CITY OF GOLDCOAST.

Broadwater Nutrient Investigation

Outcomes and recommendations – version A

12/02/14

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Scientific Advisory Panel
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Conceptual diagrams have been created by Kate Hodge, Hodge Environmental.

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1. Introduction

In 2012 in the Healthy Waterways Annual Ecosystem Health Report Card (www.healthywaterways.org), the Broadwater received a C- grade. This was a significant drop from the B it received in 2011. At the launch of the Report Card in October 2012, Mayor Tom Tate committed to improve the Broadwater Report Card grade to a B+ in two years. As a result of this commitment, Gold Coast Water and Community Services Catchment Management Unit have undertaken the Broadwater Nutrient Investigation (BNI) in order to understand the 2012 grade decline and identify and prioritise potential management actions to improve the grade.

The BNI aimed to investigate the nature and sources of nitrogen loads to the Broadwater. The investigation focussed on nitrogen loads and sources. This focus was a result of the parameter with the significant decline in compliance, namely sewage plume mapping. Sewage plume mapping is the name used in the Healthy Waterways Ecological Health Monitoring Program (EHMP) to refer to a method that indicates the sources of plant-available nitrogen and in particular sewage and processed nitrogen sources. Additionally, nitrogen is considered the key limiting nutrient in the waters of Moreton Bay and its estuaries. The project involved consolidating existing knowledge, additional sampling and monitoring and conceptualising our understanding of the Broadwater. Key nitrogen sources that impact on the Broadwater have been identified and priority management areas to reduce these have been developed. Priority knowledge gaps have been identified. Addressing these will further our understanding and enable us to prioritise the most cost-effective management actions.

An important final stage of the project is the communication of the outcomes to stakeholders within the City and in the broader scientific community. Following from these investigations the relevant stakeholders can collaboratively identify the most cost-effective actions within management areas to reduce nitrogen inputs and contribute to returning the Broadwater to a B+ grade.

2. About this document

This document is intended as a tool to communicate the outcomes and recommendations of Phase one of the Broadwater Nutrient Investigation. It is one of three versions that have been created for various stakeholders. This version (A) is a summarised version, more detailed versions (B and C) are also available.

3. A collaborative investigation

The project has been a collaborative project between Gold Coast Water and Community Services – Catchment Management Unit. Additional to the project team the investigation has drawn on the expertise of numerous other officers from both directorates, other directorates within the City and a Scientific Advisory Panel.

3.1 Project outline

The project involved developing and summarising our understanding of the system and the nitrogen inputs to the system including an intensive sampling event and additional hydrodynamic and water quality modelling to complement existing data. This understanding as well as recommended management areas and knowledge gaps is to be communicated to relevant stakeholders within and external to the City.

The investigation was carried out in three streams

1. Consolidation of knowledge of the Broadwater system.
2. Conceptualisation of understanding of the Broadwater system.
3. Sampling and monitoring of the Broadwater system.

4. Project outcomes – system understanding

4.1 Understanding the Broadwater

The Broadwater system is a shallow, semi-enclosed coastal lagoon system with exposed sandbanks, mangrove islands and seagrass beds. The Broadwater system is well-flushed system from two ocean exchanges, Jumpinpin Passage (via Southern Moreton Bay) and the Gold Coast Seaway (see Figure 1). The extent of flushing and relative importance of the two entrances is largely dependent on the tidal cycle: spring or neap. Residence time is very low relative to other coastal bay systems, with a maximum of five days for the Broadwater while at the mouth of the Brisbane River in Moreton Bay residence time is about 65 days.

The predominant nitrogen sources in the estuarine sections of the rivers entering the Broadwater are stormwater run-off from the extensive urban and road areas, particularly in the Coomera and Nerang Rivers. Inputs from rural-residential and forested areas dominate in the upper catchments of these rivers. Animal grazing and agriculture account for a greater percentage of the nitrogen loads in the Coomera and Pimpama Rivers than in the Nerang River catchment (Figure 1).

The northern part of the Broadwater and southern Moreton Bay support large areas of seagrass, and areas of seagrass than at the river mouths. These seagrass beds and mangrove forests are likely to be important in processing of nitrogen, an important ecosystem service. They also provide other ecosystem services such as habitat and food for fish and other marine animals as well as buffering the effects of storm and swell events.

Nitrogen concentrations in the rivers and the Broadwater are compared with Water Quality Objectives (WQO), specific water quality targets that have been developed for each particular waterway for an array of parameters. The strong flushing maintains good water quality with low nitrogen concentrations in almost all areas of the Broadwater. Baseflow (less than 30 millimetres rain/day) occurs on average 355 days of the year (Figure 2).

