PART 3: Implementation framework

3.1 Description of Part 3

The implementation framework described in this part of the WQIP (Part 3) is a collection of management recommendations and action plans to implement water quality improvement in Wallis, Smiths and Myall lakes. It describes the details of how to implement the strategies summarised in Sections 2.7 (Wallis Lake), 2.11 (Smiths Lake) and 2.15 (Myall Lakes) of the WQIP.

This part of the Plan has been designed for practitioners; therefore each section can be read independently. It outlines the current situation and future recommendations for catchment management in rural and urban areas, lake use strategies, institutional arrangements and pollution control systems.

As water quality improvement is not only about the technical strategies, this implementation framework includes recommendations on systems, processes and approaches.

In the first section, the overall 'approach' for implementing the WQIP is outlined. More details on the approach for rural and urban water quality management can be found in Sections 3.3 and 3.4, respectively. The main theme of the overall approach (partnerships and joint learning for sustainability) is strongly embedded in all other sections in this implementation framework.

This section concludes with an adaptive management framework, and areas for future research and investigation. This part of the Plan is designed to articulate management systems framework for the WQIP as well as address uncertainties associated with ecological management.

3.2 Approach to engagement for improving water quality

Implementation of the WQIP requires engagement of all relevant stakeholders to ensure that everyone has the opportunity to contribute to water quality improvement. A stakeholder can be considered any individual or group that affects or is affected by an issue or problem. Engagement is an "inclusive term to describe the broad range of interactions between people. It can include a variety of approaches, such as one-way communication or information delivery, consultation, involvement and collaboration in

decision-making, and empowered action in informal groups or formal partnerships" (State of Victoria, Department of Sustainability and Environment 2005).

The International Association for Public Participation (2007) [DG105]developed a spectrum for stakeholder engagement, ranging from the most basic to the most complex (in order of listing):

- **Informing** the community of policy directions of the government
- **Consulting** the community as part of a process to develop government policy, or build community awareness and understanding
- **Involving** the community through a range of mechanisms to ensure that issues and concerns are understood and considered as part of the decision-making process
- **Collaborating** with the community by developing partnerships to formulate options and provide recommendations
- **Empowering** the community to make decisions, and to implement and manage change.

While developing the Water Quality Improvement Plan, effort was made to engage people at the level appropriate to their impact on the issue, or by the issue (e.g. the more a stakeholder is impacted by an issue, the higher they climbed on the spectrum towards empowerment). The philosophy behind the CCI engagement strategy was that the greater the level of engagement achieved in developing the Plan, the more likely that stakeholders would have ownership over the Plan – therefore increasing the probability that they will have the motivation and capacity to implement them (see Appendix 1 – Engagement Report).

The level to which stakeholders will be engaged in plan implementation will vary depending on the desires of individual stakeholders and the types of actions that are recommended in the WQIP. Accordingly, stakeholders will be engaged at a range of levels from informing to empowerment, and often the levels of engagement will change throughout the duration of the project. Descriptions of the necessary commitment to each of these levels of engagement and examples of how stakeholders could be engaged in plan implementation are outlined in Table 3.1.1.

Table 3.1.1. Great Lakes Council's commitment to the levels of engagement in this strategy.

Inform	Consult	Involve	Collaborate	Empower
Promise:	Promise:	Promise:	Promise:	Promise:
We will keep you informed.	We will keep you informed, listen to and acknowledge concerns, and provide feedback on how your input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed, and provide feedback on how your input influenced the decision.	We will look to you for direct advice and innovation in formulating solutions, and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.
Example stakeholders:				
General community	General community Community groups who express an interest in water quality improvement Council CMA Board	Council staff Landholders Estuary and catchment management groups Developers Community groups who express an interest in water quality improvement	Council staff Landholders Estuary and catchment management groups WSUD professionals and engineers Industry groups	Rural Practitioner Technical Committee Estuary and catchment management groups

Adapted from: International Association for Public Participation (IAP2) (2007).

3.2.1 Partnerships

This section outlines the background and opportunities presented by the partnership approach.

Building partnerships has been recognised as an important element in engaging people in improving water quality. In the future implementation of the Plan, a partnership approach should be adopted with stakeholders to build the capacity required to achieve change – not only at an individual or behavioural level, but also at an organisational or institutional level, be it within community or stakeholder groups, or by council. The purpose of a partnership approach is to build capacity on both sides. They learn the technical approaches, you learn how to better assess needs, etc.

By recognising that traditional approaches by isolated individuals or organisations that have simply reacted to environmental problems have had limited results, this plan will move away from regulation approaches, and towards innovative responses to change and sustainability. This can be achieved through sustainability partnerships.

While partnerships have traditionally been characterised by predetermined outcomes, partnerships in the WQIP focus on process, and jointly-developed vision and innovation. No longer the last and least preferred option, partnerships are now viewed as an important opportunity for value creation (Bobenrieth 2004; OECD 2001). The flexibility that is offered through partnerships is what makes them so attractive. They can facilitate change for sustainability at several levels: individually (mental models), mechanically, technologically, environmentally, culturally and politically, to name a few. They are multifaceted, involving different levels of governance, different institutions (business, government and community), and different scopes and durations.

Partnerships present opportunities for *improved decision-making* by providing more perspectives, knowledge and experience than the local government could ever produce alone. Consistently, *actions for change* undertaken by local government alone cannot achieve the level of change required to ensure a sustainable environment and societies – opportunities provided through partnerships enable local government to approach change systemically by engaging with a variety of stakeholders and generating a whole-of-systems approach to change (Hartman, Hofman & Stafford 1999). Cross-sectoral partnerships are seen as crucial to challenging worldviews, assumptions and priorities needed for change towards sustainability (Tilbury 2004).

While partnerships usually form to achieve a mutually agreed upon outcome or change for sustainability, the design and implementation of programs has been found to represent only a minor outcome of partnerships – rather, improved *governance* is seen to

be the most significant outcome (OECD 2001). Improved governance can lead to increased ownership and participation in action, and greatly improved results.

Partnerships are about mutual capacity through power-sharing, giving stakeholders the greatest level of ownership over water quality improvement actions.[20] A focus on how the partnerships come together and operate (process) – rather than what its project achieve (outcomes) – is key in redressing inequitable power structures and providing opportunities for more equitable and mutually beneficial approaches to decision-making (Hartman, Hofman & Stafford 1999), without which sustainability could not be advanced (Hemmati & Whitfield 2003).

3.2.1.1 Responsible management of culturally significant landscapes

The understanding and appreciation of Aboriginal culture and heritage has changed in recent times from the limited scientific definition of archaeological sites to a much broader understanding that Aboriginal people have a commitment to care for Country, and therefore should be responsible for the co-management of natural resources. Aboriginal people view their environment as a holistic landscape rather than individual ecologies. Landscapes represent collections of natural resource issues with many values (vegetation, habitat, water resources, places, knowledge, stories, landscapes, objects, flora, fauna, water) that together provide a single coherent value, with particular meaning for Aboriginal people.

Our association with Aboriginal culture and heritage should be maintained and practised so that all people in the Wallis, Myall and Smiths lakes catchments can respect and understand Aboriginal cultural heritage values. Knowledge of the past, and connecting values with Aboriginal people in the region, can also teach us about what we can provide for our future. Therefore, it is essential to maintain and improve Aboriginal culturally significant landscapes so that they are maintained for use by present and future generations.

The CCI project acknowledges that traditional and contemporary Aboriginal culture and heritage will exist together with other natural resource assets that will be managed by the project. This means that other natural resource work will overlap with areas of significant culture and heritage. For example, improvement in the condition and health of the catchment will be beneficial to the preservation / conservation of Aboriginal culture and heritage. In turn, works that seek to conserve or preserve Aboriginal culture and heritage will have a beneficial impact on the condition and health of the natural resources in the catchment.

20 The philosophy behind the need to share power and develop partnerships through engaging stakeholders is described in both Section 3.1 and Appendix 1 (Engagement Strategy Report).

As a general guiding principle for landholders and land managers in the Wallis, Myall and Smiths lakes catchments, the precautionary principle should be used for protecting culture and heritage. This means that where there is uncertainty about the value of culture and heritage, the management of that place should be limited by any negative impact on the locality. For example, some practices – such as deep ripping to destroy rabbit burrows, or to erect fencing – may also be undesirable in areas that contain Aboriginal sites. These issues should be managed through a process of consultation with relevant Aboriginal officers and / or Aboriginal community representatives.

3.2.2 Learning for sustainability

Learning is an important aspect of stakeholder engagement and partnership. Increased power-sharing through engagement forces learning to move away from simply providing information and 'education about the environment' to stakeholders, towards adopting a learning for sustainability framework that allows participant-directed learning that results in measurable action and change for sustainability.

Learning for sustainability is critical to raising awareness, building partnerships and influencing the course of action in relation to issues of sustainability in local areas. In recent years, learning programs targeted at the community have changed from being narrowly focussed and didactic towards favouring more holistic and interactive approaches aligned with sustainability (e.g. the Health Lakes Program). Learning for sustainability aims to enhance community networks, build community capacity for decision-making, build community leadership capabilities and improve the environment (Tilbury, Coleman, Jones & MacMaster 2005). Traditionally, while citizens have been active in the alleviation of environmental problems, they did not usually address issues of sustainability at their source. For example, rather than addressing recycling as the only solution to waste management, learning for sustainability would encourage us to consider what we purchase and our levels of consumption as an effective waste management strategy.

Community learning for sustainability promotes the importance of the capacity of participants to direct their own learning, and recruit educators who can support this process. This factor separates traditional participation in community action (where the community may be involved in a preset activity such as planting, weeding or making interpretive signs) from participation in learning and action for sustainability. It is the values clarification embedded in the learning process that ensures that the community own and protect their actions. Inherent in this ability are the skill sets, motivations, and capacities of the community to effectively and efficiently contribute to processes of

change. Building these capacities is a core objective of learning for sustainability and what differentiates it from previous community education approaches.

Capacity-building in this sense is an essential component of sustainability, as highlighted in 'Agenda 21'. It involves people, institutions and societies building upon existing capacities through dialogue, and the development of appropriate systems and mechanisms to support change. The learning process aims to redress these inequities by empowering the individual, institution or society through a process of questioning the assumptions and beliefs that underpin their current unsustainable practices, whilst also shifting inequitable power structures through the development of decision-making processes, and the development of appropriate tools and resources. It is these factors that tie capacity-building to sustainability and learning for sustainability.

Key principles that will underpin all learning for sustainability activities include:

- visioning
- critical thinking and reflection
- participation in decision-making
- partnerships
- systemic thinking and systems change.

These principles are further described in Appendix 22.

Learning for sustainability can be characterised by the following elements (NSW Government 2006) [21]:

- promotes life-long learning
- based on the principles and values that underlie ecologically sustainable development, covering all three realms of sustainability – environment, society and economy
- evidence-based, locally relevant and culturally appropriate, simultaneously acknowledging that fulfilling local needs often has international effects and consequences
- action-oriented – a continuous process of learning and reflection, and developing motivations and abilities to be involved
- informed by different professional and stakeholder perspectives
- employs a variety of educational methods, mediums and techniques that promote participatory learning and higher-order thinking skills
- outcomes documented, learning demonstrated and experience shared
- accommodates the evolving nature of the concept of sustainability

21 NSW Government 2006, *Learning for sustainability 2007-10*, DECC, Sydney.

- engages formal, non-formal and informal education
- builds social capacity for community-based decision-making, and environmental stewardship across government and private sector organisations and institutions.

These elements have been incorporated in the recommended rural and urban strategies for water quality improvement, which relate to engagement. There is a need for a holistic 'learning for sustainability' strategy to be developed, which includes the engagement approach and recommendations identified in the WQIP, but further explores the needs, aims and objectives for learning for sustainability.

3.2.2.1 Building leadership and organisational capacity for sustainability

The WQIP will work with executive management and councillors in a capacity-building process that will ensure effective leaderships for sustainability.

Leaders are responsible for building and inspiring organisations where people continually develop their capacity to understand complexity, clarify vision and improve shared mental models. More information on building leaders for sustainability that will provide background as the implementation of the WQIP evolves is outlined in Appendix 23.

3.3 Catchment management in rural areas

3.3.1 Existing water quality management systems (rural)

In this section, rural areas [22] are defined as areas where rural land is currently being managed as a rural enterprise (thus including large rural residential areas).

In rural areas, the current approach for achieving water quality outcomes focuses on local and state governments and non government organisations working in partnership with landholders. These partnerships focus on encouraging uptake of land management practices that improve water quality while also achieving other benefits for both farming and the environment. Management systems include the plans, procedures, programs and activities used to manage land. Described here are the plans that have been written to manage rural activities in the Great Lakes catchments, and the organised and documented programs that have been developed to help implement water quality improvement actions or activities.

3.3.1.1 Plans

The following plans have been developed for the Great Lakes area by landcare and government organisations:

- Wallis Lake Catchment Management Plan
- Wallis Lake Estuary Management Plan
- Myall Rivercare Plan
- Myall Catchment: Community Catchment Management Plan
- Lower Wallamba Rivercare Plan
- Upper Wallamba Rivercare Plan
- Wank Wauk Sub-catchment Plan
- Smiths Lake Estuary Management Plan
- Port Stephens Myall Lakes Estuary Management Plan
- Catchment Action Plan.

See Appendices 8 (Wallis Lake), 16 (Smiths Lake) and 18 (Myall Lakes) for more details on the history of the development of these plans.

The development of these plans allowed partnerships to be formed with landholders and agency stakeholders. Several landholders were involved in identifying issues and solutions for inclusion in the Plan. This active involvement and participation of community

22 This does not discriminate between areas that may or may not be suitable to be managed as a rural area (from a sustainability or water quality point of view), but simply refers to the current classification of the land.

in decision-making about their catchment has led to an improvement in knowledge regarding issues and ownership of some of the solutions developed.

Working with landholders to develop the catchment plan was an approach that was especially well developed for the Wallis Catchment and led to a rapid uptake of on-ground activities by landholders (Appendix 8). Interest from landholders in undertaking on-ground works, as well as training and education programs, continues to grow.

In contrast, in the Myall catchment the development of the catchment plan followed a more traditional engagement methodology compared to the deliberate participatory approach with landholders and stakeholders provided in the Wallis. This – combined with limited and disjointed follow-up funding, and no active direct engagement of landholders in hot spot areas – has diminished the effectiveness of the Plan (Appendix 18). This has meant that the catchment plan has not been extensively implemented in the Myall Lakes catchment.

The Smiths Lake Estuary Management Study, which was developed in consultation with the community through workshops and mail-outs, considers the effects of and solutions for the entire catchment. However, the Smiths Lake catchment has very little rural land in its small catchment, and projects and programs specified by the plan focus on reducing sediment and erosion in general terms, rather than specifically focusing on the rural sector.

3.3.1.2 Programs

The plans outlined above have helped develop a number of programs. For example, the Wallis Lake Catchment Management Plan has led to a plan implementation program that is directed and overseen by the Wallis Lake Catchment Plan Implementation Group (WaLI Group) (Table 3.3.1). In late 2007, the committee expanded its membership and supported the addition of the Myall catchments to the Great Lakes Council catchment management program, given the similar catchment issues and the need for action. This has included a recent targeted program in the Crawford sub-catchment, for which a plan is currently being developed.

Industry groups, such as the Mid Coast Dairy Advancement Group, also cover the area of the Great Lakes CCI and source funding to provide assistance to dairy industry landholders interested in improving both the environmental management and productivity of their farms. More information on specific programs is outlined in Table 3.3.1.

A number of programs aimed at improving water quality are currently in operation in the Great Lakes. These are constantly evolving in response to changes in funding availability and focus. Water quality improvement projects and programs range from financial

assistance for on-ground works to capacity-building, participatory learning and training programs, and further research that will assist landholders to improve their management practices. Current water quality improvement projects and programs are outlined in Table 3.3.1.

Table 3.3.1. Summary of Current rural programs that deliver water quality outcomes.

Program	Description	Relevant catchment	Agency / Group implementing	Focus group
Wallis Lake Catchment Management Plan Implementation	This program commenced in October 2002 and following a period where administrative protocols were finalised, and the project rollout commenced. The interested landholders who assisted in development of the catchment plan were the first to be engaged to derive projects and submit devolved grant applications. The project was then extended to identify interested landholders through direct targeted engagement of landholders (in priority areas of the catchment), outline the opportunities available through a brochure mail-out and media coverage, and respond to general landholder enquiries and interest generated by natural resource management workshops. In the initial stage, the project used a specialist community engagement consultant, who visited interested landholders face-to-face to provide advice on the opportunities available to improve the management of properties to achieve environmental and productivity outcomes, and to gauge the level of landholder interest in undertaking works. A key aspect of this program was the promotion and adoption of the principles of sustainable agriculture to landholders. In this way, the program not only aims to meet environmental goals, but also to protect landholders from the ongoing or future cost associated with remediation of erosion and riparian or foreshore instability, and to promote sound grazing practices, appropriate tree retention and water quality management. As a consequence, it was envisaged that the individual landholder projects would have significant economic benefits for landholders, as well as enhance the quality of the rivers and catchment for the benefits of downstream communities and the economy of the Great Lakes itself. In mid-2004, Great Lakes Council rolled out the second phase of this program, which focussed on building partnerships between local government staff and individual landholders. The emphasis of the program has not changed, and the focus remains on working with landholders to achieve environmental outcomes and economic benefits at the farm scale. To achieve this, funding for on-ground works has been provided and the program has expanded to integrate a whole-farm planning approach, and education and training field days for landholders.			

Program	Description	Relevant catchment	Agency / Group implementing	Focus group
Catchment Action Plan Implementation	This program commenced in 2006 when the Catchment Action Plan was finalised by the Hunter-Central Rivers Catchment Management Authority. The implementation of the plan focuses on community capacity-building and education, and supporting landholders and the community to undertake on-ground improvements to natural resources. Assisting landholders with on-ground improvements is one of the areas where synergies between the Wallis Lake Catchment Plan and Catchment Action Plan Implementation exist. Funding from the CMA for plan implementation has provided resources for landholders to undertake on-ground works such as riparian fencing, off-stream watering, dam repairs, erosion repairs and vegetation management (including Property Vegetation Plans). Other activities funded by the Catchment Action Plan cover education and training programs such as Prograze, and farmers' targets for change (outlined in the sections below). A partnership program was established with the GLC to implement aspects of the Wallis Lake catchment plan relevant to the Catchment Action Plan. This partnership has provided funding for landholder sustainability projects including riparian fencing, erosion control and biodiversity conservation. Funding has also been provided for acid sulfate soil rehabilitation and wetland protection.	All catchments	CMA	

Program	Description	Relevant catchment	Agency / Group implementing	Focus group
Sustainable Grazing Program	A National Landcare Program initiative, undertaken through Manning and Karuah Great Lakes Landcare management committees. The sustainable grazing landcare program established groups to involve participants in natural resource management and best management practices for rural landholders. The program directly provides each participant with a best management practice manual, farm map, soil testing, trial work, Grass Identification workshops, and soil health and soil test interpretation. The program has established 14 groups, consisting of 257 participants and 182 separate properties. Six groups are in the Karuah Great Lakes catchment. The program has also run general public field days on Giant Parramatta grass control, aerator demonstrations, tree identification, Master Tree Growers course, native vegetation management, holistic management, biological farming, carbon sequestration, tree planting demonstrations, dung beetles, animal heath and parasite control. The program has also provided participants with information on funding opportunities and programs supported and supplied by the Hunter-Central Rivers Catchment Management Authority, DPI, and other private information and funding providers.	Wallis and Myall	Great Lakes Karuah Landcare	Landholders
Accounting for nutrients	A DPI research initiative following on from the project 'Making better fertiliser decisions'. This project recognises that nutrient budgets are not consistent across Australia, and aims to improve both assessment of budgets for dairy farms and management of nutrients. It is a dairy effluent research project for Dairy Australia, which will standardise the effluent systems across Australia. It could build the foundation for establishing environmental management systems for the dairy industry. There are no sites in the CCI project area but the results will be applied across Australia.	All catchments	DPI	Dairy industry

Program	Description	Relevant catchment	Agency / Group implementing	Focus group
Real Farm Planning	Projects are being trialled on six farms. The project builds the capacity of farmers to make well-informed decisions about the management of their properties by providing funding to do leaf tissue testing, soil tests and training on using the Farm Keeper computer-based mapping program. This is where the findings of 'accounting [pt106]for nutrients' can be applied. The project involves keeping records on what nutrients and management are applied to each paddock, and recording the results of soil tests from each paddock. This project needs technical support and the information collected can build the foundations for developing environmental management systems.	All catchments	DPI / Mid Coast Dairy Advancement Group	Dairy industry
Farmers Targets for Change	Farmer Targets for Change is a process that allows farmers to develop an action plan for managing resources on their farm. By linking with financial incentives, farmers implement on-farm change that benefits both their own production system and the catchment community. Using the principles of team work, trusted partnerships and capacity-building, farmers are engaged in ongoing sustainable farm activities. The Farmers Targets for Change program started in the Manning Valley district, following the dairy industry group Mid Coast Dairy Advancement Group's involvement in key natural resource management projects including the Dairy Effluent Management Project, the Cleaner Production on Dairy Farms project and the pilot program Setting Targets for Change, which formed the foundation for Farmers Targets for Change.	Myall and Wallis	DPI / Mid Coast Dairy Advancement Group	Dairy industry expanding to the beef industry
Milk Biz	This is the driver for business decisions and is the way that we can encourage farmers to stay involved. This project focuses on the production side of the industry and making farms profitable.	Myall and Wallis	Mid Coast Dairy Advancement Group	Dairy industry
Dairying for Tomorrow (includes DairySAT)	A program to develop regional-based projects to address environmental issues. DairySAT is an industry self-assessment tool to audit management practices. The Farmers Targets for Change Program incorporates an environmental checklist using the Dairy Self Assessment Tool (DairySAT).	Myall and Wallis	Dairy Australia	Dairy industry

Program	Description	Relevant catchment	Agency / Group implementing	Focus group
PROfarm	A training program to reflect the public benefits provided by the adoption of more sustainable farming practices. Includes courses such as Prograze and LANDSCAN. LANDSCAN assists farmers and land managers to assess natural resources, to better match land use to land capability and to balance production, profit and sustainability. Prograze is run in the field and provides skills for participants to assess pasture characteristics influencing pasture and animal production, and to develop pasture and livestock management plans.	Myall and Wallis	DPI	Landholders

3.3.1.3 Development Assessment

There are a number of activities that take place on rural land that require council's consent within GLC and GTCC. Activities that require consent include rural subdivisions, dwelling houses, intensive agriculture (e.g. poultry sheds), aquaculture, sawmills, rural industries treating or processing primary products, animal breeding establishments, tourist facilities, extractive industries and offensive storage establishments. The relevant LEPs for each respective council (e.g. Great Lakes LEP 1996 and Greater Taree LEP 1995) set out the range of land uses and activities that are permissible with consent in the rural areas. Consent for such uses is usually considered with reference to Part IV of the *Environmental Planning and Assessment Act 1979*. Consent typically requires relevant and appropriate supporting documentation to be provided within a Development Application submitted to the respective Council. A determination to approve, approve with conditions or refuse the Application is then made. For more information on how the *Environmental Planning and Assessment Act 1979* is applied, see section 3.7.1.1.

In GLC and GTCC, development assessment for land uses and activities proposed in rural areas generally considers and takes water quality impacts into account. This is typically achieved through the internal referrals process where trained staff of the Natural Systems Branch (GLC) and Environmental and Strategic Planning (GTCC) reviews each relevant development application received, and provide comments and recommendations with respect to that particular application. As such, staff considers the application with respect to the relevant statutory and legislative instruments, and provides an opinion with respect to:

- the type, nature and severity of water quality risks and threats associated with the proposal
- the opportunities and requirements for conditions of consent and protective safeguards
- the appropriateness and reasonableness of the proposal, and ultimately the form and content of any planning decision.

Based on this assessment, staff recommends whether the decision is for ultimate approval or refusal. As such, water quality protection and management issues are considered at the development approval stage within GLC and GTCC. The limitation to this process, however, is that it is rather *ad hoc*, is not embedded or entrenched in any adopted Council policy or protocol, and is not subject to adopted standards. Therefore, it might be argued that there may be a risk of variations in decision-making associated with differing opinions, perceptions and attitudes of staff involved, and the absence of standards and protocols. Additionally, there is the risk that each decision cannot readily be considered in the context of cumulative impacts on a catchment from a series of decisions.

To cite an example within GLC, all rural subdivision proposals are generally referred to the Natural Systems branch for review and consideration. Staff considers the impacts of that

particular proposal on the natural environment and water quality, including (but not limited to) consideration of whether or not:

- proposed properties boundaries are consistent with geographical and natural attributes (steep slopes, natural vegetation, threatened species, riparian habitat, etc.)
- riparian areas for new lots are fenced
- riparian water rights are not increased through creation of additional waterfront properties.

The Natural Systems staff also considers the legislative and statutory provisions associated with the subdivision application, before making pertinent and relevant recommendations to the Assessment Planners and council. This includes such legislation as the EP&A Act 1979, but also the *Native Vegetation Act 2003*, *Environment Protection and Biodiversity Conservation Act 1999* (Cth), SEPP 14 Coastal Wetlands, etc. Such recommendations involve the determination of appropriate conditions of consent to minimise harm to or protect the environment. This may involve pre-determination comment to the applicant with respect to enhanced subdivision arrangement to avoid emplacing boundaries in sensitive water quality locations, or the formal documentation of consent orders to protect water quality (i.e. protection of native vegetation stands that are important for water quality, confining future development envelopes to unconstrained portions of proposed lots, etc.). It may also involve recommending that rural subdivision be refused in areas where water quality is harmed unreasonably or significantly by poorly-designed subdivision of rural lands.

Where development involves significantly intensifying agricultural practices such as those described above, or where relatively intensive uses of rural lands are proposed (i.e. seniors living developments, tourist facilities), again there is typically a statutory and legislative framework within which environmental risks and impacts must be duly and appropriately considered by council in the consent process. For instance, many intensive agricultural enterprises are considered ‘designated developments’ under the provisions of the EP&A Act 1979, to which a formal Environmental Impact Statement must be prepared and submitted as part of the Development Application. The form and content – including referrals and concurrence – within such applications is rigorously controlled with regards to managing risks and impacts to the environment and water quality. Even where the proposed activity is not considered to be designated development, but is intensive and associated with potential environmental risks and threats, the consent authority must consider the range and severity of environmental impacts in any determination. At GLC and GTCC, the same internal referrals process described above is applied to such development applications, and formal consideration to decision-making and the form and content of consent orders is duly adopted involving the Natural Systems Branch (GLC) / Environmental Planners (GTCC) working with the Assessment Planners. The requirements of Development Applications within rural lands that may affect water quality and quantity is being continuously enhanced and upgraded, such that the water quality performance can be

ascertained and informed decisions on proposed land uses and activities can be made. Increasingly, this involves applicants assessing water quality performance through the use of modelling tools (MUSIC modelling).

As mentioned, where conditions are reasonable and justified, all assessment staff attempt to ensure that decisions and conditions are applied consistently within decisions on applications. However, as mentioned, there are no formal guidelines, standards, protocols or policy for development approvals that specifically take water quality issues into account. This is a key and significant absence, and may be limiting the effectiveness of water quality decision-making across the area of the Great Lakes CCI area.

Finally, there are a number of activities on rural lands that are permitted by state legislation (e.g. routine agricultural management activities defined by the *Native Vegetation Act 2003*), are permitted without consent in rural lands or are considered as exempt or complying development. Such land uses and actions can be undertaken without specific consent. As an example, GLC does not require consent for the construction of access tracks or dams on farms. However, when constructing dams, if a property exceeds its maximum harvestable right, the landholders are required to have a water licence from the Department of Water and Energy.

This is despite instances where the establishment of farm dams and farm access tracks has caused known or assumed significant, measurable environmental and water quality harm (i.e. dam wall failure, leading to significant sedimentation of Wallis Lake seagrass beds on land near Coomba Park (Section 2.5); alleged issues associated with access tracks at Fame Cove, Port Stephens). Similarly, in GTCC, approval is not required for the construction of a dam unless it is to be located within a defined watercourse.

3.3.2 Strategy for implementing the Farm Scale Action Plan

The farm-scale water quality improvement strategies (Farm Scale Action Plan) summarised in Table 3.3.2 have been developed by the Coastal Catchments Initiative Rural Management Practices Technical Group, and landholders and industry groups from the Wallis, Myall and Smiths lakes catchments. The action plan has drawn on the results of new research undertaken by the Department of Environment and Climate Change (DECC) – summarised in Sections 2.5 (Wallis Lake), 2.9 (Smiths Lake) and 2.13 (Myall Lakes) – as well as a literature review and field studies undertaken by the Department of Primary Industries (DPI) as part of this project.

While the majority of the feedback received from landholders has been used to develop these strategies, there were cases where the level of detail provided was greater than required for this phase of planning. The comments and feedback have been recorded in detail in Appendix 24. It

is intended that this appendix will become a resource to guide catchment management practitioners [23] who develop the programs to implement the actions identified.

The strategies outlined in this action plan are not mandatory. They are intended to guide catchment management practitioners and landholders. This plan recognises that in order to improve water quality at the farm scale, it is essential to work in partnership with landholders and assist them to undertake improved management practices on their properties. Recognising that we cannot achieve technical solutions without landholders, this action plan has equal emphasis in two key areas:

- encouraging and supporting uptake of water quality improvement management actions
- technical strategies.

Under each of these sections there are three types of future actions identified: investigation, on-ground and extension activities.

Actions have not been given priorities, as a whole-farm management approach is needed to implement the action plan. This approach assumes that one element of the farm should not be considered for improvement in isolation to other elements. It has also been noted that prioritising certain farm actions may be counter-productive, as cooperating landholders may have an alternative way of establishing priorities. For this reason, a water quality assessment and prioritisation tool for both rural and rural residential properties in the Smiths, Wallis and Myall lakes catchments is recommended in Section 3.3.2.2.

3.3.2.1 Recommended approach for implementing the WQIP in rural areas

To implement the WQIP in rural areas, the overall objective is to partner with landholders to assist them in implementing improved management practices on their properties. To support this objective, a number of approaches have been identified and include:

- whole-farm planning
- partnerships with landholders and agencies
- framework for an incentive program.

The approach builds on existing partnerships and engagement established during the WQIP, and the ongoing implementation of the Wallis Lake Catchment Plan and Catchment Action Plan. The approach is common to both the urban and rural areas identified in Section 3.2, and draws on the experiences of landholders, catchment management officers, landcare officers, DPI agronomists and industry groups. Experience gained by staff implementing the CCI engagement strategy has also influenced these approaches.

23 Catchment officers, landcare officers, and Catchment Management Authority and Department of Primary Industries staff.

3.3.2.2 Whole-farm planning

A 'whole-of-farm planning approach' has been adopted to assess and fund activities that will improve water quality. The whole-farm planning approach takes a holistic and systemic approach to farm management, and ensures that water quality issues on farms are not managed in isolation of other farm management practices. Similarly, that building relationships and engaging all relevant stakeholders is essential to effective water quality management in a catchment. This 'whole-of-farm' approach has been used successfully in the Great Lakes catchments through the Farmers Targets for Change and Real Farm Planning projects described in Table 3.3.1.

The whole-farm planning approach recognises that there is no single solution for improving water quality across a catchment. It acknowledges that in order to achieve improvements in water quality across a catchment, solutions that improve water quality need to be tailored each farm. The tailored approach takes into consideration not only the farm's use, landscape and location in the catchment, but also its property management style (including the intensity of management), landholder aspirations and the economic position of the landholder. As such, landholders must be engaged throughout the planning, implementation and management process.

Process of engaging landholders in whole-of-farm planning

The action learning technique will be used to engage landholders in the whole-farm planning approach (Revans 1980). Action learning is different from other forms of learning in that it is aimed at addressing a specific issue or focus (such as water quality management), and attempts to learn from critically reflecting on action (such as implementing and testing suitable devices or techniques for water quality management). As such, it involves identifying solutions through a process of critical questioning throughout the stages of planning, acting, observing and reflecting. By maintaining a focus on a single concern, action learning is able to engage the landholder in an iterative process of critical questioning, which builds the capacity of landholders to apply this critical questioning to other areas. This means that the skills of critical questioning can be transferred to tackle issues of biodiversity, energy, etc.

This collaborative dialogue provides an important opportunity to develop new ways of thinking and identify even more innovative solutions than what one might identify alone. The dialogue is not just about information sharing, but it is creating, testing and implementing new ideas and solutions together. An important part of this process is identifying what practices are currently working, as well as where the challenges lie. The outcomes of this dialogue will inform the development of each whole-farm plan, ensuring a level of consistency and quality across the catchment.

This approach will bring together catchment management practitioners, water quality management experts and landholders in a collaborative learning experience. The process will

draw from previous experiences and observations to identify a range issues related to farm management and the environment, as well as a range of possible solutions.

Action learning requires a personal commitment by the landholder to the water quality management on their property and to learning from practice. As such, it places the landholder at the centre of the learning process, and thus gives the landholder ownership and control over the self-guided learning experience.

It is anticipated that a range of different types of solutions may be required. Solutions could range from on-farm engineering works through to capacity building programs to achieve behavioural change. For example, to improve groundcover management, both training about sustainable grazing practices and the physical redistribution of watering points across a property might be required. While there may be cases where funding is available for on-ground works, the whole-farm approach described here highlights the need to be open to a range of options and not jump too quickly to a single solution. A range of future extension and on-ground actions are identified in Table 3.3.2.

This holistic approach to water quality management moves away from traditional linear solutions, towards empowering stakeholders to identify innovative systems-based approaches of whole-farm management (e.g. developing an industry-based environmental management system), whilst embracing the needs of landholders and the local environment.

The 'Real Farm Planning' project, a joint project between Mid Coast Dairy Advancement Group and the Department of Primary Industries, provides an example of the types of outcomes that can be achieved through a process of collaborative dialogue. This project works with landholders to collect data from farms, such as soil tests and nutrient application, which will be used in the future to inform the development of an industry-based environmental management system.

Outputs required

To assist catchment management practitioners working with landholders to develop holistic 'whole-farm plans', a variety of technical solutions to water quality improvement are outlined in Section 3.3.2. Each technical solution is divided into actions that cover different elements of farm management (e.g. groundcover, riparian management). While these actions are presented and costed separately in Sections 2.7 (Wallis Lake) 2.11 (Smiths Lake) and 2.15 (Myall Lakes), the plan presented in this form demonstrates the water quality improvements that could result from each action. In line with the whole-farm approach, it is not intended that these actions are undertaken in isolation – the full range of issues should be identified on initial contact with landholders.

To support this approach, a farm-scale assessment tool will be developed. The tool will be used to help develop a whole-farm plan (Table 3.3.2). Based on a scoring system, this tool would assess impacts of farm management on water quality – taking into account source and transport processes as well as the intensity of the activity – to help determine the level of water quality risk. It is intended that this tool would be used by different catchment management practitioners as a consistent method for water quality planning. This tool would be used as the first step in the Action Learning approach. The tool is described in Appendix 25.

Resources required

To implement the expanded programs described in Sections 2.7 (Wallis Lake), 2.11 (Smiths Lake) and 2.15 (Myall Lakes), approximately 7.5 Catchment Officers and Technical Officers would be required per year to achieve the improvements identified. If resources were available for the expanded programs, it is recommended that staffing and the specific nature of landholder engagement reflect the demographics of the catchment. This could mean that officers are specifically appointed to work with small landholdings and rural residential landholders, while others may work more closely with landholders who have larger properties.

3.3.2.3 Partnerships

Building partnerships has been recognised as an important element in engaging people in improving water quality (see Section 3.2).

Partnerships with landholders

One of the keys to implementing the rural component of the WQIP is working in partnership with landholders to assist them to undertake water quality improvement activities.

To ensure stakeholders' involvement throughout the process, catchment management programs need to be designed to cater for differences between stakeholders and tailored to the needs of each. Therefore, strategies to involve and engage landholders need to range from opportunities for one-to-one contact (e.g. on-farm visits) through to working in groups (e.g. workshops and field demonstrations).

Experience gained through implementing the Wallis Lake Catchment Plan has shown that working with landholders to scope issues and solutions for the plan, and then working with 'early adopters' to make on-ground farm improvements, can lead to a stronger acceptance of catchment management activities throughout the local area. Successful projects by individual landholders that have achieved rapid, transparent and accountable on-ground results have been used to gain the buy-in of other interested landholders. Landholders' experiences of working within the catchment management planning process and having one-to-one contact with catchment management practitioners has resulted in a snowballing effect of landholder involvement. This has allowed the catchment project to be rolled out in stages, which respond to

the increasing interest of landholders in developing projects. As a result, current landholder interest in undertaking on-ground works in the Wallis Lake Catchment exceeds available resources.

To implement the partnerships, approaches that have previously worked, continue to work and have received positive feedback at landholder workshops, will be drawn upon. These are summarised below:

- The industry approach used in the dairy industry by the Mid Coast Dairy Advancement Group was noted by Mid Coast Dairy Advancement Group representatives that it is extremely effective when landholders are working together in groups to identify solutions to issues identified on their farms. With an industry approach, it is possible to design programs that are targeted to industry-specific issues.
- Demonstration sites and field days that highlight best practice water quality management enable landholders to share their experiences, and discuss issues and solutions to their problems with technical experts in a non-threatening environment.
- Working one-to-one with landholders, establishing a rapport, and then advising and assisting them to improve their management practices.

Additional methods that have been suggested by landholders for encouraging landholder involvement will also be drawn upon. These include:

- building the capacity of landholders to work with their neighbours providing advice and training on improving land management practices in relation to water quality (using a train-the-trainer model)
- direct contact with landholders in priority areas through door-knocking and one-to-one farm visits. [24]

Encouraging landholder involvement is the first step, but maintaining their involvement is equally important and challenging. This can be achieved through maintaining regular contact, keeping people informed of new projects and programs, and providing feedback when research and planning projects are undertaken. The volume and depth of feedback from landholders during the research and planning phase of the CCI project demonstrated that the interest from the farming community in the findings of local research and planning is extremely high. Feedback from individuals involved in the project highlighted the importance of keeping landholders informed and providing them with results. This kind of feedback is critical for maintaining interest and 'momentum' with the people involved.

24 Further details about the approach to landholder engagement that has been suggested by landholders through workshops and surveys conducted as part of the CCI can be found in Appendix 26.

Partnerships and coordination between agencies

In addition to working with landholders, it is important to make sure that catchment management programs are delivered in an integrated way. This is where it becomes essential that partnerships between agencies and catchment management practitioners are established and maintained, so that the range of programs offered to landholders complement each other.

Agencies and catchment management practitioners need to present catchment programs in a way that demonstrates to landholders that there is a cohesive package of support available to them. In order to achieve this, the recommendations outlined below build on the partnerships that have been established through both the implementation of the Wallis Lake Catchment Management Plan and the development of the Water Quality Improvement Plan. These recommendations have been divided into partnerships between practitioners and partnerships between organisations.

Partnerships between practitioners

The Rural Management Practices Technical Group[25], established to develop and guide this section of the WQIP, will be the custodians of the Farm Scale Action Plan and use it to guide the coordinated delivery of the actions identified. This group will work together to:

- establish work programs and projects that complement each other to deliver coordinated catchment management programs
- share individual experiences of working with landholders to refine the delivery of coordinated catchment programs
- use and refine the farm-scale water quality assessment tool
- monitor progress towards achieving the actions and report back to each of their respective organisations
- establish joint applications to funding water quality improvement projects with landholders, research projects and education programs outlined in the Action Plan.

This Group will assess progress against the Farm Scale Action Plan on a biannual (twice a year) basis, and report back to the groups and agencies they represent. This would not preclude meeting on an as-needs basis to provide support and feedback on project design and implementation.

25 Hunter-Central Rivers CMA, Department of Primary industries (agriculture), Great Lakes Council and Karuah Great Lakes Landcare.

Partnerships between organisations

For catchment management practitioners to deliver a coordinated program of catchment management, they need to be supported in a strategic sense by senior management and board members or councillors of their respective organisations.

In 2007, statements of Joint Intent between Great Lakes Council the CMA, MidCoast Water and Greater Taree City Council were signed to formalise organisational commitments to developing and implementing the WQIP. Details of these commitments have been developed further through the process of assessing the management systems required to implement the WQIP. As the negotiated institutional arrangements cross urban and rural areas, these are summarised in Section 3.6.

An important aspect of developing organisational partnerships is creating efficiencies and consistency in water quality management across the region. One of the challenges for delivering a cohesive package of catchment management programs to landholders is the fact that there are a number of plans that cover the area of the CCI. As described in Section 3.6, catchment management plans that cover the area of the Great Lakes CCI project include the Wallis Lake Catchment Plan, the Smiths Lake Estuary Plan and the Myall Community Catchment Plan. All of these areas are covered by the Catchment Action Plan developed by the Hunter-Central Rivers Catchment Management Authority, and the Water Quality Improvement Plan. In Section 3.9, the water quality actions from the relevant plans have been analysed against the actions in the WQIP. The aim of this section is to identify where there are similarities and crossover among plans. Any reporting that occurs for the WQIP will be presented in a way that demonstrates how actions in other plans are also being achieved.

The Wallis and Myall Catchment Committee (formerly known as the Wallis Lake Implementation Committee), represented by landholder and agency stakeholders, will be the effective mechanism for maintaining partnerships, and providing feedback and advice on the implementation of actions outlined in the rural part of the WQIP. Collective public reporting against the rural part of the WQIP will be facilitated through this committee. To effectively implement the approach outlined, the committee's responsibilities will be expanded to consider the WQIP actions and include the whole area of the Great Lakes CCI. Membership may also be expanded to include representation from members of the Great Lakes CCI Advisory Committee.

Strong partnership with industry is also an important aspect of implementing this Plan. This is particularly important where issues identified are specific to a particular industry. For such an approach to be successful, coordination between agencies and industry groups would be required. Experience of DPI staff working with the dairy and beef grazing industry has demonstrated that landholder engagement programs have been most effective when the participants are from a single industry group. For example, the Farmers Targets for Change

Program was successfully developed for the dairy industry by the Mid Coast Dairy Advancement Group (DAGS). Given this experience and the low number of dairy farms in the Wallis, Smiths and Myall lakes catchments, this plan recommends that all dairy farmers in the CCI project area be encouraged to become involved in the programs that DAGS runs, so that one-on-one advice can be provided to landholders on water quality improvement actions. This would involve expanding the Farmers Targets for Change program with new and existing dairy farmers within the catchments of the Great Lakes CCI (DAGS, RMP).

Framework for a landholder incentive program

Incentive for on-ground works is one of the most effective ways to encourage landholders to change their management practices. Local landholders have indicated that they support financial assistance for training and education programs, which would assist them to achieve environmental outcomes and on-farm savings (e.g. sustainable grazing programs).

