STORMWATER MANAGEMENT PLAN

2004

sustainableNEWCASTLE

The City of Newcastle

Front cover:

“Inspection” of a street stormwater entry pit - Photographer David Gibbins.

Floating Litter boom trap in Styx Creek, Throsby Creek Catchment - Photographer Garry de Redder.

Mangrove forest edge, Lower Hunter Estuary -

Photograph courtesy Hunter-Central Rivers Catchment Management Authority.

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NEWCASTLE

Stormwater Management Plan

A catchment based Stormwater Management Plan for Newcastle.

Prepared by Newcastle City Council in conjunction with the Hunter Water Corporation, the Hunter – Central Rivers Catchments Management Authority (formerly The Hunter Catchment Management Trust) and the community.

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Acknowledgments

Newcastle City Council would like to thank those members of the community and community groups who participated so willingly in the preparation and implementation of Newcastle's Stormwater Management Plan and its review cycle.

Council recognises the contribution made by those Councils, agencies and organisations who enthusiastically supported the development, implementation and review of the Plan, including:

- Cameron Strategies
- Hunter – Central Rivers Catchment Management Authority (formerly Hunter Catchment Management Trust)
- Hunter Water Corporation
- NSW Department of Infrastructure, Planning and Natural Resources
- Hunter Region Organisation of Councils – Stormwater Extension Officer Program
- Lower Hunter and Central Coast Regional Environmental Strategy
- The University of Newcastle

EXECUTIVE SUMMARY

Governments and the community now recognise that urban stormwater pollution is a major contributor to environmental degradation of many of the State's natural waterways.

In Newcastle where most of the City's catchments have been extensively modified through urbanisation, the impacts of urban stormwater pollution are well documented.

The Newcastle Stormwater Management Plan identifies that concrete drains and channels have replaced extensive areas of natural creek and drainage systems in Newcastle. Tonnes of sediment and rubbish are annually transported into the lower reaches of the City's creeks, estuary system and beaches. Run off from roads and other sources contribute heavy metals, oils, bacteria, nutrients and other chemicals into the stormwater system and further pollute our waterways.

Stormwater pollution in Newcastle has impacted on the natural environment and the community in many ways. Extensive areas of habitat and native species of flora and fauna have been lost to current generations. Creek systems such as Throsby Creek have become choked in the lower reaches with contaminated sediments that have poisoned marine species and impacted on the economic viability of recreational and commercial fishing. Plastics, styrene and other rubbish litter the mangrove forests of the Hunter estuaries detracting from the natural and spiritual values of these places for the community. In addition to pollutants, natural creeklines throughout the City experience erosion and sedimentation impact as a consequence of increased frequency of erosive flows due to roofs, roads, paths etc built in our City.

As Newcastle strives to provide a more sustainable urban form for the benefit of future generations through its strategic planning strategies such as: the Newcastle Environmental Management Plan (Newcastle City Council, 2003); the Urban Strategy (Newcastle City Council, 1999); the Local Environment Plan (Newcastle City Council, 2000); and the total catchment management (TCM) strategies, the management of catchments and the improvement of stormwater quality and quantity become increasingly important in meeting quality of life objectives for the community.

The cornerstone of this Plan is the identification by the community of catchment values and management objectives, which serve as a guide for management action. The values identified were primarily environmental in nature, though community participants also gave priority to social and economic aspects.

The planning process involved an open and inclusive consultation approach enthusiastically embraced by the key stormwater managers and the community and delivering:

- a set of priority community catchment values
- to be protected by a set of priority stormwater management objectives
- which are influenced by a set of prioritised or key issues
- that are reflected in a series of stormwater management strategies, informed by an
- evaluation of management options
- which have generated a series of catchment-wide, as well as catchment specific, short-term actions
- to be delivered through an implementation strategy involving the Newcastle Stormwater Forum

The Plan provides a catchment-based framework for productive community and organisational partnerships, to deliver outcomes for improved stormwater quality and quantity. Seven catchment areas have been identified that cover the Newcastle LGA, namely Ironbark Creek, Throsby Creek, Cottage Creek, Purgatory Creek, Greenway Creek, the lower Hunter Estuary and a number of small Coastal catchments.

Newcastle City Council, the Hunter Water Corporation and the Hunter – Central Rivers Catchment Management Authority (former Hunter Catchment Management Trust), each have significant roles in stormwater and catchment management in Newcastle. They have made a strong commitment in the Plan to work in a cooperative manner, and to have regard to the principles of ESD and TCM in the implementation of the Plan.

The collaborative efforts of these three organisations, the community and other stormwater managers in Newcastle have delivered the majority of the priority short to mid term actions in the Action Plan 2000. Some of the key actions included:

- Continuation of Council commitment to leading stormwater improvement by resourcing Stormwater Task Force process.
- Implement the successful Business Pollution Prevention Program (BPPP) targeting high risk commercial and recreational landuses in the City
- Implementation of Creeks Alive program in conjunction with the Hunter – Central Rivers CMA and Hunter Water Corporation to capture a picture of the health and extent of the City's natural creek system.
- Implementation and ongoing evaluation of the Newcastle Urban Water Cycle Management Policy (2004) and DCP 50 for stormwater & water efficiency;
- A continued implementation of gross pollutant and sediment control devices as well as community & industry intervention programs;
- Monitoring of devices for trapping and cost effectiveness;
- Implementation of priority actions for coastal catchment stormwater management based on the Newcastle Coastal Management Program

The annual Newcastle Stormwater Forum identified in the Plan, has been a means of bringing together all participants to:

- Review progress and monitoring the effectiveness of the actions
- Provide the opportunity to expand the avenues for community participation in stormwater planning and management
- Identify and plan for future stormwater management actions
- Celebrate stormwater and catchment management
- Investigate new and emerging approaches and treatments in stormwater pollution.

The State of the Environment Report provides an important community reporting mechanism on the progress of the Plan implementation with "Water on the Web" providing a "hands on" means for finding out what's happening on the ground and how to get involved.

Thus the Plan provides a process and management framework to ensure that stormwater in Newcastle is managed in a sustainable manner through the ongoing cooperation and commitment of stormwater managers and the wider community to a catchment based, whole of water cycle approach to works and policy application.

Stormwater Management Plan Statement of Commitment, 2000

The City of Newcastle

HUNTER CATCHMENT MANAGEMENT TRUST
Care for the land

Hunter Water

NEWCASTLE STORMWATER MANAGEMENT PLAN

STATEMENT OF COMMITMENT

Governments and communities now recognise that urban stormwater pollution represents one of the most significant threats to our creeks, rivers, swamps, estuaries and coastline.

The Newcastle Stormwater Management Plan provides a framework and process for the catchment based management of issues that threaten the sustainability of the catchments and waterways in the City.

The health and well-being of communities is dependent on the long term viability of our natural systems.

Newcastle City Council, Hunter Water Corporation and the Hunter Catchment Management Trust are committed to the sustainable management of the catchments and waterways in the City and will:

- Work cooperatively in the implementation and ongoing review of the Newcastle Stormwater Management Plan;
- Support the role of the community in natural resource planning and management; and
- Have regard to the principles of ecologically sustainable development and total catchment management when exercising their stormwater and catchment management roles.

John Tate
Lord Mayor
Newcastle City Council

Harold Sternbeck
Chairman
Hunter Catchment Management Trust

David Evans
Chief Executive Officer
Hunter Water Corporation

PART A

Background to the Plan

Preamble

Introduction

PREAMBLE

Governments and communities now recognise that stormwater pollution is a major contributor to environmental degradation of many of the state's natural waterways.

In 1997 the NSW Government released a Water Reform Package as a means of building a secure water future for cities and towns throughout the state. The Government recognised that a secure water future is an essential prerequisite for the health of aquatic ecosystems, productive economies and the well being of communities.

The Water Reform Package included a requirement for local councils and stormwater managers throughout NSW to prepare a Stormwater Management Plan (SMP) for their urban communities (S 12 *Protection Of the Environment Operations Act 1999*). The primary aim of the SMP is to facilitate the coordinated management of stormwater within catchments to improve water quality and maximise the ecological sustainability of creeks and river systems.

The Newcastle Stormwater Management Plan is designed to support Council's vision for the City that Newcastle will become a model sustainable city of the 21st Century. It supports the objectives of the Newcastle Urban Strategy (Newcastle City Council, 1999) by identifying the role of catchments and natural systems in informing appropriate landuse and urban design outcomes.

Newcastle City Council has developed the Plan with the assistance of the Hunter Water Corporation, other stormwater managers and through active community participation. It recognises the important role that has been played by the Hunter _ Central Rivers Catchment Management Authority (former Hunter Catchment Management Trust) in coordinating catchment management activities in the Hunter River catchment and in particular the sub-catchments of Ironbark and Throsby Creeks.

The Plan aims to complement and strengthen the existing stormwater and catchment management frameworks in the City identified in the Newcastle Environment Management Plan 2003 (NEMP). The ongoing support for the annual Newcastle Stormwater Forum will provide the opportunity for managers to continue to review their efforts, identify new management actions and enable essential community participation. The Plan continues to provide a process to improve stormwater quality and quantity to protect and enhance the natural values of the City's catchment and waterways.

The Newcastle Stormwater Management Plan is a framework for action that acknowledges that effective management of stormwater within the City requires active involvement of many government agencies, adjoining councils, developers, industry, community groups and individuals and a change management perspective that identifies stormwater within an urban water cycle management context.

INTRODUCTION

Stormwater Management in Newcastle – a History

In 1888, Newcastle Council commended the construction of a piped system to serve the residential area. Nineteen kilometers of sewers were constructed to carry off roof water, as well as human sewage and house sullage. The Public Works Department criticised this approach, and when the Newcastle Sewerage Scheme was implemented, the drains were retained solely to discharge stormwater.

In the early 1890s, Public Works began taking out estimates for the construction of stormwater drains in Newcastle West, around Cottage Creek, in Newcastle Pasturage Reserve and in Wallsend and Plattsburg.

The drainage of low-lying parts of Newcastle Pasturage Reserve, which encroached upon Adamstown, New Lambton, Lambton and Hamilton was a comprehensive aspect of the project. The natural course of Throsby Creek was adjusted with the construction of a 3km channel and branches from Mitchell St, Tighes Hill to St James Rd, New Lambton.

In 1898 the Public Works Department concluded that the earth banks of the channels were unable to resist erosion by the water and needed to be protected. Teatree scrub was used to construct fascines, with couch grass growing through to consolidate the banks. By 1902, every stage of the Pasturage Reserve drainage scheme was completed.

The labour for the various drainage schemes came from men who had lost their jobs when local coal mines were closed down in the depression of the 1890s. The government claimed that while the work was done to appease the purchasers of crown land, it also helped to relieve the existing distress in the district.

Newcastle's growth early this century, stemming from the establishment of iron and steel works and subsidiary industries, emphasised the shortcomings of the original drainage system. In the 1920s, schemes were introduced to dispose of the larger quantity of run-off created by residential settlement and to eliminate local flooding in low-lying areas. Before 1924, the drainage system consisted mainly of earth channels of limited capacity.

Photo 1:

The first stormwater drainage project undertaken by the (Water) Board itself was the construction of the Waratah- Mayfield system. (above) Excavating the main channel. (below) A branch of the channel under construction. (Armstrong), 1967.

The transformation of the catchment was described by J.B Henson, the first Water Board engineer:

"*Originally, the catchments were flat, sandy, scrub-covered ground containing swamps and bounded by tree covered steep hills. Rainwater flowed quickly off the hills and accumulated in the swamps and on the flats, from which it flowed through natural watercourses to the Hunter River and percolated underground through the sandbeds to the same outlet. The settlement of the area has caused changes in the natural conditions, resulting in the general acceleration of the off-flow of stormwater. This is due to the clearing of trees and scrubs, formation of roads and streets, kerb and guttering, pavements, the erection of houses and the construction of surface and underground channels...The old swamps are being filled up and these areas are now no longer available for storage and so reduce the rush of water to the outlets (and) raise the flood water level."* (Armstrong, J. 1967 p. 178)

In the first decade of the 1900s, growth in the Cottage Creek catchment was rapid. The inefficiency of the system was highlighted in February 1908 when a storm caused flooding of Cottage Creek into Hunter and Steel Streets. By 1915, flooding had become so frequent that the Public Works Department was petitioned to prepare schemes to augment drainage in Newcastle, Hamilton, Wickham, Merewether, Lambton and Adamstown.

A branch of Throsby Creek known as Houghton-Le-Springs Creek then drained the low-lying part of Mayfield. Council advised the Water Board that the creek badly needed attention. A scheme was prepared which drained the creek with an open channel stretching from Tighes Hill, under the Port Waratah railway, and then by a partly covered and partly open channel following the course of the creek, across Hanbury St to Fitzroy St. The work was undertaken by the Water Board in the 1920s to give work to unemployed men.

Newcastle City Council's Engineer, J. F. Shine said of the Cottage Creek drainage system:

"*Its bed is an accumulation of ooze in which all debris that washes, or is thrown into the channel is caught and follows the process of decay, more or less dangerous to health, offensive and unsightly...The condition of the creek is an invitation to the large unthinking body of the public, anxious to get rid of rubbish, to throw it into the channel. The consequence is that it has become a kind of garbage dump for a great number of people who live in its vicinity."* (Armstrong, J. 1967, p. 186)

The Parliamentary Standing Committee on Public Works found that it was 'expedient' for the Cottage Creek stormwater channel to be widened and extended and work was commenced in 1925. The old concrete and rubble channel at Newcastle West was widened by removing one wall and extending the width. The channel under the railway line and Hunter St was duplicated to take the increased flow of water. The main practice of the scheme was to excavate and construct new channels through National Park and Branches to Merewether, Hamilton South, Merewether East and The Glebe. Some sections were covered due to safety concerns.

With the commencement of the Cottage Creek scheme, residents of the Throsby Creek catchment began to complain about insufficient drainage in their area. There was concern that the reclamation of land in the northern harbour outlet of Throsby Creek would cause serious flooding. Flooding was also a concern between Gregson Park, Hamilton and Broadmeadow Railway Station, which was drained by Styx Creek, a branch of Throsby Creek.

In 1928, the Assistant Colonial Treasurer, B. S. Stevens agreed to the Throsby Creek stormwater scheme, principally to alleviate the acute unemployment situation. The Public Works Department regraded and concreted the old earth channels of the Throsby Creek system to increase the velocity of run-off. The work took the total length of the new drainage system to 42km. As part of the project, the drainage of residential areas near Broadmeadow Station, Newcastle Race Course and Adamstown West was diverted from Styx Creek to a new underground system with an outlet near the showground.

In the 1930s, the Government handed the drains of the Cottage and Throsby Creek Systems over to the Water Board. Constructed sections of the Jesmond and Wallsend system were handed over in 1953. The Wallsend system had been constructed by the government around the turn of the century, while the Jesmond system was built in 1938-39.

Background

There is increasing recognition in the community that stormwater management needs to be undertaken in a safe and ecologically sustainable manner.

Stormwater has traditionally been regarded as a nuisance, causing many negative social and economic impacts usually associated with flooding. The stormwater management planning process now identifies a shift toward focussing on issues that affect the health and amenity of our waterways, the quality of our open space and the well being and long term viability of communities. Proposals to manage stormwater quality will need to address quantity issues and vice-versa.

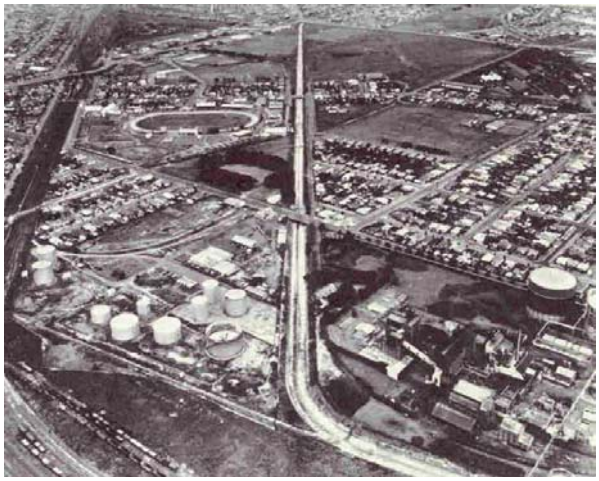


Photo 2:
The main channel of Throsby Creek originally of earth reconstructed of concrete in the Depression. (Armstrong, J., 1967)

The systems-based approach endorsed by the community and Council in the Newcastle Environment Management Plan 2003 (NEMP) identifies the need to consider all elements of the water cycle when management actions are considered. Newcastle's Urban Water Cycle Management Policy (2004) and Stormwater and Water Efficiency related Development Control Plan 50 for development reflects this strategic intent. Water Sensitive Urban Design (WSUD) is being promoted as a methodology delivering a more effective sustainable outcome for urban stormwater management than more traditional approaches. WSUD employs multi-disciplinary consideration of quality and quantity stormwater improvements and in so doing often provides esthetic, financial and social benefits of wiser water management.

Urban communities were first established in Newcastle in the early 1800s. The urbanisation of the city has continued from those early days to the point that now over 60% of the original landscape has been replaced by houses, commercial

and industrial developments, roads and other forms of community infrastructure.

The urbanisation of Newcastle has resulted in significant impacts on the natural environment. This is clearly evident through the removal of forests, the replacement of natural creek systems with concrete drains and channels and the introduction of pollutants and sediments that have destroyed fresh and salt water ecosystems and seen the accumulation of unsafe levels of toxins in some marine organisms. However, the City retains remnant wetlands and estuarine systems that are of such quality and significance that they are protected under international agreements.

The Newcastle Stormwater Management Plan has provided Council, the Hunter Water Corporation, other stormwater managers and the community with the opportunity to enhance the condition of degraded catchments and creek systems and improve water quality. Its implementation can provide long-term protection for the important ecosystems of Hexham Swamp and Hunter estuary. It can provide significant economic benefits to the community, and maintain acceptable amenity and quality of life for the many residents and visitors who enjoy the attraction of Newcastle's harbour and beaches.

Purpose of the Plan

The primary purpose of the Newcastle Stormwater Management Plan is to facilitate the coordinated and integrated catchment based management of stormwater quality and quantity within the City. The focus of the Plan is environmental protection through improved understanding, awareness and cooperation, and an emphasis on developing and implementing actions. In recent years the investment in multi-disciplinary learning opportunities in water change practices identified in SMP 2000 Action Plan has produced valuable demonstration sites and excellent up-skilling outcomes for Council staff, agency partners and the community.

This Plan is recognised as a valuable link in the process of mitigating existing impacts of stormwater and to provide the capability to avoid future impacts that threatens the sustainability of our aquatic, marine and riparian systems.

Guiding Principles

The management of stormwater quality is acknowledged to be a complex issue requiring consideration of ecological, social, and economic issues as well as physical interactions occurring in the natural environment.

The SMP is based on the principles of ecologically sustainable development, an integrated approach that recognises the interrelationship of the environment, society and the economy.

The word "sustainable" is derived from the term Ecologically Sustainable Development (ESD) that is defined in the Local Government Act (1993) as requiring:

"The effective integration of economic and environmental considerations in decision-making processes".

ESD can be achieved through the implementation of the following principles and programs:

The Precautionary Principle

If there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

Intergenerational Equity

That the present generation should ensure the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

Conservation of Biological Diversity and Ecological Integrity

That conservation of biodiversity and ecological integrity should be a fundamental consideration.

Improved Valuation, Pricing and Incentive Mechanisms

That environmental factors should be included in the valuation of assets and services.

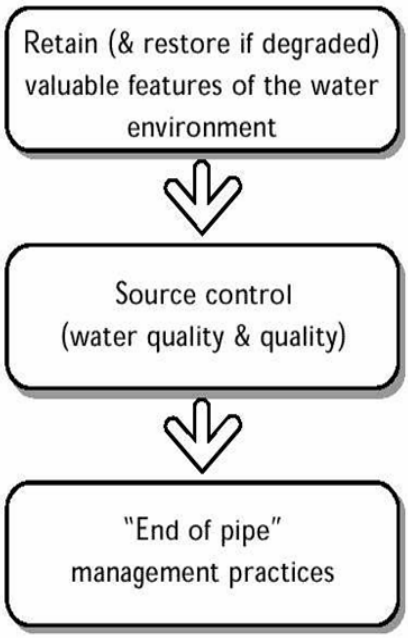


Figure 1: Stormwater Management Hierarchy (EPA, 1997)

In recognition of these principles the NSW Department of Environment and Conservation (formerly Environment Protection Authority – EPA) (1997) have proposed a compatible management hierarchy for Stormwater Management Planning, see Figure 1. The hierarchy proposes the preservation of valuable features of the water environment. It promotes cost effective stormwater management by controlling stormwater at the source and only proposing "end of pipe" techniques for residual impacts that cannot be effectively mitigated by source control.

We all live, work and recreate in "catchments", a dynamic natural system that defines a water shed for our creeks and rivers, where activities in one location can not only impact locally but impact elsewhere

in the catchment. The concept of "Total Catchment Management "(TCM) recognises that these internal linkages of natural systems need to be acknowledged in the development and implementation of the Plan. This “systems-based” approach has been encapsulated in Newcastle Environment Management Plan (NEMP) 2003 within the Water “theme” that provides strategic direction in the management of the water cycle issues set.

As members of the community of Newcastle we need to recognise the role we all have in the determination and management of Newcastle's urban structure. In the heavily urbanised catchments of the City, stormwater management should be linked very much to the way we plan and manage urban development on the fringe, infill development within existing urban areas, and even to improving performance through retro-fitting established residential/development areas. The underlying principles of Newcastle urbanism, reflected in the Newcastle Urban Strategy (Newcastle City Council, 1999), recognises that the planning approach needs to focus on the desired outcome and appropriate land use. The long-term sustainability of stormwater systems will be interdependent on the principles of Newcastle urbanism and natural resource management outlined in NEMP 2003.

How the Plan was developed

The Plan development process consists of six phases, which include:

- Phase I

  The production of an Issues Report to provide an understanding and awareness of stormwater issues within the City. It summarised much of what had already been said or written about catchment values, stormwater objectives, issues and options in the City. The Report was distributed throughout the community to interested individuals, groups and stormwater managers via mailouts, as well as Council and Hunter Water Corporation outlets. Newspaper, newsletter, radio and poster advertising welcomed participation in the project.

- Phase II

  The Consultation phase where community submissions and workshop and stormwater managers forums were conducted to review and prioritise catchment values and management objectives, and determine stormwater issues, management strategies and options for the city.

- Phase III

  Preparation of a draft SMP document incorporating all the outcomes from the consultation phase. Council endorsement for public exhibition of the draft SMP.

- Phase IV

  The public exhibition of the draft SMP allowed refinement of the catchment values and objectives, stormwater issues, management strategies and options. Participation in the review process was encouraged utilising submission call lines, workshop, focus group and one-on-one forums, in order to generate considered comment on the draft SMP.

- Phase V

  Consideration and inclusion of comment into the final SMP for adoption by Council, the Hunter Water Corporation and the Roads and Traffic Authority and thence, to the Environmental Protection Authority.

- Phase VI

  Monitoring review, reporting and updating the SMP.

The summary of the process is presented in the following flowchart, Figure 2 below. The expanded set of steps taken in developing and implementing the plan, as adapted from the EPA (1997), is included as Figure A in Appendix I.

In the development of management strategies and options for stormwater issues in the City it is critical to ensure that we fully utilise the stormwater information base and management framework that already exists, so that we are not "reinventing the wheel". A review of existing information was presented in the Issues Report, Newcastle Creating a Stormwater Management Plan (Newcastle City Council, 1999), which covered the values, objectives, issues and options as already identified through community consultation and management processes.

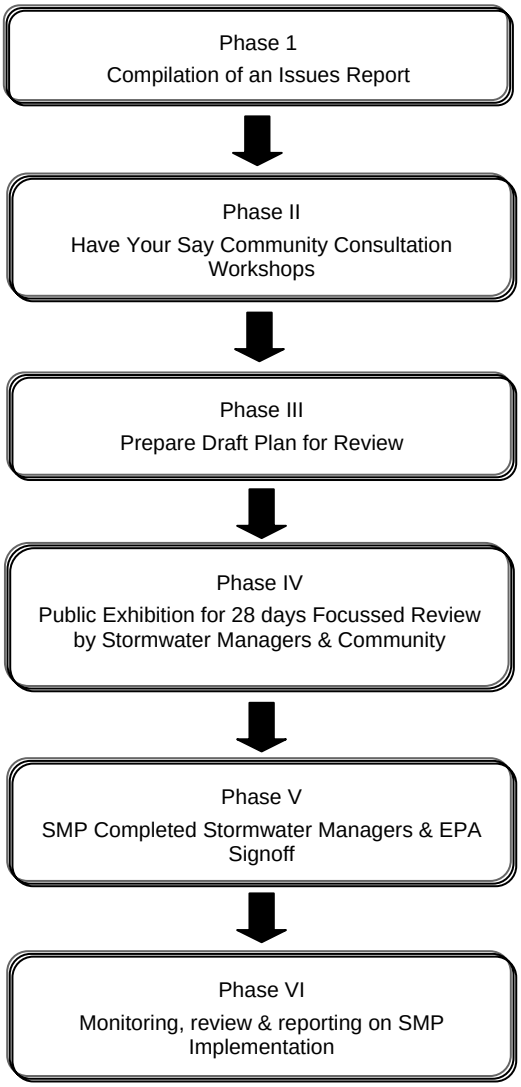


Figure 2:
Flowchart of the six phases in the development of the Newcastle SMP process.

Review of Stormwater Management Plan 2000

As part of the regular planning cycle for the stormwater management in the City, the Newcastle Stormwater Forum 2003 reported on the status of the SMP 2000 implementation and determined the scope of the SMP 2000 review (see Appendix V - SMP 2000 Action Plan status report as at June 2003). The review of the SMP 2000 revealed:

- Majority of SMP 2000 actions have been completed (68%)
- Many actions are ongoing in nature and continue to be delivered such as collaborative waterway monitoring program
- A large body of work in demonstration sites & community intervention strategies have been developed and received best practice management recognition for stormwater innovation and effectiveness such as Nobbys Beach Project (source controls, sand filter and education)
- Policy and Development Control Plan progress has been relatively rapid. This result is attributable in large extent to the increased water management capacity of staff and community members as a result of regional LHCCREMS capacity building programs and extensive community non-structural interventions supported by NSW DEC (former EPA) Stormwater Trust grant funds and Stormwater Extension Officer program resources.
- Council's internal management framework has been adaptive and flexible in its delivery of SMP program. Council's Water Task Force has proven to be a very effective management framework providing ongoing implementation, monitoring, evaluation and reporting functions across all Councils functional units.

See Graph 1 & Table 1 below for summary of outcomes of the review of the SMP 2000.

Graph 1: Outcomes of the 2003 review of the SMP 2000.

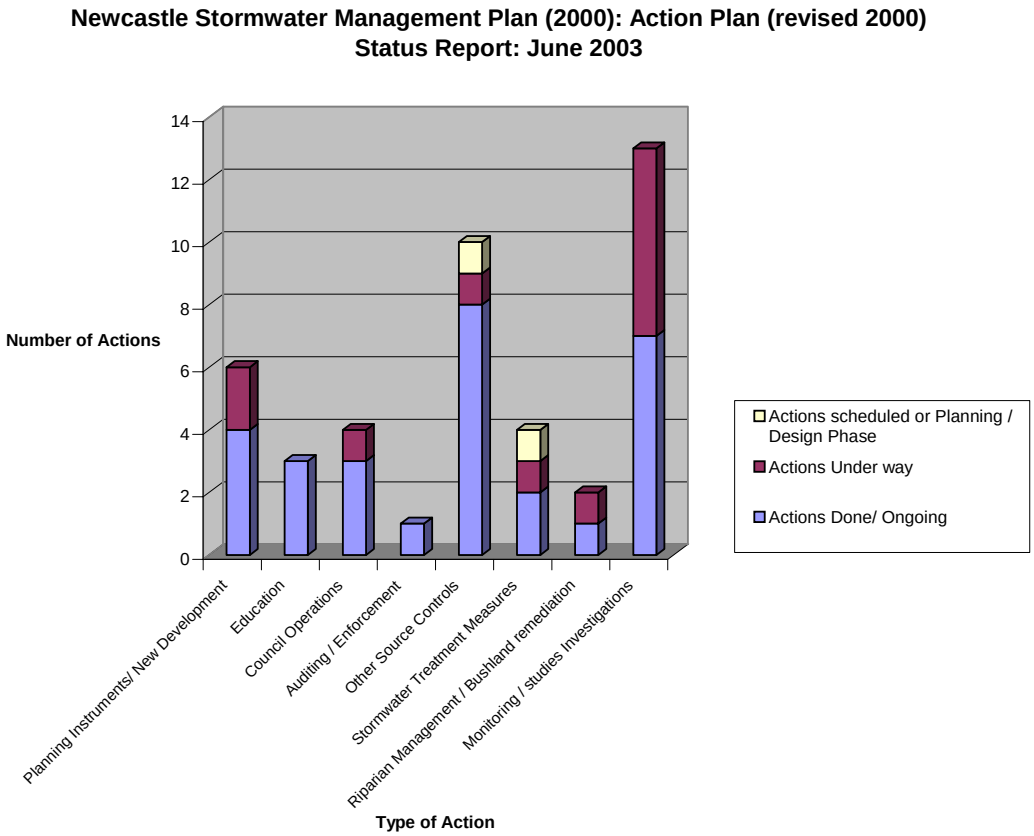


Table 1: Summary Outcomes

	Actions Complete/ Ongoing Nature	Actions Under way	Actions scheduled or Planning / Design Phase
Planning Instruments/ New Development	4	2	
Education	3		
Council Operations	3	1	
Auditing / Enforcement	1		
Other Source Controls	8	1	1
Stormwater Treatment Measures	2	1	1
Riparian Management / Bushland remediation	1	1	
Monitoring / studies Investigations	7	6	

How the Plan Works

The Stormwater Management Plan is a framework for the delivery of improvement in stormwater quality, based on the key stormwater issues identified in the community aspirations for the condition and characteristics of Newcastle's catchments.

The plan delivers by:

- identifying catchment-based stormwater issues, including obstacles to improved management;
- developing an appropriate mix of strategies, both structural and non-structural
- coordination of action in the catchments by multiple managers
- encouraging the community to participate in solutions that will protect its values
- integration of actions within Council's management planning process.

The identification of the issues set for the catchment has informed discussion and led to the determination of management strategies (Table 6), which build on existing programs and identify the information gaps in the City. Assessment of the priority issues, associated "hot spots" (Table 4) and the management strategies, produced a set of actions (Table 7). The actions incorporate the current works and programs that will be implemented by Council, Hunter Water Corporation, the Hunter- Central Rivers Catchment Management Authority (former Hunter Catchment Management Trust) and others over the next twelve months across the catchments, with an indication for the next three years where applicable.

Definition of a stormwater management framework for the City and the commitment of those agencies with management responsibilities to the implementation of the SMP, means that a coordinated and meaningful implementation program, incorporating appropriate review and reporting mechanisms, has been established.

Scope of the Plan

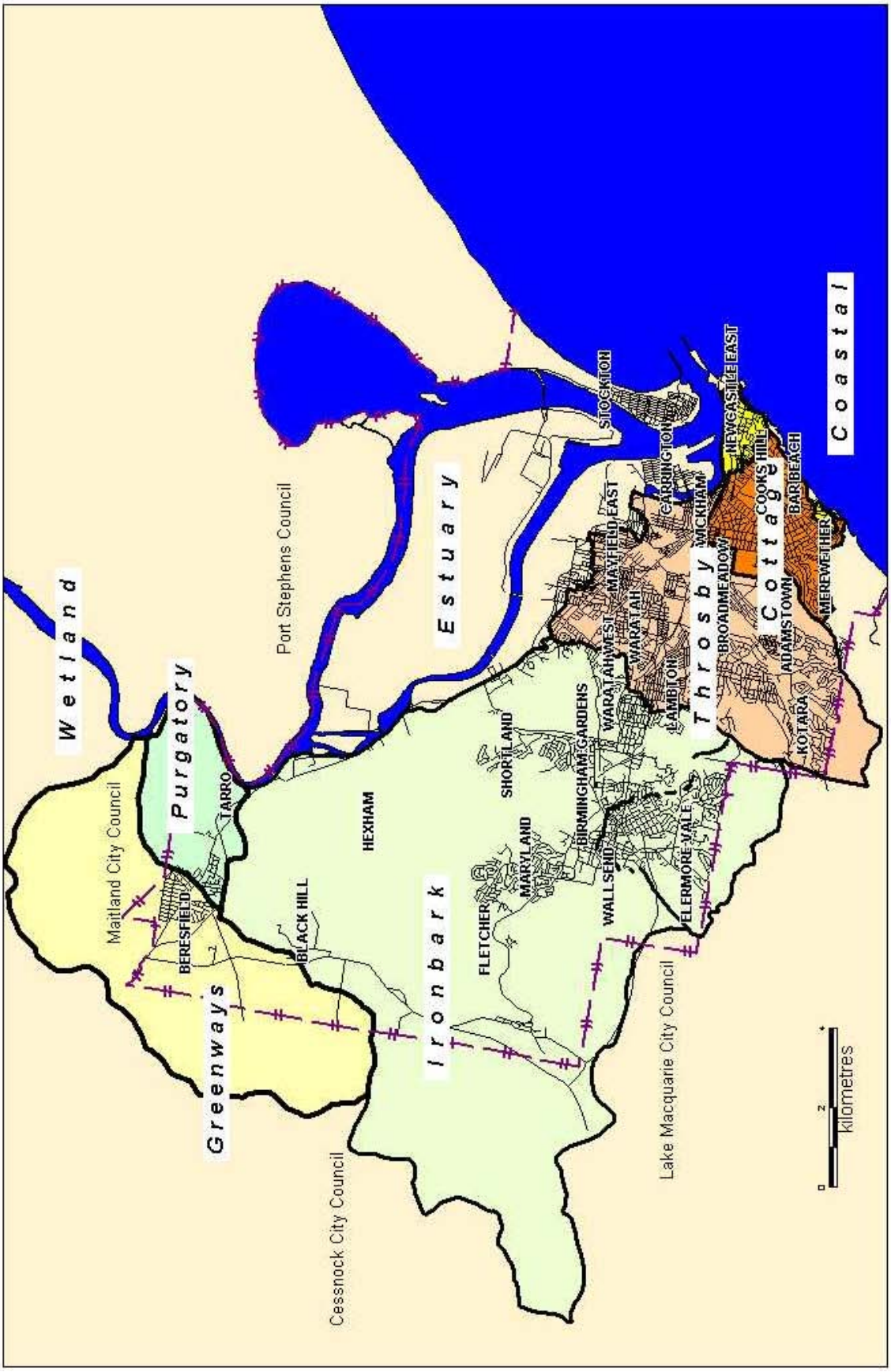
A catchment area is recognised as the fundamental unit for water cycle management and planning. A catchment can be defined as an area that supplies rainwater to a common river, creek or drainage system. A catchment-based approach was utilised in developing Newcastle's Stormwater Management Plan and has resulted in seven catchments being identified within the Newcastle LGA. These seven catchments are shown in Figure 3 and include:

1. Ironbark Creek catchment
2. Throsby Creek catchment
3. Cottage Creek catchment
4. The Hunter Estuary
5. Small Coastal catchments
6. Part of Purgatory Creek Catchment
7. Part of Greenways Creek Catchment

Detailed descriptions of the condition of the catchments, which were used to inform the development of the Plan, appear in Part C, Section 8.

Figure 3 depicts the catchments contained wholly or partly within the Newcastle LGA boundaries. The problems that arise when catchment and local government boundaries do not align was identified as an issue during the community consultation workshop and at subsequent stormwater managers meetings.

Figure 3: Newcastle Catchment Boundaries



PART B

The Stormwater Management Plan

Catchment Values and Management Objectives

Identified Stormwater Issues and Options

Management Approach

Management Framework

Implementation Strategy

Action Plan

CATCHMENT VALUES & MANAGEMENT OBJECTIVES

Catchment Values

The community consultation phase of the plan development provided opportunity to integrate the environmental, social and economic values identified in the Issues Report (Newcastle City Council, 1999). The workshop process generated additional perspectives on natural environment and recreational values, as well as the need to place Newcastle as a showcase in innovation and best management practices such as the stormwater innovation in Fig Tree Place. The prioritisation of the identified values by community workshop participants involved an aggregated individual "voting" system. The top ten prioritised values formed the basis of the further determination of priority objectives in the process. The prioritised set of values appears in Table 2 below.

