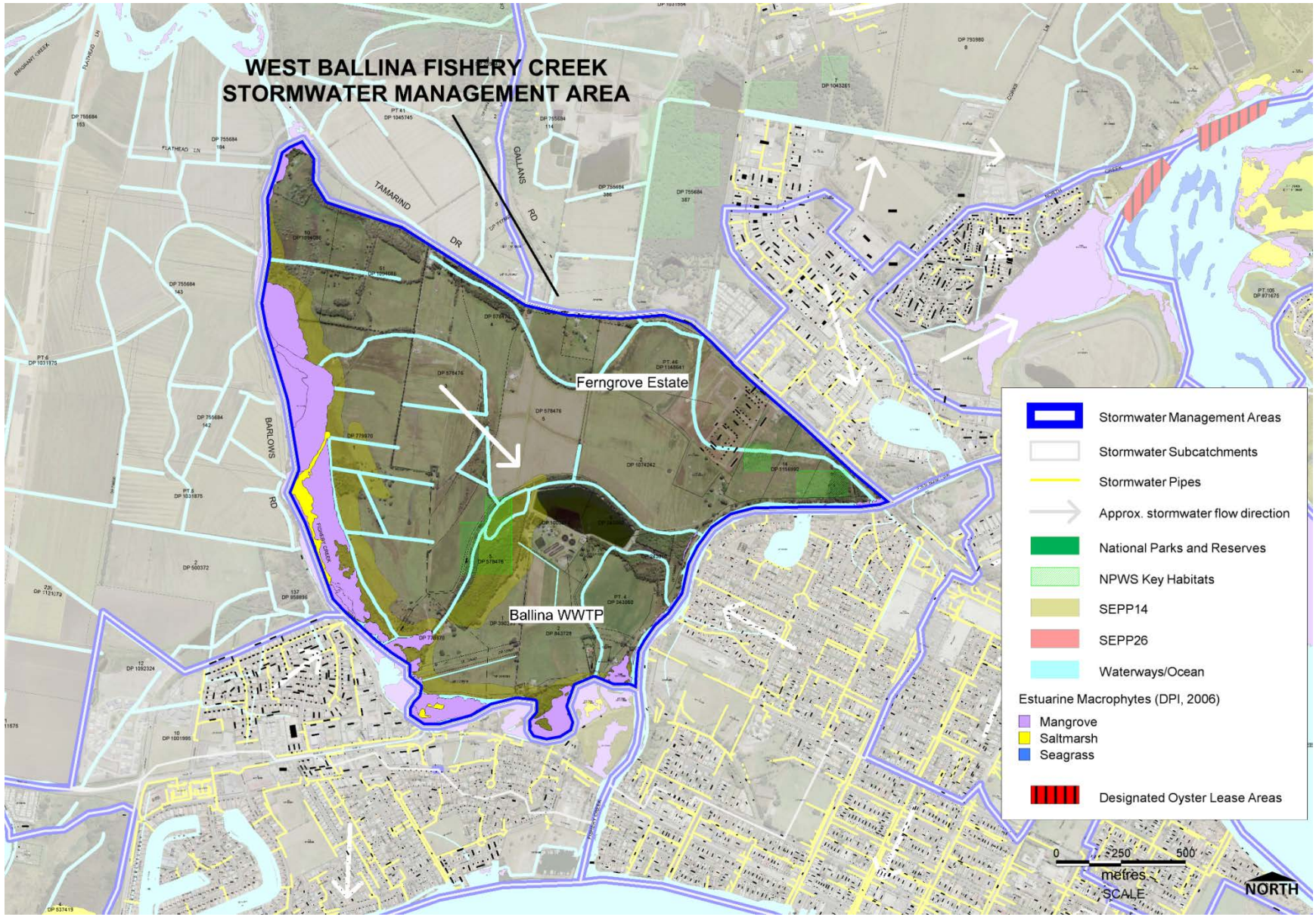


Figure 28: West Ballina Fishery Creek stormwater management area

Table 27: Wardell stormwater management area - summary of key attributes

Stormwater Management Area:	**Wardell (ID no. WA01)**
Location/suburb/Estates:	Wardell
Number of sub-catchments:	2
Total Area:	125 ha
Receiving Environments:	Richmond River
Special features/values:	SEPP14, mangroves, NPWS Key Habitat. HCV Vegetation (BSC Mapping)
Current % urban to non-urban land (approx.)	60% urban, 40% non-urban
LEP Zoning (Draft LEP 2012) (%)	27% Environmental Conservation, 3% Primary Production, 33% Low Density Residential, 7% Medium Density Residential, 13% Public Recreation, 1% Neighbourhood Centre, 5% Natural Waterways, 12% Rural Landscape
Potential pollution sources:	Urban runoff, agricultural runoff, road runoff
SQIDs	None mapped
Stormwater Issues identified:	• Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall. • Drain between River St and Walshes park does not drain adequately (survey response)

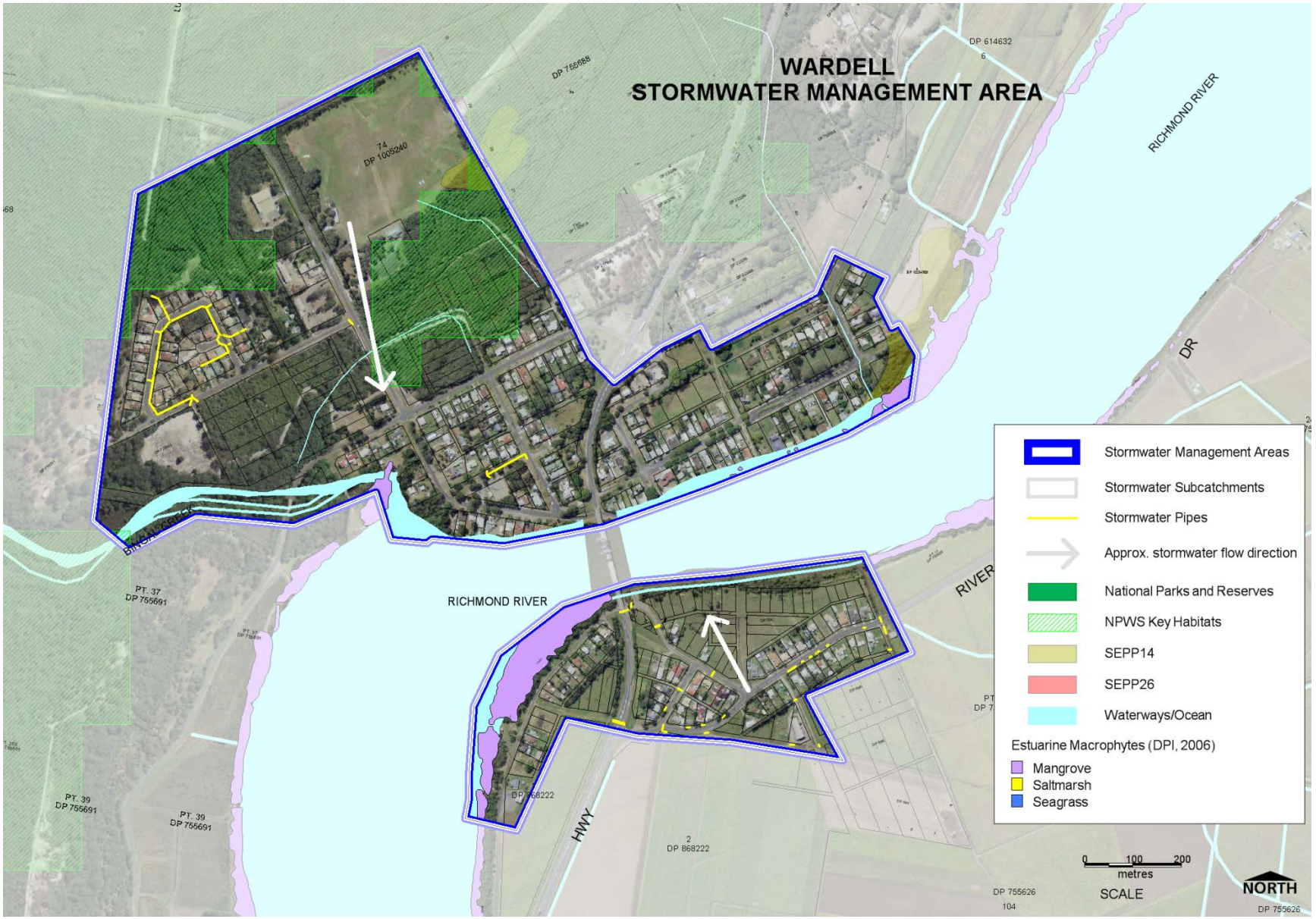
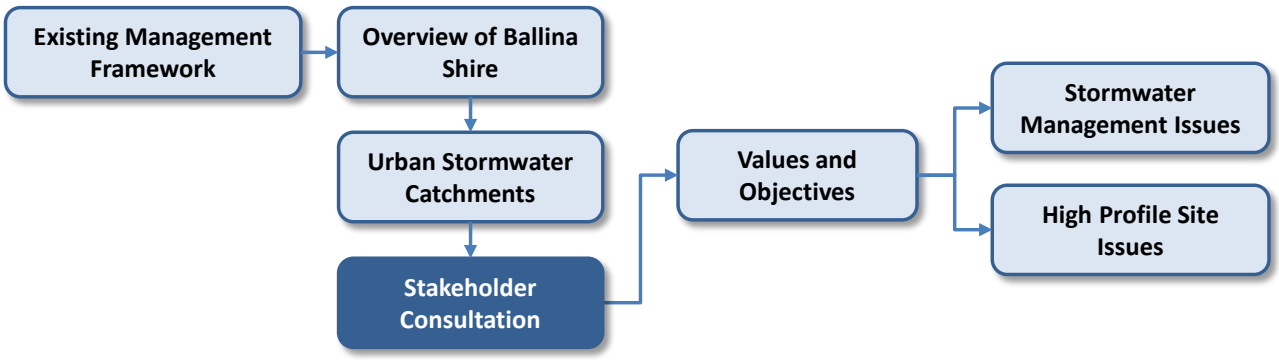


Figure 29: Wardell stormwater management area

5. STAKEHOLDER CONSULTATION



This section summarises the consultation activities undertaken as part of the development of the Urban Stormwater Management Plan.

5.1 Consultation Activities

Consultation with stakeholders was undertaken to facilitate collection of site-specific information, gain local knowledge and to identify stakeholder perceptions and aspirations in relation to urban stormwater management. This information was used to identify issues and assist in the development of the management strategies. The consultation approaches utilised are detailed in Appendix 4.

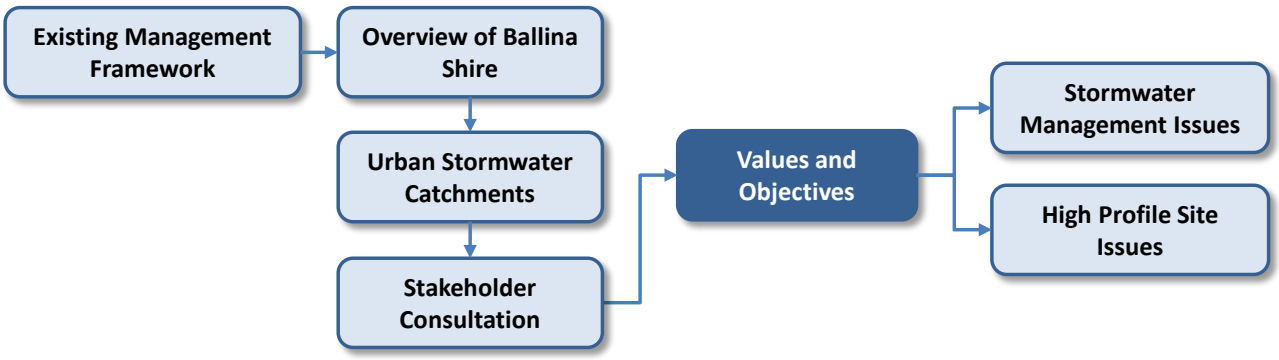
The consultation activities included:

- Development of a project webpage detailing the project, its progress and outcomes;
- Preparation of a media release;
- Advertisements in the Council notices pages of local newspapers;
- Articles in Community Connect for distribution to ratepayers with rate notices;
- An online community survey; and
- Public display of the Final Draft USMP.

Workshops with Council staff and Councillors were also held to obtain input on the issues and feedback on the proposed management actions.

Relevant external stakeholders were also contacted to provide information on the project and obtain input into development of the plan.

6. VALUES AND OBJECTIVES



The values and objectives for urban stormwater management have been derived from the consultation activities undertaken as part of this project as well as the 2002 USMS and other strategic planning processes undertaken by Council.

6.1 Established Community Values

6.1.1 Strategic Objectives

Several of the broad Shire and catchment values identified by the community during the development of the Community Strategic Plan are related to the urban stormwater management as shown in Table 28.

Table 28: Relevant Desired Outcomes, Actions and Objectives from the Community Strategic Plan

Desired Outcomes	Actions	Relevant Objective
A feeling of safety, regardless of where in the Shire	Make public spaces attractive and user-friendly	Resilient and adaptable communities
Buildings, infrastructure and public spaces that complement our natural environment	Promote built spaces and infrastructure that minimise intrusion on natural areas such as beaches and at the same time protect our heritage	A built environment contributing to health and being
	Utilise locally endemic species for landscaping	A healthy natural environment
	Develop planning guidelines and instruments to direct good environmental design	Diverse and balanced use of our land
	Restrict or minimise where possible the development of environmentally inappropriate buildings and infrastructure	Resilient and adaptable communities
	Raise awareness about climate-friendly design options through the development and promotion of local Guidelines	
	Promote designs minimising resource consumption in construction, use, maintenance or demolition	Responsible and efficient use of our resources
Clean beaches and foreshores	Develop understanding of primary pollution sources and threats and prevent or limit these sources where possible through improved engineering and public education	A built environment contributing to health and wellbeing

Desired Outcomes	Actions	Relevant Objective
	Improve foreshore and riparian vegetation	A healthy natural environment
	Prevent marine and foreshore pollution	
	Remediate foreshore and riparian vegetation	
	Ongoing education about catchments and storm water	Resilient and adaptable communities
Effective engagement with our neighbouring areas and within the region	Contribute to regional approaches to addressing natural environmental issues	A healthy natural environment
	Encourage consideration of regional implications of land use decisions	Diverse and balanced use of our land
Continuous improvement in the condition of our natural environment	Promote principles for infrastructure and urban development that minimise impact on natural habitat areas	A built environment contributing to health and wellbeing
	Improve the ways in which we take into account the value of ecosystem services	A diverse and prosperous economy
	Maintain, protect and manage natural habitat areas	A healthy natural environment
	Develop strong planning and regulatory mechanisms to protect areas designated as high or medium conservation value	Diverse and balanced use of our land
	Improve connections between areas of natural habitat on both public and private land	
	Involve people of all ages in their local environments	People attaining health and wellbeing
	Develop environmental programs and activities appropriate for all sectors of the community	Resilient and adaptable communities
	Promote the acknowledgement and reward of good practices	
	Increase our understanding of our natural habitat areas with improved mapping as a high priority	
Effective water collection, use and re-use	Encourage building design that incorporates water collection (e.g. rainwater tanks) and re-use	A built environment contributing to health and wellbeing
	Promote water re-use	Responsible and efficient use of resources
	Improve information about water	
Excellent water quality in the Richmond River, its tributaries and coastal lakes	Develop and enforce principles for infrastructure, rural land use and urban development that minimises negative impacts on water quality; encourage urban design that increases infiltration rather than run-off	A built environment contributing to health and wellbeing
	Encourage urban design that increases infiltration rather than run-off	

Desired Outcomes	Actions	Relevant Objective
	Support efforts to adopt best practice in all forms of land use, improve riverbank vegetation, encourage the removal of stock access to rivers and creeks, and build awareness about the impacts of waste on water quality	A healthy natural environment
	Promote management practices in all types of land use that lead to good water quality outcomes and utilise land use controls to locate appropriately land uses that might impact negatively on water quality	Diverse and balanced use of our land
	Providing water for healthy ecosystem functioning, establishing environmental flow requirements for the Richmond River and its tributaries, and increase understanding and management of groundwater resources	Responsible and efficient use of resources
	Establishing a coordinated approach to monitoring and works activities within the Richmond River catchment across all areas and levels of government	Transparent and accountable governance
Integrated land uses	Integrate natural ecosystems into urban areas	A healthy natural environment
Maintain our diverse and attractive landscapes	Protect prominent areas of vegetation, waterways, and geological landforms	A healthy natural environment
Holistic understanding of approaches to health	Provide environmentally sound access to the river, creeks, beaches, and natural areas for low impact recreation	A healthy natural environment
	Promote volunteering	People attaining health and wellbeing
Individual and collective action to mitigate the risks posed by a changing climate	Recognise and integrate climate change concepts into built environment and infrastructure design	A built environment contributing to health and wellbeing
	Take a precautionary approach when planning for and managing natural areas	A healthy natural environment
	Recognise and integrate climate change concepts into land use policy and planning	Diverse and balanced use of our land
	Participate in education and awareness raising opportunities	Resilient and adaptable communities
	Encourage uptake of best practice in all sectors of the community	
Infrastructure and facilities that meet individual and community needs	Promote diversity and innovation in housing design	A built environment contributing to health and wellbeing
Recognition and valuing of our natural, cultural and built heritage	Increase community knowledge of our local environments	A healthy natural environment
	Reward good environmental outcomes	
Socially and environmentally responsible business	Raise awareness of the benefits of being socially and environmentally responsible	Resilient and adaptable communities

Desired Outcomes	Actions	Relevant Objective
	Explore ways to acknowledge and reward social and environmental responsibility	
	Promote whole-of-life-cycle approach to manufacturing and business	Responsible and efficient use of resources
	Encourage life-cycle costing in both purchasing and manufacturing	
	Promote reporting systems for social and environmental responsibility	Transparent and accountable governance
Widespread participation in lifelong learning	Provide infrastructure to support learning	A built environment contributing to health and wellbeing
	Promote research and innovation	A diverse and prosperous economy
	Promote positive social interactions at neighbourhood level	People attaining health and wellbeing
	Promote a culture of lifelong learning, including volunteer organisations	Resilient and adaptable communities

6.1.2 Ecological Values

The 2002 USMS identified the ecological values which relate primarily to the physical habitat characteristics, streamflow and water quality conditions of the receiving environments. From a management point of view, the broad ecological values were summarised as “the maintenance and restoration of the aquatic ecosystem and riparian vegetation within and surrounding Ballina Shire waterways”.

The objective of DCP13 and the stormwater management objective, based on the principles of ecologically sustainable development, is “no net increase in the average annual load of key stormwater pollutants and peak discharge flow rates, above that occurring under existing conditions.” This objective specifically applies to all sites that have a sensitive receiving environment.