Riverine flows are low comparative to the strong flushing and daily nitrogen loads from the rivers to the Broadwater. Thus nitrogen plumes are generally not evident from the mouths of these rivers. There are however, areas in the rivers where WQOs are not met, these could be areas where there is low flushing and where nitrogen may accumulate in baseflow periods. These may then be flushed during rainfall.

Total catchment nitrogen loads for an average rainfall year (2006) have been modelled as part of the Gold Coast Sustainable Loads Study at 555 tonnes. The Nerang River accounted for almost half of this nitrogen load, 276 tonnes, with the Coomera River accounting for approximately 30 per cent (169 tonnes). Nitrogen loads from the Pimpama River are low compared to the other major rivers.

The City has four sewage treatment plants (STPs), with excess recycled water that is not re-used discharged at the Gold Coast Seaway via two discharge systems. This discharge is in association with the ebb tide, in order to minimise the amount that enters the Broadwater. Of the approximately 135 tonnes nitrogen discharged at the Gold Coast Seaway annually, modelling suggests only 2.3 tonnes nitrogen enter the Broadwater, the remaining is effectively flushed out to sea. Nitrogen inputs to the Broadwater from the City's reticulated sewerage network and excess recycled water discharge system are very low compared to total catchment loads.

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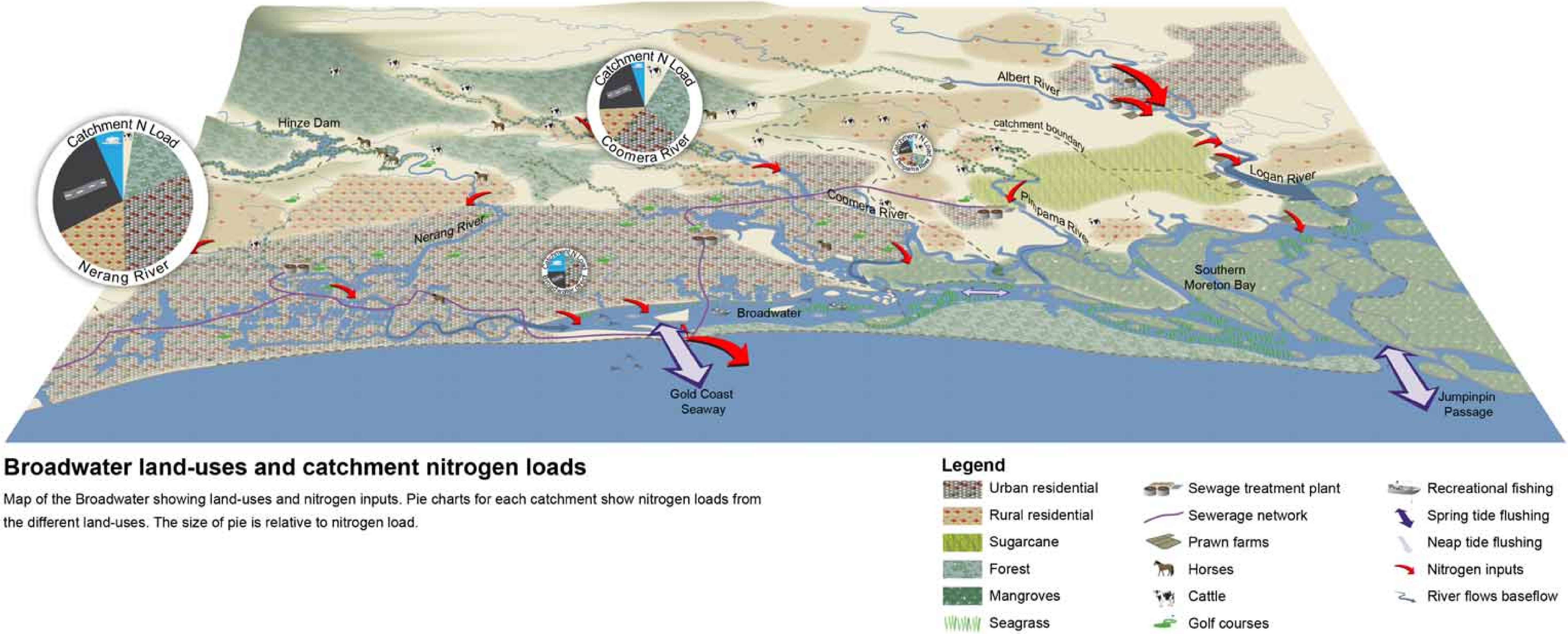
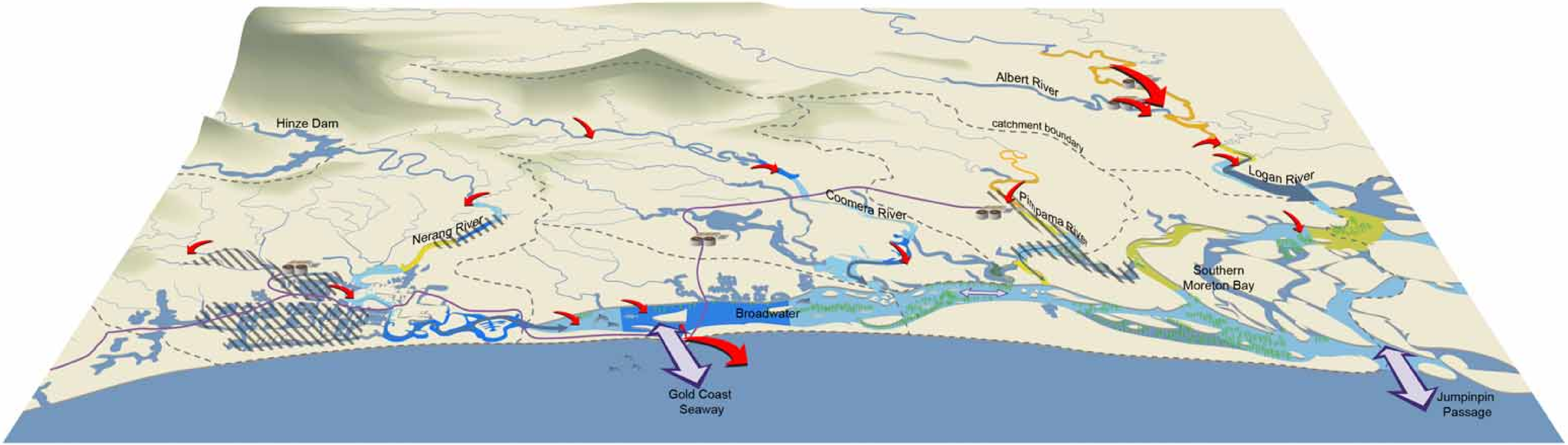