Table 2: Priority List of Catchment Values

Catchment Values	Priority
Healthy natural habitats: forested areas, wildlife corridors and urban bushland	1
Integrity of natural ecosystems and processes	2
Healthy aquatic ecosystems (freshwater, marine, estuarine & wetlands)	3
Amenity - visual, aural and odour	4
Catchment as a place for innovation in development and stormwater management	5
Protection of biodiversity regionally, in urban setting and remnant natural ecosystems	6
Passive recreation (across the catchments)	7
Land value (- including harbour values)	8
Healthy aquatic and riparian flora and fauna in the estuary and along the coastline. (Protection of foreshore aquatic vegetation & protection of mangroves)	9
View stormwater as a resource rather than a waste	10
Ecologically Sustainable Development implemented	11
Development for urban areas confined, human sized city, reduce sprawl	11
Provision of water harvesting for human re-use	11
Healthy aquatic and riparian flora in the natural creeks and wetlands	12
Lifestyle/the quality of life afforded by the catchment	12
Reinstate more natural hydrological processes including groundwater recharge	12
Maintain hydrological processes	12

Catchment Values	Priority
Healthy water quality (meets standards for secondary contact throughout catchment, supports ecological systems)	12
Value of stormwater	13
Protection of landforms (ridges, valleys, open plains)	13
Primary contact recreation - (eg; swimming, surfing) - coastal, estuary and lower reaches of Throsby Creek	13
Human consumption of fish, crustaceans and shell fish	13
Public awareness of ecological development	13
Acknowledge value by environment accounting of natural and built environment	13
Provision of water for industrial uses	13
Ongoing leadership in worlds best practice in TCM and stormwater management	13
Improve ecological development	14
Secondary Contact recreation - (across the catchments)	14
Fishing, harvesting marine fauna - sustainably	14
Tourism and recreation destination	14
Need for employment	14
Level of economic self sufficiency	14
Foreshore developments	14
Sustainable use	14
Development of information and expertise resource on stormwater management and urban development	14
Estuary - recreation - Kooragang Restoration Project	14
Fishing - Commercial/Private	14
Port of Newcastle	14

The prioritised list of community catchment Values was then collapsed under the themes of Environmental, Social and Economic values to produce the Summary Priority Values set below.

Summary Priority Values

1. The Environmental Values include:
   - Healthy terrestrial, aquatic and marine habitats which protect biodiversity regionally
   - Maintenance & enhancement of natural ecosystems and processes
   - Water quality - improve/ensure water quality meets requirements to agreed community standards

2. The Social Values include:
   - Stormwater and receiving systems that are recognised as providing lifestyle/quality of life values
   - Recreation (passive and secondary across the catchments; primary in lower reaches of Throsby Creek, Coastal and Estuary catchments)
   - Ensure the public is fully aware of the stormwater quality & other issues within the catchments
   - Stormwater systems that are healthy and safe for appropriate community use

3. The Economic Values include:
   - Newcastle to provide innovation, best practice and showcase these initiatives within a TCM and ESD approach
   - Protection of the natural and built asset base of the all the catchments (commercial and recreational fisheries, port facilities, tourism and cultural values of beaches, estuary and presentation of the Newcastle's urban from)
   - Sustainable asset management. (A stormwater system that maximises sustainability of all asset maintenance)

Stormwater Management Objectives

Priority Objectives

The priority Objectives were determined through the community workshop process and have been subject to review during the stormwater manager's workshop and subsequent community Stormwater Forums (2001 & 2003).

The full set of Objectives used by community workshop participants was generated from the Issues Report (Newcastle City Council, 1999) and NSW Department of Environment and Conservation (DEC - formerly EPA) documentation which appears in the Outcomes Report of the Workshop (Hunter Water Corporation Management Services, 1999).

The discussion of Objectives was a robust one and also helped to generate some very constructive options for action that were incorporated in the appropriate stages of the planning process.

A list of priority stormwater management Objectives that would protect or enhance the identified community catchment Values appears in Table 3 below. The Table indicates the relationship between the priority Values and Objectives identified through the consultation process.

The ongoing review of the Objective set in the light of DEC water quality objectives for the Hunter River catchment, proposed marine water quality objectives and community aspirations will continue to refine the Objectives.

Photo 3:
The natural environmental and recreational opportunities were high priority catchment values identified by the community in the SMP process. Members of the community can enjoy the boardwalk through the mangroves along the lower reaches of Throsby Creek. Community participation through the Throsby Creek TCM Committee and Landcare Group, have been instrumental in improving the amenity and ecological integrity of the lower reaches of the catchment.

Table 3: Priority Stormwater Management Objectives

ENVIRONMENTAL VALUES	OBJECTIVES
Healthy terrestrial, aquatic and marine habitats that protect biodiversity regionally.	1. Maximise biodiversity conservation within the stormwater and natural creek, estuarine and marine systems. 2. Rehabilitate, restore & enhance the natural features of the catchment, addressing weed management, protection of wetland, enhancing riparian vegetation, stream morphology and other systems on major creek drainage lines.
Maintenance and enhancement of natural ecosystems and processes.	3. Work towards reinstatement of natural hydraulic regimes within the catchments. 4. Maintain water balance with the system in order to minimise impacts of flooding, to control streambank erosion and maintain habitat and biodiversity. 5. Prioritise use of 'softer' or environmentaly compatible solutions to stormwater management that help reinstate natural values.
Water quality - improve/ensure water quality meets agreed community standards	6. Maintain and improve water quality with respect to: Nutrients/Phosphorus, Litter, Pathogens, Heavy Metals, Silt & Sediments, Turbidity, Chemical, Oils/Greases, Organic Matter, Acid Sulphate Soils.

SOCIAL VALUES	OBJECTIVES
Stormwater and receiving systems that are recognised as providing lifestyle/quality of life values.	7. Maximise and protect aesthetic and/ or visual and other amenity qualities in the catchments and waterway system. 8. Ensure the stormwater system meets appropriate safety Standards. 9. Maintain the quality of life and lifestyle in Newcastle, by developing and promoting cultural and historical values of the stormwater and natural systems.
Recreation (passive and secondary across the catchments; primary in lower reaches of Throsby Creek, Coastal and Estuary catchments)	10. Ensure that water quality meets requirements for appropriate usage. 11. Balance the environmental values and opportunities of public open space with community infrastructure needs.
Ensure the public is fully aware of the stormwater quality & other issues within the catchments.	12. Foster active and effective community participation in planning and management practices. 13. Develop community awareness of water quality, systems health and other issues. 14. Achieve intra and inter-generational equity, including ensuring that infrastructure maintenance is cost-effective and sustainable.

ECONOMIC VALUES	OBJECTIVES
Newcastle to provide stormwater innovation, best practice and showcase these initiatives within a TCM and ESD approach.	15. Deliver best practice for all new and proposed developments, to ensure no increase in pollutant load in the system. 16. Encourage innovation in design and application.
Protection of the natural and Built asset base of the all the catchments (commercial and recreational fisheries, port facilities, tourism and cultural values of beaches, estuary and presentation of the Newcastle's urban form). Sustainable asset management. (A stormwater system that maximises sustainability of asset maintenance).	17. Develop an integrated & regional approach to stormwater/catchment management, especially by integrating stormwater and flood management policies. 18. Improve the performance of the existing stormwater system. 19. Maintain and enhance the viability of commercial and recreational activities within the City's catchments. 20. Improve and apply accounting mechanisms for catchment assets in planning and decision-making processes.

Photo 4:
Shows the floating boom at Chin Chen Street on Styx Creek, in Throsby Creek catchment designed to trap floating pollutants such as litter - plastic bottles and bags, foam packaging, paper etc and organic matter such as grass clippings, leaf litter etc. This more "visual pollution" may well be associated with other "invisible" pollutants such as nutrients, bacteria/pathogens and/or chemicals and heavy metals which are not captured by such a device. A sediment trap is also located at this point in the system where approximately 20 cm3 of slit is removed monthly.

New Development

In the past stormwater runoff from urban areas has not been managed with explicit operational performance standards. Treatment of stormwater in newly developed areas was approached in an ad-hoc manner with devices being designed and installed by developers as a requirement for development but without appropriate design criteria.

Council's stormwater management plan identifies the close link between higher volume runoff in common low intensity rainfall events, and associated pollution and sediment issues. Typically, these issues manifest at the outlet to the constructed drainage system and are the result of the direct connection of impervious areas at the upstream end and the removal of natural systems.

The priority stormwater management objectives identified through the SMP process, highlighted the need to:

- Deliver best practice for all new and proposed developments;
- Ensure no increase in pollutant load in the system;
- Promote an integrated catchment management approach;
- Prioritise environmentaly compatible solutions across the range of stormwater issues; and
- Ensure the maintenance and/ or restoration of hydraulic processes is achieved.

Such objectives clearly indicate the importance placed on the control of stormwater impacts from new development by the community and stormwater managers.

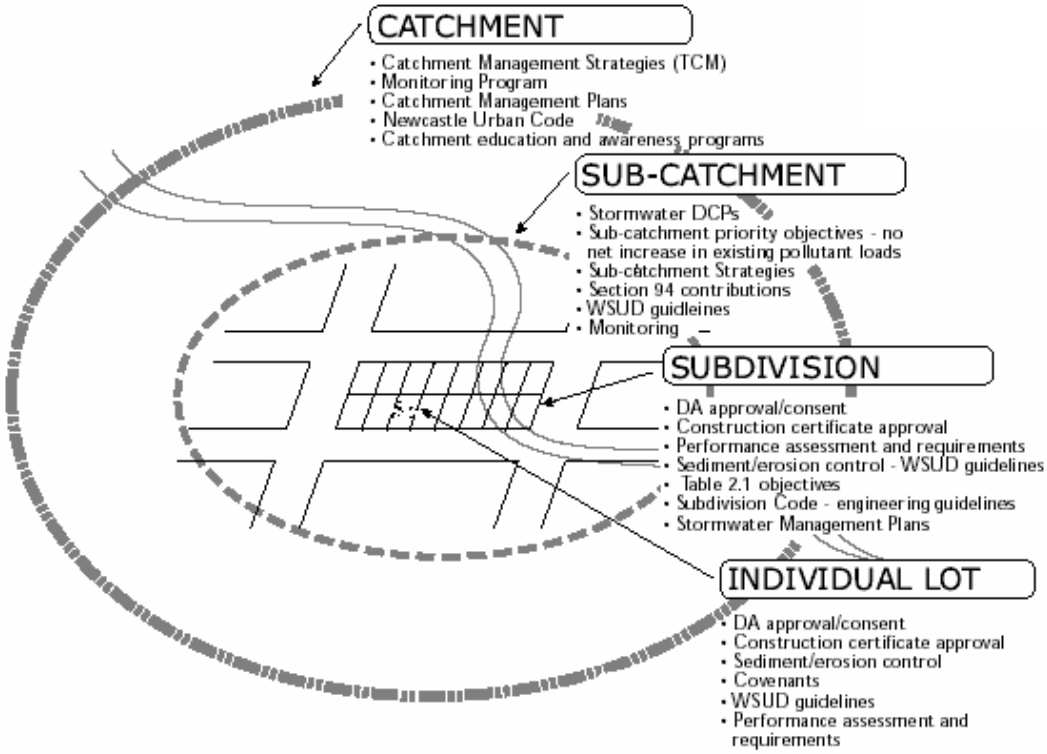
NSW Department of Environment & Conservation (former Environment Protection Authority) and Council recognises that "Source Control" is an appropriate and effective strategy to deal with this issue. The principal technique is to store an initial volume of rainfall on each new development site in site discharge controls, thereby emulating the runoff characteristics of the undeveloped site and thus protecting natural drainage lines. Council's Stormwater DCP 50 takes this "source control" approach and includes initial volume storage treatments and subsequent site discharge controls that will treat water borne pollutants as well.

The source control strategy also provides new opportunities to substitute part of the potable water supply for rainwater thus reflecting the systems-based urban water cycle management approach Newcastle advocated in the Newcastle Environment Management Plan 2003 (NEMP) in order to achieve a more sustainable City.

The continued development of the catchment-based monitoring program will support the identification of issues and priority needs for development purposes across the City.

The consideration of stormwater planning across the City's catchments for new development is illustrated at Figure 4 where stormwater performance objectives are integrated across catchment, sub-division and lot scale as indicated.

Figure 4:
New Development Stormwater Performance Objectives across whole scale of development.



Stormwater Objectives for Development Sites

Newcastle is a dynamic city with a broad range of development types. Our western sector is undergoing significant greenfield estate development while much of the eastern suburbs are experiencing high levels of redevelopment of existing residential and commercial building stock.

The objectives for development are based on receiving water tolerances to pollutants stemming from the catchment values and objectives. They are reduced to performance criteria being limits on concentrations in the discharge. How each development achieves these objectives will be a design issue. However, Council provides a suite of “deemed to comply” solutions that can be applied to most development scenarios.

These solutions and any other built infrastructure or control devices will provide different responses depending on the different likelihood of specific pollutants being in the upstream runoff. The different type of pollutants that we can reasonably expect from the various styles of development is well understood from local investigation (eg. Throsby Creek Catchment Gross Pollutant And Sediment Study, WBM Oceanics, 2002) and studies elsewhere. Table 3.1 provides a valuable tool in stormwater treatment assessment with the development of a ranking order for the application of stormwater pollutant objectives based on development style.

The rankings are defined in order of their perceived importance from A highest to F lowest, based on the system developed and reported in Stormwater Management Plan for South Creek, NSW in 1999-2000.

Table 3.1: Ranking* of Objectives for Development Styles

Development Style	Litter	Coarse Sediments	Fine Particles	Nutrients	Hydro-carbons	Cooking Oils/ Grease
Low density Residential (single dwelling & residential developments > 5ha)	B	C	A	D	E	F
High Density residential (medium density & residential developments > 5ha)	A	D	F	B	E	C
Commercial, Shopping Malls and Retail outlets	A	D	F	B	E	C
Industrial	C	D	F	A	E	B
Fast Food Outlets and Restaurants	B	C	F	D	E	A
Carparks, Service Stations and Wash Bays	C	D	E	B	A	F

Objectives for development are shown below in Table 3.2. They are the result of the community consultation, desktop review and exhibition processes conducted during 2003-04. Water quality issues are now properly addressed in Council's Development Control Plan (DCP 50) for Stormwater and Water Efficiency 2004 in comparison to previous DCP 50 drafts.

Table 3.2: Stormwater Treatment Objectives for New Development
(Based on event mean concentration of pollutants in stormwater discharge)

Pollutant	Description	Treatment Performance Objectives for Development Sites
Litter	All waste materials eg cans, packaging, bottles, butts etc.	Capture and remove all material in excess of 5mm diameter.
Sediment	Sediment discharge during the operational phase of the development.	Event mean concentration is less than 100 milligrams/litre.
Nutrients Total nitrogen Total phosphorus Ammonia		Event mean concentration is less than the following: 1000 micrograms/litre 100 micrograms/litre 15 micrograms/litre
Hydrocarbons- Motor spirit, Oil & Grease	Free floating and/ or emulsified hydrocarbons.	Event mean concentration is less than 500 micrograms/litre.

Council also recognises that runoff regimes form a significant part of the stormwater quality jigsaw. Downstream riparian values, bank stability and additional pollutant mobilisation potential are all adversely affected by increased runoff in very frequent rainfall events. Accordingly Development Control Plan 50 (DCP 50) aims to Control the outflow of stormwater from new developments to replicate the natural hydrological regime. This is achieved by requiring the storage of initial rainfall volumes. It also has benefits in mitigating the effects of development on flooding.

Buildings
Under the guidance of the Newcastle Sustainable Urban Water Cycle Policy 2004, Council recognises that the most appropriate opportunities for coherently managing water issues occur at the lot scale where water usage, sewer generation, rainfall and stormwater discharge occur. Such issues and opportunities are equally relevant in new and redeveloping areas of the City.

Accordingly, the objectives for new buildings in greenfield estates are the same as they are for redeveloped or infill areas of the City. It is anticipated that as the existing building stock turns over, the stormwater issues within our watercourses will improve over time.

After stormwater quality is addressed for lots, Council recognises that there is still a significant issue to be dealt with off roads. In addition, Council is concerned that on site measures to control water quality may not be adequately maintained when in private ownership. Experience shows that poorly maintained devices are likely to contribute significantly to downstream degradation. Accordingly, publicly owned controls are required to cater for 20% of the contributing privately owned catchment.

Under the terms of the Newcastle Local Environment Plan (LEP 2003), complying development (dwelling houses), must comply with the relevant provisions of DCP 50. Accordingly, all the provisions including site discharge controls apply to all new dwellings, including alterations and additions.

Residential estate developments
Subdivision scale controls are considered necessary to control water quality for runoff generated by roads and failed private facilities. Therefore DCP 50 requires that subdivision controls address the runoff from 50% of road reserve areas and 20% of allotment areas. This can be managed in swales on the side of the road or in public reserves as best suit the circumstances of the case.

Infill Areas
Similarly Council will need to address the runoff generated by existing roads and 20% of the allotments draining to them in older areas of the City. Council is gearing up its infrastructure renewal program to be considerate of the water quality objectives espoused in this Stormwater Management Plan (see Action Table).

Erosion & Sediment Prevention
Council utilises current best practice policy, aiming to achieve the objectives for erosion and sediment control in accordance with *Department of Housing's "Managing Urban Stormwater: Soils and Construction, 1998" (*the "blue book") as well as Council documentation for target audiences in erosion and sediment control. DCP 50 stipulates that erosion and sediment control measures must be established on the site prior to the commencement of construction and they must be maintained during the course of construction and not removed until the site is fully established, including landscaping and lawn areas (if any).

The implementation of the standardised regional approach, delivered through the REMS Sediment and Erosion Control program adopted by Council, also provides a context for development interests across the region. Over time Council has tried to apply a consistent standard to the performance of treatment devices at the subdivision level as well as provide industry awareness and training programs. This approach will be audited and refined over the next 12 months with a review of Newcastle's subdivision code and as part of Councils Erosion and Sediment Prevention Program (see Action Table).

Council recognises the need for a pro-active approach to the minimisation of site disturbance as a result of development that requires the implementation of Erosion and Sediment Prevention Plans at the outset. The approach to developing prevention plans has been successfully implemented in Washington State (USA) with the following "12 common sense" elements being an edited selection from "Stormwater Management in Washington State", Vol 11 (2000), Construction Stormwater Pollution Prevention. Council will also consider this issue in developing the Newcastle Consolidated DCP and in the review the Newcastle subdivision code in 2004.

The 12 elements included in Construction Stormwater Pollution Prevention Plans (USA, 2000) are:

- Mark Clearing Limits
- Establish Construction Access
- Detain Flows
- Install Sediment Controls
- Stabilise Soils
- Protect Slopes
- Protect Drain Inlets
- Stabilise Channels and Outlets
- Control Pollutants
- Control De-watering
- Maintain Best Management Practices
- Manage the Project

Review
The effectiveness of Development Control Plan 50 will continually be investigated through an annual review process and ongoing catchment-based waterway health monitoring (See Action Plan, Table 7).

IDENTIFIED STORMWATER ISSUES AND OPTIONS

Stormwater Issues

A large volume of information detailing the specific nature of the Issues surrounding stormwater quality in the Newcastle City catchments was provided in the SMP Issues Report. This information was presented to stormwater managers and community workshop participants. Site inspections, existing reports and documentation, feedback from community groups/individuals, recent scientific investigations, water quality monitoring and DEC (formerly EPA) developed water quality objectives for marine and Hunter River catchments. Issues were considered to be "those things that frustrate or enhance the achievement of the identified Objectives".

Many of the Issues raised were particular to Newcastle, reflecting its history of urbanisation and concerning social, economic, environmental and managerial origins. In consultation processes with the community and stormwater managers Issues that generated the greatest levels of concern included: litter; erosion; sediment; habitat; community involvement and awareness; and management. These issues are marked with an * in the list below. Given that these Issues were most often cited as currently or potentially frustrating our Objectives, options to diminish their impacts are critical, with respect to management of stormwater in the City. The Issues and their related Objectives appear in Table 4.

Site specific Issues such as: litter accumulation in the mangroves in Throsby Creek; the visual amenity of the channels in Cottage Creek; the volume of sediment deposited in the tidal region of Throsby Creek where extensive sediment removal has already taken place; as well as the extent of erosion and sourcing of sediment within Ironbark Creek were expressed throughout the consultative process. Such areas were termed "hot spots". The "hot spots" that were identified during the consultation process, appear in Table 3 along with an assessment of the cause and possible impact of the identified stormwater Issues. The identification of specific stormwater "hot spots" will be broadened as part of the catchment assessment processes identified in the Action Plan (Table 7).

Photo 5:
Litter accumulation, including rubber bedding, paper and plastics, bottles trapped in the mangroves in the tidal section of Throsby Creek. Drink bottles of a foreign origin found in the mangroves indicate that they trap both Throsby Creek and Harbour litter with the movement of the tide. Given the value the community now places on this natural asset, it is not surprising that litter accumulation in the mangroves was a recurring issue identified in the consultation phase.

The Stormwater Issues raised included:

- Litter*
- Erosion*
- Sediment*
- Habitat*
- Community Involvement & Awareness*
- Management*
- On Site Rainwater Reuse
- Grease, Oil & Petroleum*
- Heavy Metals*
- Nutrients
- Bacterial & Viruses*
- Acid Sulphate Soils
- Organic Matter
- Community Health and Safety
- Other

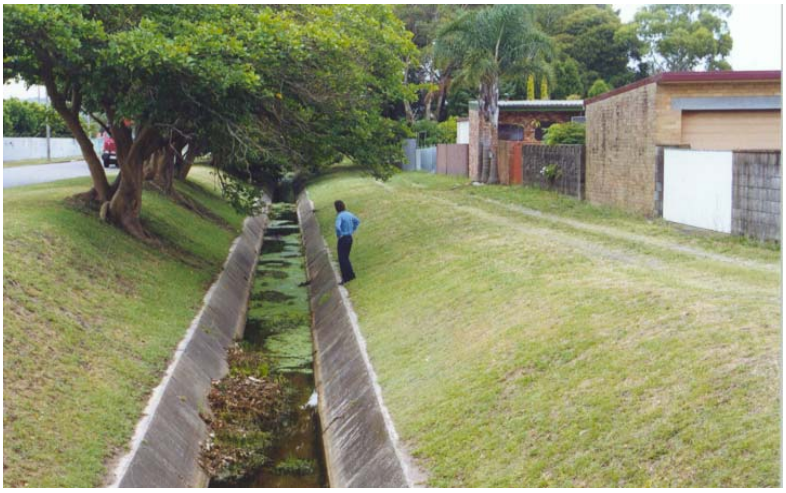


Photo 6:
Shows concrete lined stormwater channel at Darling St, in the Cottage Creek catchment. Green organic matter/algae and weed growth is noted in this section of the channel. Sediment accumulation is also an issue within this and other catchments, and other concrete lined stormwater channels.

Table 4: Priority Catchment Stormwater Issues, Impacts and "Hot Spots" in the City

ISSUE	CAUSE/SOURCE	IMPACTS	"HOT SPOTS"
Litter Related Objectives 1, 2, 5, 6, 7, 8, 9, 10, 11, 15, 18, 19	• Shopping Centres • Major facilities and venues (e.g. Showground, ISCT site) • Fast Food Outlets • Schools to varying degree • Lack of community compliance • Use of non-biodegradable packing • Lack of source control • Public open space • Insufficient bins/frequency of collection	• Aesthetics – accumulation is unsightly • "End of pipe" control measures such as booms and trash racks are unsightly • Litter accumulation in mangrove area • Can smother, be entangled with or ingested by flora and fauna.	**Ironbark** Shopping Centres Sources- Jesmond, Wallsend, Elermore Vale, Maryland Breaker Stadium & Freeway, Link Road **Throsby** Litter In Mangroves Tighes Hill/Carrington. Lower Section Of Creek, Fishermans Co-Op & Honeysuckle District & Other Park- Council Bin Provision & Collection No Litter Barriers Surrounding Channels Mayfield Branch - No GPT Chin Chen St Trash Boom- Effectiveness Energy Australia Stadium & Hockey Complex/ Rest ISCT Site/ Showground Venues Shopping Centre Sources- Garden City, Mayfield, Beaumont Street, New Lambton, Waratah Village, Broadmeadow, Adamstown Islington/ Lambton - Light Industrial Areas **Cottage** Shopping Centres – Marketown, Junction Fair, Merewether Inadequate Litter Barriers Surrounding Channel Eg. National Park **Estuary** 104 Outlets – 4 With Trash Baskets, Foreshore Open Space Recreational Use – Litter CBD/ Hunter Street **Coast** Beach Outfalls no GPT's, Beach Littering **Purgatory** Beresfield, Highway littering

ISSUE	CAUSE/SOURCE	IMPACTS	"HOT SPOTS"
Erosion and Sediment Related Objectives: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11,18, 19	• Stream banks & beds • Creek headwaters • Erodeable soils • Increased flow velocities & frequency of erosive velocities due directly connected impervious. • New urban & infill development • Denuded channel banks • Old urban areas/urban removal • Removal of "hard" treatment" (eg Lower Throsby Ck) • Flooding on soft ground • Utility easements • Incorrect gardening techniques eg • Stockpiles • Garden boundaries • Interface between concrete and natural systems • Recreation trails in urban bushland	• Loss of habitat • Loss of and damage to infrastructure assets • Reduction in system capacity • Smothering of aquatic vegetation • Increased turbidity (reduced light penetration) • Heavy metal nutrient attached to sediment • Visual amenity impacts	**Ironbark** Jesmond Bushland- bed, bank (gully erosion) + bushland tracks & trails John Hunter Hospital site Utility easements Elermore Vale/ Wallsend Park - channel bank erosion Urban sediment sources eg gutters & unsealed verges Sedimentation along creek Blue Gum Hills - new urban expansion Erosion from streams/ drainage lines in upper part of catchment. Plus tracks & trails. Channel bed, bank erosion sources. **Throsby** Sediment accumulation in lower reaches. Channel bank erosion sources – Nesbit Park Blamey Ave, Griffith Rd median strip Erosion from streams/ drainage lines in upper part of catchment. Bushland Reserves tracks & trails. **Cottage** Sediment deposition in channel at Parkway, Bar Beach Ave & Glebe Rd bridge Infill site works **Estuary** Harbour bottom accumulation **Coast** Murdering Gully access road erosion, Cliff line falls **Greenways/ Purgatory** Erosion from streams/ drainage lines in upper part of catchment. Plus tracks & trails. Sedimentation of wetlands

ISSUE	CAUSE/SOURCE	IMPACTS	"HOT SPOTS"
Habitat Related Objectives 1, 2, 3, 4, 5, 6, 7, 9, 10, 19	• Insufficient native vegetation across riparian zone • Noxious and environmental weeds • Inappropriate zoning of bushland • Inappropriate management practices • Exotic species of plants and animals • Fragmentation due utility/infrastructure/ development	• Loss of biodiversity • Weed propagation (alters integrity of ecosystems) • Erosion • Exotic fauna and flora can take over an area • Loss riparian zone habitat has multiple flow-on effects • Loss Riparian habitat produces water quality impacts • Visual amenity impacts	**All Catchments** Protection of remnant vegetation and corridor linkages. All riparian zones priority for protection/ rehabilitation. **Ironbark** Need habitat protection in Jesmond Bushland & other remnants, especially corridors. - Hexham Swamp - SEPP 14 wetland protection - Large bushland areas in upper catchments eg Jesmond, Elermore Vale, Rankin Park, Blue Gum Hills. Riparian zone – loss of habitat, weed species in upper catchment & wetland Weed sources in upper catchment eg Elermore Vale, Maryland **Throsby** Lack of natural vegetation along stormwater system riparian strips. Weed sources in upper catchment eg Kotara, Adamstown. Concrete channels and lack of natural form. Blackbutt Reserve - protection & stormwater management. **Cottage** Concrete channels and lack of natural form. Lack of natural vegetation along stormwater system riparian strips. **Estuary** Maintenance of oyster prawn catches Rehabilitation of wetland areas via improvement of flood mitigation system management. **Greenways/ Purgatory** Riparian zone – loss of habitat, weed species in upper catchment Wetland habitat protection

ISSUE	CAUSE/SOURCE	IMPACTS	"HOT SPOTS"
Community Involvement and Awareness Related Objectives 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18	• Lack of awareness of impacts of actions • Unaware of ultimate destination of stormwater • Apathy • Lack of involvement in decision making • Lack of support mechanisms • Connotations associated with "greenies" • Lack of incentive for action • Lack of 'easy" solution/ answer for issue • Poor promotion of the system and its issues • Source is often far removed from the point of impact • Lack of access to information	• No feeling of "ownership" of the system • Lack of community awareness and involvement is often a fundamental cause of many impacts	**All catchments** Lack of community "waterway ownership" and awareness of impacts of inappropriate action of individuals and resulting cumulative impacts. Need targeted program delivery for "hot spot" generators eg developers, builders, garden suppliers, mobile cleaning businesses, business, events managers etc across City Newcastle catchment Forum community projects **Ironbark** New residential areas & established areas Ironbark Creek - Wallsend rehabilitation/POM requires promotion Lack of education across all issues Impacts of open space recreation Wallsend, Rankin Park, George McGregor Park, Shortland-Birmingham gardens groups **Throsby** Lack of education across all issues Impacts of open space recreation and maintenance Lambton Ker-rai rehabilitation concept plan Waratah sub-catchment "Gutter Talk" Project **Cottage** Lack of education across all issues Impacts of open space recreation **Estuary** Lack of education for recreational users (& community across all issues) **Coast** Recreation in outfall pools, beach littering Merewether and ongoing "Clean Streets- Clean Beach" Projects **Greenways/ Purgatory** New home owners impacts

ISSUE	CAUSE/SOURCE	IMPACTS	"HOT SPOTS"
Management (Planning, Funding and Best Practice) Related Objectives 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19	• Narrow/steep channel buffers • Historic landuse & perceptions • "Hard" engineering solutions • Maintenance practices • Inter-agency management and cooperation • LGA overlaps in catchment boundaries • No allowance for different uses on open space areas • Limited funding for stormwater management • High cost of management options/ maintenance costs	• Past practices limit options for future management • Duplication of responsibilities often leads to confusion regarding actions • Most effective measures may not be incorporated • Maintenance call for private and Council assets	**Ironbark** Recreational & public use of open space Council and catchment boundaries not aligned **Throsby** Lack of space for retrofitting system Lambton Park & other sites possible Council & catchment boundaries not aligned in upper reaches **Cottage** Lack of space for retrofitting system Lack of overall catchment strategic planning framework to direct action **Greenways/ Purgatory** Lack of overall catchment strategic planning framework to direct action Council & catchment boundaries not aligned

ISSUE	CAUSE/SOURCE	IMPACTS	"HOT SPOTS"
Grease, Oil and Petroleum and Chemical Contaminants Related Objectives 1, 2, 6, 7, 8, 10 15, 18	• Road run-off • Lack of bunding on marine car parks • Commercial and industrial run-off and discharges • Bitumen from road resurfacing maintenance • Vehicle emissions • Illegal disposal of used oil and other chemicals • Diasters such as oil or fuel spills • Lack of awareness/education/apathy	• Toxicity to animals and plants (including humans) • Bioaccumulation in aquatic species • Risk of fire and explosion • Aesthetics	**Ironbark** State highway 23 F3 Link Rd to Wallsend, pacific Highway, F3 Freeway, Lookout Road. Hazard spills Light industry areas **Throsby** Maitland Rd, Lookout Road, Industrial Drive Light industry areas **Cottage** Hazard spills, Stewart Ave Light industry areas **Estuary** Hazard Spills - Pacific Highway, Industrial Drive - Main Road 108 Port activity and industrial areas Contaminated sites - Kooragang dumps Port activity **Coast** Car parks **Greenways/ Purgatory** Light industry areas Hazard spills, Highway

ISSUE	CAUSE/SOURCE	IMPACTS	"HOT SPOTS"
Nutrients Related Objectives: 1,2, 6, 7,9,10,11, 15,18	• Fertiliser use in open space/parks • Gardening practices eg. Fertiliser/soil • Composting/leachate • Pet faeces • Car washing in streets • Lack of awareness/ education/apathy • Organic matter in channels • Sewage overflows • Nutrients binding to fine sediments	• Algae growth • May trigger outbreaks of dynoflagellates • Weed growth • Odour	**All Catchments** Household inappropriate application of fertilizer/ use detergents street Illegal connections stormwater to sewer Sewer overflows, particularly along waterways **Ironbark** Fertiliser use in open spaces- Jesmond Park and golf course Around residential ponds/wetlands eg Warabrook Estate **Throsby** Racecourse & Showground Fertiliser use in open spaces- ISCT site/ District Park and golf course **Cottage** Fertiliser use in open spaces - National Park and sites associated animals housing eg Trotting/ Race Track, Showground
Organic Matter Related Objectives 1, 2, 5, 6, 7, 9, 10, 11, 15	• Deciduous trees/inappropriate species • Native tree leaf fall • Grass clippings & other domestic garden waste • Inappropriate grass cutting techniques - Council and Hunter Water contractors • Lack of public awareness/apathy	• Accumulation of leaf litter • Nutrients • Weed growth • Aesthetics • Odour	**All Catchments** Green waste (lawn clippings, leaf fall, cuttings etc) close to stormwater outlets/ channels enters channels - transported through system. Some concrete channel verge maintenance practices. Water way neighbours dumping "over the back fence" **Ironbark** Heaton, Jesmond, Federal Parks- green waste close to channels Hexham Swamp - Water hyacinth dies off annually **Throsby** District Park- green waste in near channel. Odour- Islington, Maryville **Cottage** Algal growth in channels green waste in near channels, Jenner Pde

ISSUE	CAUSE/SOURCE	IMPACTS	"HOT SPOTS"
Bacteria and Viruses Related Objectives: 6, 7, 8, 10, 14, 15, 18	• Onsite sewage system leachate • Pet and other animal faeces • Animal carcasses • Sewer overflows	• Creeks and coastal areas not fit for recreation	**Ironbark** Faecal coliform levels high in rain periods. Black Hill septic systems. **Throsby** Faecal coliform levels high in rain periods **Cottage** Faecal coliform levels high in rain periods **Coast** Outfalls- faecal coliform levels high in rain periods **Greenways/ Purgatory** Some septic systems
Community Health and Safety Related Objectives: 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 17, 19	• Mosquito breeding • Flooding • Velocity of flows • Bacteria and viruses	• Spread of disease and nuisance • Damage to property • Drowning	**Ironbark** Channel signage- Sandgate Rd Wallsend **Throsby** Channel signage- Blamey Ave, Kotara, Nile St Mayfield **Cottage** Channel signage- National Park St **Estuary, Greenways & Purgatory** Mozzie hotspots – Kooragang, fringe Hexham Swamp, Woodberry and Taro Swamp. **Coast** Stormwater outfall signage

ISSUE	CAUSE/SOURCE	IMPACTS	"HOT SPOTS"
Heavy Metals Related Objectives: 1, 5, 6, 8, 9, 10, 11, 12, 18, 19	• Road run-off • Inappropriate disposal • Inadequate source controls • There is a need to identify sources • Light to medium industry	• Accumulation in sediments • Bioaccumulation • Fish and shellfish unfit for consumption	**All Catchments** Road runoff **Estuary** Road runoff in harbour dredge material Industrial areas - contaminated land

On Site Rainwater Reuse Related Objectives: 3, 4, 6	• Particularly in infill areas with reduced permeable surface • Target new development - reduce impacts on greenfields receiving waters	• Increased frequency of lower order storm events that cause erosion creek bed & banks, localised flooding, destroy habitat. • Reduced groundwater recharge	**All catchments** All infill & new development All established areas - retrofits **Estuary** Industrial sites

ISSUE	CAUSE/SOURCE	IMPACTS	"HOT SPOTS"
Acid Sulfate Soils Related Objectives 1, 2, 6, 7, 8, 9, 10, 14, 15, 16, 18,19	• Oxidation of pyrites in soil when drained and exposed to air	• Reduced pH • Elevated soluble iron and aluminium levels • Damage to wetlands & aquatic flora & fauna • Impact of acidic water on infrastructure assets	**Ironbark, Throsby, Cottage** Lower reaches **Estuary** Kooragang, Tomago, Fullerton Cove, **Greenways/ Purgatory** Lower reaches

Evaluation of Stormwater Management Options

Broad ranges of structural and non-structural practices are available for stormwater management. On the basis of the Issues, Objectives and Values raised by the community, a number of potential broad management options have been identified, including:

- the continued support for and implementation of the principles of Total Catchment Management, Ecologically Sustainable Development and Water Sensitive Urban Design
- the use of structural devices for the treatment of stormwater
- the use of non-structural devices for the treatment of stormwater
- improved control on construction activities
- education of the community on how its activities impact on the quality of stormwater and the health of receiving waters and how they can adopt more suitable practices
- monitoring of the City's stormwater quality to measure the success of the Stormwater Management Plan's implementation
- community involvement and partnership program delivery

Key elements of a sustainable approach to stormwater management include:

- increased levels of community participation in stormwater management process
- improved skills and knowledge of relevant stormwater managers
- the use of integrated approaches
- developing working relationships involving Council, stormwater managers and the community
- implementing an integrated outputs involving a variety of structural and non structural management techniques.