Ecological values identified in the CZMP for the Richmond River Estuary (Hydrosphere Consulting, 2011) are:

- The Richmond River Estuary and wetlands provide a diversity of habitats for a range of terrestrial and aquatic species;
- The estuary supports a number of rare and threatened communities;
- Estuarine wetlands including mangroves, saltmarsh and seagrass areas provide an important role in healthy ecosystem function;
- The Richmond River estuary is recognised as one of the two most important locations for shorebird habitat in Northern NSW;
- The riparian zone provides a number of important ecological functions; and
- Good water quality is highly valued and considered a general indicator of estuary health by the community.

6.1.3 Social Values

The 2002 USMS identified the values of the local waterways (constituting the urban stormwater system) as:

- Recreation - swimming, sailing, fishing, walking, bird-watching, etc.;
- Public health and safety; and
- Visual amenity/aesthetics (water looking pleasant and clean).

Social and cultural values identified in the CZMP for the Richmond River Estuary are:

- The Richmond River Estuary has high cultural and spiritual significance to local Aboriginal communities;
- A number of European cultural heritage sites and items exist in and around the estuary and their acknowledgement and protection is important to the community;
- The estuary and foreshore areas are highly valued by the community and visitors for recreational activities;
- Scenic amenity is valued highly by the local community and visitors; and
- The estuary provides opportunities for both formal and informal education.

6.1.4 Economic Values

Economic values identified in the 2002 USMS relate to the economic resource provided by the Richmond River for:

- Town water supply;
- Transport of wastes;
- Agricultural water use for Irrigation and livestock;
- Maintenance of property values;
- Tourism appeal; and
- Habitat provision for commercial fishing and oyster production.

Economic values identified in the CZMP for the Richmond River Estuary are:

- The Richmond River catchment supports a wide range of land uses which are important contributors to the local and regional economy;
- Fishing and oyster aquaculture contribute to the local and regional economy;
- The estuary and particularly the lower estuary is considered to be a key attraction for tourists and recreational users to the area, with associated economic benefits; and
- The freshwater sections of the estuary are a valuable source of water for the agricultural industry.

6.1.5 Values Identified through Stakeholder Consultation

From the results of the community survey undertaken for the development of this USMP, the majority of community members identified the following uses and functions of the Shire's waterways as the most important (refer Appendix 4):

- Swimming (82% of respondents);
- Aquatic habitat (77%);

- Visual Amenity (74%);
- Transfer of stormwater to the ocean (73%);
- Flood control (73%);
- Fishing (67%);
- Boating (65%); and
- Education (54%).

The protection of oyster aquaculture and key fish habitats was also identified as a key objective by DPI – Fisheries, ECOFishers, Marine Parks Authority and Richmond River Oyster Farmers.

6.2 Previous Management Objectives

Long term (visionary) management objectives identified in the 2002 USMS are:

- Water quality conditions in the catchment to meet ambient water quality objectives currently in draft as part of the State Water Reforms package - National Water Quality Management Strategy;
- Flows within catchment to meet river flows objectives currently in draft as part of the State Water Reforms package - National Water Quality Management Strategy;
- Increase indigenous riparian, floodplain and foreshore vegetation;
- Water courses within catchment to be in a state of dynamic equilibrium;
- Protection of ecologically sensitive areas from stormwater impacts;
- Water quality to meet requirements for safe consumption of fish, crustaceans and shellfish;
- Visual amenity of waterways is to be maximised;
- Water quality to meet ANZECC guidelines for primary and secondary contact recreation; and
- Minimise impact of new urban developments on catchment values and management objectives.

Many of the above objectives are high-level, visionary targets for the Shire and are not directly related to urban stormwater management. As discussed in Section 3.2, flows and water quality in the Richmond River and catchment condition are largely influenced by conditions within the upstream catchment, not by urban stormwater runoff. It is acknowledged that the water quality in the Richmond River is influenced by many factors other than urban stormwater management including wastewater discharges, floodplain infrastructure, acid sulfate soils, monosulfidic black ooze and blackwater events (refer Section 3.3.4). As such, objectives and targets regarding receiving water conditions are difficult to apply and measure in practical applications of urban stormwater management.

Short term management objectives recommended in the 2002 USMS are:

- Reduce concentrations of various pollutants (nutrients, sediment, chemicals, faecal coliforms, etc.) in urban stormwater runoff;
- Prevent the bulk of litter entering the stormwater system from high litter generation areas;
- Minimise weed propagation and growth in the stormwater system;
- Enhance riparian values in stormwater affected watercourses;
- Optimise opportunities for the multiple use of stormwater and stormwater facilities;
- Protection of ecologically sensitive areas from stormwater impacts;
- Maintain and enhance the aquatic habitat values in stormwater affected watercourses;

- Maximise public education and awareness opportunities regarding stormwater issues;
- Popular swimming sites are to be within ANZECC guidelines for primary contact recreation 90% of the time during the swimming season; and
- Impact of new urban developments on water quality is to be minimised to levels depending on site specific conditions. Frequency of 1.5 Year ARI flow events are not to increase due to new urban developments.

The above short-term objectives were used in the development of design objectives in DCP13.

6.3 Water Sensitive Urban Design

Water Sensitive Urban Design (WSUD) is an internationally recognised concept that offers an alternative to traditional development practices. WSUD is a holistic approach to the planning and design of urban development that aims to minimise negative impacts on the natural water cycle and protect the health of aquatic ecosystems (Healthy Waterways Partnership, 2006). WSUD considers ways in which urban infrastructure and the built form can be integrated with a site's natural features. In addition, WSUD seeks to optimise the use of water as a resource.

The key principles of WSUD are to:

- Protect existing natural features and ecological processes;
- Maintain the natural hydrologic behaviour of catchments;
- Protect water quality of surface and ground waters;
- Minimise demand on the reticulated water supply system;
- Minimise sewage discharges to the natural environment; and
- Integrate water into the landscape to enhance visual, social, cultural and ecological values.

In 2001, BSC commenced the development of its integrated urban water management strategy (UWMS, refer Section 2.2.10). The original scope of the UWMS included:

- Demand management;
- Long-term strategic management;
- Whole of system management;
- Whole of life cycle management;
- Whole of water cycle management in a sustainable way;
- Affordability;
- Protection of public health;
- The need for resource recovery; and
- The capacity to take up new technologies.

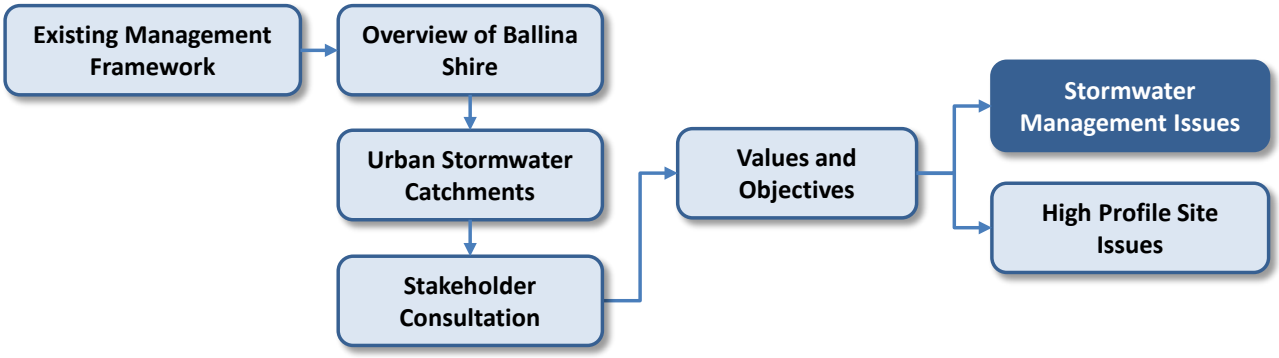
Council's Urban Water Policy Statement sets out the guiding principles and objectives that BSC will aspire to in the provision of water supply, wastewater and stormwater services to its consumers and customers. The policy provides separate objectives for water supply, wastewater and stormwater but focuses on water supply and wastewater initiatives.

A major component of the UWMS is currently being implemented through the Ballina-Lennox Head Recycled Water Master Plan. Stormwater initiatives in the current strategy are limited to:

- Development and Implementation of Current Strategy – continue to develop and implement elements of the current (2002) Stormwater Management Strategy plus other opportunities identified in the strategy review, including water sensitive urban design initiatives; and
- Stormwater Funding – explore options to support an appropriate level of funding for stormwater initiatives within the whole of the Shire including rural areas which contribute the greater share of pollutants to the rivers and estuaries.

Council has commenced the implementation of some aspects of WSUD through the Urban Water Management Strategy (Section 2.2.10) particularly the provision of recycled effluent systems. The stormwater management aspect of WSUD is a relatively new concept for BSC and the major barriers to successful implementation are the administrative structure, the lack of funding and appropriate guidelines and policies for planning, design, constructing and managing WSUD systems. However, implementing WSUD within new developments is considered to be a key objective for the protection of the Shire's waterways.

7. STORMWATER MANAGEMENT ISSUES



This section describes the key urban stormwater management issues identified through stakeholder consultation, review of existing management plans and site audits/inspections. Resolution of these over-arching issues, which are common to the management of all urban stormwater in the Shire, is considered to be fundamental to the successful implementation of this USMP. Site specific management issues and prioritisation of the stormwater management areas are discussed in Section 8.

7.1 Identification of Issues

Many of urban stormwater management issues had been previously identified by Council and in some cases are being addressed through existing Council actions. The issues are generally:

- Related to the efficiency and/or effectiveness of existing administration and management;
- Significant localised stormwater management issues which are expensive to address or require resolution of other issues before they can be addressed; or
- Minor in nature, but occur throughout the Shire and will require a coordinated approach to achieve the best outcome for stakeholders.

From the results of the community survey, the majority of community members identified the following stormwater issues as the most significant (refer Appendix 4):

- Stormwater washing into waterways from industrial sites (64% of respondents) – Stormwater pollution is discussed in Section 7.4.1;
- Stormwater drains are not regularly maintained (59%) – Maintenance is discussed in Section 7.5;
- Litter (57%) – refer Section 7.4.1;
- Stormwater washing into waterways from construction sites (56%) – Construction phase issues are discussed in Section 7.4.1;
- Stormwater runoff is unable to drain away due to inadequate drainage systems (56%) – refer Section 7.5;
- Local flooding (52%) – refer Section 7.3; and
- A lack of stream bank plants and the invasion of weeds (51%) – refer Section 7.4.3.

Specific examples of the above issues were also provided by some survey respondents (refer Appendix 4).

The key management issues are discussed in the following sections.

7.2 Governance and Administration

7.2.1 Integration of Council Stormwater Management Responsibilities

Council's urban stormwater management activities and functions are discussed in Section 2.2. Historically, as with other natural resource management considerations, the impacts of urban stormwater have not been a key consideration for local councils. Council's previous Urban Land Release Policy (1970s) did not address future stormwater management requirements and many of the land developments have resulted in a legacy of asset management issues (e.g. poor drainage, water quality impacts, lack of access for maintenance and poor asset function).

With increasing urbanisation and community understanding of the water quality and hydrological impacts of stormwater systems, increasing emphasis is being placed on the consideration of stormwater assets and their function. Urban stormwater considerations are now receiving more emphasis in the planning, development and operational responsibilities of Local Government (and the complementary roles of the State Government). Figure 2 and Table 1 (Section 2.2) indicate the wide range of stormwater management functions and activities spread across all Council groups. Due to the diverse nature of stormwater management activities and responsibilities, which affect and are affected by many aspects of Council's decision making, Council management and responsibilities related to urban stormwater have evolved in an *ad hoc* manner.

Feedback from Council staff suggests that the current stormwater management responsibilities are unclear and that stormwater considerations fall through the gaps between the related line manager responsibilities. As an example, the Open Space and Reserves Group of BSC will usually receive and respond to community complaints regarding water quality, local flooding, weed management and amenity. However, the responsibilities of this group are limited to maintenance and environmental management associated with the public reserves. Engineering design and function of the stormwater systems is not within the technical capabilities of this group but these responsibilities are not clearly allocated to other Council activity areas. Similarly, stormwater maintenance requirements and resourcing have not been a key consideration during the land-use planning and design stages. The lack of integration of the stormwater management requirements combined with inadequate funding have resulted in poor outcomes for the community and the environment. Funding is discussed further in Section 7.2.3.

7.2.2 Development Controls

As discussed in Section 2.2.5, Council's primary development controls for stormwater are contained in DCP13 which was based on the 2002 USMS. This document describes the policy objectives (for pollutant load and peak discharge flow rates), information required to demonstrate compliance, consideration for construction and operational phases, integration of water sensitive urban design, source controls, conveyance controls and discharge controls. Technical design considerations are also provided in DCP13, although these do not appear to keep up with current best-practice. For example, more stringent pollutant reductions are specified in the south-east Queensland Water By Design guidelines and the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) modelling parameters.

Feedback from Council's development engineers and planners indicate that DCP13 has been difficult to enforce and Council's design requirements have been difficult to apply due to a lack of clear policy and guidelines. Council is currently reviewing DCP13 with the aim of providing concise guidelines for the provision of stormwater management infrastructure.

7.2.3 Funding

The current funding for stormwater management activities is sourced from general purpose income allocated to the relevant Council functions and the stormwater levy which is used to fund new stormwater and drainage projects (refer Section 2.2.3). The level of Council resourcing and funding has historically been

insufficient to adequately maintain the existing stormwater systems, implement asset renewals and resolve issues with poor function of the existing systems. This is largely due to the lack of recognition of the importance of urban stormwater management relative to other Council functions.

7.3 Development of Low-Lying Flat Land

Historical development of low-lying flat land has left a legacy of issues for stormwater management. Where possible, Council intends to limit the future development of flood-liable land, except for some sites such as the Southern Cross Industrial Estate where continued expansion of this precinct is a logical extension of this employment hub.

Stormwater design is problematic in low-lying areas as many stakeholders expect stormwater to be 100% effective and may not understand site limitations in achieving this, particularly where the cause of land inundation is due to a downstream constraint. Stakeholders also may not fully understand the different mechanisms by which inundation of low lying land occurs and to what extent this is controllable through urban stormwater management strategies.

Inundation of low-lying land is caused by a range of factors. Such factors can act either individually or in combination and can have differing effects in terms of the frequency and extent of inundation, event duration, predictability and type of impact. The key causes of inundation of urban land in Ballina Shire are:

- Richmond River catchment flooding;
- Localised flooding (isolated catchments);
- Tidal/Storm Surge inundation (coastal low-lying areas); and
- Poor site drainage.

Inundation due to these issues is likely to increase with continued climate change (refer Section 7.6) with increased storminess contributing to demands on stormwater infrastructure and sea level rise continuing to exacerbate issues associated with tidal intrusion and inundation. Stormwater related issues associated with these inundation phenomena are discussed further below.

7.3.1 Catchment Flooding

Catchment scale flooding of urban areas in the Ballina Shire is primarily an issue in Wardell and western parts of Ballina itself. Such flood events occur after widespread rainfall within the broader Richmond River catchment. There is usually significant warning of rising flood waters, with modest rates of rise and fall and events often lasting for several days.

Council has developed an extensive flood model to provide a range of tools to assess the likely impacts of flooding. The model takes into account the existing catchment conditions and proposed future development. The modelling also takes into account the effect of climate change on predicted future flood events, utilising the sea level rise predictions published by the NSW Government. Work is also well underway on the preparation of a Floodplain Management Plan. This plan will allow Council to ensure the use of flood prone land is planned and managed in a manner compatible with the assessed frequency and severity of flooding. This planning involves an understanding of the level of risk and assessing the options and cost to address the risk. The plan will allow a determination of measures available to lessen the hazards relating to public safety and reduce the damage potential to property. To do this Council has completed a property floor level survey to inform on flood damage estimation. Another important part of the management plan is the preparation of an evacuation capability assessment. This assessment takes into account the flood model and allows Council to provide information on evacuation routes and warning times. With this information Council is collaborating with the SES to update the Local Flood Plan which is the plan the SES uses to manage its response to a local flood event and to improveme data gathering systems.

Council has also undertaken the Wardell & Cabbage Tree Island Floodplain Risk Management Study (2007) to provide a more strategic approach to reduce the impact of flooding and flood liability on individual owners and occupiers, and to reduce the potential for private and public losses from flooding. The report assesses a range of potential flood damage reduction measures that could be implemented at Wardell and Cabbage Tree Island. It also documents measures to address emergency response management issues that are likely to exist at Cabbage Tree Island during major flooding of the Richmond River.

The depth and extent of catchment sourced flooding, particularly in Ballina is modified by oceanic influences, where high tides, storm surge and sea-level rise all contribute to backing up of floodwaters and to modify flood behaviour in the lower parts of the estuary.

Urban stormwater infrastructure has minimal influence on large scale inundation within Ballina Shire, and the configuration of such infrastructure has negligible effect on flood impacts on other areas, largely due to the relative low density of urban development within the catchment. Consequently, catchment scale flooding is not an important consideration for stormwater management, except where the configuration of urban stormwater infrastructure can contribute to the propagation of floodwaters into areas that may otherwise remain relatively untouched. This mechanism of flood encroachment can occur in the main part of Ballina, in a similar manner as tidal intrusion into the stormwater network. As the source of flooding in low lying areas of Ballina is more likely to be due to oceanic influences, than catchment flooding, this is further discussed in Section 7.3.3.

7.3.2 Localised Flooding in Isolated Catchments

Localised flooding is caused by small storm systems producing intense rainfall bursts usually over shorter timeframes than flooding in the Richmond River. Such flooding is usually exacerbated by constriction of natural drainage points, where the discharge capacity is limited and backwater effects can encroach on urban areas. Localised flooding of this nature is often related to design and maintenance of stormwater infrastructure and has the potential to lead to property damage, public safety risk, transport interruption and loss of amenity.

Localised flooding events are usually short-lived but can build up dramatically in response to intense rainfall events. It is anticipated that the intensity of such events will increase with continued climate change. The floodplain risk management guidelines (refer Appendix 1) recommend that sensitivity analysis on rainfall intensity should consider increases of 10%, 20% and 30% above current levels. As rainfall intensity has a major bearing on the likelihood on localised flooding and stormwater infrastructure often controls discharge from such catchments, this is a key consideration for BSC.

Property damage can occur during uncontrolled overland flows when designated stormwater drainage systems are overwhelmed or through backwater effects where a downstream control point does not have the discharge capacity to drain the catchment adequately.

Safety hazards associated with localised flooding are often publicised in the media as uncontrolled flows entering stormwater infrastructure presents opportunities for thrill-seekers and poses high risk of entrapment, particularly for children. Public safety is also threatened when stormwater discharge exceeds the capacity of assets such as road culverts, leading to inundation and potentially rapid water velocities over roads.

Examples of localised flooding issues related to stormwater management in the Ballina Shire include:

- The Tanamera drain in Alstonville where maintenance of this important drainage system is hampered and there is increasing risks of inundation of nearby properties due to reduced hydraulic efficiency of the drain;
- Angels Beach Chickiba (ID no. EA01) – The residential development and Chickiba Sports Fields interfere with stormwater flows to the detriment of the fields and surrounding environments. Constrictions in drainage can contribute to elevated water levels with the wetland and encroachment into neighbouring properties; and

- Local roads in low lying areas of Lennox Head and Ballina can flood due to stormwater backup (Photo 1 and Photo 2).

