SINCLAIR KNIGHT MERZ

SKM

GREAT BARRIER REEF REGION STRATEGIC ASSESSMENT

INDEPENDENT REVIEW REPORT

3 February 2014

MILES YEATES
SINCLAIR KNIGHT MERZ
ABN 37 001 024 095
32 Cordelia Street, (PO Box 3848)
South Brisbane QLD 4101 Australia
T +61 7 3026 7100
E: MYeates@globalskm.com

Review team: Miles Yeates, Michael Huber, John Gunn (AIMS), Peter Valentine (JCU) and Susanne Cooper.

www.globalskm.com

TABLE OF CONTENTS:

LIMITATION STATEMENT

The sole purpose of this report and the associated services performed by Sinclair Knight Merz (SKM) is to complete an independent review of the Great Barrier Reef Region Strategic Assessment in accordance with the scope of services set out in the contract between SKM and the Department of the Environment (Client). That scope of services, as described in this independent review report, was developed with the Client.

SKM prepared this report from information sourced from the Client and additional material available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. SKM reviewed a 'draft for public comment' version of the Strategic Assessment reports, dated August 2013. This version may differ significantly from subsequent reports published.

SKM has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and with reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by SKM for use of any part of this report in any other context. This report has been prepared on behalf of, and for the use of, SKM's Client, and is subject to, and issued in accordance with, the provisions of the contract between SKM and the Client. SKM accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

EXECUTIVE SUMMARY

BACKGROUND

The Great Barrier Reef is recognised globally as an iconic natural asset, comprising almost 3,000 reefs, which form one of the largest, most complex and diverse ecosystems on the planet. Management of the reef ecosystem as a multiple-use marine park and World Heritage Area is being increasingly challenged by a range of complex factors, many of which have their origin outside of the marine park's boundaries.

The Australian and Queensland governments are undertaking a Strategic Assessment of the Great Barrier Reef World Heritage Area and adjacent coastal zone, with the Great Barrier Reef Marine Park Authority (GBRMPA) leading the marine components and the Queensland Government leading the relevant coastal zone components. The Strategic Assessment will help identify, plan for and manage the unique values of the Great Barrier Reef, and is being carried out under Part 10 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Sinclair Knight Merz (SKM) was engaged by the Department of the Environment to complete an independent review of the draft Great Barrier Reef Region Strategic Assessment (version released for public comment, dated August 2013), including a comparative analysis of the GBRMPA (marine) and State (coastal zone) Strategic Assessments. This report outlines the findings of the independent review and associated analyses.

METHODS

SKM established a review team comprising staff and specialist external subconsultants to assess the draft Strategic Assessment in accordance with Section 7 of the Terms of Reference. The independent review team comprised three highly experienced and internationally-recognised scientists and several SKM staff. Collectively, the review team had experience and expertise in the areas of marine park management, marine science, impact assessment, strategic program evaluation and environmental assessments under the EPBC Act. The review team undertook their work independently of GBRMPA and the Queensland Government.

The Strategic Assessment documents included in the review comprised a Program Report, Assessment Report and relevant supporting documents. SKM's team undertook an assessment of the Strategic Assessment's:

- Consistency with its Terms of Reference
- Structure and cohesiveness of presentation
- Breadth and depth
- Technical accuracy
- The validity of conclusions drawn

A comparative assessment of the GBRMPA Strategic Assessment (of marine regions and issues) and the Queensland Strategic Assessment (of the coastal zone) was also made, to identify any gaps or duplication in the management and protection of Matters of National Environmental Significance (MNES).

RESULTS

Structure and cohesiveness of the reports

Overall, the Program and Assessment reports are considered to be well written and comprehensive, particularly the literature review and technical aspects. The reports have successfully presented a large body of information in a logical way. Coherence between the descriptions of drivers, impacts and condition could be improved to assist in identifying whether any attributes have been overlooked. Chapter summaries throughout the documents are useful, although their emphasis on positive findings sometimes provides an unbalanced view of the chapters' main findings. Greater emphasis could be placed on timeframes when describing the implementation of new management initiatives. Some

improvements are also recommended in relation to the interchangeable use of the terms 'values', 'attributes' and 'elements' when describing World Heritage and Outstanding Universal Value.

Breadth and depth of assessment

The Strategic Assessment provides a comprehensive review and analysis of information relating to environmental values, impacts and management of the Great Barrier Reef. Overall, the assessment is adequate in its analysis of the diverse range of issues affecting the marine park, including declines in water quality, climate change and outbreaks of the crown-of-thorns starfish. Some improvements recommended to enhance the effectiveness of the assessment are made, with particular reference to community engagement through partnerships and improving management effectiveness. There is a focus on the marine park rather than the larger Great Barrier Reef Region, which narrows the scale of the assessment. Some important aspects of management, including mitigating impacts from marine pests and managing for resilience in response to climate change have been overlooked in the proposed Program. The connectivity of freshwater and marine habitats, port development and the management of islands also receive limited assessment. Circumstances in which the *Great Barrier Reef Marine Park Act 1975* is being applied outside of the marine park boundary could be clarified.

The independent assessment of management effectiveness provides a rigorous appraisal of the strengths and weaknesses of the current Program and its effectiveness in achieving outcomes. Strengths are in planning and processes, with management activities only partially achieving outcomes in key areas. This is reflected by the declining condition of the Great Barrier Reef, which has occurred despite significant management investment. The authors have responded positively to the assessment of management effectiveness through the establishment of target-based initiatives, but have struggled to demonstrate that actions will result in improved outcomes in the reef environment, as measureable outputs are not a feature of the current or proposed Program. Triggers are lacking for the management improvements identified. The reports convey no sense of urgency for new initiatives to halt the coral reef ecosystems' continued decline and the approach of tipping points from which they may not recover. There are insufficient data to assess management effectiveness for many species, but this is not recognised sufficiently in the assessment. In some cases (e.g. cumulative impacts), an upfront statement of the adequacy of existing management is lacking.

Technical accuracy

There is a high degree of scientific rigour across most aspects of the assessment, and the integration of science, management and community consultation has resulted in a sound evaluation. The reports are well-referenced and apply relevant scientific information, where it is available. However, some chapters draw heavily on expert opinion and do not present sufficient evidence to convince the reader that the findings and conclusions are based on the best available science. Several corrections to information presented in the reports are recommended, to address potentially misleading statements or to recommend that further supporting evidence is provided (Appendix A).

There is a general absence of management responses being triggered by the results of scientific monitoring, and stronger links between monitoring and management are recommended. The reports generally find that well-studied attributes of the reef ecosystem are in decline, but that poorly studied attributes are in good condition. While scientific investigations into reef ecosystem attributes may be prioritised towards those in poor condition, it is not clear that this is the case. Nor is it clear that giving equal weighting to conclusions about reef ecosystem condition, based either on detailed research or expert opinion, as the reports do, is appropriate.

In some cases, uncertainty in the information available on key biological processes which are reported to contribute significantly to the decline in condition of the Great Barrier Reef could have been more extensively characterised.

Validity of conclusions

The Strategic Assessment is considered to make valid conclusions about the declining status of the Great Barrier Reef, the identification of management gaps and the requirement for substantial new action. However, forward commitments are a series of incremental improvements and processes, based on descriptions such as collaborate, strengthen, engage, facilitate, encourage and promote; rather than specific and achievable actions with demonstrable impact on reef ecosystem condition. Urgent and substantially strengthened measures will be needed to address the declining condition of the Great Barrier Reef, but are generally lacking. No future management scenarios and their associated effectiveness in addressing the assessed declining condition are presented. Current management resources are only briefly described in the assessment and, based on the evidence presented, have been insufficient to reverse the declining condition of key attributes.

Some conclusions on the effectiveness of management actions appear to be overly optimistic and not supported by the evidence. The need to consider a shift from a management approach based on functional ecology to one based on restoration ecology in the southern Great Barrier Reef appears not to be fully appreciated. Further strengthening of forward commitments is recommended to address these identified shortcomings.

Comparative assessment of State and GBRMPA programs

The combined State and GBRMPA Strategic Assessments are comprehensive assessments of the Great Barrier Reef and its associated coastal landscapes and catchment. While the jurisdictional complexities of the joint management arrangements complicate the message, overall the assessments collectively identify their respective strengths and weaknesses and adequately and consistently characterise the challenges for future management. The State and GBRMPA applied different methods to assess management effectiveness within their respective geographic areas, and cross-referencing between the documents could be improved. Such inconsistencies detract from the perception of collaboration in the preparation of the Strategic Assessment between the Queensland Government and GBRMPA.

Strengths of the combined Programs include the management of tourism, field management activities (including compliance) and the joint assessment of activities requiring permits. Risks to the ongoing conservation of MNES that appear to be ineffectively managed by both the State and GBRMPA Programs include climate change, water quality and some fishing activities. Encouragingly, there appears to be strong alignment in addressing other gaps, such as the explicit consideration of MNES within legislation or policy, and improvements in the assessment of cumulative impacts and offsets.

Conclusions and recommendations

Overall the Strategic Assessment is a comprehensive presentation of the status of the Great Barrier Reef and the effectiveness of a range of management practices. It addresses the majority of the requirements of the Terms of Reference, and with further detail in some key areas, will be completely consistent with the Terms of Reference. The high quality presentation, combined with a strong technical focus are major strengths. However, forward commitments are process-focussed, do not address identified gaps and are of insufficient magnitude or urgency to respond in the manner that is clearly identified in the assessment. It is recommended that the scale of direct management action needs to be increased and targeted towards the critical issues contributing to the declining condition of the Great Barrier Reef. Resources required to implement the five principal activities of the new Program should be discussed, including the establishment of an integrated monitoring program. It is recommended that actions that will reduce cumulative impacts at key sites be prioritised and funded to improve ecosystem resilience. Opportunities have been identified to improve alignment of the GBRMPA program with that of the Queensland Government, to facilitate a seamless approach to management of the Great Barrier Reef.

1. INTRODUCTION

1.1 BACKGROUND

The Great Barrier Reef is recognised internationally as an iconic natural asset, comprising almost 3,000 reefs which form one of the largest, most complex and diverse ecosystems on the planet. More than 900 islands are located throughout the Great Barrier Reef, covering a distance of 2,300 kilometres across shallow estuarine areas to deep oceanic waters.

Management of the reef ecosystem as a multiple-use marine park and World Heritage Area is being increasingly challenged by several threats, many of which have their origin outside of the marine park's boundaries. These include climate change, ocean acidification, sediment, nutrients and pesticides entrained with catchment runoff, disease and pest outbreaks, ports and shipping, recreation and tourism, fishing and coastal development. While the Great Barrier Reef remains one of the healthiest coral reef ecosystems on the planet, its condition and resilience have declined in recent decades as a result of such pressures (GBRMPA 2009).

The Australian and Queensland governments are undertaking a Strategic Assessment of the Great Barrier Reef World Heritage Area and adjacent coastal zone, with the Great Barrier Reef Marine Park Authority (GBRMPA) leading the marine components and the Queensland Government leading the relevant coastal zone components. The Strategic Assessment will help identify, plan for and manage the unique values of the Great Barrier Reef, and is being carried out under Part 10 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). GBRMPA and the Queensland Government have together produced draft reports for public comment covering the marine and terrestrial areas of the Great Barrier Reef Region and Coastal Zone.

There is a high degree of public interest in the management of the Great Barrier Reef, both within Australia and internationally. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Committee, in its final reactive monitoring mission report in June 2012, called for a halt to new port developments outside of the existing and long-established major port areas within and adjoining the Great Barrier Reef World Heritage property until the completion of the Strategic Assessment (UNESCO 2012). The mission report also made several references to the Strategic Assessment as making an important contribution to the long term conservation of the Great Barrier Reef.

GBRMPA has recently developed the Great Barrier Reef Region Strategic Assessment to a draft stage and released it for public comment. The Strategic Assessment includes a Program Report (GBRMPA 2013a), which describes GBRMPA's legislative, planning, policy and development assessment framework, and a Strategic Assessment Report (GBRMPA 2013b), which contains an assessment of the Program's effectiveness in managing and protecting the Matters of National Environmental Significance (MNES) of the Great Barrier Reef Region. Several supplementary studies have also been completed to inform the Strategic Assessment and are available on the GBRMPA website. These were given some consideration by the review team, along with other relevant information about the reef's existing management arrangements.

The purpose and scope of the Great Barrier Reef Region Strategic Assessment is described in Sub-Chapter 1.2 of the Assessment Report and in Chapter 1 of the Program Report. The Strategic Assessment is being completed to evaluate and improve GBRMPA's management of existing and emerging risks to the Great Barrier Reef, focussing on the relevant MNES. Some aspects of the Commonwealth's management of the Great Barrier Reef are outside of GBRMPA's jurisdiction and are not the focus of this assessment, as outlined in the Terms of Reference. The Strategic Assessment also forms part of the Australian Government's response to the World Heritage Committee's concerns regarding development impacts on the World Heritage Area.

1.2 SCOPE OF WORK

Sinclair Knight Merz (SKM) was engaged by the Department of the Environment to complete:

- A peer review of the draft Great Barrier Reef Region Program Report and Strategic Assessment Report prepared by GBRMPA, as established in the endorsed Terms of Reference for the Great Barrier Reef Region Strategic Assessment
- A comparative analysis of the draft Great Barrier Reef Region Program and the draft Great Barrier Reef Coastal Zone Program (prepared by the Queensland Government) and associated strategic assessment documentation to ascertain gaps in management to protect matters of national environmental significance, including the outstanding universal value of the Great Barrier Reef World Heritage property

This report outlines the findings of the independent review.

Terms of Reference (GBRMPA 2012) for the Strategic Assessment were finalised in 2012, following a public consultation process. Section 7 of the Terms of Reference describes the Strategic Assessment process, and requires the draft Strategic Assessment Report to be peer reviewed by at least three appropriately qualified persons. The independent review is an important step in determining whether the Strategic Assessment is consistent with its Terms of Reference and has assessed and described the existing and future risks to the Great Barrier Reef and how they will be managed.

The review team considered electronic versions of the Draft Program Report (GBRMPA 2013a), Draft Strategic Assessment Report (GBRMPA 2013b) and associated Draft Appendices and supplementary reports available for public comment on the GBRMPA website. These reports and other relevant documentation were provided to SKM by the Department on 12 December 2013. The Queensland Government's Strategic Assessment of the Great Barrier Reef Coastal Zone was also considered, including published drafts for public comment of the Program Report (Queensland Government 2013a), Assessment Report (Queensland Government, 2013b) and an independent review of an earlier draft (SKM 2013).

This report utilises a variety of management terms when describing the Great Barrier Reef, including World Heritage Area, marine park and region. Environmental values of the Great Barrier Reef are also referred to in the context of MNES and Outstanding Universal Value (OUV). The application of these terms to the Strategic Assessment is explained in Chapter 1 of the Assessment Report, with examples of the differences in the meaning of these terms provided in Section 1.2.

1.3 METHODS

SKM established a review team comprising its own staff and specialist external subconsultants to review the draft Strategic Assessment in accordance with the endorsed Terms of Reference (GBRMPA 2012), which require GBRMPA to:

1. "Engage independent expertise to undertake an assessment of the effectiveness of the current Program to protect and manage the relevant MNES, including the Outstanding Universal Value (OUV) of the Great Barrier Reef World Heritage Area
2. Arrange for the content of the draft Strategic Assessment Report to be peer reviewed by at least three appropriately qualified persons
3. Provide the Minister with the independent assessment of management effectiveness, the peer review comments and a report identifying how the findings of the independent assessment and peer review have been considered in the Strategic Assessment Report and the Program Report."

Chapter 8 of the Assessment Report provides a summary of the key findings of the independent assessment of management effectiveness (UniQuest 2013), which addresses the first peer review requirement of the Terms of Reference. The second peer review requirement is addressed by this independent review by SKM. The report on this review will form part of the information to be submitted to the Minister by the Department to address the third peer review requirement of the Terms of Reference.

SKM's core review team comprised independent specialists, whose qualifications and experience are consistent with the requirements of the Terms of Reference:

- Dr Michael Huber, Senior Executive Marine Scientist, Sinclair Knight Merz. Michael is SKM's Global Practice Leader in marine science and has over 35 years' experience in consulting and research. As Member Emeritus and past Chairman of GESAMP (Group of Experts on the Scientific Aspects of Marine Environmental Protection), Mike advises the United Nations on marine environmental issues. Mike has worked with several international organisations during his career and is co-author of the best-selling university text book 'Marine Biology' (9th Edition).
- John Gunn, Chief Executive Officer, Australian Institute of Marine Science (AIMS). John has significant experience in leading development of strategy, scientific research and capability, and stakeholder engagement across a research portfolio encompassing marine ecology, fisheries, coastal systems, physical and chemical oceanography, atmospheric chemistry and climate science. Prior to joining AIMS, John had a 29-year career with CSIRO, and has authored over 150 peer-reviewed publications, book chapters, papers to international commissions and technical reports.
- Associate Professor Peter Valentine, James Cook University (JCU). Peter is former Head of the School of Earth and Environmental Sciences at JCU, where he teaches in protected area management and natural resource management. His research interests are focussed on protected area management and related conservation science issues. Peter has worked extensively on World Heritage matters and has provided advice to governments and agencies in many countries around the world. He has a detailed knowledge of World Heritage matters of the Wet Tropics and Great Barrier Reef, and is a member of the IUCN's World Commission on Protected Areas.

The core review team were supported by several additional SKM staff, including: Miles Yeates (Project Manager and Senior Marine Scientist), Susanne Cooper (Executive Consultant), Craig Clifton (Technical Reviewer) and Gavin Elphinstone (Project Director).

The method adopted for the review was agreed with the Department prior to the project commencing, and is summarised as follows:

- A project inception meeting was held to confirm project objectives, methods, communication channels and timeframes

- A briefing was given by the Department at the start of the project. It provided the SKM-led team with background on the Strategic Assessment and the approach that had been taken to developing the documents.
- The draft Program Report, Assessment Report and Appendices were reviewed, with an assessment made of their:
  1. Consistency with the Terms of Reference
  2. Structure and cohesiveness of presentation – the review team considered whether the information was appropriately structured, presented in a clear, concise and well-written manner, and whether the goals and objectives of the assessment were feasible, well-defined and targeted towards the material issues
  3. Breadth and depth – the review team considered whether the coverage of the assessment was adequate, and whether issues had been addressed in sufficient depth, or been overlooked
  4. Technical accuracy – the review team considered whether uncertainty had been adequately characterised and whether any conflict in the available information had been recorded and assessed
  5. Conclusions – to determine whether they were evidence-based, valid and comprehensive. The change process assumed in the Strategic Assessment was tested for feasibility, and the presentation of the implications of the Strategic Assessment was reviewed.
- A comparative assessment of the State and GBRMPA Strategic Assessments was undertaken to determine the extent to which the proposed Programs align and complement each other to provide an integrated and comprehensive management approach for protecting MNES, particularly MNES associated with the Great Barrier Reef World Heritage Area
- Conclusions from the review were drawn, and areas requiring further work were identified. Recommendations on improving the Strategic Assessment have been made and are presented in this report.