Figure 1: Broadwater land-uses and catchment nitrogen loads



Broadwater nitrogen map during baseflow conditions (0-30mm rain/day)

Rates of compliance with Water Quality Objectives for nitrogen are shown for the Broadwater and Southern Moreton Bay and for the estuarine reaches of the Logan, Pimpama, Coomera and Nerang Rivers. The river baseflows are shown and exchanges with the ocean aduring spring and neap tides represented. Areas in the rivers where residence times may be higher and flushing rates low are also marked.

Legend

- Seagrass
- Sewage treatment plant
- Sewerage network
- Spring tide flushing
- Neap tide flushing
- Nitrogen inputs
- River flows baseflow

Water quality objectives
- meets almost always
- most of the time
- some of the time
- almost never
- Areas with low flushing

Figure 2: Broadwater nitrogen map – baseflow

4.2 What happens when it rains

Following rainfall events, the flows from the three river systems (Pimpama, Coomera and Nerang Rivers) to the Broadwater as well as from the Logan River to Southern Moreton Bay increase dramatically, leading to increased nitrogen concentrations particularly in the northern section of the Broadwater. Concentrations exceed WQOs in a large proportion of the Broadwater as well as in the various channels of Southern Moreton Bay (Figure 3). The most marked nitrogen plume is from the Coomera River. Flows south from the Logan River appear also to flow into the northern section of the Broadwater. The spatial and temporal extent of these river nitrogen plumes are dependent on the size of the rainfall event, catchment characteristics as well as the hydrodynamics of the receiving system at that particular time.

Compliance for nitrogen concentrations with WQOs in the Broadwater is considerably reduced after 30 millimetres of rain, particularly in the northern Broadwater. Rainfall events of this magnitude occur in the Gold Coast catchments on average 10 days per year. Such rainfall events result in a 20-fold increase in the daily nitrogen load to the Broadwater.