Photo 1: Flash flooding on Pacific Parade Lennox Head (February 2012)

Photo 2: Flooding during heavy rainfall, Cherry Street Ballina (January 2012)

7.3.3 Tidal and Storm-surge Inundation and Intrusion

Inundation due to oceanic influences is concentrated in coastal regions and is a continuing issue for the low-lying areas of Ballina. Astronomical tides are predictable, with spring tides occurring on a fortnightly basis and king tides over a few days during summer and a few nights in winter each year. Spring tides alone do not pose an existing issue for Ballina, however during extreme king tides, the urban stormwater network allows penetration of tidal waters into the low lying parts of the town leading to partial inundation of low some roads by salt water. This relatively rare event is projected to become commonplace as sea level rise increases average tidal levels.

Storm surge is another phenomenon that threatens coastal urban areas. Storm surge is typically caused by a combination of factors which occur during adverse weather conditions where wind and wave setup combined with low atmospheric pressure results in temporarily increased local sea levels. This effect is most pronounced in coasts directly influenced by cyclones and is therefore a less common consideration for Ballina Shire. However, storm surge often occurs in combination with significant rainfall and associated local and catchment scale flooding. This combination of high tailwater levels and intense rainfall events can lead to significant stormwater inundation of low-lying land. Peak water levels can build over a sequence of high tides, where storm surge or flood water backed up by the first high tide is not cleared before the next high tide, thereby leading to an escalating sequence of flood peaks. The added influence of high tides and continued threat of sea level rise mean that tidal and storm surge inundation is a key consideration in the strategy for stormwater management for Ballina.

Whilst the configuration of the urban stormwater system does not cause high ocean water levels, the stormwater system in Ballina does directly contribute to tidal inundation issues by allowing the intrusion of high water into low-lying areas. This is particularly so in the centre of Ballina Island, where some areas are lower than the surrounding banks of the island. Without the open stormwater network, the rate of tidal propagation into the island would be dictated by groundwater seepage rates and the high tide would pass before any significant intrusion occurred, however with the open pipe network under the island, water level in the estuary can propagate inland at a much faster rate, thereby emerging in low-lying areas within the town centre.

This issue is not easily resolved, as a stormwater network that is as hydraulically efficient as possible is required to allow drainage of the low gradient land, yet the inclusion of tide gates or other mechanisms to prevent tidal intrusion into the pipes also have the potential to impede drainage away from the urban area.

Photo 3: Flooding at Tamar Street Bus Interchange, Ballina during a King Tide

7.3.4 Poor Site Drainage

Many parts of Ballina and Lennox Head are at very low elevation and current stormwater systems often fail to convey water during heavy rainfall. The combination of low gradients, high groundwater table and high tailwater levels (e.g. high tides, etc. as discussed above) mean that stormwater systems need to carefully consider present and future influences to ensure that adequate site drainage is achieved.

Examples of current issues associated with poor site drainage of stormwater within the stormwater management areas include:

- North Lakes / Ballina Racecourse (ID no. NO02) - North Lakes grass swales have very low grade and do not drain adequately;
- North Ballina (Airport) (ID no. NO01) - Harvey Norman Centre open drain/infiltration basin has never drained completely when it is designed to drain (Photo 4);
- Ballina Island North Creek (ID no. BA01), Ballina Island Richmond River (ID no. BA02) - Poor stormwater drainage during heavy downpours due to low grade;
- West Ballina Fishery Creek (ID no. WE02) - Ferngrove Estate grade of stormwater is not adequate to achieve suitable stormwater conveyance (Photo 7);
- The drain behind Williams Reserve, Lennox Head (ID no. LE04) - Photo 6; and
- Wardell (ID no. WA01) - Drain between River Street and Walshes Park does not drain adequately.

Specific factors that contribute to poor site drainage in low-lying urban areas are:

- Low gradients mean that there is little tolerance available in establishing site contours and drainage lines. Settlement of stormwater assets over time, errors during construction and external influences on tailwater levels can have significant effects on the efficiency of stormwater systems in low-gradient areas;
- Low gradients dictate that larger stormwater systems are required to convey design stormwater discharges. Larger systems are proportionally more expensive or can reduce the amount of land available for beneficial uses. Current development guidelines do not necessarily foresee or cater for such situations, which need to be assessed carefully on a case by case basis; and
- High groundwater levels provide little opportunity to utilise on-site infiltration to disperse stormwater. Infiltration devices, although often desirable in other situations, will often not be effective in low-lying areas, leading to ponding and poor conveyance from the site (Photo 4).

Photo 4: Stormwater drain at Harvey Norman, Southern Cross Industrial Estate. The site does not adequately convey stormwater flows

In general, traditional stormwater design does not adequately address stormwater issues in low-lying areas. Solutions that are adequate at free-draining sites are often not suitable for development in low-lying areas and site-specific solutions are often required. In addition to this, continued climate change is projected to exacerbate issues of tidal and storm surge inundation, lead to increased water table levels and lead to a greater frequency and intensity of rainfall events (refer Section 7.6). Solutions that have proved successful in the past may not perform adequately in the future.

7.4 Impacts on Receiving Environments

The Ballina Shire waterways are highly valued by the community and are focal points for recreation, tourism and local commerce. The estuaries, with the associated wetlands and waterways, support a rich biodiversity and a range of important environmental functions and local industry. Despite these recognised values, the systems are under pressure from past and existing development, catchment disturbance and hydrological modification, land use management and large-scale vegetation changes. Looking forward, the waterways face continued pressure from future development within the catchment.

Urbanisation has affected receiving environments through:

- Changes to the hydrologic characteristics (catchment hardening) of lands making them drain more quickly, partly due to the increased imperviousness, e.g. roads and roofs;
- The use of hydraulically efficient stormwater pipe systems which remove stormwater to the waterway more quickly; and
- Changing the quality of stormwater runoff due to the use of fertilisers, cars, lawnmowers and domestic animals.

Stormwater from urban areas can often discharge significant loads of pollutants to receiving water bodies. These pollutants include litter, nutrients, sediment, oxygen-depleting substances and hydrocarbons, which are transported from the site by urban runoff or stormwater. Urban runoff has particularly been found to impact seagrasses and benthic communities within the Richmond River (WBM, 2006).

While urban stormwater has been identified as a significant issue with respect to the health of the Shire's waterways, it is necessary to recognise the other major (non-urban stormwater) factors which contribute to degradation of the waterways (refer Section 3.3.4):

- Flood events, poor water quality and fish kills, which are largely attributed to the effects of floodplain vegetation clearing and modification;

- The impacts of floodplain drainage infrastructure including constructed drains, canals, levees and floodgates;
- The extensive area of acid sulfate soils on the floodplain;
- Diffuse pollutant loading from agricultural land; and
- The poor condition of the riparian zone.

The Richmond River Estuary Processes Study (WBM, 2006) reported that during significant rainfall events, the impact of nutrient loads and pollutants from urban runoff and sewerage systems was negligible in comparison to the impact of diffuse loads from the Richmond River catchment. Pollutant loads from urban inputs become relatively more important to water quality during the dry season when catchment inputs are low.

On a local scale, there are likely to be direct impacts on receiving environments as a result of urban stormwater. Several known issues have been raised at specific sites (refer Section 8). The stormwater impacts on receiving environments are discussed under the broad headings of water quality, modified hydrology and habitat values.

7.4.1 Water Quality

Water quality is an important determinant of the health of aquatic ecosystems, visual amenity of waterways and the suitability of water for recreational activities involving human contact. Various stormwater pollutants can cause a range of adverse impacts on human health and aquatic ecosystems.

Stormwater runoff

Water quality indicators of concern include:

- **Visual Water Quality Indicators:** The most obvious aspect of a pollution problem is deteriorating visual water quality. Outbreaks of blue-green algae, piles of foam, significant fish kills, cloudy and highly coloured water, and oil slicks are examples of visual problems. Floating inorganic debris and litter, such as car tyres, bottles, aluminium cans and foam boxes, raise community concerns. They can harm wildlife and damage their natural habitats as well as threatening public safety.

  BSC receives community complaints related to visual water quality indicators including litter, gross pollutants, algae blooms and fish kills in water ways. Provision of highly visible public waste receptacles and education are the key to managing sources of gross pollutants. However, during high flows and storm conditions, litter and debris is always going to be an issue for stormwater and clean-up will be required as part of routine maintenance.

- **Suspended Solids:** Turbidity from suspended solids reduces light penetration in water, affecting the growth of aquatic plants. When silts and clays settle, they may smother bottom dwelling organisms and disrupt their habitats. Since metals, phosphorous and various organics are adsorbed and transported with these particles, sediment deposits may lead to a slow release of toxins and nutrients in the waterway. The Richmond River can become highly turbid following significant rainfall. Areas of exposed soil, such as construction sites are particularly important sources of suspended sediments that can travel to waterways via stormwater systems. Correct management of construction sites will have a large impact on the amount of suspended sediment carried to receiving environments.

- **Nutrients:** Excessive amounts of nutrients, such as nitrogen and phosphorous, can promote rapid growth of aquatic plants, including toxic and non-toxic algae. This excessive growth results in the depletion of water column dissolved oxygen, smothering and/or shading of other plants, and deposition of organic sediment. The most effective management of nutrients once in the stormwater system is to settle out the silt and clay particles that have the nutrients attached to their surface. Up

to 85% of phosphorus and 70 - 80% of nitrogen can be isolated as particulate matter. Constructed wetlands and detention basins have been shown to be effective at slowing stormwater flows and allowing sediment to settle out of solution, prior to discharge of water to receiving environments.

- **Algal Blooms:** An algal bloom is caused by "the rapid excessive growth of algae, generally caused by high nutrient levels and favourable conditions" (Water and Rivers Commission, 1998). Algae are a natural component of aquatic environments and even when algal growth is abundant, it is not necessarily a problem. However, when algal blooms increase in intensity and frequency, the results can cause community concern, health problems, and in some cases can be catastrophic to the environment. Algal blooms are a symptom of water quality issues, however they can upset the natural balance of plant and animal ecosystems in a waterway or wetland and cause odours, reduction in visual amenity and fish kills. They can also degrade recreation, conservation and scenic values and interfere with economic uses such as fisheries and tourism.

  WBM (2006) reported high nutrient levels and the risk of algal blooms as a one of the key issues for the Richmond River estuary. Most strategies to address problems of algal blooms require reduction in the loads of phosphorous entering waterways from runoff. Planning on a catchment basis needs to consider pollutant loads from the various existing land uses and any proposed land uses in the whole catchment. In the case of the Richmond River and waterways, the majority of nutrient inputs are likely to come from agricultural sources in the catchment however, fertiliser use in the urban setting may contribute to nutrient issues on a local scale, particularly where stormwater detention ponds have limited flushing and exchange capacity. North Lakes has periodic algal blooms associated with poor water quality and a lack of tidal flushing. On-going water quality issues occurring in Lake Ainsworth include nutrient enrichment and periodic blue green algae blooms and this is believed to be linked to stormwater runoff from the adjacent caravan park.

- **Oxygen Demanding Materials:** Sources of oxygen-demanding materials are biodegradable organic debris, such as decomposing food and garden wastes and the organic material contained in sewage. Biological and chemical oxygen-depleting substances can give rise to water-borne diseases and present serious health risks. The biological and chemical oxygen demands of sewage overflowing into stormwater systems are high. Through environment protection regulation, sewerage utilities are being forced to reduce sewer overflows and eventually eliminate them. Management of storm sewer overflows means managing the sewer hydraulics and redirecting flows to minimise the impact of storms. Education promoting public awareness of correct disposal of garden waste, lawn clippings and other organic materials will also be important in managing oxygen demanding pollutants from urban areas.

- **Pathogens and micro-organisms:** Bacteria and viruses found in soil and decaying vegetation, and faecal bacteria from sewer overflows, septic tank seepage and animal waste, are common contaminants in stormwater after heavy rain. Pathogens and micro-organisms, including bacteria, viruses and faecal coliforms, cause water-borne diseases. They can present serious health risks from cholera, typhoid, infectious hepatitis and a range of gastrointestinal diseases.

  BSC's Beachwatch monitoring has identified elevated levels of faecal indicators (*E. coli*) at some sites following rainfall events (refer Section 3.3.4). Education promoting public awareness of the sources of pathogens to waterways will be important in the effective management of this issue. This would include removal of pet droppings, particularly from impervious surfaces.

- **Toxic Organics:** These include garden pesticides, industrial chemicals and landfill leachate. They may cause long-term ecological damage and threaten human health. Organochlorine pesticides, herbicides and insecticides can be accumulated in organisms and persist in the environment over long periods. It is not known whether toxic organics are an issue for BSC stormwater as there has not been any targeted monitoring conducted to date. Education focussing on public awareness of

stormwater issues such as application of fertilisers, herbicides and pesticides to domestic gardens and disposal of these chemicals will be important in managing this issue.

- **Heavy Metals:** Industrial chemicals can enter stormwater from a number of sources including sewerage overflows, illegal dumping and accidental spillages. Dust from brake and clutch linings of motor vehicles coupled with waste from degrading roadways and water pipes can inject ammonia, hydrogen sulphide and heavy metals (mercury, cadmium, lead and zinc) into the stormwater system. These metals can also be released from landfills through leaching and by poor agricultural practices. It is not known whether heavy metals are an issue for BSC stormwater, as there has not been any targeted monitoring conducted to date.
- **Oils and Surfactants:** Rubber from tyres and oil and grease washed from road surfaces, domestic and industrial sites, plus surfactants from detergents used for washing vehicles, are common sources of toxic pollutants in stormwater. Of the stormwater related complaints received from community members in 2009/2010 by Council, a high percentage of complaints were concerned with washing of vehicles in streets, fuel spills and oil leaks from vehicles. Education focussing on public awareness of stormwater issues, such as washing your car on the grass and management of oils and other chemicals will be important in minimising oils and surfactants reaching waterways.

A number of issues associated with water quality were raised by stakeholders during consultation carried out as part of this plan as well as in the 2002 USMS:

- On-going water quality issues in Lake Ainsworth including nutrient enrichment and periodic blue green algae blooms. Runoff from the Caravan Park and on-site wastewater systems were identified as potential sources (refer Section 8.7);
- Algal blooms and poor water quality episodes at Pacific Pines water quality pond (Montwood Drive) Lennox Head (refer Section 8.8);
- Potential water quality issues at the RTA borrow pit, located on Southern Cross Drive, Ballina Industrial Estate;
- On-going water quality issues at North Lakes, including algal blooms and odour issues, fish kills, red spot disease, etc. (refer Section 8.3). The management plan attributes the main water quality issues to lack of adequate water exchange between lakes and North Creek (tidal exchange);
- Stormwater holding pond at Elevation being polluted by construction activities and odour issues;
- Osmotic shock (sudden changes in salinity during periods of heavy rainfall) is a feature of stormwater intrusion that has negative impacts on biodiversity and ecosystems;
- Water-borne pollutants (including roadside rubbish and chemical runoff) from urban land is frequently washed into natural bushland areas via stormwater (either uncontrolled or via drains without pollutant traps) and ultimately to beach areas;
- Stormwater intrusion carries sediment and contaminants that impact on marine and aquatic biodiversity and associated systems;
- Potential stormwater impacts on oyster aquaculture (faecal coliforms, disease etc. refer Section 7.4.4);
- Major roads - Possibility of major environmental crisis such as a chemical / petrol spill etc.;
- Endangered Swamp Orchid *Phaius australis* believed to be under threat from contamination due to pollutant runoff from urban areas; and
- Stormwater impacts on The Moat/Bream Hole Sanctuary Zone and the Seven Mile Beach Habitat Protection Zone (Section 8.5). A study by Smith and James (2003) concluded that there were

adverse impacts as a result of stormwater discharge to this zone (smothering/burial of reef habitat and biota, turbidity) and better management was required.

Construction runoff

Building construction, particularly during the wetter months of the year, can exacerbate soil erosion, lead to blocked drains and contribute to stormwater turbidity, stream sedimentation and pollution. When a land parcel is cleared of vegetation, the soil is exposed and is vulnerable to erosion from wind and rainfall events. Eroded sediment becomes entrained in the runoff and transported to receiving waterways resulting in elevated suspended solids and turbidity levels in the discharges from the site. Typically in larger scale developments, site compounds also provide potential stormwater issues in the form of fuel and chemical storage and litter. Many of the water quality complaints received by BSC relate poor erosion control on building sites.

Physical methods of erosion and sediment control, as well as managing the amount of exposed soils at any one time are required to minimise stormwater impacts during constructions phases. Typically, auditing of construction sites is conducted by Council in response to complaints. In the past educational programs have targeted builders and developers to assist in awareness and improved implementation of control measures. These programs were well received and further programs are likely to produce improved erosion and sediment controls on building and development sites, including Council managed job sites.

7.4.2 Modified Hydrology

Urban development alters the natural flow path of water by converting a large percentage of naturally pervious surfaces to impervious surfaces. Instead of infiltrating into soils and percolating to groundwater tables, stormwater runs off the land surface and is conveyed via stormwater drains or pipes to receiving environments. The increase in volume of runoff and increased delivery time to the receiving environment can cause ponding and/or flash flooding during particularly heavy rainfall. In some cases, downstream environments can be permanently altered by changes to hydrology.

In the past, the prime objective of urban stormwater management has been flood mitigation. The aim was to channel stormwater as rapidly as possible from urban areas to the nearest waterway. Stormwater systems collect and concentrate flows, which can result in discharges of high velocity water to receiving environments. High velocity stormwater flow has multiple detrimental effects on receiving environments including:

- Scouring of channels and streams;
- Bank undercutting and slumping;
- Increased turbidity of the water column;
- Downstream sedimentation leading to an increased risk of flooding; and
- Potential loss of riparian vegetation and aquatic and wildlife habitat.

Many sites within the study area experience scouring, erosion, gullying and sedimentation from uncontrolled runoff during heavy rainfall events. The nature and severity of these impacts is governed by the intensity of the rain event, the erosive potential of soils and the degree of protection afforded to land surfaces either by vegetation, rock or other built structures. Moderately erodible krasnozem soils occur in the urban areas of Alstonville, Wollongbar and Lennox Head. These areas are more susceptible to erosion especially where stream gradients are high (faster flow) or there is minimal overland flow of stormwater before it enters natural drainage channels.

Some examples of erosion and scouring issues associated with stormwater raised in community consultation include runoff from urban areas to bushland sites in East Ballina and Angels Beach. Where stormwater discharges directly onto beaches, significant erosion can occur to the beach berm and near shore area

around the discharge point. Highly visible sites at Shelley Beach and Seven Mile Beach at Lennox Head have been noted as having erosion issues associated with stormwater outlets.

Several examples of localised short-term flooding have been identified within the Ballina urban areas as part of consultation with BSC, government agencies and stakeholder groups. This flooding is generally due to the intense short duration storms and can be affected by the influence of high tides in low-lying coastal areas such as Ballina Island, West Ballina and parts of Lennox Head (refer Section 7.3).