The review team worked independently of GBRMPA and did not directly interact with it during the review process. In addition to reviewing the Strategic Assessment documents, the review team referred to other relevant reports and literature available in the public domain. Weekly progress reports were provided to the Department of the Environment during the review process. SKM has not provided feedback on any editorial or formatting issues in the documents.

1.4 STRUCTURE OF THIS REPORT

The main body of this report presents the findings of the independent review, by evaluating:

- The consistency of the Strategic Assessment with the Terms of Reference (Section 2)
- Its structure and cohesiveness (Section 3)
- Its breadth and depth (Section 4)
- The accuracy of technical aspects (Section 5)
- The validity of conclusions (Section 6)
- Its consistency with the Queensland Government Strategic Assessment of the Coastal Zone, and the combined effectiveness of both assessments in protecting MNES (Section 7)

Conclusions and recommendations are described in Section 8. A detailed list of comments and recommended actions to improve the Strategic Assessment documents is provided in Appendix A. These recommendations are intended to assist GBRMPA and the Department of the Environment in revising the Strategic Assessment.

2. CONSISTENCY WITH THE TERMS OF REFERENCE

2.1 OVERVIEW OF THE TERMS OF REFERENCE

The Terms of Reference for the Strategic Assessment (GBRMPA 2012) provide a description of the geographic area to be considered in the assessment, which is the Great Barrier Reef Region and adjacent areas whose condition and management may affect the Region. Background information and context for the Strategic Assessment is also provided, and matters to be addressed in the Program description and assessment are prescribed.

A description of the scope of the Strategic Assessment is provided in Sub-Chapter 1.2 of the Assessment Report. Text boxes appear at the commencement of each chapter in the Assessment Report, outlining the relevant sections of the Terms of Reference that are addressed in that chapter.

Terms of Reference for the Strategic Assessment have been addressed in significant detail throughout the Program and Assessment reports. Some aspects of the assessment process, such as public consultation, have exceeded the requirements of the Terms of Reference, which has improved the breadth of the issues considered. Some, mostly minor, specific requirements of the Terms of Reference have not been addressed in sufficient detail, including the description of management resources and clear assessment of compliance with endorsement criteria.

2.2 PURPOSE AND DESCRIPTION OF THE PROGRAM

The Program Report provides a description of the current Program, and future management measures in the form of strengthened management and forward commitments for the 25 year duration of the Program. While the purpose of the Program Report is briefly defined in the introduction, the purpose of the Program, including Program objectives, are not clearly outlined. The Program Report could achieve greater consistency with the Terms of Reference by having a new section which describes the purpose and clear objectives of the Program.

Legislation, plans, policies and other Program components are comprehensively described and provide a clear overview of GBRMPA's activities in the management of the Great Barrier Reef. The Program description could be expanded to include details of the Authority's work internationally in sharing knowledge on marine protected area management and in advocating for the management of global threats to coral reefs. Aspects of the Program prescribed by the Terms of Reference, such as adaptive management and implementation arrangements, are logically described. A description of the principles for managing environmental impacts within the Great Barrier Reef Region assist in understanding the Program's application across such a large and diverse geographic area.

2.3 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

The Program and Assessment reports provide a thorough and systematic description and assessment of MNES. Key attributes, connectivity

and ecosystem processes fundamental to the relevant MNES are identified, assessed and discussed. The MNES assessment largely focuses on the Marine Park, presumably based on the assumption that values relevant to other MNES are implicitly encapsulated within the marine park (see page 12 5 of the Assessment Report). Where gaps exist in the identification of MNES, there are recommendations on how they might be addressed. The condition and trend of MNES (including OUV) are benchmarked, with information gaps identified and partly filled through additional studies commissioned during early stages of the Strategic Assessment process.

2.4 ASSESSMENT OF IMPACTS ON MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Impacts on MNES are comprehensively described at a variety of spatial scales, including local, regional and at a whole-of-Great Barrier Reef scale. The consideration of impacts is broad, and considers past, present and future activities, direct, indirect and cumulative impacts, and the impacts of climate change, both present and future. Key information gaps are identified and processes are proposed to address critical information needs.

2.5 MEASURES TO ADDRESS IMPACTS

There is extensive description and discussion in the Program and Assessment reports on current and proposed measures to address impacts on MNES, including OUV. Some climate change scenarios are described, although there is limited discussion on how the Great Barrier Reef can be managed for resilience in the face of potential changes. Methods are applied to identify direct, indirect and cumulative impacts, with environmental, social, cultural (both indigenous and historic) and economic issues also considered. Existing and future opportunities to work with other management agencies at a variety of scales are also outlined.

An independent assessment of management effectiveness is summarised in Chapter 8 of the Assessment Report. Demonstration cases illustrating how the Program is applied are briefly summarised for a range of relevant management issues, including planning, operations, threatened species, habitats and water quality. Detailed demonstration case reports are referenced in the reports to the GBRMPA website, but were not published at the time of this independent review.

The assessment does not emphasise any requirement for additional resources to help fill major gaps identified within the current Program. A major shift towards target-based and adaptive management over the next few years is likely to require new capability within GBRMPA, a well-designed and appropriately-resourced Integrated Monitoring Program, and ongoing commitment to a strategic research and development program. All of these activities are critical elements of the Future Program, yet the resources required to achieve this change have not been identified. Indeed the assessment appears to seek to accommodate the future Program within its existing management resources.

2.6 PROJECTED CONDITION OF MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Chapter 11 of the Assessment Report describes the projected condition of MNES, based on an evaluation of their current status, trends, actual impacts and potential future impacts. This evaluation is guided in part by the independent assessment of management effectiveness, and the current understanding of ecosystem resilience. A risk assessment is applied to the information available to assess the future risks to MNES including OUV of the World Heritage Area.

2.7 PROPOSED PROGRAM

The Program and Assessment reports outline details of recommended changes to the Program to improve its effectiveness in protecting MNES and the Great Barrier Reef generally. Forward commitments and new initiatives are focussed on processes rather than outcomes, and do not comprehensively address the gaps identified, based on the current and projected condition of MNES. Recommended improvements to related local, state and national government programs are given limited attention, despite the acknowledgement that many of the management challenges lie outside of GBRMPA's jurisdiction.

A key element of the proposed Program is the overarching management framework that underpins the holistic, integrated approach to managing the reef and extends beyond the Region's boundaries to include land-based and freshwater activities and impacts. The report states this framework will 'guide all parties working together to protect MNES in the Region' (Page 18 of Program Report) and therefore the health and resilience of the reef. Some further clarification of the purpose, scope, stakeholder involvement and authority of the management framework would be valuable.

The need for collaboration particularly with land-based stakeholders is seen as critical to effectively managing the reef, given the Authority's limited ability to influence decisions about land-based development and activities. The agricultural sector is a key industry in this regard, yet the report has few suggestions about managing the impacts from these activities beyond strengthening collaboration and partnerships. Given the central role of the agricultural sector in the Great Barrier Reef catchment, it is recommended that more specific discussion of improved management arrangements is described to provide greater consistency with the Terms of Reference.

2.8 STRATEGIC ASSESSMENT PROCESS

There is evidence of collaboration by GBRMPA with the Queensland Government in conducting the Strategic Assessment, as required by the Terms of Reference. A diverse and relevant group of demonstration cases has been selected to illustrate the application of State and GBRMPA Programs, and references to joint management arrangements and the associated intergovernmental agreement are accurate. The jurisdictional boundary between the Great Barrier Reef Region and Great Barrier Reef Coastal Zone is prominent when reviewing both Strategic Assessments, and further refinements could be made to both assessments to provide a 'whole of ecosystem' presentation of information. The differing methods applied to the assessment of management effectiveness within each Strategic Assessment make it difficult to gain a perspective of the combined management effectiveness across the entire Great Barrier Reef. This indicates a lack of coordination between the Queensland Government and GBRMPA during development of the assessment method.

Public engagement during the Strategic Assessment process is well described and extensive, exceeding the requirements of the Terms of Reference. Stakeholder workshops were held at major centres along the Great Barrier Reef at various stages of the assessment process. These were supplemented by targeted consultations with key groups. Engagement with Traditional Owners is a strength of the assessment process, which is reflected throughout the

Program description and Assessment Report. Descriptions of the important links between Traditional Owners and their land and sea country are widespread through the document and give due recognition to the contribution made by Traditional Owners to management of the reef ecosystem, past and present.

Independent review requirements of the Terms of Reference have been met or are in progress. The independent assessment of management effectiveness and its associated summary chapter are a strength of the Assessment Report and assist in identifying gaps in current management activities and where elements of the Program need to be strengthened.

2.9 ENDORSEMENT CRITERIA

There is limited discussion of how the Strategic Assessment as a whole has met the endorsement criteria outlined in Section 8 of the Terms of Reference. The only exception is that the independent assessment of management effectiveness summary (Chapter 8) concludes that inputs, process and outcomes were the elements of the management cycle where current management arrangements were least likely to meet the endorsement criteria. A table summarising how each endorsement criterion has been met would provide clarity to the assessment process and more clearly demonstrate consistency with the Terms of Reference.

2.10 FURTHER WORK

The draft reports reviewed by SKM meet the majority of the requirements of the Terms of Reference. In order to be completely consistent with the Terms of Reference, some further work on the following issues is recommended:

- Provide additional information on GBRMPA's work internationally as part of the Program description, including working in an advisory capacity and raising awareness of the impacts of climate change on coral reef ecosystems
- Improve the availability of detailed demonstration case reports by publishing them with other Strategic Assessment documentation
- The additional management resources required to implement the five principal activities set out in the proposed Program should be outlined
- Additional description of the management framework, including its structure, stakeholders, scope and implementation arrangements
- More information on improved and effective approaches for collaboration and partnerships with the agricultural sector and other stakeholders of the Great Barrier Reef catchment
- Explain why the method applied to the assessment of management effectiveness differed significantly from that of the Queensland Government's assessment of the Great Barrier Reef Coastal Zone, and the implications of these differences in presenting a 'whole of ecosystem' picture. Consider opportunities for greater alignment of the State and GBRMPA Strategic Assessments prior to their finalisation
- Focus the forward commitments on outcomes in addition to processes, with a view to filling the gaps identified in the Assessment Report. Expand the recommendations to include other local, state and national programs
- Present a clear summary of how the Strategic Assessment has met the endorsement criteria

3. STRUCTURE OF REPORTS AND COHESIVENESS OF PRESENTATION

3.1 INTRODUCTION

This section examines whether the content of the Strategic Assessment reports is appropriately structured, and whether information is presented in a clear, concise and well written manner. The cohesiveness, or degree to which sections of the Strategic Assessment fit together logically is also described. Consideration is given to whether the objectives of the assessment were feasible, well-defined and targeted towards the material issues affecting the Great Barrier Reef. Some recommendations for improvement of the documents have been made. These will enhance the reports' readability for a wide audience.

The Strategic Assessment successfully compiles a large amount of complex information, and is professionally presented and annotated to assist in exploring chapters of interest or the entire document. The integration of science throughout the documents is seamless and adds significant credibility and confidence to the key findings. While jurisdictionally complex, management arrangements are well-described and provide a sound basis for the interpretation of forward commitments and assessment of their effectiveness. Improvements are suggested to further the tangibility of management responses and enhance readability for a wide, international audience.

3.2 PRESENTATION AND COHESIVENESS

The Strategic Assessment overall is well written and comprehensive, particularly aspects relating to the review of literature and the presentation of science. The Program and Assessment Reports are informative, concise and make excellent use of tables and figures to present and summarise key information. This approach has provided an effective presentation of a very large amount of information. Chapters 4 to 7 of the Assessment Report can be difficult to assimilate as a package, due to the large quantity of information presented.

The literature review and technical aspects of the assessment are particularly strong, and provide the reader with confidence that the information presented is current, relevant and objective. The introductory chapters of both reports provide a sound foundation for the consideration of more detailed information in the following chapters. Statements within the reports are well referenced, and a summary of outcomes is provided at the conclusion of most chapters, which helps to consolidate key findings before readers move on to subsequent text. However, the structure of chapter summaries is essentially a catalogue of findings rather than an articulated interpretation of what the information means in relation to the status of the World Heritage Area. Further analysis of the effectiveness of management and the prospects for the future under various management and climate scenarios would be a valuable addition to the most relevant of these summaries. These could include an analysis of the likely benefits of future management scenarios, including business as usual, modest additional effort or major "transformational" changes together with effective global action on climate change. There has clearly been extensive consultation during the Strategic Assessment process, which has resulted in a balanced appreciation and presentation of a variety of complex issues.

While almost all of the information about the declining condition of the Great Barrier Reef is presented in the assessment, the chapter summaries don't always present such findings explicitly. The statement on page 7-13 of the Assessment Report that "at the scale of the Great Barrier Reef Region, most of its habitats and species are assessed to be in good to very good condition" may be technically correct, but if most of its key habitats and species (corals, seagrasses, seabirds, dolphins, dugong, turtles) are in 'very poor' to 'poor' condition and are declining in the southern Great Barrier Reef, then the statement could be viewed as misleading about the true status of the reef ecosystem. This approach of presenting a positive perspective in the chapter summaries is not nearly as evident in the 'Strategic Assessment In Brief' summary which provides a more balanced appraisal.

There is some lack of coherence between the structure and categorisation of drivers, impacts and condition that makes it difficult to determine if all of the key drivers and impacts have been adequately considered in the condition and trends chapter (Chapter 7). The approach to the identification of information gaps is sound, but in its current form, presents as an un-prioritised catalogue of gaps. Further analysis to determine the cost and benefits of filling each gap through management actions would improve the effectiveness of the assessment and assist the reader in reaching conclusions about the adequacy of the proposed management responses.

Throughout the chapters covering analyses of current and future condition and risk, the rates of decline in key biodiversity assets (coral reefs, seagrasses, endangered or vulnerable species) appear to be underemphasised. This seems in part due to the approach taken which gives equal weighting to every component of the ecosystem – plankton and herbivorous fish are given equal weighting with coral reefs and seagrass habitats. The apparent underemphasis (of key biodiversity assets) is not mirrored in the Summary Chapter, nor the introduction to the Program Report. It would be useful for analysis within these chapters to discuss how GBRMPA views the relative criticality of the various values and attributes they have sought to evaluate.

At times there is an element of assumed information which, if stated, would add value to the reports, particularly for audiences unfamiliar with the Great Barrier Reef. For example, page 32 of the Program Report states that the Reef Recovery Program will be rolled out with priority given to Keppel Bay, Mackay, Townsville, Princess Charlotte and Bathurst bays, without any reference to the reason for prioritising these locations. Demonstration case reports were not available on the website at the time of the independent review, despite being well into the period for public comment on the draft assessment documents. In the absence of the demonstration case reports, some further detail within the very concise summaries would have been valuable.

The structure and logic of responses to the issues raised in the Strategic Assessment (as outlined in Chapter 5 of the Program Report) are appropriate. Five new initiatives are proposed to enhance protection and reduce impacts on relevant MNES. The outcomes and target-based management framework described is a sound approach to improving the effectiveness of management actions. However, the proposed targets as described are too vague, and essentially call for an unspecified level of improvement. In order to be effective, the process of setting targets will require scientific input and the development of conceptual and quantitative models. The cumulative impact policy and net benefit policy are important components of the response to

the issues identified in the assessment, and will require a significant investment to be effective. Description of the Reef Recovery Program would benefit from more information on its intended scale and how this will be matched with the scale at which impacts occur. The integrated monitoring program is also an important component of the response, and if designed appropriately and fully implemented, could assess the effectiveness of the other four initiatives. However, the proposed five year time-frame for the development of the integrated monitoring program is too long to address the identified information gaps with the degree of urgency that is necessary.

3.3 GOALS AND OBJECTIVES

The purpose and aims of the Strategic Assessment are briefly summarised in Chapter 1 of the Program Report. A more comprehensive introduction is provided in Chapter 1 of the Assessment Report, including a section entitled "Why Undertake a Strategic Assessment?" These sections provide a good overview of the Strategic Assessment process and relevant background information, such as the findings of the World Heritage Committee's monitoring mission to the Great Barrier Reef in March 2012. The purpose of the Strategic Assessment is "to evaluate and improve [GBRMPA's] effectiveness in managing existing and emerging risks to the Great Barrier Reef, focussing on the relevant MNES." The Strategic Assessment is described as being part of the Australian Government's adaptive approach to managing the Great Barrier Reef. Further details of the assessment approach are outlined in Chapter 2 of the Assessment Report. This includes a description of the legislative basis for the assessment, steps in the process and an overview of assessment methods.

While these introductory sections are helpful, specific objectives for the Strategic Assessment (as opposed to the Program) are not clearly defined. Some sections, for example '2.4 Principles', outline key drivers that have underpinned development of the Strategic Assessment, but these differ from objectives of the assessment process. The principles provide relevant context on the assessment process and method, but provide no basis to assess whether the objectives of the Strategic Assessment have been achieved. A more explicit list of objectives for the Strategic Assessment in Chapter 1 or 2 of the Assessment Report would provide greater clarity for the reader on what the Strategic Assessment is intended to achieve and assist in evaluating and/or demonstrating its effectiveness in the concluding chapters. Linking such discussion with an evaluation of whether the endorsement criteria have been met (see Section 8 of the Terms of Reference), is also recommended.

3.4 DESCRIPTION OF MANAGEMENT ARRANGEMENTS

The Program and Assessment Reports provide an informative summary of the history of management of the Great Barrier Reef, the role of GBRMPA and the purpose and application of the Great Barrier Reef Marine Park Act 1975 (GBRMP Act). Intergovernmental management arrangements in place with Queensland are clearly outlined, including variations to these arrangements during the history of joint management. The model applied to management of the Great Barrier Reef has been described as the 'gold standard' for large scale marine protected area management (UNESCO 2012), and this is reflected in the description of current management arrangements. The description of management tools such as the application of zoning plans, plans of management and

permits is clear and concise. Demonstration cases summaries are brief and limit the reader's appreciation of selected management examples,

in the absence of the detailed supporting reports (which were not published at the time of this review). The East Coast Trawl Fishery Demonstration Case would appear to be more appropriately aligned with the Queensland Program, since the Queensland Government is primarily responsible for fisheries management on the Great Barrier Reef.