The incentive scheme proposed for this Plan prioritises projects that adopt a whole-of-farm approach, which contribute to improved farm-scale water quality as well as the catchment priorities identified in the WQIP.

The farm-scale assessment tool will be used as the basis for both assessing projects and developing the applications for funding with landholders. It is recommended that the funding framework focuses on activities that will achieve the greatest water quality outcomes. Rather than focussing on providing assistance for on-ground works, the framework should support other types of activities such as soil tests or training programs. There would also be scope within this framework to consider a range of different types of in-kind contributions from landholders. This could include their involvement in training programs, and provision of labour and cash for implementing on-ground works. For example, this could involve landholders fixing eroding farm tracks (in-kind) for a grant to fence off a stream.

Further consideration should also be given to flexible payment options for landholders. This was identified as one of the barriers to uptake of water quality improvement activities.

The focus for future incentive schemes should be on outcomes rather than outputs. This means that the success of a landholder project will be determined based on what will be achieved (e.g. the improvements in groundcover) rather than what activities are undertaken (e.g. the number of off-stream watering points).

The approach described here sets the principles for a future incentive program. It is recommended that the incentive framework used by the HCRCMA continues to be implemented in the Catchments of the Great Lakes CCI until the farm-scale water quality assessment tool (which will form the basis for the new incentive scheme) has been trialled and refined.

3.3.2.4 Improved land use planning in rural areas[pt107]

Subdivision of title / ownership of rural land has been identified by stakeholders as a major issue in relation to managing water quality in rural areas, particularly in relation to fragmentation and impacts on the landscape (weed issues, fragmentation of riparian zones, increased water access rights, intensification of land use, construction of new farm infrastructure, increased disturbance, etc.).

Development Control Plan provisions for both Great Lakes Council and Greater Taree City Council will be developed for rural subdivisions. The DCP would aim to standardise NRM design and management requirements for rural subdivisions.

Other developments (apart from subdivisions) that are permissible on rural lands – including boundary adjustment, tourist developments and single dwellings – have varying risks and potential impact on water quality. Guidelines for development assessment that will provide guidance on measures to manage potential water quality issues (e.g. stipulating a requirement for no change or an improvement in water quality, the need to fence off a stream if subdividing) are recommended for both GTCC and GLC. This approach will reduce the reliance of Development Assessment planners on Natural Systems staff for input on minor developments.

Development Control Plan provisions for dam construction are currently implemented in the Greater Taree City Council. It is recommended that development approval is required with technical certification in the Rural Residential and Rural 1a zones in GLC, GTCC and GSC.

There may be an argument that the minimum lot size of 40 ha in rural zones (Great Lakes LEP 1996) and the Rural Lands SEPP 2008 (rural subdivision for agricultural purposes) might promote ongoing subdivision and fragmentation of holdings, thus resulting in water quality impacts. Further research will be undertaken to determine the impacts of the Rural Lands SEPP, which now provides additional flexibility in the application of minimum lot size standards.

3.3.2.5 Farm Scale Action Plan[pt108]

All actions outlined in the Farm Scale Action Plan (Table 3.3.2) should be undertaken in the context of whole-farm planning to ensure that changing a management practice on the farm does not create further impacts or transfer the impact to another location.

Table 3.3.2. Farm Scale Action Plan.

Strategies to encourage landholder uptake of water quality improvement actions

Objectives	Action type	Actions	Responsibility	Identified costs (✓program costs)	Likely timing
Encouraging landholder uptake of improved management practices					
Encourage and support the uptake of management practices that maximise the water quality improvement outcomes at the farm scale. Support the coordination and implementation of these activities.	Future investigation	Undertake research to link the water quality assessment and planning tool to the DSS, and develop methods to update the DSS as scores are collated from farm visits ~ (Note: implementation of this tool is described in the recommended approach and an additional use of the tool outlined below)	Contractor with input from catchment management practitioners	60,000	2008[pt109]
		Scope the potential for rewarding landholders who achieve good water quality scores or 'best management practice' (e.g. rate re-apportioning stewardship payments or rate relief across all council areas) ~ *	Catchment management practitioners and senior management of key organisations	✓	2009–10
		Scope the possibility of rewarding landholders for Property Vegetation Plans and other conservation covenants (e.g. tax rebates or rate reapportioning) ~	Contractor	3,000	2009

Objectives	Action type	Actions	Responsibility	Identified costs (✓program costs)	Likely timing
		Identify the tax benefits currently available for landholders to undertake environmental works ~ * ^	Contractor with input from catchment management practitioners	3,000	2009
		Develop a case for revising tax laws to provide financial incentives for environmental works for both primary and non-primary producers (if necessary, following further investigation) * #	Contractor with input from catchment management practitioners	4,000	2009
		Investigate ways for improving knowledge transfer of NRM issues for rural supply stores and real estate agents ~	Catchment management practitioners	✓	2008
		Assist landholders to collect data from their farms to establish a basis for informed decision-making using the model developed for Real Farm Planning Projects. Note: this information could then be used as a basis for establishing industry-based environmental management systems ^	Catchment management practitioners, Mid Coast Dairy Advancement Group	✓	2008–ongoing
		Investigate the possibility of flexible or alternative payment options for landholders to minimise financial impediments of large up-front costs associated with undertaking on-ground works (e.g. bonds, progressive payments) ~ #	Catchment management practitioner in conjunction with NRM funding bodies	✓	2008–ongoing
	Future extension	Implement planning system and the associated resources to rank a range of farm management practices in relation to their water quality risk – use the scoring system as a way of giving feedback to landholders * and encouraging improved farm	Catchment management practitioners	✓	2008

Objectives	Action type	Actions	Responsibility	Identified costs (✓program costs)	Likely timing
		management practices ~			
		Establish an award system linked to achieving good water quality scores ~	Catchment management practitioners	✓	2009
		Promote the tax benefits currently available to landholders doing environmental works, by using case studies to demonstrate their application ~ *	Catchment management practitioners	✓	2009–ongoing
		Inform landholders that farm management plans are tax deductible *	Catchment management practitioners	✓	2008–ongoing
		Develop an education / information package on whole-farm management, covering issues relating to water quality (include information on relevant grants for on-ground works), suitable for councils to distribute to new landholders purchasing subdivided rural land * #	Contractor with input from local councils and catchment management practitioners	10,000	2009/10
		Improve NRM knowledge transfer between rural supply stores, real estate agents and clients ~	Catchment management practitioners	✓	2008–ongoing
		Encourage dairy farmers to participate in Real Farm Planning Programs, and the Mid Coast Dairy Advancement Group to assist them to achieve positive environmental (including water quality) and farm outcomes ^	Catchment management practitioners, Mid Coast Dairy Advancement Group	✓	2008–ongoing
		Implement training and education programs for staff at rural supply stores and real estate agents, on NRM farms in the local area (e.g. fertiliser application, stocking rates, drought management) ~ #	Training providers (e.g. CMA, TAFE, DPI, consultants)	✓	2009–ongoing

Objectives	Action type	Actions	Responsibility	Identified costs (✓program costs)	Likely timing
		Establish a 12-month calendar of training, workshops and field days, integrating activities undertaken by DPI, landcare, CMA, GLC ~	Catchment management practitioners	✓	2008–ongoing
		Arrange field days for landholders to visit other landholders who can demonstrate local examples of how whole-farm planning can work #	Catchment management practitioners		
	Future on-ground	Work with landholders to use the water quality assessment and planning tool developed to identify priority areas for water quality improvement (at the farm scale), so as to develop an incentive scheme that supports the uptake of management practices with the greatest water quality benefit * Note: this may involve investing in activities outside of the current rural incentive scheme scope ~ #	Catchment management practitioners, landholders	✓	2008–ongoing
		Fund sufficient staff to provide one-to-one advice to landholders and industry groups on water quality management at the farm scale, including technical staff (e.g. off-stream watering design, riparian management, dam design, soil test interpretation, erosion control, sustainable grazing) ~ * #	State, local and federal government non-governmental organisations / private enterprise	✓	2008–ongoing

Table 3.3.2. Farm Scale Action Plan (cont'd).

Technical strategies for water quality improvement

Objectives	Action type	Actions	Responsibility	Identified costs (✓ within program costs)	Likely timing
Riparian management					
Support faster uptake of riparian fencing of Crown land	Future investigation	Identify priority riparian areas for protection and rehabilitation on Crown land ~	Contractor with input from catchment management practitioners	30,000	2009–11
		Develop a case to Department of Lands to provide additional support to landholders fencing off riparian land ~	Contractor with input from catchment management practitioners	2,000	2009–11
	Future on-ground	Continue to provide funding to landholders to fence off riparian areas on Crown land with existing incentive programs ~	State, local and federal government / landholders	✓	2008–ongoing
		Fence off priority riparian areas on Crown land with minimum 50:50 funding from government (dependent on future negotiations with Department of Lands) ~	State, local, federal government (depending on owner of land) / landholders	✓	2008–ongoing

Objectives	Action type	Actions	Responsibility	Identified costs (✓ within program costs)	Likely timing
Minimise the impact of erosion of river and creek banks through stock exclusion – by establishing off-stream watering, vegetation management and, where appropriate, in-stream works. Support the coordination and implementation of these activities. [26]	Future investigation	Investigate difference in impacts of dairy and beef cattle in creeks and in different stream environments ^	Contractor (scientist) with input from catchment management practitioners	60,000	2013–15
	Future extension	Establish demonstration farms and field days to demonstrate best practice riparian management and technical aspects of off-stream watering design (pipes, pumps, troughs) ~ !	Catchment management practitioners	✓	2008–ongoing
		Provide landholders with information on the importance of large woody debris and existing information on best management practice. Recommend landholders seek professional advice on the legalities associated with and management of large woody debris *	Catchment management practitioners	✓	2008–ongoing
	Future on-ground	Priority fund fencing, weed control and off-stream watering systems on 3rd, 4th and 5th order streams ~	State, local and federal government / landholders	✓	2008–ongoing
		Priority fund active erosion sites focussing on vegetation management and stock control, particularly in areas of highly erodible soils and steep land. Where in-stream erosion is the underlying cause of bank erosion, undertake appropriate in-stream works based on professional advice ~ * #	State, local and federal government / landholders	✓	2008–ongoing

26 Absentee landholders establishing off-stream watering systems should consider alternative 'fool proof' water supplies to ensure animal ethics are protected. When undertaking riparian fencing, weed control remains the responsibility of the landholder. Ongoing weed control should always be discussed with the landholder during the establishment of projects involving riparian fencing.

Objectives	Action type	Actions	Responsibility	Identified costs (✓ within program costs)	Likely timing
		Fund technical expertise to design and manage erosion / mechanical bank stabilisation projects ^ #	State, local and federal government	✓	2008–ongoing
		Fund off-stream watering without permanent riparian fencing if alternative shade is available and the riparian areas are not at risk. This will assist with a faster uptake of improved riparian management on lower order streams ~ * #	State, local and federal government / landholders	✓	2008–ongoing
		Fund temporary fencing for gullies (until significant revegetation and stabilisation has occurred) to restrict cattle movement where alternative shade is available ^	State, local and federal government / landholders	✓	2008–ongoing
		Fund solar pumping systems to encourage greater uptake of off-stream watering systems for riparian management ~	State, local and federal government / landholders	✓ [27]	2008–ongoing
		Fund mobile shade to manage the spread of nutrients across the farm, manage groundcover and alleviate erosion – particularly applicable in situations where alternative shade is not available when the creek is fenced off ~ * ^	State, local and federal government / landholders	✓ [28]	2008–ongoing
		Promote and protect shade trees *	Catchment management practitioners / landholders	✓	2008-ongoing

27 The additional cost of solar pumps compared to standard pumps has not been costed in the program costs.
28 The cost of mobile shade has not been costed in the program costs.

Wetland management					
Protect natural wetlands from grazing pressures supporting their natural abilities to filter nutrients and sediments !	Future investigation	Collate relevant information on the benefits of maintaining natural wetlands (economic and environmental examples) ~	Catchment management practitioners	✓	2008–ongoing
		Identify the most effective locations to protect and rehabilitate freshwater and coastal wetlands for water quality improvement, including identifying wetlands at risk or with high nutrient loads ~	Contractor with input from catchment management practitioners	40,000	2010–12
		Undertake research on wet pasture management to determine if wetlands can be used as a paddock when managed appropriately (taking into account wetland type, species composition, stocking rates, timing of use)	Contractor with input from catchment management practitioners	20,000	2009–11
		Develop a case to the Department of Lands to establish a lease condition to fence off wetlands on Crown land ~	Contractor with input from catchment management practitioners	2,000	2010
	Future extension	Develop and implement a training package that promotes the benefits of maintaining natural wetlands and outlines appropriate management (field days, information sessions, establish subsection to existing programs such as Prograze, LANDSCAN and sustainable grazing program). Target field days and training to different wetland types ~	Catchment management practitioners	✓	2009–ongoing
		Provide one-to-one advice to landholders on how to manage their wetlands, including avoiding the exposure of acid sulfate soils and the use of buffer strips ~	Catchment management practitioners	✓	2008–ongoing

		Provide one-to-one advice on how to incorporate wetland management into whole-farm planning to increase uptake of wetland rehabilitation ~	Catchment management practitioners	✓	2008–ongoing
		Establish wet pasture management trials to support research findings on wet pasture management ~	Catchment management practitioners	✓	2009–ongoing
	Future on-ground	Protect wetlands by establishing a specific funding source for Property Vegetation Plans so that wetlands do not have to compete with other remnant vegetation in the assessment process ~	CMA and associated state and federal funding body	✓	2010–ongoing
		Provide incentive funding to landholders to fence wetlands (only to be used as for system grazing / crash grazing) ~	State, local and federal government / landholders	✓	2008–ongoing
		Priority fund rehabilitation and protection of wetlands that are at risk of high nutrient levels ~	State, local and federal government / landholders	✓	2010–ongoing
		Protect and rehabilitate estuarine wetlands and mangroves as the 'last frontier' of nutrient management, including establishing specific funding mechanisms (including revolving funds) to buy back significant wetland areas ~ # *	State, local and federal government / landholders	✓	2008–ongoing
		Fund rehabilitation and protection of natural wetlands by fencing out stock, providing alternative watering points and shade, revegetation, reinstating natural flow regimes (including installing tidal flow floodgates if drains are in place), and establishing buffer strips around wetlands ~ *	State, local and federal government / landholders	✓	2008–ongoing
		Protect and rehabilitate high water management and conservation value wetlands through direct acquisition, incentives and revolving fund schemes for inclusion in the conservation estate <	State, local and federal government / landholders	✓	2008–ongoing

Groundcover management					
Improve management of grazing on steep land (slope greater than 18°) to maximise groundcover and minimise the impact of erosion in these areas	Future investigation	Research the local productivity of steep lands and investigate the profitability of changing to a land use that has less impact on water quality ~	Contractor with input from catchment management practitioners	10,000	2010–12
		Investigate the possibility of providing rate rebates for excluding grazing from steep land and gullies. Support the reafforestation of these areas ~	Contractor with input from catchment management practitioners	2,000	2010–12
	Future extension	Expand existing grazing management programs to implement an education and awareness program on maintaining groundcover on steep land ~	Catchment management practitioners	✓	2008–ongoing
		Provide training on hazard reduction burning appropriate to steep grazing land using the package developed by the federal government ~	Rural fire service		2008–ongoing
		Promote whole-farm planning and management to support even grazing of steep lands incorporating strategic fencing, temporary fencing of gullies, crash grazing, off-stream watering points and shade. Promote resting of steep grazing land during high rainfall periods (autumn) ~	Catchment management practitioners	✓	2008–ongoing
		Promote tax incentives that are available with voluntary agreements for conservation of vegetation #	Catchment management practitioners	✓	2008–ongoing
	Future on-ground	Provide funding for strategic off-stream watering, shade and fencing (e.g. temporary fencing) to allow better management of grazing on steep land. Assessments would be made on a case-by-case basis ~	State, local and federal government / landholders	✓	2008–ongoing

		Undertake whole-farm planning and management to support even grazing of steep lands incorporating strategic fencing, temporary fencing of gullies, crash grazing, off-stream watering points and shade. Promote resting of steep grazing land during high rainfall periods (autumn) ~	Landholders, catchment management practitioners		2008–ongoing
		Expand dung beetle release and monitoring program ~ # *	Catchment management practitioners, landholders	✓	2008–ongoing
Maintain dense groundcover with appropriate stocking rates, appropriate fertiliser application rates, watering point distribution, shade, fencing, supplements	Future investigation	Identify the most appropriate method for informing landholders of appropriate stocking rates ~	Catchment management practitioners, Rural Lands Protection Board	✓	2008–ongoing
		Investigate the possibility of linking soil tests to fertiliser use as part of a training and education program for landholders ~	Catchment management practitioners	✓	2008–09
		Investigate the use of alternatives to chemical-based fertilisers suitable to the local area ~	Contractor with input from catchment management practitioners	5,000	2008
		Further investigation into the effect of providing off-stream shade, water and rotational grazing on water quality and riparian vegetation – including long-term data collection, case studies and demonstration sites ~	Contractor (scientist), catchment management practitioner	20,000	2010–11
		Investigate ways to encourage landholders to better plan for drought, adapt and develop drought management strategies (e.g. workshops, training, incentives), and develop and adopt strategies ~ # *	Contractor or catchment management practitioners	5,000	2009

		Investigate how sequestration of soil carbon could be applied locally in relation to global markets and how incentives could be used to promote soil carbon, especially in relation to groundcover management during drought ~ *	Contractor with input from catchment management practitioners	10,000	2009–10
	Future extension	Implement training and education programs for staff at rural supply stores and real estate agents, on NRM farms in the local area ~ #	Catchment management practitioners	✓	2009–ongoing
		Provide information to landholders on appropriate stocking rates to match feed availability, drought management strategies, nutrient management and pasture management through continued training programs, fact sheets, field days, and visits to established farms with examples of what works locally ~ * #	Catchment management practitioners, Rural Lands Protection Board	✓	2009–ongoing
		Continued training, workshops and field days on sustainable grazing to assist landholders to 'know' their farms, and access appropriate and effective training and workshops, so that they can make informed management decisions about groundcover management. Programs such as these should include subsidies for soil tests and training program costs ~ #	Catchment management practitioners	✓	2008–ongoing
		Implement education programs for staff at rural supply stores on fertiliser management and appropriate application rates, including developing a brochure for distribution with fertiliser ~	Catchment management practitioners	✓	2009–ongoing
		Promote production and environmental benefits of maintaining good groundcover #	Catchment management practitioners	✓	2008–ongoing
		Provide training, field days and information on the types of summer legumes to grow in order to biologically fix nitrogen. Improve soil health and improve the management of the application of fertilisers #	State, local, federal government / landholders	✓	2009–ongoing

		Establish case studies, field days and training for landholders on optimising the use of improved pastures and nutrient applications, such as silage of high-growth summer pastures for feed-out in winter #	State, local, federal government / landholders	✓	2009–ongoing
	Future on-ground	Expand dung beetle release and monitoring program ~ # *	Catchment management practitioners / landholders	✓	2008–09
		Fund off-stream watering at strategic locations to encourage grazing away from riparian areas ~ * #	State, local, federal government; catchment management practitioners, landholders	✓	2008–09
		Fund mobile shade where alternative shade is not provided, as an interim measure until permanent shade is established, to encourage even grazing away from riparian areas # ~ *	State, local, federal government / landholders	✓	2009–ongoing
Steep land protection					
	Future investigation	Explore mechanisms for protecting and rehabilitating steep lands including, but not limited to, options for land use change <	State, local, federal government	10,000	2009–ongoing
Farm infrastructure management					
Minimise the impact of erosion of dams and maximise their ability to filter nutrients through good design, construction and maintenance	Future investigation	Investigate the possibility of requesting development approval and technical certification for construction of all new dams in the Rural Residential and Rural 1a zones in GLC, GTCC and GSC ~	Relevant agencies (e.g. GLC / GTCC / GSC / CMA)	✓	2009–10
	Future extension	Develop a training package for contractors and drivers involved in earthmoving works on private land, including an accreditation scheme linked to a training program that identifies appropriately trained staff # ~	Contractor with input from catchment management practitioners	30,000	2009–10

		Expand education and training program for landholders including demonstration farms of good dam maintenance, construction and design ~ *	Catchment management practitioners, landholders	✓	2009–ongoing
		Develop and distribute a dam building and maintenance, and constructed earth works brochure, attaching information from DWE on harvestable rights *	Catchment management practitioners	✓	2009
		Train Development Assessment planners on the application of harvestable rights so that they are taken into account when assessing subdivisions ~	GLC / GTCC / GSC	✓	2008–ongoing
	Future on-ground	Fund alternative energy pumping systems (e.g. wind or solar) to encourage greater uptake of off-stream watering systems ~	State, local, federal government; catchment management practitioners, landholders	✓	2009–ongoing
		Fund dam removal if they are not functioning effectively (as they may be a source of nutrients and sediments) ~	State, local, federal government; catchment management practitioners, landholders	✓	2008–ongoing
		Continue to provide funding to limit stock access to dams especially the spillway and dam wall ~. When entire dams are fenced off, provide funding for off-stream watering including alternative energy systems #	State, local, federal government; catchment management practitioners, landholders	✓	2008–ongoing

Minimise the impact of farm infrastructure (roads, buildings, dams, etc.) on water quality with appropriate design, construction and maintenance	Future extension	Provide training to contractors (such as earthworks operators) involved in establishing farm infrastructure ~	Contractor with input from catchment management practitioners	10,000	2009
		Develop and provide training to contractors on design and maintenance of tracks on steep lands ~ Note: this action should be incorporated into a whole package of training	Contractor with input from catchment management practitioners	10,000 annually	2010–ongoing
		Develop an accreditation or licensing scheme linked to a training program that identifies appropriately trained contractors – this could be used as priority contractors when implementing incentive funding ~ *	Contractor with input from catchment management practitioners	5,000	2009
		Promote whole-farm planning and management with landholders to ensure farm infrastructure is located, constructed and maintained to minimise erosion and associated water quality impacts ~ *	Catchment management practitioners, landholders	✓	2008–ongoing
		Develop and implement training and education programs for staff at rural supply stores, Council officers and real estate agents on appropriate farm management * ~	Catchment management practitioners	✓	2009
		Design farm tracks and creek crossings to suit local conditions, minimise erosion and allow access for farm machinery ~	Catchment management practitioners, landholders	✓	2008–ongoing
	Future on-ground	Improve laneway management in high traffic areas (more than 80 cows) and divert laneway runoff so that it flows into paddocks rather than creeks. Provide funding for upgrading laneways and stock crossings to minimise their impact on water quality ~ ^	Catchment management practitioners, landholders	✓ [29]	2008–ongoing

29 The cost of the materials for upgrading laneways and stock crossings has not been covered in program costs, as they vary considerably from one property to another. However, the cost of advice has been included.

Nutrient management					
Appropriate nutrient application and storage	Future investigation	Undertake an independent audit of the nutrient management advice provided to landholders, including an assessment of the appropriateness of the recommended application rates and fertiliser types for the local area. Based on the audit findings, consider revising the recommendations *	Contractor with input from catchment management practitioners	20,000	2009
	Future extension	Staff who provide advice on fertiliser and chemical application and type should be trained under existing programs that cover a range of different fertiliser types and appropriate application rates, such as FertCare ^ ~	Catchment management practitioners		2008–ongoing
		Inform rural supply stores about the soil sample interpretation services available through DPI and other independent services ~	Catchment management practitioners	✓	2008
		Continued subsidies for fertiliser management training programs, such as Prograze, including subsidies for soil tests ~	Catchment management practitioners; state, local, federal government	✓	2008–ongoing
		Collate fact sheets on the use of alternatives to mineral fertilisers to assist landholders to ask appropriate questions of people providing advice on suitable fertilisers and application rates (in order to yield advice on the range of options available, including mineral and organic fertilisers) *	Contractor with input from catchment management practitioners	5,000	2009
		Establish fertiliser trial programs and field visits to trial sites to demonstrate the effectiveness of different fertilisers, including alternatives to mineral fertilisers ~	Catchment management practitioners, landholders	✓	2009

	Future on-ground	Subsidise soil tests and encourage the use of leaf analysis for landholders and promote their use. Where appropriate, build soil test results into whole-farm planning programs, linking the results to feed availability including the type and quality of the pasture, and how this relates to stocking rates ^ * #	Catchment management practitioner	✓	2008–ongoing
Appropriate management of human and animal effluent	Future investigation	Investigate the effectiveness of alternative animal and human effluent management systems that minimise water quality impacts ~	Contractor, appropriate research bodies	15,000	2009
		Investigate the appropriate management of high-use and high nutrient areas on farms (e.g. laneways, creek crossings, feed paddocks) including laneway construction methods ~	Contractor with input from catchment management practitioners	10,000	2008–ongoing
	Future extension	Extend the program of training landholders on nutrient budgeting linked to funding soil tests ~ ^	State, local, federal government	✓	2009–ongoing
	Future on-ground	Expand dung beetle release and monitoring program ~ # *	Catchment management practitioners, landholders	✓	2008–ongoing
		Provide funding and undertake upgrades of animal effluent management systems ~	State, local, federal government; landholders	4	2008–ongoing
		Provide funding for and upgrade laneways and stock crossings to minimise their impact on water quality ~ ^	State, local, federal government; landholders	4	2008–ongoing
		Encourage the establishment of nutrient containment areas for storage of nutrients away for waterways (e.g. bunding around chicken litter) ^	Catchment management practitioners, landholders	✓	2008–ongoing

Identify ways to maximise denitrification processes at the farm scale.	Future investigation	Investigate how denitrification works locally in relation to soil types and particular areas of the catchment. Identify areas where maximum benefits can be achieved ~	Contractor with input from catchment management practitioners	40,000	2012–14
		Investigate the role of dams in denitrification and the appropriate design to maximise this function ~	Contractor with input from catchment management practitioners	20,000	2012–14
		Investigate actions (at the farm scale) that could maximise denitrification processes (e.g. creation of low-lying sinks in paddocks), and consider how these will relate to harvestable rights ~	Contractor with input from catchment management practitioners	5,000	2012–14
	Future extension	Once investigations are complete, develop case studies and education material suitable for inclusion in existing education programs that demonstrate the areas on farms where denitrification can be maximised, including the role of dams and wetlands in this process ~	Catchment management practitioners, landholders	✓	2015
	Future on-ground	Once investigations are complete, fund adaptation of farms to achieve denitrification ~	State, local, federal government; landholders	✓	2015
Encourage the wider distribution of chicken litter to minimise the point-source contribution to the rivers from concentrated application	Future investigation	Scope the options for extending use of chicken litter beyond localised areas – including the suitability of a transport subsidy for people using chicken litter, linked to a DPI course that demonstrates the appropriate rate and approach to its application ~	Catchment management practitioners	✓	2009–ongoing
		Subsidise the mixing of chicken litter with mulch or develop a program of using green waste from the tip so that the litter can be used in urban areas ~	State, local, federal government	✓	2009–ongoing

	Future extension	Training, education and awareness-raising on use of chicken litter on rural properties, including advantages and disadvantages. This would involve the wider distribution of existing information about appropriate use and storage ~ #	Catchment management practitioners	✓	2008–ongoing
		Encourage the bagging of chicken litter, linked to training for use in urban areas ~	Catchment management practitioners	✓	2009–ongoing
		Establish demonstration farms to highlight how chicken litter can be used responsibly from economic and environmental perspectives #	Catchment management practitioners		
	Future on-ground	Subsidise soil tests for landholders using chicken litter linked to relevant training program covering chicken litter management ~	State, local, federal government	✓	2009–ongoing
		Implement best practice management guidelines for the use and storage of chicken litter (location of storage, silt traps, bunding)	Landholders, catchment management practitioners	✓	2008–ongoing

~ Input from Rural Management Practice Technical Group.
* Input from Landholder Reference Group.
\# Input from landcare groups and landholder workshops / CCI Landholder Survey.
^ Mid Coast Dairy Advancement Group.
< Great Lakes Coastal Catchments Initiative Advisory Committee.
! Other community groups.

Note: It will be necessary to seed additional funding to enable the actions identified for contractors to be undertaken.

3.3.3 Recommendations for management of unpaved roads

As described in Sections 2.7.1 (Wallis Lake) and 2.15.1 (Myall Lakes), remediation of unpaved roads were initially considered as part of the modelling analysis. Scenarios were focussed on the Wallamba River (Wallis Lake) and Crawford River (Myall Lakes) sub-catchments, and modelled results suggested that road remediation actions would reduce exports from roads in these sub-catchments by 4% and 13%, respectively. However, modelled changes would have little impact on the total catchment loads (≤2% of total load reductions) and an equally minor impact on estuary condition. The estimated costs of sealing roads were also considered and were identified as being prohibitively expensive to implement at the broad scale.

While this plan focuses on the impacts of land management activities on estuary condition, it is recognised that at the scale of the creek or river, water quality and ecology can be severely impacted by large volumes of sediments being transported from roads during periods of rain. This is particularly the case when the water flows into sensitive creeks and wetland areas. It is in this context that the plan recommends that best practice unpaved road maintenance and design be implemented, and future research be undertaken to identify priority areas for rehabilitation to address the impacts of unpaved roads on rivers and local wetlands. Details of these recommendations are described in Table 3.3.3.

Table 3.3.3. Action plan for rural road management.

Objectives	Action type	Actions	Responsibility	Identified costs
Rural road management				
Reduce sedimentation from rural roads with appropriate maintenance of sediment and erosion control features, and undertake road repairs and sealing in identified high-risk areas	Future investigation	Undertake risk analysis to identify where unsealed roads are highest risk to water quality, prioritise roads for management <	Land management agencies (NPWS, GLC, GTCC, NSW Forests)	10,000
		Identify and trial alternative management options for reducing sedimentation from unsealed roads (including options that are cheaper than sealing) <	Land management agencies (NPWS, GLC, GTCC, NSW Forests)	30,000
	Future extension	Develop and provide training to agency staff involved in maintaining rural roads ~ *	Land management agencies (NPWS, GLC, GTCC, NSW Forests)	100,000
		Develop an accreditation scheme linked to a training program and performance reviews that identifies appropriately trained staff ~	Land management agencies (NPWS, GLC, GTCC, NSW Forests)	20,000
	Future on-ground	Ensure that best practice road maintenance and construction are used (including appropriate sediment and erosion control practices such as mitre drains) * # <	Independent audit (GLC, GTCC, NPWS, NSW Forests)	80,000
		Close and rehabilitate unused roads (e.g. ex-forest roads on NPWS land) where they are not required for access for bushfire management and control <	Land management agencies	[30]

30 The cost of rehabilitating roads has not been included in program costs, as the costs were considered prohibitive in relation to the ecological impact on the lakes. The impacts of unsealed roads are likely to be significant in the nearby creeks. The action of rehabilitating these areas should therefore be pursued when funding becomes available. At this stage, the actual costs of works are unable to be identified, as risk analysis is required to determine the amount and nature of the repair works required.

Objectives	Action type	Actions	Responsibility	Identified costs
		Undertake road repairs and sealing of section of 'high-risk' unsealed roads identified through future investigation, with particular focus on creek crossings and approaches <	Land management agencies (GLC, GTCC, NPWS, NSW Forests)	As above
		Design creek crossings to minimise erosion and sedimentation of the creek with input from fisheries *	Land management agencies (GLC, GTCC, NPWS, NSW Forests)	

~ Input from Rural Management Practices Technical Group.
* Input from Landholder Reference Group.
# Input from landcare groups and landholder workshops / CCI Landholder Survey.
^ Mid Coast Dairy Advancement Group.
< Great Lakes Coastal Catchments Initiative Advisory Committee.

3.4 Catchment management in urban areas

3.4.1 Summary of existing urban water quality management

There has been a high level of awareness of the impact of urban stormwater runoff on the lake systems of the Great Lakes, particularly Wallis and Smiths lakes, for some time. This awareness had it origins in the response to largely negative impacts of runoff from urban areas, including local issues such as the Forster Keys water quality investigations of the early 1990s, concerns over poor sediment and erosion management practices both on private lands and public roads, acid soil runoff, recognition of the importance of good catchment management following the hepatitis A contamination, and substantial planning and investigation work associated with the Wallis Lake Catchment Plan and the Wallis Lake Estuary Plan. At the same time, community expectations to address water quality issues developed in response to local degradation and water quality concerns.

Work associated with the development of the Wallis Lake Catchment Plan identified the importance of addressing increasing nutrient loading of the lake system and the finite capacity of these natural systems to assimilate the loads. Nitrogen was identified as the key limiting nutrient, and work by Dr Graham Harris (CSIRO) and others highlighted that, in the case of Wallis Lake, the nutrient loads to the system needed to be capped in order to maintain the current healthy modified classification.

The management response by Great Lakes Council has involved a combination of planning, education and capacity-building, and on-ground retrofitting to start the process of reversing the decline in water quality associated with unmanaged stormwater flows and pollutant loading.

3.4.1.1 Planning response

The planning response has included:

- Wallis Lake Stormwater Source Control Strategy 1999
- Forster / Tuncurry and Wallis Lake Stormwater Management Plan, 2000
- Wallis Lake Estuary Management Plan, 2003
- Wallis Lake Catchment Plan, 2002
- Draft WaterWise DCP, 2004.

The most influential policy change has been the establishment of water quality objectives aimed at capping the continual increase in nutrient and pollutant load entering poorly flushed waterways of Wallis, Myall and Smiths lakes. A ‘no net increase’ objective was

applied for all new development in the Pipers Creek and Pipers Bay catchments, southern Wallis Lake, Smiths Lake, and Bulahdelah. Developments in other areas must meet the EPA standards (80% reduction in suspended solids, 45% reduction in nitrogen and 45% reduction phosphorus). The response to the objectives has been adaptive in nature as the understanding of the requirements, modelling tools and treatment responses have advanced. The operational outcomes of the objectives are:[DG110]

All rezonings (urban, rural residential, industrial and commercial) must be able to demonstrate, using MUSIC modelling, that the land is capable of development by achieving the water quality objectives and that a sustainable treatment train is available to meet the water quality objectives. Proponents are required to incorporate WSUD at source solutions rather than the sole reliance on a downstream catchment-based solution.

Development applications involving a significant increase in impervious surfaces must demonstrate, using MUSIC modelling, compliance with the water quality objectives. Proponents engage water quality specialists / hydrologists to develop a water quality strategy and plan that details:

- pre and post-pollutant export
- performance of the proposed treatment train to meet water quality objectives.
- design details of treatment train measures.
- maintenance requires
- monitoring and reporting measures.

3.4.1.2 On-ground projects

The stormwater management plans developed in 2000 identified key urban catchments requiring retrofitting to addressing existing water quality issues. These catchments were developed prior to the requirement for stormwater quality planning and management considerations. Installation of constructed wetlands, gross pollutant traps and pit-based controls have focussed on the Pipers Creek catchment, Muddy Creek, Breckenridge catchment and the urban CBD areas where pit inserts have been installed. These projects have been funded through state and federal grants, as well as local government sources. Stormwater quality assets include eight constructed wetlands, three gross pollutant traps and over 100 pit insert devices.

3.4.1.3 Education and awareness

Grant funding through the NSW Stormwater Trust was obtained to commence a stormwater quality awareness project in 2000/01. This project focussed on increasing the general awareness of the impacts of stormwater on the lakes system and the significance of behavioral change to complement stormwater quality improvement devices. Education and community involvement were key recommendations of the Wallis Lake catchment Plan and the Stormwater Management Plan. This program evolved to form the Healthy Lakes Program, incorporating education for sustainability. This program is now a core program of Council funded through the Environmental Special Rate.

The program is managed by a full-time Sustainability Education Officer employed to implement the Healthy Lakes Program. To achieve on-ground change that is both effective and sustainable, the Healthy Lakes Program utilises a combination of five avenues:

- education and partnerships (business partners programs, litter management programs, media advertising, school visits, guest speaking)
- catchment monitoring (community-based seagrass monitoring, water quality and habitat monitoring)
- structural solutions (wetland construction, litter baskets, gross pollutant traps)
- strategic planning (water-sensitive urban design, stormwater management plans)
- enforcement (*Protection of the Environment Operations Act 1997* in collaboration with council rangers).

The Healthy Lakes Program addresses many of the issues that affect local water quality, which consequently affect the economic and ecological viability of the area, and the local quality of life for tourists and residents. Since the inception of the Healthy Lakes Program, annual and project specific surveys have highlighted an increase in the overall level of community awareness regarding water quality issues. Partnership programs have gained considerable support, highlighting the ability of councils and communities to work collaboratively to manage their local environment. This includes over 120 local business, several community seagrass volunteers and 15 water quality monitoring (Waterwatch) volunteers.

The Healthy Lakes Program is designed as a long-term program offering support, guidance and involvement opportunities for the local community. To do this, the program needs to continually discover new avenues in which to encourage various community sectors to be involved in looking after their local environment.

3.4.2 Future urban area management

Most of the observed decline in the lakes' 'health' is a result of changes in the lakes' catchments. Urban and dense rural residential [31] areas make a contribution to these impacts out of all proportion to their area, and are the dominant influence in some locations (notably the urban areas of Forster in the Pipers Bay sub-catchment of Wallis Lake) (Section 2.6.2.2). Improvements to management urban and dense rural residential areas therefore have a fundamental role to play in the Great Lakes Water Quality Improvement Plan.

Four kinds of urban area management are discussed below:

1. *Development of Greenfield sites:* new urban and dense rural residential development occurring on rural land
2. *Redevelopment of established urban and dense rural residential areas:* new urban development occurring in established urban areas
3. *Managing construction sites:* a temporary land use (typically active as highly erosive surfaces for two years) whenever urban or dense rural residential development is occurring
4. *Managing established areas*: urban and dense rural residential land continuing without redevelopment. In these locations, incremental opportunities to improve public infrastructure will be taken (e.g. in road reconstruction); a retrofitting program is planned for Pipers Bay sub-catchment.

Recommendations for management of each of these cases are outlined in the following sections.

To develop these recommendations, Council staff and representatives of other stakeholders (notably developers, community groups, MidCoast Water, and NSW Government agencies) were consulted through a series of workshops. These consultations have been supported by detailed scenario modelling for urban areas by BMT WBM (2008), linked to intensive lake and catchment modelling by DECC and iCAM; Sections 2.7 (Wallis Lake), 2.11 (Smiths Lake) and 2.15 (Myall Lakes).

31 Dense rural residential development is defined here as rural residential development serviced by both town water and sewerage; lots are typically 1 to 2 ha in area.

3.4.2.1 Targets for urban and dense rural residential development

Table 3.4.1 lays out the quantitative definitions of the targets for urban and dense rural residential land that have been adopted in the Water Quality Improvement Plan. Table 3.4.2 indicates which targets apply to particular locations.

The recommendations in Table 3.4.2 derive from two considerations: (i) what do the lakes need? (to answer this question we model catchment-lake systems and ask how well the catchments need to perform to protect or rehabilitate the lakes); and (ii) what can we achieve in practice as urban land managers? (what is current best practice with water-sensitive urban design, etc.). The underpinnings of the targets are:

- for many areas of the lakes, the management goal is protection from further impacts. The target 'no net increase in sediment and nitrogen loads' derives from this. The intent is to manage land use change conservatively, so as not to drive lake decline; Sections 2.6 (Wallis Lake), 2.10 (Smiths Lake) and 2.14 (Myall Lakes)
- best practice load-based reduction targets that are expected to be adopted state-wide as a minimum standard for urban development. They prescribe pollution removal efficiencies that are achievable with affordable current best practice (BMT WBM 2008). These will produce a net improvement in pollution loads from established urban areas (as past urban design practice has been less demanding)
- for the rezoning or development of Greenfield sites, the best practice load-based reduction targets are not demanding enough, as land developed to the best practice load based reduction targets exports considerably more pollution than agricultural land or bushland (Figure 3.4.1; BMT WBM 2008). In those locations, their adoption would drive decline in the lakes, so 'no net increase' is the target for these areas; Sections 2.6 (Wallis Lake), 2.10 (Smiths Lake) and 2.14 (Myall Lakes). Experience to date indicates that this is achievable in practice, both technically and financially (i.e. land developed to these standards is affordable; BMT WBM 2008).
- targets for dense rural residential development are the same as those for urban development (BMT WBM 2008).
- for developed areas in Pipers Creek and Pipers Bay, adjacent to Forster, the target is current best practice (Section 2.6.2.2).
- the targets for construction sites (Table 3.4.1) are best practice targets based on US field research and Australian experience. We are not well placed to quantitatively assess their suitability to places like lower Wallis Lake (where a major sediment incident has led to enduring damage to seagrass beds). Adopting them would, however, lead to improvement in current practice in the Great Lakes CCI area.

Table 3.4.1. Quantitative definitions of catchment water quality targets.

Target	Definition
Best practice load-based reduction targets	• 80% total suspended solids reduction • 45% total phosphorus • 45% total nitrogen reduction when compared to the unmitigated developed scenario.[a] This is current best practice performance, with existing WSUD technologies.
No net increase for Greenfield sites	For rural and forested sites, modelling will be used to estimate current site performance, and the modelled performance will be the target for urban and dense rural residential development.
CRCCH targets for construction sites	• 60–85% reduction in total suspended solids [b]

a: BMT WBM (2008).
b: Taylor (2002).

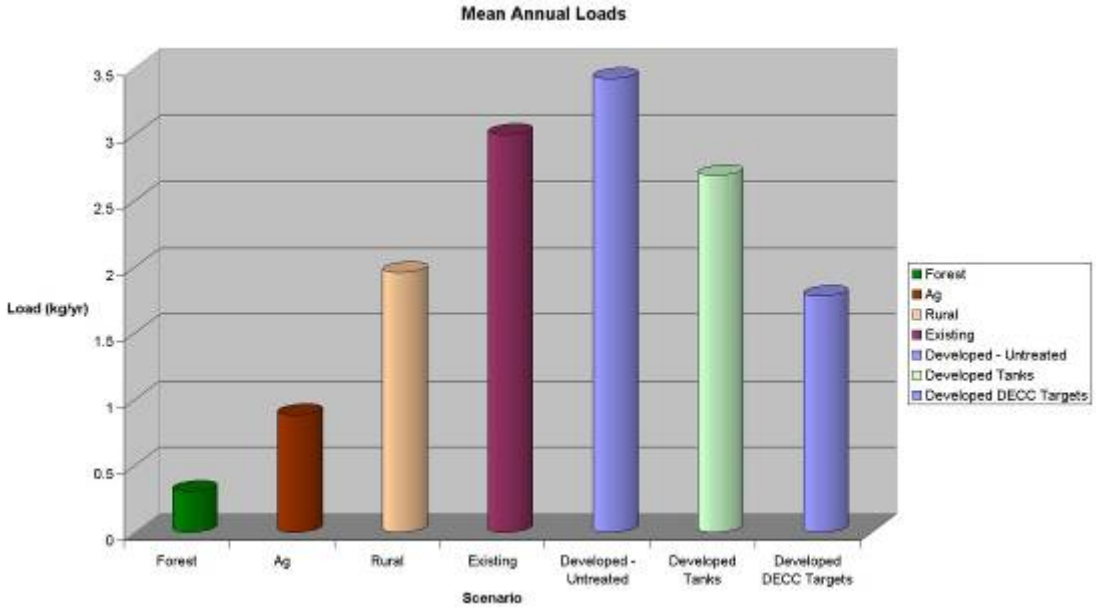

Figure 3.4.1. Comparison of loads from various land use scenarios (Source: BMT WBM 2008).