High water levels within the SEPP14 Chickiba Wetlands, East Ballina have been linked to development of the area including catchment modifications associated with the subdivision and Angels Beach Drive. The high water levels have been identified as a cause of *Melaleuca quinquinervia* dieback in Chickiba wetlands and general wetland health decline (WetlandCare Australia, 2009). Management options to improve the hydrology and condition of the wetlands have been identified as discussed in Section 8.1.

7.4.3 Habitat Values

Many of the urban areas in the Ballina Shire are fringed by important ecosystems including SEPP 14 wetlands and endangered ecological communities. In addition to the environmental values of the urban areas, the waterways support diverse fisheries, aquaculture areas and estuarine habitat (e.g. mangroves, seagrass and saltmarsh).

There are a number of important fish habitat areas in the Shire's urban areas. North Creek was found to be a refuge for fish during the 2001 Richmond River fish kill (Hydrosphere, 2010). Much of the Richmond River estuary downstream of Emigrant Creek is a dedicated Recreational Fishing Haven. There is potential for these environments to be periodically impacted by stormwater through poor water quality events and factors affected by modifications to hydrology.

Environmental weeds are an on-going issue throughout the Shire affecting habitat values and in some cases the function of stormwater management systems. The spread of weeds is often controlled by natural factors such as wind and floods. However there are a number of factors associated with stormwater assets that can impact on weed encroachment within stormwater infrastructure and into receiving environments. Stormwater can transport weed propagules (seeds, roots, tubers etc.) via stormwater drains to receiving environments. The conditions around stormwater discharge areas are often suitable for weed growth as they typically have good water availability and receive nutrient runoff from the upstream catchment. Community education regarding disposal of garden clippings (particularly weeds) assists in minimising transport of propagules to receiving environments. Regular maintenance and weed removal in vegetated stormwater assets is required to ensure assets function correctly and to minimise weed proliferation.

Stormwater has the potential to negatively impact key fish habitats, particularly seagrass. The mechanisms for impact include poor water quality, increased flows with potential to scour downstream habitats and deposition of sediment to smother benthic habitats. Under the *Fisheries Management Act 1994*, new stormwater outlets are not to be located within 50m of seagrass beds or natural wetlands.

7.4.4 Aquaculture

Culture of the native Sydney Rock Oyster is the only aquaculture industry in the Richmond River estuary and is concentrated in the lower reaches of North Creek and Richmond River. Oyster lease areas are shown on the sub-catchment maps included in Section 4. Urban stormwater discharges into some oyster leases including the drainage from the RTA borrow pit, the airport and the industrial development at North Ballina and Southern Cross Drive, the North Lakes water quality control ponds and Ballina Racecourse and the residential development areas along North Creek and the Richmond River.

There are a range of issues affecting the oyster aquaculture industry in the Richmond River estuary which are related to water quality (Hydrosphere Consulting, 2011). QX disease is a major threat to both production and saleability of oysters from the estuary and is caused by protozoan infestation of the oyster gut. After

infection, the oyster's digestive gland is destroyed and the oyster cannot take up nutrients. At this stage, oysters rapidly loose condition and there is a high mortality rate. Although the triggers for QX disease are not fully understood, it is suspected that poor water quality is a major stressor which reduces an oyster's resistance to the disease. DPI is continuing research into management of the disease, including the development of QX resistant strains of the Sydney Rock Oyster. The Richmond River is classified as a high risk QX waterway which restricts the export of oysters to other, lower risk, estuaries. QX resistant strains are being grown in the Richmond estuary however oyster mortality is still occurring

Oysters are well known for their ability to accumulate contaminants from the surrounding water and therefore the industry relies on good ambient water quality to both maintain the health of the oysters and to ensure that the product is fit for human consumption. The saleability of oysters is not only governed by the NSW Food Authority which imposes monitoring requirements and imposes harvest restrictions when required but also the public perception of the environment they are grown in. The presence of periodically high levels of faecal coliforms in North Creek has resulted in harvest closures which typically extend for 9 months of the year. The presence of pesticide residues and potential effect on the oyster industry is an ongoing concern.

7.5 Asset Management

7.5.1 Asset Data

Council has been progressively documenting the type and location of its stormwater assets. The current stormwater asset register is geographically incomplete and only includes constructed stormwater drains, pipes, gutters, pits, channels and SQIDs. The asset register has not yet been integrated with the GIS database and asset condition data are not currently included in the asset register. Condition assessments should be a key component of asset inspections and this relies on documentation of existing condition and establishing performance indicators related to function in wet and dry conditions and regular inspection of assets.

Natural assets such as natural streams, wetlands and riparian open space are also integral components of the urban stormwater system but are not currently part of Council's asset management system. Natural waterways are considered as the 'receiving environment' for stormwater and the role that natural waterways provides to convey stormwater and provide a drainage service just like built drains has received less consideration in the management of the stormwater assets. It is also these natural assets that require much of the maintenance effort to ensure adequate functioning of the system.

7.5.2 Asset Design

Many of the issues relating to poor function or performance of the stormwater systems relate to inadequate design or consideration of site-specific issues. This has resulted from the lack of clear design guidelines and lack of emphasis on the performance of the stormwater system at the development stage. Many design issues relate to the low, flat terrain and high groundwater table and inadequate consideration of these influences on drainage.

7.5.3 Asset Construction

Within Ballina Shire, major construction activity is associated with highway developments which are managed by Roads and Maritime Services. Urban construction practices are largely self-regulated with Council undertaking audits and inspections for major developments and responding to community complaints. Construction practices and erosion and sedimentation controls appear to have improved with the implementation of state government and Council guidelines as this has not been identified as a major concern since the 2002 USMS. Construction phase pollution issues are discussed in Section 7.4.1.

The key construction phase issues appear to be related to handover of assets to Council, including compliance, completion and operational requirements of the assets. This has resulted from the lack of clear guidelines and connection between the design, construction and operational phases as well as the lack of co-ordination between the different Council functions. In some cases, the developer has left the site, the site has been handed over to other developers, or the developer has experienced financial difficulty which leaves some assets (usually those with a long establishment time such as vegetated assets) incomplete. In contrast, handover activities undertaken for the Angels Beach North appear to have resulted in good outcomes for Council with the ability to modify some components of the system to reduce maintenance requirements.

Systems and processes that ensure stormwater assets are designed, constructed and established properly are not consistently applied, often resulting in Council receiving assets at the wrong time or that are inappropriate for the development or in poor condition. Council should inherit assets that are functioning properly and meet the design intent in order to protect receiving environments and avoid unnecessary maintenance burdens. Due to the nature of vegetated systems, being a combination of civil infrastructure and landscape, and the separate Council responsibilities, the process of asset handover is not being captured well.

7.5.4 Asset Maintenance

Current Council maintenance activities include:

- SQIDS – in accordance with the maintenance schedule included in the SQIDs manual; and
- Vegetated assets – regular or scheduled activities such as weeding, mowing or removing sediment and litter.

Council's SQIDs Manual documents the maintenance and service activities, cycles and service times for each device where the required information has been provided by the developer or determined by Council staff. Council's schedule for maintenance is often planned over the short-term with limited budget and is often reactive and directed to areas of complaints. Due to lack of access or visibility, some less prominent sites are overlooked (Photo 5).

Poor asset design can also contribute to maintenance difficulties. Many grass swales within the Shire have very low grade and do not drain adequately, often being water logged and unable to be mowed (e.g. Williams Reserve - Photo 6 and North Lakes). Inadequate buffer areas or access easements restrict machinery access which can contribute to establishment of nuisance vegetation and increased maintenance difficulty.

Photo 5: Outlets in inaccessible areas are difficult to access and not regularly maintained (Lennox beach headland)

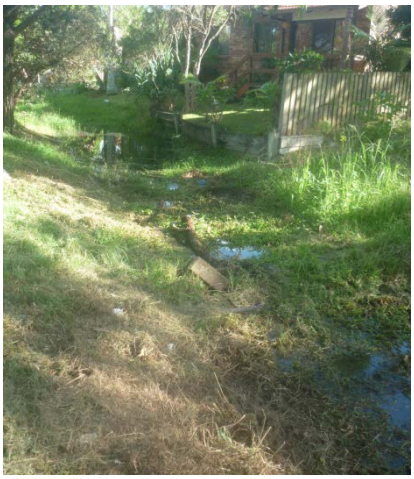


Photo 6: Waterlogged drain behind Williams Reserve, Lennox Head

A large component of the urban stormwater system consists of vegetated assets and these can be effective in reducing impacts of pollutants if they are well planned, designed, constructed and maintained. Inadequate maintenance has resulted in ongoing issues such as:

- Assets that fail to manage stormwater quality. This is potentially more serious when the ecological value of downstream waterways is high (e.g. fisheries and aquaculture areas);
- Poor amenity due to weed intrusion and pest species (e.g. Alstonville Creek);
- Litter and weeds accumulating in open drains (e.g. the Harvey Norman development) which are difficult to remove as the site is always wet;
- Health and safety problems such as mosquitoes, odours and safety risks (e.g. North Lakes, Harvey Norman development);
- High cost of rectification to a functional state (e.g. Alstonville Creek); and
- Reduced asset value.

In some cases, stormwater drains have become overgrown with vegetation which now has habitat values and/or been mapped as significant vegetation requiring stringent environmental controls. Due to the lack of planned maintenance in these areas, approvals are required before maintenance work can be undertaken. This has occurred in some SEPP14 areas fringing the waterways. In addition, *Phragmites* can establish in natural drainage systems. These aquatic reeds block the open drains (e.g. Ferngrove - Photo 7 and Skennars Head drain adjacent to Headlands Leisure Park - Photo 8) and exacerbate local flooding issues. Maintenance of such drains becomes difficult due to the density of the vegetation, the inadequate drainage and the establishment of habitat for aquatic fauna (e.g. the bush hen which is listed as a vulnerable species under the TSC Act 1995).

Photo 7: Inadequate maintenance can create blocked drainage (Ferngrove)

Photo 8: Drain at Skennars Head behind Headlands Leisure Centre overgrown with *Phragmites*

Council receives complaints about inter-allotment drainage (private mains) that are not Council assets. This arises from the land owner's lack of understanding about the function of the drainage system and their responsibilities for maintenance. Although these are not Council assets, Council often fixes these problems as 'good-will' gestures. Council should ensure private assets are adequately maintained through education, maintenance agreements attached to planning approvals, property covenants and creation of easements.

7.5.5 Capital Renewals/Rectification

Limited rectification of poorly performing or ageing assets has occurred due to limited funding and renewals planning. A cost-effective renewal program relies on accurate asset condition data and review of functional needs. Examples of major stormwater systems requiring rectification due to design flaws, poor construction and mass plant failure are discussed in Section 8.

Council currently replaces ageing assets with the similar infrastructure without consideration of future design requirements or system modifications. Increased emphasis on asset improvement and risk management is required. For example, the risk of flooding and inundation due to sea level rise needs to be considered in the renewals program.

7.6 Climate Change

The Richmond River CZMP (Hydrosphere Consulting, 2011) discusses the key issues relating to climate change adaptation. Natural variations in temperature and rainfall in NSW are influenced by the naturally variable climate systems. Although there is natural variability in the climate, there is consensus among climate scientists that the rate and magnitude of climate change is outside the expected range of this natural variability. Climate change is an important consideration for strategic planning, particularly in coastal areas where the combined effects of sea level rise and increased storminess are considered key threats.

The NSW Government's Sea Level Rise Policy (DECCW, 2009) states that sea level rise is inevitable and establishes planning benchmarks to be adopted in NSW. These benchmarks are an increase above 1990 sea levels of 40 cm by 2050 and 90 cm by 2100, an average increase of 0.8 cm per year. Sea level rise in the Richmond River estuary is anticipated to result in urban stormwater management issues including increased inundation of low lying lands, infrastructure and development and implications for drainage and flooding in urban areas. More frequent flooding of low-lying urban areas, such as much of Ballina, creates risks for the community in terms of managing urban drainage impacts.

The issue of potential increased storminess is less well understood. It is generally anticipated that rainfall events will become more intense, even if average rainfall reduces, in response to climate change. This may result in effects such as more floods as well as greater erosion of unconsolidated sediments within the catchment.

Climate change is inevitable and planning benchmarks already exist in terms of future sea level rise as discussed above. Locally, there will be impacts from climate change that are unavoidable such as sea level rise and changes to rainfall patterns and therefore long-term management planning needs to consider the likely changes to the Richmond River estuary and the factors constraining adaptation to such change. Council needs to ensure that urban stormwater management planning accounts for climate change adaptation requirements to appropriate function of the stormwater system under climate change conditions.

BSC has prepared a Floodplain Risk Management Study for the Lower Richmond (BMT WBM *et al,* 2012) which identifies that sea level rise is a significant concern for the town of Ballina. Current day flood risk on Ballina Island is relatively low, but will increase dramatically in the future. Estimated annualised flood damages increase by a factor of 10 by 2100. This is largely due to smaller, more regular, flood events affecting many more properties. For example, the flood damage from a 5 year ARI flood event in 2100 is more than three times the current day 100 year ARI flood damage.

7.7 Community Understanding and Education

Councils and other groups such as the Master Builders' Association and the NSW EPA have implemented some successful educational programs and currently provide public information on topics such as erosion and sedimentation control for building sites and stormwater pollution. However, limited information has been provided regarding the impacts of stormwater systems on localised flooding or the impacts of hydrological changes on receiving environments.

Within the community there is a general lack of knowledge of how stormwater systems work, what they should look like and how to assist their function. This can lead to complaints about performance of the systems as well as pollution from inappropriate discharges. In addition, some of the site-specific issues discussed in Section 8, the complexity of the issues and high costs of the solutions are not well understood by local residents, which lead to expectations of quick and easy solutions. Improved understanding of the function of stormwater systems and how the community can assist is required.

Photo 9: Educational Signage at Cumbalum, Ballina

The “showcase” pollution control device at the Lighthouse Beach lookout (implemented as part of the Shaws Bay Estuary Management Plan) does not function as designed and is poorly maintained (Photo 10). Modification of the site may be considered as a focal point for education on stormwater pollution.

Photo 10: Shaws Bay Stormwater Control Trial

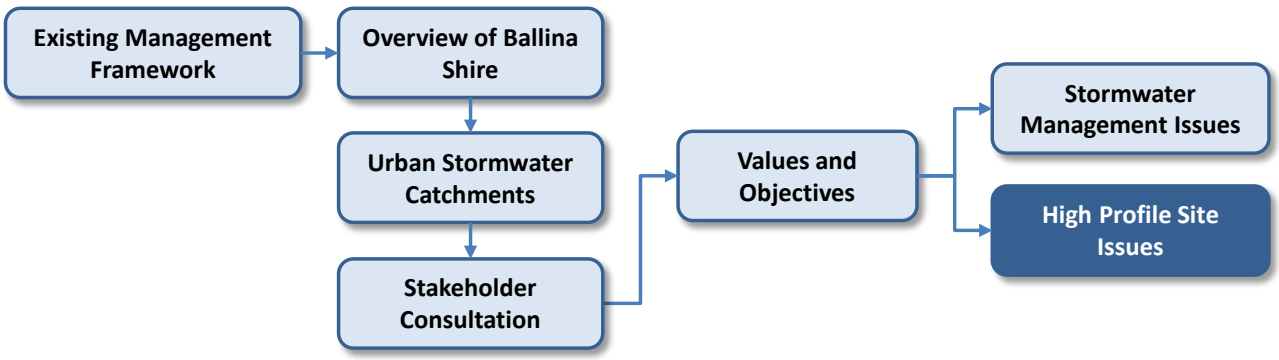
7.8 Knowledge Gaps

While there is generally a good understanding of major water quality issues in the Richmond River, the specific source of contaminants (agricultural, urban runoff, STP input etc.) is not well understood. The Richmond River CZMP includes actions for consistent catchment based monitoring and evaluation of ecosystem health issues.

Concern has been raised by stakeholders regarding the discharge of urban stormwater to sensitive receiving environments such as SEPP 14 wetlands, aquaculture areas and fish habitats. However, the key pollutants, sources and impacts have not been quantified. Existing monitoring programs are not targeted to identification of these issues. Specific investigations will be required in targeted areas to fill gaps in the current understanding of water quality issues and sources in order to direct appropriate management actions.

Informed decision-making will rely on knowledge of the key issues and the appropriate solutions. Council personnel have indicated that there is a lack of knowledge of maintenance and rectification requirements for some types of stormwater systems. Conversely, there is inadequate knowledge about which technologies and systems are appropriate for different sites and applications. This has resulted from a combination of inadequate co-ordination during the development approval stages, a lack of engineering input into maintenance tasks, decision-making undertaken without sufficient Council involvement (State Government approvals) and insufficient staff training.

8. HIGH PROFILE SITE ISSUES



This section provides examples of high profile stormwater management issues. This is not intended to be a complete list of the existing problem areas but highlights the key areas of risk for Council. The stormwater management areas are prioritised based on the key issues within each area.

8.1 Chickiba Wetlands

Stormwater Management Area: Angels Beach Chickiba (EA01)

The Chickiba Wetlands have been impacted from past developments within the area. Pressures and alterations to natural ecological function have resulted from:

- Clearing for grazing;
- Construction of infrastructure (especially roads, and also including sewage, power lines and pathways);
- Drainage for flood mitigation and agricultural endeavours;
- Other alterations to natural hydrology (including levees); and
- Urban development.

From current and past infrastructure and residential development within the SEPP 14 Chickiba Wetland catchment, and additional human disturbance pressures, the wetland has been subject to modified hydrological regimes. Drainage from the wetlands and sporting fields flows through an open drain on private property on the north side of Angels Beach Drive. This drain is subject to tidal flows from North Creek.

Infrastructure development has resulted in impeded natural flows from the wetland resulting in it becoming inundated with elevated depths of water for extended periods of time, and causing adverse ecological impacts such as *Melaleuca* dieback. In addition to the hydraulic impacts, invasive weeds are readily colonising the wetland area. This has impacts on the biodiversity value of the SEPP 14 coastal wetland. The impeded drainage has resulted in the severe degradation of over 40% of the Swamp Sclerophyll Forest in the study area, an endangered ecological community (WetlandCare Australia, 2009).

These human induced impacts have had serious impacts on the health and resilience of the current Chickiba Wetland site. These impacts include:

- Fragmentation and isolation from adjacent vegetation communities;

- Changes to water flow patterns, mainly as a result of the construction of Angels Beach Road which disrupted the primary discharge flow from Chickiba wetland and directed most discharge via a pipe culvert. This has resulted in slower overall discharge;
- Changes to wetting and drying regimes, resulting in reduced dry periods especially in the northern section of Chickiba wetland adjoining the sports fields;
- Raised surface and ground water levels, mainly as a result of impeded drainage via the constructed drain, but potentially also partly resulting from the construction of Angels Beach Road. The elevated water levels have resulted in the death of melaleuca, and their replacement by open water and more inundation-tolerant vegetation;
- Increase in sediment and nutrient loads; and
- Greater potential for infiltration of weeds;

Council is proposing to carry out works to help restore the health and ecology of East Chickiba Wetland. An environmental impact statement (EIS) has been prepared to address the impacts and causes of the degradation of the wetlands, present management actions to ameliorate them, and assess the environmental impacts of a suite of actions (WetlandCare Australia, 2009). The works consist of:

- Installation and management of a weir;
- Clearing of discharge drains and culverts including those under pedestrian paths/cycle ways;
- Improving drainage across adjacent sport fields by removing levees;
- Investigating and acting on opportunities to restore drainage to the north through private landholdings; and
- Monitoring changes in water quality and vegetation associated with the changed hydrological regime.