There is a tendency to break up the Great Barrier Reef into jurisdictional components during discussion, adding a degree of complexity that sometimes distracts from the overall message. On several occasions there is specific reference to the Marine Park boundary when discussing management issues, even though that is not the primary focus of the Strategic Assessment. On page 5-26 of the Assessment Report reference is made to the number of ports within the Great Barrier Reef Marine Park, Region and World Heritage Area. There is limited subsequent discussion of impacts from ports, and as only two ports are located within the marine park, the implication is a lessening of concern for the impacts of port activities on the Great Barrier Reef. The Report should focus its assessment on all MNES of the Great Barrier Reef, and the World Heritage Area (and region) provide a larger geographic area than the marine park. Some important aspects of management (such as the regulation of port development) are given limited attention without explanation, possibly as they are more relevant to the Queensland Government's Coastal Zone assessment. If so, further explanatory text to assist the reader in understanding such interrelationships is suggested.

When discussing world heritage values and OUV, the terms 'values', 'elements' and 'attributes' are referred to interchangeably, resulting in some confusion at times. Assessment of the impacts on the OUV of the World Heritage Area and effects on its integrity are very difficult for a large and complex property such as the Great Barrier Reef. The situation described in the Assessment is one of continuing significant loss of attribute conservation over a substantial part of the World Heritage Area (the southern area in particular). These losses generally result from cumulative impacts of multiple pressures at many locations. Because of the long period of decline for at least some measured variables, it does seem probable that further degradation of OUV will occur.

Emphasising the region-wide scale of the Strategic Assessment allows good conditions in some places (or with some attributes) to offset the poor condition of other places or attributes (at a coarse level, the northern section compensates for the southern section) when considered as a whole. A focus on the large scale also overlooks the local significance of reef deterioration site by site. It is recommended that such considerations be further expanded in Chapter 6 of the assessment report and linked with the description of existing management effectiveness.

4. BREADTH AND DEPTH OF ASSESSMENT

4.1 INTRODUCTION

This section evaluates the breadth and depth of the Strategic Assessment, focussing on the coverage of key issues affecting the Great Barrier Reef Region and the level of detail applied to the assessment. The comprehensiveness of the assessment is discussed and any areas that have been overlooked or require more detailed assessment have been identified.

A successful balance has generally been achieved between the depth of the assessment of a variety of issues and the need to provide a concise report which can be understood by a variety of stakeholders. The breadth and depth of analysis is adequate, and with some improvements to direct the focus of future management actions, will be a highly successful element of the Strategic Assessment as a whole. Expanding GBRMPA's role in partnerships and collaboration may assist in improving the achievement of management outcomes in areas such as water quality.

Some elements of the assessment are given limited attention without explanation, including the management of port activities, island management and managing for resilience in the face of climate change. The commitment to developing outcome-based targets in response to the identification of shortcomings in the effectiveness of current management activities is one highlight of the assessment process. There is no comprehensive discussion about resourcing the Program, which undermines confidence in its ability to halt the decline of MNES.

4.2 OVERVIEW

Potential impediments to the assessment associated with the large geographic extent of the study area and diversity of issues requiring consideration have been overcome successfully. The Program and Assessment Reports are broad and detailed, and have been effective in articulating a balanced coverage of the material issues for the Great Barrier Reef. Management activities and impacts are considered at a variety of scales, although the broader picture has continuous emphasis. The legislative basis of GBRMPA's management actions are well described, including joint management arrangements with the Queensland Government.

Application of the GBRMP Act outside of the marine park boundary could be further clarified. Section 3.3 of the Assessment Report describes powers for GBRMPA to address activities outside the marine park, where these influence the marine park. Given the continuing reference throughout the assessment to the significance of threats external to the marine park, it is unclear whether these powers are regularly applied, and why for example, their application in the Great Barrier Reef catchment is not discussed. Further additional information would add depth to the analysis of legislative instruments under the Program and clarify the extent of GBRMPA's management jurisdiction.

4.3 ENVIRONMENTAL ASSESSMENTS

Chapter 7 of the Assessment Report considers the current condition and trend of the Great Barrier Reef. There has been a strong reliance on stakeholder workshops and expert opinion to

guide some aspects of the assessment. While the engagement of stakeholders and scientific specialists is a strength of the Assessment, it has also meant that in some areas it has been given the same weighting as peer-reviewed science when presented to substantiate particular claims.

The assessments of current condition and trend in Chapter 7 do not provide a description of how the various confidence levels were assigned. While this was most likely based on subjective judgment rather than any empirical or modelled analysis, there is no indication of how subject matter experts, reef scientists, reef users and/or GBRMPA managers contributed to the final assessment. As there is potential for bias in the application of these methods, some further clarification of the approach taken is warranted.

Chapter 4 of the Assessment Report provides a comprehensive description of environmental values. The trend and condition assessments are based on indicators of MNES, with "biodiversity, including habitats and species" forming the only entry point into the key issue of whether the Great Barrier Reef World Heritage Area ecosystem is functioning effectively so as to maintain species, habitats, social and economic values (see Page 4-9). It is recommended that consideration be given to assigning greater weight to certain attributes (e.g. keystone species, critical habitats, energy and nutrient fluxes), which would provide a more accurate description of ecosystem integrity. Such an approach, rather than the perceived equal weighting of all attributes, would improve the accuracy of the assessment.

4.4 MANAGEMENT

There is little information presented on how GBRMPA is managing for resilience in the face of climate change (see Page 5-9 of the Assessment Report). For example, managing for improved resilience is not mentioned on Page 9-21 of the Assessment Report where potential improvements to adaptive management approaches are outlined. Such a role would seem particularly relevant to the field management program, which implements much of the operational activities of the Great Barrier Reef's management, both in the marine park and on islands. While improved compliance (implemented in part by the field management program) is foreshadowed, there is no reference to how improved compliance will be achieved above and beyond the activities of past practice. It is unlikely that improved outcomes will occur in the absence of additional resources, but there is no comprehensive discussion about resourcing the Program or the adequacy of existing funding arrangements. This undermines confidence in the future of the Program and its capacity to halt the ongoing deterioration of OUV and other MNES.

GBRMPA has adequately responded to the conclusion drawn by the review of management effectiveness (Chapter 8 of the Assessment Report), that arrangements have largely been process rather than outcome focussed, by committing to developing outcome-based targets. However, the Program description is focussed on future processes that might lead to improved outcomes, with limited clarity about how or when such outcomes will be achieved. There is no program logic articulated, describing the link between management inputs, actions and outcomes. Of the 38 recommended improvements summarised in Chapter 12 of the Assessment Report, only three appear to involve direct actions on the reef ecosystem (REC15, REC16 and REC31). Triggers for management actions are generally lacking for the majority of new initiatives. Recommended improvements could be more effective if they were specific, measurable, achievable, relevant and time bound (i.e., apply "SMART" criteria).

A key consideration will be understanding what constitutes "measurable", in terms of the uncertainty resulting from natural variability and measurement error in monitoring data, and in lag times to yield a response. One example is a proposed target for reduced coral mortality resulting from outbreaks of the crown-of-thorns starfish (COTS). If nutrient enrichment is a trigger for outbreaks of COTS, and further action to improve water quality is implemented, is a reduction of coral mortality from COTS a realistic target for water quality improvement? One important factor to consider is the lag of 3-8 years between nutrient input events and COTS outbreaks as Fabricius *et al*. (2010) describe. This highlights the difficulty in choosing realistic and measurable targets to address the key threats to the Great Barrier Reef.

As well as being specific, measurable and time-bound as reflected in the Program Report, targets also need to be achievable. It could be made clearer that target setting will be a scientifically-robust process that includes careful consideration of the types of data available to measure success and to test our present understanding of system response times.

In Chapter 6, reference is made to conditions exceeding "guidelines" (for example water quality guidelines). However there is no discussion of what occurs in the event of a trigger being exceeded and how this is linked to preventing the source of the impact. In this context, it is important to demonstrate that monitoring is more than recording (declining) condition and includes detecting contributing processes and addressing them through management actions. For instance chlorophyll concentrations have exceeded guidelines in 10-15% of the region for much of the past decade. A description of how GBRMPA responds to such exceedances would provide clarification of current management practices.

The discussion of community benefits of the environment (page 4-23 of the Assessment Report) does not include regulating services, such as coastal protection and nutrient or carbon sequestration. This may be because the discussion is largely based on public consultation, and the importance of such services is probably not front-of-mind for the general public. However, ecosystem services do not seem to be considered in any detail the assessment. In particular, nutrient cycling and the critical role of wetlands are not addressed. Nutrient cycling seems to be considered solely in terms of catchment inputs (e.g. page 7-36 of the Assessment Report). Given that a large proportion of saltmarsh, for example, has been channelised there may be opportunities to reduce nutrient inputs via saltmarsh restoration.

There are several references to marine pests in the Assessment Report, including information identifying them as a key gap (page 6-84). There is also an assessment that marine pest management is a weakness of the current Program (page 8-31). The only response in the Program Report, however, is to improve the capability to respond to incursions if they occur. The risk of marine pest incursions (especially the impact or consequence of an incursion) is likely to increase with reduced reef resilience, and the development of preventative measures is a gap in the Program response to the assessment findings. There are national and international guidelines on biofouling management which could be the basis of GBRMPA policy.

There is a strong reliance on the draft North East Shipping Management Plan to manage the potential impacts of shipping, with minimal discussion about the timelines for improvement and implementation of the measures proposed to reduce risk (page 5-53 of the Assessment Report). Further information including timelines for the outcomes proposed would help assure the

reader that the Shipping Management Plan will significantly protect MNES. In the context of the increased shipping (>10,000 ship movements by 2032), the potential impact of the increased number of industrial vessels in such an extended area of the Great Barrier Reef, and associated impacts on aesthetics are not adequately identified (apart from at vessel anchoring areas).

There are five national natural heritage criteria "identified" as being relevant to the Great Barrier Reef (page 7-49 of the Assessment Report). The Great Barrier Reef was added to the National Heritage List as a result of its World Heritage designation and it has not been fully evaluated for National Heritage (see pages 4-26 and 6-82 of the Assessment Report). It is possible that additional natural heritage criteria beyond those for which it is currently recognised may also apply to its natural heritage values. Such an assessment could prove valuable in identifying a range of additional heritage attributes not currently acknowledged and the identification of management actions to conserve them. This could be addressed as part of the future Program and may connect well with the gaps identified in both Indigenous and Historic heritage. The Australian Heritage Council could be asked to make an assessment for listing under all national heritage criteria. Indeed there may be other heritage attributes that would reach national threshold even if they do not meet World Heritage threshold.

4.5 PARTNERSHIPS AND COLLABORATION

GBRMPA has established partnerships with a variety of groups with an interest in the Great Barrier Reef. Collaboration with partners occurs across a variety of programs including Reef Advisory Committees, the Eyes and Ears Incident Reporting Program, the Reef Guardian Program and memoranda of understanding with key stakeholders. There are many successful examples of the application of partnerships within the existing Program, including areas such as tourism, compliance and indigenous engagement.

While partnerships and stewardship are highlighted as valuable mechanisms to manage the Great Barrier Reef, there is no assessment of their effectiveness. Partnerships are often most effective in addressing management issues that cross jurisdictional boundaries. The agricultural sector is not mentioned in several sections describing GBRMPA's engagement and collaboration activities with various stakeholders (e.g. Page 36 of the Program Report). Beef and sugarcane practices are critical to reef water quality, and a clearer explanation of the collaboration and partnerships of GBRMPA with the peak bodies of these primary industries would add value to the existing discussion.

The connectivity between estuarine, freshwater and marine habitats is frequently mentioned as critical in the assessment, but there does not seem to be any mechanisms to manage this effectively within the Program. A good example is Bowling Green Bay wetland, an internationally-recognised Ramsar site, 99% of which is national park. The wetland is highly significant and regionally unique, given the importance of fresh and marine water connectivity, and being one of the few intact wetlands immediately adjacent to the Region. However, 41 impediments to environmental flows have been recorded affecting the wetland, despite what would be seen as effective management, given its protected status and a comprehensive management plan (see Page 6-32 of the Assessment Report).

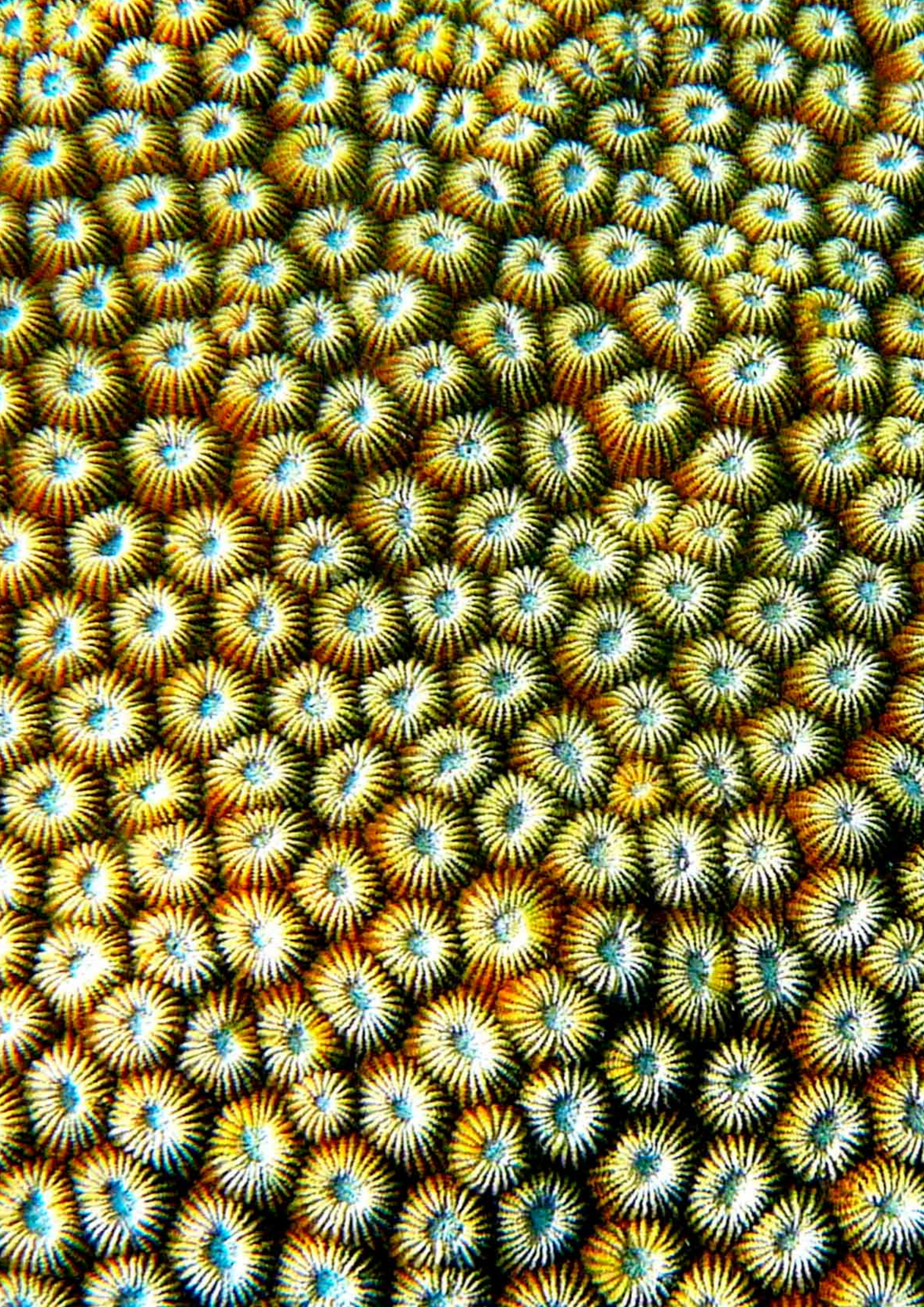
If the management of connectivity is considered to primarily be a responsibility of the Queensland Government in the management of the Great Barrier Reef Coastal Zone, then an appropriate cross reference would provide clarification. The same is true for port development, which has

minimal assessment, given its standing as one of the key management issues that prompted the need for a Strategic Assessment of the Great Barrier Reef (page 5-28 of the Assessment Report). While many of the ports may be located outside of the marine park boundary, most lie within or adjacent to the World Heritage Area and affect the marine park through activities such as dredging, the placement of dredged material and shipping. The management of islands, which largely occurs through a collaboration with the Queensland Government (field management program) also receives limited attention.

The assessed lack of effectiveness with regard to ports (Section 8.5.5 of the Assessment Report) highlights a major gap between GBRMPA's mandate and the management needs of the Great Barrier Reef (including the World Heritage Area; see page 8-39 of Assessment Report). That ten ports appear to be outside of GBRMPA's "jurisdiction" raises a more general issue about the complications of the current management arrangements for the Great Barrier Reef. Some analysis of the strengths and weaknesses of these jurisdictional issues for the inshore sections of the Great Barrier Reef would provide clarity for the reader and assist in assessing opportunities for improved collaboration between GBRMPA and other management agencies. This should include further discussion on the application of GBRMPA's powers to address activities outside of the marine park.

There is a missed opportunity to explore some specific actions that Australia might take on the international stage as part of the Program, under the guidelines of World Heritage. This would provide opportunities for the World Heritage Convention to work as intended through international cooperation, and provide an opportunity for GBRMPA and Australia to influence the international threats to the OUV of the Great Barrier Reef World Heritage Area. Such threats include climate change, pollution, shipping and impacts on migratory species (such as marine turtles, whales, dugongs, shorebirds and seabirds). There is an opportunity to explore options around each of these at the international level (bilateral or under various treaties). GBRMPA has a long history of international collaboration and leadership, and given the significance of threats that are external to the Marine Park, continued and strengthened international efforts, not only by GBRMPA, are needed to protect and restore the OUVs of the WHA.

One World Heritage obligation is "giving World Heritage a meaning in the life of the community". There are multiple reasons why this obligation delivers benefits, including the fostering of community support for programs to better protect and manage the Great Barrier Reef. It is worth highlighting this in the Program as it has had a low profile in the past. When combined with better communication about climate change and the Great Barrier Reef, the outcome could be very positive.



5. TECHNICAL ACCURACY

5.1 INTRODUCTION

This section examines whether technical aspects of the Strategic Assessment are accurate, as determined by a critical analysis of the information and evidence presented in the reports. Consideration has been given to whether uncertainty in the evidence, where present, has been adequately characterised and whether conflicts in the evidence have been recorded and discussed. Recommendations for strengthening the accuracy of information provided in the Program and Assessment Reports are described.