Note: The modelling presented here only takes into account the operational phase of Greenfield developments, and therefore does not account for construction-phase impacts. These impacts are very much dependent on implementation of erosion and sediment control programs within the GLC region (see Pollution Control Systems). Further modelling should be undertaken to determine the level of risk associated with developments occurring in particularly sensitive areas of the lakes.

Table 3.4.2. Targets for urban and dense rural residential land development.

Land development matrix *Kind of transformation:* *blue – no change* *green – Greenfield development* *yellow – redevelopment* *brown – construction*			**Kind of development**			
			No redevelopment	*New urban development*	*New dense rural residential development*	*Construction site*
	Rural land and forest		*(see rural strategy)*	• No net increase	• No net increase	• CRCCH targets [a]
	Large lot rural residential		*(see rural strategy)*	• No net increase	• No net increase	• CRCCH targets
Starting from	*Dense rural residential*		• Gradual improvements through road reconstruction, education, etc.	• No net increase	• No net increase	• CRCCH targets
	Established urban	*General case*	• Gradual improvements through road reconstruction, education, etc.	• Best practice load-based reduction targets	*(does not occur)*	• CRCCH targets
		Buladelah and other towns in the catchment of the Myall Lakes	• Gradual improvements through road reconstruction, education, etc.	• Best practice load-based reduction targets urban areas, or no net increase, whichever is more demanding [b]	*(does not occur)*	• CRCCH targets
		Catchment of Pipers Creek and Pipers Bay	• Improvements from Pipers Creek catchment retrofitting program • Gradual improvements through road reconstruction, education, etc.	• Best practice load-based reduction targets [c]	*(does not occur)*	• CRCCH targets

a: These targets derive from Taylor (2002).
b: In the Myall Lakes, tidal exchange occurs slowly, so urban development needs to be undertaken with particular care, given their importance as Ramsar wetlands.
c: A significant improvement on 'no net increase' in these locations, given the development history.

3.4.2.2 Planning controls for development

The Water Sensitive Urban Development and Design Strategy is one of the products of the Great Lakes Coastal Catchment Initiative (CCI). This Strategy sets directions for urban land (and dense rural residential land) so that these areas are managed in ways that protect the lakes' water quality. To develop the Strategy, the project team: (i) explored the literature, identifying options and barriers; (ii) held workshops with staff from Great Lakes Council, Greater Taree Council, MidCoast Water, Hunter-Central Rivers CMA, DECC, Hunter Councils and representatives of a variety of other groups – notably businesses involved in the land development industry and environment groups; and (iii) consulted with the CCI Project Advisory Committee and Great Lakes councillors.

Under the Water Sensitive Urban Development and Design Strategy, the primary tools for delivering water-sensitive urban and dense rural residential development under the WQIP are Local Environmental Plan (LEP) provisions and Development Control Plan (DCP) provisions. The LEP will specify principles and objectives that are to be achieved by development. The DCP will offer developers a choice of a 'recipe' to use or a performance standard to achieve.

These tools are foundations. The LEP and DCP provisions will articulate, in general terms, the performance standards to be achieved by developments of all kinds. For larger developments, other planning tools are also important, including:

- Voluntary Planning Agreements (VPA) – project-specific agreements with developers under the *Environmental Planning and Assessment Act 1979*. Where the required water quality management facilities will be on land that is, or will become, public, and will involve ongoing maintenance, the VPA will prescribe the management facilities that will be required as well the funding for ongoing maintenance of the facilities that should be provided to Council. An action stemming from this WQIP will be preparation of a framework for the negotiation of VPAs
- site-specific DCP / Masterplan, that can include provisions relating to the water quality management system that will be required, so that the development will achieve the water quality objective for the receiving water. The process for negotiating the Masterplan / DCP and VPA with developers is described below
- potentially, a Nutrient Offset Scheme; options for this are being evaluated.

Nutrient Offset Schemes let a development have a higher impact than environmental protection standards allow, when the developer funds works to reduce environmental impacts in related locations. More use of development offsets – where more intense development is allowed at one location in return for substantially better environmental

protection elsewhere (e.g. dedication of land to conservation) – is also under consideration through a development offset scheme.

Negotiations are in progress between Great Lakes Council and the NSW Department of Planning to finalise a clause for the Great Lakes LEP regarding lake protection.

At the time of writing, work on DCP provisions is well advanced – leveraging consultations with stakeholders, and catchment and lake modelling.

Great Lakes Council's process for negotiating a DCP / Masterplan and / or Voluntary Planning Agreement during rezoning

Key areas of land are identified for urban release in Council's conservation and development strategies. Once identified, Council seeks the support of the Department of Planning to commence the formal rezoning process, under the *Environmental Planning and Assessment Act 1979*, for the land.

As outlined in Table 3.4.2, when the rezoning process commences for land in catchments that discharge into sensitive receiving waters, developers are required to demonstrate how they will achieve identified water quality targets (i.e. no net increase in nutrients). To achieve this target, developers and Council staff undertake a staged process of negotiation. The outcome of this process will be a Masterplan / DCP for the site, which prescribes the WSUD facilities needed to achieve the identified water quality targets, and / or a Voluntary Planning Agreement under the *Environmental Planning and Assessment Act 1979*.

The staged process is outlined as follows:

Stage 1 – agree baseline condition: The first stage in rezoning Greenfield sites is to agree the 'baseline' condition with the developers; the baseline condition is the basis for the site-specific targets that developers are required to meet on their site (e.g. percentage of forested land to rural land in the release area).

Stage 2 – identify site specific targets: Using the baseline condition identified in Stage 1, urban stormwater modelling is used to determine the nutrient loads from the undeveloped site.

Stage 3 – identify Water Sensitive Urban Design (WSUD) treatments: Using urban stormwater modelling, developers then undergo a process of identifying appropriate WSUD treatments to achieve their targets that inform the DCP / Masterplan. It is at this stage of the negotiations that developers also engage with MidCoast Water to discuss

potable supply, wastewater management and reuse of water on their site. This may result in an overall integrated water cycle management strategy being prepared.

Stage 4 – peer review: Using the information derived from Stages 1 and 2, the developers then prepare a Water Management Strategy that identifies the WSUD devices that are to be used to treat urban runoff from their development. To ensure that the water quality outcomes will be achieved, the developers then fund a review of their Water Quality Management Strategy by independent consultants engaged by Great Lakes Council. Negotiations with GLC staff and consultants occur at this stage to finalise the content of the DCP / Masterplan for the site and the extent to which it incorporates the outcomes of the final Council-endorsed Water Management Strategy.

Stage 5 – negotiations on a VPA. To ensure that there is commitment to the installation of the water quality management facilities identified in the DCP / Masterplan, Council and the developer may negotiate a VPA so as to ensure these facilities, or alternatives that will achieve the same water quality result, are delivered at the development stage. The VPA may also include a commitment by the developer to fund the ongoing maintenance of the water quality management facilities so that any significant financial liability for the ongoing maintenance is not borne by Council.

Stage 6 – submit a DCP / Masterplan: Once the DCP / Masterplan, and if applicable VPA, is agreed with Great Lakes Council staff, the plan is presented to Council for approval and the land is rezoned for future development.

Stage 7 – site development: When the developers are ready to develop their site, they then submit a Development Application, which is assessed against the DCP / Masterplan established. Further detailed negotiation occurs with the developers at this stage.

Local Environmental Plan

For the CCI project, Great Lakes Council has been working with a wide variety of other stakeholders – including developers, community groups, and state government agencies – to develop a Water Sensitive Urban Design Strategy. The conclusion we have reached is that, if land use planning regulations are to make a major contribution to protecting the lakes, LEP clauses will have to play a central role.

The reasoning behind this is as follows.

1. Both SEPPs and REPs could, in principle, provide strong protection of coastal lakes from development, but the NSW government is not planning to introduce a further SEPP or REP that would address the water quality issues for shallow lakes / lagoons.

SEPP 62 – Sustainable Aquaculture (clause 15C) already provides significant powers, as:

2. "A consent authority may refuse to grant consent to development if it is not satisfied that appropriate measures will be taken to avoid or minimise any such adverse effect, impediment or incompatibility [on oyster aquaculture development]."
3. However, SEPP 62 only: (i) has relevance to some parts of Wallis Lake; and (ii) provides a relatively weak control on eutrophication. Although SEPP 62 provides a capacity to control developments that may catalyse blue-green algal blooms in Wallis Lake – because these microalgae may be toxic – serious eutrophication and sedimentation problems (macroalgal blooms, loss of seagrass beds, etc.) can occur without blue-green algal blooms.
4. DCPs do not carry sufficient statutory weight to play a pivotal role. Incremental increases in pollution can ultimately put the lakes' health at risk, and thus there needs to be a consistent, coordinated and disciplined management framework in place. DCP provisions alone will not provide appropriate consistency, as they can be varied as a result of new developer-prepared strategies and / or political influences on council decisions. The discretionary role of a DCP means that the catchment-wide water quality standards underpinning future development may be undermined if they are not consistently applied by a consent authority.
5. Voluntary Planning Agreements can play an important but limited role (particularly when rezoning is involved), as they are project-specific agreements negotiated with large developers. As the name suggests, a developer must be willing to enter into such an agreement of its own volition.

The draft LEP text is provided in Box 1. A key point of discussion is how strongly clause 5 should be worded. The draft text reads "the consent authority may refuse consent to the development of land on land that is wholly or partly within the area specified in this clause unless the consent authority is satisfied that [meets satisfactory water quality management standards]." The Department of Planning has suggested that Council "reword the above as considerations rather than as it stands above" (i.e. eliminate the words "refuse consent" and rephrase so that the above are only matters for consideration under section 79C of the EP&A Act). This approach would appear to substantially weaken the WQIP; more discussion is needed.

Box 1. Draft LEP Clause text

7.2 Water Quality Protection

(1) The objective of this clause to preserve the economic, social and environmental values of waterways, particularly those susceptible to the accumulation of pollutants, from the effects of reduced catchment water quality, including water quality decline caused by water pollution, or by indirect means such as an increase in impervious area, riparian vegetation clearance, erosion and sedimentation, changes in flow patterns, effects of drainage works, or the introduction of invasive flora or fauna.

(2) “environmental values of waterways”, “Water pollution”, “pollution of waters” and “substance” have the same meaning as that defined in the Protection of the Environment Operations Act (1997).

(3) This clause applies to:

a) Land wholly or partly within the catchment of a waterway, or part of a waterway, that is sensitive to pollutants accumulating over time; or

b) Land wholly or partly within the Wallis Lake, Smiths Lake or Myall Lakes catchments.

(4) The consent authority may take into account any influence on water quality relevant to the objectives of this Plan and clause, giving specific consideration to any influences identified in the applicable Development Control Plan.

(5) Notwithstanding any other provisions of this Plan, the consent authority may refuse consent to the development of land on land that is wholly or partly within the area specified in this clause unless the consent authority is satisfied that:

a) waste water or stormwater produced by the proposed development will not adversely impact the waterway values within the area specified in this clause, by reason of water pollution, or changes in vegetation, waterway stability or alignment, flow patterns, and/or the introduction of non-indigenous species of flora or fauna intentionally or otherwise, and

b) the development is capable of controlling the loads and concentrations of pollutants in ways that achieve the objectives of this clause, and

c) the development either:

i. controls pollutants on-site to standards specified in the applicable Development Control Plan and/or adopted storm water management plan/s, or

ii. meets off-setting requirements specified in an offset scheme in the applicable Development Control Plan or an adopted natural resource management plan, and achieves the minimum on-site standards required by the offset scheme; and

d) water sensitive urban design principles are incorporated into the design of the development.

(6) [DG111]For the purposes of Clause 5(d) above, the principles of water sensitive urban design can be summarised as follows:

(a) protection and enhancement of natural water systems (creeks, rivers, wetlands etc.);

(b) protection and enhancement of water quality, by improving the quality of stormwater runoff from urban catchments;

(c) minimisation of harmful impacts of urban development upon water balance and flow regime;

(d) integration of stormwater management systems into the landscape in a manner that provides multiple benefits, including water quality protection, stormwater retention and detention, public open space and recreational and visual amenity; and

(e) reduction in potable water demand by using stormwater as a resource.

(7) When undertaking an assessment required by this clause, the consent authority shall take into consideration the impact of the development in combination with the cumulative impact of existing development and development which may occur in the future in the same catchment or, if appropriate, the same sub-catchment.

Table 3.4.3. Proposed Development Control Plan provisions.

Location	Performance standards	Recipes to achieve performance standards	Other measures	Thresholds at which site specific MUSIC modelling (or similar) is required
Wallis, Smiths and Myall lakes Greenfield sites: All developments on lands classed or considered as native vegetation, forested, agricultural or grazing within catchments draining to Wallis or Smiths Lake (e.g. Figure 3.4.3)	*No net increase* The proponent must demonstrate that no net increase in pollutant loads occurs from developed case, when compared to the existing land use loads; this may require bioretention pods (Figure 3.4.5), bioretention basins (Figures 3.4.6 and 3.4.7), constructed wetlands, etc.			
Redevelopment in all urban areas of Wallis, Smiths and Myall lakes	*Best practice stormwater quality targets* WSUD treatment measures should achieve pollutant load reductions consistent with best practice load-based reduction targets – 80% reduction in TSS, 45% reduction in TP and 45% reduction in TN – when compared to the developed, unmitigated case	• Single dwelling to two lots o rainwater tanks with overflow pits o raingardens • Townhouse / Apartment dwellings – single or double storey ≤ eight apartments o rainwater tanks with overflow pits o raingardens • Small commercial developments ≤ 1,000 m^2 of car park o rainwater tanks o biofilters	*Rainwater and stormwater harvesting* Rainwater and stormwater harvesting techniques should be applied wherever possible, sufficient to provide alternative water sources to potable supplies for uses where potable quality water is not required *Infiltration measures* Infiltration measures should be considered where underlying soil types are appropriate, and where adverse impacts to receiving groundwaters are not likely to occur	• All developments >2,000 m^2 • Townhouse / Apartment dwellings – single or double storey > eight apartments • Small commercial developments > 1,000 m^2 of car park And perhaps additional thresholds to cater for other specific cases where high amounts of impervious surface (and therefore high runoff and pollutant loads) may be created

Source: BMT WBM (2008) (table contents are predominantly direct quotations from this report).

3.4.2.3 Development Control Plan provisions

Water-sensitive urban design performance standards

The targets outlined in Tables 3.4.1 and 3.4.2 are being embodied as performance standards for use in the Great Lakes Development Control Plan (Table 3.4.3). If urban sediment and nutrient loads into the lakes can achieve these standards, this will be sufficient to achieve the identified feasible reductions in chlorophyll-a articulated in the Plan; Sections 2.6 (Wallis Lake), 2.10 (Smiths Lake) and 2.14 (Myall Lakes).

Water-sensitive urban design recipes

Performance standards (unlike prescriptive codes) provide flexibility for developers. However, taking advantage of this flexibility involves relatively complex site-specific modelling. So for smaller developments, it is usually simpler to follow a water-sensitive urban design recipe that has been designed to comply with the performance standards. For the WQIP, recipes are being developed for the following cases:

- redevelopment of, or major renovation to, a single dwelling
- single lot subdivided into two lots
- small townhouse developments (up to eight apartments)
- small commercial developments (up to 1,000 m^2 of car park).

The design recipes have been developed using the MUSIC urban water quality model:

> "conceptual models of each development case were prepared, and a range of different individual treatment measures assessed. These individual measures were then combined such that they achieved the DECC load based reduction targets. All scenarios were presented and discussed with an external industry reference panel in January 2008 who agreed that the scenarios appeared to be a reasonable representation of the development scenarios and the proposed management measures were considered an acceptable requirement in terms of the practicality and cost of implementation on the development industry." (BMT WBM 2008, p. 10)

By way of illustration, for the 'one into two' development, the standard case chosen was an 800 m^2 residential lot with a single 200 m^2 dwelling, driveway and other associated infrastructure. This was being subdivided into two 400 m^2 lots, each with 200 m^2 dwellings, driveways and other associated infrastructure as per Figure 3.4.2.

The ecological and financial implications of using the water-sensitive urban design recipes developed for the DCP are summarised in Table 3.4.4. Redevelopment in accordance with the proposed recipes will significantly reduce loads of sediments,

phosphorus and nitrogen entering the lakes, at a relatively modest cost per property.[DG112]

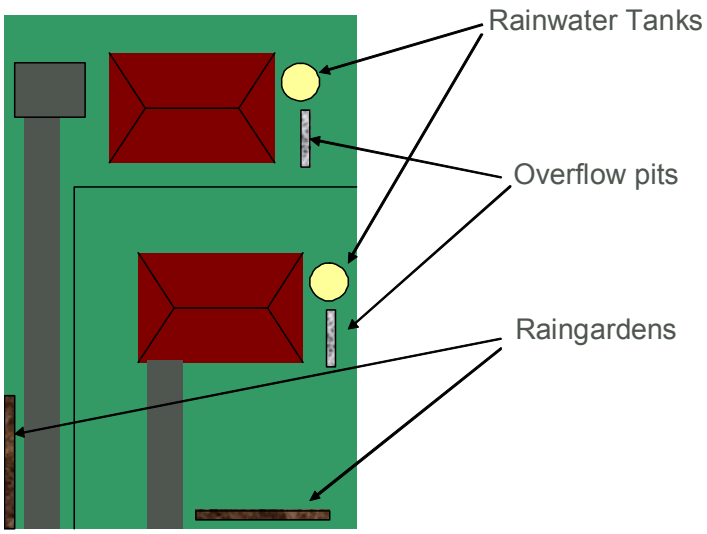

Figure 3.4.2. Single dwelling to two lots – Unmitigated and 'Deemed to Comply' solution (Source: BMT WBM 2008, p. [DG113]11).

Table 3.4.4. Redevelopment scenario results – percentage change from existing case.

Parameter	Scenario					
	2 lots untreated	2 lots 'deemed to comply'	Townhouse untreated	Townhouse 'deemed to comply'	Commercial untreated	Commercial 'deemed to comply'
Flows	+37%	+10%	+18%	-11%	+57%	+42%
TSS	-6%	-89%	-10%	-90%	+130%	-86%
TP	+19%	-54%	+13%	-60%	+98%	-48%
TN	+24%	-32%	+14%	-41%	+55%	-21%
Cost		$16,100		$23,400		$30,900
Cost per property, say …		*$8,050*		*$3,900*		*$6,180*

Source: BMT WBM (2008).

3.4.2.4 Integrated water cycle management

For Greenfield sites, integrated water cycle management in which water supply, sewerage and stormwater are considered together is important, because optimising in one direction may produce a worse outcome overall. For example, recycled water schemes often compete with rainwater tanks, because both can be used for toilet flushing and garden watering. Similarly, rainwater tank installations differ somewhat if stormwater management goals are emphasised alongside reducing demand for mains potable water: they are designed to be somewhat emptier on average, to provide for more stormwater detention.

Masterplans or DCPs for Greenfield sites are a key process in which integrated water cycle management is needed. Table 3.4.5 illustrates the kind of Integrated Water Cycle Management Objectives that can be set as foundations for Masterplans. Effective development of Integrated Water Cycle Management Masterplans includes comparisons of alternative water cycle management scenarios, to identify the design opportunities, and the trade-offs from supply, wastewater and stormwater perspectives of alternative designs.

Procedures for integrated water cycle management (principally, for the Great Lakes, involving teamwork between Great Lakes Council and MidCoast Water) need to play an important role in development control, to achieve satisfactory water cycle management outcomes for the lakes and the community.

Table 3.4.5. Example Integrated Water Cycle Management Objectives.

Objective	Target
Provide flood protection and drainage	• Attenuate runoff to maintain the pre-development peak discharge for the 100-year ARI storm event [a] • Consider the impact of the Probable Maximum Flood event on dwellings • Consider the potential effects climate change will have on flood levels • Minimise impervious area
Protect downstream aquatic systems by preserving the natural hydrological regime of catchments	• Attenuate runoff to maintain the pre-development peak discharge for the 1.5 year ARI storm event [a] • Minimise alterations to natural flow paths, discharge points and runoff volumes from the site • Adopt natural channel designs in lieu of floodways • Maximise stormwater harvesting and reuse where this does not conflict with other objectives • Maintain or improve the existing saltwater community downstream of Oyster Creek

Objective	Target
Treat urban stormwater runoff to remove contaminants	• Suspended solids – 80% retention of average annual load for particles sized 0.5mm or less • Total phosphorus – 45% retention of average annual load [a] • Total nitrogen – 45% retention of average annual load [a] • Litter – retention of litter greater than 50mm for flows up to the 3-month ARI peak flow [a] • Coarse sediment – Retention of sediment coarser than 0.125mm for flows up to the 3-month ARI peak flow [a] • Oil and grease – no visible oils for flows up to the 3-month ARI peak flow [a] • Maximise use of vegetated flow paths • Maximise 'at source' stormwater infiltration where appropriate
Reduce volumes of treated wastewater being returned to the environment	• At least a 20% reduction in wastewater generated on the MCW average of 220 litres / person / day • Recycled wastewater to achieve a standard suitable to the application
Reduce demand on the potable water supply	• At least a 40% reduction on the NSW average of 90.34 kl / person / annum [b] • Demand reduction and alternative sources such as rainwater, stormwater or recycled wastewater to be maximised where this does not conflict with other objectives
Maintain a reliable water supply	• As per MidCoast Water (2005[DG114]), Section 5. However, water quantity targets may be amended in this project subject to approval by MidCoast Water
Maintain a reliable gravity sewerage system	• As per EKA (2001[DG115]) Section 4.3.4. However, sewage quantity targets may be amended in this project subject to approval by MidCoast Water • Gravity sewers are to be graded to be self-cleansing as defined by *NSW Public Works Manual of Practice Sewer Design*, Public Works Department (1987)
Maintain a reliable recycled water system	• As per the water supply targets of MidCoast Water (2005). However, water quantity targets will be amended in this project subject to approval by MidCoast Water • Recycled water to achieve a quality suitable to the application, as per *National Water Quality Management Strategy – Guidelines for sewerage systems, use of reclaimed water* ANZECC & ARMCANZ (2000[DG116]) and *NSW guidelines for urban and residential use of reclaimed water*, NSW Reclaimed Water Coordination Committee (1993)

a: *Australian Runoff Quality*, Chapter 1, Section 1.4
b: BASIX target baseline established on NSW average annual consumption in 2003 – http://www.basix.nsw.gov.au (accessed 11 July 2006).

Source: MidCoast Water (Brendan Guiney, pers. comm. 2008)

3.4.2.5 Nutrient offset scheme

Options for a nutrient scheme are under consideration. Two kinds of legal mechanisms look promising:

- using Voluntary Planning Agreements to provide offsetting options for larger developments

- a scheme established by DECC under the *Protection of the Environment Operations Act 1997*, and administered by Great Lakes Council.

Preliminary results from catchment lakes modelling suggest that a nutrient offset scheme will be appropriate for the catchment of Pipers Creek and Pipers Bay. This is because it appears impossible to achieve the standards needed to improve the condition of these areas using current best practice. An offset scheme could fund a significant retrofitting scheme for this catchment, if the judgement is made that the redevelopment process should be to a standard necessary to achieve the community's targeted outcomes for the lakes.

3.4.2.6 Development Control processes

The planned WSUD DCP provisions include 'performance standards' options for developers, so that rather than follow a recipe provided by Council, they have the opportunity to implement innovative water management options. However, there is a difficulty with this from a Council perspective: assessing a 'performance-based' Development Application is far harder than assessing whether a 'recipe-based' Development Application conforms to a DCP recipe. Where a proposal asserts that it meets specified performance criteria, quite detailed evaluation of the proposal is needed, using the MUSIC model and / or other locally applicable tools. Great Lakes Council does not have sufficient staff with the relevant expertise to meet demand, so in order to provide this option, Council needs to be able to require that developers fund peer review of their modelling. Advice from developers is that they are willing to fund these reviews, providing:

- the process is transparent and fair
- funding peer review significantly speeds up the development assessment process.

3.4.2.7 Managing construction sites

Unmanaged erosion from construction sites releases pollutants into waterways at a rate two orders of magnitude higher than bushland. Key kinds of construction to manage are:

- new urban developments
- new rural residential developments (particularly denser developments)
- Council road works
- water supply and sewerage works.

Regarding Great Lakes Council's current erosion and sedimentation control policy, Weber (2008) commented:

> "Overall, this policy provides appropriate guidance to proponents likely to disturb areas as part of urban development which may then lead to potential exposure of soils. If complied with fully, this should provide an appropriate level of protection equivalent to best practice erosion and sediment control implementation in other areas of the state and across Australia."

However, current implementation of this policy is not strong. In particular, in Great Lakes:

- only roughly half of currently active builders have been through sedimentation erosion control classes
- regulatory effort could (in principle) be a lot higher
- whether a builder has had training, and when they had their last fine, has a big impact on their performance
- performance of Council's own jobs could be significantly higher.

There are significant gains to be made simply from getting implementation of current policy to a better level. Poor management of construction sites will undermine the WQIP:

> "significant efforts in terms of continued awareness, enforcement and evaluation will be required to ensure compliance with Council's current policy will meet best practice performance. Without this, efforts to focus on implementing WSUD in Greenfield and brownfield developments as a method of ensuring the protection of water quality in the Great Lakes region will be severely compromised." (BMT WBM 2008)

Because limited implementation – not weak policy – is what is limiting water quality outcomes, a focus on getting current policy energetically implemented is fundamental. Staff time is the major constraint. WQIP recommendations include:

- shifting from a blitz approach to an ongoing (initially low-key) erosion and sedimentation control auditing program, including auditing Council's own works. Also, evaluate whether the efficiency of Council's own regulatory efforts could be improved by increasing cross-delegations amongst Council staff
- improving the efficiency of Council's current erosion and sedimentation control efforts (both inspections, and on its own works) by an internal audit program
- working cooperatively with other councils and / or state agencies to develop regional or sub-regional erosion and sedimentation control programs, with a view to sharing costs and so delivering these services more cost-effectively.

See Section 3.7 for additional discussion of options.

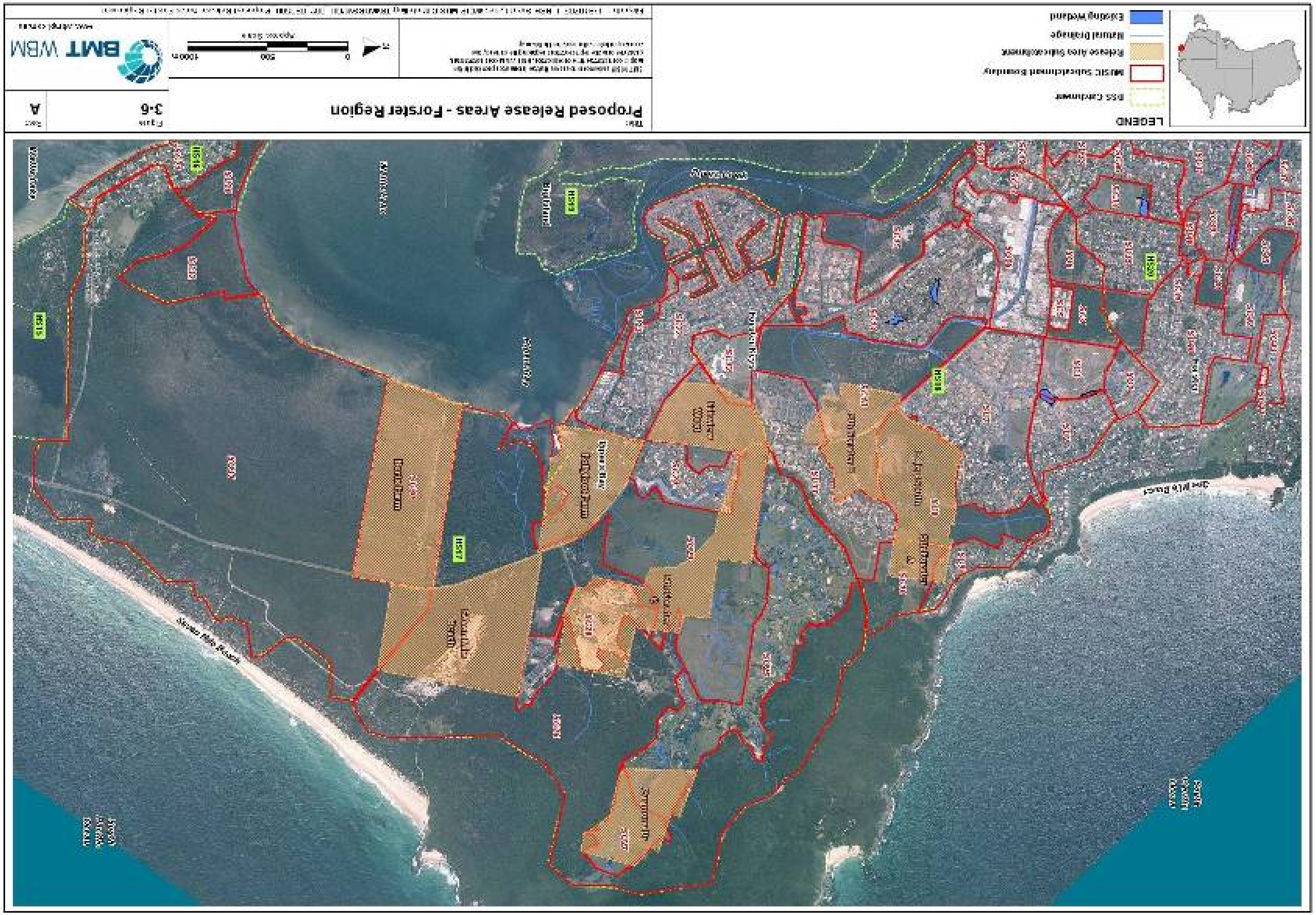

Figure 3.4[pt117].3. Proposed release areas in the Forster region (Source: BMT WBM 2008)

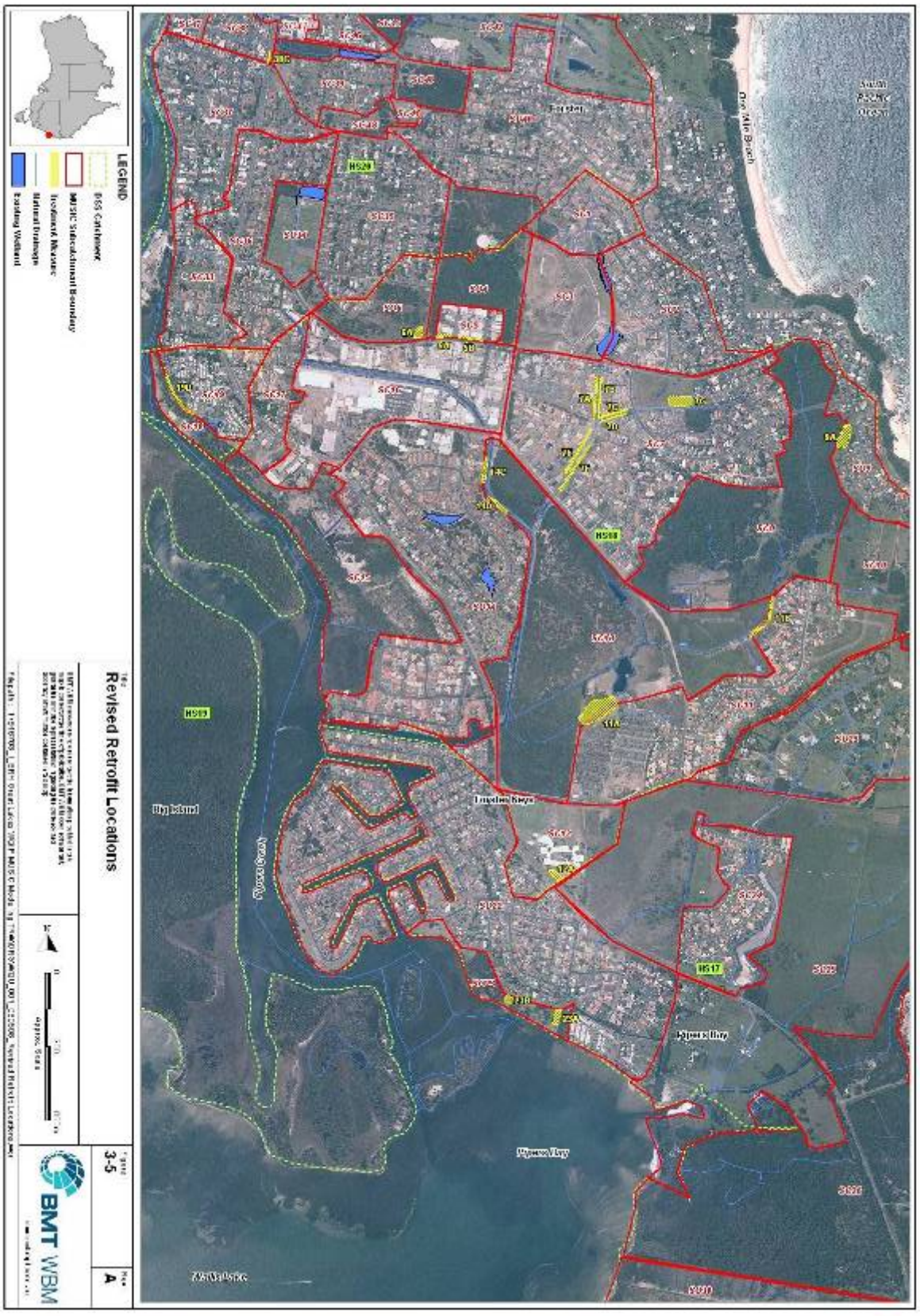

Figure 3.4.4. Proposed WSUD retrofitting locations (Source: BMT WBM 2008).

3.4.2.8 Managing established areas

Established urban and dense rural residential areas that are not in the process of being redeveloped are a major influence on some sections of Wallis Lake, including parts of its particularly vulnerable southern section. There are many aspects of management of established urban and quasi-urban areas that could be improved. In general, current service levels reflect the constrained funding environment in which Great Lakes Council, and most councils in NSW, operate. So, areas targeted for improvement need to be ones of either: (i) exceptionally high need; or (ii) where significant additional funds are becoming available, or both.

Pipers urban retrofitting program

Pipers Creek and Pipers Bay have high average chlorophyll-a concentrations and high turbidity. Substantial reductions in catchment inputs of sediments and nitrogen are required to significantly improve the ecology and amenity of these areas. (The western side of Forster is on Pipers Creek, so amenity improvements would benefit many people.)

This program involves placing bioretention systems in the streetscape in Forster. BMT WBM (2008) commented:

> "The treatment measures used in the retrofitting program should be based on biofiltration systems [Figures 3.4.5, 3.4.6 and 3.4.7] to a large degree, as the modelling has shown that these will provide an effective level of treatment if adopted, however other measures, such as grassed swales, porous pavements, infiltration systems and constructed wetlands may also provide benefits depending on site constraints and opportunities. The final form and layout of treatments will need to be further examined through site-specific studies and conceptual and detailed engineering design consistent with local, state and national guideline documents on these types of measures."

Figure 3.4.8 illustrates the approach; yellow rectangles are biofiltration devices (Figures 3.4.5, 3.4.6 and 3.4.7).

Figure 3.4.5. Dense urban area street tree bioretention.

Source: BMT WBM (2008).

Figure 3.4.6. Street tree bioretention 'pods'.

Source: BMT WBM (2008).

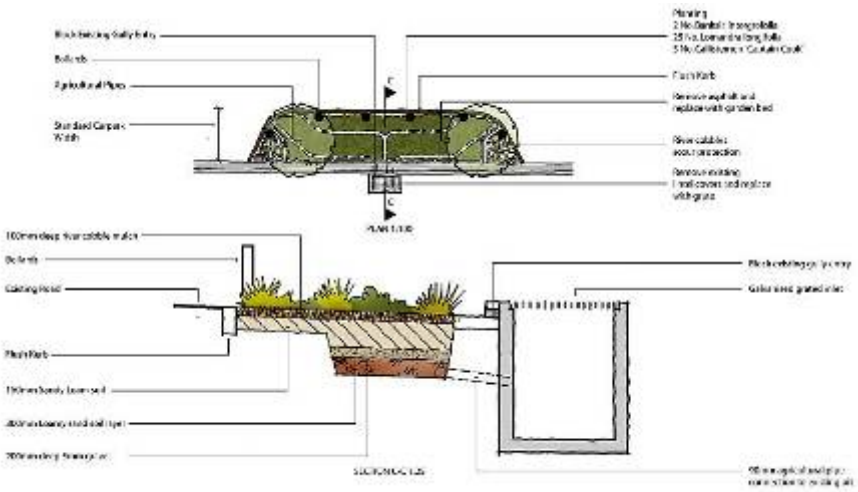

Figure 3.4.7. Diagram of pod retrofitting into existing kerb.

Source: BMT WBM (2008).

Table 3.4.6 shows what is achievable with the maximum practicable retrofitting program – a 25% reduction in total nitrogen loads and a 54% reduction in total suspended solids

loads, at a cost of $1.7 million (see Figure 3.4.4 for an overview of the proposed locations of devices).

Figure 3.4.8. A retrofitting proposal for Pipers Creek catchment.

Table 3.4.6. Improvements in pollutant loads to Pipers Creek and Pipers Bay that can be achieved with a substantial drainage system retrofitting program.

	Inflow (exisitng)	Outflow (WSUD)	% reduction
TSS (kg/yr)	238,000	109,000	54
TP (kg/yr)	496	291	41
TN (kg/yr)	4,050	3,030	25
Total acquisition cost (2007 dollars)			$1,740,000

Source: BMT WBM (2008)

Smiths Lake urban retrofitting program

In addition to the focus on mitigating loads from the existing urban areas around Forster, further assessments were also undertaken of the urban areas around Smiths Lake. The character of this area is different from the catchments around Pipers Creek and Pipers Bay. Urban development in the catchment of Smiths Lakes typically involves larger blocks, and roads have table drains (usually unsealed) rather than formal kerb and channel. The existing areas were modelled and a retrofitting scenario developed.

Scenarios were also developed to examine the impact of future release areas, redevelopment of existing areas and the potential mitigating effects of WSUD implementation in these areas. The sub-catchments and future release areas are shown in Figure 3.4.9. The results of these assessments are shown in Table 3.4.7.

Figure 3.4.9. Smiths Lake sub-catchments and release areas.

Table 3.4.7. Improvements in pollutant loads to Smiths Lake that can be achieved with a substantial drainage system retrofitting program.

	Inflow (existing)	Outflow (WSUD)	% reduction
TSS (kg/yr)	63,400	10,600.0	83.3
TP (kg/yr)	138	50.3	63.6
TN (kg/yr)	1,140	699.0	38.7
Total acquisition cost (2007 dollars)			$ 50,591,430

As can be seen from Table 3.4.7, the impacts of both the existing and future development scenarios can be significantly reduced through the implementation of WSUD measures (in this case it was assumed that biofiltration-type measures would be used in most cases). The redevelopment rates for Forster were applied to Smiths Lake – given that this is a relatively younger area of development compared to the Forster urban areas, it is likely to be an overestimate. [DG118].

3.4.2.9 Rainwater tanks retrofitting program

A rainwater tank retrofitting program was explored as a further option. The results of a desktop analysis indicated that from a whole water cycle perspective, this was attractive:

- "significant potable water savings and stormwater flow reductions can accompany the widespread implementation of rain water tank's;
- while there is no 'optimum' rain water tank size or capacity, it is apparent that the relative rate of additional benefits of increasing tank volume reduces for tanks greater than 4,000 - 5,000 Litres in size; and
- 5,000 Litre tanks, in Forster, should see the following stormwater/potable water benefits;
    - 30% reduction in long-term potable water use;
    - 22% reduction in annual average stormwater flows; and
    - possibly up to a 40% reduction in the areal extent of stormwater treatment infrastructure (we note that this is the least robust of our findings given the somewhat approximate manner in which rain water tank effects were modelled in MUSIC)." (BMT WBM 2008)

On 1 January 2008, MidCoast Water introduced a Water Smart rebate that provides $1,000 subsidy for a rainwater tank with a capacity of 4,000 litres or more, and $500 subsidy for a tank from 2,000 to 3,999 litres, where these tanks are connected to the garden, washing machine and toilets. Reduced rebates are available if fewer connections are plumbed.

3.4.2.10 Other programs for established urban and dense rural residential areas

Maintaining WSUD devices

Maintenance of WSUD devices (bioretention trenches, constructed wetlands, gross pollutant traps, etc.) is a key priority from the lakes' perspectives. Most water quality treatment devices do not treat water effectively if they are not properly maintained. For some devices, notably constructed wetlands, poor maintenance does not just carry the opportunity cost (for the lakes) of lost treatment – it shortens the lifetime of the devices (in the worst cases, dramatically). Maintaining WSUD devices poorly is thus a significant waste of investment.

At Great Lakes currently, lack of maintenance plans for WSUD devices on public land (notably constructed wetlands) and lack of staff expertise are the presenting problems. The underlying problem is primarily financial. Currently the best opportunity identified to address this is Great Lakes Council's review of financial sustainability. If its recommendations are adopted by Council and supported by the state government, then the funds needed for proper maintenance of stormwater assets will be available.

The proposed LEP and DCP changes will lead to a significant increase in WSUD infrastructure on private land – particularly raingardens and rainwater tanks, as per the proposed DCP recipes (BMT WBM 2008). Developing maintenance regimes for these is very important. Two innovations currently being explored are:

- licensing WSUD devices in a way broadly similar to the licensing of on-site sewage management systems
- requiring checks on devices as part of the conveyancing process when properties are sold.

(See the Pollution Control Systems report for more discussion of this issue.)

Water-sensitive design standards for roads

Roadworks provide some opportunities to upgrade streetscapes to better manage urban stormwater, because road and drainage systems are tightly integrated. To take advantage of these opportunities – and as part of an overall review of design standards for roads from water quantity and quality perspectives – water-sensitive design standards for urban and rural roads should be developed. A considerable amount of research and practice is available to inform decisions in this area. See, for example:

- Brisbane Council's 'Application of WSUD at Street Scale' [32]
- the Cooperative Research Centre for Catchment Hydrology's 'Water-sensitive road design' [33]
- Kingston City Council's 'Review of street scale WSUD in Melbourne' [34].