The assessment of options for stormwater management should be based on:

- a systems-based, holistic approach to natural resource management
- identifying source control (water quality and quantity)
- an integrated, multi-disciplinary approach producing beneficial long-term results
- addressing the cause of noted downstream impacts
- acknowledgment that future funding will be required to achieve continuing success
- monitoring, research and reporting
- consideration of maintenance requirements and life-cycle costs
- initiating changes in community attitudes and behaviours as a key element of environmental improvement.

A guide for the assessment of structural stormwater treatment techniques has been provided by DEC (former NSW EPA (1997)) in the draft document "Managing Urban Stormwater: Treatment Techniques". A final version of the Treatment Techniques manual as well as a number of other valuable stormwater management publications are due for release by DEC this year. Table 5 below summarises some of the treatment techniques and clearly indicates that structural techniques alone can never successfully trap all pollutants. It is therefore essential that a variety of actions be implemented to stop as much pollution as possible from entering the system in the first place. This approach is reflected in the DEC's (former EPA) Stormwater Management Hierarchy at Figure 1.

Table 5: Assessment of Structural Treatment Techniques

Treatment	Pollutant Trapping Efficiency						Costs	
	Litter	Sediment	Nutrient	Oxygen Demanding Material	Oil & Grease	Pathogen	Capital	Maintenance
Litter Baskets	M-H	I	I	L	L	I	L	M-H
Litter Racks	M-H	I	I	L	L	I	L	H
Litter Booms	M	I	I	I	M-H	I	L	H
CDS Units	H	M	L-M	L-M	L	L	M-H	M
Catch Basins	L	L-M	I	L	I	I	L	M-H
Water Quality Inlets	L-M	M	L	L	M	L	M	H
Filter Strips	L	M	L-M	L	L	L	L	L
Grass Swales	L	L-M	L	L	L	L	L	LM
Sediment Traps	L	M-H	L	L	L	L	M	M
Gross Pollutant Traps	M-H	M-H	L	L	L	L	M	M-H
Extended Detention Basins	L	M	L-M	L	I	L	L-M	L-M
Wet Basins	L	M-H	M-H	M	L	M	H	M
Constructed Wetlands	L	M-H	M-H	M	M	M	M-H	M
Infiltration Trenches	L	M-H	M	L-M	L	L-M	L	H
Infiltration Basins	L	M-H	M	L-M	L	L-M	L	H
Porous Pavements	I	M-H	M	L-M	I	L-M	M-H	M-H
Sand Filters	L	M-H	M	L-M	L-M	L-M	L-M	M-H

KEY: I = Ineffective
L = Low
M = Moderate
H = High

Source: EPA Draft: Managing Urban Stormwater - Treatment Techniques (1997)

MANAGEMENT APPROACH

What is a Management Strategy?

Management strategies are broad statements indicating a preferred group of actions to address a particular issue of concern. In identifying these strategies we have considered the impacts of a range of issues and the priority values of the Newcastle community.

The management framework for this plan incorporates five potential types of action responses to understand, manage and evaluate the identified issues in each catchment. The five main potential elements in a management strategy include:

1. Investigation (Environmental Assessment And Monitoring)
2. Planning
3. Community Education And Consultation
4. Implementation (Including On Ground Activities)
5. Evaluation and Review of Performance

For some issues or for particular catchments we may already have good environmental monitoring data that clearly describes the dimensions of the problems to be addressed. In these or other locations there may be good workable plans that have not been implemented due to lack of resources. The management strategies within the Plan will build on existing work wherever feasible to optimise outcomes for the community. This approach will facilitate an integrated management response and provide resource efficiencies.

The development of these strategies consistently highlights the opportunity to include the community in implementation through meaningful participation in the process and effective education programs to collectively improve urban stormwater outcomes.

Over the years a number of control treatment trains have been installed to manage urban stormwater in Newcastle. A priority will be to review the performance of these mechanisms with reference to our understanding of current issues, values and stormwater management objectives as well as the promotion of effective demonstration sites.

The integrated nature of this management approach will enable stormwater managers to identify linkages between strategies. For example in developing the strategies it has become apparent that we need to develop an education package for residents, to provide guidance regarding the potential impacts on stormwater from a number of things they may do around their homes or neighbourhoods with suggestions to protect downstream water quality. Instead of just having a message about singular actions like washing the car on the lawn, there is an opportunity to engage the neighbourhood in monitoring their waterway health and/or providing support for environmental repairs jobs in their reach of creek, pond, wetland, river or coastline.

Developing Effective Strategies to Manage Urban Stormwater

Analysis of the main issues impacting on stormwater quality in Newcastle indicate that a number of key issues frustrate improving stormwater management. There are a number of existing references to the impacts of urban stormwater in general and to particular problems and opportunities in Newcastle that have been used to inform the development of this plan.

Challenges and Opportunities

A particular challenge to managing stormwater issues in Newcastle stems from the community's historical approach to stormwater management. We have a highly constructed system of "drains" along drainage and creek lines, designed primarily for the purpose of removing stormwater from urban areas as quickly as possible. Stormwater itself has been considered a waste to dispose of, rather than as a positive element for harvesting, reuse and enjoyment. This has resulted in a system of concrete channels and drains through narrow strips of land, that are efficient at conveying flow but have removed significant areas of natural creek system. This challenge is most evident in highly urbanised sub-catchments where infill development adds to already high run off profiles.

Photo 7:
Shows a concrete stormwater channel in Throsby Creek catchment with urban residential and industrial development abutting both sides of the channel and creating the drainage corridor referred to in the text. Note the erosion of the unvegetated channel banks.

Improving stormwater quality in Newcastle will depend on the development of integrated approaches that recognises the urban water cycle and applies a systems-based approach to managing natural resources and environmental issues. In Newcastle the Hunter-Central Rivers Catchment Management Authority (CMA) (former Hunter Catchment Management Trust) has worked with the community and other government agencies to produce and implement Total Catchment Management strategies for Ironbark and Throsby Creek catchments that have now been incorporated within the Hunter River Catchment Blueprint. Significant improvements have been achieved through this work. The SMP process has also identified the need to prepare a management plan for the highly urbanised Cottage Creek Catchment. This is now in train as part of the joint project set of the Newcastle Catchment Management Forum (NCFM) (see Action Plan, Table 7). The NCMF is part of the new committee structure of the CMA that now covers all Newcastle's catchments.

In areas along the ocean, there are a number of smaller catchments that discharge stormwater directly to the beach. Here an integrated approach to the management of the coastal zone, through the Coastal Management Program, will provide an opportunity to incorporate stormwater management as a primary consideration in protecting our ocean foreshore and coastal beaches. Similar outcomes are envisaged for the Estuary system as part of the Estuary Process and Management Study (see Action Plan, Table 7).

Adopting the Stormwater Management Plan has given all the responsible water authorities the opportunity to implement their activities in a coordinated manner and provided valuable support to successful funding applications. Government funding bodies have are more likely to give priority to coordinated projects having appropriate evaluation mechanisms.

The adaptive nature of the management framework of this Plan has enabled it to be modified over time in response to changing community priorities, emerging issues and altered government policies, through the Newcastle Stormwater Forum, or to take advantage of particular management or funding opportunities.

Key Management Strategies to Improve Urban Stormwater

During the consultation process, stormwater managers defined the existing programs and management strategies operating across the city, assessed the strategic framework required to deliver outcomes for priority stormwater issues identified by the community and reviewed the outcome for any omissions in the coverage of the strategies. The outcome of this stage of the planning process is summarised in Table 6. Over 50% of the management strategies identified address community education and consultation responses, some 40% identify planning and works, while approximately 20% involve investigation and evaluation and review.

The recurrent themes that emerge from the strategies are either prerequisites and/or opportunities to:

- Better understand the issues
- Employ a broad range of tools
- Integrate across agencies and programs
- Foster better practices
- Highlight the potential of community outreach
- Focus stormwater management initiatives and partnerships
- Rethink historical stormwater treatments.

Better understand the issues

The development of effective and efficient management techniques for stormwater management necessitates a clear understanding of the exact dimensions of the problem. Where is it worst? What are the causes? Who is responsible? How can we fix it? Some information has been gathered for a number of the issues. However better information on sedimentation and erosion, water quality parameters and pollution movement throughout the catchments and on habitats and ecosystems affected by stormwater will enable the identification of more targeted programs. Research undertaken as a result of the SMP 2000 Action Plan has made great inroads in previously identified information gap.

In the longer term, setting targets that respond to water quality objectives derived from real time ecosystem measures, identified through targeted catchment based water monitoring processes and indicators of quality of life, and their promotion, will enable the community to be aware of progress in improving stormwater quality.

Employ a broad range of tools

In the past, the majority of stormwater treatments involved hard physical infrastructure. Increasingly, in stormwater as in other fields of environmental management, the opportunity to broaden the range of tools has been embraced since 2000. The management strategies for this plan include, in addition to remedial structural treatments, the development approval process, advocacy, learning and training, community outreach and incentive programs. Effective management strategies incorporate provisions for monitoring, evaluation and review to ensure implementation was undertaken properly and that the strategy was on target.

Integrate across agencies and programs

Total Catchment Management and systems-based natural resource management approaches have been identified in this Plan as key mechanisms to foster interagency cooperation and improve stormwater quality and quantity and flow regimes. Recent government policy have provided a planning framework and processes to manage the coast, estuary, floodplains, vegetation, natural resources, urban waterways and environmental management in the Hunter River catchment. There is a clear need to coordinate and integrate these planning and management processes. The Stormwater Forum organised by Council will provide the opportunity to review and plan for such cooperative efforts.

Major infrastructure providers such as the Hunter Water Corporation (HWC) and the Roads and Traffic Authority (RTA) will develop integrated Environment Improvement Plans to fulfil their Section 12 notices from DEC (the former Environment Protection Authority). The RTA's approach includes considering all road issues in an integrated way, so that road construction, resurfacing, and general usage, are all viewed collectively to reduce the impacts on stormwater from roads.

Foster better practices

Property owners, site managers, developers and utility providers require awareness, training in proper procedures and contingency plans to protect stormwater quality and improve frequency of erosive stormwater velocities. To augment current programs to reduce the erosion potential associated with construction activities, programs targeting inappropriate site maintenance will be required. Council, as a major owner of bushland reserves and with responsibility for works and maintenance of Council roads and facilities; Hunter Water Corporation, with responsibility for the sewage and stormwater channel system; and utility providers, need to ensure their land management and work practices reflect best management practice. Alterations to stormwater system maintenance schedules to align this activity with storm events is but one initiative to reduce the transfer of pollutants across the Cities catchments.

Owners and managers of large industrial, commercial and institutional sites have the potential to have a relatively important impact on stormwater. For example, negotiating with high litter generators to develop and implement source controls through a "Memorandum of Understanding" is a technique that has been successfully applied with a fast food restaurant chain in Newcastle. The University of Newcastle has also recognised its responsibilities and has developed best practice water sensitive design solutions for its extensive bushland campus that serve as best practice demonstration for other practitioners.

Highlight the potential of community outreach

Review of the proposed management strategies demonstrates the pivotal role for community participation and understanding in improving stormwater quality. From appropriate litter disposal to collection of unwanted household chemicals by Hunter Water Corporation, to selection of garden species and household maintenance, the general community is involved on a daily basis in activities that have the potential to affect stormwater. Information packages for home owners, small industrial premises, commercial sites, take away food outlets and sporting clubs could raise awareness of stormwater issues related to their activity and list suggestions to improve practice. Good news stories with public interest such as the humble dung beetle and Clean Up Australia and advertisements, like the successful DEC's "Solution to Pollution" TV commercials, raise community awareness. It is also recognised that the key to ensuring change practice is the appropriate engagement of these audiences in a sense of ownership of the problem and their valuable role in implementing solutions. Council's "Gutter Talk" and Creeks Alive initiatives have successfully addressed this issue in a number of the Cities catchments. Learning from these activities will continue to influence the delivery of improved community understanding and the rate of uptake of stormwater positive behaviours.

Focus stormwater management initiatives

Where issues are better understood, specific remedial action plans have been developed to respond to the needs and locations identified. The 2001-02 Throsby Creek Catchment Stormwater Project utilised a Gross Pollutant Study to identify hotspot sub-catchments and options for action that where then prioirtised and jointly funded by Council, HWC and the HCR CMA, DEC and Coast & Clean Seas grant. In general this approach has seen the management of pollutants as high up in the catchments as is feasible, where they are easier to control and treat, and their impact on the broader system is minimised. High generators of pollutants and high-risk areas have, and will continue to be, the focus of initiatives to reduce pollutant load and impact.

Development and redevelopment are two catalysts to improve stormwater management. Council's planning, development and approvals processes will be refined to ensure protection of stormwater throughout the development process. Although infill redevelopment is a particular challenge for stormwater management, the opportunity of land use change or intensification will be used to facilitate improvements to stormwater by the inclusion of

'softer' treatment options wherever this is feasible. Research in Fig Tree Place, Nobbys Beach, Warabrook Wetlands Estate, Black Duck Creek and Kotara have demonstrated the practical application of this approach.

Rethink historical stormwater treatments

The community values and objectives give priority to innovative responses to stormwater management. They recognise the pro-active approach of the Newcastle City Council, other stormwater managers in Newcastle and the community, to environmental management and consider that this should also be demonstrated through creative stormwater management solutions. Strategies to reinstitute natural stream flow and meanders, choose 'soft' over 'hard' technologies where appropriate and develop projects ready for funding opportunities are indicative of a pro-active response.

The preparation and ongoing implementation of a Stormwater Management Plan for Newcastle creates a chance to clarify the responsibility, accountability and ownership of the City's stormwater system.

Table 6: Newcastle catchment based Stormwater Management Strategies to address the identified stormwater Issues.

Issues	#	Strategies	Responsibility	Investigation	Planning	Community Education & Consultation	Works/ Implement	Evaluation & Review
Litter	**1.1**	Lobby State government to reduce creation of potential litter by waste generators – ie plastic milk & drink containers	NCC			X		
	1.2	Determine litter control needs of each catchment – including coastal catchments (eg Throsby Gross Pollutant Study) • Identify sources • Target "hot spots"- high generators • Collect litter close to source, higher in catchment • Understand how litter moves through catchment under varying flow conditions & how it is deposited within instream profile • Develop integrated litter management program including maintenance & disposal	NCC, with HCR CMA, HWC, generators and community	X	X			
	1.3	Develop more source agreements with high generators such as Garden City, Jesmond Plaza, Marketown, Marathon Stadium, Racecourse, Showgrounds, etc	NCC with high generators	X	X	X	X	X
	1.4	Ensure appropriate facilities for disposal & collection (including litter collected by community groups)	NCC				X	
	1.5	Assess the need to better align maintenance schedule with storm events	NCC/HWC	X	X			

Issues	#	Strategies	Responsibility	Investigation	Planning	Community Education & Consultation	Works/ Implement	Evaluation & Review
Litter	**1.6**	Facilitate and promote high profile clean ups – eg "Clean Up Australia Day"	NCC			**X**		
	1.7	Enforce littering legislation (and publicise)	NCC	**X**	**X**	**X**		**X**
	1.8	Conduct community education that follows litter through the stormwater system	NCC			**X**		
Erosion	**2.1**	Understand the erosion/sedimentation patterns of the catchment to target actions to gain optimum benefit (Utilise L. Ormerod's thesis in Ironbark Ck as a model)	NCC/HCR CMA/HWC	**X**	**X**			
	2.2	Undertake remedial actions to address information identified in 2.1 including • Stabilisation and rehabilitation of creek banks (*links to Habitat and Community Involvement*) • Minimise contribution from bushland (particularly NCC reserves & private holdings) • Target long term problem sites & high risk areas • In developing plans for "softer" works pay particular attention to interface between hard and soft treatment (literally 'end of pipe') • Review effectiveness of previous works procedures and implementation to improve future practice	NCC Community groups such as Landcare assisted by HCR CMA				**X**	**X**

Issues	#	Strategies	Responsibility	Investigation	Planning	Community Education & Consultation	Works/ Implement	Evaluation & Review
Erosion	**2.3**	Target building and development process by: • Regulation & enforcement (publicise) • Survey at start to provide a baseline • Utilise entire range of Council's approval and inspection procedures and powers • Training- those in industry, council staff & utility providers • Support Water Sensitive Urban Design by developing appropriate NCC development policies • Adopt principle of "no sediment beyond site" for new development • Include infill development	NCC/ other utilities & development industry & associations	**X**	**X**	**X**	**X**	**X**
	2.4	Encourage better management practices post development (eg ladnscaping) through education	NCC			**X**		

Issues	#	Strategies	Responsibility	Investigation	Planning	Community Education & Consultation	Works/ Implement	Evaluation & Review
Sediment	**3.1**	Understand/utilise a suite of control options for application to specific catchment problems to yield best outcomes including cost effectiveness	NCC/ HWC		**X**			
	3.2	Develop E&S controls for all development sites to prevent erosion & sedimentation– use of best practice	NCC & developers, industry, NSW agencies		**X**	**X**	**X**	**X**
	3.3	Consider options for sediment use (after dewatering)	NCC/ HWC NPC	**X**	**X**			**X**
	3.4	Trap sediment further up the catchment to reduce load and treat drier material	NCC & developers		**X**		**X**	
	3.5	Ensure commercial and industrial premises with hard and/or bare surfaces are maintained properly by • Regulation & enforcement (publicise) • Utilise entire range of Council's approval and inspection procedures and powers • Training- site owners, tenants/users & council staff	NCC with industry groups and land owners			**X**	**X**	
	3.6	Develop appropriate procedures for disposal of sediment	NCC/HWC NPC				**X**	
	3.7	Encourage better management practices post development through education	NCC			**X**		
	3.8	Ensure runoff from NCC community lands managed to minimise sediment and nutrients	NCC				**X**	

Issues	#	Strategies	Responsibility	Investigation	Planning	Community Education & Consultation	Works/ Implement	Evaluation & Review
Habitat	**4.1**	Increase the understanding of habitats & ecosystems affected by stormwater management to: • Identify suitable species for specific sites within the catchments • Protect aquatic ecosystems • Reinstate natural vegetation/systems within the existing stormwater system • Utilities riparian /drainage corridors as linkages between larger patches of vegetation • Identify high habitat values to target for weed & nutrient management	NCC/ HCR CMA, HWC		**X**		**X**	**X**
	4.2	Promote appropriate garden species	NCC			**X**		
	4.3	Advocate community action particularly bushland/waterway neighbours re • green waste & • nutrients impact(s) on natural habitats	NCC/HWC/HCR CMA			**X**		
	4.4	Consider other environmental management issues such as fire, flooding and safety in encouraging reinstatement of more natural habitats along drainage corridors	HWC/NCC		**X**	**X**	**X**	

Issues	#	Strategies	Responsibility	Investigation	Planning	Community Education & Consultation	Works/ Implement	Evaluation & Review
Community Involvement & Awareness	**5.1**	Support community involvement in activities leading to better stormwater management through information, support, direct assistance and partnerships	HCR CMA/NCC/ HWC			**X**		
	5.2	Recruit user groups for maintenance –"user maintains"	NCC			**X**	**X**	
	5.3	Work with community groups to foster better coordination between environmental values and social values for public open space	NCC			**X**	**X**	
	5.4	Develop targeted education campaigns for land users eg Light industrial sites, residential; takeaway foods.	NCC/EPA			**X**		
	5.5	Extend "Creeks Alive" to more local neighbourhoods	NCC/HCR CMA			**X**		
	5.6	Explore the potential for community –business- Council ownerships/partnerships with Pollution Prevention Programs	NCC/Industries & schools/HCR CMA			**X**		
	5.7	Develop messages re: what is removed from system to heighten public awareness	NCC/DEC			**X**		
	5.8	Discourage recreation vehicles in inappropriate sites	NCC/ DLWC			**X**		

Issues	#	Strategies	Responsibility	Investigation	Planning	Community Education & Consultation	Works/ Implement	Evaluation & Review
Management (Planning)	**6.1**	Review & improve existing stormwater management frameworks to respond to community values & objectives	NCC/HWC		**X**	**X**		
	6.2	Facilitate source controls and on site reuse	NCC/LHCCREMS		**X**		**X**	
	6.3	Be aware and take advantage of labour market programs	NCC				**X**	
	6.4	Identify possible funding sources; link to actions/ programs including: • investigating a levy for environmental improvements; • incorporating stormwater management strategies in Sec 94 contribution plans • "User pays" eg % of coal dust in road runoff sediments • Turning to advantage funding programs for "hard" infrastructure	ALL		**X**		**X**	
	6.5	Utilise water quality data to increase understanding of the courses of stormwater problems to: Inform public Target generators of problems (specifically where possible but generically also) Identify "good news stories"	HWC/ HCR CMA /NCC	**X**		**X**		
	6.6	Support community involvement	ALL			**X**		

Issues	#	Strategies	Responsibility	Investigation	Planning	Community Education & Consultation	Works/ Implement	Evaluation & Review
Management (Planning)	**6.7**	Identify targets to achieve stormwater quality improvements ie translate water quality objectives into measurable (and reportable) water quality criteria	NCC/HWC					**X**
	6.8	Foster openness of reporting through the use of indicators	NCC					**X**
	6.9	Consider the preparation and ongoing implementation of the stormwater management plan as an opportunity for clarification of responsibility, accountability and ownership of the stormwater system	NCC/HWC		**X**			
	6.10	Utilise Council's role as an advocate to identify opportunities and to request funding in response to new government requirements	NCC			**X**		
	6.11	Encourage EMS for large industrial and commercial sites	NCC				**X**	**X**
	6.13	Foster • integration between coast, estuary, catchment and floodplain management plans; • TCM and stormwater management and • Interagency cooperation	ALL		**X**			

Issues	#	Strategies	Responsibility	Investigation	Planning	Community Education & Consultation	Works/ Implement	Evaluation & Review
Management (Planning)	**6.14**	Facilitate TCM as an appropriate vehicle to enhance stormwater quality by: • Fostering implementation of existing TCM strategies • Assisting in updating the Throsby Ck TCM strategy • Developing an integrated TCM strategy for the Cottage Creek catchment	HCR CMA NCC DLWC HWC		**X**			
	6.15	Develop an integrated approach to the management of coastal systems (in conjunction with the Coast and Estuary Management Committee)	HCR CMA NCC DLWC HWC		**X**			
	6.16	Need to consider requirement(s) of other utility providers in drainage corridor redevelopment	NCC/HWC			**X**		
	6.17	Ensure that community health and safety issues are included in any stormwater planning processes and works	ALL	**X**	**X**	**X**	**X**	**X**

Issues	#	Strategies	Responsibility	Investigation	Planning	Community Education & Consultation	Works/ Implement	Evaluation & Review
Grease Oil and Petroleum (Chemicals)	**7.1**	Develop an integrated approach to controlling stormwater quality impact of roads, car parks and other vehicular surfaces including Runoff Construction and installation of services Re-Surfacing	NCC/RTA & owners of large car parks		**X**	**X**	**X**	**X**
	7.2	Publicise HWC's chemical collection service	HWC			**X**		
	7.3	Conduct risk assessment to identify issues for management – eg capability of system	NCC/HWC/ RTA		**X**			
Nutrients	**8.1**	Continue community education regarding household practices such as car washing, pets	NCC/ EPA			**X**		
	8.2	Need to focus nutrient management on localities within the catchments where nutrients impact on the environment – eg higher up in freshwater systems	NCC/ HWC		**X**		**X**	
	8.3	Understand and manage the impacts of septic tanks	NCC/EPA	**X**		**X**		
	8.4	Investigate implementation of new treatments in other localities such as smaller artificial wetlands						**X**
	8.5	Utilise innovative treatments with public appeal such as "dung beetles"	NCC/HCR CMA			**X**	**X**	
	8.6	Ensure runoff from NCC community lands managed to minimise sediment and nutrients	NCC				**X**	**X**

Issues	#	Strategies	Responsibility	Investigation	Planning	Community Education & Consultation	Works/ Implement	Evaluation & Review
Nutrients	8.7	Educate the community re Green waste Grass clippings Nutrients and Their impact(s) on natural habitats	NCC/HWC/HCR CMA			X		
	8.8	Investigate the relationship between nutrients and dynoflagellates	Newcastle Port Corporation	X				
	8.9	Promote appropriate garden species	NCC			X		
Organic Matter	9.1	Develop an integrated landscape plan for the City including: Preferred species for street trees Education regarding domestic landscaping procedures	NCC		X			
	9.2	Ensure council workers and others in direct contact with the stormwater system undertake proper procedures	NCC/HWC/RTA			X		
	9.3	Promote appropriate garden species	NCC			X		
	9.4	Educate the community re Green waste Grass clippings Environmental weeds Nutrients and Their impact(s) on natural habitats	NCC/HCR CMA & community groups			X		

Issues	#	Strategies	Responsibility	Investigation	Planning	Community Education & Consultation	Works/ Implement	Evaluation & Review
Bacterial and Viruses	10.1	Undertake further investigation into the presence of faecal coliforms within the catchments (linked to HWC sewer surcharge program & Shortland effluent discharge)	HWC/NCC	X				
	10.2	Understand and manage the impacts of septic tanks	NCC/EPA	X	X			
Heavy Metals	11.1	Develop an integrated approach to controlling stormwater quality impact of roads, car parks and other vehicular surfaces	NCC/RTA and owners of large car parks		X	X	X	X
	11.2	Publicise HWC's chemical collection service	HWC			X		
	11.3	Support NPC in minimising the entry of contaminants from landuse activities in the City, into the Harbour	NPC/NCC/HWC/ HCR CMA		X			
Acid Sulphate Soils	12.1	Need to take into consideration in developing treatment options in low-lying portions of the catchment	DKWC/NCC		X			

Management Framework

The Community

Groups such as Landcare, Bushcare, community and environmental groups, service organisations and professional groups have a keen interest in stormwater and catchment issues, however, all members of the Newcastle community have a role to play in the management of stormwater issues in the City. In some cases this responsibility extends to others within adjoining local council areas that live or work in a catchment that drains to the Newcastle local government area. This responsibility also extends to the adjoining Councils of Lake Macquarie and Maitland that have management roles within Ironbark, Throsby and Greenways Creek catchments and in turn Newcastle Council, which shares a management responsibility for catchments that drain into the Maitland local government area. During the Plan development process Council has had open and productive communication with both Lake Macquarie and Maitland City Councils concerning stormwater information and management approaches.

The Stormwater Management Plan needs to recognise these relationships to ensure total catchment management principles are supported. Now across all catchments in the City the Plan supports the role-played by the Hunter-Central Rivers Catchment Management Authority (formerly Hunter Catchment Management Trust) in coordinating the activities of stormwater managers through the Newcastle Catchment Management Forum.

In Newcastle the principle responsibility for stormwater management lies with Newcastle City Council and the Hunter Water Corporation, while the Hunter-Central Rivers Catchment Management Authority aims to coordinate the catchment activities of government and the community in regard to natural resource management which includes stormwater.

Newcastle City Council

Council, under the provisions of the Local Government Act (1993), has responsibility for the provision of a range of services including the construction and maintenance of road and drainage infrastructure and the management of community lands including drainage reserves, parks and beaches. The Local Government Act also prescribes a management planning framework for councils to ensure a structured and transparent process is provided for annual budgets and works programs. Council levies an annual property rate and obtains other sources of income to fund its activities.

It has wide ranging planning functions under provisions of the Environmental Planning and Assessment Act (1979) covering strategic planning and development activities within the City. There is also a raft of environmental legislation that guides and enables Council's role in natural resource management and pollution control activities.

Overlying these responsibilities councils have a charter under the Local Government Act to have regard to the principles of Ecologically Sustainable Development (as defined) when exercising its functions.

Newcastle City Council has endorsed a vision for the City supported by a set of values shared by the community. The vision and shared values, articulated in Council's Strategic Direction Statement, are used to guide the development of Council's management programs and policies. The Strategic Direction Statement is consistent with the principles of ecologically sustainable development. Newcastle City Council's Management Plan, the Newcastle Environment Management Plan (2003) and the Urban Water Cycle Management Policy (2004) will be the principal vehicles for implementing the City's Stormwater Management Plan.

The Hunter Water Corporation

The Hunter Water Corporation is responsible for over 80 kilometres of stormwater pipes and channels in the Newcastle Local Government Area. These assets are centred in the Cottage and Throsby Creek catchments and the Ironbark Creek sub-catchments of Dark Creek and Wallsend - Plattsburg. Hunter Water's role is to maintain the current capacity of stormwater drains within the constraints of new development, which in turn is the responsibility of Council. This is primarily achieved by maintaining the structural integrity of the channels and by ensuring that maintenance programs are in place to prevent accumulation of gross pollutants, silt and weed growth. Hunter Water levies a drainage charge for all properties within the Hunter Water gazetted stormwater catchments.

The Corporation's "Statement of Corporate Intent" also identifies that Hunter Water will pursue the objective of protecting the environment by conducting it's operations in compliance with the principles of Ecological Sustainable Development contained in Section 6(2) of the Protection of the Environment Administration Act 1991.

The Corporation's Environmental Management Plan identifies that the overriding objective is to cooperate with other organisations and the community to improve urban stormwater catchment management in the Hunter Water Corporation's area of responsibility. This includes working with TCM committees and local councils to support environmental programs.

For a number of years, Hunter Water have been discussing the transfer of ownership of stormwater infrastructure with Newcastle City Council, in the belief that such a transfer would place the management of new development and its associated downstream impacts in the hands of one body.

The Hunter-Central Rivers Catchment Management Authority

The Hunter-Central Rivers Catchment Management Authority (formerly the Hunter Catchment Management Trust) fulfils its essential role of bringing together government and the community in achieving the objectives of total catchment management. The Trust’s vision was for clean, healthy and productive catchments through ecological and sustainable use and management of our natural resources for the benefit of present and future communities of the Hunter. This was best demonstrated in Newcastle by the Trust's proven record of successfully involving governments and community in Throsby and Ironbark Creek Total Catchment Management Committees, to assess environmental and natural resource issues and developing coordinated catchment management plans for best management and rehabilitation of catchments.

The Hunter-Central Rivers Catchment Management Authority will continue to receive a catchment contribution on all rateable properties within the Hunter River catchment in order to assist in the delivery of the Hunter Catchment Blueprint for natural resource management for the region.

Roads and Traffic Authority

The Roads and Traffic Authority as part of its charter is responsible for the management of the operations, maintenance and enhancement of state roads, including the national highways in NSW. It provides funding to local councils to assist in the management of regional roads. This management includes the stormwater infrastructure of the road network.

An Environmental Policy was developed in 1997-98 to guide total RTA environmental management initiatives.

IMPLEMENTATION STRATEGY

Action Plan

The Newcastle Stormwater Management Action Plan (see Table 7) details the variety of stormwater activities within the City's catchments, including the new initiatives generated from the inaugural Newcastle Stormwater Forum, held in February 2000. The Action Plan has been revised and developed to address the priority stormwater issues identified in the Plan and respond to management strategies developed in consultation with the community.

The actions contained within the Plan serve as a short to mid term program to address identified priority issues. The actions have been developed in consultation with stormwater managers and community stakeholders. All actions identified are currently resourced and being implemented, or are planned for commencement within the 2000/2001 financial year.

Hunter Water Corporation's Newcastle Implementation Plan is contained in Appendix III. Hunter Water Corporation's Plan contains a progress report on their actions, including the installation of two floating trash booms within the Throsby Creek catchment and one floating trash boom in the Cottage Creek catchment, as identified in the SMP Action Plan. Hunter Water have also revised and updated their maintenance programs to maximise performance of existing control devices in Throsby Creek catchment, as well as installing a CDS gross pollutant trapping device in Lambton sub-catchment of Throsby Creek.

The inaugural Newcastle Stormwater Forum (February 2000) provided the opportunity to review and evaluate issues and strategies, as well as assess the effectiveness of the delivery of the Action Plan against the priority objectives of the Plan. There was also the opportunity to workshop current treatment train approaches and innovative at-source devices. The Forum workshop stimulated great interest and media exposure, generating active community participation in project development, which has resulted in successful funding submissions.

Photo 8:
Shows the Pratten Trap floating boom that was installed in June 2000 within the tidal section of the Cottage Creek catchment, at Wharf Road, by Hunter Water Corporation. The boom was designed to trap floating pollutants such as litter- plastic bottles and bags, foam packaging, paper etc and organic matter such as grass clippings, leaf litter etc.

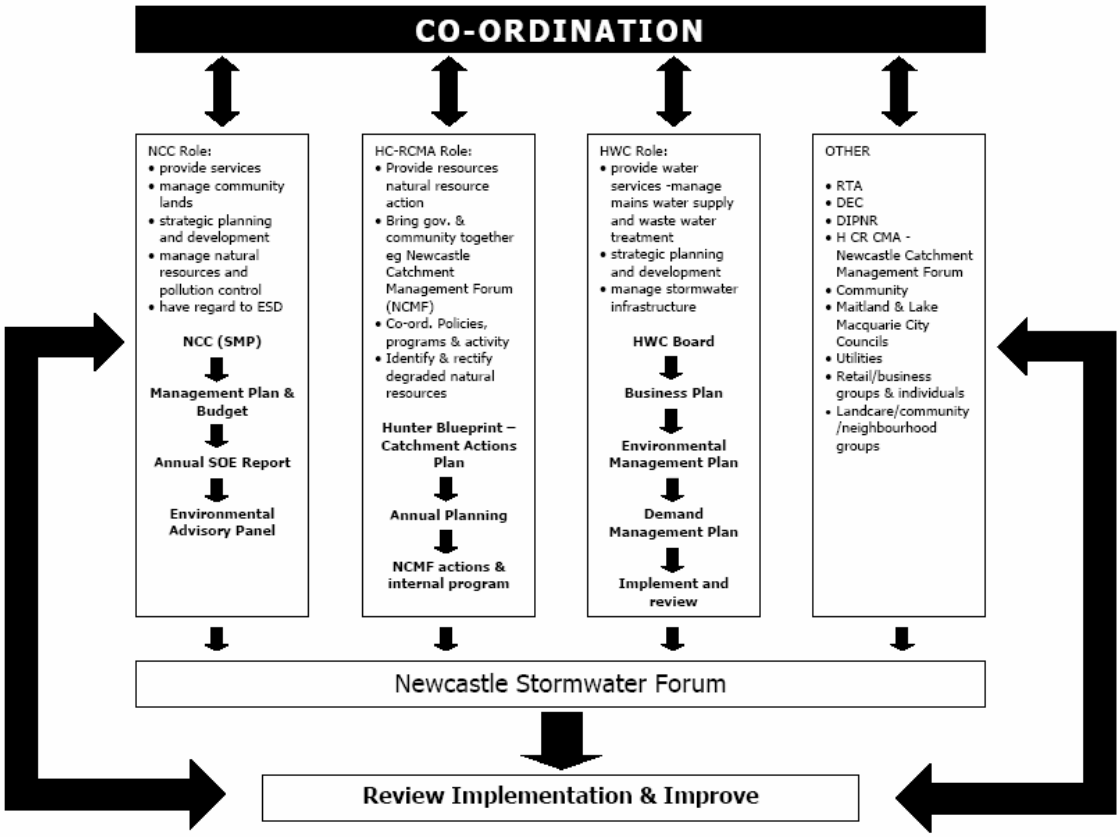
Cooperative Framework

The effective implementation of the Action Plan to manage stormwater in Newcastle will be dependent on the coordination of key stormwater managers in the City. The three key organisations involved in stormwater and catchment management are Newcastle City Council, the Hunter Water Corporation and the Hunter-Central Rivers Catchment Management Authority (formerly Hunter Catchment Management Trust). In each of these organisations the method of implementation will reflect corporate structures and processes, for example:

- Newcastle City Council would incorporate the SMP into Council's Management Planning Process and report its implementation in Council's Annual State of the Environment Report
- Hunter Water Corporation would incorporate relevant parts of the SMP within their environmental improvement program
- The Hunter-Central Rivers Catchment Management Authority would continue to include stormwater amongst the issues addressed in coordinating catchment management activities and implementation of TCM strategies.

Figure 5 shows the relationship between the internal planning processes of the stormwater managers within the City and the interactive co-operative decision making framework in which the stormwater managers group operates.

Figure 5: Stormwater Management Plan Implementation Strategy



Implementation Strategy

Coordination and Review

The SMP - Stormwater Managers Coordination Group, representing the key stormwater managers and stakeholders, interact regularly and meet on a bi-monthly basis to review activity associated with the Plan, including site inspections of the catchments.

The Stormwater Managers Coordination Group hosts the annual Newcastle Stormwater Forums, where issues such as those listed below are addressed:

- review progress;
- determine stormwater priorities in the City;
- develop stormwater management programs;
- coordinate activities/actions;
- benchmark stormwater management developments; and
- promote and celebrate the waterways of the City.

Outcomes would feed back into the revision of the SMP, TCM programs, Coastal & Estuary and other natural resource management programs and Stormwater Managers' corporate planning processes.