The Strategic Assessment is generally based upon the best available science, through the application of relevant literature and expert opinion in all relevant chapters. Overall, the accuracy of the information presented is high, and is summarised into a series of important discussions to link management of the Great Barrier Reef with scientific rigour. In some areas, uncertainty in the available evidence could be more comprehensively characterised and the strengths and weaknesses of data could be presented more explicitly. Conversely, where there is limited science available to guide the assessment, it would also be valuable to highlight this and seek to address knowledge gaps through implementation of the future Program.

5.2 BEST AVAILABLE SCIENCE

The Strategic Assessment is comprehensively referenced and generally makes use of the available scientific information. The authors have successfully brought together a broad and diverse assemblage of literature and linked this to key analyses within the assessment process, including the opinion of experts and stakeholders. The reader gains significant confidence from the evidence-based approach to the assessment throughout the documents.

Management of the Great Barrier Reef is a complex task. GBRMPA, in collaboration with the Department of the Environment, identified several key knowledge gaps throughout the assessment process and commissioned parallel studies to at least partly address some of these gaps. This demonstrates good planning and insight into the material issues for the Strategic Assessment, and has resulted in a stronger foundation of information upon which to assess condition and threats.

The independent assessment of management effectiveness (summarised in Chapter 8 of the Assessment Report) provides an accurate assessment of the current management regime and is a foundation of the assessment's key findings. This identified that the Program's strengths are generally in the areas of planning and processes, with weaknesses in achieving outcomes. Such a picture is illustrated in part through the declining condition of the Great Barrier Reef, despite the significant investment in management activities. The clear message is that desired outcomes are difficult to achieve for some of the most significant (and complex) management issues threatening the Great Barrier Reef ecosystem. The Assessment Report has responded to these findings, which appear to have been received in March 2013, through the development of a target-based management framework, demonstrating a level of responsiveness.

5.3 IMPROVING TECHNICAL RIGOUR

There are a relatively small number of areas where the information presented in the Assessment Report is not correct or appears to fall short of explaining the complete picture. In some cases, the effectiveness of management or the significance of some perceived impacts appear to have been overstated when considering the information presented in the reports. Key examples are provided in the following paragraphs.

When discussing the impacts of vessel strike on wildlife on page 6-55 of the Assessment Report, it is stated that "go slow areas and transit lanes have been declared in some areas where there is high vessel traffic and large populations of marine turtles or dugongs, such as near Hinchinbrook Island". This appears to be overstating the current management arrangements in place to address the risk of boat strike on marine fauna. While 'go slow areas' have been designated within the zoning plans of Queensland's Moreton Bay Marine Park and Great Sandy Marine Park, no such areas have been gazetted in the Great Barrier Reef Marine Park. Marked transit lanes have been established near Hinchinbrook Island, but they are voluntary and have been reported to be of limited effectiveness in changing the behaviour of vessel operators (Andersson 2008). Perhaps more relevant to the conservation of threatened species is the temporary designated vessel routes and reduced speed limits that have been adopted for some areas of the World Heritage Area through approved environmental management plans for construction projects (e.g. the construction of LNG plants and associated dredging in Gladstone Harbour). While these management arrangements are often imposed through the EPBC Act (and are therefore not strictly part of the GBRMPA Program), they have mutual benefits for marine safety and wildlife management and are worthy of some discussion in this chapter, particularly if based on advice from GBRMPA staff.

For two key issues, inshore reefs and COTS, it is often insufficiently clear the extent to which key conclusions are based more on scientific consensus rather than high quality data. Inshore reefs in the southern section of the Great Barrier Reef are particularly degraded. Two publications are repeatedly cited to support this conclusion: De'ath *et al*. (2012) and Roff *et al*. (2013). The decline reported by De'ath *et al*. (2012) was largely driven by a dramatic decrease in coral cover in the southern third of the reef, where the data used do not include any inshore reefs, and in the central third of the reef (still the southern section in terms of the Strategic Assessment) trends for inshore compared with offshore reefs are not reported. The apparent phase change in an inshore reef reported by Roff *et al*. (2013) was reported from a single inshore site (Pelorus Island) relatively far to the north, directly off the mouth of the Herbert River (in the Wet Tropics, rated the highest water quality risk in Reef Plan 2013). Thus, whilst these papers are consistent with the conclusion that inshore southern reefs are particularly degraded, they do not provide conclusive evidence of declines on a regional scale.

Regarding the palaeoecological phase shift reported for Pelorus Island, the conflicting view of Browne *et al*. (2012) that inshore turbid reefs have been stable on palaeoecological time scales is not acknowledged. It is therefore recommended that there be more discussion of the recently established inshore reef monitoring program, and that greater clarity is provided that the decline in inshore southern reefs reflects consensus rather than high-quality data on appropriate spatial and time scales. The information presented is the best available science and the decline or the

need for urgent action is not disputed. Indeed, the information available illustrates the urgent need for better data regarding trends in inshore reef condition.

Chapter 7 of the Strategic Assessment acknowledges that inshore reefs are relatively poorly studied, but such qualifications are not consistently communicated throughout the report. The decline of southern inshore reefs is rated as having high-quality evidence and high degree of consensus on page 7-11 of the Assessment Report. Consensus is clear, but high-quality evidence is more problematic. On page 7-51 of the Assessment Report, the status and trends of inshore fringing reefs are identified as a key information gap. Consistent with the precautionary principle, lack of data should not become the basis for inaction, but the importance of obtaining better information to apply to an improved understanding of resilience, recovery and restoration does not come through consistently in the assessment.

For the link between nutrients and outbreaks of the COTS, the referenced literature is the best available science, but is essentially based on two papers (Brodie *et al*. 2005; Fabricius *et al*. 2010) by the same research team. The Assessment Report is inconsistent in characterising the strength of the evidence (e.g. "emerging evidence" vs "strong evidence" in various places). More importantly, the assessment appears to accept the link between water quality and COTS without question. The finding that COTS are less abundant in Marine National Park Zones is mentioned in places but not emphasised. This does not detract in any way from the importance of improved water quality, but the assessment appears to assume that improved water quality will solve the COTS outbreak problem. The assessment refers to the potential direct control of COTS outbreaks, but would benefit from a more systematic consideration of alternative plans if it turns out that water quality improvement is not sufficient. Given the importance of COTS outbreaks to the declining condition of the Great Barrier Reef, it is surprising that the assessment does not identify any knowledge gaps/research priorities to improve the management of COTS outbreaks. It would be useful to clarify whether GBRMPA considers that current scientific understanding of COTS outbreaks is adequate for management.

Chapter 3 of the Assessment Report appears to overstate the evidence provided by the cited papers for benefits of the 2003 rezoning of the Great Barrier Reef Marine Park to sharks, dugongs, and turtles (page 3-22 of the Assessment Report). Reference 14 (McCook *et al*. 2010) states that sharks have benefited, but also that these benefits are less than for more site-attached species. For dugongs, McCook *et al*. (2010) discuss the increased portion of critical habitat protected by the 2003 rezoning. However, they do not provide evidence for beneficial effects and note that other protective measures are needed. McCook *et al*. (2010) treat turtles in a similar manner. Reference 17 (Marsh *et al*. 2005) does not address possible benefits of the rezoning for dugong, which would have been highly unlikely to occur on the short time scale between rezoning and the publication of this paper. Reference 18 (Gell and Roberts 2003) is a general review and provides no information regarding the effects of rezoning. Indeed, the paper was published before the rezoning was implemented. While there is clear scientific evidence that Marine National Park Zones and related measures provide benefits for biodiversity, some of the above-mentioned references appear to have been cited out of context.

On page 5-29 of the Assessment Report, the use of reference 114 (Erftemeijer and Lewis

2006) as providing evidence for the unqualified statement "Dredging to improve vessel access and the installation, operation and maintenance of infrastructure is affecting habitats and species" is inappropriate. As the lead sentence of this paragraph, the statement implies widespread impacts of dredging on a range of habitats and species (presumably meaning at a significant population level) within the region. Erftemeijer and Lewis's review focused entirely on one specific group (seagrass), reported that some dredging projects recorded no significant long-term effects, concluded that the potential sensitivity of seagrasses to dredging-induced sedimentation is highly site-specific, and reported that improved mitigation measures (which have to a significant extent been applied to dredging in the Great Barrier Reef Region) help prevent or minimise dredging impacts. The sentence could be deleted without detracting from the message in the rest of the paragraph, and the potential for impact is addressed better in the paragraph that follows.

Page 6-39 of the Assessment Report discusses the dispersal of sediments within the Great Barrier Reef as a result of dredging projects (including sea dumping of dredged material). Reference 137 (Bainbridge *et al.* 2012) refers to the dispersion of a fresh water plume, which is probably not representative of the dispersion of fine sediment from sea dumping. Much of the information on transport from river plumes relates to initial transport in suspension, while the buoyant plume is spatially propagating relatively rapidly on the surface. Most of the transport of dredged material after dumping at sea modelled in reference 190 (SKM APASA 2013) was by repeated deposition and resuspension. These are very different processes and the distinction between measured transport of river plumes and dispersion of dredged material from dump sites needs to be made clear. Reference 190 (SKM APASA 2013) did not evaluate the duration of time material stays in suspension, much less conclude that fine sediments remain suspended for long periods of time. Indeed, the analysis of suspended solids in that study shows very low levels resulting from sea dumping (as opposed to dredging). The basic message that dredged material potentially travels long distances is valid, but the discussion needs accurate context.

Similarly, page 6-40 of the Assessment Report presents actual and modelled plume dispersion during a dredging campaign at Hay Point, in a manner that is potentially misleading. The model prediction shown in Figure 6.19a was developed specifically to address worst conditions for Round Top Island (i.e., under the conditions of northward transport). There were other model outputs (e.g. worst condition for Victor Islet, which lies further to the south) that clearly predict much more extensive southward transport of sediment. Selecting a single figure intended to assess impacts on a receptor to the north for comparison with imagery showing southern transport is not an accurate presentation of the information.

Another technical issue identified with the assessment is that many well studied attributes of the Great Barrier Reef are reported to be in decline (particularly in the southern region), while poorly studied attributes are predominantly reported to be in good condition, with equal credence given to each. The lagoonal floor is considered to be in 'good' condition and 'stable' in all areas even though it ranked fourth in the number of 'high' or 'very high' impacts. Given the amount of trawling

that has taken place in the Great Barrier Reef Lagoon, a 'poor' and 'improving' rank would seem more appropriate, due to the reduction in trawling pressure. Similarly bony fish are all rated either 'very good' or 'good', even though there are as many 'high' to 'very high' impacts affecting them as marine turtles, and several low impacts. Page 7-52 of the Assessment Report states that monitoring of nesting seabirds is insufficient to reliably determine condition and trend, yet on page 7-47, the confidence of ratings for 'poor condition' and 'declining trend' are rated as adequate high-quality evidence and a high degree of consensus.

The condition and trends sections is significantly improved over the last Outlook Report (GBRMPA 2009) in providing indicators of trend and importantly, indicators of confidence (in the indicators of trend). There are a large number of indicators where the confidence is very limited. It is possible that for some indicators, the confidence is too low to provide a rank, but all indicators have been given a rank regardless of the level of knowledge. One potential solution is to include another rank of 'condition unknown' or 'data deficient' to cover these virtually unstudied aspects of the environment. This would also help to highlight genuine data gaps that should be filled through future research and monitoring activities. There is a general absence of management responses to be triggered by monitoring and evaluation.

5.4 WORLD HERITAGE AND OUTSTANDING UNIVERSAL VALUE

With regard to World Heritage, the Assessment Report is inconsistent in discussing the meaning of World Heritage in the context of Outstanding Universal Value. As outlined in Section 3.4 of this report, there is an apparent mixture of the terms "values", "attributes" and "elements" which causes some confusion for the reader.

The technical expression 'Outstanding Universal Value' is predicated on a number of attributes that contribute to the World Heritage site meeting specific criteria. These attributes underpin the OUV. Because of the inclusion of the word "value" in Outstanding Universal Value (always singular), associated use of the term "values" when discussing attributes has caused confusion with several examples of OUV being used in the plural and therefore confusing its meaning.

The World Heritage Committee uses "attributes" as a preferred description of the set of qualities that underpin OUV rather than "values" (see Operational Guidelines; UNESCO 2013). In the Assessment Report a good example of appropriate use of the term is in the first row of Table 10.7 on page 10-22. Elsewhere, there is less clarity. Indeed on page 4-7 the term "values" seems to be treated identically to "attributes" but later this is not applied consistently. The report would be improved with a box in section 4.2.1 that provided a clear statement about OUV, attributes, values and the logic behind the use of these terms in the context of World Heritage. Additionally, the glossary could be updated to include a definition of each term, as currently only "values" are defined.

Criterion ix provides a focus on biological and ecological processes (the only MNES that specifically refers to processes), but this is not sufficiently captured in the description nor in what needs to be protected as part of OUV. Activities that undermine such ecological and biological processes are of significant concern and should be included in discussions about impacts throughout the Strategic Assessment in addition to specific impacts on species. While such processes may be implicit in the discussion, there would be value in them being more explicit. This is consistent with the notion of "integrity" as used in World Heritage assessment and management.

6. VALIDITY OF CONCLUSIONS

6.1 OVERVIEW

Conclusions of the Strategic Assessment will shape the future 25 years of management of the Great Barrier Reef, and are among the assessment's most important components. Actions including the development of a Great Barrier Reef Long-Term Sustainability Plan and the implementation of forward commitments, can only be expected to be effective if the conclusions of the Strategic Assessment are appropriate and address the gaps identified during the assessment process.

The Strategic Assessment has been successful in assessing the condition of the Great Barrier Reef and identifying gaps in the effectiveness of current management practices. However, it is unsuccessful in identifying an effective future management approach, beyond a small number of appropriately targeted and challenging new initiatives. The vast majority of forward commitments are new processes that will have difficulty achieving outcomes in the reef ecosystems of the World Heritage Area and collectively reflect an incremental improvement rather than a substantially strengthened response. While the Strategic Assessment has accurately characterised the Great Barrier Reef as in decline across a variety of MNES, it has not effectively demonstrated that the Program proposed to improve the condition of MNES will be successful. The need for urgent and substantial action is not evident.

6.2 THE CASE FOR ACTION

Several chapters of both the Program and Assessment Reports provide a clear presentation that, without substantial strengthening of the full scope of management arrangements, the condition of the Great Barrier Reef is likely to continue to deteriorate (e.g. page 8 of the Program Report). The summary of the independent assessment of management effectiveness states that "urgent action by the Authority is needed to improve the health of coastal ecosystems and to boost the health and resilience of the reef".

Of the six elements of management presented on page 8-4 of the Assessment Report, the final element is "results in impacts or outcomes, hopefully achieving defined goals and objectives". This element is clearly a key challenge for the Great Barrier Reef, with the current management program only partially achieving desired outcomes. The need to focus more on threat reduction is recognised in the assessment in several areas (e.g. Section 8.6.4 of the Assessment Report) and many gaps are identified as requiring action.

In this context, it is important that the forward commitments and improved management arrangements outlined in the Program are specifically targeted to address gaps identified in the assessment and are focussed on achieving improvements in the condition of MNES. However, many of the management recommendations are described in terms of 'collaborating, strengthen engagement, facilitate, encourage the application of, promote the uptake, strengthen the consideration of, communicate' and similar.

These can be highly appropriate and effective measures in many contexts, but they have a voluntary, optional element to them that is likely to dilute their effectiveness in the Great Barrier Reef context. To be effective, they need to lead to direct action that contributes to reversing the current declining condition of the reef ecosystem.

The Great Barrier Reef Region has a combination of competing and sometimes conflicting interests. Land-uses in the catchment are varied and many have a long history of operation. There are multiple jurisdictions with varied objectives and strong economic growth is predicted. This is a complex mix, where management measures that have a discretionary element built around cooperation may have more limited ability to influence the key decisions for significant infrastructure, investment or land use practices. For example, page 12-10 of the Assessment Report states that a key role of GBRMPA is "collaborating with and influencing its management partners" to improve environmental outcomes across the broader region. Clearly this is part of its role, but it is not underpinned by more substantive management measures and is therefore of limited effectiveness. Stronger measures are required that give clear, unequivocal direction and mechanisms for implementation and compliance monitoring. In addition, many of these collaborative measures take time to influence change, especially in relation to long-standing land use practices. Evidence in the report suggests that action and outcomes have some urgency.

There appears to be a sense of strong optimism in the improvements that can be achieved under the Reef Plan in the chapters on water quality. The results from the last Reef Plan Report Card (Queensland Government 2013c) indicate that, while the values for nutrient loads are moving in the right direction, the rate of change looks too slow to meet the targets. In this context the assessment could go further in stressing the need for more substantial efforts to reduce nutrient and sediment inputs into the Great Barrier Reef.

Tables 8.31 and 8.32 of the Assessment Report show that the majority of processes are 'mostly effective', but the majority of outcomes are only 'partially effective'. There are likely to be many reasons for this, including legacy impacts, delays in the response of reef ecosystems to improved management arrangements, difficulties with the precise assessment of improvement of MNES and variation in conditions arising from events such as floods and cyclones, which can occur in clusters, masking or acting cumulatively with other impacting processes. Page 11 22 of the Assessment Report also shows all 'key values and attributes' of MNES are assessed as 'poor', with the exception of wetlands, which are assessed as 'good'.

At least part of the explanation for failing to achieve desired management outcomes arises from the large geographic scale of management activities. The magnitude of management investment for the Great Barrier Reef as described (briefly) in the reports appears small in comparison with the economic benefits that are generated (see page 3-25 of the Assessment Report). The current management investment does not appear to be of a sufficient scale to enable a turnaround in the decline in MNES across the broad range and scale of environmental features and processes. The field management program is a key example of a pivotal aspect of the reef management, responsible for implementation of operational activities such as compliance, island management, pest management, some monitoring and the maintenance of public infrastructure. However, funding for the field management program has been static since 2008 and declining in real terms (page 8-25 of the Assessment Report). While the activities of the field management program appear to be targeted towards the material issues and highly effective where they are applied, the scale of the reef, number of islands and diversity of tasks means that management activities can only be effective in a small number of locations, or ineffectively spread over a large area.

6.3 FORWARD COMMITMENTS

Forward commitments outlined in the Assessment and Program Reports do not seem to address the management gaps that are clearly identified in earlier sections of the Assessment Report. Indeed future management commitments are more in line with a 'business as usual' approach than the substantial strengthening that is identified as being necessary. Forward commitments are generally comprised of new processes, rather than actions targeted at improved outcomes and are a series of incremental improvements. This is inconsistent with the identified urgent and substantially strengthened measures that are needed to address the declining condition of the Great Barrier Reef.