32 http://www.brisbane.qld.gov.au/bccwr/lib184/wsud%20practice%20note%2001d%20street%20scale.pdf
33 http://www.clearwater.asn.au/resources/290_1.pdf
34 http://www.clearwater.asn.au/resources/643_1.Review%20of%20retofitted%20WSUD%20in%20Melbourne%20Final%20Report.pdf

Engagement for urban water quality improvement

The CCI recognises that everyone has a role to play in improving water quality. Ongoing engagement of a variety of stakeholders is important to ensure that businesses, residents, builders, councils, developers and real estate agents can assist with implementing the WQIP, and know what they can do to help protect and improve water quality.

Great Lakes Council currently has a Healthy Lakes Program (Section 3.4.1.3), which focuses on improving the awareness of residents and businesses, as well as local government staff and councillors. As this program has developed, there has been a movement away from simply providing information and education about the environment to stakeholders, to adopting a higher level of engagement that allows participant-directed and action oriented learning for sustainability. Elements of the Healthy Lakes Program actively involve residents and businesses in partnership programs, workshops, on-ground training and self-assessments. The philosophy behind the approach to engagement used in the Healthy Lakes Program is described in Section 3.2.

Engagement about the water quality and ecological health of Wallis, Smiths and Myall lakes will be carried through to future activities within the Healthy Lakes Program and become central to new programs developed. The new programs developed will incorporate the scientific findings and management responses outlined in this Water Quality Improvement Plan, and will continue to incorporate findings from ongoing scientific research. The Healthy Lakes Program is Great Lakes Council's main vehicle for delivering community engagement on water quality issues. However, it is important that the current knowledge is also incorporated into education materials developed by other organisations (e.g. National Parks and Wildlife information brochures about Myall Lakes).

While the focus of this section is on urban water quality engagement programs, there will be some general water quality messages that will reach, and be relevant to, the rural community. These will be communicated via media releases, advertisements and newsletters, and will include annual WQIP reporting as outlined in the Adaptive Management Strategy.

The aims for urban water quality engagement programs are to:

- build the community's capacity to protect water quality through everyday actions
- build the community's acceptance and support for WSUD solutions to water quality issues (e.g. changes to planning instruments and the provision of Water Sensitive Urban Design features)
- build organisational capacity to implement WSUD including construction, protection and maintenance of WSUD structures, and assessment of development proposals

- support the use of stormwater levy and environmental rate to address urban stormwater quality issues
- encourage the implementation of WSUD in new developments, redevelopments and in the existing urban area (via retrofitting) by raising awareness of the importance of these practices in protecting the water quality of Wallis Lakes and other receiving waters of the Great Lakes region.

Table 3.4.8 outlines programs that are designed to fulfil these aims in relation to specific stakeholder needs. These programs have been developed through discussions with Healthy Lakes Program officers based on their experiences, and Tony Webber from BMT WBM, who has drawn upon the research of André Taylor. Details on the new WSUD education program that has been recommended in the table below can be found in Appendix 28. The engagement level appropriate for the stakeholders identified (further described in Section 3.2) is also shown in the table.

Costs and details associated with this program are outlined in Appendices 14 (Wallis Lake), 17 (Smiths Lake) and 20 (Myall Lakes). The costs have been established for each lake proportionate to the size of the urban area, and the costs are included in the management action named WSUD Protection.

Table 3.4.8. Recommendations for engagement and learning programs for urban stakeholders.

Stakeholder	Importance of engagement	Engagement and learning program elements	Engagement level (refer to Section 3.2 for explanation)
Businesses	• Everyday contact with range of community (potential for flow-on education effects) • Awareness of their responsibilities under relevant legislation (e.g. POEO Act) • Potential to profit from 'clean green' image and to set a good example	• Build on partnerships developed through the Healthy Lakes Program • Undertake needs analysis to better tailor education opportunities	• Inform – consult
Residents	• Ability to control and improve lifestyle choices that directly affect the environment • Increase demand for WSUD developments • Political influence through their role as rate payers and voters	• Build on events, education avenues and partnerships developed through the Healthy Lakes Program • Promote the WQIP to ensure its ongoing implementation • Utilise the development of new WSUD devices for tours and awareness-building activities	• Inform – involve

Stakeholder	Importance of engagement	Engagement and learning program elements	Engagement level (refer to Section 3.2 for explanation)
Developers	• Ability to make large-scale changes and improvements to the urban form • Responsible for large capital expenditures • Influence over the market – able to 'sell' WSUD-improved homes and neighbourhoods	Develop a WSUD education program (see Appendix 28) that: • raises awareness of the importance of WSUD practices • builds the knowledge and capacity of developers and consultants to work out what WSUD solutions are needed, and how to implement these (including information on local water quality targets, 'deemed to comply' solutions, technical design guidance, advice on preparing stormwater management plans and other submission requirements)	Inform – involve
Builders / home builders	• Ability to make small-scale improvements to the urban form • Responsibility to abide by relevant legislation (e.g. POEO Act) • Ensuring subcontractors meet the site requirements for environmental protection	Develop a WSUD and best practice building construction education and capacity building program that: • raises awareness of the importance of WSUD practices and how to construct devices • builds knowledge of builders responsibility in relation to relevant legislation and builds capacity to improve practices, e.g. sediment and erosion control training	Inform – involve
Real estate agents	• Influence over the market – able to 'sell' WSUD improved homes and neighbourhoods	Develop a WSUD education program that: • raises awareness of the importance and value of WSUD practices	Inform
Council staff	• Influence on policy and planning regulations • Role of enforcing legislation • Duty of care to undertake best practices for water quality improvement, and set an example for community and a standard for developers • Training of staff and continuous improvement • Leadership in undertaking own activities consistent with WSUD and providing	Develop a WSUD education program that: • raises awareness of the importance of WSUD practices, council responsibilities, and policy and planning implications • builds the knowledge and capacity of development assessment, compliance assessment and asset management staff about WSUD (including information on local water quality targets,	Inform – collaborate

Stakeholder	Importance of engagement	Engagement and learning program elements	Engagement level (refer to Section 3.2 for explanation)
	demonstration sites	implementing the new DCP including 'deemed to comply' solutions, technical design guidance, skills for assessing Stormwater Management Plans and using MUSIC modelling, asset handover requirements, and maintenance requirements) • builds the capacity of stormwater engineers to manage stormwater holistically rather than through a traditional quantity-based engineering approach Develop a sediment and erosion control training and audit program that: • highlights the importance of sediment and erosion control practices in relation to lake ecology and council's and individual's responsibilities under the POEO act • is linked to a field based training and audit program aimed at improving practice and performance • includes compliance with Council's sediment and erosion policy as performance criteria for managers, team leaders and supervisors within Council's operations branch	
Students	• Ability to control and improve lifestyle choices that directly affect the environment • Increase demand for WSUD developments • Potential to influence the wider community through communication with others	• Build on education events and partnerships developed through the Healthy Lakes Program, and use findings from the WQIP to deliver these (e.g. stormwater scamper, seagrass monitoring, Water Watch) • Utilise the development of new WSUD devices for tours and awareness-building activities • Develop partnerships with senior school staff to	

Stakeholder	Importance of engagement	Engagement and learning program elements	Engagement level (refer to Section 3.2 for explanation)
		incorporate WQIP findings into the school curriculum • Develop partnerships with universities to undertake ongoing water quality research	

Current management of lake foreshore and riparian areas

Water quality issues have been identified in foreshore areas including open space, natural and residential areas. The management of foreshores needs to balance the recreational uses with tourism and the protection of the environment. Degradation of water quality can result from inappropriate activities occurring within these natural areas and includes, but is not limited to, encroachment by neighbouring residential properties through landscaping riparian areas, personal use of foreshores, boat moorings, unauthorised vehicle access to water's edge, and clearing and trampling of vegetation. The behaviours of residents neighbouring these areas can also impact significantly on water quality, and often relate to home and garden management. This can include inappropriate fertiliser use, disposal of green waste and rubbish, and stormwater pollution. Correct management, enforcement of environmental legislation and education on the use of lake foreshore areas will contribute to improved water quality entering the lake systems.

Great Lakes Council currently has one overarching foreshore management plan that applies to all community land categorised as 'natural area'. The foreshore management plan covers all foreshore areas not included in specific plans of management, areas of lake and coastal foreshores under their management. This generic foreshore management plan aims to conserve biodiversity and maintain ecosystem function, as well as provide for the restoration and regeneration of land categorised as natural area, while balancing the need for planned recreational use.

There are two Plans of Management (POM) that relate to specific foreshore areas in Coomba Park that are relevant to the management of Wallis Lake. Great Lakes Council's Plan of Management for Coomba Park Foreshore and Coomba Aquatic Club provides specific objectives to determine actions permitted in this location to protect and enhance all functions associated with the foreshore's role as a transition area between aquatic and terrestrial environments. There is no specific POM for Smiths Lakes foreshore – at present, it is covered by the generic foreshore plan. Similarly, in the Myall Lakes there is no specific POM for foreshore areas managed by Great Lakes Council (e.g. the Nerong Village foreshore). However, the foreshore of the Myall Lake, Boolambayte Lake and

Bombah Broadwater are contained within the Myall Lakes National Park and managed by the NSW National Parks and Wildlife Service. Foreshore areas in the national park are managed for conservation and recreation in accordance with the Myall Lakes National Park Plan of Management, and are largely forested, natural areas with some camping and day-use areas provided.

There are two natural area work plans for Green Point and Smiths Lake that have been established by Great Lakes Council to provide guidance to bush regeneration volunteers. These work plans provide details on the management of natural areas in each location, outlining the planned regeneration works to be undertaken by local volunteer bush regeneration groups. These plans direct site-specific goals and areas to be targeted by the volunteer groups undertaking bush regeneration techniques.

Great Lakes Council aims to be proactive with its treatment of erosion impacts upon the lake systems. Regular inspections of foreshore reserves are undertaken, and maintenance works or new projects are implemented to limit and reduce sediment entering into the lake systems. Recent examples of these works include the:

- redesign and reconstruction of Little St (Forster) car park and boat ramp
- installation of rock wall at Rest Point Parade (Tuncurry)
- redesign and reconstruction of Darawank recreational fishing platform on Lakes Way (Failford)
- installation of rock revetment wall at Mann's Road (Failford)
- resealing of car park and installation of a concrete boat ramp at Brambles Reserve (Smiths Lake)
- redesign and reconstruction of car park and upgrade to boat ramp on Marine Drive (Tea Gardens)
- reinforcement of existing rock wall at Moria Place (Hawks Nest).

All of the projects described above contributed towards the reduction of sediment from erosion activities – be it pedestrian, vehicle or the erosion of foreshores from wave action in the Wallis or Myall lakes systems.

Recommendations for the improved management of foreshore and urban riparian areas

In order to maintain and improve water quality of our lakes, this Plan recognises the importance of protecting lake riparian areas, and appropriately managing lake foreshore and open space areas. Adequate protection has its foundation in sound planning, improved enforcement of environmental legislation, and community engagement and education in these areas. This section outlines the recommendations.

Planning for riparian and foreshore management in urban areas

It is recognised that the foreshore management plan currently used by Great Lakes Council is too generic (coastal and lake foreshore combined) to have strong basis for protecting riparian areas and water quality of the adjacent water bodies. It is recommended that the foreshore plan be reviewed to address lake foreshore and coastal foreshore areas separately, and the following details be included in the revised foreshore management plan to better protect water quality:

- a list of activities that could potentially impact on water quality that are not permitted within specified areas of the lake foreshore
- areas identified for specific uses, e.g. protecting riparian vegetation for each area
- identify rules about buffer zones for riparian access, lake access, encroachment and waste management – including the appropriate disposal of animal faeces
- outline an event management policy for open space use.

Plans of management

It is recommended that specific plans of management be developed for Smiths Lake foreshore and those areas adjoining Wallis Lake (Pacific Palms, Pipers Bay, Little Street foreshore and Tuncurry). These plans will aim to reduce impacts upon foreshore reserves, thus improving water quality.

Site-specific natural area work plans

It is recommended that plans to direct volunteer bush regeneration groups are implemented and regularly updated to ensure that appropriate works are undertaken by these groups working on foreshore reserves. It is also recommend that mowing groups and other volunteer organisations operating on foreshore reserves have site-specific plans implemented to reduce any impacts on riparian zones, with the aim of protecting native vegetation, and in turn, improving water quality.

Enforcement of environmental legislation in urban foreshore areas

As outlined in the Pollution Control Systems section of this Plan (Section 3.7), there are a number of policy and regulatory tools available for protection of foreshore areas including, but not limited to, the *Water Management Act 2000* – which replaced the *Rivers and Foreshores Improvement Act 1948* – and the *Fisheries Management Act 1994*. Recommendations for improving compliance for this legislation are outlined in Section 3.7.4.2 – the signage outlined below in 'Engagement of residents in urban foreshore areas' will assist with achieving compliance.

Engagement of residents in urban foreshore areas

Given that the issues associated with encroachment into foreshore and riparian areas are largely related to the impacts of neighbouring residents' behaviour, engagement of residents is the key to limiting encroachment, improving the condition of riparian vegetation and limiting water quality impacts. It is recommended that the following material be developed and distributed to assist with improving resident behaviour in these areas:

- review existing foreshore management education resources and undertake a 'needs analysis' that considers the key stakeholders and key messages suitable for all of those identified. Consider integrating foreshore education with stormwater education packages in locations where urban land is in close vicinity to foreshore areas. Also review Great Lakes Council's foreshore management booklet to separate the management of coast and lake foreshore areas
- undertake education programs targeting residents along foreshores – including field days – on the appropriate management of foreshore and riparian areas
- establish a media campaign linked to education programs, and an education package designed to reduce the impact from issues such as animal faeces, encroachment, weed invasion, vehicle access, litter, home and garden maintenance, appropriate application of nutrients to gardens, and riparian area use
- establish signage on the appropriate use of urban foreshore areas linked to the education program, and install bins for animal faeces.

3.4.2.11 Other opportunities

A variety of other opportunities have been identified. These include:

- revisiting Stormwater Quality Plans for the villages; it has been suggested that updating them to current practice would be beneficial (as noted in the Water Sensitive Urban Development and Design Strategy)
- installing general urban drainage retrofittings in additional areas (besides the catchments of Pipers Creek and Pipers Bay) where unsatisfactory older style drainage was built, and where there is land available to significantly improve drainage line performance.

These will be pursued where funds are available, and where this makes sense in the light of alternative uses of the funds.

3.4.2.12 Implementation strategy

The implementation strategy for management of urban and denser rural residential areas is presented in Table 3.4.9.

Table 3.4.9. Implementation strategy for urban and dense rural residential areas[pt119].

Recommendation	Actions / Steps and notes	Benefit and importance	Likely cost	Staff effort	Likely timing	Lead and contributors	From
Include water quality management clause in LEP	Ongoing negotiations between Council and the NSW Department of Planning, with a view to providing explicit support for local water quality protection provisions in the Local Environmental Plan	*Very high* Underpins WQIP strengthening of planning controls, as the LEP has standing that DCP text does not	*Low*	*Low to medium*	2008	**GLC** DoP	**E, I**
Strengthen procedures for Integrated Water Cycle Management	Principally a matter of MCW and GLC cooperating during development of Masterplans of Greenfield sites, to address stormwater, water supply and wastewater management objectives jointly	*High* Will enable resolution of possible tensions between water management goals (e.g. between recycling wastewater and using stormwater for non-potable uses), and support better overall outcomes	*Low*	*Low to medium*	2008	**MCW** **GLC**	**I**
Investigate Pipers Creek and Pipers Bay Nutrient Offset Scheme with DECC	Work with DECC to see if it is possible to establish a nutrient offsets scheme under the POEO Act that Great Lakes Council can administer which will fund retrofitting work in this catchment	*High* One of the key opportunities to fund the proposed retrofitting program	*Low*	*Medium to high*	2008–09	**GLC** **DECC**	**E, I**
Develop heads of consideration for Voluntary Planning Agreements with developers	These will include: • funding for ongoing maintenance • potential offsetting arrangements	*High* Provide guidance for and improve transparency of negotiations with large developers	*Low*	*Low*	2008	**GLC**	**I**
Complete development of water management DCP	Requires further modelling and consultation, and drafting of the DCP text	*Very high* Key role articulating GLC's and (potentially) GTCC's planning requirements for urban and rural residential areas in the catchments of Wallis, Smiths and Myall lakes	*Medium*	*Medium*	2008	**GLC** GTCC MCW HCRCMA Developers Community groups	**E, I**

Recommendation	Actions / Steps and notes	Benefit and importance	Likely cost	Staff effort	Likely timing	Lead and contributors	From
Review Rural Living Strategy	When preparing draft planning instrument text also consider whether amendments to the GLC Rural Living Strategy are needed to align it with the LEP and DCP changes, and provide draft revisions as needed	*Medium to high* Important to avoid inconsistencies that undermine policy implementation	*Medium*	*Medium or low*	2008–09	**GLC** GTCC	**I**
Build WSUD considerations into road standards	Develop water-sensitive urban design standards for roads / rework the road hierarchy so that work on roads delivers on WSUD goals – with a view to guiding road design decisions (including assessment of rural subdivision proposals), periodic major works on roads, and ongoing maintenance	*Medium to high* WSUD needs to be institutionalised as normal practice. Significant improvements in use of existing funds are possible here	*Low to medium*	*Low to medium*	2008–09	**GLC** GTCC	**I**
Resource erosion and sedimentation control satisfactorily	Working cooperatively with other councils and / or state agencies to develop regional or subregional erosion and sedimentation control programs, with a view to sharing costs and so delivering these services more cost-effectively	*High* By far the most polluting land use for sediments and nutrients	*Low to medium*	*Medium to high*	Ongoing	**GLC** GTCC HCCREMS DPI DECC	**E, I**
Erosion and sedimentation control internal audits	Improving the efficiency of the Councils' current erosion and sedimentation control efforts (both inspections, and on its own works) by an internal audit program. These should be supported by appropriate capacity-building work	*High*	-	*Low to medium*	Ongoing	**GLC** **GTCC**	
Develop further sources of funds for urban water quality management	Continue with GLC's asset management funding process, aiming to place management of drainage assets on a sound financial basis. Progress the overall WQIP financial strategy	*Very high* Funding is fundamental to the implementation of the strategy	*Low to medium*	*Medium to high*	2008–09	**GLC** GTCC HCRCMA	**I**

Recommendation	Actions / Steps and notes	Benefit and importance	Likely cost	Staff effort	Likely timing	Lead and contributors	From
Urban stormwater management education and capacity building program	Run urban stormwater management community education programs	*Medium to high* Importance relates to building community support for effective policy and practice	*Low to medium*	*Medium to high*	Ongoing	**GLC** MCW	**I**
Pipers Creek and Pipers Bay catchment retrofitting program	Detailed program design. Sourcing funds – GLC's stormwater levy, and perhaps a nutrient offsets scheme for Forster, are opportunities	*Very high* Essential to make significant progress on improving the condition of Pipers Creek over the next decade	*Very high* $1.7 m	*Very high*	2008–15	**GLC** Developers	
Smiths Lake catchment retrofitting program	Detailed program design. Sourcing funds – best opportunity appears to be a nutrient offsets scheme for Forster	*Low to medium* Overall Smiths Lake is in very good condition; benefits of the program relatively local	$591,430	*High to very high*	2008–38[DG120]	**GLC**	
Improve the management of foreshore and riparian areas through improved planning, community engagement and improved enforcement of environmental legislation	• Review existing Foreshore Management Plans, Plans of Management, site-specific natural area work plans • Enforce environmental legislation to protect foreshores • Develop and implement targeted education and engagement of residents in foreshore areas	*Medium to high*	*High*	*High*	2009–ongoing	GLC	GLC

Key:

Costs		*Staff effort*		*From* = which groups recommended this approach	
Low	up to $5,000	Low	One to two weeks	E	External working group: Developers, architects, builders, community environment representatives, HCCREMS
Medium	up to $20,000	Medium	One month		
High	$30,000 plus	High	Two to three months	I	Internal working group: GLC, GTCC, MCW, HCRCMA

3.5 Lake use strategies

Through initial discussions with community stakeholders, lake use activities were repeatedly identified as having a significant impact on water quality. The CCI project was, however, designed to focus only on catchment impacts. As a result of this consistent stakeholder input and in response to concerns about the public health impacts on aquaculture, a project was established to document lake use issues and identify strategies for improvement. The community, in early discussions, raised a number of issues related to reducing erosion on banks and islands, improving management and control of aquatic activities, increasing education, and raising awareness. Appendix 4 provides a comprehensive list of issues raised by community members.

Managing the impacts of lake use issues will require management of boating and related activities through negotiated outcomes – for example, a Wallamba Memorandum of Understanding; education and targeted interventions such as upgrading of shore facilities; riverbank stabilisation; and requiring risk management procedures to deal quickly and efficiently with pollution incidents.

Key stakeholders – including staff from the Department of Primary Industries, NSW Food Authority, NSW Maritime, DECC (including NPWS), professional fishers and oyster growers – addressed the issues that community members had raised about lake use impacts. They provided input both individually and in workshops.

Wallis Lake was the focus of most concern, with most discussion focussed on boating and aquaculture. For Smiths Lake and the Myall Lakes, boating was the central area of concern.

3.5.1 Existing lake use management systems

3.5.1.1 Boating activities

NSW Maritime administers or operates under the following New South Wales legislation:

- *Commercial Vessels Act 1979*
- Commercial Vessels (Certificates of Competency and Safety Manning) Regulation
- Commercial Vessels (Emergency Procedures and Safety of Navigation) Regulation
- Commercial Vessels (Equipment) Regulation
- Commercial Vessels (Hire and Drive) Regulation
- Commercial Vessels (Load Lines) Regulation
- Commercial Vessels (Permits) Regulation
- *Navigation Act 1901*
- Navigation (Collision) Regulations

- *Maritime Services Act 1935*
- Water Traffic Regulations
- Boating (Safety Equipment) Regulation
- Management of Waters and Waterside Lands Regulations
- *Marine Pilotage Licensing Act 1971*
- *Marine Pollution Act 1987*
- *Marine Boating Safety – (Alcohol and Drugs) Act 1991*
- *Ports and Maritime Administration Act 1995*.

NSW Maritime officers manage general waterways use, facilities and operation of boats, and work with stakeholders and other agencies to improve boating management. Wallis, Smiths and Myall lakes see large fluctuations in use. Peak periods are often targeted for education and management campaigns – using staff resources from other areas – to achieve a greater impact on users.

Under the *Protection of the Environment Operations Act 1997* (POEO Act), it is an offence to pollute any waters unless permitted under a licence issued by the Environment Protection Authority. The POEO Act is complemented by the Marine Pollution Regulation 2006, which is designed to improve the management of sewage pollution from vessels and simplify the capacity requirements for sewage holding tanks. Specific provisions of this regulation include:

- the discharge of untreated sewage from vessels into navigable waters is prohibited, except into a waste collection facility such as a pump-out or on-shore toilet. This includes all NSW waters within three nautical miles of the coast
- Class 1 (passenger carrying) and Class 4 (hire and drive) vessels are required to be fitted with toilets and toilet waste holding tanks, or to have an approved plan of management for the disposal of waste.

Current programs to manage boating in Wallis Lake include:

- MoU between NSW Maritime and boat owners covering wakeboarding in Wallis Lake
- management protocols for control of spills at marinas in Wallis Lake
- upgrade of boats to prevent discharge of sewage and, in Wallis Lake, greywater and improved pump-out facilities
- upgrade of boat ramps and facilities to prevent shoreline impacts
- Environment Management System for the Wallis Lake Estuary General Fishery, including environmental protection objectives and actions to protect habitat and limit by-catch.

The *Myall Lakes National Park and Myall Coast Reserves Plan of Management 2002* includes the following actions:

- "4.9.2 Establish a monitoring program to ascertain the impacts of boating on aquatic vegetation and fauna in collaboration with relevant research institutions and community interest groups."
- "4.9.4 Develop a 'boating code of conduct' which promotes minimal impact boating."
- "4.9.8 Investigate, in conjunction with Waterways Authority of NSW, the potential application of 'no discharge guidelines' for greywater from commercial and recreational vessels."
- "4.9.9 Support the continued service of the mobile sewage collection barge and the Bombah Point pump-out facility by the Waterways Authority of NSW."
- "4.9.17 Develop and implement a fuel spillage response plan in collaboration with relevant agencies."

In Smiths Lake the Smiths Lake Boating Plan[35], prepared by NSW Maritime, plays a key role in managing impacts from boating on seagrass beds and shorelines.

Stakeholders expressed concern over damage to seagrass beds, often due to inexperienced users of 'hire and drive' boats. Water turbidity is regarded as a contributor to inexperienced users inadvertently entering shallow waters.

Seagrass beds, especially *Posidonia*, are also impacted by commercial fishing. A way forward would be to identify sensitive seagrass areas and require commercial fishing and general boating to protect these areas. DPI (Fisheries section) would be the appropriate authority to police compliance.

Since the Plan of Management was developed, the impact of jet boats and wakeboarding, and related bank erosion, has also emerged as an issue in the Myall Lakes. The extent of the impacts, and options for managing this in the Myall system, needs to be explored.

3.5.1.2 Aquaculture industry

Oyster aquaculture in Wallis Lake is a major local industry. Professional fishing also occurs in the Wallis, Smiths and Myall lakes.

The *Fisheries Management Act 1994* is the primary legislation governing aquaculture. Its objects are to conserve, develop and share the fishery resources of the state for the benefit of present and future generations. In particular, the objects of the Act include:

- conserve fish stocks and key fish habitats
- conserve threatened species, populations and ecological communities of fish and marine vegetation
- promote ecologically sustainable development, including the conservation of biological diversity.

35 See http://www.maritime.nsw.gov.au/boating_plans/smithlake.html (4 August 2008).

And, consistent with these objects, to:

- promote viable commercial fishing and aquaculture industries
- promote quality recreational fishing opportunities
- appropriately share fisheries resources between the users of the resources
- provide social and economic benefits for the wider community (section 3 of the Act).

Marine aquaculture resource planning and management may be guided by statutory Aquaculture Industry Development Plans (AIDP) under the *Fisheries Management Act 1994*. An AIDP describes areas suitable for aquaculture and the type of aquaculture, suitable methods for undertaking aquaculture, suitable species, and contains performance indicators to monitor ecologically sustainable development performance. The NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS), which is an AIDP, is the primary policy document for oyster growing in Wallis Lake.

The need for the *O*ISAS arose from concerns of both the NSW government and the NSW oyster aquaculture industry about existing and potential impacts associated with the rapid development of the NSW coastline. The OISAS identifies Priority Oyster Aquaculture Areas (POAAs) in each estuary and sets water quality objectives for these areas in line with the recommendations of the Healthy Rivers Commission (Healthy Rivers Commission 2003)[DG121]. The OISAS also establishes oyster industry best management practice standards, which are supported by a commitment to environmentally sustainable practices.

When considering an application for development that may affect a POAA or other oyster aquaculture area, SEPP 62 Sustainable Aquaculture requires the consent authority to:

- give the Director-General of the NSW DPI written notice of the development application and take into consideration any written submissions made in response to the notice within 14 days after notice was given
- take into consideration the provisions of the OISAS
- consider any issues that are likely to make the development incompatible with oyster aquaculture and evaluate any measures that the applicant has proposed to address those issues.

The consent authority may refuse to grant consent to development if, in the opinion of the consent authority, the development is likely to have an unreasonable impact on a POAA or on oyster aquaculture outside a POAA.

SEPP 62 also requires that councils have regard for POAAs in preparing new Local Environmental Plans (LEP) and making changes to land zoning. POAAs also must be identified on LEP maps.

The *Harvest Area Management Plan*, developed by the NSW Food Authority, establishes environmental conditions that lead to the oyster harvest area closing and reopening. The

process is based on robust international models. The *Australian Shellfish Quality Assurance Program* uses the best practices from European and American approaches. One disadvantage of this program, which has been identified by peer review, is that the water quality monitoring for oyster harvesting is not integrated into a broader environmental monitoring program to provide additional insight into pollutant processes and sources. The Management Plan is reviewed annually on the basis of water quality monitoring data and updated as required. Every three years a significant review is required to update information on known or potential pollution sources and the implication for harvest area management.

The management of oyster harvesting and remediation of pollution sources impacting on Wallis Lake's water quality appears to have reduced the risk of contamination of oysters for identified wet weather-related events. There have been no identified health impacts since 1997.

The issues that have been raised point to the need for improved coordination between authorities to achieve best possible outcomes, e.g. a coordinated water quality monitoring program in the Wallis Estuary and rivers impacting on oyster growing, and improved referral and incident management for pollution events.

3.5.2 Management recommendations for lake use

3.5.2.1 Boating impacts

In general terms well-maintained boats, using modern engines and operated appropriately, have little impact on the aquatic environment. Boating impacts in the lakes are reported to be minor, with few prosecutions.

The impacts of boating can be differentiated by:

- source (landing sites, marinas, boats)
- location (shallow water / seagrass areas, narrow channels, high-use areas)
- activity (speed, fishing, water sports).

Vehicle access to the shoreline can damage shoreline vegetation and promote erosion. All sites with direct shoreline access and failing infrastructure should be identified and rectified. Degraded areas should be revegetated. Currently most sites in Wallis Lake are regarded as acceptable and no major upgrades are required for environment management (NSW Maritime, pers. comm.). In the Myall Lakes there are issues with gravel ramps.

Fuel spills are highly visible. The most toxic components are volatile – direct human contact and coating of marine life must be avoided. Fuel spills are covered by response protocols, and there are requirements for NSW Maritime and the fire brigade to be notified for larger spills.

The potential for human health risks, especially via oysters sold for consumption, requires that discharge of faecal material and greywater from boats must be prevented. All the waterways in the CCI area are 'no-discharge zones' for blackwater, and holding tanks are required for all hire boats and houseboats. Toilets are provided at a number of sites for recreational boaters and there are few reports of illegal activities. Pump-out facilities are available in Wallis Lake, and in Myall Lake a boat is used to provide pump-out services for boats (NSW Maritime, pers. comm.). Discharge of greywater is also prohibited in Wallis Lake. The need for controls to prevent discharge of greywater into the Myall Lakes was identified in the *Myall Lakes National Park and Myall Coast Reserves Plan of Management 2002.* We understand however, that a 'no discharge' rule for greywater has not yet been put in place for the Myall Lakes (NPWS, pers. comm.).

A detailed review of the management of blackwater and greywater to determine how well current regulations are complied with, and whether current regulations should be modified, would be appropriate.

Healthy aquatic ecosystems are both an indicator of and a contributor to environmental health. Education of boat users to promote responsible boat handling and to prevent damage to habitat areas from boating activities is seen as the most effective approach.

The Environment Management System for the Wallis Lake Estuary General Fishery has been developed to promote sustainable fishing practices in Wallis Lake. Actions in this Environmental Management System include:

- continuing to conduct all prawn hauling using the 'anchor out' method
- minimising fish hauling activity over all seagrass beds
- investigating the potential for monitoring changes to seagrass beds in the immediate vicinity of fish haul shots.

Despite these measures, reports of impacts from commercial fishing and general boating still occur. Additional actions need to be considered including education of operators, markers for sensitive areas, and the designation and marking of 'row in' areas for fishing. Similar actions are needed for the Myall Lakes system (NPWS, pers. comm.).

The 'wave enhancing' boats used by wakeboarders can result in riverbank erosion and conflict with other users. Securing the future of these activities by identifying areas of low environmental risk, and restricting or excluding them from sensitive / unsuitable areas, is a priority. Wakeboarders generally prefer accessible locations with a range of facilities – the small number of locations that fulfil these preferences result in a concentration of impacts. Fines are not seen as a useful long-term deterrent. The preferred avenue to resolve water quality impacts caused by riverbank erosion from wakeboarding and wake-enhancing activities is a collaborative negotiated agreement among users and business. In the Wallis Lakes system, a review of the existing Wallamba River Memorandum of Understanding (MoU) is in progress. This review aims to address the impact of wakeboarding on the

riverbank and on other users in order to minimise impacts on riverbank erosion, the impact on public and private assets, and to improve safety. A review of the magnitude of this issue, and possible management responses, is needed.

Ongoing education programs and the development of memoranda of understanding, where appropriate, will provide a general context for improved management. For impacts based on source and location, targeted intervention is useful, including construction of improved facilities, collaborative planning and negotiation, education, and enforcement. Targeted activities can be prioritised for enforcement on the basis of location.

3.5.2.2 Oyster aquaculture

The oyster industry in Wallis Lake is primarily affected by wet-weather events, which bring pollutants and pathogens from the catchment areas. Land-based activities are the major sources of pollutants, pathogens, nutrients and suspended solids.

The risk management approach, adopted by the NSW Safe Foods Authority, is based on predictive models driven by catchment rainfall and salinity. The model indicates when harvesting should be both stopped and then started to minimise health risks. To date, the model appears to have worked well, as there have been no serious health impacts related to Wallis Lake oysters since 1997.

Human health risks of oyster aquaculture can have severe consequences (e.g. the hepatitis A outbreak), so the management of risk events not related to wet weather also needs to be addressed.

Human sewage remains the key risk factor for aquaculture. Improved referral of failing on-site waste disposal systems to NSW Food Authority would allow improved risk management. Legislation requires that failures in reticulated sewage systems are referred to the NSW Food Authority to implement risk management procedures for aquaculture. MidCoast Water has had notification protocols for reticulated sewage incidents in place for many years and they are strictly adhered to. There are no equivalent requirements for local government to report failed on-site sewage treatment systems.

Limitations in the legislated rules for referral of smaller pollution incidents, including failures of on-site sewage treatment systems, mean that individual Environmental Health Officers are often required to make referral decisions. Training of these staff would improve consistency of referral and then provide improved risk management by the NSW Food Authority. More generally, for Wallis Lake, the risk management strategy requires an annual sanitary assessment. The mobility of staff in local government often results in Environmental Health Officers, without experience in aquaculture areas, being responsible for sanitary management in areas where there are significant risks to aquaculture.

Aquaculture creates risks for water quality through specific impacts, such as the use of older materials for posts and trays. The industry and DPI (Fisheries section) has in place approaches to encourage farmers to upgrade materials used in oyster leases and help find alternative products. The Department of Lands requires lessees to improve management of shore-based activities that could pollute the adjacent water bodies.

Recommended management interventions include:

- developing standardised protocols and referral mechanisms for pollution events that might affect oyster growing areas, where current referral processes are not clearly articulated and rely on individual Council and government officers recognising that a pollution event might have impacts on the oyster industry and human health. (Note: Protocols and referral mechanisms for failures of reticulated sewage systems are already well-developed.)
- education and training of Council and other relevant staff to identify events that should be referred to the NSW Food Authority. Appropriate education will be required to back up the use of referral protocols so that relevant Council and government officers recognise incidents requiring referral
- an ongoing program – the Wallis Lake Oyster Lease Clean Up Program – to remove old oyster lease materials, and to employ new materials for leases and allied boating operations.

Table 3.5.1 provides a list of recommendations to better manage the water quality impacts of lake uses. The table outlines the actions and steps and likely costs and benefits of each recommendation.

Table 3.5.1. Implementation strategy – Recommended actions to manage the water quality impacts of lake uses.

Recommendation	Actions / Steps and notes	Lakes	Likely benefit	Likely cost	Staff effort	Likely timing	Lead and contributors
Review Stormwater Management Plans to clarify outcomes required to protect the environment and priority oyster growing areas in relation to SEPP 62	Review existing stormwater plans to identify components likely to affect aquaculture areas. Clarify objectives and goals in relation to aquaculture and impacts on water quality for priority oyster areas. Revise Stormwater Management Plan as necessary	Wallis Smiths Myall	Improved sustainability of oyster industry and fishing industries	30,000	*High*	High priority	**GLC** DPI (Fisheries) NSW Food Authority
Investigate the potential application of 'no-discharge guidelines' for greywater from commercial and recreational vessels in the Myall Lakes	As recommended in the Myall Lakes National Park and Myall Coast Reserves Plan of Management 2002	Myall	Reduced nutrient inputs		*Low to medium*	Medium	**NSW Maritime** DECC (NPWS) Port Stephens / Myall Lakes Estuary Management Committee
Explore the extent of environmental impacts of jet boats and wakeboarding in the Myall Lakes, developing management options as necessary	Jet boats and wakeboarding, and related bank erosion, have emerged as an issue in the Myall Lakes since the Myall Lakes Boating Plan of Management was developed	Myall	Reduced bank erosion		*Low to Medium*	Medium priority	**NSW Maritime** DECC (NPWS) Port Stephens / Myall Lakes Estuary Management Committee
Investigate marking (with poles) sensitive areas of seagrass, primarily *Posidonia*, to limit impacts from fishing and general boating. Investigate designated 'row in' areas to limit damage to *Posidonia* beds	Identify priority areas for protection. Locate suitable locations for poles in consultation with users. Mark areas as determined. Wallis Lake General Fishery Environmental Management System contains measures to protect *Posidonia*	Wallis Smiths Myall	Protection of important seagrass communities to enhance riverbank stability and improve habitat diversity	200,000	*Low*	High to medium priority	**DPI** NSW Maritime

Recommendation	Actions / Steps and notes	Lakes	Likely benefit	Likely cost	Staff effort	Likely timing	Lead and contributors
	beds and should be reviewed to cover additional actions. Implementation will require ongoing monitoring and action.						
Investigate the impact and feasibility of closing boat ramps in the lower Wallamba River during high river levels to protect banks from erosion	Identify ramps that might require closure. Assess current impacts and environmental outcomes. Consult with users. Develop agreed protocol for closures.	Wallis	Reduced impacts on river banks and less damage to riparian vegetation		*Low*	Medium to low priority	**NSW Maritime** GLC
Support actions in the Smiths Lake boating plan that relate to erosion and damage to seagrass beds	Notably controls on risks of erosion at boat ramps and damage to seagrass beds	Smiths	As identified in the boating plan	Not costed here ~	Not costed here ~	As identified in the boating plan	**As identified in the boating plan**
Explore options for upgrading gravel boat ramps in the Myall Lakes to reduce pollution from these sites		Myall	Reduced sediment discharges into the lakes		*Low to medium*	Medium to low priority	**NSW Maritime** DECC (NPWS) Port Stephens / Myall Lakes Estuary Management Committee
Prepare MoU with tourism operators for all lake areas to promote responsible practices and environment management	Review MoU in relation to environmental goals. Update as required. Ensure all operators are signatories.	Wallis	Reduced environmental impacts. Improved sustainability of oyster industry and fishing. Reduced pollution.		*Medium*	High priority	**GLC** NSW Maritime

Recommendation	Actions / Steps and notes	Lakes	Likely benefit	Likely cost	Staff effort	Likely timing	Lead and contributors
Support review of Wallis Lake recreational boating MoU to improve environmental and safety outcomes of wakeboarding	Support current review. If adopted, monitor and review implementation.	Wallis	Reduced impacts on river banks and improved safety		*Low*	High priority	**NSW Maritime** GLC
	Upgrade access and infrastructure	Wallis		200,000	*Medium*	To be determined	
Phase out old oyster lease materials	Identify remaining sites needing clean up. Implement on a priority basis.	Wallis	Improved water quality. Improved appearance of waterways.	10,000	*Low*	Ongoing	**DPI (Fisheries)** Department of Crown Lands
Develop additional pollution event referral protocols	Develop standardised protocols and referral mechanisms for pollution events that might affect oyster growing areas, where current referral processes are not clearly articulated and rely on individual Council and government officers recognising that a pollution event might have impacts on the oyster industry and human health. (Noting protocols for reticulated sewerage events are well developed.)	Wallis	Reduced pathogen risks		*Low to medium*	Medium	**NSW Food Authority** DECC GLC GTCC
Education and training of Council and other relevant staff to identify pollution events that should be referred to the NSW Food Authority	Appropriate education will be required to back up the use of referral protocols so that relevant Council and government officers recognise incidents requiring referral	Wallis	Reduced pathogen risks		*Low to medium*	Medium	**NSW Food Authority** DECC GLC GTCC

Recommendation	Actions / Steps and notes	Lakes	Likely benefit	Likely cost	Staff effort	Likely timing	Lead and contributors
Consider developing an integrated water quality monitoring program, to assist decision-making and growers	Review existing programs. In Wallis Lake, investigate supporting oyster growers measuring a greater range of parameters at the time of harvesting (in addition to salinity measures). Design program (management requirements, sites, protocols, etc.)	Wallis	Better understanding of human and ecosystem health	20,000	*Low* Input / design of program	High priority	**GLC** DPI (Fisheries) NSW Food Authority

~ As identified in the boating plan

Key:

Staff effort	
Low	One to two weeks
Medium	One month
High	Two to three months

3.6 Institutional arrangements for water quality improvement

Wallis Lake, Smiths Lake and the Myall Lakes are influenced by a wide variety of human activities in their catchments, and in the lakes themselves. Therefore to shape the lakes' ecological dynamics – protecting areas in good condition, and restoring degraded areas – many people's actions must be coordinated. In the absence of coordinated action, each of the lakes will slowly decline, as human use of the lakes and their catchments increases, and pollutant flows into the lakes increase as a result.

Governments play a central role in coordinating communities' activities so that public interests, such as the lakes' ecological health, are given their due. Alignment among influential government agencies is therefore essential to protecting the lakes' health. Institutional arrangements among government agencies underpin the Water Quality Improvement Plan. They formalise cooperation among key agencies, articulating common goals and the commitments each agency makes to serve the public interest.

The agencies' plans (from strategic to operational) are a key vehicle through which such change occurs. Aligning agencies' existing plans with the WQIP is necessary to legitimise WQIP commitments within each agency, and changes to operational plans (e.g. Development Control Plans, engineering standards and procedures, and MidCoast Water's Servicing Strategies) provide explicit direction regarding what on-ground works are required.

3.6.1 Implementation responsibilities

The Water Quality Improvement Plan lays out a wide variety of actions, in a series of implementation strategies, which together are an integrated response to the condition of the catchments, rivers and lakes. The following sections summarise these commitments from each agency's perspective.