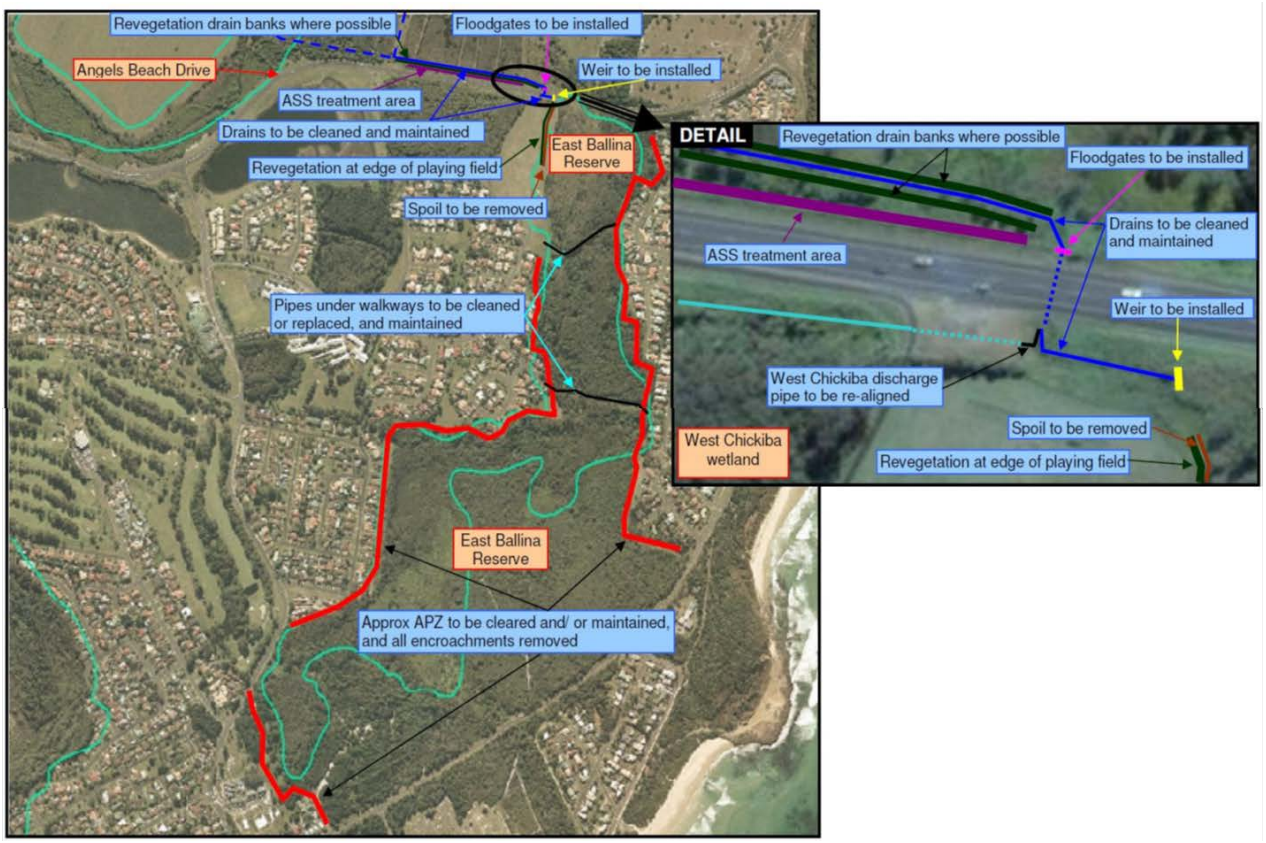


Figure 30: Plan of Drainage Works (BSC, 2012b)

A Wetland Implementation Action Plan (WIAP) has been prepared to assist with the Restoration of the SEPP 14 - Chickiba Wetlands Rehabilitation Project. While Council has identified external grants that may be available for the drain clearing and weir installation, implementation of the plan has been delayed due to lack of funding for the ongoing monitoring required as part of the EIS and Council development approval conditions.

8.2 Shaws Bay

Stormwater Management Area: Shaws Bay (EA04)

The Shaws Bay Estuary Management Plan (EMP, Patterson Britton and Partners, 2000) documents the management needs of Shaws Bay and the proposed activities which will address these needs. The Management Plan identifies 17 stormwater drains discharging from various locations around the shoreline. These represent the main potential pollutant sources from the surrounding catchment. The primary management issues related to pollution, siltation, recreation and ecology and management tasks were identified to address each of these management issues. The status of the management plan tasks is summarised in Table 29. Significant progress into resolution of the management issues has been made by Council.

Table 29: Implementation Status – Relevant Tasks from Shaws Bay EMP

Task	Current Status
Task A: Litter/debris Collection devices	Work previously completed covers the whole of the Shaws Bay residential estate ("Enviropod" baskets at inlet pits) and drainage from the Hill Street catchment including parts of Compton Drive via end of line pollution control devices. This covers most of the public stormwater drainage system entering the Bay with minor outlets from Compton Drive and some draining private land all that remain untreated. No further work is planned apart from maintaining the systems now in place.
Task B: Encouragement of Native Gardens	This has been addressed Shire-wide via the publication of the Urban Garden Guide and Protecting Reserves from Dumping Brochure. Illegal dumping is pursued wherever possible but has not been a serious issue in this area.
Task C: Garden Refuse Collection	This issue is addressed in the Council's Shire-wide Waste Management Plan which commenced in July 2011.
Task D: Gravel Aprons	Works to control scour at outlets from the stormwater drains were completed in 2010/11.
Task E: Community Education on Pollution	This is a continuing process Shire wide with advice in news letters on topical issues, publications issued with grant funding when available such as the Sustainable Urban Business Program and regular messages from all levels of Government. Rangers or Environmental Health Officers deal with offenders when evidence is available.
Task F: Regular Water Quality Monitoring	Shaws Bay is specifically addressed throughout the swimming season through the Beachwatch program run by Council in conjunction with the Office of Environment and Heritage. This includes bacterial indicators and physico-chemical parameters. The program is focussed on bathing water quality which over the years has been very good. It currently does not include nitrogen, phosphorus, algae or chemicals. It is anticipated that Shaws Bay would be included as part of the Richmond Estuary Coastal Zone Management Plan and that monitoring nutrients and other parameters could be funded as part of that program.
Task G: Install More Rubbish Bins	Complete. Adequacy is being monitored.

Task	Current Status
Task H: Improve Aesthetics of Foreshore	Management undertaken as required. Approval has been obtained for mangrove exclusion in specific areas and this is now occurring in accordance with a NSW Fisheries Permit.

Source: Ballina Shire Council (2011b)

8.3 North Lakes

Stormwater Management Area: Shaws Bay (EA04)

The North Lakes Residential Estate was established in 1991 to provide affordable housing on land located at North Creek Road, Ballina. The subdivision is located on the northern outskirts of Ballina and is situated adjacent to North Creek, an estuary which is a tributary of the Richmond River. Stormwater from the North Lakes Residential Estate catchment drains directly into a series of interconnected constructed stormwater ponds or urban lakes. The constructed urban lakes (referred to as North Lakes) collect stormwater runoff from the North Lakes residential development area only. The provision of an embankment wall with a constructed weir overflow arrangement and a reverse flow gate allow controlled interaction with the adjoining wetland and North Creek. All stormwater from the site discharges into the adjoining SEPP14 wetland area which is connected to the North Creek estuary (Tim Fitzroy & Associates, 2008).

A number of deficiencies have been identified in the operation and management of the North Lakes stormwater system. The main issues to be resolved surround the management and functionality of the lake system. Significant community concern was identified in the community survey undertaken for the development of this USMP.

The stormwater system design for the North Lakes development was not based on specific design criteria or technical specifications, nor was there a management plan established for the stormwater conveyance or constructed urban lake system. The design of the system allowed for a stormwater detention function, retaining the added increased stormwater runoff volumes and peak flows resulting from the urbanisation of the area. Other considerations in the establishment of the constructed urban lakes were visual amenity and creating a positive, natural and attractive open space area. However, there are differences between the as-built" stormwater system and the design plans, particularly (Tim Fitzroy & Associates, 2008):

- A direct hydraulic link between the two urban lakes;
- No functioning outlet structure for Lake No. 2;
- Increased water transfer between Lake No. 1 and the wetland; and
- Increased tidal inflows to Lake No 1.

During dry weather, the water level drops and odours occur.

The land (racecourse land) between the two lake systems is not Council owned and no provisions were made for public access to this area (Figure 31). This issue is particularly relevant as appropriate management of the hydraulic connection between the two lake systems a key feature of the current stormwater management system. Adding to the problems of the lack of suitable access for plant and machinery is the encroachment of paving, fences and other structures over Council property by some adjoining neighbours. As a consequence of the above factors it is not currently possible for Council to access the hydraulic connection with machinery and any maintenance has to be undertaken using hand tools such as spades and wheel barrows.

The Council managed areas include the urban lakes foreshore area, where accessible, and the swales and parks. Maintenance of Council property is undertaken via a combination of mowing, cutting, and pruning combined with weed spraying.

Council and community concerns regarding water quality, maintenance and amenity has triggered the preparation of an overarching Water Quality Management Plan (WQMP) for North Lakes to guide the future management of the system, assist in informing local residents on the lakes purpose and their potential impacts on its operation and assist to inform future planning decisions (Tim Fitzroy & Associates, 2008).

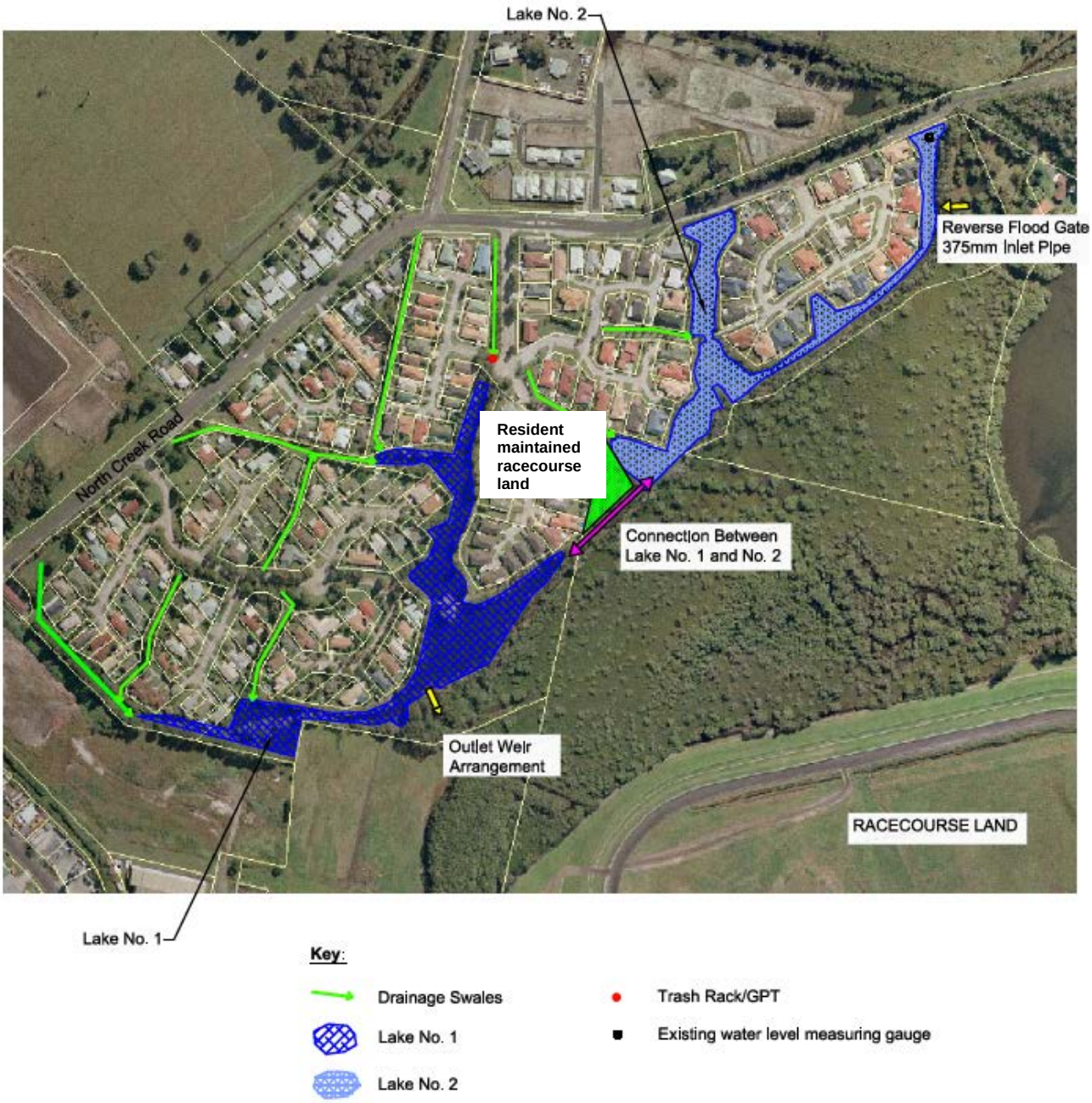


Figure 31: North Lakes site attributes (Tim Fitzroy and Associates, 2008)

A suite of recommendations are proposed to address the issues identified. Six improvement areas are included in the plan to improve the overall efficiency, performance and management of the North Lakes Residential Estate stormwater system:

- Swale drainage performance – swales are often subject to long periods of inundation and large melaleuca trees are planted on the swale edge creating difficulties for maintenance of these assets;
- Land ownership and access rights to open channel hydraulic connection;
- Hydraulic connectivity between lake systems;
- Outlet weir maintenance;

- Vegetation management; and
- System monitoring.

Implementation of the management plan has been hampered by lack of funding, the complex nature of the issues, stakeholder concerns and access issues.

8.4 Alstonville Creek (Tanamera Drain)

Stormwater Management Area: Alstonville (AL01)

During construction of the Tanamera Drain (part of Alstonville Creek), the downstream property was impacted by sedimentation. The property owner brought a successful litigation action against Council and the result is that ongoing maintenance of the drain is limited to minimal slashing of vegetation during dry weather. The original design and construction of the drain and the lack of maintenance has created a marshy, water logged swale area which is wider than originally designed and has the potential to cause localised flooding of neighbouring properties.

The watercourse itself feeds into Maguires Creek, which contains some of the few subtropical rainforest remnants in Ballina Shire. The creek system is currently infested with exotic grasses, environmental and noxious weeds. With insufficient riparian vegetation along its entire urban length, weeds proliferate and the local community are unable to appreciate the reserve as a natural feature. Stormwater outlets deposit rubbish into the system and fast moving water scours the existing landform. An old concrete invert runs along part of the watercourse length speeding up the water, reducing nutrient assimilation capacities and scouring particular sections. The construction of the Alstonville bypass and associated stormwater detention system (through Crawford Park) has the potential to increase flows in Tanamera Drain following heavy rainfall.

A concept plan has been prepared for rehabilitating a section of the Alstonville Creek stormwater catchment reserve from Apex Park through to and including the Tanamera stormwater reserve (GeoLINK, 2003). The plan includes paths and cycle ways, recreation facilities, interpretive signage, revegetation works, creek restoration and stormwater facilitation. The capital cost was estimated as $1.36m (indexed to 2012$). Council has not been able to fund implementation of the plan.

Council has negotiated an agreement with the land owners to incrementally implement the concept plan, however a staged process has not yet been developed. The concept plan needs to be reviewed to assess the costs and implications of the current situation and develop a cost-effective staged approach which addresses the key risks.

8.5 Cape Byron Marine Park (Seven Mile Beach, Lennox Head)

Stormwater Management Area: Lennox Head (LE03)

Both the Cape Byron Bay Marine Park Authority and DPI (Fisheries) have expressed concern about the potential impacts of stormwater discharge to the Cape Byron Marine Park at Lennox Head. The Moat/Bream Hole Sanctuary Zone and the Seven Mile Beach Habitat Protection Zone are special areas designated for protection of this unique habitat (Photo 11). The Moat / Bream Hole Sanctuary Zone includes the waters of the Moat/ Bream Hole that are bounded by the southern side of the Lennox Head Boat Channel, the reef edge of the Moat/ Bream Hole, the beach adjacent to the Moat/Bream Hole at mean high water mark, and the boulder foreshore which occurs adjacent to Lennox Head.

Stormwater pipes discharge onto the beach adjacent to the Moat/Bream Hole Sanctuary Zone. A study by Smith and James (2003) concluded that stormwater runoff had the potential to adversely affect benthic communities in this zone through osmotic shock, the transport of sediment from the beach and pollution from urban runoff which may result in burial of reef habitat and smothering of attached biota. The study recommended consideration of alternatives to the current stormwater discharge arrangement at the Moat.

Photo 11: Cape Byron Marine Park signage with stormwater pipes in background

Council has installed socks on the 450mm and 600mm stormwater pipes that discharge directly onto the beach. According to the asset register, the socks are listed as sediment traps and are to be inspected and cleaned after heavy rain or at least 3 times a year. It is not known whether these devices have been successful in reducing the impact on the Marine Park. Although acting as gross pollutant traps, it is unlikely that the coarse-meshed socks would address sedimentation issues. At the time of inspection, the stormwater pipe discharging near the Bream Hole was partially buried with sand (Photo 12).

Photo 12: Sock installed on stormwater pipe discharging onto Seven Mile Beach, Lennox Head

Several other stormwater headwalls discharge stormwater from urban areas to Seven Mile Beach. The headwalls are generally located along the base of the dune, but sand movement and erosion in this dynamic environment means this will not always be the case. Inspection of several stormwater outlets in April 2012 revealed that the stormwater assets on the beach varied from relatively new headwall structures to older assets in varying states of decay. Some assets have been destabilised and were cracked and leaking. Many beach stormwater outlets were also showing signs of erosion around and behind the structures. Community concerns include the decrease in visual amenity on the beaches due to the degraded condition of stormwater assets. All outlets have the nets attached to the discharge pipe acting as catch gross pollutant traps.