Despite these high rainfall-associated nitrogen loads, the Broadwater system appears able to record low nitrogen concentrations at other times of the year, largely as a result of the powerful flushing effects of Jumpinpin Passage and the Seaway. Although the short residence time in the Broadwater means that the nutrients appear fairly rapidly flushed, catchment nitrogen sources are evident in the nitrogen signatures of the mangroves at the river mouths and the Broadwater. This suggests these sources are playing a role in the Broadwater ecosystems, however this is not well understood.

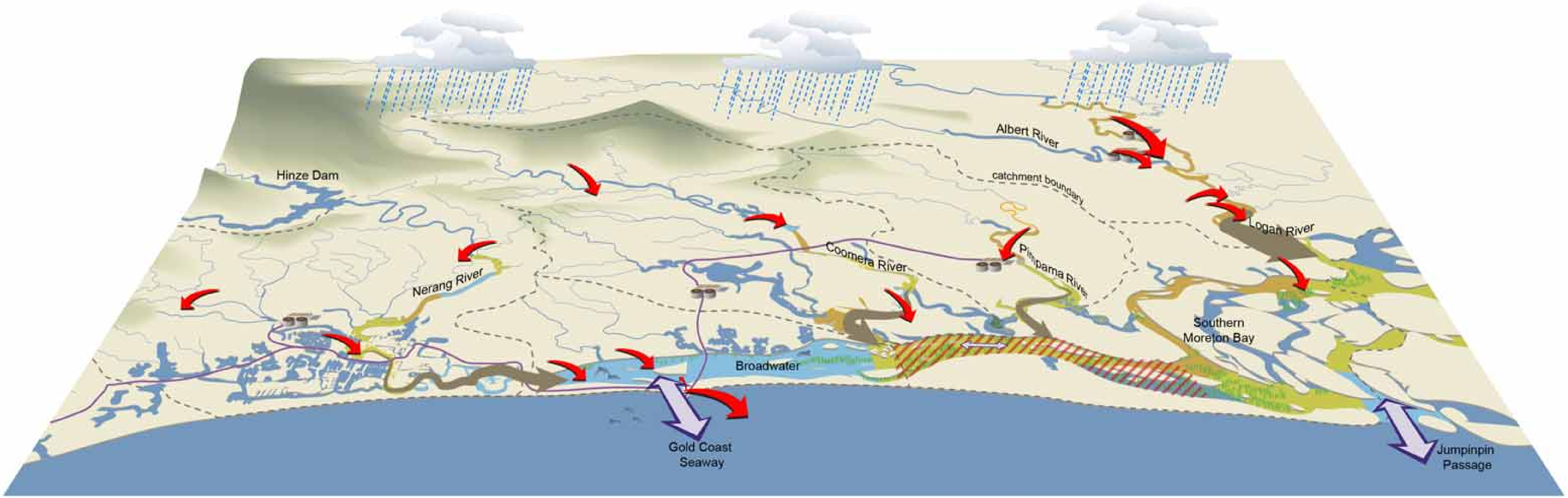
An area in the northern Broadwater has been identified as an ‘Impact Risk Zone’ as this area receives considerable loads of nitrogen and sediments when it rains from the Coomera and Pimpama Rivers and flushing may be lower than in other parts of the Broadwater. The river plumes that are associated with rainfall also carry sediments that can smother seagrasses. The combined effects of nutrients and sediments are a concern for the ecosystems in this area that are important in maintaining the health of the Broadwater. Thus, a greater focus on the ecosystem health of this area could enable it to be used as an indicator of the overall health of the Broadwater system.

A conceptual diagram of our understanding of the system is presented in Figure 4.

4.3 Understanding the report card grade

The Healthy Waterways Report Card grades for the Gold Coast estuaries, catchments and the Broadwater have been largely consistent, exhibiting fair to good ecosystem health since the first grades in 2003. The decline in waterway health reported for the Broadwater in 2012, from a B in 2011 to a C- in 2012 was found to be a result of sampling immediately after a high rainfall event and its effect on one parameter, sewage plume mapping. Thus the result reflected the health of the Broadwater at a time of high catchment inputs combined with a period of lowest tidal flushing.

In 2013, the Broadwater grade improved to a B-. This is a considerable improvement, however the mapping of nitrogen sources has not recovered to full compliance. Thus, there is still work to be done to ensure the grade lifts to a B+ by 2014.