3.6.1.1 Great Lakes Council

Role	• GLC plays a lead role in many aspects of catchment and lake management in the region, including land use planning, stormwater management, pollution control generally, community education, and advocacy on behalf of the lakes and the community's interests in the lakes. • It has the lead role in implementing the WQIP, and its work underpins management and implementation of the Wallis Lake Catchment Management Plan, the Wallis Lake Estuary Management Plan, the Smiths Lake Estuary Management Plan, and the catchment management aspects of the Port Stephens / Myall Lakes Estuary Management Plan.
Actions	
Urban	• Include water quality management clause in LEP. • Strengthen procedures for Integrated Water Cycle Management. • Investigate Pipers Creek and Pipers Bay Nutrient Offset Scheme. • Develop heads of consideration for Voluntary Planning Agreements with developers. • Complete development of Water Management DCP for Greenfield urban development and redevelopment of established urban areas. • Review Rural Living Strategy. • Build WSUD considerations into road standards. • Resource erosion and sedimentation control to achieve best practice erosion and sedimentation control. • Undertake erosion and sedimentation control internal audits. • Develop further sources of funds for urban water quality management. • Undertake urban stormwater management education. • Undertake Pipers Creek and Pipers Bay sub-catchment retrofitting program. • Undertake Smiths Lake catchment retrofitting program. • Undertake urban foreshore management program including improved planning, community engagement and enforcement of environmental legislation.
Rural	• Encourage and support the uptake of management practices that maximise the water quality improvement outcomes at the farm scale. Support the coordination and implementation of these activities with landholders including: o supporting faster uptake of riparian fencing of Crown land o minimising the impact of erosion of river and creek banks through stock exclusion, establishing off-stream watering, revegetation and mechanical bank stabilisation (where appropriate) o protecting natural wetlands from grazing pressures, supporting their natural abilities to filter nutrients and sediments o improving management of grazing on steep land (slope greater than 18°) to maximise groundcover and minimise the impact of erosion in these areas o maintaining dense groundcover with appropriate stocking rates, appropriate fertiliser application rates, watering point distribution, shade, fencing and supplements o minimising the impact of erosion of dams and maximising their ability to filter nutrients through good design, construction and maintenance o minimising the impact of farm infrastructure (roads, buildings, dams, etc.) on water quality with appropriate design, construction and maintenance o appropriate nutrient application and storage o appropriate management of human and animal effluent o identifying ways to maximise denitrification processes at the farm scale o encouraging the wider distribution of chicken litter to minimise the point-source contribution to the rivers from concentrated application

	• Reduce sedimentation from rural roads with appropriate maintenance of sediment and erosion control features, and undertake road repairs and sealing in identified high-risk areas.
Lake use	• Consider developing an integrated water quality monitoring program. • Review Stormwater Management Plans to clarify outcomes required to protect the environment and priority oyster growing areas in relation to SEPP 62. • Prepare appropriate MoU with tourism operators for all lake areas to promote responsible practices and environmental management. • Support review of Wallis Lake recreational boating MoU to improve environmental and safety outcomes of wakeboarding. • Investigate the impact and feasibility of closing boat ramps in the lower Wallamba River during high river levels to protect banks from erosion. • Work with NSW Food Authority and DECC to develop additional pollution event referral protocols. • Undertake education and training to identify pollution events that should be referred to NSW Food Authority.
Pollution control systems	• Conduct a local audit of initial compliance with adherence to, and on-ground effectiveness of, conditions of development consent. • Review the need for a pool of pollution control experts to support local government. • Review fee structures for inspecting on-site sewage management systems. • Proceed with the Water Quality Partnership for data sharing. • Revise *On-site Sewage Management Strategy* so that it reflects the latest Australian standards. • Expand use of pollution control cross-delegations within the region, if this can be done efficiently. • Support exploration of the environmental protection implications of the NSW government's proposed changes to planning law. • Support efforts to establish thorough reviews of the NSW Private Certification system in appropriate forums. • Investigate the benefits and legal options for requiring checks on WSUD infrastructure such as rainwater tanks, bioretention systems and native planting as part of the conveyancing process. • Investigate the potential for a licensing scheme for WSUD devices analogous to that which is in place for on-site sewage management systems. • [NB122]Explore opportunities for joint auditing of erosion and sedimentation control at different scales across the region (from partnerships between two councils, to the whole region). • Investigate alternative models for formalising responses to complex cases. • Initiate conversations between agencies at manager / senior manager level on how to strengthen informal cross-agency professional networks, and in particular how to induct new employees quickly into those networks. • Shift from a blitz approach to an ongoing (initially low-key) erosion and sedimentation control auditing program, including auditing Council's own works. Education to support this regulatory work is needed. • Evaluate whether the efficiency of Council's own regulatory efforts could be improved by increasing cross-delegations among Council staff.
Institutional arrangements	• Aligning agency plans with the WQIP. • Partnering to seek funding for natural resource and environmental management programs. • Joint auditing (e.g. erosion and sedimentation control, development assessment, WSUD device maintenance). • Joint monitoring (including data sharing). • WQIP public reporting.

	• Joint policy development (e.g. erosion and sedimentation control). • Liaison regarding rural and rural residential development in GTCC local government area in Wallis Lake catchment. • Joint environmental / sustainability education programs.
Adaptive management	• Adaptive policy development o Use the decision support system to explore the resilience of proposed policies o WQIP coordination groups to use the identified options for reducing uncertainty to guide WQIP implementation o Revise the decision support system to reflect evolving knowledge • Evaluating organisational performance o Normal operational checking and correction as WQIP programs are implemented o Development assessment management system audit: advice requested appropriately; conformity of approvals to planning standards; compliance with conditions of consent; performance of the built form o Organisational self-evaluations modelled on the 360° performance reviews used in human resources • Evaluating ecological outcomes o Field assessment of drainage line water quality close to Greenfield subdivisions o Field assessment of rural practice outcomes o Monitoring program of local fish diversity in rivers o Short-term event-based chlorophyll-a, turbidity, etc. monitoring program o Long-term chlorophyll-a, turbidity, etc. monitoring program

3.6.1.2 Greater Taree City Council

Role	• Thirty percent of the catchment of Wallis Lake is in the GTCC local government area. Most of this area is rural land (the exception is a relatively small area, Tallwoods, where land use planning controls on urban development are largely complete). • GTCC therefore has a key role to play managing rural land – both broadacre and rural residential. Its contributions are primarily through joint funding (with GLC) of a catchment management officer, and liaison with GLC regarding rural land development proposals (on an exceptions basis).
Actions	
Urban	• Complete development of Water Management DCP for Greenfield urban development and redevelopment of established urban areas. • Review Rural Living Strategy. • Build WSUD considerations into road standards. • Resource erosion and sedimentation control satisfactorily. • Undertake erosion and sedimentation control internal audits. • Develop further sources of funds for urban water quality management.
Rural	• Encourage and support the uptake of management practices that maximise the water quality improvement outcomes at the farm scale. Support the coordination and implementation of these activities with landholders including: o supporting faster uptake of riparian fencing of Crown land o minimising the impact of erosion of river and creek banks through stock exclusion, establishing off stream watering, revegetation, mechanical bank stabilisation (where appropriate) o protecting natural wetlands from grazing pressures supporting their natural abilities to filter nutrients and sediments o improving management of grazing on steep land (slope greater than 18°) to maximise groundcover and minimise the impact of erosion in these areas o maintaining dense groundcover with appropriate stocking rates, appropriate fertiliser application rates, watering point distribution, shade, fencing and supplements o minimising the impact of erosion of dams and maximising their ability to filter nutrients through good design, construction and maintenance o minimising the impact of farm infrastructure (roads, buildings, dams, etc.) on water quality with appropriate design, construction and maintenance o appropriate nutrient application and storage o appropriate management of human and animal effluent o identifying ways to maximise denitrification processes at the farm scale o encouraging the wider distribution of chicken litter to minimise the point-source contribution to the rivers from concentrated application • Reduce sedimentation from rural roads with appropriate maintenance of sediment and erosion control features, and undertake road repairs and sealing in identified high-risk areas.
Lake use	• Work with NSW Food Authority and DECC to develop additional pollution event referral protocols. • Undertake education and training to identify pollution events that should be referred to NSW Food Authority.
Pollution control systems	• Review the need for a pool of pollution control experts to support local government. • Review fee structures for inspecting on-site sewage management systems. • Proceed with the Water Quality Partnership for data sharing. • Expand use of pollution control cross-delegations between within the region, if this can be done efficiently. • Explore opportunities for joint auditing of erosion and sedimentation control at different scales across the region (from partnerships between two councils, to

	the whole region). • Investigate alternative models for formalising responses to complex cases.
Institutional arrangements	• Aligning agency plans with the WQIP. • Partnering to seek funding for natural resource and environmental management programs. • Joint auditing (e.g. erosion and sedimentation control, development assessment, WSUD device maintenance). • Joint monitoring (including data sharing). • WQIP public reporting. • Joint policy development (e.g. erosion and sedimentation control). • Liaison regarding rural and rural residential development in GTCC local government area in Wallis Lake catchment. • Joint environmental / sustainability education programs.
Adaptive management	• Evaluating organisational performance o Normal operational checking and correction as WQIP programs are implemented o Development assessment management system audit: advice requested appropriately; conformity of approvals to planning standards; compliance with conditions of consent; performance of the built form o Organisational self-evaluations modelled on the 360° performance reviews used in human resources • Evaluating ecological outcomes o Field assessment of rural practice outcomes

3.6.1.3 MidCoast Water

Role	• As the water and sewerage authority, MCW has a key role to play in all water cycle management decisions. Three places where their activities intersect helpfully with lake protection are: (i) encouraging the use of rainwater tanks; (ii) supporting recycled water reuse schemes (e.g. for watering playing fields, golf courses); and (iii) water supply catchment management. • They also have a key contribution to make as a repository for, and sharer of, water management data.
Actions	
Urban	• Contribute to development of water management DCP. • Strengthen procedures for Integrated Water Cycle Management. • Undertake urban stormwater management education. • Retrofitting rainwater tanks in existing urban areas using rebates.
Pollution control systems	• Proceed with the Water Quality Partnership for data sharing.
Institutional arrangements	• Aligning agency plans with the WQIP. • Partnering to seek funding for natural resource and environmental management programs. • Joint auditing (e.g. erosion and sedimentation control, development assessment, WSUD device maintenance). • Joint monitoring (including data sharing). • WQIP public reporting. • Joint policy development (e.g. erosion and sedimentation control). • Liaison regarding rural and rural residential development in GTCC local government area in Wallis Lake catchment. • Joint environmental / sustainability education programs.
Adaptive management	• Evaluating organisational performance o Normal operational checking and correction as WQIP programs are implemented o Organisational self-evaluations modelled on the 360° performance reviews used in human resources

3.6.1.4 Hunter-Central Rivers Catchment Management Authority

Role	• The HCRCMA coordinates natural resource and environmental management in a region extending from Gosford to Taree, and inland to Merriwa. • From a WQIP perspective, its emphases include: (i) it sets regional targets for water quality, amongst many NRM issues; and (ii) it is an important source of funding and advice, particularly for rural land management.
Actions	
Urban	• Contribute to the development of Water Management DCP for Greenfield urban development and redevelopment of established urban areas. Develop further sources of funds for urban water quality management.
Rural	• Encourage and support the uptake of management practices that maximise the water quality improvement outcomes at the farm scale. Support the coordination and implementation of these activities with landholders including: o supporting faster uptake of riparian fencing of Crown land o minimising the impact of erosion of river and creek banks through stock exclusion, establishing off stream watering, revegetation and mechanical bank stabilisation (where appropriate) o protecting natural wetlands from grazing pressures, supporting their natural abilities to filter nutrients and sediments o improving management of grazing on steep land (slope greater than 18°) to maximise groundcover and minimise the impact of erosion in these areas o maintaining dense groundcover with appropriate stocking rates, appropriate fertiliser application rates, watering point distribution, shade, fencing and supplements o minimising the impact of erosion of dams and maximising their ability to filter nutrients through good design, construction and maintenance o minimising the impact of farm infrastructure (roads, buildings, dams, etc.) on water quality with appropriate design, construction and maintenance o appropriate nutrient application and storage o appropriate management of human and animal effluent o identifying ways to maximise denitrification processes at the farm scale o encouraging the wider distribution of chicken litter to minimise the point-source contribution to the rivers from concentrated application • Reduce sedimentation from rural roads with appropriate maintenance of sediment and erosion control features, and undertake road repairs and sealing in identified high-risk areas.
Pollution control systems	• Proceed with the Water Quality Partnership for data sharing. • Explore opportunities for joint auditing of erosion and sedimentation control at different scales across the region.
Institutional arrangements	• Aligning agency plans with the WQIP. • Partnering to seek funding for natural resource and environmental management programs. • Joint auditing (e.g. erosion and sedimentation control, development assessment, WSUD device maintenance). • Joint monitoring (including data sharing). • WQIP public reporting. • Joint policy development (e.g. erosion and sedimentation control). • Liaison regarding rural and rural residential development in GTCC local government area in Wallis Lake catchment. • Joint environmental / sustainability education programs.

Adaptive management	• Evaluating organisational performance o Normal operational checking and correction as WQIP programs are implemented o Organisational self-evaluations modelled on the 360° performance reviews used in human resources

3.6.1.5 Department of Environment and Climate Change

Role	• DECC has an important role as a national parks manager in the WQIP catchments. However, this is a land use that is very beneficial for the lakes, and regulations around park use ensure that these areas will continue to be relatively low sources of pressure on the lakes. Accordingly, this function is not emphasised here. • DECC's actions are grounded in the WQIP implementation schedules in pollution control, where DECC is both a centre of expertise and a lead designer of the regulatory environment.
Actions	
Urban	• Investigate Pipers Creek and Pipers Bay Nutrient Offset Scheme. • Support satisfactory resourcing of erosion and sedimentation control.
Lake use	• Develop additional pollution event referral protocols. • Assist in the education and training of GLC and other relevant staff to identify pollution events that should be referred to NSW Food Authority.
Pollution control systems	• Review the need for a pool of pollution control experts to support local government. • Review fee structures for inspecting on-site sewage management systems. • Expand use of pollution control cross-delegations between within the region, if this can be done efficiently. • Explore opportunities for joint auditing of erosion and sedimentation control at different scales across the region. • Investigate alternative models for formalising responses to complex cases. • Initiate conversations between agencies at manager / senior manager level on how to strengthen informal cross-agency professional networks, and in particular how to induct new employees quickly into those networks.
Adaptive management	• Evaluating organisational performance o Normal operational checking and correction as WQIP programs are implemented o Organisational self-evaluations modelled on the 360° performance reviews used in human resources • Evaluating ecological outcomes o Monitoring program of local fish diversity in rivers o Short-term event-based chlorophyll-a, turbidity, etc. monitoring program o Long-term chlorophyll-a, turbidity, etc. monitoring program

3.6.1.6 Department of Planning

Role	• The number of WQIP actions that fall to DoP is very small. However, these contributions are worth highlighting because of the large impact that DoP's decisions have on water quality management. Essentially, by far the most tractable tranche of water quality risk management is putting in place strong planning controls to ensure that new urban development is water-sensitive. The strength and weakness of the controls employed depends to a large extent on what DoP supports.
Actions	
Urban	• Work with GLC to include water quality management clause in Great Lakes' LEP
Pollution control systems	• Consider initiating conversations between agencies at manager / senior manager level on how to strengthen informal cross-agency professional networks, and in particular how to induct new employees quickly into those networks
Adaptive management	• Evaluating organisational performance o Normal operational checking and correction as WQIP programs are implemented o Organisational self-evaluations modelled on the 360° performance reviews used in human resources • Evaluating ecological outcomes o Field assessment of rural practice outcomes

3.6.1.7 Department of Primary Industries (Agriculture)

Role	• DPI's fisheries and aquaculture management has considerable importance for the Great Lakes. However, from a WQIP perspective, it is their roles as educators and regulators of rural land managers that are most important. In particular, their contributions to the rural land management program developed jointly by DPI, GLC, HCRCMA and landcare are important for WQIP implementation.
Actions	
Urban	• Support satisfactory resourcing of erosion and sedimentation control.
Rural	• Encourage and support the uptake of management practices that maximise the water quality improvement outcomes at the farm scale. Support the coordination and implementation of these activities with landholders including: o supporting faster uptake of riparian fencing of Crown land o minimising the impact of erosion of river and creek banks through stock exclusion, establishing off-stream watering, revegetation and mechanical bank stabilisation (where appropriate) o protecting natural wetlands from grazing pressures, supporting their natural abilities to filter nutrients and sediments o improving management of grazing on steep land (slope greater than 18°) to maximise groundcover and minimise the impact of erosion in these areas o maintaining dense groundcover with appropriate stocking rates, appropriate fertiliser application rates, watering point distribution, shade, fencing and supplements o minimising the impact of erosion of dams and maximise their ability to filter nutrients through good design, construction and maintenance o minimising the impact of farm infrastructure (roads, buildings, dams, etc.) on water quality with appropriate design, construction and maintenance o appropriate nutrient application and storage o appropriate management of human and animal effluent o identifying ways to maximise denitrification processes at the farm scale

	o encouraging the wider distribution of chicken litter to minimise the point-source contribution to the rivers from concentrated application • Reduce sedimentation from rural roads with appropriate maintenance of sediment and erosion control features, and undertake road repairs and sealing in identified high-risk areas.
Lake use	• Investigate marking (with poles) sensitive areas of seagrass, primarily *Posidonia*, to limit impacts from fishers and general boating. • Investigate designated 'row in' areas to limit damage to *Posidonia* beds.
Pollution control systems	• Expand use of pollution control cross-delegations between within the region, if this can be done efficiently. • Initiate conversations between agencies at manager / senior manager level on how to strengthen informal cross-agency professional networks, and in particular how to induct new employees quickly into those networks. • Explore opportunities for joint auditing of erosion and sedimentation control at different scales across the region.
Adaptive management	• Evaluating organisational performance o Normal operational checking and correction as WQIP programs are implemented o Organisational self-evaluations modelled on the 360° performance reviews used in human resources

3.6.1.8 Other agencies' WQIP actions

The following contributions from other agencies have been suggested during development of the WQIP. In many cases, discussions with these agencies have not occurred, or are at an early stage, so further exploration of these proposals will occur while the draft WQIP is on exhibition.

Agency	Plan	Action
HCCREMS / Other councils	Pollution control systems	• Review fee structures for inspecting on-site sewage management systems. • Reviewing the need for a pool of pollution control experts to support local government. • Support exploration of the environmental protection implications of the NSW government's proposed changes to planning law. • Consider expanding use of pollution control cross-delegations between within the region, if this can be done efficiently. • Exploring opportunities for joint auditing of erosion and sedimentation control at different scales across the region. • Investigate alternative models for formalising responses to complex cases. • Initiate conversations between agencies at manager / senior manager level on how to strengthen informal cross-agency professional networks, and in particular how to induct new employees quickly into those networks.
	Urban	• Resource erosion and sedimentation control satisfactorily.
Local Government and Shires Association	Pollution control systems	• Initiate exploration of a mechanism to respond to apparent breaches of legislation in the CCI area that are not prosecuted by state government agencies.
NSW Health	Pollution control systems	• Investigate On-site Sewage Management System accreditation, and a standard funding model, or some other means of establishing a consistent risk management approach to on-site sewage management across NSW, with other local councils and DECC.

Agency	Plan	Action
		• Advise on the performance of On-site Sewage Management System when they are only used for weekends and holidays, and lead a process seeking designs better suited to intermittent use. • Consider the appropriateness of reviewing current standards for biological oxygen demand for On-site Sewage Management Systems and discuss with DECC.
DPI (Fisheries section)	Lake use	• Consider developing an integrated water quality monitoring program. • Remove old oyster lease materials with the Department of Lands. • Review Stormwater Management Plans to clarify outcomes required to protect the environment and priority oyster growing areas in relation to SEPP 62.
DECC (NPWS)	Rural	• Protect and rehabilitate high-value wetlands in the conservation estate. • Reduce sedimentation from rural roads with appropriate maintenance of sediment and erosion control features, and undertake road repairs and sealing in identified high-risk areas.
	Lake use	• Investigate the extent of environmental impacts of jet boats and wake boarding in the Myall Lakes, developing management options where necessary. • Investigate options for upgrading gravel boat ramps in the Myall Lakes to reduce pollution from these sites.
NSW Food Authority	Lake use	• Consider developing an integrated water quality monitoring program. • Develop additional pollution event referral protocols. • Education and training of GLC and other relevant staff to identify pollution events that should be referred to NSW Food Authority. • Review Stormwater Management Plans to clarify outcomes required to protect the environment and priority oyster growing areas in relation to SEPP 62.
NSW Maritime	Lake use	• Prepare appropriate MoU with tourism operators for all lake areas to promote responsible practices and environment management. • Support review of Wallis Lake recreational boating MoU to improve environmental and safety outcomes of wakeboarding. • Investigate the impact and feasibility of closing boat ramps in the lower Wallamba River during high river levels to protect banks from erosion. • Investigate marking (with poles) sensitive areas of seagrass, primarily *Posidonia*, to limit impacts from fishers and general boating. • Investigate designated 'row in' areas to limit damage to *Posidonia* beds. • Investigate the extent of environmental impacts of jet boats and wakeboarding in the Myall Lakes, developing management options where necessary. • Investigate options for upgrading gravel boat ramps in the Myall Lakes to reduce pollution from these sites.
Department of Crown Lands	Lake use	• Remove old oyster lease materials with DPI (Fisheries).
Port Stephens / Myall Lakes Estuary Management Committee	Lake use	• Investigate the extent of environmental impacts of jet boats and wakeboarding in the Myall Lakes, developing management options where necessary. • Investigate options for upgrading gravel boat ramps in the Myall Lakes to reduce pollution from these sites.

Agency	Plan	Action
CCI Advisory Committee	Adaptive management	• Adaptive policy development o Use the Decision Support System to explore the resilience of proposed policies o WQIP coordination groups to use the identified options for reducing uncertainty to guide WQIP implementation o Revise the decision support system to reflect evolving knowledge
WQIP coordinating groups	Adaptive management	• Adaptive policy development o Revise the decision support system to reflect evolving knowledge • Evaluating organisational performance o Prepare checklists of actions undertaken, and not undertaken, for use in annual and seven-yearly reviews o Reporting on program outputs as required by the Hunter-Central Rivers Catchment Action Plan • Reporting o Annual WQIP reporting o Seven-yearly WQIP report and review o Explore options for improving the integration of NRM plan implementation and reporting on progress
Landcare / Catchment management practitioners	Rural	• Encourage and support the uptake of management practices that maximise the water quality improvement outcomes at the farm scale. Support the coordination and implementation of these activities with landholders including: o supporting faster uptake of riparian fencing of Crown land o minimising the impact of erosion of river and creek banks through stock exclusion, establishing off-stream watering, revegetation and mechanical bank stabilisation (where appropriate) o protecting natural wetlands from grazing pressures, supporting their natural abilities to filter nutrients and sediments o improving management of grazing on steep land (slope greater than 18%) to maximise groundcover and minimise the impact of erosion in these areas o maintaining dense groundcover with appropriate stocking rates, appropriate fertiliser application rates, watering point distribution, shade, fencing and supplements o minimising the impact of erosion of dams and maximising their ability to filter nutrients through good design, construction and maintenance o minimising the impact of farm infrastructure (roads, buildings, dams, etc.) on water quality with appropriate design, construction and maintenance o appropriate nutrient application and storage o appropriate management of human and animal effluent o identifying ways to maximise denitrification processes at the farm scale o encouraging the wider distribution of chicken litter to minimise the point-source contribution to the rivers from concentrated application • Reduce sedimentation from rural roads with appropriate maintenance of sediment and erosion control features, and undertake road repairs and sealing in identified high-risk areas.
	Adaptive management	• Evaluating ecological outcomes o Field assessment of rural practice outcomes

Agency	Plan	Action
Farmers	Rural	• Encourage and support the uptake of management practices that maximise the water quality improvement outcomes at the farm scale, including: o supporting faster uptake of riparian fencing of Crown land o minimising the impact of erosion of river and creek banks through stock exclusion, establishing off-stream watering, revegetation and mechanical bank stabilisation (where appropriate) o protecting natural wetlands from grazing pressures, supporting their natural abilities to filter nutrients and sediments o improving management of grazing on steep land (slope greater than 18°) to maximise groundcover and minimise the impact of erosion in these areas o maintaining dense groundcover with appropriate stocking rates, appropriate fertiliser application rates, watering point distribution, shade, fencing and supplements o minimising the impact of erosion of dams and maximising their ability to filter nutrients through good design, construction and maintenance o minimising the impact of farm infrastructure (roads, buildings, dams, etc.) on water quality with appropriate design, construction and maintenance o appropriate nutrient application and storage o appropriate management of human and animal effluent o identifying ways to maximise denitrification processes at the farm scale o encouraging the wider distribution of chicken litter to minimise the point-source contribution to the rivers from concentrated application • Reduce sedimentation from rural roads with appropriate maintenance of sediment and erosion control features, and undertake road repairs and sealing in identified high-risk areas.
	Adaptive management	• Evaluating ecological outcomes o Field assessment of rural practice outcomes
Developers	Urban	• Contribute to development of water management DCP.
	Adaptive management	• Evaluating ecological outcomes o Field assessment of drainage line water quality close to Greenfield subdivisions
Community groups	Urban	• Contribute to development of water management DCP.

3.6.2 Coordination responsibilities

3.6.2.1 CCI Project Advisory Committee

The Great Lakes Coastal Catchment Initiative Advisory Committee has a key transitional role to play as the Water Quality Improvement Plan passes from the planning phase to implementation.

Among other things, the shift from water quality improvement planning to effective implementation involves:

- key operational agencies (Great Lakes Council, Greater Taree Council, MidCoast Water, and the Hunter-Central Rivers Catchment Management Authority) embedding WQIP commitments in their operational plans and beginning to implement them
- NRM coordinating groups (in particular the Great Lakes Catchment Committee and the Great Lakes Coastal and Estuary Committee, and MidCoast Water's Sustainable Water Cycle Management Committee) taking on WQIP agendas as components of their coordination responsibilities
- a variety of NRM and land use plans being reviewed, and where necessary revised, to embody WQIP commitments.

Many strategic plans falter in the transition from strategic planning to operational commitment: this is how they come to live only 'on the shelf'. It is strongly recommended that the Advisory Committee continues to meet until it is satisfied that this transition into operational practice has occurred satisfactorily.

During this transition phase its key responsibilities are:

- to oversee embedding of WQIP commitments in agencies' activities – providing support, a forum for discussion and resolution of implementation issues, and holding agencies accountable, as required
- to oversee key NRM groups taking up the WQIP commitments, providing support as needed
- to secure formal management commitment from each of the agencies involved in implementing the WQIP to the actions that the WQIP commit them to.

Securing formal management commitment from implementing agencies involves two kinds of activity:

- each Advisory Committee member who is a representative of an implementing agency needs to take responsibility for securing formal commitment from their agency to the WQIP actions (this may entail some adjustments to the WQIP, but hopefully these will be rare)

- for agencies that have key roles in implementing the WQIP, but are not represented on the Advisory Committee, the Advisory Committee should make personal representations to staff in these agencies with a view to supporting these agencies making a formal commitment to their WQIP actions; key agencies who will need to be approached include the Department of Planning, State Forests, the Department of Lands and NSW Health.

3.6.2.2 Operational water cycle management agencies

Four agencies make core operational contributions to management of water quality outcomes:

- Great Lakes Council, with operational responsibilities for land use planning, roads and drainage, pollution control, and many aspects of environmental management
- Greater Taree City Council, with the same responsibilities in a rural area that is approximately 30% of the catchment of Wallis Lake
- MidCoast Water, which supplies potable water to, and treats wastewater from, urban areas in the catchments of the Great Lakes, and also makes some direct contributions to catchment management (particularly through its management of water supply catchments)
- the Hunter-Central Rivers Catchment Management Authority, with catchment management responsibilities for a region from Gosford to Taree; the CMA have made particularly important financial contributions to management of rural lands in the catchments of the Great Lakes.

Their collaboration is fundamental to delivering the WQIP on the ground.

Among these four agencies, Statements of Joint Intent (SoJIs) have been used to formalise their joint commitments to water quality management goals for the Great Lakes. Three have been negotiated as the WQIP has developed, between:

- Great Lakes Council and Greater Taree Council
- Great Lakes Council and MidCoast Water
- Great Lakes Council and the Hunter-Central Rivers Catchment Management Authority.

The SoJIs commit the partners to:

- ownership and maintenance of the products of the WQIP planning process (particularly the catchment and estuarine modelling, and the Decision Support System)
- data sharing and record keeping, e.g. water quality data through the Water Quality Partnership, and information on properties and works in the catchment

- appropriate contributions to funding and implementing the WQIP
- MCW has agreed to work out what its funding and implementation priorities should be under the WQIP
- the HCRCMA has agreed to recognise the importance of the WQIP in implementing the priorities of the Catchment Action Plan
- additional commitments have not been identified for GTCC
- monitoring, ongoing reporting and evaluation to guide adaptation of water quality management activities.

The SoJIs are provided in Appendix 2.

3.6.2.3 Joint Action Plan

Discussions among representatives of these four agencies have led to the proposal that operational cooperation between them, under the SoJIs, be formalised through a Joint Action Plan. Other agencies (as per Table 3.6.1) will be requested to contribute in specific areas appropriate to their responsibilities. The intent here is to strengthen cooperation in operational management: working together more closely (with more discussion and joint action) where this could significantly improve on-ground outcomes. We expect benefits from formalising these commitments in efficiency and effectiveness, through improved alignment among the agencies and sharing of resources. The proposals for cooperation outlined here (Table 3.6.1) are draft proposals that are under discussion among the SoJI agencies.

One of the attractions of expanding collaboration between the agencies is the potential for improving the financial position of environmental management in the WQIP regions, by such means as:

- interagency partnerships attracting additional funding from state and federal governments
- pooling existing resources to use them more efficiently (joint auditing programs may achieve this, for instance).

The draft Joint Action Plan is provided in Table 3.6.1.

Table 3.6.1. Draft Joint Action Plan for the Great Lakes WQIP.

Program	Areas	Core partners				Other possible partners	Notes
		GLC	GTCC	HCR CMA	MCW		
Improving catchment management systems	Aligning agency plans with the WQIP	yes	yes	yes	yes	State Forests DECC (National Parks) Marine Parks	• Each agency is committed to aligning its strategic and operational plans with the WQIP for Wallis, Smiths and the Myall lakes (Table 3.6.2 lists the relevant plans) • Joint use of the WQIP's decision support system will inform this work.
	Partnering to seek funding for natural resource and environmental management programs	yes	yes	yes	yes	DECC	• Including discussing how local government environmental rates and stormwater rates, and a possible CMA catchment rate, should each be positioned
	Joint auditing	yes	yes	yes	yes	State Forests National Parks	• Improve quality and extent of programs by sharing existing resources, e.g. Catchment Action Plan Monitoring, Evaluating, Reporting program. Possible focuses include: o erosion and sedimentation control o development assessment o WSUD device maintenance
	Joint monitoring (including data sharing)	yes	yes	yes	yes	State Forests National Parks Marine Parks	• MCW's aerial photography is being shared, for instance • Evaluation of effects of programs is an important gap to address, as auditing of NHT2 spending has shown large gaps in measurement of outcomes
	WQIP public reporting	yes	yes	yes	yes	State Forests	• Joint ownership of the WQIP review processes is envisaged • Ecological outcomes and organisational performance will be covered, and also socio-economic effects where possible
Land use planning	Developing DCPs	yes	yes	Supporting role	yes	DoP	• For example: o the WSUD DCP work that is currently being undertaken cooperatively o a consistent DCP for dam construction in GTCC and GLC
	Use of Integrated Water Cycle Management approach when developing Masterplans of Greenfield sites	yes	Supporting role	Supporting role	yes	DoP	• Will enable resolution of possible tensions between water management goals (e.g. between recycling wastewater and using stormwater for non-potable uses), and support better overall outcomes

Program	Areas	Core partners				Other possible partners	Notes
		GLC	GTCC	HCR CMA	MCW		
	Policy development	yes	yes	yes	yes	DECC DoP	• Erosion and sedimentation control policy • WSUD policy • Catchment management policies
	Liaison regarding rural and rural residential development in GTCC local government area in Wallis Lake catchment	yes	yes	yes	yes		• What is envisaged here is a formal agreement between Greater Taree Council and Great Lakes Council that GTCC Council will consult GLC about planning decisions with the potential to have a significant impact on Wallis Lake water quality • Development of common policies on rural subdivision and guidelines for water quality management in rural developments
On-ground programs	Strengthening management of water supply catchments	yes	yes	yes	yes	State Forests DECC	• Catchments where improved land management benefits each of farmers, water supply operations, and downstream rivers and lakes, so they are a priority • MCW will play a lead role in increasing the joint focus on these catchments
	Riverkeeper / on-ground advocate for the rivers' interests	yes	yes	If the program embraces catchments and water quality appropriately	yes	NSW Maritime	• Riverkeeper programs provide on ground advocates for rivers who look from the rivers' perspective at the catchment • Commonly Riverkeepers have a focus on gross pollution, and on lake and river use activities; a focus on subtler forms of pollution - sediments, nutrients and pathogens - would be needed to support the WQIP
	Rural land protection and restoration	yes	yes	yes	In the Crawford and Darawakh (drinking water catchments)	DECC DPI (Agriculture) Landcare	• A cooperative program in the Crawford (a water supply catchment in the catchment of Myall Lakes is already in view) • MCW's emphasis is on water supply catchments • Darawakh and Frogalla Wetland Management plan is being jointly implemented
	Rural water and energy use efficiency programs	In-principle support	yes	Supporting role	yes	DPI (Agriculture) DWE	• Explore opportunities for cooperation provided by WQIP
	Environmental / Sustainability education	yes	yes	yes	yes	DPI DECC DWE	• Further work aligning agencies' programs with each other and sharing resources, to create a more efficient, more mutually reinforcing joint program

3.6.2.4 Aligning NRM and land use plans with the WQIP

NRM coordination forums

There are a variety of plans that need to be updated to reflect the WQIP. Among these, the NRM plans that are owned and overseen by key NRM coordination groups have a central role to play.

The key groups, and the main plans they oversee, are:

- Wallis and Myall Lake Catchment Management Group:
  - the Wallis Lake Catchment Management Plan
  - the Myall Lakes Estuary Management Plan (catchment management sections)
- Wallis / Smiths Lake Estuary and Coastal Management Committee:
  - the Wallis Lake Estuary Management Plan
  - the Smiths Lake Estuary Management Plan.

These groups provide key forums for interagency / stakeholder coordination, so from a WQIP perspective what is sought is that:

- the committees commit to updating the plans that they manage to reflect WQIP recommendations
- they undertake to commence monitoring implementation of WQIP recommendations that relate to their areas of operation
- they commit to reporting regularly on progress with implementation of the WQIP, in conjunction with progress with implementation of the other NRM plans that they oversee, to the community.

Great Lakes Council provides key logistical support to these committees, so Great Lakes Council's active support is necessary for this transition in the committees' roles to occur.

Sustainable water cycle management

A second aspect of plan alignment is looking at the combination of the Water Quality Improvement Plan, which has an emphasis on rainfall and runoff, and MidCoast Water's Sustainable Water Cycle Management Strategy, with an emphasis on water supply and sewage, as an integrated water cycle management strategy designed to deliver sustainable water cycle management. The related phrases 'integrated water cycle management' and 'sustainable water cycle management' emphasise three points:

- *that water **cycles***: the big picture is a cycle from the planet's surface into the atmosphere and back to the surface again; embedded in this are many finer-grained flows, including such loops as extraction from rivers, transfer via water treatment

plants to homes, and then discharge via sewage treatment plants and pipes to the ocean, etc.

- *integrated management*: looking at these flows holistically when managing water, so that opportunities to improve both water supply and stormwater outcomes are taken when, for example, rainwater tanks are being considered
- *sustainability*: seeking water use outcomes that are sustainable from all perspectives: providing clean drinking water reliably; using water in ways that protect (as far as practicable) the environments that supply water and receive wastewater; and managing water in ways that are financially sustainable.

From an operational perspective the central questions are:

- Are there opportunities for improving the financial or environmental efficiency of water management that are not being taken – in other words, are there opportunities to improve outcomes that are being missed?
- Are the processes that are in place to manage water capable of recognising and responding to the opportunities that arise from considering the water cycle holistically when management decisions are being made?

MidCoast Water has formed a Sustainable Water Cycle Management Committee with representatives from Great Lakes and Greater Taree Councils, and the Hunter-Central Rivers Catchment Management Authority. The committee has been established to facilitate partnership on water and environmental issues. This is one vehicle for follow-through.

Areas of collaboration that have been identified, which the SoJI partners are working on together, include:

- management of water supply catchments to protect water quality
- how MidCoast Water uses its funding for environmental initiatives
- effluent reuse for potable water substitution – golf courses and sports fields
- collaborative development of Environmental Management Systems
- Water Sensitive Urban Design and Development, including assessment of water cycle aspects of development applications – particularly looking at water supply, sewerage and drainage aspects of subdivision proposals and other large developments
- improving urban water use efficiency, including business and home audits of energy and water usage
- development of greenhouse gas assessments.

Work on the last five of these program areas is partly funded by a joint Urban Sustainability Program that Great Lakes Council, Greater Taree City Council and MidCoast Water applied for successfully together.

Table 3.6.2 reviews the identified points of intersection between the WQIP and MidCoast Water's Sustainable Water Cycle Management Strategy. These articulate a key part of the agenda for negotiation among the SoJI partners about what the Joint Action Plan will involve operationally, and what integrated, sustainable water cycle management is in practice.

Table 3.6.2. Integration of the Water Quality Improvement Plan and MidCoast Water's Sustainable Water Cycle Management Strategy.

Water cycle areas		Opportunities that an integrated approach presents	How addressed in the WQIP	How addressed in MCW's planning and operations	Ways in which collaboration could be strengthened
General	Funding	*Use of MCW's funding for environmental programs* MCW has annual funding of (currently) about $1.3 million per annum for environmental programs, including catchment management. Funding is also directed towards purchasing natural wetlands, and other high priority environmental protection measures.		MidCoast Water's Sustainable Water Cycle Management Committee, in which all the SoJI signatories participate, provides guidance	
	Environmental Management Systems	*Collaborative development of Environmental Management Systems* The joint (GLC, GTCC and MCW) Urban Sustainability Grant is funding cooperative development of EMSs to foster alignment between the three partners on environmental management generally, and water cycle management in particular.	The Adaptive Management Strategy lays out foundations for lake water quality aspects of an EMS. The approach developed in the Adaptive Management Strategy can inform development of the EMSs.		Ongoing cooperation through the Urban Sustainability Grant
	Reducing greenhouse gas emissions	*Investigation of ways to reduce greenhouse gas emissions* The joint (GLC, GTCC and MCW) Urban Sustainability Grant is funding cooperative development of greenhouse gas assessments.			Ongoing cooperation through the Urban Sustainability Grant

Water cycle areas		Opportunities that an integrated approach presents	How addressed in the WQIP	How addressed in MCW's planning and operations	Ways in which collaboration could be strengthened
Rural catchments	Rural land management	*Water supply catchment management* Joint funding of rural water quality management in water supply catchments, as this moderates water supply treatment costs and improves outcomes for rivers and lakes. Possible programs include: • riverbank restoration • groundcover reestablishment	An extensive program of rural catchment management has been developed in the WQIP (Section 3.3.2), and water supply catchment (notably Crawford River) has been identified as a priority area. In addition, negotiations about an expanded program of catchment management for the Crawford River are taking place (Appendix 21[DG123]).	MCW has committed additional funding to rural land management programs in the Crawford catchment for 2008–10	Further modelling to strengthen the relationship between available funding the identified program of catchment management for the Crawford River
	On-site sewage treatment	*Providing reticulated sewerage to smaller settlements* Reticulated sewerage can be provided to areas with mains water, reducing risks of pollutant flows to groundwater	The timing on plans for reticulated sewerage was taken into account when deciding the development rates of Coomba Park, of which the impacts on water quality are modelled in the trajectory of development	Projects MCW has identified for the 'backlog' provision of sewerage to urban settlements include: Stroud Road, Coomba Park, Allworth, North Port Stephens (Pindimar, Bundabah, North Arm Cove) and Nerong	
Urban catchments	Urban water use	*Improving urban water use efficiency* Encouraging efficient use of water in urban areas because this: (i) reduces demand for extractions from rivers; and (ii) can reduce water and nutrient flows from urban areas into streams (e.g. by efficient use of park and garden watering)	Urban education recommendations (Section 3.4.1.3)	• MCW is committed to improving water use efficiency, and the other partners are committed in principle to supporting this work • MCW has introduced a Water Saving Rebate program for retrofitting existing housing, which subsidises all water saving devices up to a total subsidy of $1,500 per property. It is potentially a $1.1 million per annum program.	Sharing material and key messages

Water cycle areas		Opportunities that an integrated approach presents	How addressed in the WQIP	How addressed in MCW's planning and operations	Ways in which collaboration could be strengthened
		Rainwater tank strategies Evaluating the opportunities presented by rainwater tanks in an holistic way, taking account of benefits to management of urban runoff and reductions in demand for water	Rainwater tanks play a key role in the WSUD DCP recipes for urban development and their impacts have been modelled in the redevelopment management actions as well as in the retrofitting scenario	• BASIX now requires rainwater tanks • MCW's Water Saving Rebate program provides substantial rebates for retrofitting existing housing with rainwater tanks	• Close consideration of tensions between effluent reuse and rainwater use via development of Integrated Water Cycle Management strategies when developing Masterplans of Greenfield sites • Ongoing cooperation through the Urban Sustainability Grant
	Urban effluent management	*Effluent reuse strategies* Reusing effluent reduces the pollutant burden on water bodies into which treated effluent is discharged, and its demands on water sources (rivers and groundwater systems). May increase the nutrient load onto watered areas (though this can simply substitute for fertiliser)		MCW is committed to a substantial expansion of its effluent reuse program	
	Urban runoff	*Stormwater harvesting* Stormwater harvesting has the potential to make a significant contribution in urban areas where storage (possibly in the form of aquifer recharge) is available		MCW is in the early stages of investigating possible schemes	

Note: A limitation of this analysis, from a water cycle management perspective, is that it is based on scoping in workshops and conversations of points of intersection between an analysis of urban water cycle management (led by MidCoast Water in its Sustainable Water Cycle Management) and a more general analysis of catchment management (undertaken for these WQIP), rather than a top-down integrated analysis of the water cycle as a whole. Integrated modelling sometimes reveals unexpected opportunities, and provides a robust quantitative description from which to articulate the overall strategy.

Other agency plans

The organisational plans that the SoJI partners have identified as needing review, and where necessary revision, to bring them into alignment with the WQIP are listed in Table 3.6.3.

Table 3.6.3. SoJI partners' plans that need to be reviewed for alignment with the WQIP.