Given the alarming decline in coral cover across large parts of the reef, there is an urgent need for more 'restoration ecology' research, such as intensive monitoring of sites for recovery after COTS outbreaks or cyclone damage, testing the efficacy of COTS control, trialling restoration methods, assessing priority areas to enhance resilience, and more confident identification of ecosystem tipping points. This would test the accuracy of our current understanding and provide evidence to improve the effectiveness of management actions on the reef. De'ath *et al.* (2012) suggest that COTS control alone would be sufficient to allow coral recovery at a reef scale, which is a testable hypothesis. The urgency of targeted research applied to reef restoration is not clearly articulated sufficiently in the Program Report.

The Program Report includes a number of what should be very useful initiatives.

- Development of a Cumulative Impacts Policy is critical, but will be challenging on many levels. Conceptually, there is a major challenge in developing a quantitative understanding of how multiple human and natural impacts interact in affecting the health and long term resilience of the Great Barrier Reef ecosystem. The preliminary qualitative assessments are useful but inadequate as a basis to make significant management and investment decisions. For this, quantitative understanding will be critical if future management of impacts is to be based on their relative contribution to health or decline. Basing an adaptive management strategy around cumulative impact risk assessment in a complex and heterogeneous system will also present a major governance challenge both to GBRMPA and their partners across the Commonwealth and State Governments.
- The development of "Best Practice Standards for Managing Impacts", so that impacts are "managed such that ecosystem thresholds are not reached" is also a welcome response. As the Program Report acknowledges, this will require development of suitable methods for assessing impacts, and adequate data. The commitment to developing the Standards must be matched with a commitment to implement (and resource) them, or there is a risk of repeating the pattern highlighted in the review of management effectiveness of having a good understanding of the issues, good process, good output (a policy), but poor outcomes. In order to manage impacts, they need to be measured at a scale and frequency that is meaningful to inform and adapt management.
- The Net Benefit Policy is similarly well-conceived, and its goal of developing a "Strategic Framework to guide actions and manage funds for protecting and restoring the values of the Great Barrier Reef" is a positive step forward. The Reef Trust concept provides a potential funding basis for well-targeted major initiatives.

7. COMPARATIVE ASSESSMENT OF QUEENSLAND AND GBRMPA STRATEGIC ASSESSMENTS

7.1 INTRODUCTION

The GBRMPA and Queensland programs are intended to provide an integrated, complementary and comprehensive management approach to protecting MNES within the Great Barrier Reef, in conjunction with existing Australian Government legislation, programs and policies, such as the EPBC Act.

This section outlines the findings of a comparative assessment of the draft Great Barrier Reef Region Strategic Assessment (GBRMPA) and draft Great Barrier Reef Coastal Zone Strategic Assessment (Queensland Government). The purpose of the analysis is to ascertain gaps in management to protect MNES, including OUV of the Great Barrier Reef World Heritage Property.

The extent to which the current and proposed programs align and complement each other was considered to provide an integrated and comprehensive management approach for protecting MNES. The review team sought to identify any notable or important information and management gaps or deficiencies that are evident from considering the Strategic Assessment reports and Program reports together. Proposed areas of management where clarification is required in relation to the delineation of responsibility and other relevant implementation matters were also considered.

The Queensland and GBRMPA programs share a commitment to give greater consideration to MNES in the implementation of their respective management activities. When considered collectively, several areas of strength and alignment are evident; such as the management of tourism, the prioritisation of limited field management activities, and the application of spatial tools and science to inform management decisions. Weaknesses and gaps in the programs primarily relate to the coastal interface, where issues such as water quality and connectivity, which stretch across a variety of land uses, habitats and jurisdictions are not effectively managed. Some aspects of the Great Barrier Reef's management, such as administering approvals under the EPBC Act, are not described or assessed in either the Queensland or GBRMPA Strategic Assessments.

There are opportunities to significantly strengthen both Strategic Assessments through more detailed collaboration, and cross referencing between the Queensland and GBRMPA documents, to present an integrated approach to the management of MNES. While there may be small areas of duplication, it is the gaps of climate change, extreme weather and water quality that require the most attention.

7.2 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

A common theme of both assessments is that the legislation upon which the Programs are based does not specifically establish or reference MNES. In the case of the GBRMPA Strategic Assessment, protection of MNES is based on key values and attributes of MNES, which are afforded protection through the management of the Great Barrier

Reef Marine Park. Likewise, the Queensland Program was not established with MNES in mind, and the protection afforded to MNES through the Queensland Government's existing program has been largely coincidental rather than the product of a targeted legislative framework. The Queensland Program proposes to develop a planning framework that explicitly considers MNES, which will bring stronger alignment of management and assessment activities with that of the Commonwealth. The first recommended improvement outlined in the GBRMPA Program is to explicitly incorporate consideration of all values relevant to MNES, including elements of the property's OUV, into the Authority's programs, plans and policies. There appears to therefore be mutual agreement that MNES will form a significant part of management of the Great Barrier Reef in the future. This new resolve of both management jurisdictions to focus on MNES appears to be a key benefit of the Strategic Assessment process and a demonstration of incremental improvement and alignment in management direction.

7.3 STRENGTHS AND ALIGNMENTS

Overall the joint management arrangements in place for the Great Barrier Reef are considered to be effective and appropriate for the jurisdictional responsibilities of the State and GBRMPA. There are functional similarities in the approach taken between the jurisdictions to managing the landscapes of the Great Barrier Reef, its coastal zone and catchment. The establishment of a reserve system across the landscape is one such approach. The Great Barrier Reef zoning plan establishes Marine National Park Zones over approximately 30% of the marine park, where all forms of extraction are prohibited. Within the Great Barrier Reef Coastal Zone, national parks and other protected area tenures are also established on land and protect the functional landscapes upon which the Great Barrier Reef can rely. Importantly, both reserve systems apply a representative area approach to contribute to the protection of representation examples of the various habitats and bioregions.

The assessment of major developments in and around the Great Barrier Reef World Heritage Area is another strength of both programs. The Queensland Program is very focussed on development assessment and has several targeted legislative instruments to provide for marine habitat protection and sustainable use of the coastal zone and catchment. GBRMPA is generally directly involved in the assessment of projects located within the marine park, and provides advice to the Department of the Environment for approvals under the EPBC Act. Marine parks permits are generally assessed jointly by the Queensland Parks and Wildlife Service and GBRMPA, and permits may be granted with identical conditions to address relevant legislation applying across the combined jurisdictions. Permit compliance is generally completed by the field management program, which has direct and strategic links to GBRMPA staff.

The spatial understanding of environmental values at a regional scale is a strength of both assessments. The Queensland Program applied vegetation mapping techniques to highlight environmental values and identify areas where clearing had been extensive, potentially contributing to impacts downstream. GBRMPA has a good understanding of bioregions and habitats, which is being enhanced through ongoing research. While extensive knowledge gaps exist, the information available is impressive given the large geographic extent of the Great Barrier Reef Region and the difficulties in monitoring remote marine ecosystems.

The management of tourism in the Great Barrier Reef is a success and represents good work in providing improved performance, reduced impacts despite the rising visitor numbers, and some excellent examples of partnerships with industry and researchers. In the context of World Heritage obligations, the tourism operators present the World Heritage values to visitors, with additional support from GBRMPA and the Queensland Parks and Wildlife Service through the field management program.

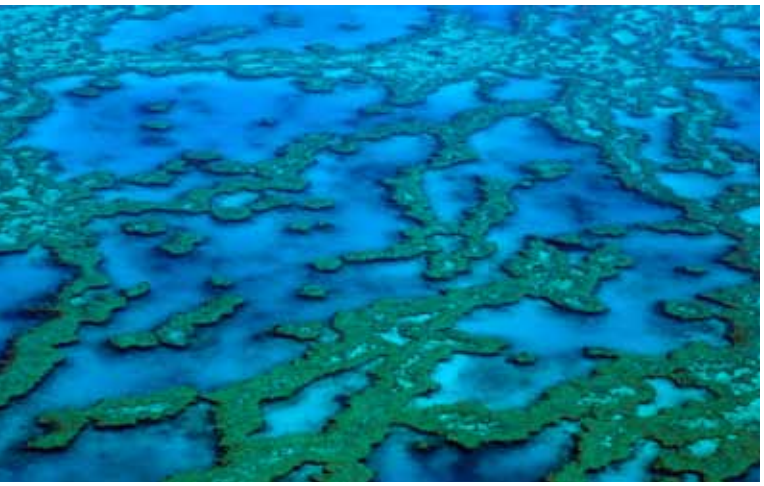
7.4 GAPS AND INCONSISTENCIES

Both Strategic Assessments evaluated the effectiveness of current management activities (Program elements). Unfortunately, the method used to assess management effectiveness differs significantly between the GBRMPA and Queensland Government Strategic Assessments. GBRMPA commissioned an independent assessment of the effectiveness of its Program, which was based on the application of an IUCN management effectiveness framework as well as a similar system applied to the Outlook Report (GBRMPA 2009). The Queensland Government developed its own criteria for assessing management effectiveness, based on the endorsement criteria from its Terms of Reference and other best practice management standards available. The contrasting approaches cause great difficulty in assessing how effective the combined Programs are at managing MNES, a fundamental step in identifying gaps and strengths overall.

The condition and trend assessments applied the same grading system, which resulted in a relatively consistent approach across both Strategic Assessments. However, cross references from the Queensland Strategic Assessment Report to results of the GBRMPA assessment of condition and trend could be improved with further explanation. The condition and trend is evaluated for four separate regions within the Great Barrier Reef Region assessment (GBRMPA 2013b). However, when cited by the Queensland Assessment Report, only the southern inshore rating appears to be reported, potentially skewing interpretation of the broader marine assessment. The Great Barrier Reef Region Strategic Assessment does not discuss or present the results of the Queensland Government assessment of the Coastal Zone in any detail.

The approach to assessing risk was similar in the Queensland and GBRMPA Strategic Assessments. One key difference was the inconsistency of the final risk tables (GBRMPA Table 10.2; Queensland Table 3.8-4). Combinations of consequence and likelihood for the two assessments, in some cases, gave different overall risk ratings. For example, an activity rated as possible and with catastrophic consequences is assessed as very high risk in the GBRMPA assessment and high risk in the Queensland Government assessment.

The Strategic Assessments highlight that addressing impacts at the broad, whole-of-Great Barrier Reef scale is a significant challenge, particularly impacts on coastal ecosystems, connectivity and water quality. These are areas that appear to ‘fall between the cracks’ for both the Queensland and GBRMPA assessments. The Queensland Strategic Assessment did not comprehensively demonstrate these matters were being managed effectively, especially connectivity. Water quality is mainly being addressed through changing agricultural practices which have a weak compliance regime and limited, insecure funding sources. There was no thorough assessment of the adequacy and effectiveness of measures to improve water quality flowing into the Great



Barrier Reef, especially from broad-scale land-uses. The GBRMPA Strategic Assessment identifies deterioration in water quality from catchment runoff as a major impacting process affecting the Great Barrier Reef, and links this with much of the decline in coral cover. While new management activities are proposed to address the issue, they are dominated by processes which have a low likelihood of resulting in significant improvements.

The comparative assessment of programs also identified that there is a significant blurring of the lines of responsibility throughout the coastal waters of the Great Barrier Reef, which in essence arises from the lack of detail in either assessment on how major activities or issues in these inshore waters are managed. Port development is a key example of an issue fundamental to the origin of the Strategic Assessment, and is central to the concerns of the World Heritage Committee. However, this activity received limited attention in either the Queensland or GBRMPA assessment. Discussion about associated activities, such as dredging and the fate of dredged material when placed at sea is also fairly minimal and seems to be complicated by the jurisdictional lines between coastal (Queensland) and marine (Commonwealth) waters. Without further explanation, the reader is unclear whether each jurisdiction views these issues as the other's key responsibility, or if the activities have been overlooked.

Responsibility for islands appears to complicated from a tenure perspective and not conducive to a consistent approach (See Section 9.5.2 of the GBRMPA Assessment Report). The tenure arrangements for islands are highly varied, with some included within the marine park despite being non-tidal, some being national park and others a variety of government and privately owned tenures. The demonstration case on island management provides examples of targeted island management activities which provide meaningful conservation outcomes. However, such management activities do not appear to be widespread, and are likely to lack the resources required for broad application.

Elements of the Queensland and GBRMPA programs established to manage the Great Barrier Reef are not always complementary. One example is the application of seasonal closures to protect nesting seabirds on islands, which are not replicated within waters immediately adjoining the islands. Also, while about 400 islands are protected as national park, there are some of high conservation value that are not within the protected area estate. There does not appear to be joint recognition of some planning tools by GBRMPA and the Queensland Government, as demonstrated by the Cairns Area Plan of Management, which appears to be an important management tool for GBRMPA in addressing tourism threats but is reported not to be approved by the Queensland Government (see page 9-28 of the GBRMPA Assessment Report). While the joint management arrangements and a commitment to them appear to be strong, there are unexplained anomalies which over-complicate and constrain the effective implementation of some management actions.

From a legislative perspective, there are elements of the Commonwealth Government's management of the Great Barrier Reef which sit outside of GBRMPA and are therefore not within the scope either the Queensland or GBRMPA Strategic Assessments, as outlined in their respective Terms of Reference. One example is staff from the Department of the Environment who implement the EPBC Act, through the administration of approvals along the Great Barrier Reef coast. This means that there are some aspects of the Great Barrier Reef's management that are not considered within the collective Strategic Assessment process.

In general, fisheries is another issue that has received limited attention in either assessment. The Coastal Zone assessment did not address fisheries issues in any detail, although most fisheries management is a State responsibility. The Terms of Reference for the marine assessment clearly focus on GBRMPA's management arrangements, although some aspects of fisheries management are described. As an example, the GBRMPA Assessment Report describes the trawl fishery and notes in several places, including the independent effectiveness review in Chapter 8, that the trawl fishery still has latent overcapacity. But there is no clear indication in either program report how this issue is to be addressed, and it would appear to be part of the Queensland Government's jurisdiction, rather that of GBRMPA.

For a small number of potentially significant issues, Program elements seem to be acting in a direction contrary to the findings of the Strategic Assessment. For example, the new Regional Plan for Cape York Peninsula proposed by the Queensland Government may affect catchment runoff, a major contributor to water quality declines in areas where extensive agriculture and coastal development occur. The new Plan for Cape York Peninsula seeks to enable and support more intensive development (including agriculture) in a region that to date has had very limited activity, which underpins the good condition of the northern section of the Great Barrier Reef. Some discussion of the prospects for impacts on the relatively pristine northern section of the Great Barrier Reef are warranted in light of the Queensland Government's proposals. More broadly, amendments to the vegetation management framework in Queensland appear to be inconsistent with the desire to address catchment runoff and associated water quality issues for the Great Barrier Reef by improving land use practices.

In order to identify further key gaps in the whole-of-Great Barrier Reef Program, values or impacts which were assessed as either 'partially effective' or 'ineffective' for outcomes in the GBRMPA Assessment Report (Chapter 8) were identified. Consideration was then given to the extent to which gaps leading to the lack of effectiveness are addressed by the Queensland Program. The scale of gaps between the programs was described as either large, medium or small, and the significance of the gap for the protection of MNES of the Great Barrier Reef was assessed as either high, moderate or low. Results of this comparison are presented in Table 7-1. Activities for which management gaps are largest and there is a high significance for protection of MNES of the Great Barrier Reef are 'climate change and extreme weather' and 'water quality protection'. These impacting processes are recognised by both assessments as key risks to the future of the Great Barrier Reef, and their management should form a more prominent role in the future commitments for each program.

Table 7-1 Assessment of whether weaknesses in the GBRMPA program are addressed by the Queensland program, and the scale and significance of gaps for the protection of MNES of the Great Barrier Reef.

Value or impact which scored Partially Effective or Ineffective in GBRMPA Strategic Assessment	Management effectiveness assessment overall (outcomes)	Are gaps addressed by the Queensland Government Program?	Size of gap in management between Programs?	**Significance for protection of MNES of the Great Barrier Reef**
Historic heritage values	Partially effective	There is some state legislation to protect historic heritage values but this aspect of management is not a focus of the Queensland Program	Large	Low. The Great Barrier Reef World Heritage Area is recognised for its natural heritage values, with historic heritage values comprising a relatively minor part of the MNES.
Climate change and extreme weather	Partially effective	There is limited scope for direct action from the Queensland Government. Improved operational management of the Great Barrier Reef for resilience in the face of climate change (for example through the field management program) is a weakness of both proposed Programs.	Large	High. A greater emphasis is required on managing for resilience in the face of climate change. As climate change impacts are likely to be cumulative, reducing other impacts (e.g. from illegal fishing and pests) is likely to be critical.
Water quality protection (catchment runoff)	Partially effective	The Queensland Government has management actions in place, such as the Reef Plan, and is preserving portions of the catchment through the protected area estate. Such actions are partially effective and could be strengthened, given the magnitude of the task and the significance of this issue for the future of the Great Barrier Reef.	Medium	High. Water quality appears to be the most significant legacy issue affecting the Great Barrier Reef, primarily from catchment runoff. Large declines in inshore and mid shelf coral cover appear to be either directly or indirectly linked with water quality declines.
Coastal development (protection of coastal ecosystems)	Partially effective	Queensland has a coastal development assessment framework in place across various legislative instruments, and relevant policies and strategies such as the draft Queensland Ports Strategy. Development assessment is a key focus of the Queensland Program. Cumulative impact assessment and offsets are recognised weaknesses of both Programs.	Small	Medium. The large number of coastal developments and expanding population in the coastal zone are relevant. The management of cumulative impacts and offsets are the largest gaps.
Commercial fishing	Partially effective	The Queensland Government is primarily responsible for managing commercial fisheries in the Great Barrier Reef. However, there is limited discussion of this function in the Queensland Strategic Assessment, making it difficult to assess the Program effectiveness.	Medium	Medium. The accidental take of threatened species as bycatch is gradually being reduced through active management and has a history of success.
Recreational fishing	Partially effective	The Queensland Government is primarily responsible for managing recreational fisheries in the Great Barrier Reef. However, there is limited discussion of this in the Queensland Strategic Assessment, making it difficult to assess the Program effectiveness.	Small	Small. Illegal fishing may have significant impacts at a local scale and reduce the effectiveness of marine national park zoning at protecting MNES. Such impacts may reduce ecosystem resilience.
Port activities	Partially effective	The Queensland Government has recently released the draft Queensland Ports Strategy and has legislative frameworks in place to manage and assess port developments and their associated operations. Neither Strategic Assessment has a detailed consideration of port development.	Small	Medium. Further research on the impacts of dredging and material placement activities is needed. Assessment of cumulative impacts and offsets are gaps which are identified for further action.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 SUMMARY OF CONCLUSIONS

The conclusions of the independent review have been summarised by applying the descriptions outlined in Table 8-1. A summary of the review team's assessment of the adequacy of the Strategic Assessment across the key sections of the GBRMPA Program is provided in Table 8-2.