8.6 Skennars Head Drain

Stormwater Management Area: Skennars Head North Creek (LE07)

An open drain to the east and south of Headlands Estate Leisure Park, Skennars Head drains the Leisure Park, the Headlands Estate residential subdivision and the wetland to the north of Skennars Head Road

(refer Table 11). The drain has been constructed at low elevation and is often waterlogged with standing water in the southern section. *Phragmites* have established within the drains as maintenance is limited to occasional slashing. Vegetation removal causes a build-up of organic matter and sediment in the drain, exacerbating the poor drainage. The area is popular with bird watchers as nesting areas for the Bush Hen have been established in the drain (listed as a vulnerable species under the *TSC Act 1995*). Residents and management of the Leisure Park have also expressed concern about the potential for flooding.

The key issue with the drain is the lack of regular maintenance which has resulted in the establishment of Bush hen habitat and the risk of localised flooding. Future maintenance activities would require approvals in relation to the modification of habitat for the vulnerable Bush hen.

8.7 Lake Ainsworth

Stormwater Management Area: Lake Ainsworth (LE02)

In 2002, Council adopted the Lake Ainsworth Management Plan (GeoLINK, 2002). The Management Plan identified a number of key issues relating to the lake and recommended a number of strategies and actions that would protect and where possible, improve the lake environment and its surrounds. However, a number of the strategies identified in the plan required more detailed planning and investigation. In late 2004, Council as the Reserve Trust Manager for the Lake Ainsworth Crown Reserve, prepared a Master Plan to guide land use and the future development of the Crown Reserve. Following consideration of a number of issues, the Reserve Trust adopted the Master Plan for the future use and management of the Reserve in November 2006. The preferred option included water quality improvements to retain, filter and treat as much of the overland flow from the catchment as possible prior to entering the lake. The primary objective of treating the flows from the catchments was to remove pollutants including sediments, nutrients, hydrocarbons and litter (Connell Wagner, 2005). The adopted Master Plan also included development of alternative access roads around the lake and associated stormwater systems.

DPI-Crown Lands doe not support the adopted Master Plan in relation to the provision of access roads. Council cannot implement the stormwater management requirements until an agreed approach to traffic management is developed.

8.8 Pacific Pines Water Quality Control Pond

Stormwater Management Area: Pacific Pines (LE06)

NSW Fisheries and EcoFishers have identified the Pacific Pines water quality control pond as a pollution “hot spot” due to the occurrence of algal blooms. In addition, development of the upslope areas has changed the downstream hydrology and impacts are experienced on downslope floodplain areas. The pond is upstream of SEPP14 wetlands and mangrove areas adjacent to North Creek. There is also concern about the potential exacerbated impact of the future development of the Pacific Pines Estate which would also utilise the existing pond as the downstream component of the stormwater system (Photo 13).

Photo 13: Pacific Pines Residential Development and water quality control pond

Council is engaging with the developer to undertake rectification measures that increase the capacity of the pond. Future development stages would require additional measures to treat stormwater within the catchment.

8.9 Prioritisation of Site Management Issues

Council is faced with a range of site-specific urban stormwater management issues which are the legacy of poor planning, coordination and development controls and inadequate funding. Council has progressed the planning for rectification of many of these issues and is implementing some components with the limited funding available.

Based on the discussion in the above sections, the description of the stormwater management areas (Section 4) and stakeholder feedback (Appendix 4), a risk assessment has been undertaken to prioritise the site specific actions within each stormwater management area considering:

- Environmental risks – downstream impacts, connectivity with surrounding ecosystems, habitat value, water quality impacts;
- Property risks – flooding, erosion;
- Community Concern - community values, feedback from stakeholders; and
- Rectification progress – Council's progress with development and implementation of a solution.

The USMP aims to address all identified issues through holistic management actions, increased effort or through site-specific management actions. The prioritisation process allows identification of the key risks and allocation of appropriate management actions. The USMP aims to direct funding to the stormwater management areas with the highest overall risk within the short-term.

The risk assessment is summarised in the following table.

Table 30: Prioritisation of Stormwater Management Area Issues

SMA		Key Management Issues	Environmental Risks	Property Risks	Stakeholder Concern	Rectification Progress (key issues)	Priority
WO01	Wollongbar	None identified	Ongoing maintenance (e.g. weed removal) required.	None identified	Low	N/A	Not rated
AL01	Alstonville	Tanamera drain historical issues and maintenance difficulties	Weed encroachment, mosquitoes, snakes, platypus habitat	Lack of maintenance increases flooding risk to adjacent properties	Medium	2003 Concept Design, ongoing landholder negotiations	High
LE01	Fig Tree Hill	None identified	SEPP 14 wetlands to the east (unquantified impacts)	None identified	Low	N/A	Not rated
LE02	Lake Ainsworth	Unresolved master planning inhibits progress of stormwater improvements	On-going water quality issues in lake including nutrient enrichment and periodic blue green algae blooms	None identified	Recreational value of lake to be protected	Master Plan included stormwater improvements but relies on resolution of traffic management issues.	High (once master plan approved)
LE03	Lennox East Seven Mile Beach	Protection of Cape Byron Marine Park Sanctuary Zone and Habitat Protection Zone	Untreated stormwater flows (apart from gross pollutants) discharges into key fish habitat	None identified	Fish habitat protection	Periodic maintenance of GPT socks	High
		Cracked stormwater drains on beach contribute to erosion and reduced amenity	Beach scour	None identified	Beach amenity to be protected	None	Medium
		Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall	None identified	Localised flooding of roads during heavy rainfall	Flooding, restricted access	None	Low

SMA		Key Management Issues	Environmental Risks	Property Risks	Stakeholder Concern	Rectification Progress (key issues)	Priority
LE04	Lennox West North Creek	Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall	Vegetation associated with stormwater drains is protected (e.g. service station), restricting maintenance activities	Localised flooding during heavy rainfall. Ponding in swales restricts access and contributes to risk of localised flooding (e.g. Williams Reserve)	Flooding, restricted access	None	Medium
LE05	Boulders Beach	Increased stormwater flows to Boulder's wetland and beach. Future maintenance of assets in major development area.	None identified	None identified	Council maintenance requirements for Coastal Grove development (e.g. rain gardens)	None	Low
LE06	Pacific Pines	Water quality control pond algal blooms and poor water quality, potentially exacerbated by future residential development.	Pond drains into SEPP 14 wetland and mangroves – potential water quality impacts (sedimentation, reduced salinity, nutrients etc.)	None identified	Fisheries concern regarding pollution from pond	Council engaging with developer to improve performance of pond and stormwater systems. Development controls for future stages.	High
LE07	Skennars Head North Creek	*Phragmites* blocking open drain adjacent to Headlands Leisure Park exacerbating localised flooding issues	Bush hen habitat now established (Vulnerable species under *TSC Act 1995*) requiring environmental assessment before maintenance work can be done	Increased flooding risk due to lack of maintenance	Flooding, restricted access (Headlands Leisure Park)	None	High
LE08	Skennars Head Sharpes Beach	None identified	None identified	None identified	None identified	N/A	Not rated

SMA		Key Management Issues	Environmental Risks	Property Risks	Stakeholder Concern	Rectification Progress (key issues)	Priority
LE09	North Creek Road	Water quality in stormwater pond at Elevation	Drains to oyster lease area	None identified	Resident concern regarding reduced amenity	None	Medium
NO01	North Ballina (Airport)	RTA borrow pit poor water quality (not quantified)	Drains to oyster lease area	None identified	Fisheries concern regarding impact on oyster lease	None	High
		Harvey Norman Centre open drain/infiltration basin does not function as designed. Accumulation of litter and weeds. Lack of access for maintenance.	Drains to oyster lease area	Increased flooding risk due to lack of maintenance	Council concern regarding function of drain, lack of maintenance and safety risk (water depth)	None	High
NO02	North Lakes/ Ballina Racecourse	Water quality issues in North Lakes stormwater ponds (algal blooms, odours, fish kills). Lack of access for maintenance due to land ownership and water logging of swales. Weeds and bank erosion around lakes.	Drains to SEPP 14 wetland, mangroves and oyster lease area	Increased flooding risk due to lack of maintenance. Lack of amenity due to poor water quality, fish kills, odours.	Property owners concerned about lack of amenity and flooding risk.	North Lakes Water Quality Management Plan has not been implemented due to lack of funding and complexity of issues.	High
NO03	Southern Cross Drive	Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall	Drains to vicinity of oyster lease area	Localised flooding during heavy rainfall	Flooding, restricted access	None	Medium

SMA		Key Management Issues	Environmental Risks	Property Risks	Stakeholder Concern	Rectification Progress (key issues)	Priority
CU01	Cumbalum	Weeds observed in rock-lined channels. Access for maintenance difficult due to high slope and rocks	Ongoing maintenance (e.g. weed removal) required.	None identified	None identified	None	Low
		Future development of Precinct A and B.	Drains to Newrybar Swamp (SEPP14), Ballina Nature Reserve and key habitat areas.	To be addressed through future development controls.	Significant community concern regarding impact of development.	Rezoning plan developed but stormwater issues not yet resolved.	High
EA01	Angels Chickiba	Modified hydrological regime due to residential development has impacted on Chickiba wetlands	Vegetation (*M. Quin* and endangered swamp orchid) and flooding impacts, poor drainage of sports fields, weed growth	Water logging prevents maintenance of asset protection zones	Council and community concern about impacts on Chickiba wetland and sports fields.	WIAP being developed. Implementation of actions is limited by funding	High
EA02	Angels Beach	Water-borne pollutants (including roadside rubbish and chemical runoff) from urban areas is washed into natural bushland areas via stormwater (either uncontrolled or via drains without pollutant traps)	Transport of weed propagules (seeds, roots, tubers etc.) to key habitat areas. Scouring, erosion, gullying and sedimentation from uncontrolled runoff during heavy rainfall events from urban areas to bushland sites.	None identified	Community concern regarding impact on downstream vegetation	Bush regeneration activities through volunteer groups.	Medium
EA03	Prospect/ North Creek	None identified	Drains to SEPP 14 wetland, mangroves and oyster lease area	None identified	None identified	None	Not rated

SMA		Key Management Issues	Environmental Risks	Property Risks	Stakeholder Concern	Rectification Progress (key issues)	Priority
EA04	Shelly Beach/ Black Head	Cracked stormwater drains on beach contribute to erosion, reduced amenity	Beach scour	None identified	Beach amenity to be protected	None	Medium
		Lack of drainage from Beachfront Parade and Bayview Drive results in stormwater funnelling through pedestrian underpass and into adjacent bushland causing erosion/ sedimentation	Bushland erosion and sedimentation	None identified	Beach amenity to be protected	None	Medium
		"Showcase" stormwater trap at Ballina Lighthouse headland not adequately maintained or functioning effectively.	Beach pollution	None identified	Missed opportunity for community education facility.	Maintenance regime (SQIDs manual)	Low
EA05	Shaws Bay	Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall	None identified	Localised flooding during heavy rainfall	Flooding, restricted access	Implementation of Shaws Bay Management Plan	Low
		Mangroves established in stormwater drains due to tidal intrusion and lack of maintenance.	Environmental assessment required before maintenance work can be done (removal of mangroves)	Localised flooding during heavy rainfall	Community concern regarding impacts on sea grass	Implementation of Shaws Bay Management Plan	Low

SMA		Key Management Issues	Environmental Risks	Property Risks	Stakeholder Concern	Rectification Progress (key issues)	Priority
BA01	Ballina Island North Creek	Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall	Drains to oyster lease area	Localised flooding during heavy rainfall/high tides	Flooding, restricted access, saltwater intrusion	Flood Risk Management Study, draft Flood Risk DCP	Medium
		Ageing assets need repair/replacement	Drains to oyster lease area	Localised flooding during heavy rainfall/high tides	Flooding, restricted access, saltwater intrusion	Renewals program	Medium
BA02	Ballina Island Richmond River	Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall	Drains to oyster lease area	Localised flooding during heavy rainfall/high tides	Flooding, restricted access, saltwater intrusion	Flood Risk Management Study, draft Flood Risk DCP	Medium
		Ageing assets need repair/replacement	None identified	Localised flooding during heavy rainfall/high tides	Flooding, restricted access, saltwater intrusion	Renewals program	Medium
WE01	West Ballina Richmond River	Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall	Drains to oyster lease area	Localised flooding during heavy rainfall/high tides	Flooding, restricted access, saltwater intrusion	Flood Risk Management Study, draft Flood Risk DCP	Medium

SMA		Key Management Issues	Environmental Risks	Property Risks	Stakeholder Concern	Rectification Progress (key issues)	Priority
WE02	West Ballina Fishery Creek	Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall	Drains to oyster lease area	Localised flooding during heavy rainfall/high tides	Flooding, restricted access, saltwater intrusion	Flood Risk Management Study, draft Flood Risk DCP	Medium
		Ferngrove Estate: stormwater assets (vegetated swale and basin) overgrown with weeds and difficult to maintain. Grade of stormwater not adequate to achieve required stormwater conveyance.	None identified	Localised flooding during heavy rainfall/high tides	Council and resident concern regarding lack of maintenance, reduced amenity and flooding risk.	None	Medium
WA01	Wardell	Stormwater drainage on floodplain is impeded by low grade and high water table and often fails during heavy rainfall	None identified	Localised flooding during heavy rainfall/high tides	Flooding, restricted access	Floodplain management plan	Medium

9. DEVELOPMENT OF THE USMP IMPLEMENTATION PLAN

Based on the urban stormwater management issues identified in the previous sections, a prioritised schedule for implementing the proposed management strategies is presented in the USMP Implementation Plan (Volume 1 of the USMP).

The Implementation Plan includes:

- Management strategies based on the issues raised in this document (Volume 2);
- Broad actions (managerial, operational, planning, design and construction) required to implement each strategy;
- A 10-year schedule of actions required to implement the USMP; and
- Key performance indicators (KPIs) and targets for the successful implementation of the actions.

Management strategies identify those responsible for the delivery of each action, the estimated costs and potential sources of funding. The strategies consider and support the broader policies, strategies and targets identified at the state, regional and catchment level. Where issues are already being addressed by other management strategies, this is recognised in the USMP.

Management actions are immediate, ongoing, short term (1 - 3 years), medium term (4 - 6 years) or long term (7+ years). The implementation of some options may be reliant on pre-requisite actions which are required to determine the most appropriate solution and cost estimate.

A monitoring program has been developed utilising the KPIs, for the purposes of the on-going review and adaptation of the USMP Implementation Plan to ensure it continues to deliver sustainable outcomes. Where relevant, links to the Councils' existing environmental monitoring and reporting (such as the State of the Environment reports) activities were developed.

The implementation of the plan is supported by a process for reviewing the effectiveness of the plan and adapting it as required. This aspect of the project is essential for ensuring that the urban stormwater management actions become a reality.

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Appendix 1: Planning Context

This Appendix provides detailed information on the planning processes that apply to the management of urban stormwater in Ballina Shire.

State Government Policies and Guidelines

Relevant environmental planning instruments under the *Environment Planning and Assessment Act, 1979* are summarised in Table 31.

Table 31: State Environmental Planning Policies

Policy	Application to this Plan
North Coast REP, deemed SEPP (1988)	This plan covers all of the North Coast LGAs. It identifies environmental features that are important to the region and provides a basis for new urban and rural development. The plan sets requirements for, and guides, the preparation and processing of local environmental plans and some forms of development.
State and Regional Development SEPP 2011	The State significant assessment system establishes two separate assessment pathways known as State significant development (SSD) and State significant infrastructure (SSI). Projects that fall into these categories are assessed by the Department of Planning and Infrastructure. The SEPP defines which projects come into the system. The SSD assessment system has been established to guide planning decisions on large-scale industrial, resource and other proposals and development in precincts identified as important for the State by the NSW Government.
SEPP 1 (Development Standards)	The aim of SEPP 1 is to provide councils with the flexibility to vary development standards contained within gazetted environmental planning instruments where it can be demonstrated that compliance with the development standard, in the particular circumstances of an individual development application, is unreasonable or unnecessary.
SEPP (Exempt and Complying Development Codes) 2008	Streamlines assessment processes for development that complies with specified development standards. The policy provides exempt and complying development codes that have State-wide application, identifying, in the General Exempt Development Code, types of development that are of minimal environmental impact that may be carried out without the need for development consent; and, in the General Housing Code, types of complying development that may be carried out in accordance with a complying development certificate as defined in the *Environmental Planning and Assessment Act 1979*.
SEPP No. 4 - Development without Consent and Miscellaneous Complying Development	This policy allows relatively simple or minor changes of land or building use and certain types of development without the need for formal development applications.
SEPP Remediation of Land, 1998	Councils must ensure contaminated land undergoes remediation before it is developed through the application of land remediation guidelines. The appropriate management and remediation of contaminated sites will minimise the risk of contamination of waterways.
SEPP Building Sustainability Index (BASIX), 2004	This SEPP operates in conjunction with Environmental Planning and Assessment Amendment (Building Sustainability Index: BASIX) Regulation 2004 to ensure the effective introduction of BASIX in NSW. The SEPP ensures consistency in the implementation of BASIX throughout the State by overriding competing provisions in other environmental planning instruments and development control plans, and specifying that SEPP 1 does not apply in relation to any development standard arising under BASIX. BASIX was mandatory for regional NSW from 2005/06. All new residential development, as well as residential alterations and additions, are required to meet targets for water and energy efficiency.

Policy	Application to this Plan
SEPP Infrastructure, 2007	Provides a consistent planning regime for infrastructure and the provision of services across NSW, along with providing for consultation with relevant public authorities during the assessment process. The SEPP supports greater flexibility in the location of infrastructure and service facilities along with improved regulatory certainty and efficiency The policy consolidates and updates 20 previous State planning instruments which included infrastructure provisions. It also includes specific planning provisions and development controls for 25 types of infrastructure works or facilities.
SEPP 71 Coastal Protection	The policy has been made under the *Environmental Planning and Assessment Act 1979* to ensure that development in the NSW coastal zone is appropriate and suitably located, to ensure that there is a consistent and strategic approach to coastal planning and management and to ensure there is a clear development assessment framework for the coastal zone
SEPP 62 Sustainable Aquaculture	Encourages the sustainable expansion of the industry in NSW. The policy implements the regional strategies already developed by creating a simple approach to identity and categorise aquaculture development on the basis of its potential environmental impact. The SEPP also identifies aquaculture development as a designated development only where there are potential environmental risks.
SEPP 26 Littoral Rainforests	Protects littoral rainforests, a distinct type of rainforest well suited to harsh salt-laden and drying coastal winds. The policy requires that the likely effects of proposed development be thoroughly considered in an environmental impact statement. The policy applies to 'core' areas of littoral rainforest as well as a 100 metre wide 'buffer' area surrounding these core areas, except for residential land and areas to which SEPP No. 14 - Coastal Wetlands applies.
SEPP 19 Bushland in Urban Areas	Protects and preserves bushland within certain urban areas, as part of the natural heritage or for recreational, educational and scientific purposes. The policy is designed to protect bushland in public open space zones and reservations, and to ensure that bush preservation is given a high priority when local environmental plans for urban development are prepared.
SEPP 14 Coastal Wetlands	Ensures coastal wetlands are preserved and protected for environmental and economic reasons. The policy applies to local government areas outside the Sydney metropolitan area that front the Pacific Ocean. Land clearing, levee construction, drainage work or filling may only be carried out within these wetlands with the consent of the local council and the agreement of the Director General of the Department and Planning. Such development also requires an environmental impact statement to be lodged with a development application.