Hunter-Central Rivers Catchment Management Authority	• Catchment Action Plan o The WQIP provides an opportunity to update the Catchment Action Plan, as they address Great Lakes management issues in considerably more detail than the Catchment Action Plan • First statutory review of the Catchment Action Plan at 5 years (in 2011)

MidCoast Water	• Strategic Business Plan
	• Sustainable Water Cycle Management Plan
	• Plan of Management
	  o Three-year plans, revised each year; the plans where funding commitments are made
	• Servicing Strategies
	  o These define what developers are required to provide (and are therefore the location where requirements for water efficiency and water reuse are described)

Great Lakes Council	• Management Plan
	  o Includes overall budget commitments
	• Land use plans
	  o Conservation and development strategies and programs
	  o Rural Living Strategy
	  o Land use planning instruments: LEP, DCP
	  o Standard conditions of development consent
	• Ecosystem management plans
	  o Catchment Management Plans
	  o Stormwater Management Plan
	  o Estuary Management Plans
	• Environmental Management System
	  o Under development (supported by grant funding)
	• Engineering standards and procedures
	  o These define operational practice for engineering works

Greater Taree Council	• Management Plan • Land use plans (including LEP, DCP, standard conditions of development consent) • Ecosystem management plans • Engineering standards and procedures

Appendix 29 provides a further extensive list of natural resource management and land use plans that need review in a variety of identified areas to test their alignment with the WQIP. These plans are as follows:

- Natural resource management plans
  - Coolongolook Rivercare Plan

- Darawakh / Frogalla Wetland Management Plan
- Forster / Tuncurry and Wallis Lake Stormwater Management Plan
- Hunter-Central Rivers Catchment Action Plan
- Lower Wallamba Rivercare Plan
- Mid Wallamba Rivercare Plan
- Myall Catchment: Community Catchment Management Plan (2001)
- Myall Lakes National Park Management Plan
- Myall Rivercare Plan
- Port Stephens – Great Lakes Marine Park Management Plan
- Port Stephens – Myall Lakes Estuary Management Plan
- Smiths Lake Boating Plan of Management 2005 – 2010
- Smiths Lake Estuary Management Plan
- Wallingat National Park Draft Plan of Management
- Wallis Lake Catchment Management Plan
- Wallis Lake Estuary Management Plan
- Wallis Lake Wetlands Management Strategy
- Wang Wauk Sub-catchment Plan
- Water Sharing Plan for Lower North Coast Unregulated and Alluvial Water Sources (Draft).

- Land use plans
  - Foster / Tuncurry Conservation and Development Strategy
  - Great Lakes Community Strategic Plan 2020
  - Great Lakes Local Environmental Plan
  - Greater Taree Local Environmental Plan (1995) and Draft Greater Taree Local Environmental Plan (2008)
  - Hallidays Point Conservation and Development Strategy (2000)
  - Hunter Regional Environmental Plan 1989
  - Rural Living Strategy
  - Rural Residential Strategy and Release Program (2000)
  - South Forster Structure Plan (February 2007).

3.6.3 Way forward

3.6.3.1 CCI Advisory Committee responsibilities

The Great Lakes CCI Advisory Committee has a key role to play overseeing the transition from the planning phase to the implementation phase.

- Formal confirmation of acceptance of WQIP commitments is needed from each of the agencies participating in WQIP development (e.g. inclusion of these commitments in strategic and / or operational plans as appropriate).
- Negotiations with other state agencies that have important contributions to make but are not represented on the Advisory Committee are needed. The Advisory Committee needs to lead this process.
- The transition from strategic plan development to operational agency practice needs to be kept under review to support successful transitions. This involves keeping a watching brief across all WQIP issues, and following up on problems as needed.

The Advisory Committee can disband when it is satisfied that WQIP commitments are satisfactorily embedded in the implementing agencies' practice.

3.6.3.2 NRM coordination forums' responsibilities

The Great Lakes Catchment Management Committee and the Great Lakes Estuary Management Committee have two responsibilities:

- to ensure that WQIP insights and commitments are appropriately reflected in the NRM plans that they oversee
- to track implementation of the WQIP actions that relate to their areas of responsibility, alongside the commitments made in other NRM plans.

3.6.3.3 Operational water cycle managers' responsibilities

The main steps in the process of finalising a Joint Action Plan for Great Lakes Council, Greater Taree Council, MidCoast Water and the Hunter-Central Rivers Catchment Management Authority – to carry forward the commitments made in the Statements of Joint Intent – are as follows:

1. Further collaborative development of the agenda outlined above
2. Review of the proposed commitments by senior management in each organisation
3. Sign off at Board / Council level on an agreed Joint Action Plan
4. Follow through on joint action as agreed, using coordination mechanisms that have yet to be decided on; as noted above, the main options are:
    - through existing forums, notably estuary and catchment management committees
    - through a Water Quality Improvement Plan steering group that would meet periodically with a specific focus on carrying forward the WQIP agendas.

3.7 Pollution control systems

This section looks at the management of sediment and nutrient flows to the Wallis, Smiths and Myall lakes, with particular reference to seven policy and regulatory tools:

- the *Environmental Planning and Assessment Act 1979* (particularly managing compliance with conditions of consent)
- the *Fisheries Management Act 1994*
- Great Lakes Council's Erosion and Sediment Control Policy
- Great Lakes Council's On-Site Sewage Management Strategy
- the *Native Vegetation Act 2003*
- the *Protection of the Environment Operations Act 1997*
- the *Water Management Act 2000*.

These were selected by Great Lakes Council, in consultation with the Commonwealth Department of Environment and Water, on the basis of their importance to local environmental management and environmental management in NSW generally. Through the CCI, three areas were explored in relation to the policy and regulatory tools:

- how they, and the management systems established around them, are intended to (among other things) protect the lakes
- how effective their use is in practice
- recommendations for review and improvement of the legislation, policies and systems.

3.7.1 Policing development consents

3.7.1.1 *Environmental Planning & Assessment Act 1979*

The Environmental Planning & Assessment Act 1979 (EP&A Act) is the key legislation governing land use in NSW. It is administered by the Minister for Planning.

The EP&A Act creates three different *Environmental Planning Instruments* to manage competing land uses: Local Environmental Plans (LEP); Regional Environmental Plans (REP) and State Environmental Planning Policies (SEPP). Following an amendment to the Act in June 2005, the Minister can now require Environmental Planning Instruments to conform to a specified model or set of guidelines of what each planning instrument should contain. These guidelines are described in the Act as *standard instruments.*

SEPPs regulate issues of state importance and may relate to identified geographical location(s) or cover particular issues across the entire state. SEPPs act in a variety of

ways: they can protect environmentally sensitive areas such as bushland and coastal wetlands; they can also take consenting power away from councils and transfer them to the Minister for a variety of uses, including for major projects.

Councils may also develop Development Control Plans (DCPs) to guide land use planning. DCPs sit alongside LEPs and expand on certain aspects of the LEP. DCPs are not legally binding, but councils are required to consider them when assessing a Development Application (DA).

A DA is made by the owner of land (or with the owner's permission) to a consent authority, such as a council, for the purpose of subdividing land, constructing a building, undertaking works or changing the use of land. The consent authority must consult all Environmental Planning Instruments that apply to that land to decide whether development consent is required. Integrated developments are developments that require approval under at least one additional piece of state legislation besides the EP&A Act. Such legislation includes the *Fisheries Management Act 1994* and the *Water Management Act 2000.* The consent authority (e.g. a local council) cannot consent to an integrated development without the approval of the other approval authority and cannot impose conditions which conflict with that approval.

As part of the 2005 amendments to the EP&A Act, the Minister is now the consent authority for two new types of development identified as *major projects* and *critical infrastructure projects.* Major projects are defined as those of state or regional environmental and / or social significance, and include developments such as sensitive coastal projects. Critical infrastructure projects are those declared by the Minister as essential environmental, economic or social projects for NSW.

The EP&A Act requires the consent authority to take account of a range of issues when considering a DA. These include any current or exhibited draft Environmental Planning Instruments, relevant DCPs, whether the land is in a coastal zone, any social or economic effects, or effects on the natural or built environment.

Some projects undertaken by government authorities, such as road and electricity works, do not require development consent. Their environmental impacts are assessed under Part V of the EP&A Act.

Councils have discretion under the EP&A Act about how, or indeed whether, to respond to breaches of development consent. Councils can undertake civil enforcement by fining offenders, placing 'stop work' orders on developments, or commencing action in the Land and Environment Court. The Land and Environment Court has discretion about what orders are made when a breach of planning law is proved. If the Court does make an

order and a developer does not comply, then the Court may impose a large fine, confiscate land and could imprison the offender.

The NSW Government is currently in the process of introducing some of the most significant changes to planning laws in NSW for several decades. While there is support for some aspects of the new legislation, particularly from the development industry, widespread opposition is coming from the community, local government and planning lawyers. The Local Government and Shires Associations of NSW have expressed their concerns at the proposed legislative changes: “communities may lose their right to have a say over local development, Councils’ role in the development process will be significantly reduced, and funding of local infrastructure will be under threat.” (*Planning Draft Exposure Bills Local Government and Shires Associations of NSW Preliminary Assessment*, April 2008, p. 3). Other concerns that have received public attention have been the proposal for the Minister of Planning to compulsorily acquire private land at market value and then to sell it to a developer, who may then develop the site and potentially make a profit from the acquired land. The Minister must be able to demonstrate that this process will result in a net public benefit. Another concern that has been raised by planning lawyers is that the draft bills prevent legal challenges to certain decisions made by the Minister, potentially overriding long held principles in administrative law of natural justice and procedural fairness.

Management practice

Plan-making and development assessment under the EP&A Act are being reviewed in other parts of the water quality improvement planning process (see ‘Rural Development Assessment’ and ‘Future Urban Management’ in section 3 of the Act). The focus here is on compliance with conditions of consent, i.e. on the relationship between what is built and what was approved.

Two phases are relevant here: (i) during construction; and (ii) during ongoing use. During construction, checking of compliance with conditions of consent can be robust. Where major infrastructure is being built that will pass into public ownership (e.g. roads, drains, water supply, sewerage) the level of scrutiny is high, and the outcomes usually satisfactory. For other kinds of development, scrutiny appears to have been weakened by the introduction of Private Certification under the EP&A Act. Two consequences of this have been identified that warrant consideration in a review of the Act:

- Creating the role of Private Certifiers has privatised regulation, and that creates a conflict of interest for the certifiers: on one hand, they are paid by the developers to certify developments, and on the other, a key part of their role is policing compliance with conditions of consent to protect the public interest in ways that are (in part) costly for developers. The situation is similar to financial auditing. However: (i)

traditions of probity and accountability are well developed in accounting, but are nascent in private certification of development; and (ii) business owners usually value the accuracy of their accounting records, whereas failure to comply with conditions of consent commonly harms the public interest or the interests of neighbours. From a public interest perspective, the current model of Private Certification warrants review because of the risk of Private Certifiers putting developers' interests ahead of the public interest. Lobbying by the Local Government and Shires Association is addressing this point.

- When a council is the certifying authority, authorised officers under the POEO Act who are involved in certifying developments also experience a conflict of interest. If they, for example, issue a warning or on-the-spot fine for non-compliance with erosion and sedimentation control standards, they make private certification much more attractive to developers, putting council income from development assessment at risk. In practice, that commonly means that the two roles are separated. However, there is an opportunity cost for water quality protection in this: opportunities to underline the importance of, for example, erosion and sedimentation control during certification visits that would have been taken in the past, are not taken now. In practice, the level of scrutiny of compliance is considerably lower. In this respect, Private Certification has reduced the efficiency of use of public funds.

Some conditions of consent prescribe how a property should be managed over the long term (e.g. retaining vegetation, maintaining WSUD devices). Policing these conditions is the area of greatest difficulty for councils. In the case of rainwater tanks, bioretention systems or native planting requirements, long-term adherence to consent conditions will make a significant contribution to water quality outcomes; equally, their failure will have a significant negative impact on water quality. Approaches worth investigating to improve adherence include:

- licensing WSUD devices on private land, in a way similar to licensing of On-site Sewage Management Systems
- requiring checks on the compliance of WSUD devices / properties at the time of conveyancing.

The first of these recommendations is supported by initial legal advice (Peter Rees, Malik Rees, 26 June 2008). A major weakness of the current arrangements is that while councils can condition a development to require installation and maintenance of a WSUD device on private land, current powers do not permit inspecting the devices on residential properties unless invited onto the property by the landowner. Malik Rees recommend addressing this with a legislative change to the *Local Government Act 1993* along the lines of the On-site Sewage Management System legislation, by which approval for a

WSUD device would be required – and then, if the approval is appropriately conditioned, an ongoing inspection regime can be established.

For the latter, conditions of development consent might be listed on the S149 Certificate issued by councils – and councils could charge a cost recovery fee to inspect and certify compliance when a property is to be sold. Integrating WSUD checks into the conveyancing process would ensure that new owners are aware of their obligations. Enforcing conditions of development consent as part of the conveyancing process would at least renew consent conditions each time the property was sold, and may also increase community awareness of consent conditions and of the need to adhere to these conditions. This is an area where advice on legal mechanisms would be helpful.

GLC's ecologists identified that they put considerable effort and research into ecological conditions of development consent. However, they had only anecdotal information on how well proponents adhered to these conditions over time, and on the effectiveness of these conditions in achieving their stated aims of, for example, maintaining a remnant of a threatened species. An ongoing audit of both adherence to and effectiveness of ecological development conditions, as part of a comprehensive environmental audit system, would provide feedback to support enforcement. It would also improve the effectiveness of conditions of consent in achieving stated outcomes and improving water quality protection, among other things.

Overall, the management systems that discipline adherence to conditions of consent are extremely weak. For most public interest outcomes, GLC is unable to demonstrate on-the-ground compliance with the EP&A Act. Lacking effective management systems, which monitor and audit compliance, the level of compliance with conditions of development consent is uncertain. Resourcing is a major contributor to this weak enforcement of conditions of consent. A robust management system design, and increased staffing with appropriate supports (e.g. access to vehicles for site inspections), are what is needed to enable effective enforcement. A first step would be an audit of compliance with, adherence to, and effectiveness of, conditions of consent to scope the problem. This is an issue for local government in NSW in general, so it could be carried out at regional or state level if resources for it can be found more readily at those scales.

Recommendations

1. Participate in the debate about the NSW government's proposed changes to planning law, emphasising that it is important to examine how alternative ways of regulating environmental planning affect environmental outcomes. (Regional Organisation of Councils / HCCREMS may be able to assist with this.)
2. Acknowledge the improvements that the NSW government has announced, and support efforts to establish thorough reviews of the NSW Private Certification system

in appropriate forums (e.g. with the NSW Government, the Commonwealth Government and in local government networks) that can test whether: (i) on-ground outcomes from private certification are satisfactory; and (ii) whether the system's design should be altered (in detail, or fundamentally) to function well in the public interest.

3. Investigate the potential for a licensing scheme for WSUD infrastructure such as rainwater tanks, bioretention systems and native planting on private land, analogous to that which is in place for On-site Sewage Management Systems.
4. Investigate the benefits and legal options for requiring checks on WSUD infrastructure on private land as part of the conveyancing process.
5. Conduct a local audit of: (i) initial compliance with; (ii) adherence to; and (iii) on-ground effectiveness of conditions of development consent. This will clarify the extent of the problem in this area of planning regulation. This should be undertaken with a view to developing management systems to improve compliance with, and the effectiveness of, conditions of consent.

3.7.2 General pollution control

3.7.2.1 *Protection of the Environment Operations Act 1997*

The *Protection of the Environment Operations Act 1997* (POEO Act) governs pollution of water, noise and air in NSW. It authorises the Environmental Protection Authority (EPA), local councils and other regulatory bodies to issue pollution licences and notices, and to take legal action. It also creates a number of pollution offences and penalties. As such, it underpins many aspects of pollution control management in NSW.

From the perspective of pollution control *systems*, the POEO Act, and the powers it creates, are tools. The POEO Act provides the major legal framework for GLC's On-site Sewage Management Strategy and its Erosion and Sediment Control Policy, both of which are discussed in detail below. Most of the discussions of pollution management *systems* that use the POEO Act's powers occur in later sections of this report. In these initial comments, our focus is on how well-crafted these tools are for pollution control, in general terms.

Under the POEO Act, the EPA has authority to issue *environment protection licences* (DECC act on these on behalf of the EPA), which approve specific polluting activities and water pollution. The activities approved under pollution licences are also referred to under the Act as *scheduled activities.* Local councils are responsible for all activities that do not require a pollution licence. Other bodies, such as the Marine Parks Authority and NSW Maritime, have responsibility for activities under their control that also do not require a pollution licence.

The EPA and local councils can issue pollution notices, formally known as *environment protection notices*, which require persons to clean up, prevent or cease polluting activities. The EPA is responsible for notices for *scheduled activities* – activities undertaken by a public authority or the state, and premises that already have an environment protection licence.

The Act uses a wide definition of water pollution, which includes an extensive list of materials that cannot be placed in or close to a water body that encompasses sediments and nutrients, among other things (see the Dictionary at the end of the POEO Act). It is an offence under the Act to cause any listed substance to enter a water body without a pollution licence.

While the EPA has authority under the Act to prosecute any offence, it primarily prosecutes scheduled activity offences. Councils can only prosecute scheduled activity offences with permission of the Land and Environment Court. They are also unable to prosecute for offences related to a pollution licence, for noise pollution from vessels or in buildings next to navigable waters, and for works undertaken by the state or a public authority.

Under the POEO Act, there is a range of criminal offences for polluting activities. There are three tiers of offences, with tier one being the most serious. Penalties for tier one offences can be as high as $5 million for a company, or $1 million and seven years imprisonment for an individual.

Management practice

Two general aspects of the POEO Act's use were identified as concerns by agency staff we consulted:

- Although on-the-spot fining generally works well, the process of initiating court action (particularly in state agencies) raised concerns. It appears that, usually, a case only proceeds when there is a high likelihood of the agency winning in court. There are some exceptions – notably when a test case is deliberately being run, and when a matter has attracted significant media attention. This approach reduces financial and reputational risk for the agencies, but reduces protection of the environment. The question this raises is: what alternative arrangements for initiating and carrying through with prosecutions could better protect the public interest, in all respects (taking into account the financial costs of legal action, and the environmental costs of inaction)? The police force provides an alternative model. The police have a duty to investigate possible offences and take appropriate action. Decisions about whether to charge a person are made by police officers on the merits of the case in a less risk-averse way.

- The POEO Act differentiates licensed and non-licensed pollution, with activities with higher actual or potential impacts being licensed. The range of the non-licensed activities includes an upper end that can be difficult for councils to manage, because their expertise is primarily to do with the simpler, and / or more common, kinds of pollution risk. Great Lakes Council's practice illustrates one response to this. They have designated one officer to handle larger cases that may go to the Land and Environment Court, so that they have one staff member with more expertise in court processes and requirements. Another approach that may be better for councils in general would be for the EPA to provide a support group dedicated to assisting with these more challenging, non-licensed cases.

Recommendations

1. When apparent breaches of legislation in the CCI area are not prosecuted by state government agencies, the cases should be discussed at a senior level between the agencies, and vigorous, effective responses to poor environmental management should be sought.
2. Review the need for a pool of pollution control experts to support local government with other local councils, via HCCREMS' networks, and, if such a team would add considerable value, explore the possibilities of the EPA / DECC providing it, either directly, or via positions hosted in organisations such as HCCREMS.

3.7.3 Sewage discharge risks

3.7.3.1 GLC On-site Sewage Management Strategy

GLC's management of its On-site Sewage Management Systems is governed by its *On-Site Sewage Management Strategy.* This policy was first approved by Council in 1999 and last reviewed in October 2006. It provides operational direction for the approval, monitoring, record-keeping, reporting, review, educational strategies, fee structure and staffing of the management of its On-Site Sewage Management Strategy.

GLC's Strategy operates under section 68 of the *Local Government Act 1993*, which requires councils to develop a strategy for on-site sewage management and allows them to charge fees for On-site Sewage Management System services. Alongside this enabling legislation sits the Environmental and Health Protection Guidelines, *On-Site Sewage Management for Single Households*, and the Australian and New Zealand Standards 1547:2000, 1546.1:1998, 1546.2:1998 and 1546.3:1998, which contain performance standards for the installation, operation and maintenance of On-site Sewage Management Systems. Additionally, to enhance the ecological and social

sustainability of its strategy, GLC has articulated a process of community and user education, to be implemented with sensitivity to local circumstances.

Councils have powers of enforcement regarding the management of On-site Sewage Management Systems under the *Local Government Act 1993* and also under the *Protection of the Environment Operations Act 1997.* The *Environmental Planning and Assessment Act 1979* also provides legislative underpinnings for local and regional planning instruments, which regulate the installation of On-site Sewage Management Systems in Great Lakes.

The NSW Department of Health is required, under the Local Government (General) Regulation 2005, to accredit standard designs for commercially manufactured and distributed human waste treatment and storage devices. Any conditions attached to a particular design will be reflected in councils' approvals.

Additionally, GLC has undertaken two local studies of the North Arm Cove / Pindimar and Coomba and Allworth catchment areas to provide area specific recommendations for On-site Sewage Management Systems.

The Strategy identifies that GLC's annual State of the Environment Report will detail the effectiveness of the strategy by reporting on its inspection program, any particular patterns of failure, and on the results of its environmental auditing process.

Management practice

GLC's *On-Site Sewage Management Strategy* and the management practices by which it is implemented deliver a comprehensive approval, inspection, follow-up, record-keeping and education program. Regular visual inspections are undertaken based on the following risk factors:

- whether an On-site Sewage Management System is located in a known area of concern
- "information contained in the Applications for Approval to Operate,
- GIS overlays of waterways, sensitive areas, soil types, flood characteristics and groundwater information related to cadastral details,
- block size information contained in Council's property system.
- information gained from previous audits / inspections in the Great Lakes Council Area".

High-risk properties are inspected every one to two years, medium-risk every three to four years and low-risk once every five or more years. Service reports of systems are reviewed regularly. Additionally, GLC staff is actively involved in a Hunter and Central

Coast regional Septic Tank Action Group, which works to share information and address issues common to On-site Sewage Management Systems across the region. GLC administers its *On-Site Sewage Management Strategy* on a user-pays basis, which is revenue neutral to Council. Currently there is 3.5 staff working in this program.

Stakeholders who were consulted identified that the response by councils across NSW to these risks is very variable, however. While Great Lakes Council's response is comprehensive (as one would expect, given the 1997 hepatitis A outbreak associated with Wallis Lake oysters), Greater Taree City Council's (GTCC) response was seen as typical of much of local government. It is at a lower level – GTCC's program is administered by a permanent part-time staff member, and building surveyors rotate in the role of undertaking new installation approvals and assessment. GTCC's risk profile was seen as broadly similar to GLC's, particularly given that 30% of the catchment of Wallis Lake falls within the GTCC local government area. This suggests that the state government should take a larger role in determining the level at which On-site Sewage Management System programs are implemented. For GTCC, a review of their fee structure – seeking an approach that will fund inspection at a higher level – would be appropriate.

For Great Lakes Council, the most pressing operational difficulty under current management arrangements is that the requirement to achieve cost neutrality, and the current fee structure for On-site Sewage Management System inspections, obliges Council officers to pursue the ongoing inspection program – moving on to uninspected systems – rather than to commit time to following up any identified non-complying On-site Sewage Management Systems in a timely manner. Currently, GLC provides a free follow-up inspection on properties where a 'works required' letter has been issued. Any further follow-up inspections then incur a $55 inspection fee. A review of the fee structure is needed.

Because of concern about the potential effects of On-site Sewage Management Systems on downstream water bodies, testing of concentrations of faecal coliforms and nutrients is undertaken by (among others) MidCoast Water and the Great Lakes and Port Stephens Shellfish Association. This water quality data supports risk management from the lakes' perspective. It is not a direct measure of On-site Sewage Management System performance, of course, as many other factors influence these concentrations (including tidal flushing – salinity concentrations are a marker for that).

As required by the On-Site Sewage Management Strategy, GLC's State of the Environment Reports contain quantitative data on the Strategy, such as the number of new On-site Sewage Management Systems installed and a breakdown of the types of systems. However, the qualitative information sought by the On-Site Sewage

Management Strategy [DG124]– such as any potential patterns of system failure, the effectiveness of the Strategy measured against its goals and a review of relevant water quality data – are not included. GLC's State of the Environment Reports do identify the problems of integrating and reporting on the water quality data, which is collected by various authorities, and detail progress towards a strategy for an internet-based geographical information system (GIS) and database of water quality data. A Water Quality Partnership to share water quality data is being established. Partners include MidCoast Water (who are hosting the data base and its planned internet presence), GLC, GTCC and the HCRCMA. Using the shared data, indicators of the effectiveness of the On-site Sewage Management System strategy can developed and then be regularly reported on in Council's State of the Environment Reports, as required in the On-Site Sewage Management Strategy.

A number of other, more technical, issues worth following up were also identified:

- While the designs of On-site Sewage Management Systems are accredited by NSW Health, and councils' approvals reflect those of NSW Health, current domestic On-site Sewage Management Systems do not work well in a weekend / holiday house setting. The systems are designed for ongoing domestic use by a family in a single dwelling. Weekend / holiday use is often for isolated periods of two to three days, sometimes by many more people than a single family. Under normal circumstances, an On-site Sewage Management System takes several days to begin operating effectively. Under intermittent weekend use, an On-site Sewage Management System would be unlikely to achieve accredited NSW Health Department standards. Underlying system design issues like this need to be addressed by NSW Health and manufacturers. NPWS (pers. comm. 2008) has suggested that GLC and GTCC consider requiring sealed pump-out systems on the basis that these systems can cope with 'shock' loads.
- Some of the current industry standards and guidelines were identified as needing review, e.g. a biological oxygen demand (BOD) of 20 mg/L for systems accredited for beneficial reuse was identified by environmental health professionals as being based on long-term practice rather than scientifically tested health standards. Similarly, the BOD test of five days appears to be based on the historical experience of wastewater flow along English rivers to the sea! This suggests that a conversation about whether these standards need review would be an appropriate next step.
- Great Lakes Council's existing On-site Sewage Management System operational policies and procedures need to be updated so that they reflect current best practice, and the latest Australian and New Zealand Performance Standards.

Recommendations

1. Raise the possibility of councils developing a consistent risk management approach to On-site Sewage Management Systems across NSW, with state government support and with other local councils, DECC and NSW Health.
2. GLC and GTCC should review their fee structures for inspecting On-site Sewage Management Systems to improve the environmental protection these programs offer. The fee structures should include a fee that supports timely follow up of non-complying On-site Sewage Management Systems, maintaining the cost-neutral nature of this service for Council.
3. Viewing this issue in a wider context, and combining this recommendation with the previous one: local and state government could work together to develop model management arrangements for On-site Sewage Management Systems that provide for appropriate checking and correction through a standard funding model. The state government could audit implementation of these management arrangements, with audit effort proportional to risk to environmental and ecological health.
4. GLC is to proceed with development of its reporting on On-site Sewage Management System performance, via its involvement in the Water Quality Partnership.
5. NSW Health should be requested to provide advice on the performance of On-site Sewage Management System when they are only used for weekends and holidays. NSW Health should also be requested to lead a process seeking designs better suited to intermittent use – specifically, the possibility of requiring sealed pump-out systems should be considered.
6. Discuss the appropriateness of reviewing current standards for biological oxygen demand[pt125]for On-site Sewage Management Systems with NSW Health.
7. GLC is to revise its *On-site Sewage Management Strategy* so that it reflects the latest Australian Standards.

3.7.4 Erosion and sedimentation risks

3.7.4.1 Introduction to legislation and policy

A variety of pieces of legislation and policy address erosion and sedimentation risks. One key context in which these matters are addressed is development assessment under the EP&A Act. When developments are assessed, the long-term erosion and sedimentation risks to rivers and lakes of a proposal are one head of consideration. Another is the risks of the construction process – approvals commonly include conditions of consent relating to erosion and sedimentation control. In various kinds of sensitive areas, where development is 'integrated', i.e. approvals from multiple agencies are required, judgments about both the risks of proposed designs and the construction process are provided by the state government under the *Water Management Act 2000*, the *Fisheries Management Act 1994*, and the *Native Vegetation Act 2003*.

Design considerations are being covered through other parts of the Great Lakes CCI program's work. Specific issues regarding compliance with conditions of consent were covered in the earlier discussion of the EP&A Act. In this section of the report, after outlining the three Acts and the Great Lakes Erosion and Sedimentation Control policy, we look at two compliance issues – compliance with: (i) State Government conditions of approval; and (ii) GLC's erosion and sedimentation control policy specifically, because construction sites are high-risk areas from the lakes' perspectives.

Water Management Act 2000 – Activities on waterfront land

The *Water Management Act 2000* regulates the use and extraction of water, activities in or close to water bodies, and works such as the building of dams in NSW. In January 2008 the controlled activities provisions of the *Water Management Act* came into force. These provisions replaced similar clauses in the now repealed *Rivers and Foreshores Improvement Act 1948.* The new controlled activity provisions of the *Water Management Act* require approval from the Minister for activities such as the construction of buildings, the removal of material or vegetation, the deposition of material, and any actions impacting the flow or quantity of water on waterfront land. It is an offence to undertake any actions on waterfront land that are in breach of the Minister's approval. The Minister has powers of investigation, remediation and prosecution, and can order removal of unauthorised works, and the suspension and cancellation of an approval. Under the *Water Management Act*, the Department of Water and Energy advises councils whether proposals referred to it are approved, and if they are, what the conditions of the approval are (if any).

Fisheries Management Act – Degradation of riparian land

The Fisheries Management Act 1994 seeks to "conserve, develop, and share the fisheries resources of New South Wales for the benefit of future and present generations." [36] It specifically aims to conserve fish, threatened marine species and marine vegetation; to protect key fish habitats; and to promote ecologically sustainable development.

As a strategy to protect fish habitats, the Minister has made a number of Habitat Protection Plans. Under the Act, these require public authorities such as councils to notify the Department of Primary Industries when they plan works or receive applications for developments that threaten key fish habitats. Under Habitat Protection Plan No. 1, such works or developments include dredging, reclamation and construction of weirs, roads and reservoirs that could impede fish passage or damage marine vegetation – including mangroves and seagrasses, and de-snagging. Habitat Protection Plan No. 2 aims for "no net loss of sea grasses within coastal and estuarine waters of NSW." (Fish Habitat Protection Plan No. 2: Seagrasses). It applies to activities such as dredging, construction of bridges, operation of aquaculture, bait digging and collecting, and point-source pollution.

While not required under the *Fisheries Management Act*, public authorities – including councils – are encouraged to reflect the provisions of Habitat Protection Plans in all appropriate policies and plans, particularly any relevant environmental planning instruments.

To provide further protection for fish and marine vegetation, the degradation of native riparian vegetation alongside creeks and rivers in NSW was listed as a Key Threatening Process under the *Fisheries Management Act* in November 2001. Such a listing as a Key Threatening Process requires formal consideration as part of the development assessment process under Part 1, section 5A of the *Environmental Planning and Assessment Act 1979.*

These *Fisheries Management Act* provisions thus legitimise good riparian land management in a range of ways – particularly in environmental planning processes under the EP&A Act, and in councils' own operations.

Native Vegetation Act – Land clearing on rural lands

The Native Vegetation Act 2003 governs the management of native vegetation on land that is leased or privately owned in rural New South Wales. The *Native Vegetation Act* does not have jurisdiction over native vegetation in national parks, state forests and other conservation areas (as defined by Schedule 1 of the *Native Vegetation Act*), or on urban

land. From a lake water quality perspective, the importance of this legislation is its capacity to protect riparian groundcover in rural areas.

It is an offence under the *Native Vegetation Act* to clear native vegetation unless:

- the Minister has given development consent
- approval has been given for a Property Vegetation Plan
- the vegetation is unprotected regrowth or specified groundcover
- it is for the purposes of sustainable grazing, existing cultivation or rotational farming
- it is for routine agricultural management activities.

Routine agricultural management activities on vulnerable land, i.e. steep or highly erodible land, or on protected riparian land, also require Ministerial approval – with exceptions including safety, noxious weeds, pest control, and boundary fence and farm road construction.

Officers of DECC have powers of enforcement of the Act including entry and inspection, 'stop work' orders, remedial work and criminal prosecutions.

GLC erosion and sediment control policy – Construction sites

Great Lakes Council's erosion and sediment control policy is quite brief. Its main points are: all disturbed soil materials are to be contained on-site; their management must be governed by an Erosion and Sediment Control Plan, or approval conditions of a similar character; and the site must be managed by appropriately knowledgeable people who act with due diligence. Detailed guidance on how this should be done is provided through a Code of Practice. The Policy and Code were developed in 1995, so there is scope for it to be updated. (Improving compliance is the priority, however – see below.) The techniques that the Code recommends are as follows:

- managing flows
  - diversion banks, catch drains, table drains
  - drop-down drains
  - level spreader
  - channel stabilisation
- stabilising sites
  - jute mesh
  - turf laying
  - use of geotech fabric liner for stabilisation of temporary earth drains or channels
  - 'plastic' fabrics, plastic natural fabrics, etc.
  - concrete linings, rock / rock grouting, rock mattresses, gabions, etc.

36 Habitat Protection Plan No. 3: The Hawkesbury–Nepean River System, p. 2.

  - grade-stabilising structures

- trapping sediments
  - hay bale barriers
  - silt fences
  - silt fence installation
  - sediment traps for minor catchment areas
  - discharge of water
  - rock / blue metal groyne or ‘sausage’
  - sediment traps (sediment ponds, silt traps, sediment control structures)
  - shake down areas / access stabilisation
  - buffer zones.

Specific guidance is provided for each of:

- building sites
- civil construction sites
- subdivision and development
- Council construction and maintenance works and practices.

3.7.4.2 Management practice

Complex cases

Complex cases, where many laws have – or appear to have – been broken, can be difficult to coordinate. When activity on a site may involve potential breaches under a number of pieces of legislation, it is not always immediately clear which state agencies should be involved or which agency should take the lead. Sites were identified where an inability to coordinate a timely response had resulted in avoidable pollution occurring, and the potential loss of an opportunity to collect evidence to enforce compliance or to prosecute alleged polluters.

The collective capacity to negotiate approaches owes much to the strength or weakness of personal relationships between staff in different agencies. Knowing who to talk to, and officers’ mutual respect, and the like, are important influences on how well these cases are handled. There may be benefit to additional formalisation of approaches to complex cases (at least of some kinds), and / or there may be benefit in intentionally fostering these informal networks more than happens at present (mostly they develop in an *ad hoc* fashion). A possibility for improving coordination would be for the Department of the Environment and Climate Change to assume coordination responsibility initially, as a matter of course, when the case appears complex. Other models for improving coordination to produce a timely response should be explored.

Willingness to prosecute

A major weakness in the implementation of the *Native Vegetation Act* is government's unwillingness to prosecute. The issues are as discussed above under the POEO Act.

Compliance with state government conditions of approval

General issues regarding compliance with conditions of consent that are part of approvals under the EP&A Act are covered above under the discussion of that Act, which focuses on councils' management of compliance with conditions of consent. Conditions provided by the state government under each of the *Water Management Act*, the *Fisheries Management Act* and the *Native Vegetation Act* are covered in part by that discussion, as Council's policing conditions of consent will identify failures to comply with state government-imposed conditions as well as those imposed directly by the Council. However, responsibility for compliance with state legislation rests with the state government. This discussion addresses those responsibilities.

We understand (from workshop discussions) that in the case of developments on which conditions are imposed under the *Water Management Act*, for example, there is a single departmental officer based in the Hunter who is responsible for compliance throughout that region. Evidently, a single officer cannot ensure appropriate levels of compliance across the entire region, even acting with good council support (which is not currently the norm, as councils are poorly resourced in this area as well, as discussed above). This suggests the possibility of taking a more integrated approach to environmental management compliance and enforcement. Currently, a number of council and state government environmental officers, each with a small number of powers under a diverse range of legislation, travel the region / local government area inspecting many of the same sites. Possibly, environmental officers from councils, and regional and state authorities, could have wider delegations of inspection and investigation under a range of legislation. That is, responsibility for collecting evidence could be shared more widely. Discretion about issuing notices, fining and prosecuting would remain with the responsible authority under the legislation. Integration through cross-delegations has the potential to produce savings in staffing and travel time, and to address some coordination issues between authorities. What is possible here needs to be clarified.

Management of construction sites

The importance of good control of sedimentation and erosion control is underlined by modelling carried out for the Great Lakes CCI project by BMT WBM (Figure 3.7.1). Compliance with erosion and sedimentation control policy in the catchments of Wallis, Smiths and the Myall lakes is not extremely low, but it appears to be lower than a 'typical regulated rate'. Figure 3.7.1 indicates that improved management of construction sites is

a significant opportunity to reduce pollution flows to the lakes – particularly lower Wallis Lake, as much of the proposed construction is in its catchment.

Council's rangers undertake on-the-ground enforcement of Great Lakes Council's Erosion and Sediment Control Policy. Due to resourcing constraints, sediment and erosion control compliance is managed through occasional blitzes and follow-up action in relation to complaints. Every few years, when a judgement is made that sediment and erosion control standards of local builders are slipping, a blitz of building sites is undertaken over a period of some weeks. This improves compliance with the policy; it also results in complaints to both officer and political levels at Council about the blitz and the subsequent fines.

With this approach, it is very difficult to determine the actual level of ongoing compliance with the policy. Given the damage that poorly managed construction sites can do to the lakes (Figure 3.7.1), enforcing compliance with this policy should be an important environmental management priority for GLC. Working within current resources, a business-as-usual approach could be adopted, rather than a blitz approach. Regular inspections of a small number of sites, with complementary educational efforts, would provide better support for a local culture of compliance. If compliance with this policy were prioritised or if additional resources could be secured, then regular inspections of a larger number of sites – supported by an expanded construction site education program – would provide substantially better support for a local culture among builders. Within GLC, consideration could be given to delegating powers to environmental officers under a number of pieces of legislation and, if needed, supporting these officers with a range of technology to provide on-site expert information and advice. Such technology may include mobile phones with high-quality digital photography, online and / or phone access to a senior environmental officer, and an online expert information system.

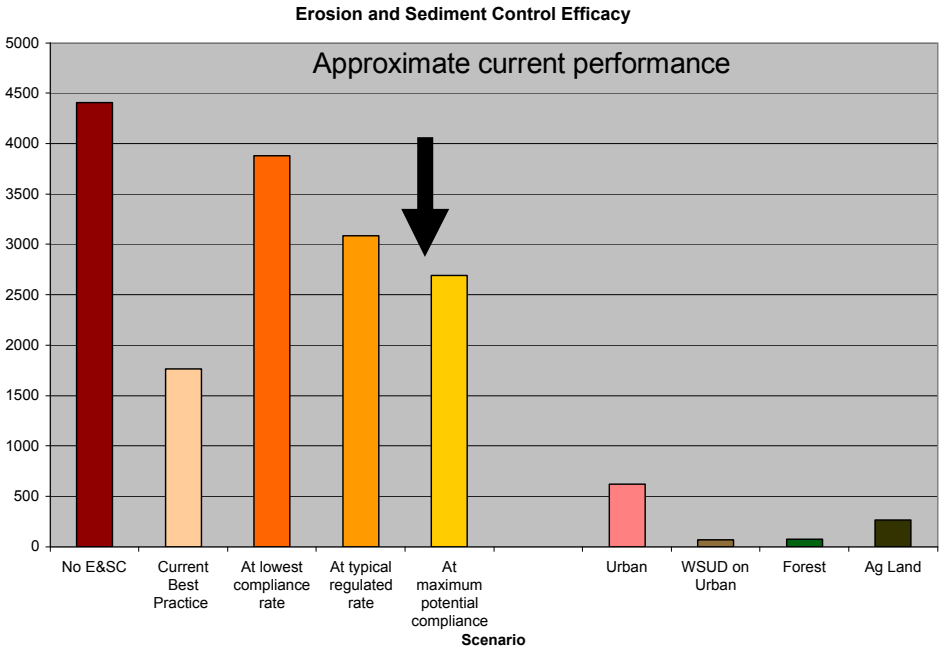

Figure 3.7.1. Erosion and sedimentation control efficiency (Source: Tony Weber, BMT WBM, pers. comm., April 2008, based on Taylor 2003).

As recommended in the Water Sensitive Urban Development and Design Strategy, another promising avenue for addressing the resourcing constraints is to explore the feasibility of regional and sub-regional erosion and sedimentation control auditing programs. The financial efficiencies of programs at three alternative scales should be explored: a joint program between GLC and GTCC, a sub-regional program, or a regional program brokered through HCCREMS and / or with the state agencies as outlined above. Discussion needs to canvass what the set-up costs would be, and which arrangements are likely to have the highest environmental benefit.

Great Lakes Council's own works do not always comply with Council's Erosion and Sediment Control Policy. While considerable resources have been invested in training Council construction workers in best practice sediment and erosion control construction procedures, workshop participants identified that some Council staff continued with old-style work practices, which did not comply with Council's policies. Council's works frequently involve projects that are very public, such as road construction. So as well as having direct effects on the lakes, this non-compliance tends to undermine local builders' willingness to comply with Council's policy. It also undermines Council's credibility when it issues fines for non-compliance with the Erosion and Sediment Control Policy. In conjunction with auditing the private sector, Council needs to substantially improve management of its own jobs. An internal audit program, perhaps also undertaken by Council rangers, is needed to provide better support for Council operations.

A third area of concern is how effectively private certifiers are enforcing Council's policy. Given the pattern outlined above, it seems likely that this is also a weak link in erosion

and sedimentation control (see also the general discussion of compliance with conditions of consent under the EP&A Act, above).

3.7.4.3 Recommendations

1. Investigate alternative models for formalising responses to complex cases, e.g. whether it would be helpful if DECC assumed coordination responsibility initially, as a matter of course, in such cases.
2. Initiate conversations between agencies at manager / senior manager level on how to strengthen informal cross-agency professional networks, and in particular how to induct new employees quickly into those networks.
3. Discuss with compliance groups within state agencies and local governments in the region whether increasing cross-delegations would enable more efficient use of government staff to police compliance with conditions of consent and pollution control regulations. Include within this conversation, discussion of ways in which joint auditing of erosion and sedimentation control might be undertaken at different scales (from partnerships between two councils, to the whole region).
4. At Great Lakes Council, shift from a blitz approach to an ongoing (initially low-key) erosion and sedimentation control auditing program, including auditing Council's own works. Also, evaluate whether the efficiency of Council's own regulatory efforts could be improved by increasing cross-delegations among Council staff.

3.7.5 Strategy for implementing recommendations

Table 3.7.1 provides an outline of the recommendations to improve pollution control systems. Against these recommendations steps, likely costs and likely benefits are given.

3.7.5.1 Operational commitments

Table 3.7.1. Recommendations to improve pollution control systems.