In addition to the Council's monthly Stormwater Managers meeting and annual Forum review, Council will be kept informed of the implementation of the SMP through monthly reports from the Stormwater Management Plan Coordinator. Such updates will be used to prepare community newsletter items for distribution as well as publication in Council's newspaper and newsletters.

A report reviewing the SMP will be prepared following the completion of a 3-year time frame, for Council's consideration.

Reporting Mechanisms

Newcastle City Council's annual stormwater reporting process will report against the effectiveness of the Plan implementation, for stormwater managers and community, using a variety of vehicles including:

- The Annual State of Environment (SOE) Report;
- An annual SMP Report produced as a lift-out on the basis of the SOE Report;
- Council reports;
- Media coverage;
- Community newsletter articles;
- Stormwater education materials and fact sheets series;
- Circulars; and
- Public reports on Council's web-site.

Hunter Water Corporation would report their activities through their Annual Environment Report. The Hunter-Central Rivers Catchment Management Authority will report on their involvement in the stormwater management process through their annual reporting mechanisms and promotional materials. More detailed activities of the Newcastle Stormwater Forum and Trust involvement would be put in a report to be considered at their bimonthly meetings.

In addition to vehicles such as the SOE reporting and regular community newsletters, it is anticipated that the water quality-monitoring program for the City will be distributed through web-site access, across all of the stormwater management agencies, to facilitate community access.

Performance Monitoring Mechanisms

The stormwater managers of the City are committed to ensuring the implementation of the Plan. This is clearly reflected in the Statement of Commitment signed by the CEO's and Lord Mayor of the Hunter Water Corporation, the Hunter-Central Rivers Catchment Management Authority and Newcastle City Council respectively. Monitoring of stormwater activities within all the catchments of the City is required to determine baseline conditions, as well as being utilised in assessing the effectiveness of implementing the SMP.

The water quality-monitoring program that is identified within the SMP includes two specific areas of monitoring:

- the collection of scientific water quality and biological indicator monitoring or quantitative monitoring; and
- observation assessment collected in the field that assesses broad performance criteria or qualitative monitoring.

The collation of data associated with the catchments will also be augmented by performance review monitoring to determine the effectiveness of the SMP implementation strategies, with comparison of actual project outputs compared to targets set. This will be incorporated within the Forum review process, with strategies instigated to realign projects where required.

Quantitative Monitoring

- *Water quality and biological monitoring*

The Issues Report, prepared as a background research paper to inform the community workshop sessions of the SMP development, identified some data existed in respect to water quality in all catchments of the City. The data provided a cursory picture of the pollution loads however it was primarily haphazard, unstandardised and collected for a variety of end purposes, some without rigour in collection, analysis or reporting.

Hence, the Action Plan includes a City wide monitoring program that incorporates macro-invertebrate sampling program that has been upgraded to allow for signal scoring of species reflective of Newcastle habitat. This will provide all stormwater managers with a reliable baseline for waterway health measures. In addition water quality data will generated from grab samples taken by a network of volunteers across the City under the Waterwatch banner. All outcomes will be made available to community through "water on the web" and distribution of promotional materials and group newsletters.

Sampling collected by automatic samplers over the course of storm events at targeted catchment sites is also envisaged at a later date. The University of Newcastle would undertake the design, development, management and analysis of this higher order water-quality monitoring program. The core parameters will be decided after the results of the broad-scale sampling program are reviewed. Future sampling will be specific to storm events, target specific parameters in order to generate cost-effective monitoring and analysis, that will be reported in a "plain English" manner for community distribution.

In addition to the water-quality monitoring program, other parameters monitored through the following programs could be incorporated into the city-wide reporting, including:

- Biological indicators such as the Hunter River oyster monitoring program within the estuary;
- Newcastle Port Corporation's harbour dredge spoil monitoring program;
- Hunter Water Corporation's water quality monitoring program for the Estuary;
- DIPNR's water quality monitoring program within Ironbark Creek; and
- Council's ocean baths monitoring program.

- *Qualitative Monitoring*

Observational monitoring will be conducted across the catchments of the City by staff as well as trained community members. All projects incorporating at source controls involved an element of community participation in observational monitoring, particularly where street cleansing regimes are involved. It is essential that those closest to the project precinct, in addition to staff, are reporting on the effectiveness of the activities. Proforma report sheets will be prepared where required.

In addition an extensive creek assessment program, including photo assay, riparian vegetation condition and biophysical waterway attributes is being delivered through Council's Land & Water Program, funded through the Newcastle Environment Levy.

The observations of staff and community members can be incorporated to view:

- litter - quantity, composition and source (if appropriate)
- oil/grease surface film
- scum &/or foam on surface
- odour
- algal growth
- turbidity or water clarity - visibility
- organic matter - garden refuse/leaves/lawn clippings
- Riparian zone - vegetation extent, composition – fauna
- Creek condition
- Aquatic plants and animals eg fish and other invertebrates
- erosion - site, extent, remediation works required
- sedimentation - site/source

Newcastle Sustainable Community Indicators (2003)

The Newcastle Sustainability Indicators project has identified a series of parameters that reflect the aspects of quality of life in the City where progress needs to be made if we are to be a City with a sustainable future. Such a program would provide the broad context of the role of stormwater systems and catchments/ beaches as important aspects of quality of life in the City, as well as an appropriate distribution point for data collated from the water quality-monitoring program.

Indicators are widely used for measuring purposes and are typically designed to show change over time. In developing the Implementation Strategy for the Plan it was considered appropriate to develop a set of "core" indicators that would aid stakeholders to determine the effectiveness of the Plan. In addition to the qualitative and quantitative monitoring discussed, these core indicators for stormwater will require medium to long term monitoring, evaluation and review. The fourth indicator, "the annual Hunter River School Prawn catch" as below, is already incorporated within the Newcastle Sustainability Indicators project. The remainder of the indicators detailed below, will be considered in Phase II of the project:

1. The level of community participation in specified stormwater management activities
2. The depth of sediment accumulation (measured annually in centimetres) in Throsby Creek
3. The amounts of sediment (in tonnes) removed annually from the Throsby Creek system
4. The annual Hunter River School Prawn catch (in kilograms)
5. The extent (measured in metres) of stream bank stabilisation and riparian rehabilitation completed on an annual basis
6. The trend for key pollutants (through a water quality monitoring program) in selected sites
7. The quantity of litter removed (through key GPT monitoring).

Cost Benefit Analysis and Risk Assessment

In the development of Council's annual management plans that include the implementation of actions contained within the SMP, a cost benefit analysis needs to be carried out in appropriate circumstances, to prove the effectiveness of actions. The potential for some control options to exacerbate local flooding or contribute negatively to other aspects of the natural environment necessitates that a risk assessment process also be undertaken as part of the design and planning process. There is a need to build on development of appropriate accounting mechanisms for natural/stormwater systems to improve the effectiveness of cost/benefit analysis.

Action Plan

Table 7: Newcastle Stormwater Management Action Plan 2004. (Note: summary of abbreviations used in Action Plan is located at end table)

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
01	Continue to develop and implement capacity building program for Council officers involved in implementing policy and conducting activities that impact urban water cycle management, particularly stormwater.	Council's Water Task Force identified Erosion & Sediment (E&S) as priority area for action and Environment Levy (EL) funds will be used to deliver this as part of the Land & Water Management program. Water Sensitive Urban Design (WSUD) and riparian zone management also targeted. Lower Hunter & Central Coast Regional Environment Management Strategy (LHCCREMS) 3rd round Stormwater Trust Grant program now available on CD for Council use. NCC will be engaged in further extension activities planned for regional Councils as part of the LHCCREMS 4th rnd Stormwater Trust Grant being implemented in 2004 in line with uptake of suite of UWCM policy initiatives.	Newcastle City Council (NCC): Task Force - all areas • Development & Environment (D&E) • City Strategy (CS) • City Services &Presentation (CSP) • Human Resources (HR) -Training LHCCREMS NSW Department Environment & Conservation (DEC)	NCC in-kind 2003 – ongoing EPA Strategic grant & LHCCREMS contribution	2004-06 ongoing	All gross pollutants Erosion Sediment Habitat Community involvement management monitoring resource utilisation	5, 6, 8, 9, 11, 12, 13, 15, 16, 17, 18
02	Continue to participate in activities developed through Hunter Stormwater Extension Officer (SEO) program	Hunter SEO has been delivering successful capacity building opportunities for regional Council officers since June 2002. SEO's will be funded by EPA till August 2004. LHCCREMS will also deliver additional urban water cycle capacity building opportunities through grant funds for regional Councils including establishment of urbanwater.info website.	Hunter Councils NCC: • D&E • CS • CSP • Community Partnerships (CP) • HR	NCC in-kind EPA grant funds – LHCCREMS administered	2004 – for term of program	• All Issue set	All objectives

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
03	Implement an integrated, targeted Urban Water Cycle Education Program	The Newcastle Environment Management Plan 2003 identifies the pivotal role played by environmental education in the development of sustainable communities and in particular the change management required to ensure Newcastle has a healthy urban water cycle. The NCC Land & Water Program will deliver Creeks *Alive* projects targeting reconnection of communities to local creeks – raising awareness and behaviour change in targeted areas of the City in association with key water health monitoring sites during 2004-2007. Project partners are NCC, Hunter Water Corporation and Newcastle Catchment Management Forum (NCMF) - a Committee of the HCR CMA. Display board systems and successful "stormwater code of conduct" and "creek/ bushland &/or wetland good neighbour" materials identifying positive community stormwater behaviour changes can be used for: • events • as part the displays in Council community facilities • "sustainable schools" visits etc. Additional funding opportunities/grants will be investigated.	NCC • CS • CD • D & E • CP • Summerhill • CSP All partners • Hunter Water Corporation (HWC) • Hunter-Central Rivers Catchment Management Authority (HCR CMA)	NCC: Land & Water Program $10,000 + support of environmental education $10,000 HWC Stormwater Environment Improvement Program (SEIP) in-kind Streamwatch Water watch in-kind	2004-2007 Ongoing Ongoing Ongoing	• all gross pollutants • sediment • erosion • habitat • community awareness/ involvement • management	1, 2, 3, 5, 6, 7, 10, 11, 12, 13, 14, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
04	Support for /and development of "Care groups" such as Bush, Care, Creek Care, Beach Care, Dune and Coast Care	Review of current Councils Community Greening Centre (CGC) model delivery for support services for community greening interest groups and individuals is being undertaken. The results of the review and benchmarking process will be used to provide targeted cost-effective outcomes for Newcastle greening program delivery. Build on current resource, training and group delivery capacity of the CGC. This activity base will deliver Newcastle Environment Management Plan 2003 (NEMP 2003) initiatives & improve Councils ability to respond to emerging natural resource management imposts for local government.	NCC: • CSP • Other operational and planning functions HWC HROC HCCREMS HCRCMA	NCC $13,000 cash & in-kind	2004 - ongoing	• gross pollutants • erosion • sediment • community involvement • management	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 16

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
05	Provide interpretative signage as part of Councils Urban Water Cycle program delivery.	Council will continue to expand the suite of interpretative environmental signage that includes Kotara baffle box, Warabrook, CGC & Nobbys project sites. Signage is planned for Lambton Ker-rai, Gregory Parade Park - Kotara Roof to Creek Project, Kullaibah Reserve rehabilitation and Blackbutt Reserve. HWC will erect community interpretative/awareness and safety signs within the channels in consultation with City stormwater managers. The process of "creek naming" & associated signage will continue across the City as part of the Creeks Alive project delivery (see 23.7).	NCC Task Force • CS • CSP • CP HWC HCR CMA /NCMF RTA	NCC in-kind and grants funds /sponsorship where available $8000 cash (HWC/CMA)	2004-05 ongoing 2004-05 ongoing	• All Issue set • Indigenous recognition	6. 8, 9,12, 13, 14, 17
06	Implement Hunter Catchment Blueprint Action Plan as appropriate	The Hunter Catchment Blueprint highlights the need for urban stormwater impact amelioration within the Hunter catchment as a priority issue. Council will be seeking external funding opportunities as they arise to ensure the sustainable management of Newcastle's catchments.	NCC • Task Force HWC HCR CMA /NCMF Relevant state and federal agencies	NCC in-kind Project partners	Ongoing	• All Issue set	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 16

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
07	Continue to monitor, evaluate, refine and implement the urban water related activity list contained within the Newcastle Environment Management Plan 2003 (NEMP).	Council's Water Task Force will continue to provide management representation to the NEMP Action Managers group and through the implementation of the Water Task Force work plan, drive the progress of the NEMP 2003 water theme objectives. The NEMP 2003 identified as a priority the need to: • develop, adopt & implement an UWCM Policy and associated regulation framework for Newcastle • develop the assessment tools to enable more effective delivery of UWCM measure within the City • provide training & learning environment necessary for change management practices • develop community stewardship and ownership of program outcomes through effective environmental education interventions.	NCC: • Task Force • NEMP - Environmental Managers Team Council staff: • CS • D&E • CSP • CD DEC DIPNR LHCCREMS Hunter SEO	NCC in-kind Land & Water Program	Ongoing	• All Issue set • Indigenous recognition	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
08	Develop and implement Newcastle Urban Water Cycle Management (UWCM) Policy package for stormwater, water efficiency & flooding as identified in the NEMP 2003 Water theme and progress future natural asset policy initiatives.	The NEMP 2003 identified as a priority the need to develop, adopt & implement an UWCM Policy and associated regulation framework for Newcastle. In March 2004 Council endorsed the UWCM Policy package that includes: • A sustainable UWCM policy for Newcastle • Flood Policy & associated Development Control Plan (DCP) 55 • Stormwater Management Plan 2004 Stormwater & Water Efficiency DCP50 (containing erosion & sediment prevention guide) was endorsed in September 2004. Future policy work has been identified under a natural resources management umbrella & incorporates environmental flows, ground water, waste water reuse, natural creek/riparian zone protection, groundwater and natural channel design/maintenance guidelines (*see Creeks Alive*). • As part of this process options for progress in natural resource management will require their incorporation within the review of the Newcastle Local Environment Plan 2003 (LEP) and development of the Newcastle Consolidated DCP.	NCC: Stormwater Task Force • CS • D&E • CSP (Parks) Community Industry partners NSW Dept. Infrastructure Planning & Natural Resources (DIPNR) NSW DEC HCR CMA	NCC in-kind	March 2004 - ongoing	• all pollutants • erosion • sediment • habitat • community involvement • management • monitoring • resource utilisation	4, 5, 11, 15, 16, 17

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
09	Develop a sub-division code that reflects UWCM policy context where UWCM objectives are incorporated into subdivision design and delivery.	The principles and objectives of the Newcastle UWCM Policy package will be incorporated in Newcastle's subdivision code to ensure that the design and the performance objectives for subdivision development deliver sustainable outcomes for the City. This is included in the work plan for Council's Water Task Force.	NCC: Task Force • D&E • CSP • CS Industry - MBA/HIA etc Community HWC HCR CMA DIPNR DEC Other relevant agencies & regional partners	NCC in-kind	2004 develop for exhibition Ongoing implementation	• all pollutants • erosion • sediment • habitat • community involvement • management	4, 5, 6, 7, 8, 11, 15, 16, 17, 19
10	Investigate the role of the Urban Forest as a natural resource management tool in addressing UWCM issues for the City.	Conduct an organisational review of tree management in the City with a view to develop an Urban Forest policy and program to deliver stormwater quality and quantity improvements as one of the multi-objective outcomes.	NCC • Task Force • D&E • CSP • CS • HWC HCR CMA /NCMF Partners	NCC in-kind Project partners	2004 -ongoing	• all pollutants • erosion • sediment • habitat • community involvement • management	4, 5, 6, 7, 8, 11, 15, 16, 17, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
11	Continue Council commitment & participation in the Newcastle Catchment Management Forum (NCMF)	The NCMF has superceded the total catchment management processes previously co-ordinated through the HCR CMA (former HCMT) for Ironbark and Throsby Creeks. Council will continue its commitment and participation as a member of the Newcastle Catchment Management Forum (NCMF). The consideration of Newcastle's catchments now extends to include Greenways and Purgatory Creek systems as well as Cottage Creek. Specific catchment actions are tabled below.	NCC: Task Force • CS • HWC • HCR CMA	NCC in-kind Project partners	Ongoing	• all pollutants • erosion • sediment • habitat • community involvement • management • monitoring • resource utilisation	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20
12	Develop shared Council and Hunter Water Corporation stormwater management standards for new and redevelopment.	Council will work in collaboration with HWC to develop shared organisational standards/ guidelines for stormwater management for new and re-development sites using the UWCM policy and DCP 50 – Stormwater and Water Efficiency to guide process.	NCC: Task Force • CS • D & E • HWC	NCC in-kind	2004 and ongoing	• all pollutants • erosion • sediment • habitat community • involvement • management	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
13	Newcastle Environment Levy Erosion & Sediment (E&S) Prevention Program	Erosion and Sediment (E&S) Prevention is identified as a priority issue of concern by Councils Water Task Force (2002). This is also supported by the outcomes of the total catchment management strategy reviews completed in 2002 for Ironbark & Throsby Creeks. As part of the Newcastle Environment Levy 5 year erosion and sediment prevention program Council will: • Site selection by patrol, D.A lodgements and issuing of construction certificates. • Regular site inspections over the life of the construction site. • Assessment of the status of the sediment controls and overall environmental performance of the site. • Specific site education covering both the technical installation of sediment controls and greater environmental awareness. Enforcement action including warnings and directions for corrective action and formal action under the POEO Act namely clean up notices, prevention notices, compliance cost notices and penalty infringement notices. HWC also provide E&S training for field staff for water & sewer maintenance. Opportunities for delivering joint programs to provide economies of scale and policy integration will be investigated.	NCC: • D&E • City Strategy • CP • Task Force Regional LG partners MBA Industry • HWC	NCC: $60,000 pa Compliance program & enforcement revenue generated $20,000 Land & Water Program In-kind	2003 – 2007 ongoing	• community involvement • management • erosion • sediment • habitat	4, 5, 6, 7, 8, 11, 15, 17, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
14	Refine and improve NCC Operations-Stormwater	Council's Stormwater Task Force has completed an audit process for all Councils functional areas in relation to stormwater activities that includes for example parks & gardens, street cleansing, road maintenance, pit & drain cleansing & fleet management, education, companion animal program, DA processes etc. The Task Force identified E&S prevention as the priority areas for focused attention and developed a three-year priority work program to address this and other issues. The Task Force work plan also includes Council's capacity building initiatives aimed at generating more sustainable open space maintenance practices under the "Sustainable Parks Maintenance Program". The Senior Management Team has endorsed the Task Force work plan for implementation.	NCC • CSP Design Parks and Recreation Construction Maintain EMS • CS • D&E • HWC LHCCREMS	NCC in-kind in-kind in-kind	2003-06 ongoing	• all pollutants • erosion • sediment • habitat • community involvement • management	1, 2, 4, 5, 6, 8, 10, 11, 14, 15, 18
15	At Source gross pollutant control program for commercial areas, high risk car parks facilities and other "hotspots" sources across Newcastle catchments.	The installation of kerb protectors, pit insert and street cleansing regimes in neighbourhood retail precincts during 2001-2003 has produced cost-effective options for improving stormwater quality. The investigation of alternative, as well as modifying current, designs for retrofitting appropriate sites will continue to be implemented across the City. A structural refit of pit within Waratah Village shopping precinct, in the Waratah sub-catchment of Throsby Creek, will be undertaken in 2004 as part of the "Streets to Creeks" initiatives.	NCC: Task Force • D&E • City Strategy • CSP • CP HWC HCR CMA Business/ community groups	NCC in-kind & $10,000 (HCR CMA) in association with partnership programs	2003-07 monitoring ongoing	• erosion • sediment • gross pollutants • hydrocarbons • heavy metals • community involvement • management	12, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
16	Continue the implementation of the Sustainable Parks Maintenance program across Newcastle's catchments	Council has successfully delivered a capacity building program for operational staff in relation to alternative landscaping methodologies that incorporate improved biodiversity, maintenance and water resource use through open space landscaping projects designed and delivered in multidisciplinary teams. Extending the reach of the program across the Cities work crews and locality types will continue.	NCC: • CSP • managers/ co-ordinators from D&E, CS, CD	NCC in-kind & cash for planting	2003 - ongoing	• community awareness/ involvement • management • all pollutants • erosion • sediment • habitat	4, 5, 6, 7, 8, 11, 15, 17, 19
17	Continue to implement a Business Pollution Prevention Program for high-risk commercial premises and recreational facilities \ landuses across all Newcastle's catchments	Council has developed a Business Pollution Prevention Program (BPPP) based on the successful Warabrook Wetlands Project outcomes. BPPP work plans and materials have been produced. The BPPP is now being implemented in other pollution hot spot areas. To date both Wickham and Maryland Industrial areas have been audited. Over 100 audits have been completed in this program to date.	NCC: • D&E • CP	NCC in-kind	2003 - ongoing	• all gross pollutants • sediment • community / industry awareness/ involvement • management	5, 6, 7,11, 12, 13, 14, 15, 18

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
18	Continue to refine a comprehensive Stormwater Asset register for all catchments and develop natural assets register as parallel process	On-ground definition including maintenance schedules and monitoring outcomes, for all existing and new stormwater treatment devices & infrastructure, across all catchments, need to be incorporated (in case of new infrastructure) and maintained in Councils database. Drainage condition reports need to be produced. Natural assets in the form of urban creeks & riparian zones need to be incorporated within compatible mapping programs and database developed to facilitate the appropriate prioritisation processes for capital works projects within the natural system.	NCC: • Task Force • CS • CSP	NCC in-kind	Ongoing 2004-06	• community awareness/ involvement • management • all pollutants • erosion • sediment • habitat	5, 8, 11, 12, 14, 15, 16, 17, 18,
19	Continue implementation of drainage management system	Use of close circuit TV to identify problem areas and target stormwater hotspots. Database needs to be available in order to ensure opportunities for stormwater quality improvements can be maximised for all new works.	NCC: • CSP • CS, asset management	$77,000 pa	Ongoing Ongoing	• all gross pollutants • sediment • heavy metals • management	8, 5, 14, 15, 16, 17, 18

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
20	Continued monitoring and review of the street cleansing program across all catchments	• Cleansing Program covers all catchments commercial/industrial large and local centres – includes road & footpath sweeping and pit maintenance • Street cleansing in Charlestown commercial area at headwaters Throsby Creek • Review of service level and management program incorporating product benchmark assessment • Review of gross pollutants (& associated sediment /heavy metals) collected to ensure "hot spots" identified in SMP are targeted.	NCC: • Task Force • CSP Lake Mac CC & Newcastle Catchment Management Forum (NCMF) NCC: • CSP • Task Force NCC: • CSP • CS • Task Force	NCC : $1.1 million pa In-kind In-kind In-kind	ongoing ongoing 2002 ongoing Ongoing	• all gross pollutants • sediment • heavy metals • community awareness/ involvement • management	5, 6, 7, 8, 10, 12, 13, 16, 17, 18
21	Implementation of the Newcastle Companion Animals Management Plan	Council will continue to identify and implement new "leash free" and "dog agility" areas across the City. Maintenance of the existing 15 facilities, responsible pet ownership education opportunities and enforcement programs will continue.	NCC: • D & E • CSP	NCC $20,000 pa	Ongoing	• Nutrients • Pathogens • Community awareness/ involvement • management	7, 9, 10, 12, 13,

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
22	Coordinate and conduct an annual Newcastle Stormwater Forum	The Newcastle Stormwater Forums have been very successful in engaging and connecting stormwater managers and the community across the City as well as regionally. The Forums will continue to provide the opportunity to review progress of SMP, report accordingly and investigate options in change management.	NCC: • Task Force • CS HWC RTA Lake Mac CC & other Hunter Council partners HCR CMA /NCMF NPC Community	NCCin-kind $1,000	Annually - ongoing	• community awareness/ involvement • management	5, 6, 11, 12, 13, 14, 15, 16, 17, 18, 19
23	The RTA with assistance from Council will formulate a stormwater action plan	High-risk areas have been identified. RTA need to be engaged in a co-operative program that will detail works design and prioritise actions. Funding opportunities will be investigated.	NCC • Task Force • CS – assets RTA	NCC in-kind	2004	• gross pollutants • management • oils/grease • sediment • heavy metals	2, 4, 5, 6, 7, 11, 13, 14, 15, 16, 18, 18
24	Deliver *Creeks Alive* Program across Newcastle's catchments	Program includes: • Creek /Riparian Zone policy framework and technical design /maintenance manuals & guidelines • Creek assessment process for all Newcastle's creek systems and works program prioritisation process • Creek monitoring – including water bug and water quality parameters • Creek mapping on GIS & database • Creek care groups developed and resourced across all catchments • Creek naming process across the City • Community support provided for works and rehabilitation	DIPNR NCC: • Task Force • D&E • CS • CSP • CP • HR	NCC Environment Levy $100,000 pa Land & Water Program over next three years	6/03 – 6/07 Ongoing	• all gross pollutants • sediment • heavy metals • community • awareness/ involvement • management	5, 6, 11, 12, 13, 14, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
25.1	*Creeks Alive* program elements include: • Develop natural channel design guidelines and maintenance manual documents for Newcastle catchments.	Change maintenance practices in existing natural creek assets and design of drainage works that reflect natural channel design would significantly improve the environmental performance and aesthetics of the City's water way network. The preparation of natural channel design guidelines and maintenance manual will be a valuable tool in Councils infrastructure design, assets and operational areas. It will assist in guiding the development of the Newcastle Consolidated DCP and review of strategies and actions through to service level delivery for operational areas.	NCC: • Task Force • CS • CSP • D & E Department of Environment & Conservation (DEC) DIPNR	NCC E Levy in-kind	2003-05 ongoing	• Community awareness • management • habitat • erosion • sediment	5, 8, 11, 12, 13, 14, 15, 16, 17, 18,
25.2	*Creeks Alive* program elements include: • Develop policy framework for environment / natural assets management (creek lines) as per UWCM policy	As identified in the Sustainable Urban Water Cycle Policy for Newcastle 2004, a policy framework for the protection and management of the city's natural asset base is required. Incorporate natural assets management practices and riparian zone management requirements and extent within Councils planning process including LEP (2003) review, Consolidated DCP development and best practice guidelines.	NCC • Task Force & all NCC groups with HWC HCR CMA DIPNR LHCCREMS Hunter SEO	NCC Land & Water program DIPNR community	2004-06	• community awareness/ involvement management • all pollutants • erosion • sediment • habitat	5, 6, 11, 12, 13, 14, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
25.3	*Creeks Alive* program elements include: • Creek assessment process for all Newcastle's creek systems and GIS mapping	Council has prepared a creek assessment manual for Newcastle's catchments. The manual is being used in the field by Council staff, volunteers and community groups to assess the condition of creek lines across the City. The database developed will be utilised to prioritise the works program required to improve the performance of the Creek system. The database will also be incorporated onto Councils GIS mapping process improving environmental accounting for Council's natural assets.	NCC: • Task Force • D&E • CS • CSP • CP • HR DIPNR	NCC E Levy Land & Water program and in kind Grant funds Community and project partners contributions	2004 ongoing	• all gross pollutants • sediment • heavy metals • community • awareness/ involvement • management	5, 6, 11, 12, 13, 14, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
25.4	Creeks *Alive* program elements include: • Develop and implement a water quality-monitoring / health card reporting program for all Newcastle catchments as part of the Creek *Alive* Project	As part of the Creek *Alive* project, community involvement in water bug surveys biannually and regular water quality testing will be conducted and reported as health measures for the Cities catchments. Monitoring outcomes will be promoted using existing Waterwatch/ Streamwatch / NCC / HWC program support. In association with the Streamwatch and Waterwatch programs already successfully underway in the Hunter, NCC has worked with HCR CMA and DIPNR staff to trial a number of appropriate water quality monitoring sites and methodologies. NCC has developed site criteria and methodology for 75 sites across the city. 25 of the sites are committed to community monitoring. The program also has access to a roving water quality sampling unit and options for more rigorous water quality analysis are available where defined. Utilising the creek health indicators for inclusion within the Newcastle Sustainable Community Indicators Program, SOE reporting and NEMP 2003 reporting will be investigated.	NCC HWC HCR CMA Waterwatch/ Streamwatch DIPNR	NCC E Levy Land & Water program $20,000 pa HWC $20,000 pa (SEIP) In-kind In-kind	2004 – 2007 ongoing ongoing Ongoing	• community awareness/ involvement • management across full range of issues	6, 7, 9, 10, 12, 13, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
25.5	*Creeks Alive* program elements include: • urban water cycle education initiatives	Building on the successful Stormwater in Newcastle Catchments (SEINC) program (run in conjunction with HWC and HCR CMA over the last 4 years), Council will continue to implement targeted stormwater education outcomes under the *Creeks Alive* banner. Any intervention will aim at increasing awareness as well as behavioural changes, in line with reconnecting communities to creek reaches (waterways & receiving waters) at the neighbourhood scale. Community "Creek Crawls" have been a successful delivery tools that have continue to be delivered with the assistance of a 2004 EPA Environment Trust (ET) Grant.	NCC HWC HCR CMA DEC	NCC funds and in-kind in-kind (see action 03) In-kind $5000	2005 and ongoing	• all gross pollutants • sediment • heavy metals • community • awareness/ involvement • management	5, 6, 11, 12, 13, 14, 15, 16, 17, 18, 19
25.6	*Creeks Alive* program elements include: • Maintain and update Councils "Water on Web" site	The *Creeks Alive* program will be regularly updating the information available to the community on new initiatives in urban water cycle management, outcomes of Newcastle's creek health monitoring, What's On column and responding to the Discussion Forum members.	NCC • CD • Executive Services (ES) HWC	NCC E Levy Land & Water program $5,000 & in-kind $1,500	2003 – 2007 Ongoing 2003	• all gross pollutants • erosion • sediment • community awareness/ involvement • management	5, 6, 11, 12, 13, 14, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
25.7	*Creeks Alive* program elements include: • Develop and resource community creek care/ support groups for assessment, monitoring and rehabilitation of the creek lines • Creek naming process across the City	In association with the delivery of the greening program across the City the Creeks *Alive* program and the Community Greening Centre program delivery will develop effective and sustainable creek care/ support groups across all catchments. It is essential that ongoing sustainable outcomes for the waterway system of the City are embedded in community connection with their waterways and their health. Successful creek naming projects in City have delivered greater connection and understanding of behavioural impacts on the stormwater system, including natural creek line values, where project has been delivered. This experience will be used to provide a process for communities to name their creeks across the City.	NCC: • D&E • CS • CSP • Community Greening Centre • CP Community Project partners	NCC E Levy Land and Water program and in-kind Envirotrust Grant 2005-06 NCC E Levy and in-kind	2003 – 2007 Ongoing	• all gross pollutants • erosion • sediment • community awareness/ involvement • management	5, 6, 11, 12, 13, 14, 15, 16, 17, 18, 19
26	Instigate riparian corridor revegetation practices and initiatives where ever the opportunity arises across the Newcastle's catchments	Stormwater management partners will work cooperatively through the NCMF process, to identify and implement re-vegetation initiatives within the riparian zones across Newcastle's catchments. Council will be able to provide a valuable contribution through the information base, expert advice and policy framework developed as part of the *Creeks Alive* program.	NCC • Task Force • CSP • CS • D&E • CD HWC HCR CMA /NCMF	NCC E Levy In-kind HWC In-kind	Ongoing	• all gross pollutants • sediment • heavy metals • community • awareness/ involvement • management	5, 6, 11, 12, 13, 14, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
27	Continue to develop and monitor Kotara "Roof to Creek" research Project and flow on incentive program for household tank retrofit across the City.	Kotara Roof to Creek Project is a 4th round EPA Stormwater Trust Grant research project that involves the monitoring of catchment performance to determine the impacts of retrofitting rainwater reuse strategies for household use and open space landscaping refits. The research outcomes from this Project will be fundamental to the assessment of catchment performance interventions and future policy development not only at local but regional, state-wide and national significance. Deliver an incentive program for household use tank retrofits to improve downstream impacts from stormwater in conjunction with HWC.	NCC HWC University of Newcastle Community DEC Industry sector	DEC (formerly EPA) Stormwater Trust grant NCC Land & Water program & in-kind HWC cash and in-kind University of Newcastle in-kind NCC e Levy HWC In-kind	Complete works 6/05 Monitor 2005-06 ongoing 2004-05 ongoing	• all gross pollutants • erosion • sediment • community • awareness/ involvement • management	5, 6, 11, 12, 13, 14, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
28	Continue to invest in Newcastle Council Water Task Force – role updated to incorporate urban water cycle considerations.	Council's stormwater managers participate in Councils Water Task Force, meeting monthly to review and direct work program. The adaptive management model identified in the Stormwater Management Plan 2004 has successfully been delivered through the Water Task Force process, engaging managers from across the organisation in multi-disciplinary planning that has generated top value outcomes. The process was used as the template for delivering the wider NEMP 2003 management model. The role of the Water Task Force has now formally adopted the implementation of the NEMP 2003 Water theme initiatives across Councils relevant functional areas.	NCC Task Force Managers from: • CS • D&E • CSP • CP • HR LHCCREMS Hunter SEO Hunter Councils Industry partners	NCC in-kind	ongoing	• all gross pollutants • erosion • sediment • community awareness/ involvement • management • resource utilisation	4, 5, 11, 15, 16, 17
29	Continuing refinement of MAPP financial model for sustainable built & natural asset management	Councils stormwater assets, both natural and constructed infrastructure requires a flexible data management process to enable sustainable management of these resources. There are resource implications for appropriate management of assets once they are registered.	NCC: • Task Force Council staff: • CS • D&E • SP	NCC in-kind	Ongoing	• all gross pollutants • erosion • sediment • community awareness/ involvement • management • resource utilisation	8, 5, 14, 15, 16, 17, 18

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
CITY-WIDE ACTIONS							
30	HWC and NCC investigate opportunities for deformalising appropriate sections of the constructed stormwater drainage system.	Reinstating environmental values in Newcastle's waterway system to whatever extent is feasible whilst consideration is given to flooding impacts will be investigated by HWC and NCC officers as opportunities arise. (see area specific projects under following catchments section)	NCC • Water Task Force HWC HCR CMA /NCMF	NCC in-kind HWC in-kind	Ongoing	• all gross pollutants • erosion • sediment • habitat • community awareness/ involvement	8, 5, 14, 15, 16, 17, 18
31	Investigations of stormwater reuse strategies.	Council is implementing a Parks Water Refit Program to identify alternative water sources for open space and facilities management purposes across the City. Sites included in the program: • No 2 Sportsground – investigate bore &/or rainwater capture from grand stand roof via tanks as well as a water and energy audit of all amenities buildings • Jesmond Park – investigate harvesting stormwater from open, channelised section of drainage line within the Park for re-use in watering rose gardens & sporting fields • Mitchell Park / Townsend Oval – investigate alternative water sources for open space uses • No 1 Sportsground – investigate supply of new pump and water sources and undertake water and energy audit of all amenities buildings	NCC Task Force • D&E – AMEIF • CSP • CS	NCC E Levy $50,000 2005-06 in-kind	2003 – ongoing	• all gross pollutants • erosion • sediment • community awareness/ involvement • management • resource utilisation	8, 5, 14, 15, 16, 17, 18