Broadwater nitrogen map following rainfall events (>30mm rain/day)

Rates of compliance with Water Quality Objectives for nitrogen are shown for the Broadwater and Southern Moreton Bay and for the estuarine reaches of the Logan, Pimpama, Coomera and Nerang Rivers. Rates of compliance are reduced compared with baseflow conditions. The river flows following rainfall are shown and exchanges with the ocean during spring and neap tides represented. An area in the northern Broadwater has been identified as an 'Impact Risk Zone' as this area receives considerable loads of nitrogen and sediments when it rains from the Coomera and Pimpama Rivers and flushing may be lower than in other parts of the Broadwater.

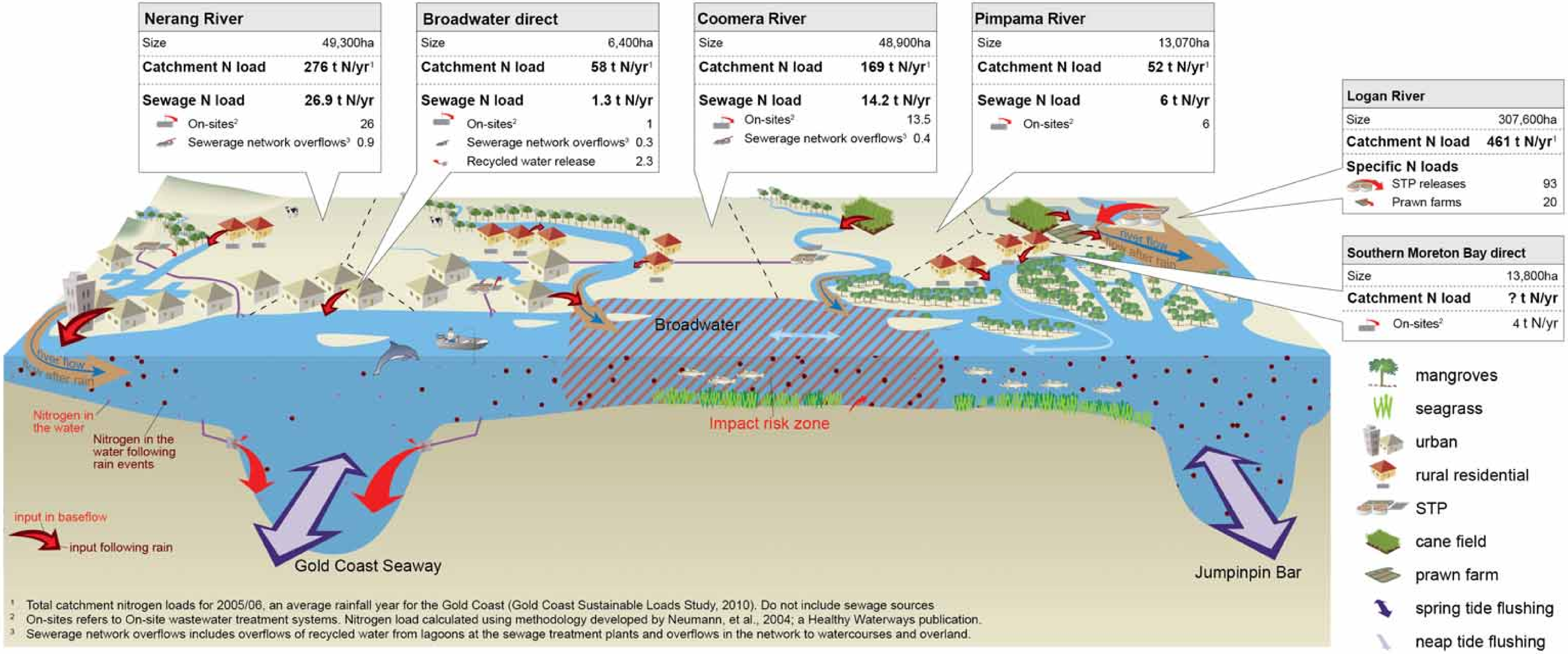
Legend

- Seagrass
- Sewage treatment plant
- Sewerage network
- Spring tide flushing
- Neap tide flushing
- Nitrogen inputs
- River flows rainfall event

Water quality objectives

- meets almost always
- most of the time
- some of the time
- almost never
- Impact risk zone

Figure 3: Broadwater nitrogen map – when it rains



Broadwater conceptual diagram for nitrogen

Conceptual diagram that represents schematically the key issues, loads and processes for nitrogen in the Broadwater. Total catchment nitrogen loads are presented as well as sewage nitrogen loads; conditions under baseflow conditions and following rainfall events.