Recommendation	Actions / Steps and notes	Likely benefit	Likely cost	Staff effort	Likely timing	Lead and contributors
Conduct a local audit of: (i) initial compliance with; (ii) adherence to; and (iii) on-ground effectiveness of conditions of development consent. This will clarify the extent of the problem in this area of planning regulation. This should be undertaken with a view to developing management systems to improve compliance with, and the effectiveness of, conditions of consent.	1. Design an audit of conditions of development consent. 2. Audit initial compliance, adherence and (in a preliminary way) effectiveness. [effectiveness is a complex matter, so the initial audit will make a preliminary assessment and scope what is needed to assess effectiveness well] 3. Develop a design for a management system to manage compliance with conditions of consent. 4. Implement the management system. 5. Share learnings with staff in other agencies (other councils, HCCREMS, DoP, etc.). [Note that costing given here assumes this will be done internally.]	*High*	-	*Medium*	2008–09	**GLC**
Review the need for a pool of pollution control experts to support local government with other local councils, via HCCREMS' networks and, if such a team would add considerable value, explore the possibilities of the EPA / DECC providing it, either directly or via positions hosted in organisations such as HCCREMS	1. Compare experience across councils: how often do these cases come up, how accessible is expertise currently, and what benefits would easier access to expertise bring? 2. Negotiate access to expertise (e.g. to a team at DECC), if the need warrants this.	*Low*	-	*Low* per organisation	**2009**	**HCCREMS** DECC GTCC GLC Other councils
GLC and GTCC should review their fee structures for inspecting On-site Sewage Management Systems to improve the environmental protection	1. Review the fee structure and develop recommendations. 2. Adopt the revised fee structure. 3. Evaluate the effects of the change.	*High*	-	*Low*	2008	**GLC** GTCC Other councils

Recommendation	Actions / Steps and notes	Likely benefit	Likely cost	Staff effort	Likely timing	Lead and contributors
these programs offer. The fee structures should include a fee that supports timely follow up of non-complying On-site Sewage Management Systems, thus maintaining the cost-neutral nature of this service for Council.	4. Share learnings (GLC) and leverage what is learned (other councils, DECC, etc,).					DECC
MCW, GLC, GTCC, HRCMA and other stakeholders to proceed with the Water Quality Partnership. GLC to strengthen its reporting on On-site Sewage Management System performance.	1. Develop Water Quality Partnership for data sharing. 2. GLC to expand its reporting on On-site Sewage Management Systems in Council SOE reports in line with its On-site Sewage Management System Strategy.	*Medium to high*	*Medium to high*	*Low to medium*	2009	MCW GTCC HCRCMA **GLC**
GLC revise its *On-site Sewage Management Strategy* so that it reflects the latest Australian Standards. As part of this, consider the possibility of requiring sealed pump-out systems.	1. Review and revise text. 2. Adopt changes.	*Medium*	-	*Low*	2008–09	**GLC**
Investigate On-site Sewage Management System accreditation, and a standard funding model or some other means of establishing a consistent risk management approach to OSM across NSW.	1. Exploratory conversations with NSW Health on this recommendation	*Low*	-	*Low*	2009	**NSW Health** DECC
Advise on the performance of On-site Sewage Management System when they are only used for weekends and holidays, and lead a process seeking designs better suited to intermittent use.		*Low*	-	*Low*	2009	**NSW Health** DECC
Consider the appropriateness of reviewing current standards for		*Low*	-	*Low*	2009	**NSW Health** DECC

Recommendation	Actions / Steps and notes	Likely benefit	Likely cost	Staff effort	Likely timing	Lead and contributors
biological oxygen demand for On-site Sewage Management Systems and discuss with DECC.						
Discuss with compliance groups within state agencies and local governments in the region whether increasing cross-delegations would enable more efficient use of government staff to police compliance with conditions of consent and pollution control regulations. Include within this conversation, discussion of ways in which joint auditing of erosion and sedimentation control might be undertaken at different scales (from partnerships between two councils, to the whole region).	1. Review the opportunities and constraints. 2. Exploratory conversations regarding possible arrangements. 3. Request legal advice if needed. 4. Implement additional cooperative /joint programs.	*High*	-	*Low to medium*	2008–09	**HCCREMS** GLC GTCC Other councils DECC DPI
Investigate alternative models for formalising responses to complex cases, e.g. whether it would be helpful if DECC assumed coordination responsibility initially, as a matter of course, in such cases.	1. Review the opportunities and constraints. 2. Exploratory conversations re possible arrangements. 3. Implement agreed approach to complex cases.	*High?*	-	*Low* for Councils, *Medium* for DECC	2009	**DECC** GLC GTCC Other councils HCCREMS
Initiate conversations between agencies at manager / senior manager level on how to strengthen informal cross-agency professional networks, and in particular how to induct new employees quickly into those networks.	1. Review the opportunities and constraints. 2. Exploratory conversations regarding possible arrangements. 3. Actions to strengthen informal cross-agency networks as agreed.	*High?*	-	*Low*	2008	**GLC** Other councils / HCCREMS DECC DPI DoP
At Great Lakes Council, shift from a	1. Redesign rangers' workloads to provide for	*High*	-	*Low to*	2008	**GLC**

Recommendation	Actions / Steps and notes	Likely benefit	Likely cost	Staff effort	Likely timing	Lead and contributors
blitz approach to an ongoing (initially low-key) erosion and sedimentation control auditing program, including auditing Council's own works. Education to support this regulatory work is needed. Also, evaluate whether the efficiency of Council's own regulatory efforts could be improved by increasing cross-delegations among Council staff.	ongoing low-key auditing. 2. Review the potential for other authorised officers to make a larger contribution to erosion and sedimentation control. 3. Dovetail these changes with negotiations regarding regional or subregional cooperation on erosion and sedimentation control.			*medium*		

Key:

Costs		*Staff effort*	
Low	up to $5,000	Low	One to two weeks
Medium	up to $20,000	Medium	One month
High	$30,000 plus	High	Two to three months

3.7.5.2 Contributions to community debate

Table 3.7.2. Contributions to community debate about pollution control.

Issue	Importance	Avenues (for advocacy)	Resource requirements
Contribute to debate about the NSW government's proposed changes to planning law underlining the importance of testing the ecological impacts of alternative approaches. (Regional Organisation of Councils / HCCREMS may be able to assist with this.)	The NSW Government's current proposals substantially reduce local communities' capacity to manage their own areas. How this will play out for the lakes is not clear. However, a major shift in the distribution of power to manage land use change is underway, and it appears to be occurring without proper scrutiny of its environmental management implications.	• Direct to NSW government parliamentarians • With Local Government and Shires Association • With Regional Organisation of Councils	• Councillor and staff time for advocacy: low to medium
Acknowledge the improvements that the NSW government has announced, support efforts to establish thorough reviews of the NSW Private Certification system in appropriate forums (e.g. with the NSW government and the Commonwealth Government).	The system as designed and implemented appears to be high-risk. The conflict of interest built into being paid by developers to regulate them appears to invite corruption. Anecdotal evidence suggests problems on the ground, including failure to manage compliance with erosion and sedimentation control standards professionally. A systematic, thorough evaluation of the scheme's performance and design is needed.	• To NSW government (including DoP) • With Local Government and Shires Association • With Regional Organisation of Councils	• Councillor and staff time for advocacy: low to medium
Investigate the benefits and legal options for requiring checks on WSUD infrastructure such as rainwater tanks, bioretention systems and native planting as part of the conveyancing process.	WSUD treatments on private land are fundamental to restoring and protecting the lakes (especially Pipers Creek and lower Wallis Lake). It is therefore extremely important that systems for managing the public interest outcomes of this infrastructure on private land are developed. These two options, and others to be identified, need to be investigated, and a reliable management regime negotiated.	• With DoP • With DECC • With Local Government and Shires Association • With Regional Organisation of Councils / HCCREMS • With the SIA and other urban water management groups	• Funds for legal advice • Staff time for policy development and advocacy: medium • Look to DECC to take over leadership of this
Investigate the potential for a licensing scheme for WSUD devices analogous to that which is in place for On-site Sewage Management Systems.			

Issue	Importance	Avenues (for advocacy)	Resource requirements
When apparent breaches of legislation in the CCI area are not prosecuted by state government agencies, the cases should be discussed at a senior level between the agencies, and vigorous, effective responses to poor environmental management should be sought.	This is an area of significant weakness in environmental law in current practice. It is unclear how this can be addressed effectively in an affordable way, so exploration is appropriate.	• DECC • DoP • Local Government and Shires Association	• Which leadership should be at state level (e.g. DECC, DoP, Local Government and Shires Association)
On-site Sewage Management System management system accreditation, and a standard funding model, or some other means of establishing a consistent risk management approach to OSM across NSW, with other local councils, DECC and the Department of Health.	Local government effort should be proportional to risk *across* local government areas, not simply within them. Having established a legal obligation for councils to adopt policy for On-site Sewage Management Systems, and provide a means to raise funds to do so, the state government should follow through and check that councils' management arrangements are in fact satisfactory, and initiate corrections as appropriate (and this process should be held by an ongoing management system, not be a one-off effort).	• DECC • NSW Health	• Leadership on this issue should be at state level • Contribution from GLC: low
NSW Health to be requested to provide advice on the performance of On-site Sewage Management System when they are only used for weekends and holidays, and NSW Health to be requested to lead a process seeking designs better suited to intermittent use.	This is an area of weakness in On-site Sewage Management System performance. Its relative importance to receiving waters has not been quantified (to our knowledge); clearly, rural holiday destinations are the concern.	• DECC • NSW Health	• Leadership on this issue should be at state level • Contribution from GLC: low
Discuss the appropriateness of reviewing current standards for BOD for On-site Sewage Management Systems with NSW Health.	It has been pointed out that the current standards have historical roots, and it is suggested that a scientific re-evaluation is necessary.	• DECC • NSW Health	• Leadership on this issue should be at state level • Contribution from GLC: low

3.7.6 Summary

Overall, the pollution control systems in place to manage compliance with conditions of consent and diffuse source pollution are weak. No management system has been developed around conditions of consent (e.g. no proactive processes to close plan–do–review loops are in place), and the management arrangements around erosion and sedimentation control are sketchy (e.g. there have been two audits of Council performance, and there are infrequent blitzes evaluating developers' performance). Management of On-site Sewage Management Systems, however, is fairly strong – workshop participants identified a number of valuable refinements to current practice at GLC.

Two initiatives in which Great Lakes Council is involved are particularly promising:

- Great Lakes Council's Sustainability Team, which is coordinating efforts across Council in environmental management
- the regional grant funding for development of Environmental Management Systems.

Both these processes are well placed to action the recommendations included in this section on Great Lakes Council's behalf.

These programs can support improvement of pollution control systems in the Great Lakes catchments in a number of ways, including:

- the Environmental Management Systems to be developed for Great Lakes Council and Greater Taree City Council are a tool through which implementation of all the recommendations outlined above can be managed
- the urban stormwater audit and capacity building strand could be the vehicle for:
    - auditing the effectiveness of conditions of consent that relate to erosion and sedimentation control
    - implementing an ongoing erosion and sedimentation control auditing program, including auditing Council's own works.

3.8 Financing the Water Quality Improvement Plan

Funding for the Water Quality Improvement Plan's urban, rural and lake use actions is essential for them to be implemented. Sourcing funds is one of the major challenges confronting the organisations and community members committed to WQIP actions.

Current lake water quality management in the Great Lakes region draws on the resources of:

- residents, particularly through rates, and through an urban storm water levy commencing July 2008
- farmers, through on-farm activities and on-ground works
- land developers and their clients
- Great Lakes Council
- Greater Taree City Council
- MidCoast Water
- Hunter-Central Rivers Catchment Management Authority
- NSW Government
- Australian Government.

However, many of the actions identified in the Water Quality Improvement Plan are not likely to be funded through these sources, or not funded to the level that is recommended here.

For these unfunded programs, the situation is relatively difficult. There is a wide variety of possible sources of funds (Table 3.8.1). Looking at them alongside each other, and in the light of the WQIP funding needs, a number of difficulties stand out:

- Funding the WQIP rural programs is difficult: all of them need recurrent funding; currently the only ongoing funding for rural work is very modest contributions from Great Lakes Council's environmental rate and Greater Taree City Council's rates, which provide for the employment of a catchment officer to help facilitate the implementation of the Wallis and Myall catchment programs, and MidCoast Water's program in water supply catchments; and there are no obvious sources of additional recurrent funding for this work.
- Maintenance of Water Sensitive Urban Design (WSUD) systems in Great Lakes local government area has a reasonable chance of being satisfactorily funded in a decade: this will occur if Great Lakes Council increases its rates to put its asset management on a sustainable basis as per the recommendations of the Review Today Assessment undertaken by Percy Allen and Associates. In the short to medium term, Council will be faced with an increasing portfolio of WSUD assets whose

maintenance is only partly funded from identified sources (Great Lakes Council's incoming Stormwater Levy, and innovative funding approaches such as use of community title, and advances from developers negotiated under Voluntary Planning Agreements, will make significant but limited contributions).

- There is a variety of other urban catchment management activities and management system processes, that require recurrent funding (e.g. a proposed retrofitting program for Pipers Creek catchment, assessing WSUD aspects of development applications, better erosion and sediment control on construction sites, and measuring ecological condition) that are currently not funded, or are insufficiently funded, for which suitable funding has not been identified (recognising that Great Lakes Council's Stormwater Levy will make a valuable, partial contribution).

The general approach that we have settled on to address this situation is:

- an overall entrepreneurial approach: making a virtue of necessity – taking a flexible, opportunistic approach to sourcing funds for programs
- energetically seeking recurrent funding from the most promising sources (notably, supporting efforts to place the Councils' asset management on a sound financial basis)
- supporting creative use of existing funds.

A financial strategy is being developed as an implementation tool for the WQIP. It will be designed as a support for internal entrepreneurs: offering suggestions on how funding needs can be matched to funding sources, on how funding bodies can be approached about key WQIP program areas, and on how existing agency and community resources can be leveraged. An outline of which stakeholders could contribute funds and in-kind resources to WQIP program areas is provided in Table 3.8.2. The table provides judgments on the relative importance and relative security of these sources of support for WQIP implementation.

In the short term it is recommended that there be some transitional investment to support delivery of the WQIP in order to maintain momentum that has been established in developing the Plan. This transitional funding is required to achieve the following:

- Short term: six months
    - Capacity-building of development assessment planners and subdivision engineers to implement the new Water Sensitive Urban Design Development Control Plan.
    - Develop a business plan for implementing the Water Quality Improvement Plan in order to secure more funding from the range of sources identified.

- Medium term: one to two years
    - Facilitate organisational change to revise stormwater management plans and relevant management systems to reflect the recommendations in the WQIP.
    - Build the capacity of staff in the engineering section responsible for stormwater management, to manage stormwater holistically rather than through a traditional quantity-based engineering perspective.
    - Ensure the Natural Systems section has a monitoring and overseeing role to ensure that sustainability and water quality outcomes envisaged in the WQIP are achieved at the development and rezoning stage.
    - Develop systems to ensure that the required stormwater management procedures and objectives are in process through Environmental Management Systems.

Table 3.8.1. Possible sources of funds for the WQIP.

Potential source	Available for	Capital and / or recurrent	Typical duration	Estimated size	Likelihood of availability	Other notes	What is required to secure access
Community funding directly							
Developers and their clients	• WSUD capital works required as part of development consent	Capital		$20 million–$60 million	• Amount of work required will depend on planning standards adopted, which will in turn depend on technical analyses, market conditions, and councillor and state government decisions	• These are substantial public assets with a very important role in protecting the lakes, so it is very important that appropriate maintenance funding is found	• Adoption of planning standards
Community title residents	• Maintenance of WSUD devices on common property, owned under community title	Recurrent	Ongoing		• Already in place for WSUD maintenance in some locations; expected to continue to expand	• Residents purchase in these subdivisions understanding they will maintain jointly-owned WSUD devices	• Development and approval of subdivisions using community title
Developers fund in advance (Voluntary Planning Agreement)	• A number of years of maintenance on WSUD structures handed over following negotiation • Used on substantial new developments with WSUD devices on public land	Recurrent	10–20 years		• Already in place for WSUD maintenance in some locations; more such arrangements are expected	• These are negotiated under Voluntary Planning Agreements • From the Council perspective, the aim is to have the developer cover a period of use similar to that which they cover when they hand over roads (some agreements are therefore for funding for 20 years of maintenance)	• Negotiation by councils and developers of conditions of this kind in Voluntary Planning Agreements

Potential source	Available for	Capital and / or recurrent	Typical duration	Estimated size	Likelihood of availability	Other notes	What is required to secure access
Developers Greenfield bonds (section 68 of the *Local Government Act*)	• Correction of WSUD device design and construction failures	Capital	10–20 years		• Applicability of section 68 being investigated	• WSUD devices are, for the most part, relatively young in engineering terms, so good data on costs and performance are hard to come by, and there are significant uncertainties. Bonding internalises this risk in the development process, which is fairer from a whole-community perspective.	
Nutrient offsets scheme (developers and others)	• WSUD retrofitting works in related urban locations • Possibly rural works	Capital, possibly some recurrent	Ongoing while development that cannot fully achieve water quality objectives on site continues		• Occasional arrangements under Voluntary Planning Agreements are possible; the likelihood hinges on finding a legal basis for a more general scheme	• Legal mechanisms that can clearly be used to formalise this have not been identified yet • Voluntary Planning Agreements would allow some case by case arrangements to be put in place, guided by an adopted Council policy	• Development of a Council policy on offsets, and inclusion of offsets in the heads of agreement to guide negotiation of Voluntary Planning Agreements • For a general scheme, further scheme design work and support from the NSW Government (led by DECC and / or DoP)
Farmers, through on-farm activities and works	• Works on rural properties (e.g. improvement of groundcover, riparian fencing)	Capital and recurrent	Ongoing		• Certain to occur. What is uncertain is how much work will be done.	• Some contributions by farmers are in-kind contributions that match grant funds	• Cooperative programs and education (as included in the rural segments of the WQIP) will catalyse growth

Potential source	Available for	Capital and / or recurrent	Typical duration	Estimated size	Likelihood of availability	Other notes	What is required to secure access
Local government							
GLC – General rates	• Potentially for maintenance of WSUD devices (as part of Council's asset management program)	Recurrent	Ongoing	After fully implemented (over a period of seven years), sufficient to fully fund maintenance of Council-owned WSUD devices	• Depends on how Council's consideration of its long-term financial position unfolds (Percy Allan review). Considered reasonably likely.	• Under current funding, no funds are available for rural land management, and that is unlikely to change – given the tight funding situation of NSW councils, and the fact that most rate payers live in urban areas	• Council and the community need to consider rate rises above CPI as a way of managing assets more cost-effectively over the medium to long term
GLC – Environmental rate	• Organisational support for implementation of the WQIP (through existing GLC environmental management positions)	Capital and recurrent	Ongoing if periodically renewed by Council	$670,000 / year	• In place, due for renewal in 2009 with the potential to increase		• Periodic renewal of the rate with Council, community and state government support [37]
GLC – Stormwater Levy	• Water quantity and water quality works, education / capacity-building, and planning.	Capital and recurrent	Ongoing if periodically renewed by Council	$360,000 / year, of which half will be for water quality work	• Accepted by Council (2008)	• Water quantity funds are directed at flood management and similar	• Community, Council and state government support
GTCC – General rates	• Potentially for maintenance of WSUD devices (as part of Council's asset management program)	Capital and recurrent	Ongoing		• Not likely to be a significant source of funds unless GTCC moves to increase rates to manage assets sustainably over the long term		• Council and the community need to consider rate rises above CPI as a way of managing assets more cost-effectively over the medium to long term
GTCC – Environmental rate	• Environmental programs	Capital and recurrent	Ongoing if periodically renewed by Council		• To date, GTCC has not committed to an environmental rate or levy		• Council aligning behind an approach to levy funds for environmental management

37 Need to confirm that rate renewals need to be approved by the State government.

Potential source	Available for	Capital and / or recurrent	Typical duration	Estimated size	Likelihood of availability	Other notes	What is required to secure access
GTCC – Stormwater rate	• Currently directed only to water quantity works; could be directed to planning for the urban catchment in Wallis (Tallwoods) or retrofitting.	Capital and recurrent	Ongoing if periodically renewed by Council		• In place, but not available for water quality works		• Periodic renewal of the rate with Council, community and state government support
Regional NRM groups							
Hunter-Central Rivers Catchment Management Authority (HCRCMA)	• Rural, urban and lake use projects and programs that fit CMA selection criteria (and in particular are aligned with Catchment Action Plan commitments). Projects that are nationally competitive will have access to a larger pool of funds.	Capital and recurrent	Fixed term, usually between one and three years	• $1.9 million from NHT (now 'Caring for Country'	• Opportunities will certainly be there. The challenge will be being sufficiently competitive to access them.	• Commonwealth funding for the CMA has been reduced by 40% (2008). These funds are a major portion of the CMA's funds for use on projects in the Great Lakes. • Overall Commonwealth funds are not being reduced. However, CMAs will need to bid for the balance on a competitive basis. • Access to funding through the CMA will depend more strongly on being able to demonstrate the competitiveness of proposals at regional or national level.	• For locally held funds, regionally competitive bids. For nationally managed funds, nationally competitive bids.

Potential source	Available for	Capital and / or recurrent	Typical duration	Estimated size	Likelihood of availability	Other notes	What is required to secure access
MidCoast Water – rates	• Rural land management in drinking water catchments • Land purchases for wetland protection • Water efficiency investments • Education, water use efficiency and sustainable water cycle management	Capital and recurrent	Usually fixed-term. Ongoing (with periodic renewals) is possible.	• $1 million/ year over the MCA region	• Committed programs	• $200,000 / year for rural land management across the MCW area, prioritising water supply catchments • $700,000 / year for wetland purchases across the MCA area • $1.1 million over 10 years for a SmartWater program that funds rainwater tanks. etc.	• MCW policy decisions
State and federal grant programs							
State government grants (e.g. Environmental Trust)	• Rural, urban and lake use projects that fit grant selection criteria	Capital and recurrent	Fixed term, usually between one and three years		• Funding is committed to grant programs. Great Lakes applications for grant funds will be tested in competitive bidding processes.	Currently have $1.16 million grant for audit, environmental management systems and effluent reuse, plus education for sustainability program.	• Grant applications and negotiations with Commonwealth agencies
Commonwealth government grants (e.g. Caring for Country)	• Rural, urban, and lake use projects that fit grant selection criteria	Capital and recurrent	Fixed term, usually between one and three years		• Potentially significant grant funding will be available through the Commonwealth's 'Caring for Country' program. Both Myall (Ramsar site) and Wallis lakes (major aquaculture area) have features that make them nationally competitive.		• Grant applications and negotiations with state agencies

Table 3.8.2. Options for resourcing programs.

Programs to be funded		Urban development						WSUD Protection [2]	Rainwater tanks retrofitting	Rural programs	Lake use	Pollution control	Adaptive management	
		Greenfield sites [1]		Urban Redevelopment		Urban Area Retrofittings							Monitoring, evaluation, reporting	Research
Sources of funds		Capital	Maintenance	Capital	Maintenance	Capital	Maintenance							
Developers / buyers		+++	+ while bonded under sec. 68	+++	+ while bonded under s 68	++ with an offsets scheme [3]				+ with an offsets scheme			+	
Community title contributions from residents			++ [4]											
Farmers										+++ [5]				
Council rates • General • Environmental • Stormwater levy	Dedicated funding [6]		+++		+++	+++ [7]	+++	+++		+	+	+++	++	+
	Synergistic uses of funds committed for other purposes [8]					+		+				+		
Regional NRM [pt126]bodies	HCRCMA					+		+		++	++	+	+++ [9]	++
	MidCoast Water								+++	++ in water supply catchments				
State and federal government	Grants [10]	+ underwrite innovation?		+ underwrite innovation?		++		+		+++	+++	+	+	+++
	Agency in-kind / collaboration							+		+	++	+	++	++

Key:

Relative importance as a source of funds for the program area +++ ++ +

Security of funding Good Moderate Poor

Notes:

1. The WQIP programs that have green cells (good funding prospects) for their most important sources of funding (+++) are the most likely to be implemented. Those whose most important funding sources (+++) are coloured red (funding particularly insecure) are those most at risk of not being implemented. As a general rule, green '+++' cells still involve substantial challenges. For example, capital funding for water-sensitive urban design on Greenfield sites hinges on good planning practice in local Councils and, in places, support from the NSW Department of Planning. Also, this table does not make time lags explicit. For example, adequate funding for maintenance of Greenfield sites will only be available as a matter of course when and if Council rates have increased sufficiently for Council's asset management to be on a sound financial basis. It may take a decade to complete a transition to financial sustainability, and this will only occur if the local community is prepared to support it (notably as the Community Strategic Plan is being developed).
2. 'WSUD Protection' is the term used in the discussion of 'Management Strategies to achieve Ecological Condition Targets 2.7, 2.11 and 2.15' for work to put in place water-sensitive urban design standards in Council LEPs and DCPs.
3. An offsets scheme is difficult to establish. WSUD targets set in the WQIP will need to be revised upwards – going beyond current best practice to a level that is required to achieve desired lake water quality outcomes – and NSW Government support for implementation of an offsets scheme (probably under the POEO Act) will be needed.
4. The relative importance of contributions to maintenance of WSUD devices in new subdivisions will depend on how frequently community title is used for ownership of WSUD assets (and similar).
5. It is anticipated, based on past experience, that farmers will contribute (mainly through in-kind contributions). These contributions will be in proportion to funding sourced off-farm for rural programs.
6. These contributions are a mixture of councils directing staff effort to the WQIP program identified, and councils funding other parties to undertake work (e.g. contracting university research).
7. Some dedicated Council funding is available for this work via GLC's Stormwater Levy. Currently identified funding falls well short of the funds required for the retrofitting program.
8. This row identifies areas where existing Council programs not directed at water quality management can be adapted so that they also achieve water quality goals, without increasing costs significantly. For example, road and drainage works can involve gradual improvements to drainage infrastructure to provide additional water quality treatment.
9. To date, it is difficult to see where many aspects of monitoring, evaluation and reporting will be funded from. In principle, the HCRCMA is the most obvious funding body for measurement of ecological condition, as the HCR Catchment Action Plan obliges them to report on progress against estuarine Ecological Condition Targets. DECC Waters and Catchment Science also undertakes work in this area, and the kind of chlorophyll-a monitoring they have recommended is identical to that which they are already undertaking in a range of NSW estuaries. Given that Wallis Lake and the Myall Lakes are high-profile NSW estuaries, it may well be that DECC can make a major contribution here. Great Lakes Council is expected to fund a range of monitoring, evaluation and reporting activities via in-kind contributions, e.g. erosion and sedimentation control auditing. They are a much less secure source of funding for measurement of ecological condition (e.g. chlorophyll-a).
10. In general, Commonwealth and state governments are relatively insecure funding sources for local programs. Funding is dependent on persuading them that local programs are priorities from state and Commonwealth perspectives. However, their funding plays crucial enabling roles in the rural, lake use and research areas, and what is achieved in these three areas will depend largely on their willingness to fund Great Lakes Council's programs. Their in-kind contributions (e.g. advice and cooperative implementation of programs) are also valuable support, and these are much easier to access. They may also underwrite innovative WSUD capital works to offset the risks to developers and councils of trialling new approaches.

3.9 Adaptive Management Strategy[pt127]

3.9.1 Embracing uncertainty

Managing the Wallis, Smiths and Myall lakes, and their catchments, in ways that look after residents' and visitors' quality of life – and which also support the local economy, and sustain wetlands, rivers and the lakes – is challenging. A wide variety of uncertainties may influence outcomes, for example: How successful will fund-raising efforts be? How many farmers will change their practices? How successful will measures to protect southern Wallis Lake from the impacts of urban development be?

Management systems to support implementation and evolution of the WQIP need to reflect these uncertainties. When uncertainty is dealt with in an industrial context, the goal of management systems is often identified as 'continuous improvement'. Socio-ecological systems are considerably less predictable than industrial processes. An alternative benchmark by which management can be tested is: Has management adapted appropriately, as circumstances and understanding have changed?

This section of the WQIP outlines a strategy for managing adaptively: a proactive approach to managing the Great Lakes catchment–lake systems in ways that embed flexibility and responsiveness into WQIP implementation.

Three principles that inform the design of this adaptive management strategy are:

1. *Planning to adapt – closing plan / do / review loops*. Closure is needed at multiple levels. In ISO 14001, the International Organization for Standardization's model for Environmental Management Systems[38], 'checking and correction' is differentiated from 'reviewing and planning', a differentiation important in adaptive management:

   > "It is useful to conceptually separate the review of plan implementation from the review of the plan itself by describing two cycles in adaptive management: an inner cycle, in which targets are fixed, performance monitored and actions chosen, and an outer cycle (over a longer time scale) in which the overall strategy (i.e. the WQIP), including objectives and targets, monitoring and performance measures, available actions and decision rules, is reviewed and revised." (Eberhard *et al*. 2008) [pt128]

38 See http://www.iso.org/iso/iso_14000_essentials.

In practice, plan / do / review loops are needed at many resolutions in the WQIP, including:

- project level (e.g. is increasing regulatory effort increasing compliance on construction sites?)
- program level (e.g. are the actions committed to under the Wallis Lake WQIP being done?)
- ecosystem level (e.g. are chlorophyll-a concentrations in Wallis Lake tracking as expected?).

The loops are designed to support revisions to plans, practices and funding at multiple resolutions.

2. *Resilience – preferring strategies and tactics that are likely to work out well across a range of scenarios*. A lot of traditional management planning focuses on working out what scenario is most likely, and committing to the plan that will work out best in those circumstances. An alternative, more risk-averse, approach is to look for a management approach that is likely to work out well, amidst the uncertainties. In a classical adaptive management context, the aim is to have a strategy that is resilient at the level of ecological condition targets. So here, for example, one would prefer management approaches that will achieve the targeted chlorophyll-a concentrations across a range of plausible ways of modelling the system.
3. *Exploration – managing as investigating.* Management that is outcome-focussed is always, in certain respects, exploratory. Two kinds of exploration can be differentiated:

    - *passive* – where one sets goals and measures outcomes to see whether they are achieved, and adapt as necessary: setting chlorophyll-a ecological condition targets and measuring progress towards them as catchment management improves is an illustration
    - *active* or *experimental* – where one proactively uses management to probe system dynamics in 'management experiments'; for example, Great Lakes Council is planning to move from erosion and sediment control 'blitzes' to a continuous but relatively low level of auditing – trialling alternative approaches to influencing developers and builders, in ways that control for other influences on their behaviour (e.g. state government programs), would make this a management experiment.

Table 3.9.1 outlines the main uncertainties identified during the water quality improvement planning process, via modelling of system dynamics and development of management approaches. It recommends ways of approaching them that are likely to be

more resilient. More work exploring the resilience of alternative policy settings is needed, and it is intended that this will take place using the Decision Support System (DSS) developed with the Water Quality Improvement Plan following adoption of the WQIP. Table 3.9.1 also outlines options for reducing uncertainty – negotiations, investigations, management experiments and research that can help focus management efforts better. These are listed here to provide an agenda for Great Lakes Council and others to build into their coordination and implementation activities. It also provides a preliminary list of ways in which management could adapt if circumstances unfold unexpectedly.

Improvements in understanding of the catchment–lakes systems' socio-ecological dynamics should result from both the investigations flagged in Table 3.9.1, and the combination of operational performance evaluation and ecological condition monitoring outlined in Table 3.9.2. It is intended that the DSS be revised (i.e. its assumptions, equations, documentation, etc.) as appropriate, as knowledge of socio-ecological dynamics improves.

Table 3.9.1. Working with key uncertainties.

Uncertainties	Management implications	Towards resilience	Recommended options for reducing uncertainty	Recommended options for adaptation
		Approaches likely to work out well across multiple scenarios	Actions likely to lead to significant learning	Ways of managing if things go wrong
Policy-dependent				
Availability of needed funds	Many aspects of the WQIP (especially the rural programs) require funding well in excess of local and regional NRM agencies' current funding. WQIP projections are aspirational from a funding perspective.	Following through on all catchment management improvements that are not directly dependent on the tax bases of local, state or Commonwealth governments (notably, improving planning controls). Emphasising pursuit of multiple objectives to make maximum use of existing funds, e.g. achieving WSUD outcomes through Council road renewal programs. Taking an entrepreneurial approach to WQIP implementation: working on multiple fronts to source funds, approaching funding sources innovatively, and doing what can be funded.	Proactive exploration of funding sources. Sourcing funds; especially recurrent funding, e.g. environmental, stormwater and catchment rates, and increases in general rates to enable sustainable asset management.	If funds for WQIP programs are unavailable, possibilities include slowing the rate of development, seeking in-kind contributions from other agencies, and (unpalatably) tolerating additional ecological decline.
State government (esp. DoP) policy regarding local environmental planning	State government support is essential if WSUD provisions are to become requirements under the GLC LEP and DCP. If the state government rejects GLC's WSUD provisions, much of the community's ability to improve the condition of Wallis Lake will be undercut.	Making a major effort to ensure that key state government politicians and bureaucrats understand the risks that urban development poses for the lakes, in particular the risks to the high ecological values of lower Wallis Lake.	Negotiations with the state government at regional, head office and political levels.	If the state government does not provide good support, proceed at the local level with clear DCP provisions – applying them consistently – and make good use of opportunities to address WSUD issues in Voluntary Planning Agreements.

Uncertainties	Management implications	Towards resilience	Recommended options for reducing uncertainty	Recommended options for adaptation
Management of state forests: • logging regimes (variability) • quality of erosion control practice	State forests are a substantial percentage of the catchments of the Great Lakes. Intensification of logging regimes has the potential to undermine the water quality improvement work undertaken on other land uses. The quality of erosion and sedimentation control is also a key issue, as logging can generate large loads of sediments and nutrients.	In principle, more intense improvement of catchment management on other land uses would provide a buffer against intensification of State Forests' impacts. In practice, little more buffering is possible.	Engage State Forests in further river and lake water quality management activities. Confirm with the DECC that their regulation of State Forests is consistent with the WQIP. Peer review of State Forests' and DECC's practices would reduce uncertainty for local and regional NRM managers from other agencies.	If State Forests' impacts intensify, raise awareness in the local community of these impacts and, if they are occurring in the Myall catchment, raise the implications for international agreements (Ramsar, etc.) of this intensification with the Commonwealth government and (again unpalatably) tolerate additional ecological decline in the region's rivers and lakes.
Urban practice effectiveness (part engineering, part social)				
Effectiveness of selected WSUD practices ("at least +/- 10%" error for WSUD treatment trains)	Risks of driving slow decline in the lakes, if in practice the designs work somewhat less well than expected.	Over-engineer the WSUD recipes, and the designs adopted for Greenfield sites, sufficiently to provide a high level of confidence that what is designed will indeed protect the lakes.	Encourage researchers to quantify variability of designs, in varying circumstances, more precisely.	Retrofitting drainage lines that are performing below expectations. (This is expensive compared to effective up-front design, however, and may be impossible if sufficient land is not available.)
Ability to achieve 'no net increase' in pollution loads, over the long term, from Greenfield sites. Ability to achieve best practice performance from redevelopments over the long term. For both contexts, a major uncertainty is the quality of maintenance of WSUD devices on private land over the long term.	The WQIP (*and* Great Lakes Council's pre-WQIP policy) depend upon WSUD works being able to achieve design performance over the long term. Because the proposed WSUD recipes for redevelopments site all WSUD devices (principally rainwater tanks and raingardens) on private property, the long-term performance of these devices is uncertain. They need to be retained on site and appropriately maintained for WSUD design objectives to be met.	Developing WSUD device licensing analogous to the On-site Sewage Management System licensing. An easement (or similar) covering the raingarden location could reduce the risk of its removal.	Careful monitoring of owners' and occupiers' retention, use of, and care for WSUD devices, so a dataset is built up that quantifies risk of failure of WSUD devices on private land due to owner neglect.	If devices fail through neglect, then maintenance or retrofitting will be required. Funding this would probably be difficult (the more so, because public funds would be being expended on private land).

Uncertainties	Management implications	Towards resilience	Recommended options for reducing uncertainty	Recommended options for adaptation
Rural practice effectiveness (part engineering, part social)				
Effectiveness of diverse rural practices, e.g. the costs, extent and effectiveness of actions to remediate deteriorated stream banks	Projections for river and lake health are based on assumptions about the effectiveness of rural water quality management practices. If they are less effective than expected, then aquatic ecosystem improvements will be proportionally slower (and in the worst case, net decline might occur even if substantial effort goes into improving rural catchments' performance).	Multiple practice improvements are already built into the WQIP, and the proposed intensity of effort is already relatively high from the farmers' perspectives. Consequently, 'over-engineering' rural catchment management to reduce risk of failure is not a practical option in the short term. Adaptation will be needed if the practices work less well than expected.	Encourage researchers to quantify variability of practices, in varying circumstances, more precisely.	If practices work significantly less well than expected, options include evolution of the practices to find forms that work more effectively and / or more reliably, and adoption of stricter controls on practices (e.g. requiring off-stream watering of stock).
The level of uptake and consequent on-ground change following rural programs	Rates of uptake have a large influence on WQIP effectiveness, particularly for the freshwater reaches of the river systems.	Focusing on practice changes that make financial as well as environmental sense. Providing incentives and support that are tuned to the pattern of tension between public and private interests.	Researching experience in other locations. Piloting alternative approaches to see what farmers find attractive in practice.	If rates of take-up proved particularly low, much more use of regulation is a possibility. Community support for strong defence of the public interest (particularly in river health) would be needed for this to be legitimate.
Septic systems as sources: locations, discharge flows, nutrient, etc. concentrations in discharges [38]	If pollutant loads from septic systems are substantially higher than expected (e.g. if many more residents discharge effluent illegally than expected), the risks they pose to oyster production and eutrophication will be proportionally higher. In the absence of reliable figures on potential discharges, it is difficult to say how important the uncertainty is.	Moving to a pump-out charge that is independent of the volume of wastewater, to reduce the financial benefit of illegal discharges. Improving inspection fee arrangements so that follow-up of non-complying systems is self-funding (rather than an expense to Council).	Close investigation of a sample of systems or sub-catchments to get more precise performance data. Field investigations to identify illegal discharges and gauge the level of risk.	If it turns out that the contribution of On-site Sewage Management Systems is substantially higher than expected, then management effort should be increased in appropriate ways to reduce impacts.
Risks from unpaved roads in Myall catchment	Unpaved roads are relatively intense erosion sources (per unit area), and when they are close to waterways their pollution contribution can be significant.	A precautionary approach would improve erosion control – for example, by sealing key sections near waterways.		

38 This is a subset of a wider question about pathogen dynamics. Of particular interest is how large a contribution installation of a sewage treatment plant for Nabiac and placing caravan parks on mains sewerage has made to reducing the risks of a recurrence of the 1997 hepatitis A epidemic.

Uncertainties	Management implications	Towards resilience	Recommended options for reducing uncertainty	Recommended options for adaptation
Effects of fire management	Fires substantially increase catchment areas' nutrient and sediment export rates until revegetation has occurred. Fire management is therefore a risk factor, from the lakes' perspective. The frequency and intensity of fires is relatively difficult to control.		Investigating whether some burning regimes (e.g. smaller, more frequent fires, rather than infrequent large fires) are better from a cumulative impact perspective.	Limited capacity to adapt. Pulses of relatively high pollution export rates associates with fires have a long history in the Australian landscape.
Socio-economic				
Population growth rate and related redevelopment rate	Because redevelopment is a driver for improvements in Wallis Lake, in this respect slower growth is a negative for the lakes. However, Greenfield sites add risk to the catchment – the critical issue is can 'no net increase in pollutant loads' be achieved over the short and long term. So in this respect, a slower rate of growth that provides more opportunities for learning is desirable from a lake protection perspective.	Requiring high-quality stormwater management on urban and rural residential land, as recommended in the WQIP, makes a major contribution to improving the catchment–lake systems' resilience in the face of population and development pressures. Reducing the rate of land availability (i.e. rezoning at a slower rate), and other planning controls, could be used to govern the rate of population growth and associated development rates.		If rates are slower than expected, adaptation is not required. If rates are faster than expected, it may make sense to increase scrutiny of construction site performance (although that should always be high).

Uncertainties	Management implications	Towards resilience	Recommended options for reducing uncertainty	Recommended options for adaptation
Biophysical				
Climate change: • increased variability • effects on pollution export rates	An increased frequency of extreme events, and difficult to predict changes in overall rainfall, will shift catchment–lake dynamics. The rate of change is difficult to predict, beyond the fact that it is very fast relative to the last 10,000 years of climate history. Over the initial seven years of WQIP implementation, the signal of climate change in weather is likely to be undetectable.	Placing proportionally more effort on source controls, rather than downstream treatment.	Encouraging research into practices for managing construction sites sustainably in high-flow events. (Major improvements in the quality of source controls, and increased responsiveness to weather information and predictions, may be helpful.)	Marked adaptation to incremental changes is not likely to be needed. If the global climate goes through a phase shift (triggering, for example, rapid substantial sea level rise), major adaptation that is difficult to characterise now will be needed.
Groundwater dynamics and influence: their potential to undercut WSUD strategies	Flow paths are often unclear, and flow rates are often slow, so the ecological effects of allowing polluted water to infiltrate into groundwater are often unclear. In some locations, groundwater levels are very variable and not well known, and this can complicate WSUD device selection.	The WSUD approach recommended in the WQIP does not count infiltration as 'removing' pollutants from the system – no net increase has to be achieved without any use of infiltration. This avoids long-term groundwater pollution problems. Choosing WSUD designs that are less vulnerable to unexpectedly high water tables (especially when available groundwater level data is from relatively dry years) is advisable where groundwater is relatively close to the land surface.	Encourage research into groundwater dynamics under different climate and geological conditions, with a view to providing guidelines regarding the variability that designers should cater for as a matter of course.	Treating polluted groundwater is difficult and expensive. WSUD designs that are predicated on inaccurate levels may be able to be corrected with retrofittings. This is expensive, however.

Uncertainties	Management implications	Towards resilience	Recommended options for reducing uncertainty	Recommended options for adaptation
Limited understanding of aquatic ecosystem processes [39]	Quantitative process knowledge is limited, as in many other areas of ecosystem management. In general, improved process understanding improves modelling capability. However, benefits of increased precision in particular areas are usually low when there are high levels of uncertainty about the problem domain, as is usually the case in ecosystem management.		Do sensitivity testing with the DSS, to explore which model assumptions have the most impacts on modelled lake ecology. Leverage other modelling and information as available, to seek to identify areas of research where improvements in process understanding may have a large influence on management decision-making.	
Information gaps regarding catchment erosion characteristics, including lack of spatial resolution in soil and land use data, local rates of stream bank erosion, and location and extent of gullies	Improved understanding of catchment biophysical characteristics may allow better targeting of water quality management efforts. This is particularly true where effort is applied more intensely to concerning sub-catchments (when travel time is a significant factor in program efficiency, this is often the case, for example).	Keep investment in catchment management improvement at a level that fully supports landholders' willingness to improve their practices, as gaps in datasets will have relatively little impact on catchment management programs under these circumstances. [Note that it is believed that the rural program as designed is pitched at this level.]	Use the DSS to investigate which catchment parameters have the most impact on modelled outcomes, and identify which of the influential parameters are less accurately quantified. Then experiment with plausible variations in the values of these more uncertain parameters to identify which datasets it is worth investing in, because better quality information could substantially alter management decisions.	