The draft documents address the majority of the requirements of the Terms of Reference, and with further improvement, could be completely consistent with them. The documents therefore represent significant progress towards establishing a robust and comprehensive Strategic Assessment for the Great Barrier Reef Region. The reports are comprehensive, well referenced and have been informed by extensive public engagement processes. Further work is recommended to clarify some areas of confusion, refine the explanation of some key technical areas and develop stronger management actions that will more directly address the declining condition of the Great Barrier Reef ecosystem.

Table 8-1
Description of assessment method for summary table.

Assessment	Description
	A rigorous and detailed assessment has been completed. If gaps exist, they are relatively minor and can be addressed with minimal rework.
	The assessment has been partially effective, with some gaps present. Further work is recommended to improve the rigour of the assessment.
	Major gaps are present and conclusions are not based on the available evidence or sufficiently supported by information. A more detailed description, assessment and/or justification for the outcomes of the assessment are required.
	Not applicable

Table 8-2 Summary table of SKM's assessment of the adequacy of the Strategic Assessment.

Summary of Adequacy of Strategic Assessment						
Program component	Coverage of topics within the Terms of Reference	Structure and cohesiveness	Breadth and Depth	Technical Accuracy	Validity of conclusions	Key comments, focussing on gaps
Introduction and objectives						No clear objectives for the Strategic Assessment process.
Identification of MNES						Improve use of terms when describing MNES and OUV (e.g. values, attributes and elements).
Description of Program legislation and policies						A clear description of the management framework is provided.
Environmental Regulation						Diverse range of tools in legislation, policy and management plans. Further description of scale of implementation would be useful.
Engagement						Tourism is a strength. Influence outside of the marine park lacks the traction needed to improve outcomes, because some stakeholders may not be effectively engaged and may have differing priorities (e.g. the agricultural sector).
Knowledge, integration and innovation						The "act, monitor, check" step is often missing. Data deficient attributes are assessed as being in good condition, without rigorous science, skewing the overall picture. Methods for obtaining expert opinion could be explained in more detail, with a discussion on how the information presented is the best available science (in the absence of published scientific information).
Addressing spatial scale						Good overall. When discussed at a whole-of-Great Barrier Reef scale, the significance of the decline in condition of the southern inshore region is sometimes underemphasised.
Strengthened management						The right kind of initiatives are proposed, but resources appear to be lacking to implement them at the scale required.
Forward Commitments						Forward commitments are processes rather than outcome-focussed and are not of a scale required to address the declining MNES. They are also not aligned with key gaps in the current Program.
Implementation and Governance						No discussion of the adequacy of resources to meet the challenges identified in the assessment. Demonstration of strong collaboration with the Queensland Government could be improved.
Demonstration Cases						Good examples are summarised. No detailed demonstration cases were published at the time of the review. The fisheries demonstration case appears more relevant to the Queensland Government Program.

8.2 OUR OVERARCHING VIEW

In the 2009 Outlook Report (GBRMPA 2009) the Authority Chair, Dr Russell Reichelt, stated that: "The outlook for the Great Barrier Reef ecosystem is at a crossroad, and it is decisions made in the next few years that are likely to determine its long-term future. Given the strong management of the Great Barrier Reef, it is likely that the ecosystem will survive better under the pressure of accumulating risks than most reef ecosystems around the world."

Since that statement, peer-reviewed studies have shown that the condition of foundational ecosystems (e.g. coral reefs, seagrass habitats) and species (e.g. dugongs, turtles, sharks) within the Great Barrier Reef World Heritage Area have declined very significantly. This is particularly true in the southern two thirds of the region where human activities such as agriculture and coastal development are affecting the quality of water in the reef lagoon.

Based upon the evidence presented in the Strategic Assessment, it would seem reasonable to suggest that the reef has now travelled through the crossroads and is on course towards even greater decline in the absence of significant interventions. Arguably, the GBRMPA Program should include restoration ecology actions as well as protective management, and move away from an assumption that the reef will be protected with the current approaches to halting and reversing the declines.

Given this, a reasonable expectation of the Queensland and GBRMPA Program Reports is that they should provide a compelling case for how they will deliver significantly improved, adequately resourced and timely management of risk for the Great Barrier Reef World Heritage Area. Critical to achieving a halt to the declining condition of MNES across the vast region encompassed within the World Heritage Area will be the scale and effectiveness of interventions proposed within the future programs.

The GBRMPA Program Report sets a 25 year time frame for action. This is appropriate - a long term adaptive management strategy and implementation plan is required, and the Authority has properly proposed milestones/stages in the implementation of the Program. However, there is a risk that the 25 year implementation time frame may suggest to the Government and GBRMPA that actions to address the many challenges faced by Great Barrier Reef ecosystems are not urgently required and that additional resources for implementation are unnecessary.

Across the Assessment and Program Reports, there is little evidence that GBRMPA plans to meet the requirement for immediate additional interventions. The Program Report, for example, introduces a gradual (over the first five years) improvement in strategy, process, stakeholder engagement and introduction of targets that alone are unlikely to be sufficient to arrest what is in

some cases an alarming decline in the condition of core ecosystem components. There are no plans to develop an enhanced and integrated monitoring program until the sixth year (2020) of the 25 year program. For expanding or new monitoring components, this would result in inadequate data with which to gauge trends in declines or improvements in condition until 2025-2030. There is considerable evidence from coral reefs in other parts of the world that these systems reach tipping points, shifting from coral reef systems to algal or mixed soft bottom/ algal communities. Without a comprehensive and well-integrated monitoring program, it would be difficult to determine whether management actions were being effective in avoiding movement towards such a tipping point. If this state were ever reached, it would be very difficult to reverse and rebuild ecosystem integrity.

There are several gaps identified in the current management framework, including a lack of understanding of ecological processes that underpin MNES, the distribution and intensity of recreational use of the marine park and knowledge of indigenous and historic heritage. Improved management will have immediate resource implications: GBRMPA active across a broad range of policy areas, targeted interventions by both the Commonwealth and State Governments, an integrated monitoring program, and addressing the gaps in knowledge that currently inhibit the ability to understand and mitigate future risks. It is important that the Assessment and Program reports acknowledge this need for more resourcing, as well as the costs and implications of not implementing improved management, through the ongoing decline of MNES.

8.3 RECOMMENDATIONS

Detailed recommendations to improve the adequacy, readability, technical standing and comprehensiveness of the Strategic Assessment are provided in Appendix A. These recommendations are summarised into the following key issues:

- Reconsider forward commitments of the proposed Program, with a view to comprehensively addressing the management gaps identified in the Assessment Report. This will enhance the effectiveness of future management activities by targeting them towards the critical issues contributing to the declining condition of the Great Barrier Reef. The scale of direct action also needs to be increased.
- Impose a stronger focus on outcomes in the development of forward commitments. Re-evaluate whether the processes fundamental to the existing draft forward commitments are likely to facilitate a reversal of the decline of MNES across large parts of the Great Barrier Reef.

- Explicitly outline the additional resources required to implement the five principal activities set out in the proposed new Program. Ensure that the form and governance of the Reef Trust allows for ongoing resourcing of the Program throughout its life.
- Provide further details on the establishment of an integrated and funded research, development and monitoring program to guide future management activities and evaluate their effectiveness. Current scientific knowledge gaps are limiting the effectiveness of existing management approaches, and a more detailed understanding of the World Heritage Area's function is required. Consider a national research strategy model for the Great Barrier Reef, similar to those in place for water research, climate research and Antarctic research.
- Evaluate the contributions that GBRMPA can make to managing the Great Barrier Reef for improved resilience in the face of climate change. Prioritise and fund an expansion of actions which will reduce cumulative impacts at key sites and boost ecosystem resilience. Build upon the successful activities of the field management program across a broader area.
- Work closely with the Queensland Government to improve the alignment of the Strategic Assessments, reducing uncertainties associated with jurisdictional boundaries and facilitating a seamless, whole-of-Great Barrier Reef approach. Consider the collective weaknesses of both Programs and options to reduce impacts in such areas to MNES including OUV.
- Strengthen the technical standing of the Strategic Assessment by providing a more comprehensive characterisation of gaps in data and alternative hypotheses.
- Consider how GBRMPA can incorporate the science of restoration ecology into its management of the southern inshore region, to guide management effectiveness, test current scientific understanding and enhance resilience.

9. REFERENCES

- Andersson, M. (2008). Hinchinbrook Area Boater's Opinions Of and Compliance With Dugong Conservation Initiatives. Independent Study Project (ISP) Collection. Paper 561.
- Bainbridge, Z.T., Wolanski, E., Álvarez-Romero, J.G., Lewis, S.E. and Brodie, J.E. (2012). Fine sediment and nutrient dynamics related to particle size and floc formation in a Burdekin River flood plume, Australia, Marine pollution bulletin 65(4): 236.
- Brodie, J., Fabricius, K.E., De'ath, G. and Okaji, K. (2005). Are increased nutrient inputs responsible for more outbreaks of crown-of-thorns starfish? An appraisal of the evidence, Marine Pollution Bulletin 51(1-4): 266-278.
- Browne, N.K, Smithers S.G, Perry C.T (2012). Coral reefs of the turbid inner-shelf of the Great Barrier Reef, Australia: An environmental and geomorphic perspective on their occurrence, composition and growth. Earth Science Reviews 115: 1-20.
- De'ath, G., Fabricius, K.E., Sweatman, H. and Puotinen, M. (2012). The 27–year decline of coral cover on the Great Barrier Reef and its causes, Proceedings of the National Academy of Sciences 109(44): 17995-17999.
- Erftemeijer, P.L. and Lewis, R.R. (2006). Environmental impacts of dredging on seagrasses: a review, Marine Pollution Bulletin 52(12): 1553-1572.
- Fabricius, K.E., Okaji, K. and De'ath, G. (2010).Three lines of evidence to link outbreaks of the crown-of-thorns seastar Acanthaster planci to the release of larval food limitation, Coral Reefs 29: 593-605.
- GBRMPA (2009). Great Barrier Reef Outlook Report 2009. Commonwealth of Australia.
- GBRMPA (2012). Great Barrier Reef Region Strategic Assessment Terms of Reference. Great Barrier Reef Marine Park Authority, 18 pp.
- GBRMPA (2013a). Great Barrier Reef Region Strategic Assessment - Program Report, Draft for Public Comment. Great Barrier Reef Marine Park Authority, 84 pp.
- GBRMPA (2013b). Great Barrier Reef Region Strategic Assessment – Strategic Assessment Report, Draft for Public Comment. Great Barrier Reef Marine Park Authority, 636 pp.
- Gell F.R, Roberts C.M (2003). Benefits beyond boundaries: the fishery effects of marine reserves. Trends in Ecology and Evolution 18(9): 448-455.
- Marsh H., De'ath G., Gribble N.A and Lane B. (2005). Historical marine population estimates: triggers or targets for conservation? The dugong case study. Ecological Applications 15(2): 481-492.

- McCook, L.J., Ayling, T., Cappo, M., Choat, J.H., Evans, R.D., DeFreitas, D.M., Heupel, M., Hughes, T.P., Jones, G.P., Mapstone, B., Marsh, H., Mills, M., Molloy, F.J., Pitcher, C.R., Pressey, R.L., ... Russ, G.R., Sutton, S., Sweatman, H., Tobin, R., Wachenfeld, D. and Williamson, D. (2010). Adaptive management of the Great Barrier Reef: A globally significant demonstration of the benefits of networks of marine reserves, Proceedings of the National Academy of Sciences 107(43): 18278-18285.
- Queensland Government (2013a). Draft Program Report. Great Barrier Reef Coastal Zone Strategic Assessment. Draft published for public comment.
- Queensland Government (2013b). Draft Strategic Assessment Report. Great Barrier Reef Coastal Zone Strategic Assessment. Draft published for public comment.
- Queensland Government (2013c). Great Barrier Reef Report Card 2011. Reef Water Quality Protection Plan. Published by the State of Queensland.
- Roff, G., Clark, T.R., Reymond, C.E., Zhao, J., Feng, Y., McCook, L.J., Done, T.J. and Pandolfi, J.M. (2013). Palaeoecological evidence of a historical collapse of corals at Pelorus Island, inshore Great Barrier Reef, following European settlement, Proceedings of the Royal Society B-Biological Sciences 280(1750): 2012-2100.
- SKM (2013). Independent Review of the Draft Great Barrier Reef Coastal Zone Strategic Assessment. Report prepared for the Department of the Environment.
- SKM APASA (2013) Improved dredge material management for the Great Barrier Reef Region, Great Barrier Reef Marine Park Authority, Townsville.
- UNESCO (2012). Mission Report – Reactive Monitoring Mission to the Great Barrier Reef (Australia), 6th to 14th March 2012. United Nations Educational, Scientific and Cultural Organisation, 99 pp.
- Uniquest (2013). Assessment of Management Effectiveness for the Strategic Assessment of the Great Barrier Reef Region. Hockings M., Leverington A., Gilligan B. UniQuest Pty Ltd.

APPENDIX A: RECOMMENDATIONS

APPENDIX A. RECOMMENDATIONS

Recommendations for improvement of the Program Report and Assessment Report are outlined in the following table.

#	Page Reference	Comment	Action
DRAFT Program Report			
1	**General Comment**	The Program Report could achieve greater consistency with the Terms of Reference by having a new section which describes the purpose and clear objectives of the Program.	Insert new section describing Program purpose and objectives.
2	**11**	Second bullet point: The first sentence notes the importance of action at the international level, but the remaining text does not identify engagement at this level. GBRMPA does have a long history of international collaboration and leadership. Continued and strengthened international efforts are needed to protect and restore the OUV of the World Heritage Area. The same comment applies to Section 4.2.	Explicitly identify engagement at an international level.
3	**13**	GBRMPA has undertaken a range of activities internationally that are relevant to Sections 4.2 and 4.3. The focus of these may have been more on international assistance rather than management of the Great Barrier Reef, but could include specific international cooperation that addresses threats to the reef. Examples include climate change, and mortality of threatened species, such as turtles, outside Australia's jurisdiction. Such actions will require a whole-of-government response.	Consider the inclusion of international activities in the Program description. Section 3.3 is one appropriate place to stress that effort beyond the reef-wide scale (including the Great Barrier Reef catchment) is needed.
4	**13**	Even though not a GBRMPA instrument specifically, the Interim Guidelines on the Outstanding Universal Value of the *Great Barrier Reef World Heritage Area—for Proponents of Actions* are highly relevant to Section 4.1.9.	Refer to the Interim Guidelines and integrate in text.
5	**18**	Description of management framework is brief.	Some further clarification of the purpose, scope, stakeholder involvement and authority of the management framework would be valuable.
6	**24**	Targets section: GBRMPA has taken into consideration the effectiveness assessment's conclusion that arrangements have largely been process- rather than outcome-focussed, and have committed to developing outcome-based targets. It is also appropriate that such targets are specific, measurable, achievable, relevant and time bound. The report is clear that the targets in Table 5 are preliminary, and will be developed further. A key consideration will be detailed understanding of what constitutes "measurable", in terms of the real uncertainty resulting from natural variability and measurement error in monitoring data, lag times to get a response, and so on.	Clarify that target setting will be a scientifically robust process that includes careful consideration of the types of data available to measure success and an understanding of system response times.

#	Page Reference	Comment	Action
DRAFT Program Report			
7	**24**	The discussion of targets also states that not enough is known regarding heritage values to set outcome-based targets so the targets will be action- rather than outcome-oriented. The same is probably also true for at least some of the biological value targets, and even where outcome-based targets can be set and should be the priority, there should also be targets developed for implementing specific actions to achieve the desired outcomes.	This may be inherent in the overall program development and implementation but could be made more explicit in Section 5.2.3.
8	**29**	The statement "by improving transparency and providing certainty about assessment requirements" could be expanded to explain how this will be done.	Describe the specific actions that will be used to achieve this (recognising this is a policy that will be developed).
9	**32**	What is the justification for prioritising the areas mentioned for the Reef Recovery program? Many of the locations listed were demonstration cases. Would priorities change had different demonstration cases been chosen? Why Mackay-Whitsunday when this area has achieved the highest reduction in pollutant loads (case study) and water quality is identified as the main threat to reef resilience? Description of the Reef Recovery Program would benefit from more information on its intended scale and how this will be matched with the scale at which impacts occur.	Explain reasons for choosing these areas as priorities, and/or consider different demonstration cases. Provide more information on the intended scale of the Reef Recovery Program and how this aligns with the scale at which impacts occur.
10	**Appendix 4**	Impacts are not the same as risks	Correct wording
11	**Validity of conclusions**	The Program Report does not identify sustaining and improving fisheries in relation to community benefits and direct uses.	Include in the Program Report.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
12	**3-5**	The application of the *Great Barrier Reef Marine Park Act 1975* outside of the boundary of the marine park could be further clarified.	Provide further details on the powers described in Section 3.3 of the Assessment Report, including examples of their application previously, or reasons why they have not been applied. Some analysis of the strengths and weaknesses of the existing legislation in addressing activities within the inshore areas or catchment of the Great Barrier Reef would improve the discussion.
13	**3-8**	The *Great Barrier Reef Marine Park Aquaculture Regulations 2000* are described as part of the Program, despite recent GBRMPA publications announcing the intention to repeal them.	Their current status and future plans for their implementation could be clarified.
14	**3-9**	*Marine Parks Regulation 2006* is not listed in Queensland legislation.	Add Marine Parks Regulation 2006 to the list of Queensland legislation.
15	**3-12, Table 3.1**	The table caption does not say the content relates only to GBRMPA tools, though the callout to the table in the text does place focus on GBRMPA. Even so, the table does include some other instruments, for example permits issued under Queensland Marine Parks Regulations. Not including Reef Plan under partnerships seems a significant omission as it is a centrepiece of the overall management of the World Heritage Area (Reef Plan is included in Section 4.2.1 of the Program Report). Queensland's role in fisheries management, and the recently issued Interim Guidelines on the Outstanding Universal Value of the Great Barrier Reef World Heritage Area—for Proponents of Actions, are also important components that should be mentioned in the table.	Review table caption and content.
16	**3, Table 3-2**	GBRMPA issues joint permits for some coastal development projects which may extend beyond state waters (for example involving dredging, material placement activities or pontoons).	Add dot to the Table for permits and coastal development.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
17	3-22	Sharks, dugongs and turtles – this section somewhat overstates the evidence provided by the cited papers for benefits of the 2003 zoning to sharks, dugongs, and turtles. Reference 14 (McCook *et al*. 2010) states that sharks have benefited, but also that these benefits are less than for more site-attached species. For dugongs, McCook *et al*. (2010) discuss the increased portion of critical habitat protected by the 2003 rezoning, however they do not provide evidence for beneficial effects; they also note that other protective measures are needed. McCook *et al*. (2010) treat turtles in a similar manner. Reference 17 (Marsh *et al*. 2005) does not address possible benefits of the rezoning for dugong, which would have been highly unlikely to occur on the short time scale between rezoning and the publication of this paper. Reference 18 (Gell & Roberts 2003) is a general review and provides no information regarding the effects of rezoning, in fact the paper was published before the rezoning was implemented.	Reconsider appropriate references for this section.
18	4-7	The reference simply to "aesthetic value" ignores the "superlative natural phenomena" component of criterion vii.	Include superlative natural phenomena component
19	4-8	Criterion ix provides a focus on biological and ecological processes (the only MNES that specifically refers to processes) but this is not sufficiently captured in the description nor in what needs to be protected as part of OUV. Activities that undermine such ecological and biological processes are of significant concern and should be included in discussions about impacts throughout the strategic assessment in addition to specific impacts on species for example. This is also implicit within the notion of "integrity" as used in World Heritage assessment and management.	While such processes may be implicit in the discussion, there would be value in making them explicit.
20	4-23	The discussion of community benefits of the environment does not include regulating services such as coastal protection, nutrient/ carbon sequestration. This may be because the discussion in largely based on public consultation, and the importance of such services is probably not front-of-mind for the general public. However, regulating services do not seem to be considered in the report. In particular, nutrient cycling and the critical role of wetlands are not addressed. Nutrient cycling seems to be considered solely in terms of catchment inputs (e.g. Strategic Assessment page 7-36), but given that a large proportion of saltmarsh, for example, has been channelized are there opportunities to reduce nutrient inputs via salt marsh restoration?	Include regulating services in community benefits.
21	4-32	1st sentence: Opening statement that these are baleen whales could be taken to imply that species discussed in subsequent paragraphs are not.	Revise wording