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
IRONBARK CREEK							
IC01	Implement Wallsend Instream Enhancement Project – an urban revitalisation project for Wallsend reach of Ironbark Creek driven by urban water cycle and ecosystems design determinants - Phase II	The consultancy involving preliminary design and feasibility testing for the Wallsend Instream Enhancement Project has been completed. The data gathered will be used to inform the progress of site rehabilitation works that include landscaping/ tree planting, drainage infrastructure works and weed removal from Ironbark Creek bed and banks throughout 2004. Funding opportunities for implementation of Phase II, in addition to NCC Environment Levy funding will be investigated, whilst the development of a NCC Plan Of Management (POM) for the community lands within the site continues.	NCC Internal stakeholder group • CSP • CS • D&E • CP External reference group HCR CMA	NCC in-kind $70,000 In-kind $5000 (NCMF)	2004 – ongoing	• all gross pollutants • erosion • sediment • habitat • community involvement • management • community consultation • open space planning	2, 4, 5, 6, 7, 8 9, 11, 12, 13, 14, 15, 16, 17, 18, 19
IC02	Ironbark Creek – *Alive for the Future* – community visioning process	Under the Wallsend Instream Enhancement Project – a community visioning process will be launched with an Ironbark Creek community celebration day in Wallsend Park in February 2004, with a range of family activities and information sharing to occur. Appropriate steering committee and reference groups are being established as part of the community ownership/ consultation process.	NCC Internal stakeholder group • CSP • CS • D&E • CP External reference group HCR CMA HWC	NCC in-kind	2004 – ongoing	• all gross pollutants • erosion • sediment • habitat • community involvement • management • community consultation • open space planning	2, 4, 5, 6, 7, 8 9, 11, 12, 13, 14, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
IRONBARK CREEK							
IC03	Hexham Swamp Rehabilitation Program	Program includes the opening of the floodgates to allow re-establishment of tidal zone habitat across the swamp and voluntary purchases of effected properties. Improvements to biodiversity, habitat, fish nursery stocks etc envisaged. Water quality monitoring will be conducted by HCR CMA. Such changes in the receiving water of the Ironbark Creek catchment will impact on stormwater treatment train decision making for the whole catchment and fresh/estuarine ecosystem conservation needs.	HCR CMA coordination Community NCC HWC Hunter Wetlands NCMF	$5 million check with Trust for costs	2000 - ongoing	• erosion • sediment • habitat • community involvement • management	1, 2, 4, 6, 7, 8, 9
IC04	Develop sediment management strategy for the Ironbark Creek Catchment as identified the Ironbark Creek Total Catchment Management (ICTCM) Strategy 2003.	The E&S issue was addressed in the documentation developed through the revised ICTCM Strategy 2003. Council in partnership with other stakeholders in the NCMF will implement the action plan as outlined in the Strategy. The development of a gross pollutants & sediment study, along similar lines as the study produced for Throsby Creek catchment, will be considered in order to identify specific works program.	NCC • CS HCR CMA • NCMF HWC SRA others	NCC in-kind E&S funding source resources	2005-06	• erosion • sediment • habitat • gross pollutants • community involvement • management	1, 5, 6, 16, 17, 18
IC05	The Wetlands Centre Stormwater treatment device installation	Council will continue to work with the Wetlands Centre in order to address erosion and associated sedimentation issues impacting on the Wetlands Centre ponds from surrounding road/residential runoff. The Centre plays an important role in the delivery of environmental / urban water cycle education initiatives in the City. Works for an area near Tuxford Park that drains to the Wetlands Centre eastern pond was completed in 2005.	NCC • CSP • CS • CD • Wetlands Centre (ongoing maintenance)	Delivered as part of Warabrook Wetlands Project	2004 -05	• erosion • sediment • habitat • community involvement • management	5, 6, 12

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
IRONBARK CREEK							
IC06	Review and implement Wentworth Creek SMP - Performance, Monitoring & Review	Utilising existing monitoring equipment and data sets, Council in conjunction with the University of Newcastle will review installation outcomes of the initial stage of the program and prepare forward workplan for the project. A remote green field monitoring station is still part of the project that will provide valuable baseline data for the City. However, the logistics involved in data capture are yet to be resolved.	NCC: • CS • CSP • D & E • Summerhill Facility Newcastle University	NCC $18,000 + in-kind	Review 2004 and ongoing	• erosion • sediment • community involvement • management	3, 4, 6, 7, 14, 15, 16 ,17, 18
IC07	Ongoing implementation of the Blue Gum Hills Catchment Management Strategy	WBM Oceanics (2003) completed the final report reviewing the implementation and evaluation of the Blue Gum Hills Catchment Management Strategy. The report will be considered by Council's Water Task Force and the community Environment Advisory Panel in the preparation of appropriate response to the recommendations.	NCC: • D&E • City Strategy Development interests Community groups	NCC in-kind	Final report 2003 Ongoing	• erosion • sediment • habitat • community involvement • management	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17
IC08	Warabrook Wetlands Project monitoring and promotion	Continue to monitor performance of treatment devices and workshop application through Councils construction processes and external industry promotion where appropriate. Provide feedback and updates to Warabrook Community Forum. Continue to support businesses and supply information and BPPP materials through NCC water web site.	NCC in-kind NSW DEC LHCCREMS	NCC in-kind	2004 - 2006	• all gross pollutants • erosion • sediment • habitat • community involvement • management • community consultation • open space planning	2, 4, 5, 6, 7, 8 9, 11, 12, 13, 14, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
IRONBARK CREEK							
IC09	Investigation of Warabrook Wetlands complex	Council in collaboration with other stakeholders will undertake a preliminary investigation of the SEPP 14 identified Warabrook wetlands system to determine inputs, issues, land tenure and provide recommendation on appropriate natural resource management initiatives suitable for the wetland complex.	NCC University Newcastle \consultants TWC	NCC E Levy	2004-05	• all gross pollutants • erosion, sediment • habitat • community involvement • management • community consultation • open space planning	2, 4, 5, 6, 7, 8 9, 11, 12, 13, 14, 15, 16, 17, 18, 19
IC10	Ironbark Creek – Creeks *Alive* Community Support Officer	Council in collaboration with other stakeholders will provide resources to support community action within riparian zones of Ironbark Creek catchment. The position will be targeting establishment of 9 new groups in Stage 1 of project.	NCC HWC HCR CMA Local residents	NCC E Levy Envirotrust Grant 2005-06.	2005-06	• all gross pollutants • erosion, sediment • habitat • community involvement • management • community consultation • open space planning	2, 4, 5, 6, 7, 8 9, 11, 12, 13, 14, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
IRONBARK CREEK							
IC11	Blue Gum Hills "Creeks *Alive*" Project	Council and Hunter Water Corporation will conduct pre-project survey work in the Blue Gum Hills area to quantify the awareness, knowledge, aspirations and behaviour of residents in relation to ownership of local catchment and water smart home issues, in order to plan an effective intervention program for 2006-2007.	NCC HWC NCC HWC HCR CMA	NCC E Levy HWC $12,000 cash NCC E levy HWC HCRCMA	2005-06 2006-07 Ongoing	• all gross pollutants • erosion, sediment • habitat • community involvement • management • community consultation • open space planning	2, 4, 5, 6, 7, 8 9, 11, 12, 13, 14, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
THROSBY CREEK CATCHMENT							
TC01	Continue to utilise information from Throsby Creek Catchment Sediment and Gross Pollutant Management Strategy Monitoring and maintenance of CDS gross pollutant device installed in Lambton Ker-rai drainage line	Throsby Creek Catchment Sediment & Gross Pollutant study (2002) provides gross pollutant and sediment characteristics of the 22 sub-catchments, along with review of gross pollutant trapping techniques and possible treatment options. The Study in conjunction with the Throsby Creek TCM Strategy review (2002) will be used to inform the future development and infrastructure design within the catchment. HWC has installed a CDS unit within the Lambton Ker-rai Creek sub-catchment. Monitoring to date indicates that an average of 10 m3 of gross pollutants are removed from the system monthly. HWC will continue to monitor and maintain the unit.	HWC HCR CMA NCC TCTCM DLWC TLC CCS HWC	NCC in-kind $30,000 (CCS) $15,000 pa maintenance & monitoring	2001-03 complete Ongoing	• all gross pollutants • erosion • sediment • habitat • community awareness involvement • management	3, 5, 8, 9, 13, 15, 18
TC02	Continue to implement the strategic actions contained within the Throsby Creek TCM Strategy review (2002).	As part of the NCMF process, sediment prevention measures and erosion/sediment control sites will continue to be identified and collaborative works program developed. Sediment sources from creek bed/bank erosion are identified as priority sites. Council will utilise the information collation process of the *Creeks Alive* assessment program to inform rehabilitation process for Throsby Creek catchment.	NCC HCR CMA HWC DIPNR	NCC inkind	2003 ongoing	• all gross pollutants • erosion • sediment • habitat • community involvement • management	1, 2, 5, 6, 7, 10, 11, 14, 16, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
THROSBY CREEK CATCHMENT							
TC03	Master Plan for Raspberry Gully (Styx Creek)	Complete design plans for the maintenance and development of the natural attributes of Raspberry Gully, including heritage interpretation trails, tree planting, weed control, drainage and stormwater treatment (upper reaches of Throsby Catchment)	Lake Mac CC	In-kind	2004-05	• All issues • community involvement • management	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 , 14,16, 17
TC04	Improvements to stormwater drainage in the headwaters of Styx Creek	Drainage works by Lake Mac CC to provide improvements in stormwater velocity and quality as it moves through Sherburn Place residential area in headwaters of catchment.	Lake Mac CC	In-kind	2004 - ongoing		3, 5, 6, 8, 11, 12, 16, 17, 18
TC05	Continue the maintenance and upgrade program for the floating boom systems for gross pollutants and sediment traps within Throsby Creek catchment.	HWC has installed a floating trash boom at Chin Chen Street, Islington boom and within the Mayfield Branch. The sediment trap at Islington continues to be maintained, capturing approx. 300 cm^3 pa. Monitor composition and volume of trapped gross pollutants indicates 10 and 2 cm^3 trapped on average per month respectively. Ongoing trapping reporting & evaluation will continue.	HWC	Ongoing costs as required	Install complete 6/2000 - maintain and monitor ongoing	• gross pollutants • community involvement • management	6, 7, 8, 13, 16, 17, 18, 19
TC06	Arnold Street Reserve, Carrington Stormwater Improvement Project	The project includes bank stabilisation, drainage works, landscaping & infrastructure in consultation with local community and Dockside development to improve stormwater impacts within Arnold Street reserve within the tidal reaches of the catchment at Carrington. Council is in the process of lodging a DA for the works program.	NCC HCR CMA Waterways Carrington residents Dockside development	Jointly funded (cash & in-kind)	2003 - ongoing	• Sediment • Erosion • Community involvement • Management	2, 4, 5, 6, 7, 8, 9 , 11, 12, 13, 14, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
THROSBY CREEK CATCHMENT							
TC07	Black Duck Creek Stormwater Trust grant monitoring and promotion	Continue to monitor performance of treatment devices and workshop application of principles through Councils construction processes, community consultation, Blackbutt Reserve POM and external promotion where appropriate.	NCC EPA LHCCREMS	NCC in-kind	Ongoing	• all gross pollutants • erosion • sediment • habitat • community involvement • management • community consultation • open space planning	2, 4, 5, 6, 7, 8 9, 11, 12, 13, 14, 15, 16, 17, 18, 19
TC08	Street cleansing program in headwaters of the Throsby Creek catchment	Street cleansing in Charlestown commercial area at headwaters Throsby Creek is identified as a priority issue for the headwaters of the catchment	Lake Mac CC and Newcastle Catchment Management Forum (NCMF)	LMCC inkind	Ongoing	• all gross pollutants (heavy metals, fine sediment, litter) • habitat • management	5, 6, 7, 8, 10, 12, 13, 16, 17, 18
TC09	Waratah " Clean Streets Clean Creeks" Project	Delivery of Waratah Project aimed to significantly improved stormwater knowledge and behaviour of local residents and business practices within the catchment. The understanding of catchment connections rose amongst residents.	NCC HCR CMA HWC	Jointly funded (cash & in-kind) NCC E Levy HWC $10,000	2004-2005	• Sediment • Erosion • Community involvement • Management	2, 4, 5, 6, 7, 8, 9 , 11, 12, 13, 14, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
THROSBY CREEK CATCHMENT							
TC10	Throsby Creek Creeks Alive Community Support Project	Council in collaboration with other stakeholders will investigate resources to support community action within riparian zones of Throsby Creek catchment.	NCC HWC HCR CMA	NCC E levy	2006 ongoing	• Sediment • Erosion • Community involvement • Management	2, 4, 5, 6, 7, 8, 9 , 11, 12, 13, 14, 16, 17, 18, 19
TC11	Lambton Ker-rai Deformalisation Project	This project aims to increase urban habitat & biodiversity, improve water quality, recreational amenity & access and aesthetics of the Lambton Ker-rai creek reach within Lambton Park. The project is a collaboration between community, Chamber of Commerce, recreational users, Council, HWC and CMA.	NCC HCR CMA HWC Local residents Recreational groups	Jointly funded (cash & in-kind) NCC E Levy HWC HCR CMA	2004 – 2007	• Sediment • Erosion • Community involvement • Management	2, 4, 5, 6, 7, 8, 9 , 11, 12, 13, 14, 16, 17, 18, 19
TC12	Lower Throsby Creek Deformalisation Project	HCR CMA has facilitated the development of a deformalisation study of the lower reaches of Throsby Creek. The study is being conducted by WBM Oceanics (2004-05). The project Steering Committee comprises Council, Hunter Water, CMA and local residents. The project is a culmination of aspiration of local residents for improvement works within the lower reaches of the creek.	NCC HWC HCR CMA Local residents	HWC HCRCMA NCC	2004 ongoing	• Sediment • Erosion • Community involvement • Management	2, 4, 5, 6, 7, 8, 9 , 11, 12, 13, 14, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
COTTAGE CREEK CATCHMENT							
CC01	Development of priority actions for Cottage Creek Catchment based on the Hunter Estuary Management Program studies	Coast and Estuary Project Officer has been appointed and as part of Hunter Estuary Management program will include the determination of priority actions to address the stormwater quality in the catchment within the work plan. The NCMF will also be considering the addition of such information within the management strategy for the City's catchments.	NCC • CS	$20,000 subject to funding	2004 ongoing	• gross pollutants • sediment • habitat • heavy metals • community involvement • management	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
CC02	Cottage Creek floating trash boom	HWC installed a floating trash boom immediately upstream of Wharf Road in Cottage Creek during 2000. Continuing monitoring and maintenance is being undertaken. Refinements and modifications to improve performance of device are ongoing.	HWC	Ongoing costs as required	Install complete 6/2000 - maintain and monitor ongoing	• gross pollutants • sediment • community involvement • management	6, 7, 8, 13, 17, 18, 19
CC03	Total Catchment Management framework to cover Cottage Creek catchment.	The HCR CMA Newcastle Catchment Management Forum (former TCM committee) now covers all Newcastle catchments, including Cottage Creek in its area of interest. It is hoped that new state government NRM structures will now incorporate this valuable initiative. In the interim NCMF members will develop a gross pollutant report for the catchment in a similar manner as that completed for Throsby Creek.	NCC HWC HCR CMA NPC Community reps DIPNR	NCC in-kind	2003 – ongoing	• All issue sets	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
COTTAGE CREEK CATCHMENT							
CC04	Cottage Creek Catchment Gross Pollutant Study	NCC facilitated the completion of the Cottage Creek Catchment Gross Pollutant Study during 2004-05 in a similar manner as that completed for Throsby Creek Catchment. The recommendations from the study will be used to inform the development of "Clean Street Clean Creek" Project within the catchment in 2005-07.	NCC HWC HCR CMA	NCC E Levy HWC in-kind HCR CMA in-kind	2004-05	• All issue sets	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
CC05	Cottage Creek " Clean Streets – Clean Creeks" Project	The Cottage Creek " Clean Streets – Clean Creeks" Project is an integrated on-ground works and education project delivered in pollution "hotspots" and priority Cottage Creek sub-catchment/s identified as part of the Cottage Creek Gross Pollutant Study. The project will target reconnecting community to their local waterways as a precursor to change to more positive stormwater related behaviours.	NCC HWC HCR CMA	NCC E levy Project officer & in-kind HWC $15,000 at-source controls $10,000 education HCR CMA $15,000 at-source controls	2005-063 – ongoing	• All issue sets	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
COASTAL AND ESTUARY CATCHMENTS							
CE01	Link investigations of stormwater issues in the "Estuary Catchment" to the Hunter Estuary Management Program	The Estuary Process Study as part of the Hunter Estuary Management Program will feed into the Estuary Management Study and Plan.	NCC Others	$20,000 (in-kind)	2004 ongoing	• gross pollutants • litter • sediment • heavy metals • habitat • management	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
CE02	Link investigations of stormwater issues in the "Coastal Catchments" to the Newcastle Coastal Management Program	The determination of priority actions for Coastal Catchments in the City will be based on the outcomes of the Coastal Management Study and Coastal Management Plan to be initiated as part of the Newcastle Coastal Management Program in 2000.	NCC Others	NCC in-kind	2004 ongoing	• gross pollutants • habitat • management	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
CE03	Bathers Way Project	The extension of the Great North Walk along the coastal margin of the City, incorporating stormwater treatment works and habitat protection options along the length of the trail. Remediation of King Edward Park surface and rill erosion issues has been incorporated within project design.	NCC + Conservation Volunteers Australia	$150,000	2003 – 2004	• gross pollutants • litter • sediment • erosion • habitat • community involvement • management	1, 2, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 18

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
COASTAL AND ESTUARY CATCHMENTS							
CE04	Merewether "Clean Beach - Clean Street" Project	Council in collaboration with HWC will deliver community intervention methodologies within the approx. 1 ha urban catchment above the Merewether Beach stormwater outfall, in order to improve the stormwater quality that drains form the catchment. This catchment specific initiative is jointly resourced by HWC, NCC and local businesses. The project won the National Stormwater Industry Association prize in 2004 for Stormwater Education.	NCC HWC Local businesses Community Recreational stakeholders	$10,000 $9,600 in-kind	2003-04 2003-04	• gross pollutants • litter • sediment • erosion • habitat • community involvement • management	1, 2, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 18
CE05	Nobby's Precinct Stormwater Improvement Program.	A series of at-source street inlet treatment devices and sandfilter now remove all stormwater pollution from Nobbys Beach. Promotion opportunities as best practice demonstration will continue to be delivered. Maintenance for the device set has been incorporated within existing NCC parks, street cleansing and facilities management operational areas. Monitoring, data collection and assessment will continue.	NCC Task Force • CS EPA Trust Grant Waterways NPC Community groups	$2000 pa est. (maintenance)	Complete Ongoing maintenance	• gross pollutants • habitat • heavy metals • community involvement • management	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
COASTAL AND ESTUARY CATCHMENTS							
CE06	Fort Scratchley Redevelopment and Plan of Management production.	A Plan of management for Fort Scratchley will be developed for 2005. UWCM principles will underpin process to deliver improved outcomes for surface and stormwater drainage issues within and associated with the site in the context of heritage and on site considerations.	NCC	NCC in-kind	2003 ongoing	• gross pollutants • habitat • litter • sediment • erosion • community involvement • management	
CE07	Dixon Park/Bar Beach "Clean Beach - Clean Street" Project	Council in collaboration with HWC delivered community intervention methodologies within the urban catchment above the Dixon Park and Bar beach stormwater outfalls, in order to improve the stormwater quality that drains form the catchment. This catchment specific initiative is jointly resourced by HWC, NCC and local businesses. Extension of project to other coastal catchments will be investigated.	NCC HWC Local businesses Community Recreational stakeholders	NCC E levy HWC $10,000 in-kind	2004-05	• gross pollutants • litter • sediment • erosion • habitat • community involvement • management	1, 2, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 18

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
PURGATORY CREEK CATCHMENT							
PC01	Investigate and review the stormwater options defined for Purgatory Creek within the Maitland SMP and incorporate within Newcastle's implementation program	The catchment defined by Purgatory Creek within the Newcastle LGA was incorporated within Maitland CC's SMP process. Outcomes defined for the catchment will be assessed and incorporated or refined, where appropriate into NCC's implementation program.	NCC MCC Task Force	NCC in-kind	2004-05	• gross pollutants • litter • sediment • heavy metals • habitat • management	1, 2, 5, 6, 7, 8, 9, 11, 12, 13, 15, 16, 17, 18, 19
PC02	Participate in development of a Total Catchment Management framework to cover Purgatory Creek catchment	A new TCM framework has been instigated by the HCR CMA (Newcastle Catchment Management Forum) that now covers all Newcastle catchment including Purgatory Creek. It is hoped that new state government NRM structures will now incorporate this valuable initiative.	NCC MCC HWC HCR CMA NPC Community reps DIPNR	In-kind	2004 – ongoing	• All issue sets	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
PC03	Continue to implement the Beresfield Golf Park Masterplan	The Beresfield Golf Park Masterplan contains a number of stormwater quality improvement ponds and water reuse initiatives that would benefit the Thornton SEPP 14 wetlands receiving waters of suburb of Beresfield.	NCC • CSP – internal stakeholders group MCC	EL funds and major projects $2 million	2003-2006	• gross pollutants • litter • sediment • heavy metals • habitat • management	1, 2, 5, 6, 7, 8, 9, 11, 12, 13, 15, 16, 17, 18, 19

Ref No.	ACTION	Status	Responsibility	Funding	Time frame	Priority Issues	Priority Objectives
GREENWAYS CREEK CATCHMENT							
GC01	Total Catchment Management framework to cover Greenways Creek catchment	A new TCM framework has been instigated by the HCR CMA (Newcastle Catchment Management Forum) that now covers all Newcastle catchments including Greenways Creek. It is hoped that new state government NRM structures will now incorporate this valuable initiative.	NCC MCC HWC HCR CMA NPC Community reps DIPNR	In-kind	2005 – ongoing	• All issue sets	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
GC02	Investigate & review the stormwater options defined for Greenways Creek within the Maitland and Cessnock SMP's and incorporate within Newcastle's implementation program	The catchment defined by Greenways Creek within the Newcastle LGA was incorporated within neighbouring local government boundaries during the SMP process. Outcomes defined for the catchment that is primarily rural residential in nature will be assessed and incorporated or refined, where appropriate into NCMF's project implementation program.	NCC Task Force MCC	NCC in-kind	2005-07	• gross pollutants • litter • sediment • heavy metals • habitat • management	1, 2, 5, 6, 7, 8, 9, 11, 12, 13, 15, 16, 17, 18, 19

Action Table (2000 to date):

Abbreviations

AMEIF	Australian Municipal Energy Improvement Facility
BPPP	Business Pollution Prevention Program
CGC	Community Greening Centre – Newcastle City Council
CP	Community Partnerships (Newcastle City Council)
CS	City Strategy (Newcastle City Council)
CSP	City Services & Presentation (Newcastle City Council)
DA	Development Application
DCP	Development Control Plan
D&E	Development and Environment (Newcastle City Council)
DEC	Department of Environment and Conservation
DIPNR	Department of Infrastructure Planning and Natural Resources
EL	Environment Levy
EPA	Environment Protection Authority, now part of DEC
ES	Erosion and Sediment
ES	Executive Services (Newcastle City Council)
ET	Environment Trust
HCR CMA	Hunter Central-Rivers Catchment Management Authority
HIA	Housing Institute of Australia
HR	Human Resources (Newcastle City Council)
HWC	Hunter Water Corporation
LEP	Local Environment Plan
LG	Local Government
LGA	Local Government Area
LHCCREMS	Lower Hunter & Central Coast Regional Environmental Management Strategy
LMCC	Lake Macquarie City Council
MBA	Master Builders Association
MCC	Maitland City Council
NCC	Newcastle City Council
NEMP	Newcastle Environmental Management Plan 2003
NPC	Newcastle Port Corporation
NCMF	Newcastle Catchment Management Forum
NRM	Natural Resource Management
NSW	New South Wales
POM	Plan of Management (Newcastle City Council)
P & R	Parks and Recreation (Newcastle City Council)
RTA	Roads and Traffic Authority
SEPP	State Environmental Planing Policy
SEINC	Stormwater Education In Newcastle Catchments Project
SEIP	Stormwater Environment Improvement Program
SEO	Stormwater Extension Officer
SMP	Stormwater Management Plan
SRA	State Rail Authority
TCM	Total Catchment Management
TCTCM	Throsby Creek Total Catchment Management
TWC	The Wetland Centre
UWCM	Urban Water Cycle Management
WSUD	Water Sensitive Urban Design

PART C

Newcastle's Catchments

Newcastle Catchment Characteristics
Newcastle Catchment Descriptions
Bibliography
Appendix I
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Appendix V

NEWCASTLE CATCHMENT CHARACTERISTICS

Climate

Newcastle experiences a moderate, warm, temperate climate. Mean temperature and rainfall readings are shown in Table 8.

Table 8: Temperature and Rainfall Data for the Newcastle Area (Maryville).

Annual Mean Maximum Temperature	22.8˚C
Annual Mean Minimum Temperature	14.1˚C
Mean Annual Rainfall	1106.7mm/year
Mean Number of Rain Days/Year	132 days

Soils

Most of the Newcastle Local Government Area lies on the Lower Hunter Plain and Awaba Hills physiographic regions. Matthei (1995) described the regions as below:

Lower Hunter Plain

The soils of the Lower Hunter Plain are predominantly Prairie Soils, some Chernozems and Brown Clays, with Humic Gleys in the lower Hunter delta. Solonchacks occur on the tidal flats. The dominant soil landscapes are Hamilton (hm), and Beresfield (be).

Awaba Hills

The soils of the Awaba Hills region are Yellow Podzolic, Soils and Soloths, with some red Podzolic Soils and Brown Podzolic Soils on upper slopes and some Lithosols and Bleached Loams on resistant parent material. In the Newcastle LGA, the dominant soil types of the Awaba Hills Region are Killingworth (ki), Cockle Creek (cc), and Cedar Hill (ce).

Table 9: Description of the dominant soil landscapes in the Lower Hunter Plain.

	Hamilton (hm)	Beresfield (be)
Soil Landscape Group	Residual- Deep soils have formed from in situ weathering of parent material.	Residual- Deep soils have formed from in situ weathering of parent material.
Landscape	Level to gently undulating well-drained plain on Quaternary deposits in the Hunter Plain Region. Slopes are <2%, elevation is up to 12m, local relief is <1m. Completely cleared.	Undulating low hills and rises on Permian sediments. Slope gradients 3- 15% Local relief to 50m. Partially cleared tall- open forest.
Soils	Deep, well drained weak Podzols, with some deep, well-drained Brown Podzolic Soils on fans.	Moderately deep (<120cm), moderately well to imperfectly drained. Yellow Podozolic Soils and brown Soloths occur on crests, with moderately deep, well drained Red Podozolic soils and red Soloths on upper slopes, moderately well to imperfectly drained brown Soloths and yellow Soloths on sideslopes and deep, imperfectly to poorly drained Yellow Podzolic Soils yellow Soloths and Gleyed Podozolic Soils on lower slopes.
Qualities and Limitations	Wind erosion hazard, ground water pollution hazard, strong acidity, non-cohesive soils.	High foundation hazard, water erosion hazard, Mine Subsidence District, seasonal waterlogging and high run-on on localised lower slopes, highly acidic soils with low fertility. Table 8: Description of the dominant soil landscapes in the Lower Hunter Plain. Residual- Deep soils have formed from in situ weathering of parent material. Level to gently undulating well-drained plain on Quaternary deposits in the Hunter Plain Region. Slopes are <2%, elevation is up to 12m, local relief is <1m. Completely cleared. Deep, well drained weak Podzols, with some deep, well-drained Brown Podzolic Soils on fans. Wind erosion hazard, ground water pollution hazard, strong acidity, non-cohesive soils.

Table 10: Description of the dominant soil landscapes of the Awaba Hills Region

	Killingworth (ki)	Cockle Creek (cc)	Cedar Hill (ce)
Soil Landscape Group	Erosional- Primarily sculpted by erosive action of running water. Soil depth is usually shallow, and its origin is variable and complex. Soil is either absent, derived from in situ weathered bedrock or from water washed parent material.	Alluvial- Formed by deposition along rivers and streams. Parent material is alluvium. Landscapes include floodplains and alluvial deposit.	Colluvial- Affected by mass movement. Parent material consists of colluvial mass movement debris.
Landscape	Undulating to rolling hills and low hills on the Newcastle Coal Measures. Elevation 50-160m, local relief 30-100m, slopes are 3-20%. Predominantly uncleared tall open forest.	Narrow floodplains, alluvial fan deposits and broad delta deposits. Slope gradients are 0-2%, elevation is <1-50m, local relief is <1m. Cleared open forest.	Rolling to steep rises on siltstones and sandstones. Local relief is up to 100m, elevation is up to 100m, slopes are 15-40%. Cleared tall open forest.
Soils	Shallow to moderately deep, well to imperfectly drained Yellow Podozolic Soils, yellow Soloths, Gleyed Podzolic Soils and Gleyed Soloths on crests and slopes, with shallow, well drained Structured Loams, Bleached Loams and Lithosols on some crests.	Deep, imperfectly to poorly drained yellow Soloths, and Yellow Podzolic Soils on floodplains, deep moderately well to poorly drained Yellow Earths and Grey Earths on delta and fan deposits, with deep, imperfectly to well-drained Yellow Podzolic Soils.	Moderately deep to deep, well to imperfectly drained Brown Podzolic Soils, and moderately deep, well drained Structured Loams.
Quantities and Limitations	High water erosion hazard, Mine Subsidence District, foundation hazard, shallow soils (localised), seasonal waterlogging (localised), sodic, dispersible soils of low wet strength, very strongly acid soils of low fertility.	Flood hazard, water erosion hazard, localised permanently high water-tables and periodic to permanent waterlogging, high run-on, acid, infertile sodic/dispersible soils of low wet strength.	High mass movement hazard, high foundation hazard, steep slopes, Mine Subsidence District, acid soils.

Geology

The geology of the Newcastle area is very complex. The most important feature is the Hunter Fault, a zone of thrust faults trending in a north westerly direction which passes beneath the deep Quaternary sediments of the coastal plain. The Hunter Fault is the boundary between the Permian sediments of the Sydney Basin and Carboniferous system that outcrops to the north-east.

The Newcastle Coal Measures consist of a basal formation overlain by four subgroups; Waratah Sandstone - cross-laminated grey brown sandstone at the base; Lambton Subgroup - coal, sandstone, shale, minor conglomerate; Adamstown Subgroup - massive conglomerate, tuff, coal and shale; Boolaroo Subgroup - irregular coal seams, tuff, sandstone and shale. (Adopted from Matthei, 1995).

Topography

The land form and natural drainage patterns of the City result from two major influences. Firstly, the Hunter River and associated flat, poorly drained alluvial and estuarine deposits and secondly, the outcrop of sedimentary rocks forming a series of ridges and spurs primarily along the southern sector of the LGA boundary.

Notable features include:

- A series of steep-sided ridges and spurs with well defined drainage lines along the southern sector;
- Undulating landform generally in the central sector, extending from Jesmond to Shortland and Waratah with defined natural drainage lines generally modified;
- Isolated hills formed by sedimentary outcrops immediately south of Newcastle Central Business District (CBD), these include Obelisk Hill and Shephard's Hill;
- Flat low-lying landforms, including reclaimed swamp areas and estuarine deposits to the west and south-west of Newcastle CBD, with extensive man-made drainage channels;
- Flat areas of Stockton Peninsula formed by levelling coastal sand dunes;
- Flat low-lying alluvial deposits forming Hexham Swamp; and
- Undulating landform on sedimentary rocks along the western sector of the LGA.

The rate of soil loss through erosion is related to the length and the gradient of the slope segment within the catchments.

Figure 6 shows the Newcastle Local Government Area featuring topography of the region defined by 10 metre contour intervals, within the confines of the data available. Significant waterways, the Hunter River estuary and coastline, and the major transport links are also noted.

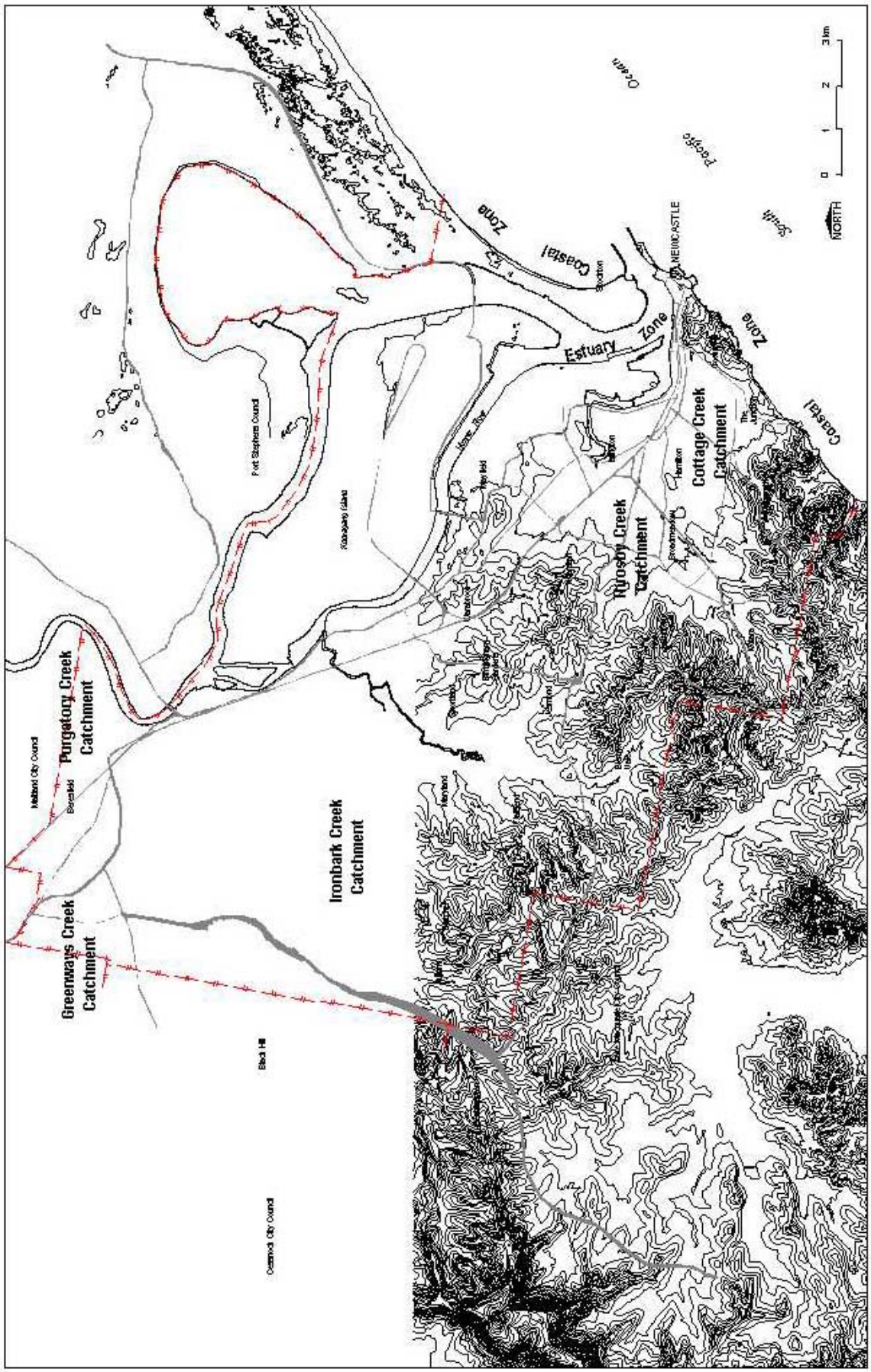
Hydrology

CEPA (1993) indicate that with the urbanisation of the catchment, major irreversible impacts on hydrology occur. This change increases with the proportion of the catchment converted to impervious surfaces such as roofs, roadways and other paved areas.

Land clearing reduces the opportunity for local ponding of surface water and the installation of gutters, pipes and concrete channels also contributes to hydrological change.

Compared with the run-off from a forested catchment (2%), the percentage of run-off from an urban catchment may be as high as 98 - 100%.

Figure 6: Newcastle Catchment Characteristics



Urban development can have the following effects on hydrology:

- Increased run-off volume due to impervious surfaces, resulting in a higher volume of water reaching drains and water bodies;
- Reduced flow resistance, resulting in "flash-floods" and reducing the time taken to reach peak flow by 50 - 90%;
- High velocity flows wash off and transport a higher amount of solid material into the receiving waters;
- Higher volumes and velocity of run-off can transport many more pollutants into the receiving waters; and
- The timing, quantity and quality of dry weather discharges are altered due to lower levels of groundwater recharge.

Vegetation

There are four broad vegetation communities remaining in the City, covering about 40% of the LGA. They include wetlands, remnant bushland, grasslands and coastal grasses.

- *Terrestrial - the surface of the catchments.*

There are only a few pockets of remnant bushland in the City, including:

- Blackbutt Reserve in the head waters of Throsby Creek catchment
- George McGregor Park and Jesmond Bushland at the headwaters of Ironbark catchment
- the Wentworth Creek sub-catchment at Fletcher, just west of Maryland, within the Ironbark Creek catchment

Glenrock State Recreation Area is also an ecologically valuable site and will be addressed in the catchment-based, stormwater management planning process by Lake Macquarie City Council.

Other scattered areas exist in the western half of the City and the south west of Beresfield in the Blackhill locality. Many of these areas are known or likely to provide habitat for some rare plants and animals. Some small isolated packets of littoral and riverine rainforest still survive in these areas.

Scattered grasslands are located on the fringes of Hexham Swamp and the western fringes of Kooragang Island. Scattered tree cover is common in these areas, lending to its scenic appeal and providing habitat for birds, bats and arboreal mammals. Coastal grasses are the least well represented of the four main vegetation communities found in the City. (Newcastle Land Use Strategy, 1995)

Figure 7 shows the flora and fauna habitat distribution throughout Newcastle City. This map was adapted from the Newcastle Land Use Strategy (1995).

- *Riparian - surrounding the waterways and drainage channels*

The waterways that flow through the city in their lower reaches are predominantly formed concrete channels, with little if any ecological integrity or value. Proposals to de-formalise some sections of the concrete drainage channels, to reinstate vegetation and landforms of similar structure to natural riparian habitats, has been a source of discussion within the Catchment Management Committees and community groups.

Riparian Zone

Council's Creek Assessment Process (CAP) has mapped the creek and riparian zone condition of 48 km or approx. 50% of the estimated natural waterways in the City to date The CAP is primarily a condition audit that is due to be completed in 2005. Data collated from the audit will be incorporated within Councils GIS/Asset database so that prioritization for works can be completed" (see Figure 8).