NSW Government Sea Level Rise Policy Statement, 2009

To support sea level rise adaptation, the NSW Government has prepared a Sea Level Rise Policy Statement. This sets out the Government's approach to sea level rise, the risks to property owners from coastal processes and assistance that Government provides to councils to reduce the risks of coastal hazards.

The Policy Statement includes sea level planning benchmarks which have been developed to support consistent consideration of sea level rise in land-use planning and coastal investment decision-making. The adopted benchmarks are for a rise relative to 1990 mean sea levels of 40 cm by 2050 and 90 cm by 2100. These benchmarks represent the Government's guidance on sea level rise projections for use in decision-making.

NSW Diffuse Source Water Pollution Strategy

The NSW Diffuse Source Water Pollution Strategy provides a framework for coordinating efforts in reducing diffuse source water pollution across NSW. The Strategy promotes partnerships, provides a guide for investment, and provides a means to share information on projects and their outcomes across the State. Developing and implementing this Strategy is a joint initiative by the State's natural resource managers (at State, regional and local government levels), building on and supporting a range of existing diffuse source water pollution management actions.

The main aim of the Strategy is to reduce diffuse source water pollution inputs into all NSW surface and ground water and contribute towards the community agreed NSW water quality objectives and State-wide Natural Resource Management targets listed in the State Plan - A new direction for NSW.

A Priority Action Plan has been developed as part of the NSW Diffuse Source Water Pollution Strategy. It identifies agreed projects that will be progressed across NSW to help improve management of priority diffuse source water pollution problems. The first NSW Diffuse Source Water Pollution Strategy Annual Report was published in November 2010. It reports on the implementation of the individual actions identified it the Priority Action Plan.

Case studies implemented as part of the strategy include retrofitting an existing concrete channel with a GPT upstream of a constructed multi-cell wetland to prevent pollutants being transported to Lake Macquarie and riparian improvements, stormwater treatment and reuse. The strategy can be used to support bids for project funding and to encourage collaboration between organisations to achieve cost efficiencies.

Interim Water Quality and River Flow Objectives

The ANZECC Guidelines for Fresh and Marine Water Quality (2000) provide a framework for conserving ambient water quality in rivers, lakes, estuaries and marine waters. This framework is used to develop water quality and river flow objectives.

The EPA has developed water quality and river flow objectives for the Richmond River Catchment. Each objective aims to improve river health by recognising the importance of natural river flow patterns. Councils are required to consider these environmental values and long-term goals when assessing and managing the likely impact of its activities on waterways.

The objectives were developed in a whole of government process lead by DECCW. Objectives were developed through extensive community consultation and are intended to assist resource managers in assessing and setting targets for environmental values with associated water quality indicators defined by ANZECC.

There are eleven WQOs that provide reference levels to guide water quality planning and management. The objectives consist of three parts, environmental values, their indicators, and their numerical criteria. Environmental values outline values and beneficial uses of the environment that are important to a community. The primary contact recreation environmental value for example, includes swimming or any activity with a likelihood of water being swallowed. The indicators provide a measurement of specific environmental trends while the criteria provide the framework for measuring how close current water quality is to meeting the desired levels.

NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS)

This identifies the key water quality parameters necessary for sustainable oyster aquaculture and establishes a mechanism to maintain and improve the environmental conditions required for sustainable oyster production. The commercial and recreational fishing industry (driven by the environmental subcommittee of the Seafood Industry Advisory Council) is developing a water quality initiative, based on the strategy. The OISAS will be reviewed in 2012.

National Parks and Reserves Plans of Management

The management of national parks, nature reserves and state conservation areas in NSW is in the context of the legislative and policy framework, primarily the *National Parks and Wildlife Act 1974 (NPW Act),* the *NPW Regulation, Threatened Species Conservation Act 1995 (TSC Act)* and the policies of the National Parks and Wildlife Service (NPWS).

Other legislation, international agreements and charters may also apply to management of the area. In particular, the *Environmental Planning and Assessment Act 1979 (EPA Act*) may require the assessment and mitigation of the environmental impacts of works proposed in this plan. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act*) also applies in relation to actions that may impact on matters of national environmental significance, such as migratory species and threatened species listed under that Act.

A plan of management is a statutory document under the *NPW Act*. Once the Minister has adopted a plan, no operations may be undertaken within the planning area except in accordance with this plan. This plan will also apply to any future additions to the planning area. Should management strategies or works be proposed for the planning area or any additions that are not consistent with this plan, an amendment to this plan or a new plan will be prepared and exhibited for public comment.

The Ballina Nature Reserve is a receiving environment for the Cumbalum and Lennox Head urban areas.

Floodplain Management Plans

The Floodplain Development Manual published in 2005 was prepared in accordance with the NSW Government's Flood Prone Land Policy. It guides councils in the development and implementation of detailed local floodplain risk management plans to produce robust and effective floodplain risk management outcomes.

The floodplain risk management process consists of the following steps:

- Flood Study: Defines the nature and extent of the flood problem, in technical rather than map form.
- Floodplain Risk Management Study (FRMS): Determines options in consideration of social, ecological and economic factors relating to flood risk.
- Floodplain Risk Management Plan (FRMP): Preferred options publicly exhibited and subject to revision in light of responses. Formally approved by the council after public exhibition and any necessary revisions due to public comments.
- Plan Implementation: Implementation of flood, response and property modification measures (including mitigation works, planning controls, flood warnings, flood readiness and response plans, environmental rehabilitation, ongoing data collection and monitoring) by council.

Ballina Shire Council has prepared a FRMP for Wardell and a FRMS for Ballina.

Regional Management Plans

NRCMA Catchment Action Plan

The 2006 Northern Rivers Catchment Action Plan (CAP) has been developed by the Northern Rivers Catchment Management Authority (NRCMA) under the *Catchment Management Authorities Act, 2003* (NRCMA, 2006). The Plan sets a 10-year investment strategy for targeted investment for the region which extends over most of the NSW North Coast, from the Camden Haven River in the south to the Queensland border in the north and extending west to the Northern Tablelands. The CAP is the central mechanism to prioritise and deliver natural resource management investment and outcomes to the community of the Northern Rivers region.

The CAP draws together targets outlined in three previous Catchment Blueprints that have been reviewed and evaluated through a facilitated process of stakeholder engagement. Targets aim to improve the natural assets such as water, coastal landscapes and estuaries, the marine environment, soil, cultural heritage and biodiversity. The CAP also promotes the value of communities in the catchment, and aims to capture the communities' priorities and aspirations for the protection and enhancement of natural resources in the region.

The CAP outlines many varied approaches to achieve targets, the majority of which rely on voluntary input from landholders and other stakeholders. The CAP also provides priorities to guide a range of other processes including local government and NSW Government regulatory processes.

Richmond River County Council

Richmond River County Council (RRCC) was constituted by proclamation on 25 November 1959 and has been delegated with the responsibility for flood mitigation activities for Ballina, Lismore and Richmond Valley Councils. Council's proclamation was amended most recently on 5 September 2008, when natural resource management of the flood management infrastructure was formally incorporated as a RRCC function.

RRCC provides a coordinating role in floodplain management, working with constituent councils, State and Commonwealth agencies, university researchers, and floodplain industries to develop long-term effective natural resource management strategies for the Richmond River Floodplain and estuary. Council is responsible for the routine maintenance of its various canals and floodgate structures including the construction and replacement of flood mitigation infrastructure.

Council Management Plans

Environmental Action Plan

The EAP informs Council's Delivery Program and Operational Plans that are required by the Department of Local Government as part of the Integrated Planning and Reporting Framework. Each of these programs and plans serve to inform the community about how Council is moving toward its commitments in the Ballina Shire Council Community Strategic Plan (CSP).

The EAP outlines Council's own commitments in meeting the environmental components of the CSP and identifies the principal activities that the organisation is undertaking to meet those objectives. It documents planned improvements in Council's practices that will improve the environmental sustainability of the organisation. Although these actions are focused on improving environmental outcomes, many actions also have economic or social benefits. This plan aims to improve the planning and priority setting for the Council as a whole organisation with respect to its various environmental initiatives. This action plan will assist in the review of resources available to develop and implement environmental programs, ensure we are able to measure our performance, and identify areas which would benefit from a more proactive development of programs and initiatives.

Relevant environmental achievements include:

- The Sustainable Urban Business Project which assessed businesses in the area with the view of improving their environmental sustainability. The focus was to assess environmental matters such as energy usage, waste management, water and stormwater management, air emissions and use of raw materials.
- The Erosion and Sediment Control Enforcement Program which reduced the amount of sediment and other material entering the stormwater system thus protecting the water quality of the Shire's waterways.

The EAP includes an action to update and implement the urban stormwater management plan. The EAP also includes actions that have yet to be progressed as well as ideas that have been put forward by staff, Councillors and the public that may be considered in the future. Examples include:

- A stormwater risk assessment for climate change (particularly for floodplain areas) to improved public health and water quality and feed into long-term decision making about future of low lying urban areas.
- Stormwater Quality Management Plan at Council's Waste Management Facility to improved water quality and reduced risk of pollution.

State of the Environment (SOE) Report

SOE reporting is effectively a "Report Card" on the condition of the environment and natural resources. Council prepares these reports each year, as a measure of what initiatives have been undertaken in the local area in response to environmental issues and to assess new emerging environmental trends. Relevant pressures impacting achievement of the CSP objectives are identified in the 2009/10 SoE Report (Ballina Shire Council, 2010) as follows:

- Contaminants such as lawn clippings, pet droppings, sediments, rubbish, oils and grease from urban stormwater place stress on our waterways. These contaminants can cause water quality problems, reduce visual amenity and impact adversely on aquatic flora and fauna. Preventing these contaminants entering our waterways is an ongoing challenge for the community and Council.
- Approximately 80% of the population live in an urban area, whether this is in the coastal settlements of Ballina and Lennox Head, the river village of Wardell or the plateau townships of Alstonville and Wollongbar. The benefits of a highly urbanised population include containment of urban sprawl and enhancement of lifestyle by ensuring people live close to amenities. The disadvantages include management of stormwater, provision of appropriate levels of key infrastructure, traffic management and conflicts between differing land uses.

Other Relevant Council Management Plans

Strategic plans prepared by Council are discussed in the following table.

Table 32: Ballina Shire Council Strategic Plans

Plan	Application to this Study
Ballina Foreshore Master Plan	The Ballina Foreshore Master Plan builds on existing information on Crown land and Council sites on the Richmond River foreshore located between Burns Point ferry and the Missingham Bridge. The foreshore land includes several large Crown and Council sites and a number of smaller ones that together provide a foreshore asset for the Ballina community. In preparing the Ballina Foreshore Master Plan each site was assessed in terms of physical and environmental characteristics, existing infrastructure and facilities and planning constraints and opportunities.
Vegetation and Land Management in the Maguires Creek Catchment	This report has been prepared for Richmond Landcare Inc. and Ballina Shire Council, in conjunction with Landcare groups in the Maguires Creek catchment, to provide information relating to the current land use, existing native vegetation and environmental restoration projects being undertaken within the catchment.
Vegetation Management Plans	Ballina Council is in the process of producing Vegetation Management Plans for all the reserves in the Shire that contain native vegetation.
Acid Sulfate Soils Management Plan	Recent changes to Council's local environmental plan now require development consent to be obtained for certain works on lands where there is a potential to expose acid sulfate soils, either by excavation or by lowering the water table.

Plan	Application to this Study
Ballina Coastal Reserve Precinct Plan	The Ballina Coastal Reserve Plan of Management has been developed for the coastal Crown lands within Ballina Shire north of the Richmond River to the northern Shire boundary. The Ballina Coastal strip consists of 93% Crown land of the immediate coastal foreshore and approximately 85% of all land east of the Coast Road. The preparation of the Plan of Management allowed for the creation of a single Reserve for Public Recreation and Coastal Environmental Protection under section 87 - *Crown Lands Act 1989* that is known as the Ballina Coastal Reserve. Ballina Council was subsequently appointed as the Trust manager of this very large Crown Reserve. The Ballina Coastal Reserve Plan of Management was prepared to assist Ballina Shire Council in achieving integrated, balanced, responsible and ecologically sustainable development and management of the Ballina Shire coast. The Precinct Plans are designed to develop the management objectives and recommended management strategies found in the Plan of Management. Precinct Plans are action plans developed at a local level to address social, recreational and environmental issues. The five Precincts delineated in the Plan of Management are: 1. Northern Shire boundary on Seven Mile Beach to Ross Street just south of Lake Ainsworth 2. Lake Ainsworth to Shag Rock (south of Lennox Point) 3. Shag Rock, Boulder Beach, Skennars Head and North Sharpes Beach 4. Flat Rock, Angels Beach and Black Head 5. Shelley Beach, Ballina Lighthouse Beach, Shaws Bay and surrounds.
Emergency Risk Management Plan	The Emergency Risk Management Strategy documents the hazards/sources of risk (severe storm, flood, bush fire, transport accident, etc.) which would require a significant and coordinated response. The strategy includes information relating to sources of risk/hazards which have resulted in large emergency events and which have occurred in or around the Ballina local government area.
Growth Management Strategy	Ballina Shire Council has prepared the Draft Ballina Shire Growth Management Strategy. The purpose of the draft strategy is to provide a framework for managing population and employment growth in Ballina Shire with respect to residential, commercial and industrial development over the planning period of 2012-2031. The draft strategy was on public exhibition until 1 June 2012.

Appendix 2: Status of 2002 USMS Actions

This Appendix provides a summary of the implementation status of the actions in the 2002 Urban Stormwater Management Strategy.

Management Options/Actions	**Status (2011)**
Council as a whole	
Lobby state and federal government agencies for increased stormwater funding	Unknown
Review allocation of rate income	This is done as part of Council's normal operations.
Building Services	
Distribution of relevant guidelines with all building approvals (education program for builders).	The following information is sent out with building approvals: Sediment & Erosion Control Guidelines for Builders and Developers. Planning for Erosion and Sediment Control on Single Residential Allotments. Erosion and Sediment Control Warning Sign.
Development Services	
Liaise between Council, DLWC, NSW Fisheries and RCMA where stormwater impacts on aquatic ecosystems and fisheries are likely to be significant.	This is routinely done through the development application process.
Delineate existing 50 metre riparian vegetation buffers on GIS system for protection through planning controls.	This has not been done. Develop Services Land Information Mapping Officer was not aware of this action.
Exhibit and invite public submissions to draft stormwater management strategy	Unknown
Public and Environmental Health	
Distribute urban residents questionnaire	This questionnaire has not been distributed
Public Information strategy (schools, shopping centres, Council chambers, media advertisement)	Council has stormwater information on their website. Articles are also placed in the advertorial of the local paper. Educational seminars have been held for erosion and sediment control for Council staff, builders and developers. Brochures are available at Council chambers. Environmental Health Section has an education and enforcement program for erosion and sediment control.

Management Options/Actions	Status (2011)
Stencil labelling of Roadside Stormwater drainage pits	This was carried out as part of the Stormwater Education & Assessment Project (SEA). The was an initiative of the Ballina, Byron, Kyogle, Lismore, Richmond Valley and Tweed Council's to work with businesses to foster a commitment towards protecting the local environment.
Contact and investigate improved fertiliser, pesticide and herbicide use by bowling and gold clubs and ranges.	This was carried out as part of the Stormwater Education & Assessment Project (SEA). The was an initiative of the Ballina, Byron, Kyogle, Lismore, Richmond Valley and Tweed Council's to work with businesses to foster a commitment towards protecting the local environment.
Undertake business waste audit (including identification of locations and extent of hazardous substances & investigation of possible funding opportunities to subsidise hazardous waste disposal facility).	This has not been carried out as recommended in the Strategy however the storage of wastes were reviewed during the Sustainable Urban Business project business audits. The storage of wastes is also reviewed should Council receive a complaint.
Discuss with DLWC the possibility of expanding the 'Streamwatch' program conducted by various schools throughout the Shire.	This has not occurred.
Continued active participation in the 'Northern Rivers Phosphorus Reduction Campaign' organised through DLWC and Lismore City Council.	The 'Northern Rivers Phosphorus Reduction Campaign' is no longer operational but it has been replaced with such programs as the Stormwater Trust Program through DECCW.
Investigate measures to prevent pollution from slipways, boat maintenance and boat refuelling at Smith Drive, Ballina Quays and Boat Harbours.	Council has not carried out any investigations, however DECCW has carried out a survey in the Ballina area on these issues.
Enforcement of sediment and erosion control requirements for building sites (increased site inspections, advice, warning and fines – education program for builders).	An erosion and sediment control education and enforcement program has been implemented to monitor building and development sites in the Shire.
Modification of guidelines for builders and developers to ensure they clearly define responsibilities and penalties for non-compliance (education program for builders).	Guidelines are readily available as Council's front counters relating to stormwater management and erosion and sediment control. Education programs have been carried out for local builders and developers.
Prepare a list of developer guidelines including acceptable stormwater treatment measures that incorporate efficacy, aesthetics, safety and affordability (including maintenance costs).	This has been produced except they do not discuss maintenance costs.