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
22	4-43	Light attenuation is the amount of decrease in light availability per metre, so depth does not necessarily determine light attenuation per se (light availability does depend on depth). Also, light attenuation is determined by concentrations of dissolved substances and plankton as well as sediment.	Clarify definition.
23	4-43	The statement that open oceans are effectively nutrient deserts refers primarily to central ocean gyres. Upwelling areas can have relatively high nutrient concentrations (though still lower than inshore areas in the context of the Region). Note the reference to the influx of nutrient-rich upwelled water on page 4-16. This is an example of not referring to key cycling processes such as immobilisation by uptake/deposition and denitrification.	Clarify statement.
24	4-43	Most atmospheric carbon dioxide does not remain as dissolved gas, instead it mostly forms bicarbonate and carbonate ions.	Suggest saying "*where it stays in dissolved form*".
25	4-45	The statement that water as a medium allows more competition than air (presumably meaning the terrestrial environment) is difficult to support scientifically.	The statement does not appear to add any value – delete, or provide evidence.
26	4-46	Connectivity: The concepts in the reports are critical to the context of the importance of maintaining connectivity (e.g. through the reserve network) and in understanding that impacts on one area can flow onto other areas and hence management needs to be on large spatial scales.	It would be worth briefly mentioning the flip side: that species or habitats with low natural connectivity are likely to be especially vulnerable. This can apply to species (e.g. inshore dolphins, live bearers, recent evidence that larvae of some reef fishes are not as dispersive as previously assumed) or to habitats that are spatially isolated by distance or current patterns.
27	5-overall	The Assessment Report focusses on the marine park in various sections, rather than the broader Great Barrier Reef Region. Some important aspects of management, such as port development, connectivity and water quality receive limited attention, without explanation.	Provide further information on management issues at the land and ocean interface, or explain why these are not addressed comprehensively (e.g. they are within the scope of the Queensland Coastal Zone Strategic Assessment). Cross referencing between the GBRMPA and Queensland Strategic Assessments would be useful.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
28	5-4	There seems to be some confusion in the first paragraph of 5.2.2: Climate Change. "Climate variability from year to year" is an oxymoron. Climate is a term used to describe the continuing condition of a place with regard to the drivers of weather. While weather and seasons change from year to year, climate does not. Climate change occurs over much longer timelines. Hence the confusion around climate change in the popular media. Within a given climate there are often seasonal, yearly and decadal variations of weather.	Change wording to reflect definition of climate change.
29	5-4	The latest IPCC report (released since the assessment reports were prepared) revises some of the predictions in this section, which could be updated in the final report.	Update according to latest IPCC report.
30	5-5	The Mauna Loa data series actually began in the late 1950s not the 1960s.	Correct dates
31	5-7	There would be value in discussing the prognosis even if atmospheric CO2 was to plateau at 400 ppm. What lags would there be before the system stopped deteriorating further? Is there a tipping point beyond which some functions stop and some species vanish? In the scenario of a return to 350 ppm, how long a lag before recovery and what gaps would there be once recovery is reached?	Further analysis of CO2 scenarios and climate change would improve the documents.
32	5-8	Treatment of climate change pressures (and indeed many other drivers) seems to suggest that all change will be gradual (e.g. Figure 5.3). This is not necessarily true, particularly when one considers that climate change is not the only driver/pressure and that interactions between climate change and other pressures may be compounding. There is plenty of evidence from coral reef systems in other parts of the world that reefs reach tipping points, from which they rarely rebound.	Revise assumption and associated text to consider non-linear and sudden changes.
33	5-9	There is little information presented on how GBRMPA is managing for resilience in the face of climate change.	Explain how management activities are focussed on improving resilience.
34	5-22	Reference to the repeal of the *Vegetation Management Act 1999* in Queensland is made but no discussion of risks associated with that.	Insert discussion of repercussions of the repeal of this legislation.
35	5-24	Aquaculture description does not include a description of sustainability issues.	Would be useful to briefly describe the environmental sustainability issues that previous aquaculture operations have had.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
36	**5-29**	1st paragraph in Impacts: Use of reference 114 (Erftemeijer & Lewis 2006) as providing evidence for the unqualified statement "Dredging to improve … is affecting habitats and species." is inappropriate. As the lead sentence of this paragraph, the statement implies widespread impacts of dredging, on a range of habitats and species (presumably meaning at a significant population level), within the Region. Erftemeijer & Lewis's review focused entirely on one specific group (seagrasses), reported that some dredging projects reported no significant long-term effects, concluded that the potential sensitivity of seagrasses to dredging-induced sedimentation is highly site-specific, and reported that improved mitigation measures (which have to a significant extent been applied to dredging in the Region) help prevent or minimise dredging impacts.	The sentence could be deleted without detracting from the message in the rest of the paragraph, and the *potential* for impact is addressed better in the paragraph that follows.
37	**5-29**	2nd paragraph under impacts: references for recent reviews of Erftemeijer *et al.* (2012) and Foster *et al.* (2012; reference 178 in Chapter 6) regarding dredging impacts on corals and reefs could be added.	Add these references.
38	**5-55**	Defence activities are only briefly summarised.	Provide reference or other justification for the statement that introduction of marine pests is the highest risk from all defence activities. In addition, should the use of active sonar, other defence-related shipping noise, and possibly fuel dumping from aircraft at least be mentioned with regard to defence, even if only to explain why they are not significant?
39	**5-62**	Year for reference 74 (Roff *et al.*) is cited incorrectly – the paper was formally published in 2013. This also occurs in other chapters.	Correct citations
40	**6-11**	2nd paragraph, Indirect Legacy Impacts: This is an example of sweeping general statements being supported with very limited explicit supporting data. Reference 21 (Roff *et al.* 2013) concluded there was a phase shift at one location in North Queensland that is likely to be particularly exposed to increases in terrestrial runoff. The Roff *et al.* study by itself does not provide support for reduced resilience on a reef-wide scale nor that such loss is "particularly in southern areas." The scientific consensus statement and supporting reviews provide more valid broad support.	Cite more references to support general statements.
41	**6-17**	The latest IPCC report (released since the assessment reports were prepared) revises some of the predictions in this section, which could be updated in the final report.	Update according to latest IPCC report.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
42	6-17	If the broad prediction that ocean acidification will "ultimately affect most marine life" is important it should be supported with reference citations. Most likely the sentence can be deleted without changing the key message.	Provide reference citations or delete sentence.
43	6-21	Guidelines for chlorophyll concentrations are explained in this section, but there is no explanation of what management responses are implemented in response to an exceedance.	A description of how GBRMPA responds to exceedances of this type would provide clarification of current management practices.
44	6-32	Acid sulphate soils. The seawater initially contains sulphate ion, not sulphides	Correct text
45	6-33	2nd paragraph: Loss of estuarine habitats: It is unclear how brackish water habitats differ from estuaries. More importantly, the statement of loss is potentially misleading and not supported by the cited reference 20 (Informing the Outlook). Informing the Outlook says 9% of estuaries have been lost (pages 31, 78 and 116). Informing the Outlook does indicate (pages 80 and 100) that some 30% of saltmarsh habitat has been modified by bunding – this is not the same thing as habitat loss (i.e., change in spatial extent). There is a statement on page 69 of Informing the Outlook that >30% of saltmarsh has been lost, but this appears to refer to modification rather than actual loss. Informing the Outlook does not appear to provide any basis at all for the upper figure of 60% loss of estuarine habitat, nor the statement that mudflats are one of the major habitat types lost.	Clarify difference between brackish water habitats and estuaries. Revise use of cited reference 20.
46	6-33	3rd paragraph, coastal reclamation: Distinction of land disposal (initially defined as above HAT) and reclamation is inconsistent.	Clarify and make consistent
47	6-35	Dredging	Erftemeijer *et al.* 2012 (effects of dredging on corals) should be added to reference list for dredging impacts
48	6-35	Reference is made to "the effects of dredging activities are well documented", but the bulk of our understanding (and particularly the studies referred to) are not particularly relevant to the tropical inshore and reefal communities of the Great Barrier Reef lagoon - e.g. the North Sea benthic communities and Indian coastal waters. The lack of information regarding the impacts of dredging on the inshore systems of the Great Barrier Reef (and indeed the hydrodynamics of the GBR lagoon) is an impediment to risk assessments. Elsewhere in the Strategic Assessment, GBRMPA sets out the systematic approach they will use to evaluate and minimise risk. The case of dredge impacts is one in which it would be prudent to note the lack of system specific information, which limits the ability to undertake the kind of risk assessment required.	In the context of this section of the Strategic Assessment, it would be worth noting the requirement for more research into region-specific impacts, and the development of adequate baselines and thorough monitoring of systems that will be affected by the proposed dredging activity in the GBRWHA.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
49	**6-39**	4th paragraph: Reference 137 (Bainbridge *et al.* 2012) refers to the dispersion of a fresh water plume – this is probably not representative of the dispersion of fine sediment from sea dumping. Much of the information on transport from river plumes relates to initial transport in suspension, while the buoyant plume is spatially propagating relatively rapidly on the surface. Most of the transport of dredged material after dumping modelled in reference 190 (SKM APASA 2013) was via repeated deposition and resuspension – i.e., these are very different processes and the distinction between measured transport of river plumes and dispersion of dredged material from dump site needs to be clear. Reference 190 (SKM APASA 2013) did not in fact evaluate the duration of time material stays in suspension, much less conclude that fine sediment remain suspended for long periods of time. In fact, the analysis of suspended solids in that study shows very low levels of TSS resulting from sea dumping (as opposed to dredging). The basic message that dredge material potentially travels long distances is valid, but the discussion needs accurate context.	Revise use of cited references to provide accurate context.
50	**6-39**	5th paragraph: Direct comparison of river plume transport with dredge material transport is not appropriate. River plumes carry sediment at the surface in a freshwater layer, the SKM APASA modelling dealt with transport via continuing resuspension/ settlement.	Delete first sentence.
51	**6-39**	The question of what happens to sea-dumped dredged material seems crucial to the major concerns about port development and maintenance dredging. The discussion given to this is currently inadequate.	A much greater discussion is needed along with presentation of implications for decisions about marine dumping of dredged materials.
52	**6-40, Figure 6-19**	The presentation of Figure 6.19 is potentially misleading. The prediction shown in Figure 6.19a was specifically to address worst conditions for Round Top Island, i.e., northward transport. There were other model outputs (e.g. worst condition for Victor Islet) that clearly predict much more extensive southward transport. Selecting a figure intended to assess impacts on a receptor to the north for comparison with imagery showing southern transport is not a balanced analysis of the information.	Present all appropriate figures in the reference or choose a better example. The message that model predictions are not always accurate is still valid.
53	**6-46**	The "trophic" approach to examining the impacts of extraction ignores an important element of the ecology and vulnerability of the various species groups that are covered - that of their mobility.	Suggest that some coverage be given to species/groups/trophic levels that we know are mobile/ pelagic versus those we know are sedentary/site attached, as they are more demersal/benthic. We'd expect to see different impacts on these two groups across a suite of pressures.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
54	**6-55**	When discussing the impacts of vessel strike on wildlife, it is stated that "go slow areas and transit lanes have been declared in some areas where there is high vessel traffic and large populations of marine turtles and dugong, such as near Hinchinbrook Island". This appears to be overstating current management arrangements, as the go slow areas are voluntary and have been reported to be of limited effectiveness in changing the behaviour of vessel operators (Andersson 2008).	Provide further clarification of the management arrangements in place to reduce boat strike on wildlife.
55	**6-56**	In Tables 6.6 and 6.7, the grouping of "no effect" and "unknown" into a single category is inappropriate.	Following the precautionary approach, one would expect either to see the two categories separated, or for those where the effect is unknown to be placed in a data deficient category.
56	**6-67**	Following an introduction to the qualitative modelling approach taken to examine the response of a system to impacts, the report notes that "while model links are qualitative ….they, nonetheless, represent a rigorous means to formally assess a system's dynamics and its response to disturbances". The method is only as good (or rigorous) as the data or expert opinion that generates the results. Rigour implies that there is a degree of repeatability, and this is not necessarily the case if data are not robust, or different groups of experts are used to develop a qualitative representation of the system.	It would be important either to make this qualifier, or to change the statement of worth from rigorous to useful.
57	**6-71**	GIS analysis methods are neither described or cited from the literature, leaving the reader with little by which to gauge how robust/useful they are. A cumulative impact map is a key example.	Describe/cite GIS analysis methods, in particular the derivation of the cumulative impact map.
58	**6-76, Figures 6.31, 6.32, 6.33, 6.8.3**	The analysis is actually of exposures, not impacts. Although the intensity levels used have been correlated to impacts, there is tremendous variation in sensitivity among species and populations within species that are not taken into account in the analysis. Nor does the analysis consider cross-shelf gradients in sensitivity. Spatial predictions of high water quality impacts are likely to be misleading for soft-bottom communities. These analyses are clearly useful tools for risk assessment but it is important to be very clear that they are not impact predictions *per se*.	Clarify that these are not impacts, but exposures.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
59	**6-76, Figs. 6.31, 6.32, 6.33, 6.8.3**	The work on cumulative impacts provides a useful initial framework but the need for validation through further monitoring and experimental studies should be made clear and be reflected in the proposed program. It would have been useful to test the spatial predictions of cumulative water quality stress against measured changes in condition, though it is recognised that there are limits on what could be achieved in the assessment. Recognising there are limits, it is somewhat surprising that spatial analysis in figures 6.29 and 6.30 is not linked in some way to the water quality analysis – readers may visually overlay Figure 6.30 and 6.33 and conclude impacts are high everywhere. Further steps using measured changes in condition would be useful to investigate whether it is appropriate to apply equal weighting to the different stressors, which could help in refining management priorities. Presumably these sorts of issues will be part of developing approaches to cumulative impact assessment but it may be useful to provide specific examples of research needs.	Clarify need for validation through further monitoring and experimental studies and include in proposed program. Link spatial analysis in figures to water quality analysis. Provide specific examples of research needs.
60	**6-79**	The cumulative impacts section could be improved. The title of this section seems inappropriate. The text in this section discusses the outcomes of the cumulative impacts, not of the assessments.	It is recommended to state upfront: a) the immaturity of our understanding of how to quantify cumulative impacts, and b) how essential this understanding is if we are to progress from the current method of planning and executing a single intervention for a single impact. Consider the title Assessment of Outcomes arising from cumulative impacts.
61	**6-81**	The summary of impacts of the strategic assessment should directly state the key reductions in habitat: average 50% decline in coral cover along the entire reef (much larger decline in southern and central regions). Coral cover is an accepted proxy for the condition of coral reefs worldwide. The decline has impacts on the last three of the world heritage criteria. Similarly, the water quality reduction over the last decade (regardless of whether there is evidence that the Reef Plan and other actions are acting to stop the decline) has had and continues to have a very significant impact on ecological and biological processes, on the intrinsic natural beauty and on habitats for (inshore reef) biodiversity.	Include direct statements describing key reductions in habitat in the summary of impacts.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
62	**6-83**	Useful summary of the required information/knowledge/systems and links to management of the World Heritage Area. However, it is unclear how this long list of required information and the call for a major integrated monitoring program will be resourced. Currently the funding of science for the Great Barrier Reef is spread across a large number of program areas in State and Commonwealth Government (Department of Education/ARC, Department of Industry, Department of Agriculture, Department of Environment, Department of Defence).	It is recommended to give greater focus and coordination to the major challenge of providing the highest priority/critical information required. This requires more than a list of topics within the Strategic Assessment. An Integrated Research and Development and Monitoring Strategy and Funded Program for the Great Barrier Reef World Heritage Area appears to be required, and should be articulated as a priority within the Strategic Assessment.
63	**6-87**	This section is a summary of the chapter's conclusions rather than dealing with outcomes. The summary does not highlight a sense of urgency. Having learned last year that the Great Barrier Reef had suffered an average of 50% decline in coral cover over the preceding 27 years, with central and southern regions having suffered much higher declines (north of Cooktown the picture is much better), and seen the biodiversity values of the inshore regions continue to decline, the "prognosis" for the Great Barrier Reef World Heritage Area under a business-as-usual scenario is at best poor. Table 6.11 is somewhat flawed in its representation of impacts on values as it continues with the logic used in tables 6.8 and 6.9 where Grading Statements are used to categorise impacts. The grouping of interactions that are "unknown" with those that are known to be insignificant or non-existent essentially is inappropriate. For example, the impact of ocean acidification on the Great Barrier Reef is currently poorly understood; at species, community and whole of ecosystem level. However, we know from direct measurement that calcification rates in corals that have been studied in detail are falling (in some cases dramatically). This may well be due to thermal or other environmental stressors, but it may also be that the significant drop in pH over the last 50 years is part of that impact. Similarly the impact of ocean acidification on foraminifera calcification has already been demonstrated for pelagic species, and recent work on benthic foraminifera that play a key role in sediment dynamics on coral cays and reefs suggest that they too are vulnerable under near-real time pH levels.	Re-title chapter or change content to deal with outcomes. Highlight a sense of urgency in managing the Great Barrier Reef. Separate "unknown" impacts from "insignificant/non-existent" impacts.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
64	**7-overall**	The information gaps are presented as a list without prioritisation. The coverage is adequate for the purposes of the assessment, but there is a gap when summarising condition and trend, in that major declines in coral cover, seagrasses and inshore biodiversity are not stated to be currently affecting the broader values of the Region, and if these declines are not arrested are likely to have much more dire impacts. To counter the status and trends in these major habitat/ecosystem foundations, there is reference to the poorly understood/studied elements of the system such as plankton communities, primary productivity. The Assessment has most likely established its view of these communities on expert opinion rather than hard data, this may not be an adequate basis for reporting as it has been in this Chapter.	Prioritise information gaps. Highlight declining condition of the reef. Reconsider the use of expert opinion rather than data for the basis of assessment.