Those drainage lines still in a natural condition within the LGA, often suffer from exotic weed infestation and streambed and bank erosion. Successful re-introduction of native species within the riparian zones will greatly enhance the opportunities for increased "urban biodiversity".

Wetlands

About half the natural vegetation areas of the City are covered by wetland communities, comprising mangrove forests and salt and fresh water marshes. Most of the wetlands are in Hexham Swamp, on the edge of Fullerton Cove and on Kooragang Island. Much of the wetlands are protected in Nature Reserves managed by the National Parks and Wildlife Service.

The wetlands are considered to be some of the most important in NSW, providing habitat for rare and endangered species of birds and mammals, as well as providing valuable fish breeding and feeding within the extensive mangrove forests on the southern shores of the Hunter River. Many kinds of birds visit the wetlands during trans global migration to roost and feed. Many native species are protected by agreements made by Australia with Japan and China and provisions of the National Parks and Wildlife Act. Kooragang and Hexham Wetlands are recognised as internationally significant wetlands under the United Nations Ramsar Convention. Improvements to wetlands are planned throughout Newcastle City, including Kooragang Islands Rehabilitation Project and the Ironbark and Throsby Creek TCM strategies.

Perhaps the most significant area of aquatic habitat in the Newcastle area is Hexham Swamp and Ironbark Creek. The Ironbark Creek TCM Strategy included a description of aquatic fauna in the creek and much of the following is taken from that document.

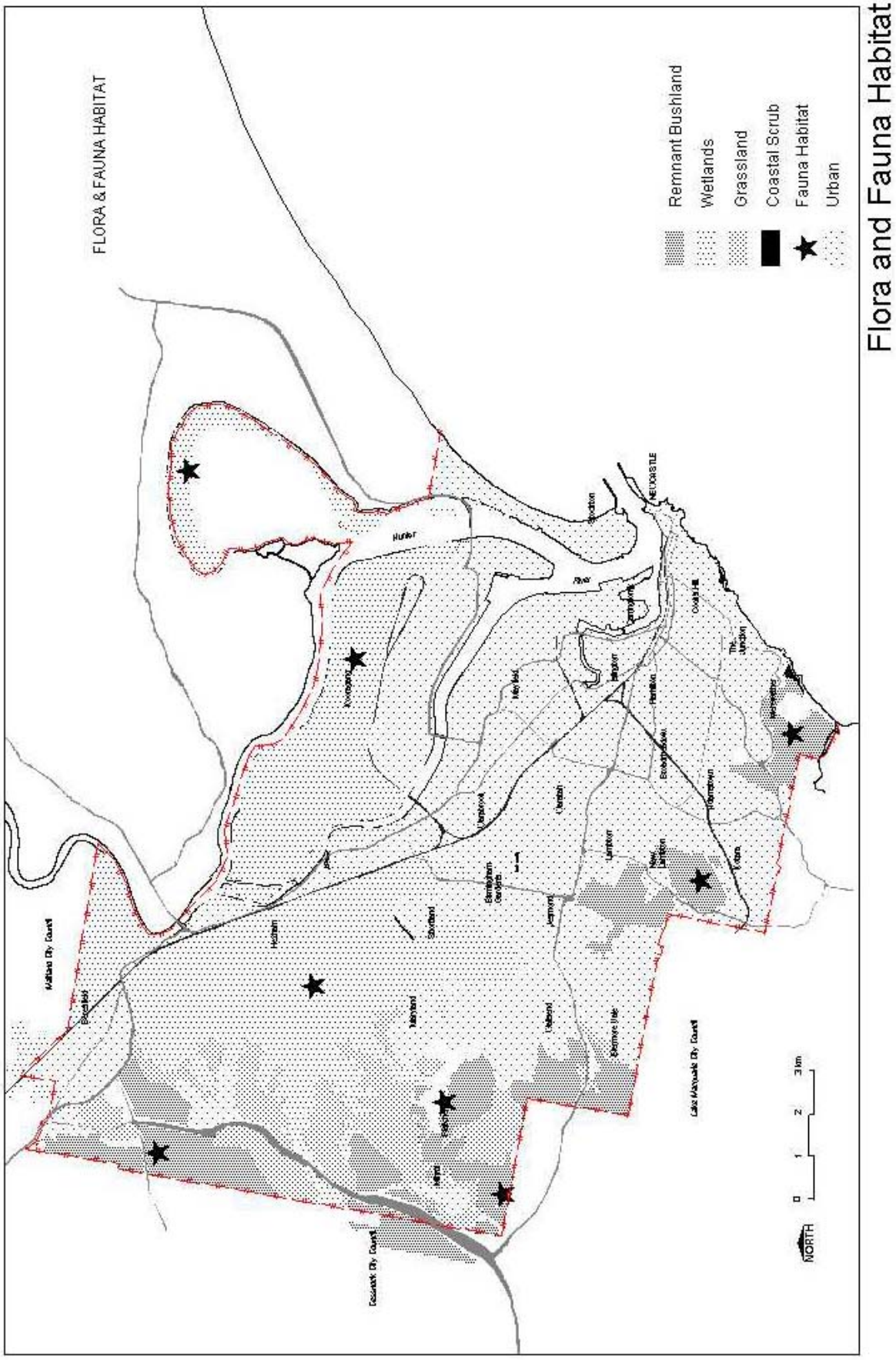
A 12 month study by Shephard (1992, in Ironbark TCM, 1996) found 32 species of fish and six species of prawn and shrimp. Of the fish, 11 species were freshwater, 20 saltwater and one euryhalline (sea mullet). When compared with nearby Moscheto Creek a saltwater system, Shephard (1992) classified Ironbark Creek as a freshwater system in terms of composition of fish species and numbers of each species. The mangrove areas in Ironbark Creek were dominated by non-commercial freshwater species such as gobies, gudgeons, the introduced mosquito fish and juveniles of sea mullet.

The Throsby Creek TCM Strategy (1989) described the existing environment in the downstream sections of Throsby Creek as a degraded aquatic environment with a depleted fishery, subject to closures on the taking of fish and invertebrates due to a perceived risk of contamination. Water quality investigations indicated that the creek could support a richer aquatic flora and fauna and with appropriate rehabilitation and management, particularly of the inter-tidal and foreshore zones could become a viable, dynamic ecosystem with enhanced habitat qualities.

The Throsby TCM Strategy stated that the re-establishment of estuarine inter-tidal flora and fauna would improve the ecosystem and benefit the long term health of the creek.

Photo 9:
This shows the Stockton sand spit area that provides valuable habitat for migratory waders, located beside the northern end of Stockton Bridge.

Figure 7: Flora and Fauna Habitat



Water Quality

In general terms, not enough data has been generated to give any trends, however based on various studies: erosion and sedimentation; gross pollutants; nutrients: heavy metals; litter and microbiological contamination are the major pollutants within the City's waterways. These are typical urban stormwater characteristics. Anecdotal evidence from Clean-Up day sites such as the mangrove area of Throsby Creek, also indicates a limited litter load might be washed upstream on the tide from the Harbour with the find of foreign language labels plastic bottes.

Urban runoff contains a complex mixture of pollutants including hydrocarbons from roads, chemicals from tyres, detergents, animal excrement, garbage and many unknown contaminants. For example researchers from the University of Newcastle detected trace levels of abietic acid, a contaminant derived from tyres, in the tissue of the marine gastropod Austrocochlea constricta from a site within Newcastle Harbour. A study conducted by Riley (1999) indicated that the major source of alphiatic hydrocarbons (acid) and the metal cadmium, lead and iron in urbanised environments is from road stormwater runoff, where surface deposition of oil, spilled fuel and exhaust emissions allow increased loading of creeks and rivers. (Hunter Estuary Data Compilation Report, Jan 1999.)

Levels of heavy metals in the tissues of oysters deployed for a 3 month period in the entrance to Newcastle Harbour were significantly higher than those found in the tissues of organisms deployed in the entrance of Port Stephens (EPA, 1995). The likely source of contamination is industrial effluent, as well as residential stormwater, discharged into the Hunter Estuary.

Sewer surcharge from Hunter Water Corporation's wastewater transportation system is the subject of performance based on the number of sewer overflow events, where private properties are affected, not exceeding 6,500/ year. The year to date result (as at February 2005) showed 2565 sewer overflow events where private properties were affected. Sewer surcharges or overflows are generally related to either tree root blockages or wet weather conditions.

Dry weather surcharges are predominantly the result of tree root blockages and are generally very localised in nature, so environmental impact is usually limited. To address this problem Hunter Water adopts a number of maintenance practices including:

- Use of water jetting to clear blockages. This is carried out in conjunction with a camera inspection *(by closed circuit television)* to ensure the blockage has been removed;
- Where appropriate full replacement of the failed assets; and
- Where replacement is not warranted the use of chemical root treatment to minimise the opportunity for regrowth of tree roots.

Wet weather surcharges are predominantly caused by ingress of stormwater into the sewerage system. This can be caused by a number of factors with major ones being:

- General surface flooding covering access points *(eg manholes, shafts, yardsinks)* and allowing stormwater into the system;
- Illegal connection of stormwater *(eg off roofs*) into the sewerage system;
- Infiltration of groundwater into the sewerage system via cracked pipes; and faulty joints in the Corporation's sewers and in privately owned house drains.

To address wet weather surcharges Hunter Water has embarked on a significant investigation and capital rehabilitation/upgrade program. This is geared at precisely measuring current system performance, identifying deficiencies and determining remedial actions. This is a long term program of works as the sewerage system is an integrated one. It has to be reviewed holistically or else remedial works might simply move the problem from one location to another.

Hunter water's licences for wastewater effluent discharge quality now incorporate load levels. All Newcastle wastewater plants have recently (as at February 2005) complied with their EPA license load targets for BOD, NFR, pH, Grease, Total Nitrogen, Ammonia, Total Phosphorous and Fecol Coliforms.

All beaches also complied with these guidelines.

Land Use

Table 11 below summarises the generic landuse within the City, as at 1998. This breakdown of land use zones has remained unchanged over the last few years.

The population in Newcastle is 131,300 (ABS, 1996). The LGA covers 210 sq km comprising some 56,351 properties that attract Council rates.

Table 11: Landuse Zoning in Newcastle - by Percentage and Area
(State of Environment Report, NCC 1998)

Land Use	1998 AREA (ha)	1998 %
Industrial	3,609	17.0
Commercial	200	1.0
Recreational	701	3.5
Urban Bushland	690	3.0
Wetlands	4,210	19.5
Future Urban	1,060	5.0
Rural	1,254	6.0
Mining	1,310	6.5
Total	**21,300**	**100.0**

The Lower Hunter Housing Market Study (1993) undertaken for the NSW Department of Planning found adequate land would be available to accommodate an additional 200,000 people in the Lower Hunter. The Government's policy document "Cities for the 21st Century" (DUAP, 1995) predicts an additional 145,000 people will move from Sydney to the Lower Hunter. Sustaining this extra growth will require over 30,000 additional dwellings and 40,000 jobs beyond current baseline projections.

The predicted population growth will increase demand on potable water and increase the rate of urbanisation and development in the region. Such development can impact on the health of the catchments and their creek systems through siltation, nutrient and other contaminant loading as a result of urban runoff and sewage discharge. Newcastle's growth is mainly occurring to the west of the City within the Ironbark Creek catchment. The area between Maryland and Minmi has a forecast population of 25,000 people within 20-30 years. The clearing of land for urban development will create significant pressure on the aquatic systems within the catchments.

Photo 10:
Highland County is one of the new residential subdivisions within the Wallsend - Minmi growth corridor. In-line water quality control structures such as this pond and outlet structure may provide some water quality improvement, however integrated, at-source control measures (within the lot scale) could provide more sustainable, long term outcomes for the community and the creek.

NEWCASTLE CATCHMENT DESCRIPTIONS

The following is a compilation of a variety of source documents and personal communication from community members and stormwater managers throughout the Newcastle region. The gaps in our information base are identified and provide clear indications as to where future research and data collection efforts could be considered.

The Newcastle catchment contains substantial coastline and estuary regions as a consequence of our location at the mouth of the Hunter River. In the lower reaches of the City's catchment are the flood plains and wetlands of the river's estuary. To the south, a system of ridgelands drain to the estuary along creeklines and drainage channels, through the Cottage, Throsby and Ironbark Creek catchments. These creeklines form three sub-catchments of the Hunter that are nearly wholly contained within the Newcastle local government boundary. To the north Greenways and Purgatory Creeks move through valuable wetland areas in their progress to the Hunter River.

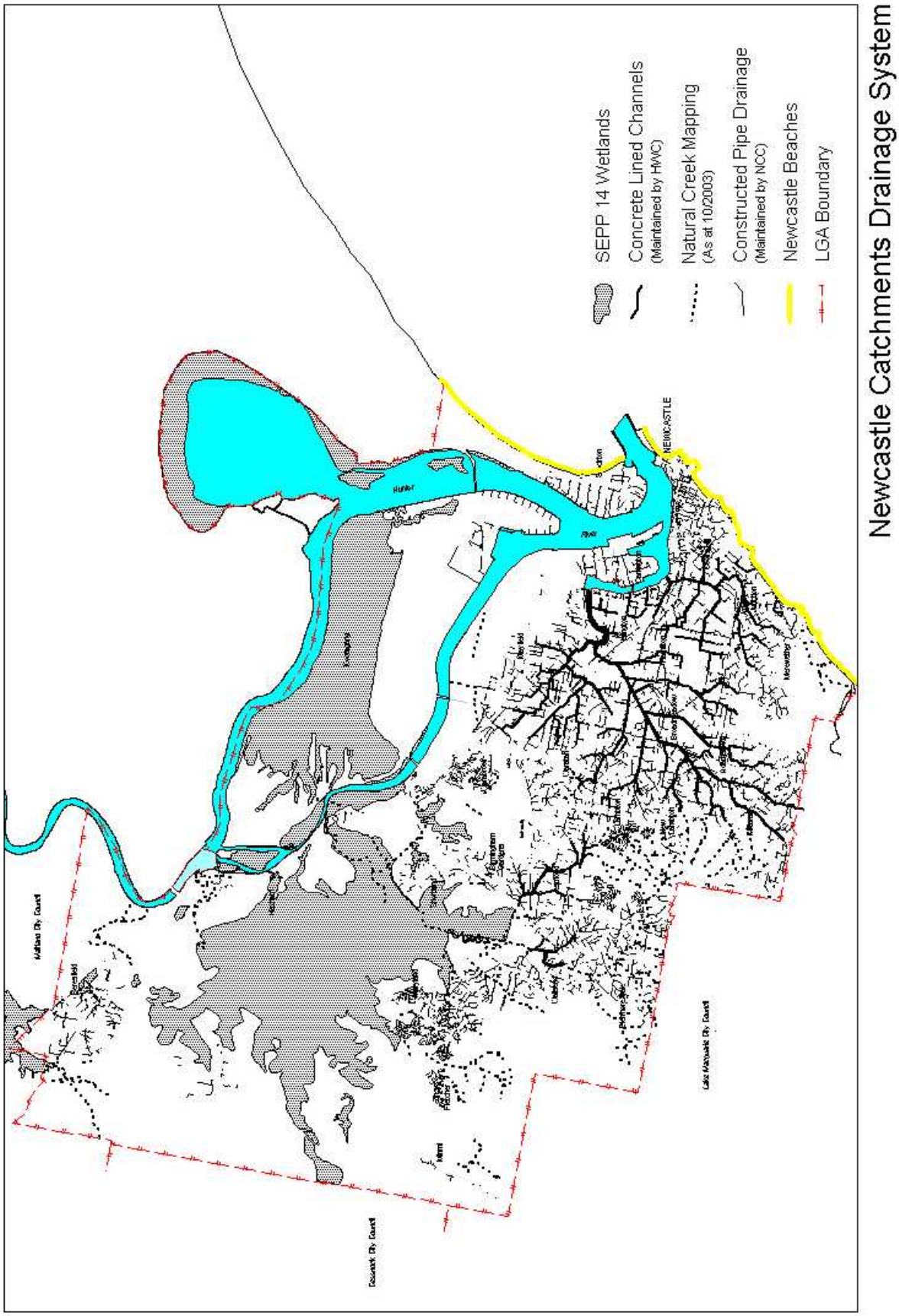
For the purposes of stormwater management we have considered seven catchment areas (which can be seen in Part A Figure 3):

1. Ironbark Creek;
2. Throsby Creek;
3. Cottage Creek;
4. the Hunter Estuary;
5. Small Coastal catchments;
6. Part of Purgatory Creek Catchment; and
7. Part of Greenway Creek Catchment.

The urbanisation of the City has produced a vast coverage of impervious area over the catchments including a constructed drainage network of roads, pit inlets, pipes and formed channels that have substantially modified the performance of the catchments. However, we have also been able to maintain some sections of our urban creek network in a relatively natural form. Figure 8 below is perhaps a more realistic view of the City’s catchments as it depicts natural creeklines (to the extent that they are currently mapped, see Action Plan #25), road inlets and constructed pipe drainage, concrete lined channels and wetlands.

In the Plan preparation process Council has liaised closely with Lake Macquarie City Council in relation to Throsby and Ironbark Creek catchments, and with Maitland City Council in relation to Greenways and Purgatory Creek catchment.

Figure 8: Newcastle's Catchment Drainage System



Ironbark Creek Catchment

Ironbark Creek is the largest tidal creek draining to the Hunter River in the City. Its catchment covers some 12,500 hectares and has a diversity of landuse, including urban and limited rural residential, industrial and commercial, important transport and communication corridors, recreation, conservation, agriculture, mining, forested land and wetland.

The Creek flows from the hills in the south of the catchment, through the suburb of Wallsend before winding its way over a large floodplain known as Hexham Swamp and entering the Hunter River at Sandgate. Hexham Swamp is a fresh water and estuarine wetland which was once the largest predominantly freshwater wetland on the near north coast of New South Wales. The sensitive nature of the wetland and its ecological importance has been recognised with its identification as a State Environment Planning Policy No 14 Coastal Wetland or as it is often referred a SEPP 14 Wetland.

Given it is the receiving waters of Ironbark Creek this provides a number of challenges for the way in which we live in this catchment. Figure 9 shows the Ironbark Creek catchment boundary, major suburbs, transport network and the Hunter Water stormwater channels.

Landuse and Urban Development

Urban development since 1824 has resulted in the clearing of approximately 2,000 hectares of land, or approximately 16% of the catchment which is now categorised as urban land. The catchment also consists of 3,800 hectares of swamp land and 6,700 hectares of forests and rural lands. Mount Sugarloaf and the northern section of the Sugarloaf Range extending to Blackhill dominate the western part of the catchment. Most of this area remains forested. The area to the east of Sugarloaf Range and along the southern boundary of the catchment is generally low undulating hills.

Much of these eastern and southeastern margins have been developed as residential areas, reflecting the constraints on development imposed by Hexham Swamp and the associated floodplains of the Hunter River. Some urbanised lands are affected by flooding in several localities around the wider Ironbark Creek catchment.

In 1991 the population in the catchment was approaching 40,000. Ninety-two per cent of the population, live within the Newcastle City Council area and the balance live mainly in the City of Lake Macquarie Council area. A very small number live in the Cessnock City Council area of the catchment. The catchment is the principal location for new urban development of Newcastle in the Minmi-Maryland corridor.

Much of Newcastle's present and future potential urban living areas are within Ironbark Creek Catchment. Urban development has put considerable quantities of sediment and nutrients into the creek and receiving wetlands. The enriched water has encouraged unwanted aquatic plants such as Alligator Weed, which now chokes large reaches of the creek.

Major residential areas are expected to be established in parts of the catchment over the next 30 years. Most of this will occur in the Maryland-Minmi corridor but development is also planned at Cardiff Heights, Wallsend, Wallsend South, Glendale and Beresfield. Rural-residential development is expected for the Mt Sugarloaf, Stockrington and Minmi areas.

Recreation and conservation are important landuses in the catchment. About 30 per cent of the area is dedicated specifically to these uses. Hexham Swamp Nature Reserve, Mount Sugarloaf Reserve, Jesmond Bushland, Shortland and Waratah Wetlands and the former Wallsend Brickworks constitute the main parcels of recreation and conservation land.

Although agriculture is continuing to decline in the area, cattle grazing is carried out over much of the western parts of the catchment. The continuous operation of floodgates on Ironbark Creek since 1971 has prevented entry of tidal water into the swamp system and allowed a large proportion of the Hexham Swamp to also be grazed seasonally. The Hexham Swamp Rehabilitation Project will attempt to reverse these impacts. The project includes the modifying the operation of the floodgates to restore tidal flows, regeneration of wetland native flora and fauna habitats across the swamp and voluntary purchases of effected properties. Improvements to biodiversity, habitat, fish nursery stocks etc are envisaged.

Such changes in the receiving water of the Ironbark Creek catchment will impact on stormwater treatment train decision making for the whole catchment.

Coal mining has been an important industry in the catchment for almost a century and a half. Gretley Colliery, immediately west of Wallsend, is the only mine now in operation. There is a proposal for a small open cut mine in the future.

Jesmond and Wallsend have major commercial centres. Smaller centres are located at Elermore Vale and Warabrook. The industrial areas of Hexham, Sandgate, Wallsend and Jesmond are principally involved in local service, automotive, engineering, transport and storage activities. The Hexham dairy factory is the only processing industry.

The Main Northern Railway line skirts the northeastern edge of Hexham Swamp, parallel to the Hunter River and an abandoned colliery railway crosses the swamp. The Seahampton to Minmi segment of the Sydney to Newcastle F3 Freeway and the link road between the Freeway and Wallsend traverse the catchment as do several high voltage transmission lines, two water supply lines and a natural gas pipeline. The improved accessibility afforded by the Freeway is likely to generate land use changes, which could in turn place additional pressures on the catchment.

Flood Regimes

The construction and the subsequent one way operation of floodgates over the past two decades at the confluence of Ironbark Creek and the Hunter River have resulted in major environmental and landuse changes.

The floodgates at Ironbark Creek have reduced the likelihood of Hunter River floods inundating Hexham Swamp, and almost eliminated tidal exchange, allowing an increase in grazing areas within the Swamp.

Simultaneously, the severely limited tidal exchange that has resulted from leaving the gates in a lowered position, even when the Hunter River is not in flood, has degraded the estuarine ecosystem associated with the Creek. A freshwater system with reduced areas of inundation has largely replaced the previous extensive mangrove and saltmarsh plant communities. This has also reduced the nursery areas for fish, prawns and other marine organisms.

Previous planning practice did not allow the full consideration of the flood environment, resulting in the development of areas that today would be considered inappropriate. Many flooding problems have now been 'locked in' to the catchment, which has made the management of these problems very difficult.

The nature and extent of flooding has also been altered by the process of urbanisation. Flooding from local run-off has become worse as urbanisation increases the extent of 'hard surfaces' (concrete, roads, roofs, paved areas) in upland areas, creating much greater and faster downhill flows. In more recent years many developments have been required to control their runoff to arrest this process.

The Blue Gum Hills Stormwater Management Strategy (1996) has addressed the need for an integrated system of urban stormwater management in the proposed developments of the Minmi-Maryland area of the catchment. A program of review and adaptive management change is in place as a quality control process, in an attempt to improve the catchment performance post development.

Water Quality

Water quality in Ironbark Creek is characterised by high nutrient levels with consequent excess plant growth and undesirable variability in dissolved oxygen. The reduced tidal exchange has resulted in oxidation of acid sulphate soils, lowered pH levels in several tributaries and raised soluble iron levels in the local waterways. (Ironbark Creek TCM Strategy, 1996)

A briefing from Louise Ormerod (pers. com., 1999) based on her PhD outcomes, as well as her experience gained within urban catchments over the last twelve years, indicated a number of sediment sources within the Ironbark Creek catchment associated with landuse and the channel. Dr Ormoerd's PhD thesis reported on her studies of Ironbark Creek Catchment using heavy metals and caesium-137 as sediment tracers.
These sediment sources included:

- Topsoil sources within remnant bushland areas eroded by sheet or rill erosion;
- Subsoil sources, or gully erosion within remnant bushland, associated with walking and bike trails. These were especially bad on steep slopes;
- Urban sources, including material found within urban gutters and drains, and from construction sites within the catchment. Urban gutters and drains were thought to combine all major sources from urban areas; and
- Channel Banks. Erosion associated with altered hydrological responses.

Channel sources were found to be the major source of sediment within floodplains and the channel. The second major source tended to be from urban sources. Fine sediments from urban areas are generally flushed through the stream system and are probably deposited within the Hunter Estuary or in Hexham Swamp when overbank flooding occurs there. Because these sediments are the most highly polluted (Horowitz, 1985, Foster and Charlesworth, 1996), they may be toxic to downstream aquatic biota. Gully and topsoil sources were found to be more significant in the upstream portion of the study where drainage lines flowed through a remnant bushland area, near the John Hunter Hospital.

The Ironbark Creek Ecosystem report (1993) indicated that:

"*Water quality in Ironbark Creek is moderate to highly eutrophic. The creek is characterised by high phosphorous levels, undesirable variability in dissolved oxygen and excessive plant growth. Poor quality is evident in tributaries where tidal exchange and salinity have been diminished. Floodplain drainage has also resulted in acid sulphate soil oxidation affecting several tributaries by lowering pH levels and contributing significant quantities of soluble iron to the waterway. In upper catchment areas most drainage channels are observed frequently trapping a substantial amount of litter*."

A comprehensive and integrated set of recommendations to rehabilitate and conserve the estuarine, aquatic and terrestrial ecosystems, manage the risks of flooding, reduce nutrient loads and other pollution and erosion were delivered in the Ironbark TCM Strategy (1996).

Site visits have indicated that a number of potential pollution sources exist in the catchment including, but not limited to:

- Fertiliser use in open space within the catchment;
- Erosion and subsequent sedimentation problems due to unsealed roads and tracks within bushland and urban areas;
- Grass clippings and garden waste dumping in close proximity to channels;
- Sedimentation loads from denuded stream banks, roads and median strips and landscaping stock piles; and
- Large sealed areas around shopping centres and an extensive road network sourcing sediments, litter, heavy metals, grease and oil pollution.

Photo 11:
Exposed road verges provide one of many sediment sources which enables the material to make its way through the stormwater system and eventually pollutes the wetland (receiving water body) here in Ironbark Creek catchment. Sediment is also a major issue in Throsby and Cottage Creek catchments.

As part of the Hexham Swamp Rehabilitation Project a water quality monitoring program has been established by Hunter Central-Rivers Catchment Management Authority.

Ecology

Development within the catchment has had numerous impacts on the ecology of the area. A large proportion of the open forest community has been cleared in the upper reaches of the catchment. Forested areas, which remain, are mainly spotted gum - ironbark open forests with wet sclerophyll and rainforest species in protected gullies. (Ironbark TCM, 1996)

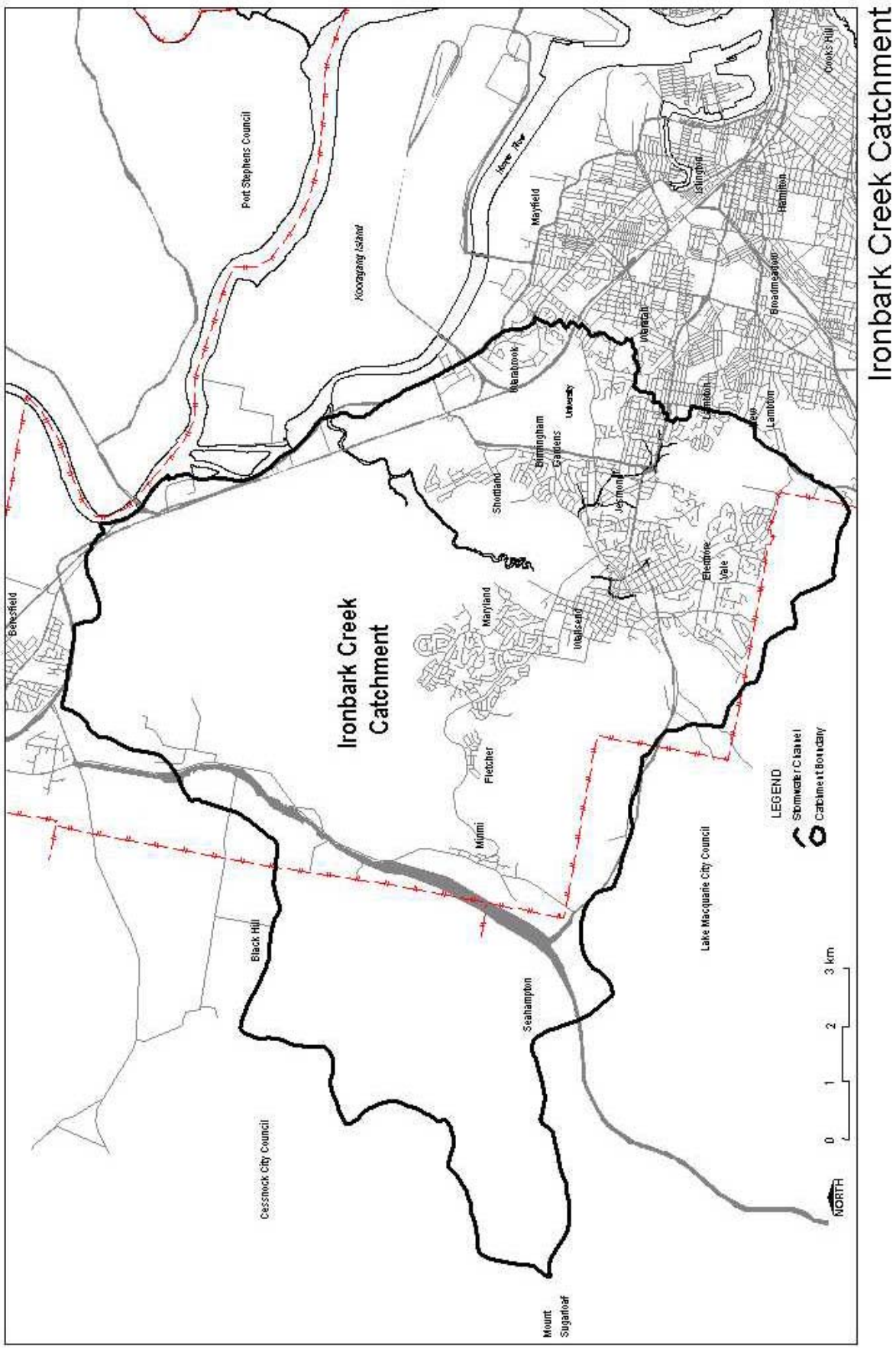
An assessment of Hexham Swamp in 1992 noted a dominance by common reed, coupled with significant reduction of estuarine communities and community diversity. Between the 1970s and 1992, the aerial extent of mangroves had been reduced from 180 to 20 hectares. (Ironbark TCM, 1996)

According to the Ironbark TCM Strategy (1996), a total of 207 species of birds have been recorded in the catchment including the endangered Regent Honeyeater and another eight species considered vulnerable or rare. Six migratory bird species, protected under government agreements with China and Japan inhabit wetlands in the catchment.

Photo 12:
Council's Creeks *Alive* program offers residents the opportunity to get involved in water bug monitoring of their local creeks. All this data along with Council's creek condition assessments is collated to form a 'health report card' for Newcastle's creeks.

Photo 13:
Local residents meet at George McGregor Park, Elermore Vale for a guided nature walk through the Park before commencing improvement works. This is one of many sites within Ironbark Creek catchment where active community groups are supported by Council's Creeks *Alive* Community Support Officer to improve their local creek riparian areas.

Figure 9: Ironbark Creek Catchment



There have been limited studies into the mammal and reptile species in the catchment. NPWS records indicate that 53 mammal and 14 reptile species are expected to occur in the catchment. Nine of the mammal species are listed as endangered and include terrestrial mammals and bats. Eleven frog species, including the endangered Green and Golden Bell Frog, have been recorded, mainly in the freshwater communities at the western side of Hexham Swamp.

A study in 1992 (in Ironbark TCM, 1996) recorded 32 species of fish and 6 species of prawn or shrimp in Ironbark Creek. 11 of the fish species were freshwater species, 20 were saltwater and 1 was euryhaline (Sea Mullet).

Total Catchment Management

The Ironbark Creek TCM Committee was a robust and active whole of government response to catchment issues that impact on natural resources, including water quality within the catchment and receiving waters. This committee has now been superseded by the Newcastle Catchment Management Forum, as a committee of the Hunter Central-Rivers Catchment Management Authority under NSW government restructure of the Department Infrastructure & Natural Resources. The Newcastle Catchment Management Forum continues to oversee the delivery of natural resources management, however it's charter now covers all the catchments within the Newcastle LGA boundary.

In line with the findings and objectives of the Ironbark Creek TCM Strategy, Council adopted the Blue Gum Hills Stormwater Management Plan covering the areas for proposed urban residential development in the Wentworth Creek sub-catchment. Council's DCP 50 – Stormwater and Water Efficiency will also add to the enforcement suite for stormwater management design and onsite controls, using current best practice methodology. Community members, Landcare and Bushcare groups work throughout the catchment actively pursuing areas of TCM strategy.

Drainage Channels

Hunter Water controls 2.8 km of stormwater channels in the Wallsend-Plattsburg area. These channels contain the Creek through the commercial area of Wallsend, and lead into Ironbark Creek, south of Minmi Rd. They were constructed primarily in the 1930s with some works continuing in 1989.

Hunter Water also controls approximately 5 km of stormwater channels in Dark Creek sub-catchment. These channels drain the more urban areas of the catchment such as Jesmond and North Lambton, and eventually feed into the lower, natural reach of Dark Creek and onto Ironbark Creek. They were also constructed primarily in the 1930's with some works continuing in1979.

Hunter Water's responsibility also involves the maintenance of the drainage system so that there is no interruption to the flow in the system and the Corporation's assets and the public is not in any danger. The maintenance details include:

- Maintenance of the grounds along the drains, in a three weeks cycle from September to April inclusive and a five weeks cycle from May to August. This includes a minimum distance of three metres measured horizontally from the outside edge of the stormwater channel or as specified;
- Cleaning of the inside of the channels;
- All clippings are collected and removed from the site, including the clippings that have fallen into the drain; and
- Reporting on volumes of any trash and silt removed.

Throsby Creek Catchment

Throsby Creek and its tributaries form a highly modified drainage network that collects stormwater from the major part of central Newcastle and conveys it to Newcastle Harbour. The catchment of the creek covers an area of approximately 3,000 hectares, the majority of which are within the boundaries of Newcastle City Council area. A small section of the upper catchment falls within the Lake Macquarie City Council area.

The upper parts of the catchment are bounded in south and south-west by Lookout Road, Charlestown Road and Pacific Highway (to Merewether Heights). The lower catchment is bounded to the north-west by Waratah and Mayfield (West through to East), to the north along a drainage line generally between Maitland Road and Industrial Drive, and to the east and south-east by the suburbs of Wickham, Hamilton and across Broadmeadow Racecourse. Figure 10 shows the extent of the Throsby catchment, major suburbs, transport networks and Hunter Water's stormwater channels.

Few places within Throsby catchment remain in a relatively natural state with the majority of the drainage network being channellised in concrete stormwater drains and the landuse predominantly residential. One exception to this is Blackbutt Reserve, which constitutes one of the largest remaining natural bushland pockets in the City, and forms part of the headwaters of the catchment. The area around the old mine at the top of the main channel and the Army reserve east of Brunker Road are two other areas in a relatively natural state. There are a number of active Landcare, Bushcare and community groups in the catchment who work towards achieving protection of the natural values of the catchment. However, heavy use and park infrastructure also contribute to pollution loads within the catchment.

Urbanisation of the lower catchment commenced in the mid to late 1800s and continues today with infill developments and small developments in the steeper upper catchment. The majority of urbanisation of the sloping lands of the mid to upper catchment is thought to have occurred during the 1960s and early 1970s. The population of the catchment today is 67,512 - equivalent to 21.4 people per hectare (Wolfenden, 1999), which is quite high by Australian standards, being exceeded only by some densely settled inner suburbs of the main cities. Landuse in the catchment comprises predominantly built environment with only 23% of the catchment existing as bushland or open space. This will clearly influence catchment management techniques that could be constructed.

Table 11: Landuse in the Throsby Creek Catchment. (Wolfenden, 1999)

Landuse	Area (hectares)	Percentage of Catchment
Bushland, mostly regrowth	280	9
Parks and recreational areas	420	14
Built environment (dwellings, commercial and light industrial)	2,450	77
Total	**3,150**	**100**

Although the catchment landuse is predominantly residential, the industrial and commercial areas play significant roles in the stormwater issues due to their increased areas of hard surfaces; eg car parks, roof tops and storage yards which provide little infiltration for stormwater.