Management Options/Actions	Status (2011)
Produce guidelines for builders regarding potentially polluting activites including acid washing, paints, solvents, concrete slurries, brick/paver cutting etc.	Guidelines have been produced by the Master Builders Association and Council has modified and reproduced these brochures and booklets for the Ballina Shire.
Enforcement of laws concerning littering, rubbish dumping and disposal of trade wastes.	Council's EHO's and Rangers enforce such laws as part of their general duties.
Continued involvement in and promotion of 'clean-up Australia day' and water week.	Environmental Health Section are routinely involved in 'Clean-up Australia day' each year.
Review preparedness for major crisis e.g.. Fuel tanker spill	Hazmat & Fire Brigade
Increased signage regarding stormwater issues in revegetation demonstration, problem litter areas, illegal rubbish dumping areas.	This is routinely done when required in conjunction with Council's Open Spaces and Reserves Section.
Continued water quality monitoring for faecal coliforms in high use recreational areas.	Council is involved in the DECCW Beachwatch program that provides regular and reliable information on beach water quality to enable people to make informed decisions about where and when to swim. Beachwatch monitors water at swimming locations to assess the level of faecal contamination. Enterococci as the single preferred indicator organism for the detection of faecal contamination in recreational waters. Council currently monitors 6 sites in the Ballina Shire.
Continue to enforce restrictions (e.g. Management plan requirements) for development on acid sulfate soils.	ASS are routinely considered when assessing development applications.
Investigate funding possibilities with other Richmond catchment Councils, DLWC and EPA to employ an environmental education officer to work throughout the catchment.	This has not occurred.
Apply for general stormwater funds/grants.	Grant application in process through the DECCW for an Estuary Management Program
Apply for stormwater funds/grants specific to local Councils.	Grant application in process through the DECCW for an Estuary Management Program.
Participate in catchment based water quality monitoring program (to replace local government monitoring) proposed as part of the Richmond catchment urban water management workshop, 7 & 8/12/99	This has not occurred.
Formulate and undertake periodic stormwater quality monitoring program at priority points throughout the Shire (e.g.. Wollongbar and Ballina Industrial Estates, Kerr Street, North Creek Canal).	This has not occurred.
Engineering Works	

Management Options/Actions	Status (2011)
Earthworks to divert stormwater runoff around Lumley park, Alstonville	Redirection of overland flow and improvement to swales has occurred along Park Ave.
Inspect all stormwater outlets into water bodies (and review maintenance and repair program) to ensure discharges are non-erosive.	Resource allocation has not allowed for this action to be undertaken. Response is limited to reported incidents.
Earthworks to divert stormwater runoff around Bangalow Palm forest, Tara Downs, Lennox Head	Nil
Increase cleaning frequency of litter rack installed at Ballina Fair shopping centre	Not recorded as Council maintenance responsibility.
Review of cleaning program for stormwater pits (litter and sand) and high litter areas.	Maintenance program in place for pits and structures with Stormwater Quality Improvement Devices (SQID)
Continue to enforce restrictions on development in flood prone areas.	Refer Council planning documents
Development of a flood management plan.	Floodplain Risk Management Study and Plan currently in progress. Forecast completion 2011.
Investigate the imposition of a section 94 contribution on developers (stormwater levy).	Nil
Apply for general stormwater funds/grants.	Ongoing liaison with Corporate Comms & Tourism section for grant advice
Apply for stormwater funds/grants specific to local Councils.	Ongoing liaison with Corporate Comms & Tourism section for grant advice
Open Spaces and Reserves	
Review Council fertiliser, pesticide and herbicide use in public areas	Council has a Pesticide Use Policy that was reviewed Feb this year. Council only uses organic fertilisers and usage level is low.
Assistance to urban weed control, revegetation and fencing efforts by Landcare and other community groups and schools (cooperation, advice and provision of plants, materials and equipment).	Council continues to support the efforts of volunteer environmental groups working on both public and private land. National Tree Day and World Environment Day are celebrated with planting days at Pat Morton Lookout. Council pays for their insurance and provides material and training.

Management Options/Actions	Status (2011)
Install signage in Crawford Park (Alstonville) and the Ballina Bicentennial Gardens to promote native vegetation plantings as showpiece/demonstration areas for household plantings (low fertiliser and water requirements)	Not done did not know this was requested. Would not use these sites if this project was to be considered.
Review grass cutting strategy to increase height of grass near stormwater drains, creeks, lakes and the Richmond River.	Would have little effect as the same amount of growth would still be removed at each cut. Council only mows essential areas around houses and is always looking to eliminate mowing if possible.
Continued wetland and riparian rehabilitation through appropriate plantings along Alstonville Creek off Tanamera Drive.	Has not been funded.
Install signage (including species list) in Lumley Park, Alstonville, to promote existing riparian vegetation as a showpiece/demonstration area for revegetation works.	Not funded or done
Review adequacy of rubbish bin network (size, location and cleaning frequency) in commercial centres, and high use areas (parks, popular picnic sites, beaches, etc.).	There are ongoing problems with misuse of bins in many locations and to assist with the management of these issues bins are only located at essential high use areas.
Strategic Services	
Review and modify Council planning instruments and policies (including Subdivision Code) to ensure all future urban developments incorporate appropriate BMP stormwater treatment measures according to EPA	Stormwater DCP provisions currently under review as part of comprehensive DCP renewal. Subdivision being addressed as part of this process.
Review and modify Council planning instruments and policies (including Subdivision Code) to ensure, where applicable, the use of vegetative swale rather than kerb and gutter in future road design.	Stormwater DCP provisions currently under review as part of comprehensive DCP renewal. Subdivision being addressed as part of this process.
Review and modify Council planning instruments and policies to protect ecologically sensitive areas (exclude proposed stormwater discharge points within 50m of sensitive habitats. Ensure discharge follows well established drainage paths).	LEP renewal has identified additional areas for environmental protection zoning. Draft LEP includes provision addressing erosion and sedimentation in relation to significant natural areas and habitat. Stormwater DCP provisions currently under review as part of comprehensive DCP renewal. Subdivision being addressed as part of this process
Review and modify Council planning instruments (including Subdivision Code) to ensure all future urban developments incorporate water sensitive urban design principles.	Stormwater DCP provisions currently under review as part of comprehensive DCP renewal.

Management Options/Actions	**Status (2011)**
Provide training to Council staff in accordance with modified planning instruments and policies (including Subdivision Code).	Training is planned in relation to implementation of new LEP upon its completion. Similar training may be provided upon update of DCP.
Apply for general stormwater funds/grants.	Strategic and Community Services Group has undertaken no action in this area.
Apply for stormwater funds/grants specific to local Councils.	Strategic and Community Services Group has undertaken no action in this area.
Water, Sewer and Waste	
Identify Wardell residents not connected to the new sewer system and investigate ways to encourage their connection.	This has not been actioned by anybody in Water and Sewer
Digitise existing stormwater network including drains, swales and modified natural drainage channels for incorporation into Council's GIS database.	Stormwater is managed by Engineering Works. This action is part of a joint project proposal for his position with Water and Sewer and Engineering Works)

Appendix 3: Review of Other Council Urban Stormwater Management Strategies

During data review stages of the USMP the stormwater management strategies and activities of other Councils were reviewed to present a summary of current practice. Staff from 4 other Councils were interviewed to document their approach to stormwater management.

Below is a summary of activities other councils have undertaken to manage stormwater in their local government areas.

Local examples

Lismore City Council

Lismore City Council (LCC) updated their Stormwater Management Plan (SMP) in 2007. The SMP divides the Lismore urban-zoned area into stormwater sub-catchments to simplify assessment of issues. The Plan outlines the community values, threats to stormwater quality and quantity, the management objectives and lists the strategies to achieve these objectives. An adaptive implementation approach has been adopted where strategies will be incorporated into 'action plans' on an annual basis and integrated with longer term plans in line with Council's three year management plans.

LCC have recently introduced a stormwater management services charge to allow council to undertake management actions outlined in the Plan. The Plan includes a framework for the expenditure of the stormwater management services charge and provides and overarching implementation process for strategies identified in the SMP.

Currently Council are working on some key sites, where stormwater assets have been retrofit to improve stormwater quality, biodiversity, habitat and aesthetics. Examples are Browns Creek channel design and Rotary Drive headwall remediation. Many projects have been undertaken in partnership between LCC and EnviTE NSW.

LCC is also working on finalising a service level agreement between Council departments to ensure maintenance requirements for stormwater are understood and carried out to a certain standard.

Tweed Shire Council

Tweed Shire Council is currently updating their Urban Stormwater Quality Management Plan (adopted by Council in 2000) to reflect current best-practice. The plan was at Final Draft stage at the time of compiling this review. The Tweed plan contains comprehensive background information of general stormwater issues and principles, the Tweed catchments and receiving environments affected by stormwater and has a strong emphasis on achieving water quality objectives for downstream waterways. The plan sets out:

- Stormwater management objectives;
- Best practice design guidance and refers to latest versions at that point in time, rather than a static reference; and
- Specific guidance on monitoring and maintenance of SQIDs.

The Tweed plan refers to a number of guidelines, resources and tools that should be used to implement best practice stormwater management, many of which have been developed by the Water By Design program for the South East Queensland Health Waterways Partnership.

Tweed Shire Council Development Design Specification D7 – Stormwater Quality is the policy specification that prescribes stormwater quality measures to be adopted for development requiring consent under the Environmental Planning and Assessment Act 1979. The design specification refers to the USQMP which may be updated overtime with regard to local stormwater objectives.

The Tweed plan documented the stages of SQID development from design and approval to construction and maintenance. This could be a useful exercise to apply to the BSC USMP incorporating all stormwater assets (not just SQIDs) and identify where issues have been identified along the way. This should assist in identifying which stages of the process need to be improved.

TSC staff were interviewed to ascertain their approach to urban stormwater management. One of the key changes in approach was the concept of compensatory activities to offset residual and cumulative impacts of stormwater discharge into waterways. Where it is determined that the residual discharge from a development

will have a detrimental impact on water quality objectives in the receiving environment, Council may consider a Voluntary Planning Agreement (VPA) via which stormwater impacts on the waterway are offset by rehabilitation, retrofit or compensation measures at another location – within the same catchment. The basis of this concept is that the overall ecological health and resilience of the waterway can be improved as a result of the development, despite the potential worsening of water quality due to development discharge. A VPA can also be a mechanism via which resources are strategically redirected to contribute to catchment wide water quality initiatives, achieving ecological and economic benefits of scale, rather than smaller, localised stormwater devices.

The Tweed plan appears to be a general guidance document and does not set out a specific implementation plan of actions to be implemented by Council and/or other agencies with timeframes, responsibilities and funding sources identified.

Byron Shire Council

Byron Shire Council completed their Urban Stormwater Management Plan in 2000 with the primary aim of addressing 'environmental protection' issues. This included stormwater quality, river flow, riparian vegetation and aquatic habitat management. The plan did not address flood or drainage mitigation issues. The approach closely followed the methodology set out in the EPA's Draft Council Handbook for Managing Urban Stormwater (1997). It contained the following components:

- the definition of stormwater management objectives for the catchments;
- identification of stormwater management problems and issues;
- the evaluation and ranking of potential stormwater management options;
- an implementation strategy which defines the management framework,
- detailed costs of implementing the actions, and a timeframe for implementation;
- a monitoring program to assess the effectiveness of the plan; and
- an evaluation and reporting program.

The Plan contained a three year implementation strategy. To date there has not been a review of the USMP, and the document currently has limited use in day to day running of Council.

NSW Examples

Cooks River

The Cooks River Stormwater Management Plan was completed as a partnership with 13 local councils, state agencies and the community under the Stormwater Trust program in 1999. A review of the plan has not been undertaken to date. The plan focussed primarily on improving water quality and the health of the Cooks River by identifying solutions to stormwater problems, which together with sewage overflows was considered the biggest contributor to water quality degradation. The approach followed the EPA's guidelines of defining values, identifying issues, objectives and setting out a prioritised implementation program detailing costs, timeframes and reporting and review requirements.

Newcastle City Council

The Newcastle Stormwater Management Plan (SMP) was completed in 2004 with the main focus on environmental protection. A review of their preceding Action Plan (2000) noted the success of Council's Water task Force as a management framework in providing ongoing implementation, monitoring and evaluation and report across all Council's functional units.

Interstate examples

Water By Design (South East Queensland)

The Water by Design program is part of the Health Waterways Partnership in SEQ. Most Local Councils in the region are members of the partnership including Gold Coast City Council, Brisbane City Council and Sunshine Coast Regional Council. The program supports the management of the whole urban water cycle in order to achieve sustainable development, including protecting and restoring the natural water cycle. A number of tools and resources to assist practitioners design, construct and implement water sensitive urban design have been or are being developed by the Water by Design Program. The suite of tools, resources and guidelines represent one of the most comprehensive and integrated management approaches to urban stormwater management in Australia. While these tools and resources have been tailored to South East Queensland, they are relevant to the Far North Coast NSW in terms of an effective overall management approach.

The document map for the program shows the range of guidelines published by Water by Design as well as those currently in development. The documents are arranged in line with the urban development process, starting with planning and concept feasibility and progressing to operation and maintenance.

Knox City Council (VIC)

Knox City Council has recently completed their Water Sensitive Urban Design (WSUD) and Stormwater Management Strategy (2010). The main focus of the strategy is on implementing WSUD to disconnect impervious surfaces from waterways wherever possible. The Strategy follows detailed research by Knox in partnership with Melbourne Water that identified stormwater as a major source of degradation to downstream waterways. The program focuses on six priority areas:

- Protection of high-value waterways;
- Addressing identified “hotspots” with high pollution loads;
- Integrating WSUD into Council retrofit and upgrade projects;
- Planning program reform;
- Maintenance of WSUD assets; and
- Evaluation of effectiveness of WSUD.

Derwent River (TAS)

The Derwent Estuary Stormwater Management Plan (2005) was prepared as a model for local governments in Tasmania. The SMP provides options to improve the management of stormwater, both in the catchment and within council planning and development frameworks. The SMP focuses on three major areas:

- “retro-fitting” existing urban areas to improve stormwater quality – this includes wetlands, rainwater tanks, education signage, habitat rehabilitation (revegetation)
- proactive council planning and development controls to minimise the impacts of future development on stormwater quality and quantity; and
- community and council stormwater awareness programs.

A summary of the opportunities identified for the development of the BSC USMP is given in the following table.

Table 33: Summary of key components of other urban stormwater management plans

Council	Year	Consultation			Issues identified				Objectives	Options/ Strategies		Implementation		
		Internal	Agencies	Community	Receiving environment impacts	Asset Management	Maintenance	Organisational	Stormwater objectives	Options identified	Options assessment and ranking	Implementation Plan with responsibility, timeframes and costing	Funding identified	Reporting and feedback
Lismore	2007	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓ To be developed annually	✓	✓
Tweed	2012	✓	✓	✓	✓	✓ SQIDs only	✓ SQIDs only		✓	✓				
Byron	2000	✓	✓	✓	✓	✓ SQIDs only	✓ SQIDs only	✓	✓	✓	✓	✓	✓	✓
Cooks River (13 councils)	1999	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
Newcastle	2004	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
Knox City	2010	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓
Gold Coast	No Plan													
Derwent River	2005	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓

Appendix 4: Consultation Activities

This Appendix provides a summary of the consultation activities undertaken during the development of the USMP and the outcomes.

Community Consultation

Consultation with community members was undertaken to facilitate collection of site-specific information, local knowledge and identification of community perceptions and aspirations. This information was used to identify issues and develop the management strategies.

The community consultation activities were targeted to Council's residential customers and included successful tools that have been utilised by Council for other similar projects.

The consultation activities included:

- Development of a project webpage detailing the project, its progress and outcomes;
- Preparation of a media release (attached);
- Advertisements in the Council notices pages of local newspapers;
- Articles in Community Connect for distribution to ratepayers with rate notices; and
- An online community survey.

Webpage

The project webpage was used to introduce the project, provide project updates and provide download links to documentation and the community survey. The webpage was hosted in Councils website from 20 February 2012 for the duration of the project (refer Figure 32).

Community Survey

The community survey was open between 20 February 2012 and 19 March 2012. A copy of the survey and the results are attached. 72 responses were received (70 online and 2 hard copies).

Council staff (internal stakeholders)

A workshop with Council staff was held on 14 February 2012 to obtain information on current and proposed future Council activities that relate to stormwater management including planning and development controls, monitoring, environmental and public health, water supply, sewerage, asset management, engineering works, open spaces and reserves, waste management, human resources, risk assessment and flooding. The aim of the workshop was to capture information from Council on potential and known stormwater issues, impacts, related projects and obtain any data that may be relevant. A summary of the workshop outcomes is attached.

An additional workshop was held with Council staff and DPI-Fisheries representatives on 5 June 2012 to present the draft findings of the project and obtain feedback.

External Stakeholders

Relevant external stakeholders were contacted by email or post to provide information on the project and obtain input into development of the plan. Written submissions are attached.

Table 34: Contact with External Stakeholders

Stakeholder	Contact	Status/Feedback
NSW DPI (Fisheries)	Patrick Dwyer	Written submission received 20/3. Meeting held 20/3/12 and 5/6/12.
NSW Office of Environment and Heritage	Rob Donahoe	No response
Richmond River County Council	Michael Wood	RRCC is interested in impact of Cumbalum development on Newrybar Swamp flood – will commence flood model in 2012.

Stakeholder	Contact	Status/Feedback
NSW Department of Planning and Infrastructure	Grafton	Not interested in being involved.
Roads and Maritime Services	Grafton	No response
Northern Rivers Catchment Management Authority	Peter Boyd, Area Manager, Murwillumbah,	Get involved in DAs only due to limited resources
Northern Rivers Tourism	Russell Mills or Jess McClean	Not interested in being involved.
Ballina Fisherman's Cooperative	Phil Hilliard	No response
Richmond River Shellfish Programme (Oyster Industry)	Geoff Lawler	Written submission received 16/3/12.
Jali LALC		No response.
Richmond Landcare	Kerrie O'Neill	Not interested in being involved.
Ballina Environment Society	Lyn Walker	Written submission received 10/4/12.
ECOFishers NSW	Ken Thurlow	Written submission received 17/3/12.
NSW State Emergency Services	Richmond Tweed Region	No response.
NSW Marine Parks Authority – Cape Byron Marine Park	Andrew Page	Written submission received 17/3/12.
Master Builders Association	Regional Manager - Selina Atkinson	Have forwarded email to members in area. No response.
Lennox Head Chamber of Commerce/Combined Sports Assoc.	Louise Owen	No response.
Ballina Chamber of Commerce and Industry		No response.
Alstonville Wollongbar CoC		No response.
Ballina Coastcare	Neil Denison	Written submission received 2/4/12.

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Urban Stormwater Management Plan

The Urban Stormwater Management Plan is currently being reviewed.

Take the Urban Stormwater online survey now - click here.

What is stormwater and where does it go?

Stormwater is water that starts as rainfall and enters stormwater pipes and streams. Stormwater runoff carries pollutants that have accumulated on surfaces such as roads, roofs, car parks and construction sites. Within the Ballina Shire, most stormwater runoff drains to downstream waterways including small creeks and eventually the Richmond River estuary. Stormwater runoff in some small coastal areas, such as Lennox Head and parts of East Ballina drain directly to the ocean.

What is the project?

Ballina Shire Council has engaged local consultants, Hydrosphere Consulting, to review and update the Ballina Urban Stormwater Management Plan. The aim is to improve the sustainability of the Shire's urban stormwater infrastructure and to protect the health of our waterways for future generations.
The new management plan will focus on reviewing Council's management and planning processes to ensure that stormwater systems are designed, constructed and maintained to best practice standards. The aim is to deliver the greatest benefit to the community at the least cost.
Whilst the plan will address stormwater management issues in the urban areas of Ballina, Wardell, Lennox Head, Wollongbar and Alstonville, the actions to be developed will have flow-on benefits to all our waterways and beaches.

How you can be involved

As part of the development of the management plan, the project team will consult with stakeholders and the community to facilitate collection of site-specific information, local knowledge and identification of community perceptions and aspirations. This information will feed into the identification of management issues (such as pollution hot spots) and tailoring of management strategies.

To obtain information from the community, residents and businesses are invited to complete an online survey. Alternatively, you can download a hard copy here and post your response to:

Attention: Urban Stormwater Management Project Team
Hydrosphere Consulting
PO Box 7059
Ballina 2478

Hard copies can also be obtained from Council's Customer Service Centre, corner Tamar and Cherry Streets, Ballina.

Please note: Survey closes Monday 19 March 2012.

For further information contact:
Robyn Campbell, Hydrosphere Consulting
ph. 02 6686 0084
http://www.hydrosphere.com.au/?p=contact

Figure 32: Initial Webpage content

Attachments

- Media Release
- Community survey
- Survey Results
- Summary of Workshop Outcomes – Council (Internal) Stakeholders
- Written submissions from external stakeholders.