Figure 4: Broadwater conceptual diagram for nitrogen

5. Project outcomes - recommendations

Priority management areas have been identified. The Scientific Advisory Panel have assisted in the development of the outcomes and recommendations, however these are City of Gold Coast recommendations. These areas will be communicated with relevant stakeholders and form the basis of collaborative work to identify more specific management actions within these areas together with the responsible stakeholders. Priority management areas are presented in the figure below.

5.1 Priority management areas

5.1.1 Stormwater management

Nitrogen and sediment loads in stormwater run-off from urban, rural-residential and road land-uses dominate catchment nitrogen loads. The City works to reduce these loads through a number of management actions. Continued stormwater management is critical to ensure nitrogen and sediment loads do not increase with the growing population of the city. This includes continued commitment to the development and implementation of Stormwater Management Plans (SMP) to reduce nitrogen loads from existing roads, urban and industrial areas.

As part of a comprehensive compliance program, education of developers and residents of the potential impacts of sediment and nitrogen run-off will contribute to reducing these nitrogen loads. Existing City programs should continue to be supported and possible future initiatives investigated.

5.1.2 Management of on-sites

There are more than 12,000 OWTS in the Gold Coast area of the Broadwater catchment. Nitrogen loads from OWTS have been estimated to be approximately 46.5 tonnes per year. There are two main pathways for this load, via the groundwater for compliant systems and via surface flows in association with non-compliance. While nitrogen loads can be reduced with increased compliance, for some areas where nitrogen loads are high, upgrading or replacing existing septic systems with alternative OWTS or retrofitting with the reticulated sewerage network, may be required to reduce nutrient loads substantially.

Management approaches can include

- upgrading or replacing existing systems in areas with high nutrient loads
- targeted compliance auditing
- educational programs to increase awareness and build knowledge of the potential impacts of non-compliance on our waterways are a way of reaching more households with less resources.

Additionally, the appropriateness of current policies for application of on-site wastewater treatment systems to meet sewerage needs in future developments should be addressed. In future amendments of the City's City Plan, a map layer that identifies high-risk areas and minimum lot sizes for properties with OWTS should be developed.

5.1.3 Restore healthy catchments

The freshwater regions of the City generally receive fair to good grades in the Healthy Waterways Report card, as do the estuaries. However, nitrogen loads from rural-residential, agricultural and grazing land-uses contribute a significant portion to the nitrogen budget of the Broadwater, approximately 20 per cent.

The most cost-effective actions will need to be identified from the suite of options for different areas of the catchment: urban, rural-residential and rural. The City plays a key role in these management approaches through its planning scheme, by managing and maintaining its own assets and through its catchment management and education role.

Management approaches include

- Riparian vegetation - retain existing and rehabilitate or restore previously cleared riparian vegetation.
- Promote creek-bank stability and livestock exclusion from creeks.
- Maintain vegetation cover within catchments.
- Establish buffer corridors.

These management approaches can also apply in the estuarine (downstream) regions of the rivers. Of particular importance is the establishment of appropriate setbacks from waterways, floodplains and wetlands in greenfield development areas.

5.1.4 Maintain low nitrogen loads from the City's reticulated sewerage network

The system for the discharge of excess recycled water is effective in maintaining a very low nitrogen load from the reticulated sewerage network to the Broadwater. Of the 135 tonnes nitrogen discharged at the Seaway, less than 2 per cent enters the Broadwater. This is a very small load compared to that of other nitrogen sources.

For the health of the Broadwater it is important to maintain these very low loads from excess recycled water discharges. This is an ongoing challenge for the City given the continued growth of the region. There are four key management actions that will ensure this:

- Minimise recycled water that enters the Broadwater.
- Continue to manage STPs in a manner that avoids the release of recycled water from STP lagoons to nearby environments.
- Continue to reduce network overflows, particularly in dry weather.
- Maintain high levels of nitrogen removal at the STPs.

5.1.5 Communication of BNI outcomes and recommendations

This investigation has developed the first system conceptual understanding for the Broadwater, similar to what has existed for Moreton Bay. These outcomes need to be communicated within the City, to SEQ scientific community, other councils and the wider community.

5.2 Monitor and understand

This investigation has highlighted the importance of understanding the Broadwater system. Continued monitoring and interpretation of these results will enable us to identify the most cost-effective management actions that will maintain and improve the health of our waterways.

Areas that require knowledge building and co-ordination of existing knowledge building activities have been identified, and include:

- Investigations to assist in prioritising management actions - OWTS and Stormwater.
- Actions to co-ordinate and consolidate existing monitoring and modelling.
- Research to inform our understanding of the ecosystem health of the Broadwater.

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