Downstream of Tighes Hill, the creek is tidal. The very low gradients for this part of the Creek create a depositional environment and so sediment accumulates from the catchment. This lower section of the creek flows through the inner city suburbs of Islington, Wickham, Maryville and Carrington and has been the site of major restoration works as part of the implementation of the TCM strategy. $6 million has been spent on dredging in response to the large volumes of sediments that have accumulated over time. Dredged material from the tidal stretches of the creek was estimated at 73,900 cubic meters. Dredge material analysis revealed high levels of iron. (Public Works Department, 1991). It is also in this area, among the mangrove forests along the Carrington foreshore, that litter and other forms of pollution now tend to accumulate.

Detailed analysis of Throsby Creek catchment relevant to the identification of stormwater issues, including, erosion, sedimentation, foreshore development, hydrology, pollution, ecosystem, sub-catchment delineation and tidal inundation etc appear in:

- Throsby Creek TCM Strategy Task Group Reports (1989),
- The revised Throsby Creek Strategy Action Plan (2001); and
- The Throsby Creek Catchment Gross Pollutant Study completed for Hunter Water Corporation by WBM Oceanics (2000).

The Throsby Creek TCM Strategy (1989) was successful in addressing many significant issues within the catchment. Improvement in aesthetic appeal for the tidal section of Creek between Maitland Road and Hannell Street has been spectacular, with the establishment of mangroves, bank vegetation, community access points, bike tracks and art installations.

The boardwalk constructed amongst the mangroves between Hannell and Cowper Street Bridges, has added a valuable ecological and recreational asset to the community. The foreshore restoration work carried out by the Honeysuckle urban development, around the old Wool Stores site, has also increased the recreational and aethestic values of this area. Mangroves act as filters in tidal sections of natural ecosystems, so it is no surprise that they also 'filter' litter and other pollutants in an urbanised environment.

The Throsby Creek TCM Committee revised the Throsby TCM Strategy (1989) and developed the Throsby Creek Strategy Action Plan (2001) to address heightened community awareness values, and take advantage of new approaches and technologies. This committee has now been superseded by the Newcastle Catchment Management Forum, as a committee of the Hunter Central-Rivers Catchment Management Authority under NSW government restructure of the Department Infrastructure & Natural Resources. The Newcastle Catchment Management Forum continues to oversee the delivery of natural resources management, however its charter now covers all the catchments within the Newcastle LGA boundary.

Hunter Water controls 52.75km of stormwater infrastructure in the Throsby Creek network. The drainage network is complex, comprising some 59 branches and sub-branches, and made up of a combination of open channels, pipes and culverts. The infrastructure in Throsby Creek was completed in 1936, with some additional works conducted as late as 1978.

Existing stormwater treatment devices installed by Hunter Water include:

- One trash rack on the Adamstown Branch, between District Park Tennis Centre and the Westpac Rescue Helicopter headquarters;
- One “CDS” unit or end of line pollution trap located on the Lambton Branch of the creek, between Energy Australia Stadium and the Hockey Centre, and
- One sediment trap, with a floating boom in the Throsby Creek system located in the Main Channel, between Chin Chen St and Maitland Rd, adjacent to the Tighes Hill TAFE. The floating boom efficiency has been the source of continual improvements as Hunter Water seeks to reduce the impacts of large items such as shopping trolleys and tyres snagging the boom when they reach this point in the channel.

Hunter Water's program of maintenance works in Throsby Creek catchment also includes:

- Sediment trap - remove accumulated sediment every 3 months. Estimated 20 cubic metres/ month material is collected;
- Floating boom at Tighes Hill - inspected weekly and remove accumulated floatable matter. Reinstate boom if broken as soon as practicable. Est. 10 cubic metres/ mth material collected;
- Trash Rack - inspect weekly, clearing material from the screens into the collection area, empty collection area monthly. Est. 3 cubic metres/ mth material collected;
- CDS Unit inspected and remove accumulated material bi-monthly. Est. 10 cubic metres/ mth material collected;
- Reporting on volumes of any litter (and composition) and silt removed;
- Maintenance of the grounds along the drains, in a three weeks cycle from September to April inclusive and a five weeks cycle from May to August. This includes a minimum distance of three metres measured horizontally from the outside edge of the stormwater channel or as specified. All

clippings are to be collected and removed from the site, including the clippings that have fallen into the drain; and cleaning the inside of the channels.

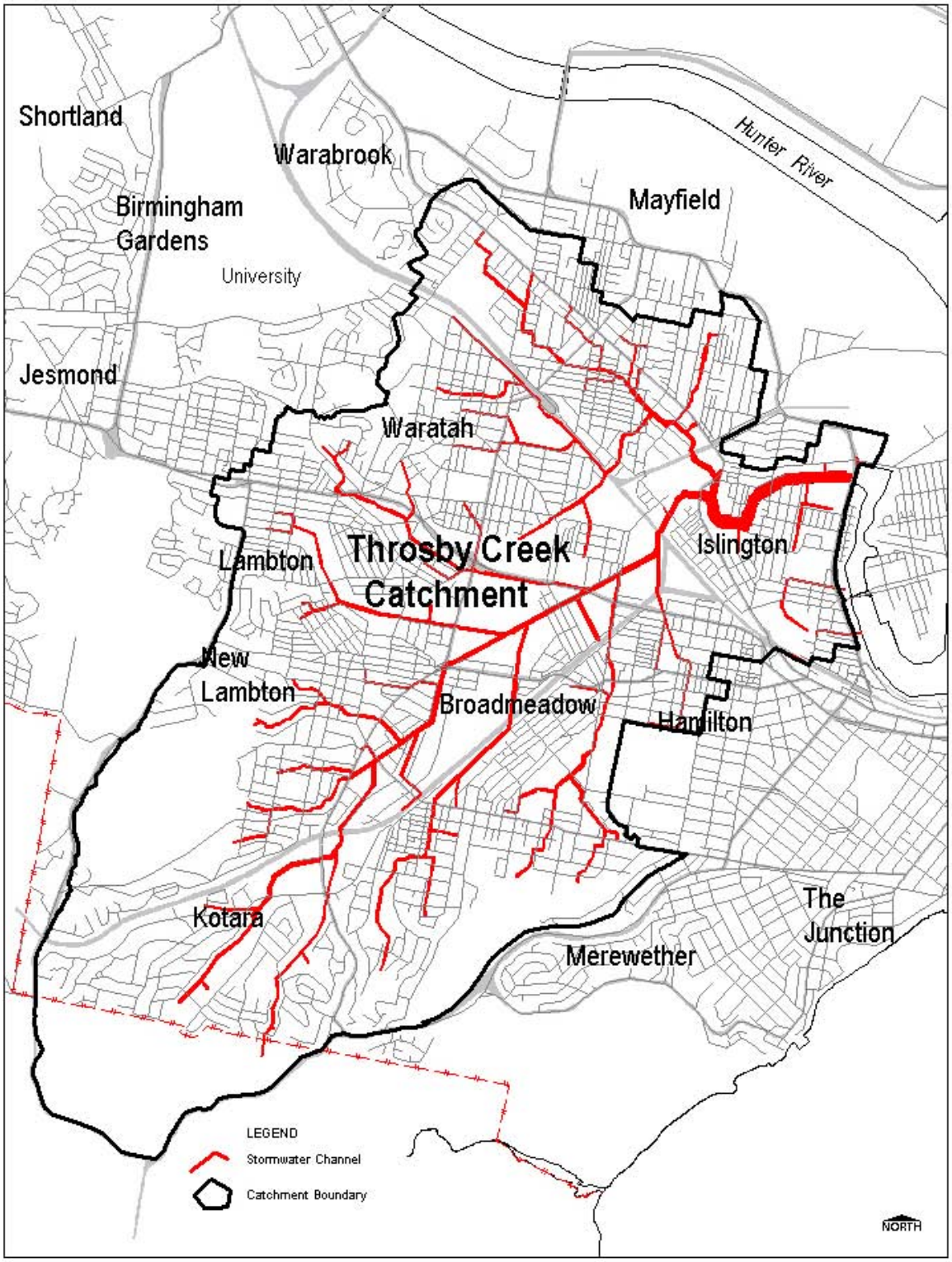
Council has undertaken numerous collaborative, integrated stormwater projects, including “at-source” control device trials and education interventions, within the Throsby Creek catchment over the past years. Such projects have produced stormwater quality treatments such as:

- Sediment trap device or “baffle-box” in Kotara, that removes an average of 1cubic metre of sediment per week from system;
- “Natural channel” rehabilitation of eroded creeks & drainage lines such as Kullaibah Reserve and Black Duck Creek that stabilise bed and bank erosion, so removing sediment sources from system;
- Street pit entry covers for the Lambton Shopping Centre to prevent litter, down to cigarette butt size, from entering the drainage system;
- Creek friendly car park designs that infiltrate road runoff prior to entering creek at Community greening Centre, Kotara as well as remove oils/ grease and litter in the case of Energy Australia Stadium car park stormwater inlet devices; and
- Targeted community engagement methodologies such as “Gutter Talk” that have created improved stormwater behaviours, ownership and attitudes when delivered at a street corner or neighbourhood scale.

The delivery of such projects has been influenced by the strategic direction chartered by Council in the preparation of an Urban Water Cycle Management Policy for Newcastle (2004). In addition the outcomes of the Throsby Creek Catchment Gross Pollutant Study (WBM Oceanics, 2000) provided valuable data on the indicative gross pollutant generation across 22 distinct sub-catchments identified for Throsby Creek. See Figure 11.

Photo 14:
The Lambton Ker-rai Creek naming ceremony, Lambton Park 2003. Council's stormwater education project in Lambton sub-catchment triggered an active community response that ultimately delivered a naming process for the local creek that runs through Lambton Park. (Ker-rai in Awabakal language means stream). Local residents continue to be involved in planning to improve the natural features and environmental performance of the Lambton Ker-rai.

Figure 10: Throsby Creek Catchment



Throsby Creek Catchment

Photo 15:
The Adamstown Branch stormwater channel within Throsby Creek catchment, showing the trash rack that has collected leaves, fast food wrappers, plastic bags, tyres, soft drink bottles and paper. Sediments in the form of mud and dirt also collect behind the grids of the rack. Regular cleaning is required to prevent litter load further down the catchment clogging the grids and hence, sending stormwater over, rather than through the grids, and so carrying its litter.

Hunter Water conducts limited stormwater sampling in Throsby Creek, at the Hannell St Bridge. Dry weather samples are taken monthly, with wet weather samples conducted during all significant rain events. This sampling frequency means that the results are skewed by wet weather samples. It is also noted that the samples would represent substantial dilution due to the tidal nature of the Hannell St bridge site.

Additionally, the number of samples - around 20 - are insufficient to draw conclusions about the overall quality but can give some indication as to the quality of stormwater.

Results are summarised in Table 12 below, and preliminary assessment of the data indicates that:

- BOD may not be a concern in regard to stormwater management;
- Dissolved oxygen concentrations remain reasonably constant in dry and wet conditions;
- As expected, faecal coliform levels are higher during rain events;
- Suspended solids levels are of concern in Throsby Creek; and
- Phosphorous and Nitrogen levels appear high if compared to ANZECC guidelines, however ANZECC suggest site specific studies be undertaken to determine desired levels for individual waterways.

In September 1996, Hunter Water, in conjunction with the Hunter Catchment Management Trust undertook a water quality sampling program which included two sediment samples. On October 25, 1996 and March 18 1997, Hunter Water took sediment samples from Throsby Creek, on the Mayfield Branch opposite the Tighes Hill Bridge, and from the main channel near the bowling club. The results are summarised in Table 13.

Despite the lack of applicable guidelines for estuarine/marine sediments, results were compared to the Draft EPA Biosolids Guidelines (1995) with respect to recommended exposure settings. All metals, with the exception of lead and zinc, complied with Grade A exposure settings - the highest standard suitable for use in playgrounds and other contact areas.

Table 12: Summary of Water Quality data for Throsby Creek (Hannell St Bridge)

Unit		Dates Samples	Mean	Max	Date	Rain (mm)	Min	Date	Rain (mm)
BOD	mg/L	8/5/96 to 20/11/98	5.04	6	18/11/98	101.40	5		
DO	mg/L	2/7/97 to 20/11/98	6.96	9.1	18/11/98	101.40	3.62	20/11/98	15.4
FC	col/	13/12/95 to 20/11/98	6303	36000	19/11/98	52.40	4	14/1/98	0
SS	mg/L	2/7/97 to 20/11/98	61	388	18/11/98	101.40	14	10/8/98	0
								14/1/98	0
TON	mg/LN	13/12/95 to 20/11/98	0.34	1.6	19/11/98	52.40	0.01	11/3/98	0
TP	mg/L P	13/12/95 to 20/11/98	0.12	0.39	10/7/96	0.00	0.016	8/8/96	0

Table 13: Summary of sediment sampling (25-10-96 and 18-3-97) for Throsby Creek

Metal	Result
Arsenic (As) (mg/kg)	6.9
Chromium (Cr) (mg/kg)	74
Lead (Pb) (mg/kg)	330
Mercury (Hg) (mg/kg)	0.3
Zinc (Zn) (mg/kg)	730
Cadmium (Cd) (mg/kg)	1.3
Copper (Cu) (mg/kg)	110
Nickel (Ni) (mg/kg)	45

Both lead and zinc were somewhat elevated, being classified as Grade C exposure - suitable for use in a residential environment with a substantial vegetable garden. However, both lead and zinc concentrations had reduced slightly from a similar sampling program in 1991.

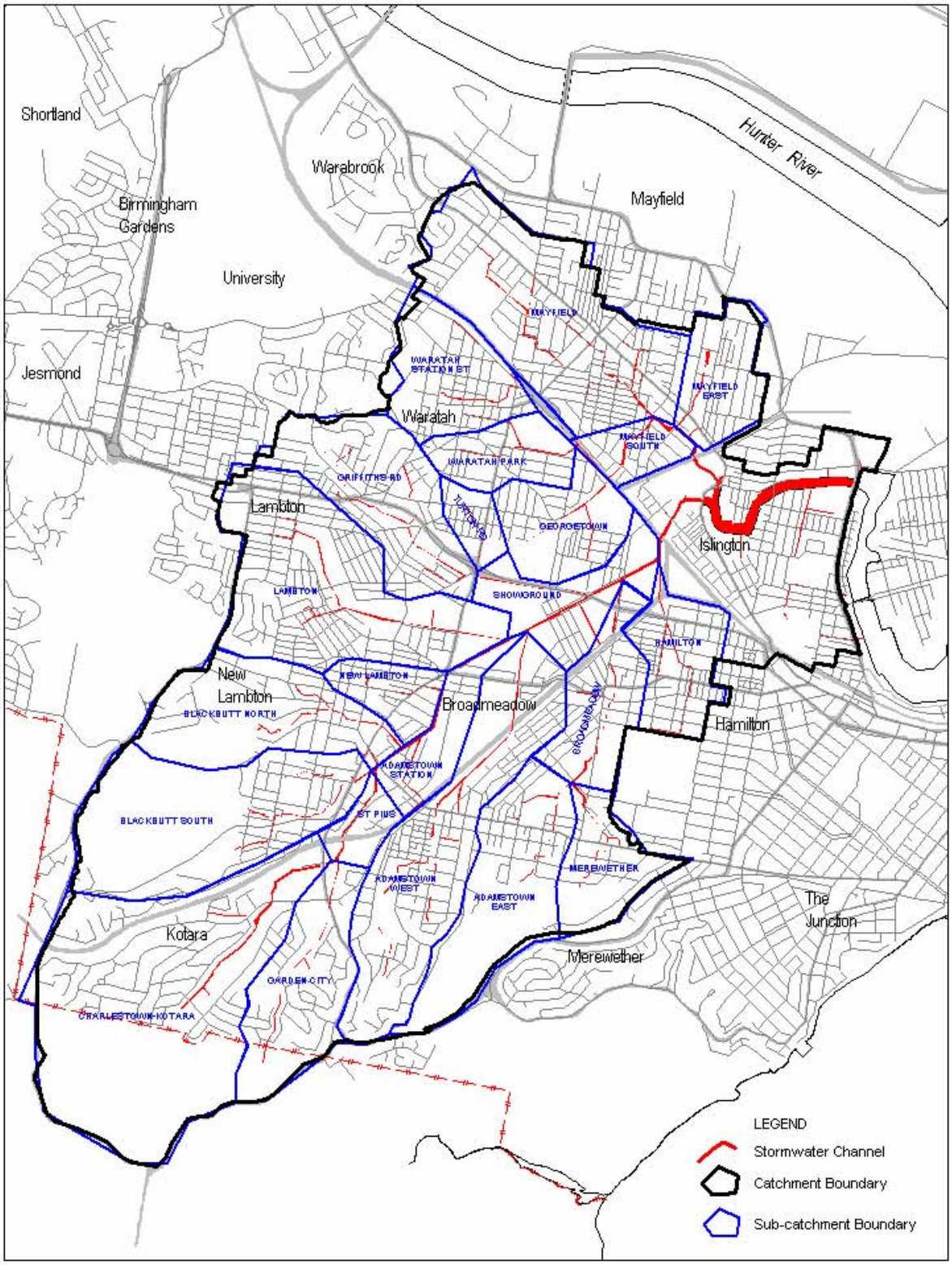
Additional sampling periods are required.

Site visits have indicated that a number of pollution issues exist in the catchment including, but not limited to:

- Supply and collection frequency of council litter bins in open spaces and the lack of litter barriers around some channels;
- High litter levels on the streets and in the gutters;
- Litter accumulation amongst the mangroves and tidal sections of the catchment;
- Grass clippings and garden wastes in close proximity to channels; and
- Sedimentation loads from denuded banks, roads and median strips.

The responsibility for urban stormwater management within Throsby Creek Catchment is shared between Council, Hunter Water, and Lake Macquarie City Council.

Figure 11: Throsby Creek Catchment - breakdown into 22 sub-catchments



Cottage Creek Catchment

Cottage Creek catchment covers an area of approximately 800 hectares of medium density residential and commercial development (Willing and Partners, 1984) in the south-eastern section of Newcastle City. It includes the suburbs of Merewether, Hamilton, The Junction and Cooks Hill. Figure 12 shows the extent of the Cottage Creek catchment, major suburbs, transport networks and Hunter Water's stormwater channels.

The Merewether Flood Behaviour Study (NCC, 1995) identified that around the turn of the century settlement was primarily single dwelling housing on the lowland areas of the catchment. Some of this area, near the National Park, is reclaimed swamp for which drainage channels were constructed to control flooding. The steep upper regions of Merewether had no development at this early stage.

The 1950's characteristics of the catchment were determined for the Study, from aerial photographs as including:

- Merewether Heights was sparsely developed;
- The main residential development was single house dwelling;
- Housing Commission unit blocks were built along Parkway Avenue; and
- Near Nesca Park approximately half of the current residential blocks were developed.

The majority of the concrete stormwater drainage channel infrastructure had been constructed by this time. Current changes include increased sites of dual occupied blocks, increased number of unit blocks and increased amounts of impervious areas due to commercial and residential development.

Hunter Water currently controls 20.5km of stormwater infrastructure in the Cottage Creek drainage system. A floating boom to trap oils and floating trash on the Cottage Creek discharge point to the Harbour at Wharf Road has been installed and maintained by Hunter Water.

Hunter Water's program of maintenance works in Cottage Creek catchment includes:

- Floating boom - inspected weekly and remove accumulated floatable matter. Est. 2 cubic metres/ mth material is collected;
- Reporting on volumes and composition of any litter removed;
- Maintenance of the grounds along the drains, in a three weeks cycle from September to April inclusive and a five weeks cycle from May to August. This includes a minimum distance of three metres measured horizontally from the outside edge of the stormwater channel or as specified. All clippings are to be collected and removed from the site, including the clippings that have fallen into the drain; and
- Cleaning of the inside of the channels.

Hunter Water also conducts limited stormwater sampling in Cottage Creek at Wharf Rd. Dry weather samples are taken monthly, with wet weather samples conducted during all significant rain events. As is the case for Throsby Creek this sampling frequency means that the results are skewed by wet weather samples and it is also noted that the samples would represent substantial dilution due to the tidal nature of the Wharf Rd site. Additionally, the number of samples - around 20 - are insufficient to draw conclusions about the overall quality. Again, due to these factors, the sampling results should not be used to compare the stormwater quality to standards or guidelines, but can give some indication as to the quality of stormwater.

Results are summarised in Table 14, and preliminary assessment of the data indicates that:

- Dissolved oxygen concentrations do not appear to be an area of particular concern;
- Faecal Coliforms rise quite sharply during rainfall events;
- Suspended solids concentrations rise during rainfall events; and
- Phosphorous and Nitrogen levels appear high if compared to ANZECC guidelines, however ANZECC suggest site specific studies be undertaken to determine desired level for individual waterways.

Table 14: Summary of Water Quality Results for Cottage Creek (Wharf Rd)

Unit		Dates Samples	Mean	Max	Date	Rain (mm)	Min	Date	Rain (mm)
TP	mg/L P	13/12/95 to 20/11/98	0.175	1.3	16/4/97	5.20	0.02	8/1/97	8.80
TON	mg/LN	13/12/95 to 20/11/98	0.547	2.7	06/5/98	21.80	0.01	14/1/98	0.00
SS	mg/L	2/7/97 to 20/11/98	37.85	82	11/3/98	0.00	8	20/5/98	20.20
FC	col/ 100mL	13/12/95 to 20/11/98	25378.85	4800000	6/5/98	1.84		14/1/98	0.00
DO	mg/L	2/7/97 to 20/11/98	7.77	13.1	24/9/97	19.20	5.1	20/11/98	15.40
BOD	mg/L	8/5/96 to 20/11/98	5	5			5		

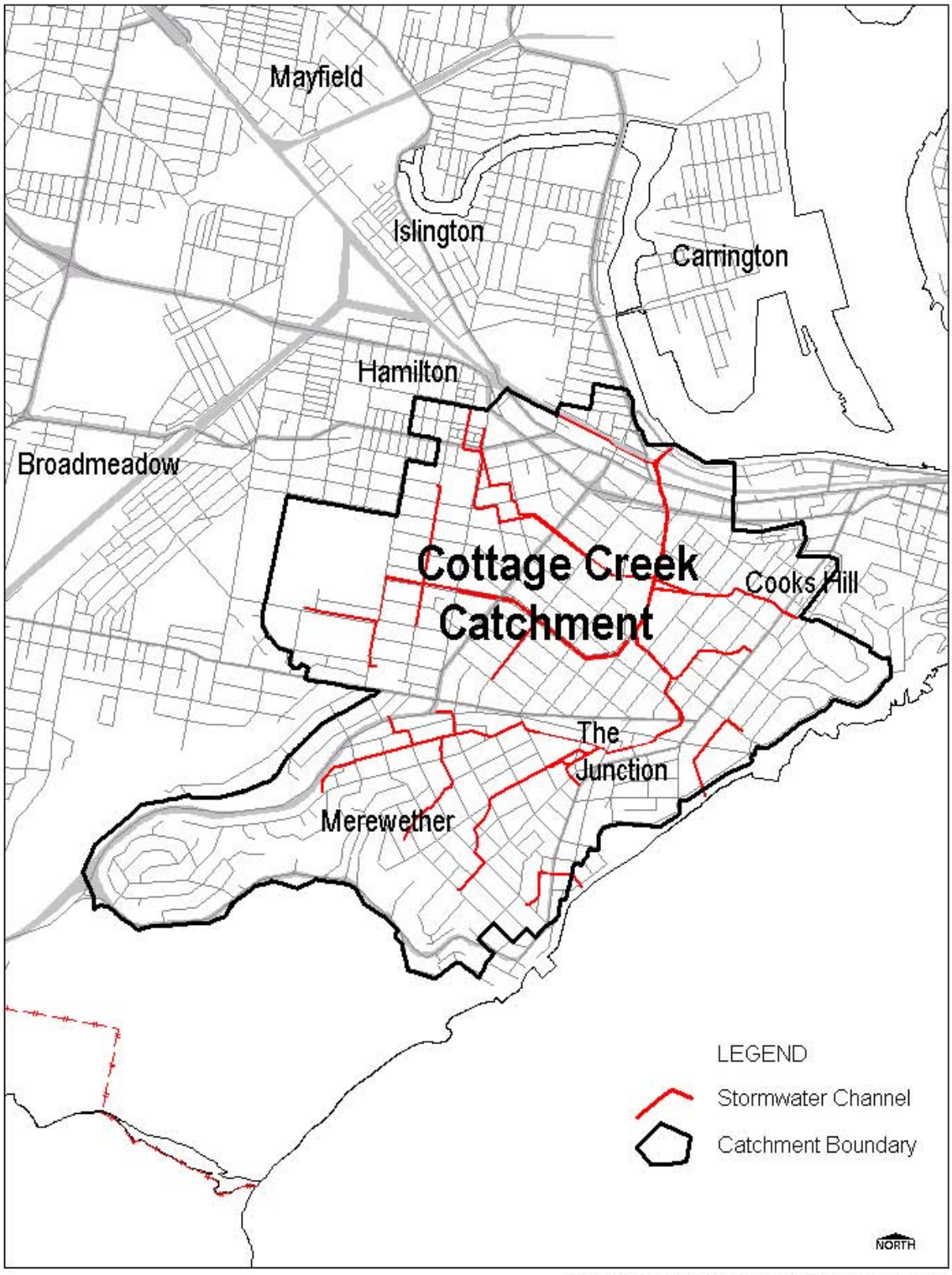
The responsibility for urban stormwater management within Cottage Creek Catchment is shared between Council and Hunter Water.

The lack of Total Catchment Management Studies for Cottage Creek catchment was identified as a data gap in the Hunter Estuary Data Compilation Report, (Jan, 1999) and a need for comprehensive water quality monitoring, including source point determination capability was identified as a potential future management option.

The Newcastle Catchment Management Forum, as a committee of the Hunter Central-Rivers Catchment Management Authority under NSW government restructure of the Department Infrastructure & Natural Resources, now oversees the delivery of natural resources management within the Cottage Creek catchment. The preparation of a Cottage Creek Gross Pollutant Study is timetabled for 2004-05 to assist in prioritisation of target sub-catchments and associated actions.

Photo 16: Newcastle East Public School take part in regular Creeks *Alive* water quality monitoring for the Cottage Creek catchment as well as education initiatives such as the Cottage Creek 'Catchment Crawl'.

Figure 12: Cottage Creek Catchment



Cottage Creek Catchment

Hunter Estuary

(Including Kooragang Island, Fullerton Cove, some of City East and the suburb of Stockton.)

Of the Harbour and Estuary area, 2926 ha is taken up in the Kooragang Nature Reserve with further areas also recommended for protection. The Reserve covers Fullerton Cove and the north-eastern section of Kooragang Island including, the adjacent intertidal and aquatic areas. It was listed as a RAMSAR Wetland of International Significance in 1984. The Kooragang Wetland Rehabilitation Project was initiated in 1993 to compensate for the loss of fish and other wildlife habitat in the Hunter River Estuary. The project area covers 1560 ha on three sites: Ash Island, Tomago and near Stockton Bridge.

The Kooragang Island region is predominantly sandbeds so infiltration of rainfall is significant and hence limits direct stormwater runoff to the estuary. Stormwater runoff occurs mainly from road surfaces in the area and for the purposes of this assessment, is deemed an insignificant source. However, the mangrove forests and either intertidal areas of the Island accumulate significant volumes of gross pollutants, believed to originate in urban stormwater from Hunter River catchments.

Pollutants present in urban runoff across the city, represent a significant pressure to the Hunter Estuary. Newcastle City Council has indicated 104 stormwater outlets, which discharge directly to Newcastle Harbour. The vast majority of outlets discharge untreated stormwater with no sediment, nutrient or trash removal. The major outlet located on the Foreshore of the Harbour, and draining the East End Precinct of Newcastle, is screened to remove gross pollutants. Stormwater effluent is not treated at any of the other numerous outlets which discharge into the Estuary.

Council has had trash baskets/pits within the stormwater drainage system discharging to the Harbour since 1992. This has been in response to the large amounts of debris i.e. bottles, plastics, paper etc found within the drainage systems and is most evident where drainage lines discharge into waterways and open space areas. There are currently four trash baskets in place, one at Foreshore Park and three in Carrington at Hargreaves and Robertson Streets.

Photo 17:
Shows the typical array of litter and gross pollutants removed from the trash baskets (Foreshore Park) during the regular cleaning program conducted after rain events (on average every 6 weeks).

Honeysuckle has significantly changed public and residential land adjoining the harbour, bringing heightened levels of enthusiasm for protection of this tidal region of the City. Stormwater quality was one of the issues addressed in the development process with gross pollutant & oil/grease capture designed within the pit drainage for the development, as well as proprietary “CDS” units installed.

There are currently three boat launching ramps (Carrington, Stockton and Horseshoe Beach) within the harbour on Crown Land and administered by The Waterways Authority, and two others at Hexham and Kooragang. Carrington and Horseshoe Beach facilities appear to have no pollution control bunding on the ramp or car park facilities for 40 and 30 trailers respectively. Information about the others was not available at time of printing.

Many data gaps were identified for the estuary in the Hunter Estuary Data Compilation Report (1999). Some of those relevant to stormwater included:

- The effects of stormwater pollution on aquatic biota;
- Contribution of stormwater to hydrocarbon pollution;
- Determination of pollutants present in stormwater runoff and there sources e.g. abietic acid from tyres;

- Sewage system overflows;
- Leachates from dump sites; and
- A GIS system that allows the integration of layers of physical environment with biological and social environment adjoining the estuary.

The responsibility for urban stormwater management within the estuary is shared between Council, Hunter Water, NSW Fisheries and Newcastle Port Corporation.

Photo 18:
The Kooragang Island Rehabilitation Program staff and volunteers seen here hard at work, have changed the Island over the past 10 years from degraded habitat, to offering important sites for the migratory wader populations, in these internationally significant wetland areas that surround the City.

Photo 19:
Areas of the Estuary such as the sand spit at Stockton provide the Sharp-tailed and Curlew Sandpiper with welcome refuge.

Coastal Catchments

This region is limited to those areas of coastal runoff that drain directly to the ocean. This includes such areas as:

- Cliffs and headlands including Murdering Gully;
- Beaches from north to south including Stockton, Nobby's, Newcastle, South Newcastle, Susan;
- Gilmore, Dixon Park, Bar, Merewether and Dudley;
- Ridge Street drainage; and Watt Street drainage.

The Newcastle Bight is perhaps the most significant coastal resource in the Hunter Region. About 5% of Newcastle Bight is in Newcastle City and is developed as the suburb of Stockton. The coastal zone is generally fully urbanised south of the Hunter River ie; there is no dune system as such remaining. The only exception to this is the predominantly natural bushland setting of Murdering Gully and its foredune system including Burwood Beach, even though it is the site of Hunter Water's main waste water treatment works in the Newcastle area. This region having less than 1000 residents is not considered in this current urban stormwater management plan.

There are 11 stormwater drainage outlets in the coastal zone discharging directly to beaches and headlands. These outlets are identified in Figure 13 (WBM Oceanics Australia, 1999). Remedial works to combat erosion problems are required at several outlets. The stormwater drain outlet at Newcastle Beach has been removed in the past year and the drainage redirected to the Hunter River at Newcastle East.

Photo 20:
The headwall of the stormwater outfall at Merewether Beach

The coastal stormwater discharges can form ponds when the beach is in a depositional phase with a high beach berm preventing water from flowing into the ocean. The quality of the stormwater runoff in terms of bacterial and virus counts is still not determined and has been identified as part of our data gap.

However, parents often see these ponds as a safe alternative for their children to swim in, and as a result, put their children in danger of contracting water borne diseases if contaminated stormwater is an issue. Photo 12 shows the headwall of the stormwater outlet that discharges directly onto Merewether Beach.

Newcastle City Council provides beach cleaning, litter collection and a foreshore maintenance program as part of its beach maintenance program. Council in conjunction with government agencies, industry and the community have recently convened a Coast and Estuary Management Committee to more clearly identify and manage those issues and pressures that impact on the natural resources within the coastal zone.

Water quality sampling has been undertaken by Hunter Water in the Coastal Zone. Numerous data collection days by Streamwatch volunteers has also occurred. Preliminary results of the Streamwatch project indicate that the levels of phosphorus are routinely high in the city, while Council and Hunter Water did analysis and confirmed the impact of faecal contamination in stormwater flows, which reach the beach.

Council has undertaken water quality testing at the saltwater baths for many years and results over the previous year indicate 100% compliance level against faecal coliform standards.

There still remains the need for assessment by the Coastal Estuary Management Program with

respect to comprehensive water quality monitoring requirements in this zone.

Council has undertaken a number of stormwater initiatives jointly with Hunter Water, the community and local stakeholders in the coastal zone:

- The first project the Nobbys “Street to Beach” Project developed a model for a practical approach in integrating aging infrastructure and existing resources with a program of new technology works and education initiatives. Pollutant loads included large amounts of litter, hydrocarbons and heavy metals from roads and carparks plus bacteria and nutrients from dog droppings. Nobbys is one of the few sites in Australia to trial innovative sandfilter technology in the treatment of stormwater pollution. The outcome was an integrated works and education program that removed stormwater pollution all together from Nobbys beach. . The Project has been recognised as the NSW champion in innovative pollution controls in Clean Beach Challenge (2002).
- The work continued into 2002-03 with Merewether “Clean Streets- Clean Beach” project that adopted the “Gutter Talk methodology developed by Council staff to engage local residents in positive stormwater behaviours. The project received the Stormwater Industry Association National Community Education Award in 2004 and set the scene for continuing projects in the Dixon Park and Bar Beach areas.

The responsibility for urban stormwater management within this coastal region is shared between Council and Hunter Water.

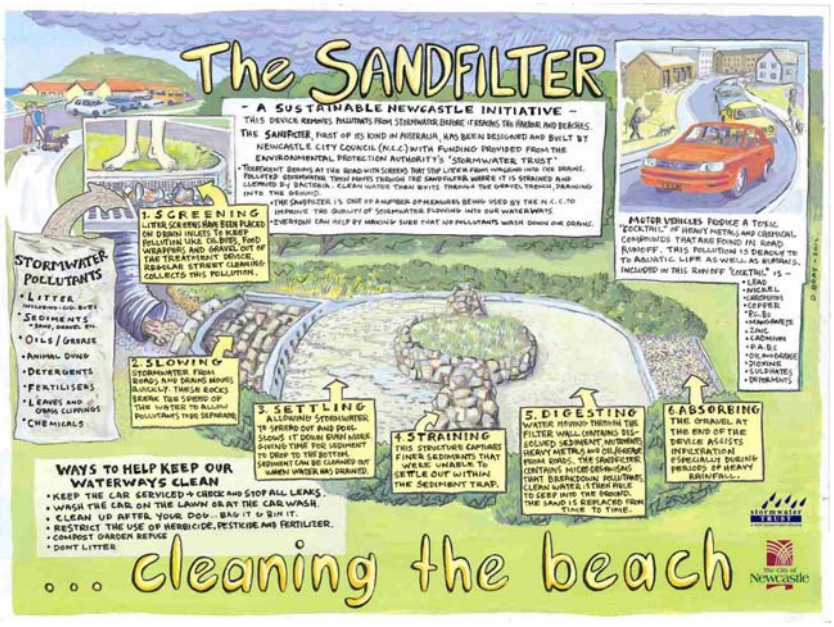
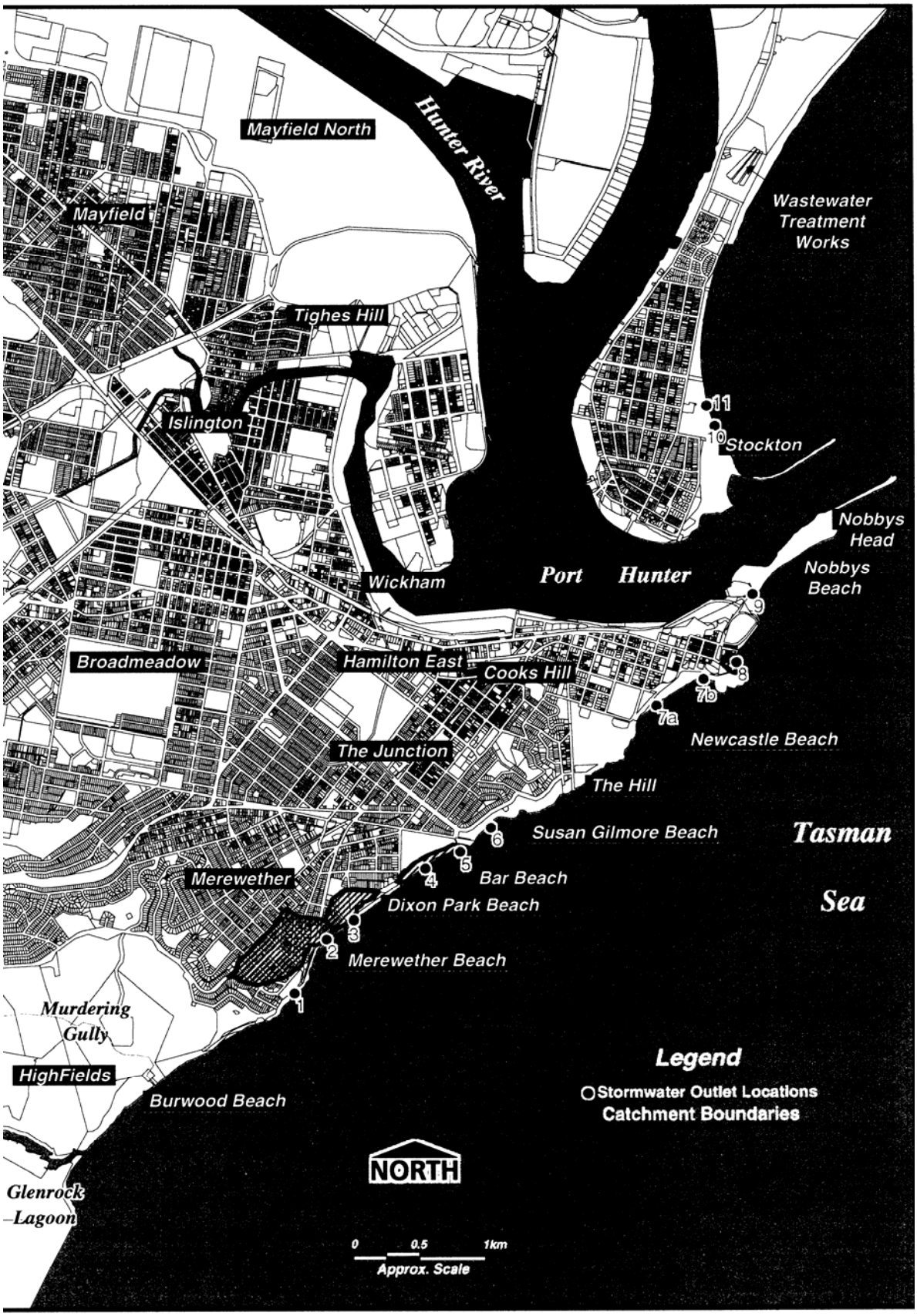


Photo 21:
Interpretative signage at the Nobbys Beach sandfilter.