39 For example: (i) Dynamics of in-stream processes, including transformation and attenuation of nutrients within a river system; (ii) Lake resuspension and settling mechanisms, and 'bottom stresses'; these may cause unexpected lags in lake responses to catchment improvements; and (iii) Benthic plants' ecological dynamics, including how light attenuation in estuary water columns varies, and their use of light at specific wavelengths.

Uncertainties	Management implications	Towards resilience	Recommended options for reducing uncertainty	Recommended options for adaptation
Modelling capability (data available, process knowledge, modelling technique)				
Accuracy of model calibration, and its implications for the models' predictive power	The parameter settings needed to calibrate the model proved puzzling to the modellers in various respects (Appendix 5). The model outputs are therefore a reasonable facsimile of observed dynamics. However, confidence in the underlying process representation is relatively low. What this implies is that confidence in the models' representation of system dynamics outside the range of observed dynamics (e.g. major changes in catchment management, substantial climate change) is relatively low. Exploration of 'limiting cases' (e.g. 1750 land use) with the model is therefore not possible. The model is probably therefore a reasonable guide to the effects of incremental policy changes, but an uncertain guide to the effects of more radical policy changes.	Perhaps working on a typology of Australian catchment-lake systems at a level sufficient to support strong qualitative predictions (direction and order of magnitude of change) regarding different kinds of rivers' and estuarine lakes' responses to substantial catchment management changes.	Identification or development of catchment models that represent the systems' range of possible dynamics (under widely varying land management assumptions) more robustly. However, the additional 'value add', from a management perspective, over and above the existing model, may well not be large enough to justify the investment.	If the model is judged to be an unreliable guide to the likely effects of major policy changes, it can still be used to educate stakeholders regarding the fundamentals of catchment–lake dynamics.

3.9.2 Plan / do / review loops

Local natural resource management (NRM) agencies with the primary responsibilities for implementing the WQIP are:

- Great Lakes Council
- Greater Taree City Council
- MidCoast Water.

The Hunter-Central Rivers Catchment Management Authority is the regional NRM agency with key responsibilities in supporting local NRM and overseeing performance. Three state NRM agencies have important roles as sources of technical expertise, policy frameworks and regulatory regimes:

- Department of Planning
- Department of Environment and Climate Change
- Department of Primary Industries.

A variety of other agencies and groups are making important supporting contributions (see Section 3.6).

Primary responsibility for implementation, for checking and correction as implementation occurs, and for measuring ecological outcomes, rests with each of these agencies.

Figure 3.9.1 is a generic model of adaptive management practices that outlines the general approach that the organisations actioning the WQIP are expected to take. It is an overview of the particular plan / do / review loops that play central roles in the WQIP's adaptive management strategy. Table 3.9.2 outlines these loops in more detail, providing the rationales for the management system design recommended.

3.9.2.1 Measuring performance

Table 3.9.2 is designed to show:

- the multiple layers of feedback provided on programs: there are feedbacks that serve a range of needs from operational control to strategic review
- how these feedbacks cover a range of spatial resolutions – from on-site where work is occurring, to nearby, to the scale of major land uses (rural, urban) in a sub-catchment or catchment, to the lakes as such (recognising the lakes as integrating their catchments).

Figure 3.9.1. Adaptive management activities (Source: Eberhard *et al*. 2008).

Additional explanations of key points in the program are provided in the notes that accompany Table 3.9.2. Extensive supporting information on the proposed monitoring regime and Ecological Condition Targets is provided in the accompanying appendices (Appendix 30[DG129]).

Table 3.9.2 also underlines the links between the WQIP and the HCRCMA's Catchment Action Plan targets, as these are very important in accessing funds because they demonstrate the consistency of the WQIP with the NSW Government's plan for the region, and hence with the NSW State Plan and the Australian Government's objectives.

The actions outlined in the WQIP contribute to meeting State Plan Target E4 Better environmental outcomes for native vegetation, biodiversity, land, rivers and coastal waterways – and meet NSW Government targets for protection of our natural environment. The State Plan target is outlined in the state's Catchment Action Plans. The WQIP actions contribute to the Hunter-Central Rivers Catchment Management Authority's Catchment Action Plan.

We recommend that the task-focussed evaluations outlined in Table 3.9.2 be complemented by organisational self-evaluations modelled on the 360^{o} performance reviews used in human resources. For each organisation, the organisations around it would provide feedback on its performance as a contributor to the institutional landscape. This kind of collaborative evaluation provides opportunities for each organisation to provide and receive clear feedback on the difficulties that organisations are experiencing when working together. From the perspective of improving lake outcomes, it would be

beneficial for all of the organisations playing major roles in shaping lake outcomes (GLC, GTCC, MCW, HCRCMA, DoP, DECC and DPI) to undertake this kind of evaluation. The evaluations would document a qualitative synthesis of the feedback from other stakeholders, identifying patterns – specifically strengths and weaknesses – and making recommendations for improvement as appropriate.

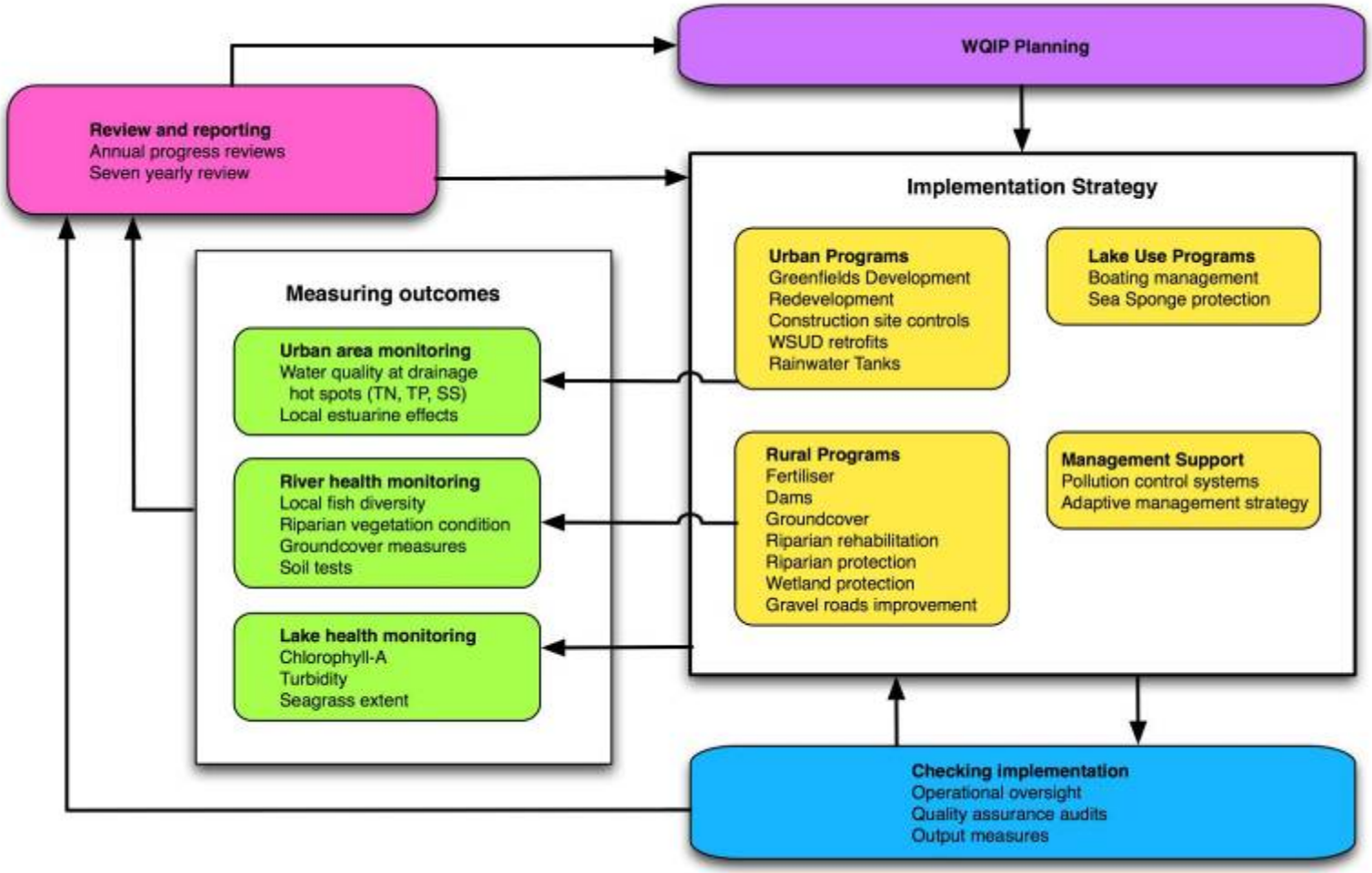

Figure 3.9.2. Fundamental plan / do / review loops in the WQIP.

Table 3.9.2(a). Operational and output measures by program.

Landscape	Programs	Primarily used in operational control [3]			Primarily used in strategic review and planning [4]
		Checking implementation is occurring [1]	Normal operational checking and correction [2]	Quality assurance measures [5]	Single program output measures [6]
Rural [7]	Nutrient management (Fertiliser)	x	x		
	On-site Sewage Management System monitoring [8]	x	x	Audit of the effect of changed fee structure on follow-up of problematic On-site Sewage Management Systems [9]	
	Infrastructure management (Dams)	x	x		
	Groundcover management	x	x		Hectares of farmland managed with good groundcover (*contributes to HCRCMA Catchment Action Plan MTs 10 and 15*) Additional hectares under sustainable grazing management (*HCRCMA Catchment Action Plan MT 15*) Hectares of highly erodible soils revegetated (*HCRCMA Catchment Action Plan MT 10*) Hectares of actively eroding soils stabilised (*HCRCMA Catchment Action Plan MT 11*) [10]
	Riparian rehabilitation	x	x		Kilometres of riparian land fenced (*contributes to HCRCMA MTs 17 and 18*) Hectares of native riparian vegetation regenerated (*HCRCMA Catchment Action Plan MT 18*)
	Riparian protection	x	x		Hectares of native riparian vegetation protected (*HCRCMA Catchment Action Plan MT 17*)
	Wetland protection	x	x		Hectares of wetlands enhanced (*HCRCMA Catchment Action Plan MT 07)* Hectares of native vegetation protected (*HCRCMA Catchment Action Plan MT 01*) Hectares of natural wetlands protected from grazing pressures (*contributes to HCRCMA MT 07*)

Landscape	Programs	Primarily used in operational control			Primarily used in strategic review and planning
		Checking implementation is occurring	**Normal operational checking and correction**	**Quality assurance measures**	**Single program output measures**
	Unpaved roads remediation [11]	x	x	Erosion and sedimentation control audits [13]	Kilometres of rural roads where erosion and sedimentation is managed well (*contributes to HCRCMA MT 09*) Kilometres of roads affecting sensitive areas that are managed using best practice erosion and sedimentation controls (*HCRCMA Catchment Action Plan MT 09*)
				Multi-program output measures [12]	Additional hectares covered by property plans (*HCRCMA Catchment Action Plan MT 16*) Hectares of properties managed with identified best practices (*contributes to HCRCMA MTs 15 and 16*) Hectares of farmland with improved nutrient management (*HCRCMA Catchment Action Plan MT 13*)
Urban	Construction site controls	x	x	Erosion and sedimentation control audits [13]	
	Water Sensitive Development of Greenfield sites	x	x	Development assessment management system audit: • advice requested appropriately • conformity of approvals to planning standards • compliance with conditions of consent • performance of the built form. [15] Quality of maintenance of WSUD devices on private land, community title land and public land. [15]	
	Water Sensitive Redevelopment	x	x		
	Urban Mitigation (Water Sensitive Urban Design retrofittings) [14]	x	x		Hectares of urban areas above sensitive waterways retrofitted with current best practice stormwater management (*HCRCMA Catchment Action Plan MT 23*)
	Urban Mitigation (Water Sensitive Urban Design rainwater tanks) [16]	x	x		

Landscape	Programs	Primarily used in operational control			Primarily used in strategic review and planning
		Checking implementation is occurring	**Normal operational checking and correction**	**Quality assurance measures**	**Single program output measures**
Lake use programs	Boating management	x	x		
	Sea sponge protection	x	x		
Management support	Pollution control systems [17]	x	x		
	Adaptive Management Strategy [18]	x	x		

Table 3.9.2(b). Ecological and outcome measures by program.

Landscape	Programs	Primarily used in strategic review and planning		
		Proximate ecological outcome measures [19]	**Sub-regional waterway outcome measures** [19]	**Lake ecological outcome measures** [19]
Rural	Fertiliser	Soil tests that examine the nutrient concentration and pH of topsoils	Local fish diversity [20]	Achievement of WQIP's predicted effects on chlorophyll-a concentrations [21] Consistency with long-term ecological condition targets: • chlorophyll-a • turbidity • salinity • temperature • Secchi depth [21] Consistency with short-term ecological condition targets: measures as above, taken 3–5 days after a major rainfall event [22] Acceptability of long-term trends in seagrass / macrophyte and macroalgal abundance [23]
	On-site Sewage Management System monitoring			
	Dams	The number of annual dam overflows		
	Groundcover	The height of pasture, the area of bare ground and the overall % of groundcover		
	Riparian rehabilitation	Assessments of riparian vegetation condition [24]		
	Riparian protection			

Landscape	Programs	Primarily used in strategic review and planning		
		Proximate ecological outcome measures	**Sub-regional waterway outcome measures**	**Lake ecological outcome measures**
Rural (cont'd)	Wetland protection			
	Unpaved roads remediation			
Urban	Construction site controls		If funds can be sourced, a management experiment to measure the ecological effects of WSUD improvements in an urban area. If funds are constrained, use chlorophyll-a to measure fit of lake outcomes to model predictions. [26]	
	Water Sensitive Development of Greenfields	Field measurements of success in practice in achieving 'no net increase' compared to pre-development land use [25]		
	Water Sensitive Redevelopment			
	Urban Mitigation (Water Sensitive Urban Design retrofittings)			
	Urban Mitigation (Water Sensitive Urban Design rainwater tanks)			
Lake use programs	Boating management			
	Sea sponge protection			
Management support	Pollution control systems			
	Adaptive Management Strategy			

Notes to Tables 3.9.2(a) and 3.9.2(b)

1. This column refers to checking by coordinating groups (e.g. Great Lakes Council, the Wallis Myall Catchment Management Committee) that programs are being implemented by WQIP partners. The review of work done versus work planned or recommended in the WQIP is to occur as part of periodic assessments of program implementation (including annual reviews and a major review of the WQIP after seven years). As many of the WQIP actions are wholly or partially unfunded, an entrepreneurial approach to funding many programs is being followed, so this reporting will need to report on both: (i) success sourcing funds; and (ii) delivery of funded programs.

2. This column refers to normal operational checking and correction, commonly by line managers, e.g. engineers overseeing construction projects.

3. These three measures – checking that tasks are being carried out, operational checking and correction, and specific quality assurance measures (notably audits) – are primarily used for operational control by the organisations responsible for implementing and coordinating the WQIP. This data also informs strategic reviews of progress. Results of operational checking and correction, and checking by coordinating groups that programs are being implemented, also inform strategic reviews.

4. There are four measures primarily useful in strategic review and planning contexts: biophysical measures of program outputs, ecological outcomes adjacent to works, subregional ecological outcomes (e.g. in streams and specific bays) and overall outcomes for lakes. Annual reports and seven-yearly reviews involve judgments about how WQIP implementation is progressing. The intention is that these judgments will be informed by these expanding datasets, and other information that is available.

   We expect that it will be possible to make good judgements about socio-ecological trends and effectiveness of WQIP implementation from: (i) WQIP implementation operational measures (basic managerial reporting happening as a matter of course, and quantification of effort and quality assessments occurring on an exceptions basis): (ii) the measures of ecological outcomes (at a range of spatial scales, from lakes as a whole to results at hot spots); and (iii) other data sources and the insights embodied in the WQIP's Decision Support System.

5. Specific quality assurance measures have been identified for a small number of programs. To make the table easier to read, where an operational program does not have an identified quality assurance measure, the cell is grey. (The same rule is followed in the remaining columns of the table.) The quality assurance measures outlined in this column address four areas of particular sensitivity: management of problematic On-site Sewage Management Systems, management of construction sites, development assessment and control, and maintenance of WSUD devices. These four program areas are important because: (i) these are relatively high intensity pollution sources; and (ii) scoping work undertaken during the water quality improvement planning process identified significant weaknesses and / or risks in these four areas.

6. The Hunter-Central Rivers Catchment Management Authority's Catchment Action Plan (HCRCMA Catchment Action Plan) is the NSW Government's primary statement of the region's natural resource management targets. Alignment with the Catchment Action Plan is therefore important for accessing funds. The Catchment Action Plan includes a variety of targets for delivery of on-ground works (ha protected, ha regenerated, etc.) that relate directly to actions recommended in the WQIP. (There is a much wider set of Catchment Action Plan Management Targets, which the recommended WQIP actions support.) In general, it is advisable to keep a record of program outputs – it is particularly important to do so in the areas identified in this column. (See the Catchment Action Plan for detailed explanations of each of these targets.)

Output targets for on-ground achievements will need to evolve to reflect capacity to fund these works. This is necessary because the seven-year targets for the WQIP demand a level of funding that is beyond the currently identified resources of the local and regional NRM agencies. Reporting will need to account separately for: (i) whether the outputs actually produced are appropriate given the funds committed; and (ii) the gaps between outputs funded and what would be needed to achieve the WQIP's ecological targets.

7. Note that the division 'rural / urban / lake' is somewhat arbitrary. In particular, management of denser rural residential development is largely covered under the 'urban' programs listed in this table. For definitions of the programs listed in this table, see the descriptions elsewhere in the WQIP.

8, 9. This recommendation comes from the Pollution Control Systems report. It addresses a particular difficulty currently experienced at Great Lakes Council: that since the On-site Sewage Management System is a user-pays program, for the most part site inspections can only occur at points where fees can be charged. Currently, no fees are charged when systems that have failed are reinspected, so follow-up is patchy. The proposal is to change the fee structure to support consistent follow-up. The aim of the audit is to check that this change in approach has been effective. (See the Pollution Control Systems Report for more details.)

10. Note that the HCRCMA targets are not – and are not intended to be – mutually exclusive: for example, a single hectare of land could count towards all four of these targets; one place may have many kinds of environmental value.

11. A program focussed on unpaved road 'hot spots' has been recommended.

12. The three HCRCMA Catchment Action Plan Management Targets listed in this row are integrating targets for rural landscapes. Because the Catchment Action Plan is a key vehicle for NRM funding, and because these are important in the Catchment Action Plan, the WQIP should report on these as well.

13. Poorly managed construction sites are extremely intense pollution sources – sediments and nutrients leave these sites at rates two orders of magnitude higher than bushland. Effective control of these sites is therefore very important for protecting lake health. Current practice is not strong. A program combining regulation and education (including improving practice on government construction sites) is needed to improve this. There are diverse auditing models available. (See the Pollution Control Systems Report for more detail.)

14. Note that in some parts of the WQIP, the term 'mitigation' is used to describe the combination of WSUD retrofittings in established urban areas, and implementation of MidCoast Water's Water Smart program that is (among other things) providing rebates for installation of rainwater tanks. See Section 3.4 of the WQIP for an overview of the proposed WSUD retrofittings and MidCoast Water's publications for details of the Water Smart program.

15. Land use planning outcomes are a key area for checking and correction for GLC, as GLC's policy and practice here have a large influence over land development, which is a major source of risk for Wallis Lake. What is envisaged here is management system audits of development assessment and control. Four phases of the process need review:
    - *The quality of the evaluation of development proposals*. Key issues include: whether proposals that warrant expert review by water quality modellers are recognised as such, and whether that review occurs and is heeded.
    - *Compliance of planning approvals with DCP requirements*. This is particularly important, as most of the water quality

management controls are being built into the DCP via performance standards, or recipes that deliver on these performance standards. If this aspect of the DCP comes to function as 'guidance' that is often departed from, then Wallis Lake will not improve as planned, and may decline significantly in some regions.

- *Whether what is built is what was approved*. For WSUD devices there is a significant learning curve for most involved, so tracking performance for a number of years after the DCP changes are introduced will be important.
- *Whether what is built functions as expected*. Design performance of many WSUD devices is relatively well understood in general terms, and it is believed that research on the performance of particular designs in Great Lakes settings is not needed (Tony Weber, BMT WBM, pers. comm.). However, the quality of ongoing on-ground performance is much less certain, as the WSUD recipes rely on installation of devices on private land that owners will need to maintain, and funding for maintenance of WSUD devices on public land is insecure and has been insufficient to date.

Checking the maintenance of WSUD devices on residential properties is an area of particular difficulty, as current regulatory arrangements do not provide a right of entry to inspect devices on these properties. Such a right exists for On-site Sewage Management Systems, so one option is to seek regulatory powers along these lines. See the Pollution Control Systems Report for more detail on this.

16. MidCoast Water's Water Smart program is implementing this strand of the WQIP. The program funds retrofittings of residential and commercial properties to improve water use efficiency. Rainwater tanks are a key part of the program. The tanks improve stormwater management as well as demand management.

17. Performance measures for key pollution control systems are covered on program lines in this table (notably the On-site Sewage Management System, and erosion and sedimentation control audits).

18. Implementation of the Adaptive Management Strategy itself needs to be tracked. That is a responsibility of the coordinators of the WQIP – Great Lakes Council, the catchment and lake management groups, and the SoJI partners.

19. The measures of ecological condition outlined in these three columns are all measures developed in discussion with DECC, and most of them are outlined in DECC Waters and Catchment Science's report on ecological monitoring (Appendix 30). See that report for more details on these measures.

    The measures outlined in these columns are all formal quantitative assessments. It is important that these are complemented by sensitivity to informal flows of information about catchment and lake dynamics. Formal monitoring programs focus attention where significant changes are expected. Recognising surprising and unpredicted changes accurately and quickly is often as, or more, important for good environmental management as using quantitative field assessments to study dynamics. Listening to people with on-ground experience, heeding professionals' impressions and spending some time in exploratory investigations are important complements to formalised measurement of ecological outcomes.

20. DECC's fieldwork for the WQIP demonstrated that this was an effective measure of rural catchment management performance. Fish data needs to be combined with data on implementation of on-ground practices to make these judgments. See the monitoring report (Appendix 30) for details.

21. A judgement that underpins the WQIP is that increases in nutrient inflows stimulating 'nuisance' aquatic plant growth (i.e. macroalgal and phytoplankton blooms) and increases in sediment loads shading

seagrasses are the two main risks to the lakes that need additional focussed management attention. (This reflects a judgement that pathogen risks are now reasonably well-managed; a range of measures to reduce inflows of sewage into the Wallis Lake system were introduced following the 1997 hepatitis A outbreak.)

Chlorophyll-a concentrations are a measure of aquatic plant growth, and turbidity and Secchi depth are measures of light penetration, which all directly shape the distribution and abundance of seagrasses. These two measures provide the main evaluation of ecological condition recommended in the WQIP. Lake salinity and temperature, and measures of ecological outcomes at hot spots, give supplementary perspectives on system dynamics.

These measures are gathered to answer two different kinds of questions:

(i) whether the management targets set in the WQIP are being achieved; these have been set for chlorophyll-a for different regions of the lakes (see Part 2 of the WQIP)

(ii) whether regions of the lakes are or are not in their targeted 'ecological condition' (see Appendix 10).

Our powers to answer these questions are relatively limited, however. The program designed to measure long-term trends in the concentration of chlorophyll-a (Appendix 30 Monitoring) is capable detecting changes in chlorophyll-a concentrations of about 0.5 µg/L – in general a difference of about 10% in chlorophyll-a concentrations (Appendix 30; Peter Scanes, pers. comm.). This sensitivity is not great enough to detect the effects of WQIP measures in most regions of the lakes. The difference between implementing the WQIP and not implementing it approaches the limits of detection in the Myall system: that is, in the absence of the WQIP, slow decline is predicted (WQIP Part 2). For Smiths Lake, which is in near-pristine condition, the management focus is protection. There is no expectation of catchment changes occurring that would lead to significant decline in Smiths Lake. For Wallis Lake, the urban retrofitting program – combined with redevelopment – is predicted to produce measurable reductions in chlorophyll-a concentrations in Pipers Creek and Pipers Bay (WQIP Part 2). These changes can be framed as management experiments: that is, by comparing reference sites with dynamics in this region of the lakes, the effectiveness of the WQIP catchment management program can be tested. For the river-dominated sections of the Wallis Lake estuary, the projected estuary response to improved catchment management is too small to be measured (WQIP Part 2). For these sections of Wallis Lake, the proposed WQIP catchment management improvements are a modest step towards the community's aspirational targets.

Although the chlorophyll-a measures are unable to discern the predicted differences between 'WQIP' and 'no WQIP' scenarios in most locations, they are sufficiently sensitive to flag concerning declines caused by nutrient inflows in the lakes (Peter Scanes, pers. comm.). Declines of 0.5 µg/L or more are not predicted, and if observed, are likely to reflect significant unexpected problems with catchment management.

Addendum: Historically, nitrogen and phosphorus concentrations in the lake water column have played a major role in efforts to measure catchment management success. DECC has now researched nutrient concentrations and plant biomass in four estuarine lake systems, and has reached the conclusion that it is far easier to discern the signal of catchment nutrient loads in the plant biomass than in the nutrient concentrations as such (Peter Scanes, pers. comm.). The program recommended here reflects that. What is at issue is residence times in each medium: biomass integrates the signal over a substantially longer period of time, and presence in the water column can be very brief (depending on whether or not nutrients are limiting plant growth).

22. Measurements of chlorophyll-a concentrations after rainfall events may prove to be a considerably more sensitive measure of catchment management performance than long-term averages for lakes and sub-regions of lakes. Targets for events have been set as part of the

WQIP (Appendix 10). This is an area for further investigation. Research informing the WQIP demonstrates two differences in chlorophyll-a concentrations in disturbed and undisturbed lake regions: adjacent to disturbed regions, chlorophyll-a concentrations rise higher in response to nutrient pulses, and they remain elevated for longer (Peter Scanes pers. comm.). Potentially, this insight can be developed into a robust, relatively sensitive protocol for evaluating the performance of catchments around estuarine lakes.

23. Maintenance of seagrass beds is a key goal of the WQIP. It is proposed to measure outcomes here simply: by surveys of their extent, both in the field and potentially from aerial photographs (see Appendix 30).

24. The measures proposed are: “Proportion of banks that are bare (lacking vegetation or leaf litter) within 5m either side of stream. Percent cover of trees >10m in height within 5m either side of stream. Percent cover of trees <10m in height within 5m either side of stream. Percent cover of shrubs, vines and rushes within 5m either side of stream. Percent cover of trailing vegetation over stream surface.” (Appendix 30).

25. Under current policy, Greenfield urban development in the catchments of the Great Lakes must achieve ‘no net increase’ in the pollution load, over and above the agricultural land and bushland that it is replacing. Some checking of whether this is being achieved on the ground is advised (say, on a sample of Greenfield development projects), because of uncertainties about: (i) success managing the construction process; and (ii) maintenance of WSUD devices. Building evaluation into development approval is appropriate. Water quality in drainage lines (nitrogen and suspended solids in particular) should be the focus.

26. As noted in point 21, the urban catchment management program proposed for Forster (Wallis Lake) provides an opportunity for a management experiment exploring the relationship of estuarine lake condition to urban catchment performance. The experimental design would involve reference sites, including undisturbed areas and lake areas influenced by urban areas with various management regimes. This would be the most powerful way to test the effectiveness of the main urban components of the WQIP. This would be relatively expensive, however; given its scale and cost, this is an approach to adopt if partners with an interest in a joint investigation can be found.

The fallback for evaluating the effects on the lake of the urban renewal program and Greenfield programs is the monitoring protocol recommended by DECC (Appendix 30).

3.9.2.2 Review and public reporting

Reporting to the community

Two primary layers of review and public reporting for the Water Quality Improvement Plan are planned:

1. Annual reports, which would cover: (i) implementation progress; (ii) on-ground program outputs; (iii) assessments of the quality of key activities; (iv) assessments of ecological condition; and (v) advice on emerging issues and recommended program changes.
2. A seven-yearly major review (the first to occur in 2015), which would thoroughly consider progress with the WQIP and plan the next period of work.

These reports need to be public reports accompanied by appropriate media releases, and supported by external professional peer review.

It is intended that these reviews will draw on all the sources of information outlined in Table 3.9.2 and its accompanying notes, and such additional information as is available – particularly the synthesis of research to date documented in the WQIP, and documented in a particularly dynamic way in the Decision Support System (DSS). The DSS, using updated information, should be able to play a significant role supporting the seven-year review of WQIP implementation and development of the revised WQIP.

In general, the measures of ecological outcomes will provide feedback slowly. Some of the 'hot spot' measures, and other measures closely tied to WQIP works (e.g. groundcover measures, measures of riparian condition, measures of water quality in drainage lines) may provide useful feedback relatively quickly (e.g. in one to five years, depending on program design). Measures of in-lake outcomes, i.e. direct measures of the environmental values most important to the community, may take decades to show a demonstrable signal from catchment management efforts, or may provide no clear feedback unless an unexpected, surprising perturbation of the system occurs (e.g. dense phytoplankton blooms in southern Wallis Lake). Nonetheless, because these ecological outcomes are what is of central concern to the community – and are, therefore, what justifies investment in the WQIP – the annual and seven-yearly reporting needs to be framed from the perspective of these outcomes. It needs to tell the story of the community's efforts to manage the catchments and lakes, for the community to digest and respond to.

Integrating natural resource management reporting

The seven-year initial review is timed to meet the region's commitment to the Australian Government under the CCI project – the WQIP have been developed with an emphasis on seven years of implementation as a first stage. There is significant overlap between the management commitments involved in a range of natural resource management (NRM) plans, including:

- Wallis, Smiths and Myall lakes Water Quality Improvement Plan
- Wallis Lake Catchment Management Plan
- Wallis Lake Estuary Management Plan
- Smiths Lake Estuary Management Plan
- Myall Lakes Estuary Management Plan
- a number of Stormwater Management Plans.

Integrating NRM systems better to enable easier reporting on performance against these plans, and to support holistic natural resource and environmental management, is desirable. That may involve adopting a different reporting period for the second phase of WQIP action, and probably a different kind of planning process during this review. These are matters to be determined when the 2015 review is being planned.

Leveraging reforms to local government planning and reporting

The new Local Government Planning Framework (Figure 3.9.3) may be a useful catalyst for better integration. It provides a number of opportunities for carrying the WQIP forward. These include:

- The Community Strategic Plan is a vision for the community – not a vision for the Council as such. WQIP goals therefore fit very naturally into the Plan, and should certainly have a significant place in it. (The consultative nature of the WQIP planning process aligns well with the process expected for the Community Plans.)
- The Annual Report is a report on progress against the vision and goals of the Community Strategic Plan. As such, it is a very appropriate place to report on WQIP activities and outcomes, given that these have been integrated into the Community Strategic Plan.

Figure 3.9.3. The new Local Government Planning Framework (Source: Department of Local Government 2006).

The Department of Local Government (2006) commented specifically regarding environmental reporting:

> "State of the Environment reporting would not be prescribed, though councils would be expected to develop adequate monitoring and reporting frameworks, in consultation with the CMA."

In this model, the Delivery Plan is a four-year plan developed by each council following its election. Additional consultation will be required if the Council wishes to depart significantly from the directions identified in the Community Strategic Plan. The Delivery Plan is supported by annual Operational Plans, which are the responsibility of the General Manager, and detail what will be done each year to action the decisions made in the Delivery Plan. These two documents are centred on Council actions, so they do not readily hold the breadth of the implementation plans for the WQIP. However, they are a key vehicle for delivery of Great Lakes Council's and Greater Taree Council's commitments. Given that the two councils have a central role to play in implementation of the WQIP, it is essential for the WQIP's implementation that the WQIP vision and

commitments are woven into these new planning and reporting documents. The Annual Review could provide a focussed, grounded report on progress with the WQIP.

At Great Lakes Council, the proposed approach to implementing these local government management system changes is to implement a computer-based performance tracking system. This system can be used to simplify reporting organisational performance against NRM plans if two distinctive requirements are met:

- the system is implemented in such a way that multiple agencies' operational responsibilities can be tracked (not just a single local council's)
- the system is set up in a way that readily supports having a data base of planned actions that will be implemented only as and when funded – that is, it needs to support an entrepreneurial, opportunistic approach to planning and implementing.

3.9.2.3 Implementation strategy

The implementation strategy for the Adaptive Management program is presented in Table 3.9.3.

Table 3.9.3. Implementation strategy for the adaptive management program.

Recommendation	Actions / Steps and notes	Benefit and importance	Likely cost	Staff effort	Likely timing	Lead and contributors
Adaptive policy development						
Use the decision support system (DSS) to explore the resilience of proposed policies	1. Explore the projected sensitivity of the catchment–lakes system to changes in assumptions about how current policy will play out on the ground (e.g. testing the effects of WSUD device maintenance by using higher pollution export rates). 2. In the process, explore the DSS's capacity to support exploration of resilience: explore its limits as a representation of the catchment–lakes systems. 3. These explorations should be supported by the identification of uncertainties and analyses of options for more, rather than less, resilient policy settings provided in Table 3.9.1.	*Very high* This may reveal significant weaknesses in current policy proposals, catalysing adaptation of the WQIP	*Low*	*Medium to high*	*2008, first quarter 2009*	**GLC** **CCI Advisory Committee** Other stakeholders
WQIP coordination groups to use the identified options for reducing uncertainty to guide WQIP implementation	1. The options for reducing uncertainty identified in Table 3.9.1 are reference points in which a culture of sensitivity to uncertainty – and thence a culture of exploratory management – can be fostered. Further surprises are likely (cf. the hepatitis A outbreak and the Myall Lakes blue-green algal blooms), so support for this kind of approach is important. 2. Table 3.9.1 includes a variety of specific suggestions for reducing uncertainty of relevance to specific WQIP activities. Coordinating groups should ensure these are given due consideration in project planning, as WQIP implementation proceeds.	*High* The uncertainties identified are ones with the potential to substantially affect the success of the WQIP, so it is important that they are addressed during implementation.	-	*Medium*	*Ongoing*	**GLC** **CCI Advisory Committee** Other stakeholders

Recommendation	Actions / Steps and notes	Benefit and importance	Likely cost	Staff effort	Likely timing	Lead and contributors
Revise the decision support system to reflect evolving knowledge	1. Improvements in understanding of the catchment–lakes systems socio-ecological dynamics should result from both the investigations flagged in Table 3.9.1, and the combination of operational performance evaluation and ecological condition monitoring outlined in Table 3.9.2. 2. It is intended that the decision support system be revised (i.e. assumptions, equations, documentation, etc.) as knowledge of socio-ecological dynamics improves.	*Medium to very high* Level of importance depends on what is learned about catchment–lake dynamics that changes the assumptions documented in the DSS.	*None to medium*	*Low to medium*	*Periodically, as results become available*	**GLC** WQIP coordinating groups Other stakeholders
Evaluating organisational performance						
Normal operational checking and correction as WQIP programs are implemented	1. What is envisaged is normal good management. This action is a reminder to stakeholder organisations to be accountable to each other for the quality of their operational management. 2. Issues with the quality of operational management should be raised in the 360° performance reviews recommended.	*Very high* This is an essential foundation for program implementations.	-	*High to very high*	*Ongoing*	**All stakeholders, including:** **GLC** **GTCC** **MCW** **HCRCMA** **DoP** **DECC** **DPI**
Prepare checklists of actions undertaken – and not undertaken – for use in annual and seven yearly reviews	1. A basic accountability to the WQIP and its stakeholders is (at least) annual reporting on what has and has not been done to implement the Plan. 2. Quarterly reviews to support annual public reporting may well be helpful for stakeholders. Reporting could be aligned with local government obligations.	*Very high* An essential element of coordinating WQIP implementation.	-	*Low to medium*	*Ongoing*	**WQIP coordinating groups (GLC, committees)** Other stakeholders

Recommendation	Actions / Steps and notes	Benefit and importance	Likely cost	Staff effort	Likely timing	Lead and contributors
Audit of the effect of changed fee structure on follow-up of problematic On-site Sewage Management Systems	*As per the Pollution Control Systems implementation strategy (Section 3.7).*					
Erosion and sedimentation control audits	*As per the Pollution Control Systems implementation strategy (Section 3.7).*					
Quality of maintenance of WSUD devices on private land, community title land, and public land.	*As per the Pollution Control Systems implementation strategy (Section 3.7).*					
Development assessment management system audit: • advice requested appropriately • conformity of approvals to planning standards • compliance with conditions of consent • performance of the built form.	1. Design the audit process. (This *could* be actioned as a set of separate audits.) 2. Conduct the audit(s). 3. Modify practice to address weaknesses. 4. Conduct follow-up audits to assess performance as necessary.	*High* Land use planning is an extremely influential catchment management process, and current quality assurance is weak for some elements of the process.	-	*Low to medium*	*Annually*	**GLC** **GTCC**
Organisational self-evaluations modelled on the 360^{o} performance reviews used in human resources	1. Each organisation will seek feedback from organisations it is accountable to, organisations that are accountable to it, and organisations with whom it works in partnership regarding how well it contributes to cooperative efforts to manage the catchment–lakes systems sustainably. 2. Results are prepared primarily for each organisation's own use, so they would be shared at their discretion.	*High* Has the potential to significantly improve interagency coordination.	-	*Medium*	*Annually*	**GLC** **GTCC** **MCW** **HCRCMA** **DoP** **DECC** **DPI**
Reporting on program outputs as required by the Hunter-Central Rivers Catchment Action Plan	1. Each program implemented under the WQIP should keep records of outputs. 2. Coordinating groups should combine these periodically to provide overviews of progress with delivery of Plan components.	*Very high* Essential for professional reporting on progress to stakeholders, and specifically to demonstrate alignment with the Catchment Action Plan.	-	*High to very high*	*Ongoing*	**WQIP coordinating groups (GLC, committees)** Other stakeholders

Recommendation	Actions / Steps and notes	Benefit and importance	Likely cost	Staff effort	Likely timing	Lead and contributors
Evaluating ecological outcomes						
Field assessments of drainage line water quality close to Greenfield subdivisions	1. Seek partners for research into Greenfield subdivisions' performance when the target is 'no net increase'. 2. Develop research designs. 3. Undertake the research.	*High* The WQIP for Wallis Lake relies on Greenfield sites achieving 'no net increase' in practice, over the long term. There are significant uncertainties regarding long-term performance (notably regarding the quality of maintenance); field assessments are necessary to assess the level of risk.	*Medium*	*Medium*	*Ongoing*	**GLC** **Developers**
Field assessments of rural practice outcomes	1. These include: • assessments of riparian vegetation condition • assessments of groundcover • soil tests • recording dam overflows. 2. See Appendix 30 for details.	*High* Provides fundamental data for evaluating the ecological effects of the rural program.	-	*Medium to high*	*Ongoing*	**GLC** **GTCC** **DPI** **Farmers / landcare**
Local fish diversity in rivers	1. See Appendix 30 for details.	*High* Provides fundamental data for evaluating the ecological effects of the rural program.	*Medium*	*Medium*	*Every three years*	**GLC** DECC
Short-term event-based lake chlorophyll-a, turbidity, etc. monitoring program	1. See Appendix 30 for details. 2. If research partners can be found, this program could be scaled up to a multi-site management experiment to report more definitively on the urban catchment / estuarine ecology dynamics, supporting better ecosystem management in coastal regions.	*High* Provides readings, in the shorter term, of the catchments' influence on the lakes.	*Medium*	*Medium*	*Ongoing*	**GLC** DECC

Recommendation	Actions / Steps and notes	Benefit and importance	Likely cost	Staff effort	Likely timing	Lead and contributors
Long-term lake chlorophyll-a, turbidity, etc. monitoring program	1. See Appendix 30 for details. 2. If research partners can be found, this program could be scaled up to a multi-site management experiment to report more definitively on the urban catchment / estuarine ecology dynamics, supporting better ecosystem management in coastal regions.	*Very high* The fundamental datasets for tracking effects of urban improvements on Pipers Bay, and identifying surprising declines in lake health.	*Medium*	*Medium*	*Ongoing*	**GLC** **DECC**
Reporting						
Annual WQIP reporting	These reports need to be public reports accompanied by appropriate media releases, and supported by external professional peer review. It needs to tell the story of the community's efforts to manage the catchments and lakes, for the community to digest and respond to.	*Very High* Fundamental accountability under the WQIP. Will enable stakeholders and the community to track progress.	*Low to medium*	*Medium*	*Annually*	**WQIP coordinating groups (GLC, committees)** Other stakeholders
Seven-yearly WQIP report and review	It is intended that these reviews will draw on all the sources of information outlined in Table 3.9.2 and its accompanying notes, and such additional information as is available – particularly the synthesis of research to date documented in the WQIP, and documented in a particularly dynamic way in the decision support system. The decision support system, using updated information, should be able to play a significant role supporting the 7-year review of WQIP implementation and development of the revised WQIP.	*Very high* Fundamental accountability under the WQIP. Will enable a major review of progress, and integration of learnings from seven years experience of more intense catchment management into refocussed catchment–lakes plans.	*Low to medium*	*High to very high*	*2015*	**WQIP coordinating groups (GLC, committees)** **Other stakeholders**

Recommendation	Actions / Steps and notes	Benefit and importance	Likely cost	Staff effort	Likely timing	Lead and contributors
Explore options for improving the integration of NRM plan implementation and reporting on progress	This should specifically include using the new Local Government Planning Framework (Figure 3.9.3) as a catalyst for better integration.	*High* May generate significant time savings, and also improve clarity and consistency of NRM reporting to stakeholders.	-	*Low to high*	*2008–09*	**WQIP coordinating groups (GLC, committees)**

Key:

	Costs		*Staff effort*
Low	up to $5,000	Low	One to two weeks
Medium	up to $20,000	Medium	One month
High	$30,000 plus	High	Two to three months

3.9.2.4 Research agenda

The ‘options for reducing uncertainty’ column in Table 3.9.1 lists a variety of research questions that are of interest from a management perspective. Appendix 7 lists the research questions of particular interest from a modelling perspective, and includes notes of some other issues that have emerged during WQIP discussions. Together these define a research agenda with which to carry forward the WQIP work.

From an adaptive management perspective, it is worth underlining that the range of possible questions far exceeds our research capacities, so it is important to discern which questions are more and less likely to yield answers that have significant impacts on management priorities. From this perspective, modelling difficulties are informative, but not definitive. The key is for managers to be aware of the uncertainties about socio-ecological dynamics, and look for areas where new learning may provide unusually helpful insight.