Photo 22:
Merewether Clean Streets Clean Beach Project (2003-04) was the first of the coastal catchment, stormwater education projects sponsored by Hunter Water Corporation and conducted by Newcastle City Council. Surveys revealed significant changes in positive behaviours of local residents as shown here, 'pledging' to use their new brooms to sweep their gutters, as part of the Merewether 'Gutter Talk' education day.

Figure 13: Coastal Zone Stormwater Outlet Locations



Greenway and Purgatory Creek Catchments

Greenways Creek enters the Hunter River estuary about 5 or 6 km upstream of Hexham Bridge. The majority of the creek's catchment is used for rural pursuits, however there are large areas of bushland and some significant urban areas.

Woodberry, Beresfield and Thornton all fall within the catchment, which extends south through bushland to Black Hill. The catchment has an area of 5340 hectares.

Scotch Dairy Creek and Weakley's Flat Creek are the major tributaries that run into Woodberry Swamp, which in turn is drained by Greenways Creek. Woodberry Swamp is a large feature at the bottom of the catchment and is listed as a SEPP 14 wetland.

Land use of the catchment since 1966 is shown in table 15 below.

Table 15: Landuse and Development Since 1966

Land Use	1966 (%)	1975(%)	1993(%)	1998(%)
Bushland	44%	37%	33%	31%
Poultry Sheds	0%	4%	4%	4%
Urban General	2%	7%	10%	12%
Industrial	1%	1%	1%	5%
Grazing & Rural Residential	40%	40%	40%	34%
Cropping	4%	4%	4%	4%
Wetlands	9%	7%	8%	8%

The catchment that existed within Greenways, 4-Mile and Millers Forest catchments had a population of 28,000 in 1998. The main population centres in the catchment are Thornton, Beresfield and Woodberry. Large industrial areas are located at Thornton and Weakleys Flat, which is currently being expanded.

The main agricultural pursuit in the catchment is grazing, however there is also a large chicken farming operation in the upper catchment.

Two types of flooding occur in the catchment. Flooding from the Hunter River and local catchment flooding.

The construction of levees along the Hunter River has protected the floodplain areas from nuisance flooding associated with small, frequent Hunter River floods as well as from tidal surges. The flood drains constructed in association with the levees also provide a mechanism for drainage of localised flooding / runoff from the floodplain. The agricultural productivity of the floodplain is, therefore, likely to have improved significantly as a result of the levees and drainage, however the altered hydrologic regime is likely to have had a significant effect on natural ecological processes.

Anecdotal evidence suggests that since the 1960's urbanisation of the catchment and silting of the flood drains have combined to increase the frequency and extent of inundation of low lying areas particularly in Woodberry Swamp.

The Newcastle Catchments Management Forum has recently extended its area of interest to cover Purgatory and Greenways Creek Catchments. Figure 3 indicates the Purgatory and Greenways Creek Catchments boundaries in relation to the Newcastle LGA boundary. It is envisaged that projects addressing various issues will be established, as funding becomes available, in collaboration with Maitland and Cessnock City Councils. The Newcastle Catchment Management Forum is currently recruiting a local representative from the area to participate in the process.

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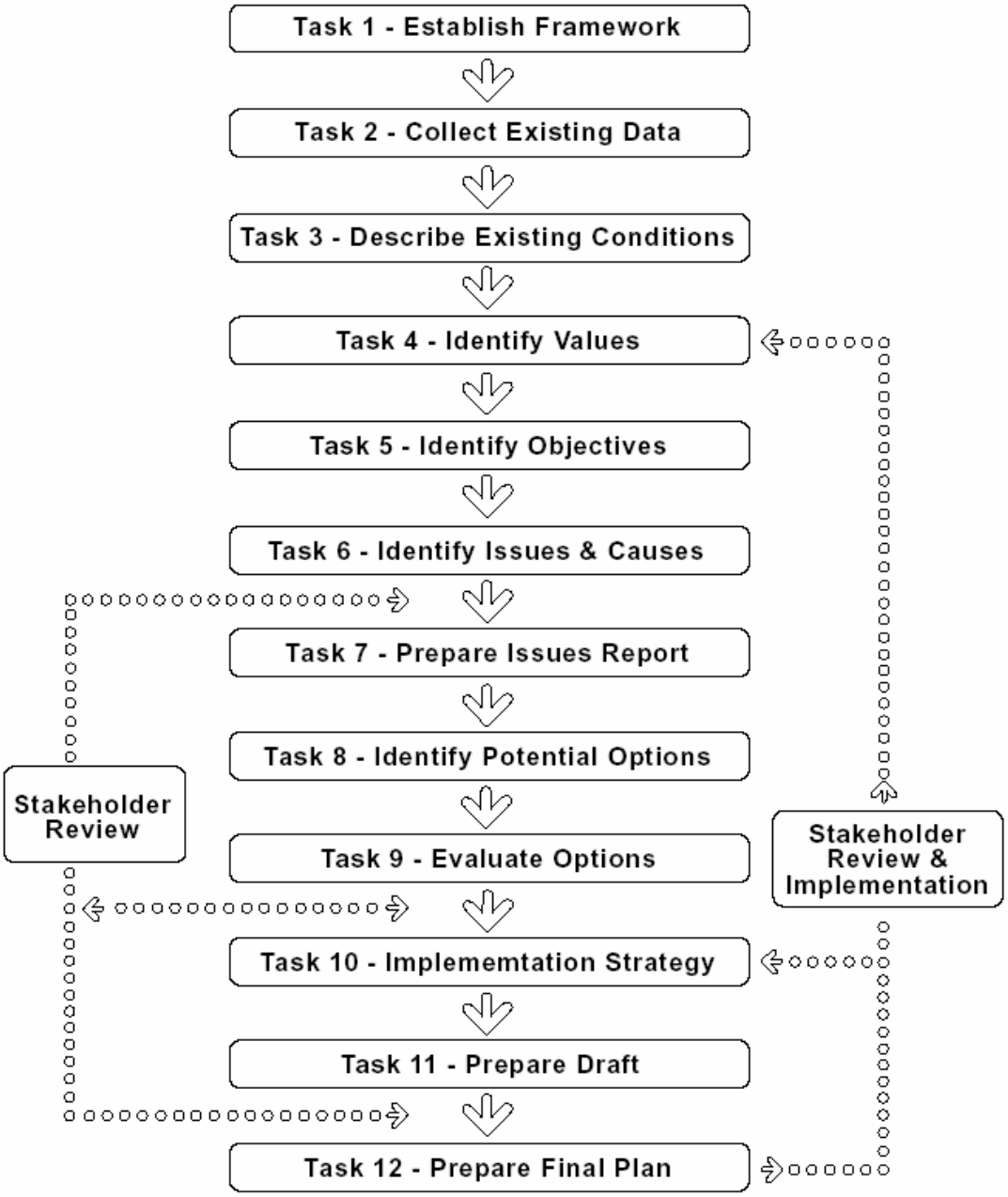
Appendix I

Figure A: **Flowchart of the planning phase process used in producing the Newcastle Stormwater Management Plan (adapted from EPA, 1997).**



Appendix II

Draft excerpt from the RTA Stormwater Environmental Improvement Plan, 1999.

The following excerpt provides some detail on the process that the RTA will instigate with respect to stormwater issues across all Council's and presumably applying to the actions identified by the RTA in Table 6 for the Newcastle district.

"**General Options:**

Many SMP's received from councils identified that the RTA should contribute to a number of common identified similar actions, such as:

- Development of a hazardous spill response
- Street Sweeping
- Identification of road runoff pollutants
- Continued participation in the SMP process
- In house training in stormwater management
- Review Maintenance Practices

In order to address these general options raised by council and provide a uniform approach by the RTA, in addressing stormwater management, the RTA will:

- Develop a work instruction for response to hazardous spills for implementation throughout the RTA.
- Further investigate the use of street sweeping as stormwater pollution control measure.
- The development of the RTA Water Quality Prioritisation and Cost Apportionment Methodology for Stormwater Management Plans has identified the road runoff pollutants and the indicative amount of those pollutants.
- Will continue to participate with councils in the SMP process by attending committee meetings and providing appropriate information.
- The Environment and Community Policy Branch of the RTA is developing a training course for RTA staff and contractors, in conjunction with Department of Infrastructure Planning and Natural Resources (DIPNR) in management of stormwater.
- Review current maintenance practices to reduce the adverse impact on stormwater.

In addition the RTA will identify what stormwater pollution control devices have been installed on State roads and develop appropriate maintenance schedules for them. The RTA will also investigate suitable options for treatment of runoff from State roads".

Appendix III

Hunter Water Corporation Stormwater Environment Implementation Plan

REF	ACTION	RESPONSIBILITY	FUNDING	TIME FRAME	ISSUES ADDRESSED	PROGRESS
New action	Develop and implement a water quality monitoring program for all stormwater catchments	HWC NCC HCMT	$20,000 each per year	1999/00 ongoing	Water quality monitoring	Specific details to be finalised by Hunter Water and Newcastle City Council
New action	Assist Council in community awareness programs highlighting the impact of stormwater pollution	HWC	$10,000 per year	1999/00 ongoing	Community understanding of stormwater pollution issues	Funding of $10,000 provided to Newcastle City Council towards education project.
New action	Participate in annual reviews of the Stormwater Management Plan and the Implementation Strategies	HWC	Incorporated in recurrent budget	Jul 00 – ongoing	Stakeholder commitment	Will continue to be undertaken in conjunction with Council and other stakeholders.
Existing commitment	Continue HWC funding commitment to stormwater channel maintenance	HWC	$300,000 per year	1999/00 ongoing	Sediment and litter removal	Ongoing maintenance of stormwater system including pollutant and sediment removal, rehabilitation and ground maintenance.

REF	ACTION	RESPONSIBILITY	FUNDING	TIME FRAME	ISSUES ADDRESSED	PROGRESS
Existing commitment	Provide Council with water quality monitoring data collected by Hunter Water for sewer catchment licensing	HWC	Incorporated in recurrent budget	Jul 99 – ongoing	Stakeholder commitment	Information is provided periodically and as requested.
Existing commitment	Participate in catchment management committees such as Newcastle Catchment Management Forum and NCC Coastal and Estuary Committees	HWC	Incorporated in recurrent budget	Jul 99 – ongoing	Stakeholder and community management of stormwater issues	The Corporation is committed to continued representation on the nominated committees.
Existing commitment	Continue to support community education and participation through the Streamwatch Program	HWC	$8,000 per year	Jul 99 – ongoing	Community understanding of stormwater pollution issues	HWC provide funding to HCMT towards Streamwatch officer salaries and supply of equipment. (Bruce Petersen)
Existing commitment	Provide training to Hunter Water officers in erosion and sediment control principles and methods.	HWC	$5,000 per year	Aug 99 - ongoing	Erosion and sedimentation	An internal training course (Course No. 50) is provided for HWC employees.

Appendix IV

Abbreviations

- **AMEIF** Australian Municipal Energy Improvement Facility
- **ANZECC** Australian & New Zealand Environment & Conservation Council
- **BOD** Biological Oxygen Demand
- **BPPP** Business Pollution Prevention Program
- **CEPA** Commonwealth Environmental Protection Authority
- **CGC** Councils Community Greening Centre
- **CP** Community Partnerships (Newcastle City Council)
- **CS** City Strategy (Newcastle City Council)
- **CSP** City Services & Presentation (Newcastle City Council)
- **DA** Development Application
- **DCP** Development Control Plan
- **DE** Development and Environment (Newcastle City Council)
- **DEC** NSW Department of Environment and Conservation (former Environmental Protection Authority (EPA) and National Parks and Wildlife Service (NPWS)
- **DIPNR** NSW Department of Infrastructure, Planning and Natural Resources (former Department of Land and Water Conservation, Department of Urban Affairs and Planning and Environmental Protection Authority)
- **EL** Environment Levy
- **EMS** Environmental Management System
- **ESD** Ecologically Sustainable Development
- **GPT** Gross Pollutant Trap
- **HIA** Housing Institute of Australia
- **HCRCMA** Hunter-Central Rivers Catchment Management Authority (former Hunter Catchment Management Trust)
- **HIA** Housing Institute of Australia
- **HWC** Hunter Water Corporation
- **LGA** Local Government Area
- **LHCCREMS** Lower Hunter & Central Coast Regional Environmental Management Strategy
- **LMCC** Lake Macquarie City Council
- **MBA** Master Builders Association
- **MCC** Maitland City Council
- **NCC** Newcastle City Council
- **NEMP** Newcastle Environmental Management Plan 2003
- **NPC** Newcastle Port Corporation
- **NSW** New South Wales
- **RTA** Roads and Traffic Authority
- **SEIP** Stormwater Environment Improvement Program – Hunter Water Corporation
- **SEO** Stormwater Extension Officer – Hunter Region
- **SMP** Stormwater Management Plan
- **SRA** State Rail Authority
- **TCM** Total Catchment Management
- **TCTCM** Throsby Creek Total Catchment Management
- **TWC** The Wetland Centre
- **UWCM** Urban Water Cycle Management
- **WSUD** Water Sensitive Urban Design
- **TAFE** Technical and Further Education
- **TCM** Total Catchment Management
- **TLC** Throsby Land Care

Appendix V

Newcastle Stormwater Management Plan 2000 Action Plan delivery - status report as at June 2003

Ref No.	Action	Status report	Status	Responsibility
City Wide Actions				
01	Continue to refine and implement a capacity building program for Council officers involved in activities that impact the urban water cycle management, particularly stormwater.	LHCCREM'S EPA 4th rnd Stormwater Trust Grants will develop and implement training programs to improve the capacity of council officers to manage various aspects of urban water cycle utilising WSUD principles should be available for implementation at the end of the 2003. Council will also deliver a series workshops, covering priority operational areas of Council, in addition to the LHCCREM's program. Participation in industry competency programs including TAFE Stormwater Training & SIA workshops is also being undertaken.	Complete & ongoing	LHCCREMS NCC: Development & Environment (D&E) City Strategy (CS) City Services &Presentation (CSP) Training
02	Community education displays and workshops – events based eg Summerhill community garden site, Greening Centre, Figtree Place, Ecohome and Water Week.	Good "stormwater/ creek, bushland &/or wetland neighbour" behaviour now all covered in displays that are available for Council community facilities.	Ongoing	NCC: Summerhill facility D&E CCS Community Development (CD) CSP

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City Wide Actions				
03	Develop and implement the Newcastle Urban Code - Stormwater	The Newcastle Urban Code (now know as Newcastle Consolidated DCP) is continuing to evolve, incorporating urban water cycle and stormwater considerations for the City that will be considered by Council in November 2003 including: UWCM policy Flood policy and atlas mapping Flood DCP 55 Stormwater DCP 50 for development and redevelopment incorporating Erosion & Sediment Prevention objectives Newcastle Stormwater Management Plan 2003 revision The policy package implications for development and natural resource management will also be considered within the revision of LEP in September 2004.	Complete and ongoing	NCC: CS D&E CS CSP Task Force NCC: CS D&E CS CSP Task Force
04	Review of water cycle considerations	Council has made a major investment in the development of a policy set that recognizes the systems based approach required to consider the full range of impacts across all functional areas of Council in the management of water in the City. The policy package to be considered by Council in March 2004 incorporates that milestone areas of flood, stormwater and water efficiency considerations where policy has been fully assessed as well as highlighting the environmental flow issues that require future policy development..	Complete and ongoing	NCC Task Force that includes: D&E CS CSP Community Partnerships (CP) Training
05	Erosion and Sediment Control DCP	Current development of DCP 50 stormwater for all new & redevelopment in the City incorporates Erosion and Sediment prevention direction for development. As part of the Environment Levy (EL) an erosion and sediment control compliance officer as well as training and awareness raising for industry and council staff will begin in 2003 and will be ongoing for duration of EL (2007).	Complete and ongoing	NCC: D&E CS Task Force

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City Wide Actions				
06	Council and Hunter Water Corporation stormwater management standards for new and redevelopment.	Council and Hunter Water Corporation have worked cooperatively on many demonstration projects since 1999. Council have progresses the development of DCP 50 – stormwater containing water quality standards and guidelines that can be used to progress the development of shared organisational standards/ guidelines for stormwater management at new and infill development sites.	Ongoing	NCC: CS D & E HWC
07	Ecological accounting framework for natural asset management	The LHCCREMS ecological accounting framework for natural asset management project has not progressed.	Discontinued	LHCCREMS
08	Refine and improve NCC Operations- Stormwater	Council's Stormwater Task Force has completed an audit process for all Councils functional areas in relation to stormwater activities that includes for example parks &gardens, street cleansing, road maintenance, pit & drain cleansing & fleet management, education, companion animal program, DA processes etc. The Stormwater Taskforce identified E&S prevention as the priority areas for focused attention and developed a three-year priority work program to address the issues. The Senior Management Team has endorsed the workplan for implementation.	Complete & ongoing	NCC Task Force
09	Develop and implement a Catchment Audit Program for high-risk commercial premises & recreational facilities \landuses	Council has developed a stormwater pollution audit program targeting high-risk landuse throughout the catchments. The Griffith Road light industrial area of Throsby Ck catchment was targeted initially. Program work plans and materials were subsequently modified and expanded to cover all pollution related issues and utilised in the Business Pollution Prevention Program (BPPP) in the Warabrook Wetlands Project in 2002-03. BPPP work plans and materials have been produced for use city-wide. To date both Wickham and Maryland Industrial areas have been audited. Over 100 audits have been completed in this program to date.	Complete and ongoing	NCC: D&E CD CP

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City Wide Actions				
10	Continue to refine a comprehensive Stormwater Asset register for all catchments	Stormwater treatment devices & infrastructure have been audited through on-ground inspection and incorporation via mapinfo as one of Councils GIS layers and as part of the major asset preservation program (MAPP) database. Maintenance requirements and pollutant trapping rates have also been recorded.	Complete and ongoing	NCC: CS CSP
11	Street cleansing program across all catchments	Cleansing Program covers all catchments commercial/industrial large and local centres - includes road & footpath sweeping and pit maintenance Street cleansing in Charlestown commercial area at headwaters Throsby Creek requires greater collaboration with LMCC Review of service level and management program incorporating product benchmark assessment Review of gross pollutants (& associated sediment /heavy metals) to ensure "hot spots" identified in SMP are targeted.	Continuing	NCC: CSP Task Force Lake Mac CC NCC - CSP NCC – CSP & CS
12	Management of drainage management system.	Use of close circuit TV to identify problem areas and target stormwater hotspots – incorporate opportunities for stormwater quality improvements in all works. This information has been very valuable in implementing WSUD drainage works. In addition we have also used the video footage to produce "draincam" videos that are used in community awareness raising events. The footage can "unearth" connections between homes & streets and the drainage line and creeks for local residents.	Complete and ongoing	NCC: CSP CS CP

Ref No.	Action	Status report	Status	Responsibility
City Wide Actions				
13	Develop a treatment technique document for Newcastle catchments including existing treatments, target pollutants, efficiencies and guide to physical constraints to applying devices.	Council has documented all existing treatment devices, new infrastructure as it comes on line and maintenance visits & issues within Councils GIS asset register. Development of a guide to devices for Newcastle catchments has not been completed. The NSW Environment and Conservation (formerly NSW EPA) has contracted the preparation of a similar document for distribution to NSW local government.	Complete	NCC: CS CSP D & E
14	Implementation of the Newcastle Companion Animals Management Plan.	The program has delivered 15 “leash free” areas across the City and the installation of associated dog poo bag dispensers and bins for disposal of pet droppings. Responsible pet ownership initiatives including free chipping days, dung beetle releases, and distribution of 1,000’s of dog pooch pouches to dog owners as well as dog tag engraving have been delivered at myriads of events city-wide.	Complete and ongoing	NCC: D & E CP

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City Wide Actions				
15	Develop and implement an integrated Urban Water Cycle /Stormwater Education Program	An integrated community stormwater education program has been delivered through the resources of the Stormwater Education in Newcastle Catchments (SEINC) project in last three years in conjunction with Councils Black Duck and Warabrook EPA grants projects. The SEINC project focussed on cigarette butt litter during 2002 training enforcement /blitz officers; delivering butt out containers to businesses located at major employment hubs throughout the City; working with other local government at a regional level to deliver integrated mass media campaigns; and installing cigarette butt dispenser across Councils facilities. During 2000-01 SEINC delivered stormwater community awareness raising initiatives including shopping centre displays and student "Catchment Crawls" through to cooperative promotion of anti-litter message with Knights sponsorship program at Energy Australia Stadium Knights home games. Coast & Clean Seas and NHT funding was used to provide a backdrop off TV, radio & newspaper communication citywide. Project partners are NCC, Hunter Water Corporation and Newcastle Catchment Management Forum (HCMT/TCMC).	Complete and ongoing	NCC City Strategy Community Development D & E HWC HCR CMA
16	Coordinate and conduct annual Newcastle Stormwater Forums	The inaugural Newcastle Stormwater Forum was held 28/2/2000 and repeated in 2001, 2002 and 2003. The Forums have been used as a valuable opportunity to reconnect those stormwater related managers in the City in regard to the SMP. However value adding to the gathering has occurred through provision of workshop sessions learning about new management techniques in structural treatments such as street inlet technology workshops through to new thinking in art of community behavioural change management.	Complete and ongoing	NCC: Task Force CS HWC Lake Mac CC & other HROC partners HCR CMA /NCMF NPC Community

Ref No.	Action	Status report	Status	Responsibility
City Wide Actions				
17	Develop and implement a water quality-monitoring program for all catchments	In association with the Streamwatch and Waterwatch programs already successfully underway in the Hunter, NCC has worked with HCMT and DIPNR staff to trial a number of water quality monitoring sites and methodologies. NCC has used these trials to refine site criteria and promotion process for monitoring waterway health indicators through the bi-annual waterbug surveys and regular water quality at the same sites. NCC has initially targeted 30 sites for the first year of the program in 2003-04. The database developed will be logged onto existing DIPNR web facilities as well being utilised in development of a City-wide waterway health map and database available through the Urban Water connection on Council website.	Complete and ongoing	NCC HWC HCR CMA DIPNR
18	Provide interpretative signage as part of Councils Urban Water program delivery	Council has provided interpretative signage in project areas such as: Nobbys to interpret the sandfilter device; at Kotara to explain the causal relationships, issues and function of the baffle box; in Warabrook wetlands to explain the issues, causes and solution for blue green algae problems of the ponds; and at the Community Greening Centre to interpret the new infiltration based car park treatment. NCC is also working with local aboriginal community members to ensure that the continuing suite of environmental interpretative signage includes indigenous issues surrounding the site and/or issue set being addressed. The suite is planned to expand and include other Community Greening Centre sites, Blackbutt Reserve stream rehabilitation works, Lambton Ker-rai renaturalisation project and Kullaibah Reserve alternative drainage line treatment. HWC will continue to erect community awareness and safety signs within the channels in consultation with city stormwater managers.	Complete and ongoing	NCC HWC HCR CMA

Ref No.	Action	Status report	Status	Responsibility
City Wide Actions				
19	The RTA with assistance from Council will formulate a stormwater action plan.	High-risk areas have been identified. Progress on this action has been limited. Funding opportunities will be investigated.	Ongoing	NCC RTA

Ref No.	Action	Status report	Status	Responsibility
Ironbark Creek Catchment				
20	Implement Wallsend Instream Enhancement Project – Phase I Phase II	Wallsend Instream Enhancement Program is an urban revitalisation project where the Phase I consultancy (WBM), involving preliminary concept design and feasibility testing for the project has been completed. An internal stakeholders group, reference group and steering committee will be established to ensure the effective development of a Plan of Management (POM) for this reach of Ironbark Creek in the Wallsend precinct of Ironbark Creek catchment is completed, utilising all information compiled to date. Landscaping/ tree planting, infrastructure works, weed removal from Creek bed and banks has been delivered during 2002 – 2003. Funding opportunities for implementation of Phase II will be investigated in line with the development of a POM for the site. The POM process will be launched with a community creek celebration day in Wallsend Park in February 2004 where a range of family activities and information sharing will occur.	Complete and ongoing Require additional substantial resource post POM delivery	NCC Stakeholders group Reference group HCR CMA /NCMF HWC Recreational/retail groups Interest groups NCC CSP CS

Ref No.	Action	Status report	Status	Responsibility
Ironbark Creek Catchment				
21	Hexham Swamp Rehabilitation Program	Includes opening of the Ironbark Creek floodgates to allow re-establishment of tidal zone habitat across the Swamp and removal of farming pressures from the swamp through voluntary buy back processes. Improvements to biodiversity, habitat, fish nursery stocks etc are envisaged for the project. Water quality monitoring is being conducted by HCMT through Manly Hydraulics. Such changes in the receiving water of the Ironbark Creek catchment will impact on stormwater treatment train decision making for the whole catchment.	Complete and ongoing	HCR CMA coordination Community Agencies
22	Develop sediment management strategy- Ironbark Creek	A Management Strategy that addressed the issue of erosion and sediment transport within the catchment was prepared as part of the review of the Ironbark Creek TCM Strategy being developed by the TCM committee.	2004	NCC City Strategy HCR CMA - NCMF HWC, SRA, others
23	The Wetlands Centre, Shortland - Stormwater treatment device installation	Council is working with the Wetlands Centre in order to address erosion and associated sedimentation issues impacting on the Wetlands Centre ponds from surrounding road/residential runoff. Works associated with drainage around Tuxford Park should be completed in 2004.	Ongoing	NCC CSP Wetlands Centre (ongoing maintenance)
24	Implement Phase II Wentworth Creek SMP - Performance, Monitoring & Review	Newcastle University in association with Council have designed and installed new monitoring sites throughout the catchment. 3 monitoring stations established to allow for the determination of site contribution to stormwater loads moving through the system where vandalised prior to effective data collection, in spite of high grade security measures used at the sites. Whilst the roving sampler was repaired, all the data takers & programs were stolen. The 4th more remote, green field area site is still operational and will provide valuable baseline data for the City. Project partners will review installation outcomes and the limited data collected to date, prepare alternative options and map a future course for project implementation.	Complete and ongoing	NCC: D & E CS CSP Summerhill Waste Management Facility Newcastle University

Ref No.	Action	Status report	Status	Responsibility
Ironbark Creek Catchment				
25	Ongoing implementation of the Blue Gum Hills Catchment Management Strategy	Ongoing implementation and evaluation of the Blue Gum Hills Catchment Management Strategy has included a review of the on-ground effectiveness of the Strategy conducted by WBM Oceanics. The final Report (2003) indicates that there have been significant negative impacts on Wentworth Creek and the Hexham SEPP 14 wetlands that constitute the receiving waters of the system as a result of the catchment urbanisation. The report will be considered by Council's Task Force and the community Environment Advisory Panel in the preparation of appropriate response to the recommendations. In addition to the Strategy review there has been a large volume of work generated by Council and DIPNR (formerly Planning NSW) in the review of scenarios locally for the Tank Paddock - Minmi corridor and regionally through the Thornton to Killingworth Corridor assessments. These will be valuable tools in providing effective review of future development scenarios for the Blue Gum Hills corridor.	Complete and ongoing	NCC: D&E CS Task Force NEAP Development interests Community groups

Ref No.	Action	Status report	Status	Responsibility
Throsby Creek Catchment				
26	Develop Throsby Creek Sediment and GPT Management Strategy	A Throsby Creek Catchment Gross Pollutant Report was delivered and used to run a cost benefit analysis for a number of constructed gross pollutant trapping scenarios across the catchment. Using the report, Project partners decided to construct a CDS unit at the confluence of the Lambton line and the main Styx Creek. The Lambton catchment had previous at-source controls and extensive community consultation processes run through a Council Stormwater Trust grant so it would complete the suite of initiatives for the catchment. At-source controls were also investigated in the Waratah Village shopping Centre where Permapave products where trialed. Whilst all gross pollutants where prevented from entering the stormwater system they failed to hold up under car traffic and they where removed. Product trials continue in the suburban shopping centre of Georgetown Road.	Complete. The modification to the CDS design will continue	HWC, HCR CMA , NCMF, NCC, DIPNR, TLC, CCS
27 **28**	Reduction of gross pollutants, erosion stabilisation.	The CCS grant was completed in 2003 and included installation of bed structures and bank erosion control structures within the creek line at Kotara Park. Councils baffle box installed downstream has also been successful in trapping sediment loads instream. The grant also enabled Council to trial a low-flow bio-remediation treatment for stormwater flows that had eroded open space and gas line infrastructures in the Styx Creek sub-catchment. The overland rock lined and landscaped flow path has proven to be an aesthetic and environmentally positive outcome.	Complete and ongoing	HCMT HWC DIPNR NCC HCR CMA NCC

Ref No.	Action	Status report	Status	Responsibility
Throsby Creek Catchment				
29	At Source Control program for commercial areas, high risk car parks facilities and erosion/ sedimentation sources within catchment	Council has successfully trialed the use of in-house designed kerb protectors and pit inserts, in association with street cleansing regimes, to produce cost-effective options for improving stormwater quality particularly in suburban retail precincts and high visitation areas. Lambton and Nobbys have been successful designs however ongoing maintenance issues including the removal of fines & grass clipping aggregation from protector screens, continues to limit the effectiveness of the devices. The pit basin design to treat hydrocarbons, sediment and gross pollutants in high turn over car parks such as the Energy Australia Stadium has also proven to be highly successful. Encouraging similar car park owners to retro fitting such devices have proven somewhat successful in the Warabrook wetland industrial estate. New development will be required to address pollutant loads by draft DCP 50 – Stormwater, being considered by Council in November 2003. Sediment and erosion point source control measures have been installed inline within Kotara and Black Duck Creek sub-catchments. Monitoring continues in association with ongoing policy development and interpretative environmental education signage.	Complete and ongoing	NCC: City Strategy City Services & Presentation HCR CMA HWC ISC Trust DEC (EPA Stormwater Trust)
30	Master Plan for Raspberry Gully (Styx Creek)	Complete design plans for the maintenance and development of the natural attributes of Raspberry Gully, including heritage interpretation trails, tree planting, weed control, drainage and stormwater treatment (upper reaches of Throsby Catchment).	Ongoing	Lake Mac CC NCMF
31	Improvements to stormwater drainage in the headwaters of Styx Creek	Drainage works by Lake Mac CC to provide improvements in stormwater velocity and quality as it moves through Sherburn Place residential area in headwaters of catchment, have been completed. Preliminary observation suggests the works are performing to specification.	Ongoing	Lake Mac CC NCMF

Ref No.	Action	Status report	Status	Responsibility
Throsby Creek Catchment				
32	Landcare and Bushcare group support and development	Council's Community Greening Centre (CGC) has developed and implemented volunteer training programs. The CGC provides the resources for greening Newcastle and the review of resourcing levels and requirements for delivery of Newcastle natural resource management program are currently being audited. This benchmarking process should provide the options and the vision for a model in urban greening for the City that is responsive to community and NEMP 2003 environmental priorities. The Landcare office in LMCC has coordinated groups in upper reaches of Styx Creek.	Complete and ongoing	Lake Mac CC NCC: City Services and Presentation
33 **34**	Upgrade Chin Chen Street boom – Throsby Creek catchment. Install floating boom in Mayfield Branch - Throsby Creek catchment	The two floating trash booms installed by HWC in Throsby Creek on Mayfield side of the TAFE and in Styx Creeks in Islington. Both traps have been commissioned and are trapping approx 10 cubic metres and 2 cubic metres of litter and organic debris as a monthly average respectively.	Complete. Maintenance, reporting & evaluation on ongoing basis	HWC
35	Arnold Street Reserve Stormwater improvement project	A technically feasible design outcome suitable to the local community is yet to be determined. Further work on issues of ASS and height of high tide/storm inundation in local streets is currently being resolved.	Ongoing	NCC HCR CMA Waterways

Ref No.	Action	Status report	Status	Responsibility
Cottage Creek Catchment				
36	Development of priority actions for Cottage Creek Catchment based on the Hunter Estuary Management Program studies	Councils Coast and Estuary Project Officer, as part of Hunter Estuary Management program, will include the determination of priority actions to address the stormwater quality in the catchment within the work plan.	ongoing	NCC CS
37	Cottage Creek GPT installation	HWC installed a floating trash boom immediately upstream of Wharf Road in Cottage Creek. Whilst the logistical constraints of the site and the effective trapping capacity of the boom has limited litter capture, HWC has managed to remove an average of 2 cubic metres of pollutants on a monthly average from reaching Newcastle Harbour.	Complete & ongoing	HWC
38	Link investigations of stormwater issues in the "Estuary Catchment" to the Hunter Estuary Management Program	The Hunter Estuary Processes Study is part of the Hunter Estuary Management Program and due to be completed in early 2004. Stormwater management issues relating to water quality, erosion & sedimentation and their sources have been identified and will be incorporated into the Estuary Management Study and Plan to be commenced in 2004.	Ongoing	NCC Other stakeholders
39	Incorporate the stormwater initiatives, defined for Purgatory Creek within the Maitland SMP, within Newcastle's implementation program.	The catchment of Purgatory Creek has been mapped and incorporated within the new total catchment management model established by the HCMT in 2003, in collaboration with Council. The new Newcastle Catchment Management Forum (NCMF) has also incorporated the Greenways Creek catchment in the northwest corner of the LGA so that all waterways moving through Councils area of responsibility has been captured under one management umbrella. Site inspections of catchment issues for both creeks have already been conducted through the NCMF. Outcomes contained within Maitland & Cessnock CC's SMP's for the both Purgatory & Greenway Creek catchments will be incorporated into NCC's implementation program as well as future actions identified by Council and the NCMF.	2003 and ongoing	Maitland CC Cessnock CC NCC Task Force CS

Ref No.	Action	Status report	Status	Responsibility
Cottage Creek Catchment				
40	Link investigations of stormwater issues in the "Coastal Catchments" to the Newcastle Coastal Management Program	Stormwater issues within the coastal zone were incorporated in the development of the Coastal Management Study and Coastal Management Plan with priority actions for Coastal Catchments in the City determined. Such issues where also incorporated within the NEMP 2003. Implementation is occurring through the Newcastle Coastal Management Program.	2002/03 and ongoing	NCC C&EMC Task Force Others stakeholders as required
41	Bathers Way Project	The Project involves extension of the Great North Walk along the coastal margin of the City, incorporating stormwater treatment works and habitat protection options along the length of the trail.	ongoing	NCC Local groups
42	Nobby's Precinct Stormwater Improvement Program.	This program has been successfully implemented with all stormwater pollution now removed from Nobbys Beach. Newcastle east residents groups, Dunecare, local recreational users and facilities management are all extremely pleased with the outcomes. The success of the project has been reflected in Nobbys Beach being the recipient of State KAB Clean Beach awards over last two years. Program legacies include: Dunecare groups, dog poo disposal facilities, clean up groups, cleaning regime for street and sandfilter devices incorporated into Council maintenance budgets.	Complete and ongoing	NCC DEC (EPA Stormwater Trust Grant) DIPNR NPC community groups