65	**7-7**	The lagoon floor is assessed to be in good condition. Given the amount of trawling that has taken place in the Great Barrier Reef lagoon, a 'poor' and 'improving' rank would seem more appropriate, due to the reduction in trawl pressure.	Reconsider the assessment of lagoon floor.
66	**7-33**	Understanding and appreciation. This point links to one other World Heritage obligation - that of "giving World Heritage a meaning in the life of the community". There are multiple reasons why this obligation delivers benefits, not least of which is the garnering of community support for programs to better protect and manage the Great Barrier Reef. It is worth highlighting this in the Program as it has had a low profile in the past. Along with better communication about Climate Change and the Great Barrier Reef, the outcome could be very positive.	Highlight community aspects of World Heritage listing.
67	**7-34 to 38**	The section is highly variable in terms of the information content it provides, ranging from well-founded where data are adequate (e.g. freshwater input) to lacking where there is very little understanding or monitoring of the processes either by the Research and Development community or GBRMPA.	The determinations of trend and status are unlikely to be meaningful for those where data are inadequate, and in those cases the Assessment would be better listing them as data deficient.
68	**7-35**	Sedimentation. The reference to plumes and characterisation of likelihood do not accurately reflect the results of the cited study.	Text "*resuspended plumes likely to travel considerably further*" should be revised to "*resuspended sediments potentially travelling considerably further*".
69	**7-41**	"globally important breeding colonies of seabirds and marine turtles": the comment that there have been declines in some populations appears to fit the grading statement for good, rather than poor. What evidence is there for a declining trend?	Provide evidence for trend or revise comment.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
70	**7-47, 49, 52**	7-52 states that monitoring of nesting seabirds is insufficient to reliably determine condition and trend, yet on p 7-47 and 7-49 the confidence of ratings for poor condition and declining trend are rated as having adequate high-quality evidence and a high degree of consensus.	Resolve conflicting information.
71	**7-49**	National Heritage - there are five criteria "identified" as being relevant to the Great Barrier Reef. The Great Barrier Reef was not formally evaluated for National Heritage listing and it is likely that other attributes may achieve threshold if formally pursued (and these are just as well protected as World Heritage). Such an assessment could prove valuable in identifying a range of additional heritage attributes not currently acknowledged.	Consider a formal assessment of National Heritage criteria for the World Heritage Areas.
72	**7-54**	Environmental processes: gaps should be identified with regard to nutrient and carbon cycling.	Review and correct if necessary.
73	**7-54 to 55**	As in Chapter 6, the use of the title Outcomes seems inappropriate. These are findings and conclusions, not outcomes of the Assessment. The first stated "outcome" suggests that most habitats and species are in good to very good condition, yet the second outcome statement discusses corals, seagrasses, marine mammals, sharks and some species of fish being in poor to very poor condition. That two of the major habitats on the Great Barrier Reef are in serious decline seems incompatible with the first outcome's statement. The reality seems more likely that where we know coral and seagrass communities are in decline, we don't have adequate monitoring of the abundance/status and trends of the communities that depend on the coral and seagrass habitat.	The first conclusion should be more cautious and focussed on the available information.
74	**8-overall**	There is a consistent theme within the management review that for management to be effective there needs to be an integrated and comprehensive monitoring program developed and funded. The Program Review supports this in setting an integrated monitoring program as one of its priority actions. However, the 5 year timeframe for this action does not seem appropriate. Given that what is not measured cannot be managed, a management strategy rethink would start with what the information/monitoring needs are to ensure that targets and actions are set with a measure of confidence, that they are the right targets and form a basis to demonstrate that progress towards the targets is being measured and made.	Given the concerns about a number of major components of the ecosystem, and the significant impact of any further declines on the social and economic values of the Region, it is recommended that a reprioritisation of the integrated monitoring program is an immediate priority.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
75	**8-overall**	The method for assessing management effectiveness differs considerably from that used by the Queensland Government in the Great Barrier Reef Coastal Zone Strategic Assessment.	Explain why the methods differ and the implications for presenting a 'whole of ecosystem' picture across both Strategic Assessments. Consider opportunities for greater alignment of the Queensland and GBRMPA Strategic Assessments prior to their finalisation.
76	**8-overall**	The agricultural sector is a key industry for the Great Barrier Reef, yet there are few suggestions for strengthening management of this industry. Partnerships and stewardships are highlighted as valuable mechanisms to manage the Great Barrier Reef, but there is no assessment of their effectiveness.	More specific discussion of the improved management arrangements relating to the agricultural sector is recommended. Provide an assessment of the effectiveness of partnerships and stewardships within the existing GBRMPA Program.
77	**8-29**	It is surprising to see the "mostly effective' ratings for all of the outcomes except Biodiversity. This seems to say that GBRMPA has been doing their business effectively but have had relatively little effect on Biodiversity. Three of five biodiversity measures used in the review are declining, one is stable and only one (related to green zone health) is improving.	Given that Biodiversity Protection is a critical outcome for the protection of MNES, it is recommended that the Program Review provide sufficient new/ improved approaches such that there is a high likelihood of achieving the required improvements in outcomes.
78	**8-39**	Given that ten ports are outside GBRMPA's "jurisdiction" there is a general issue about the complications of managing the Great Barrier Reef.	GBRMPA's jurisdiction needs further discussion.
79	**8-94**	Concern around the statement made that "Grading for indicators around condition and trend and traditional knowledge were frequently made with limited evidence" support the earlier observations that GBRMPA does not have the required information base (monitoring, quantitative assessments etc.) on which to judge its own performance.	More appropriate treatment of areas with limited information.
80	**9-overall**	Very useful approach to examining and responding to the multiple and varying issues identified in preceding chapters. Section 9.11 sets out the case for being proactive which is supported. Arguably, the greatest threat to a number of these case studies for which direct intervention is possible is in the area of water quality improvement through improved land use practices or just reduction in the extent of harmful practices. The fact that this is not explicitly raised here is an omission.	Clarify third bullet point in 9.11. Explicitly include importance of improved land use practices.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
81	**9-overall**	Strongly agree with the section on Partnerships and the conclusion that these are key.	There would be benefit in adding enhanced effectiveness of partnerships between policy makers, regulators and researchers, to ensure maximum value is extracted for each research and monitoring investment dollar.
82	**9-overall**	A good coverage of the issues relating to dugong management leads to a "conclusion" (although it is not labelled as such) that improving adaptive management of dugongs is important. Regular monitoring of seagrass condition, population assessments, cumulative impacts assessment, feasibility of restoration and rehabilitation of seagrass habitats are all mentioned as elements of an adaptive management approach. Yet despite the urgency of the need to protect southern dugongs, these actions all seem to be left to the later years of the Program Report. This is one example of potential future management actions within what is really a business as usual approach.	There should be a clearer articulation on the urgency to act on identified gaps in management effectiveness.
83	**9-8, Figure 9.1**	The Y axis seems truncated or the data are wrong. The range mentioned in the legend is from zero to 5 (dugongs caught per beach) but the Y axis only goes to 3.0.	Caption could be corrected.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
84	9-10 to 13	In relation to corals, it is suggested that upfront in the "Significance" section, it is made clear that without healthy coral communities, the Great Barrier Reef World Heritage Area would likely degrade/evolve (as other Coral Reefs throughout the world have done) into ecosystems dominated by algal communities where overall biodiversity, natural beauty, etc. will be significantly diminished. There is a body of literature within the resilience and coral reef ecology domains that suggest coral reefs reach a tipping point at which point they switch from coral dominated systems to algal domination. A description of such phenomena should be mentioned in this chapter, in part to balance some of the comments around the potential of reefs to recover after cyclones. One other issue linked to this point is that scattered throughout the Assessment and Program Reports there is a theme of blaming coral decline, seagrass decline and associated troubles for southern dugongs and turtles on an unusually high frequency of severe cyclones (i.e., natural events that GBRMPA can do nothing about). In other places (climate change risks/impacts for example) there is acknowledgement that climate change projections suggest that cyclone intensity will increase over the next few decades - in effect raising the risk that the recent impact of high intensity cyclones will continue, a trend that would suggest in future there will be a heightened requirement to deal more effectively with a variety of anthropogenic impacts - water quality, COTS, coastal degradation, if we are to avoid reaching a tipping point.	Highlight risk of degradation/ evolution from coral reef to algal community, and that this may occur as a tipping point. Also highlight risk of increased cyclone intensity with climate change, leading to a future need for better management of the anthropogenic impacts to coral.
85	9-12	"Coral cover has declined throughout the Region." could be interpreted as contradicting other statements. Coral cover has declined on average over the Region as a whole but that is not the same as a decline everywhere.	Clarify
86	9-13	This section gets to the heart of the challenge facing the managers of the World Heritage Area - our coral reefs are in decline and we need to take action to increase their resilience. However, statements such as those in this section - that declines will continue "over the coming decades" - do not reflect recent analyses of trends. Projections within the De'ath *et al.* (2012) coral decline paper suggest that declines of coral cover in the southern region will be faster than implied by "in coming decades". There is a lack of emphasis on the possibility that once coral cover gets below 5% we may well see these ecosystems tipping away from coral-dominated habitats.	Revise "in coming decades" comments in light of recent analyses of trends, and emphasise the risk of tipping points.
87	9-13	Section 9.4.4. The message that overarching climate change needs to be addressed through a whole-of-government response is critical and needs to be more prominent in the Program Report.	Give message more prominence.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
88	**9-16**	The comment about many islands having serious legacy impacts and the extent of impacts on the islands should be read in the context that World Heritage obligations include rehabilitation and this has been of very limited effectiveness.	Clarify rehabilitation intentions and effectiveness.
89	**9-34**	Enhancing protection and restoration. This section provides no specific information about what further actions are needed and why. What aspects of wetland function have been compromised? This is another example that there does not appear to be a clear, targeted strategy to restoration ecology.	Actions are required, including a clear, targeted strategy for restoration ecology.
90	**10-6 to 7**	In this section we see the first attempt to examine the overall health of the reef and its "resilience", and this is well done. However, as noted frequently in the commentary for previous chapters, the conclusions regarding the state of the Great Barrier Reef are not adequately reflected in the presentation of risks, trends and case studies.	More recognition on the poor state of the Great Barrier Reef in the conclusions.
91	**10-overall**	"Maintaining the resilience of the Great Barrier Reef ecosystem will require major increases in effort to reduce local impacts and global climate change" is the most direct statement of the requirement for increased action by the Authority, Queensland and Commonwealth Governments. This statement is not linked to the possible consequences of not acting.	Link statement to consequences of inaction to provide a balanced analysis of the options.
92	**11-overall**	This Chapter is based largely on expert opinion-based modelling (qualitative and Bayesian belief networks) and while this methodology has great appeal as an approach for tackling complex problems/complex systems where data are not adequate to allow thorough analysis of trends in or interactions between system components, the extension of the model output into a table of future condition (and hence risk) of the Great Barrier Reef is questionable. More explanation of the method and uncertainties/ possible biases (e.g. a relatively small group of "experts" was involved many of whom share a common history of working on the Great Barrier Reef).	Provide further details on the modelling method and explain or reconsider its validity for predicting future condition.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
93	**11-overall**	Similarly, the projected conditions of many of the other attributes (shoals, plankton etc.) are based on a very poor knowledge of current condition. To suggest that future condition can be predicted based on poor current knowledge is an inappropriate method/approach and contrary to the precautionary principle. The heterogeneity in projected states (as there was in the current condition and risks) seems to reflect how well the abundance and condition of the stated variable has been examined. Coral reefs, seagrass beds, dugong populations, turtle populations, and seabird populations have all been studied, and all (with the exception of those north of Cooktown) are in poor or very poor condition, and have poor projections. Where there is quantitative assessments of fish populations, a similar pattern is apparent (with the exception of coral trout). However, in many other variables where there is little or no population data, it is suggested that their condition and projected condition (albeit with limited confidence) is good.	More appropriate expression of condition is recommended for attributes with limited data.
94	**11-13 to 15**	Perhaps as an example of the shortcomings of the qualitative/ expert opinion based approach, the Chapter's analysis of projected condition includes some interesting anomalies. For example, while the experts agree that there are likely to be very poor outlooks for coral reefs (the critical habitat for the majority of bony fish species in the Great Barrier Reef World Heritage Area), sea grasses (habitat for adults and juveniles of a large number of bony fishes) and sharks (an important group of apex predators both on and off reefs), the outlook for bony fish is good. At best a major reduction of coral and seagrass habitat would see a major species shift along the Great Barrier Reef.	Reconsider analysis approach and specifically, the conclusions in relation to bony fish.
95	**12-overall**	The lack of a statement around the timeframes that are being applied is of concern. Throughout the document there are various inferences/references to timeframes in the order of "next few decades", "next 25 years". However, the available data on declines in coral cover, seagrass, inshore biodiversity, dugongs, turtles and seabirds all suggest that unless the trends can be halted and reversed in the relatively near future (5-10 years), the risks of tipping into an irreversible state shift is high, particularly with the growing risks associated with climate change (noting that little of the declines recorded to date can be directly attributed to climate change).	Timeframes need to be more clearly defined and prioritised into the next 5-10 years for actions addressing key risks.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
96	**12-overall**	The assessment recommends providing a management framework that sets out outcomes and targets for the Region's values and progressively incorporates ecosystem thresholds as understanding improves. This recommendation could be interpreted as meaning that there will be no setting of outcomes and targets until our knowledge of the system is "improved or adequate".	If this is the meaning intended, it is contrary to the precautionary principle, and there should be an explicit statement to the effect that targets will be set based on the precautionary principle and refined as more knowledge becomes available.
97	**12-overall**	This section deals with the recommended improvements to local, state and national Government Programs and is a useful articulation of how GBRMPA and various levels of government interact. The suggestion that "the key roles of the Authority is collaborating with and influencing its management partners to improve environmental outcomes in the Region", raises the question of why the Commonwealth as a whole doesn't sign on to the enhanced processes suggested. The "where we could do better" paragraphs in this section include the following statement: "Consistent with the terms of reference, the following is a description of potential avenues for improvements in related local, state and national government programs. It is noted that any such recommended improvements are the view of the Authority and not necessarily those of the other relevant agencies."	There is a requirement for common acceptance of these actions/directions across these many layers of government if the shared goals are to be achieved.
98	**12-5**	The assertion that the assessment's focus on the Marine Park means that values relevant to other MNES are implicitly considered could be further justified or explained. It is clear that there are gaps. The recommendation will assist in addressing those gaps.	Reconsider or further justify the assertion.
99	**12-7**	REC13 involves a review and update of the Great Barrier Reef Marine Park Heritage Strategy.	Consideration could also be given to formal assessment of the Great Barrier Reef National Heritage by the Australian Heritage Council.
100	**12-9**	There seems to be a lack of action to be triggered by monitoring and evaluation. No indication is given of how such monitoring will be effective in protecting/managing the Great Barrier Reef .	Expand on monitoring triggers and consequences.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
101	**Throughout**	With regard to World Heritage, the Report suffers from inconsistency in discussing the meaning of World Heritage in the context of OUV. There is an apparent mixture of the terms "values", "attributes" and "elements" likely to cause confusion in the reader. The technical expression OUV is predicated on a number of attributes that contribute to the World Heritage site meeting specific criteria. These attributes underpin the OUV. Because of the inclusion of the word "value" in Outstanding Universal Value (always singular), associated use of the term "values" when discussing attributes has caused much confusion with many examples of OUV being used in the plural and therefore confusing its meaning (not in this report). The World Heritage Committee uses "attributes" as a preferred description of the set of qualities that underpin OUV rather than "values" (see Operational Guidelines). In the Report a good example of appropriate language is in Table 10.7 on page 10-22 (the first box). Elsewhere, beginning page 4-7, there is less clarity. Indeed on page 4-7 the term "values" seems to be seen as identical to "attributes" but later this is not applied consistently. The report would be improved with a box in the section 4.2.1 that provided a clear statement about OUV, attributes, values and the logic behind the use of these terms in the report in the context of World Heritage.	Clarify language around OUV through definitions and review of application of key terms.
102	**Throughout**	The chapter summaries don't always present findings about the declining condition of the Great Barrier Reef explicitly.	Reconsider the presentation of key findings in the chapter summaries.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
103	**Consistency with TOR**	The area to be covered includes the Region plus areas outside that may affect the Region.	It is recommended that there be some additional assessment of the changes proposed to land use in the terrestrial catchments of the Great Barrier Reef and potential consequences of policy changes with regard to Queensland Government initiatives (especially reducing environmental assessment requirements and vegetation protections). Also, some additional analysis of the Cape York Regional Plan and consequences for the Great Barrier Reef World Heritage Area is advised. The far northern section of the Great Barrier Reef may be subject to increases in pressure following the proposed changes outlined in the new Cape York Plan. At the very least this needs to be flagged as a matter of concern in the next 25 years.
104	**Consistency with TOR**	The Strategic Assessment considers MNES in a thorough and comprehensive manner. The discussions about World Heritage and OUV are comprehensive and mainly clear with a few minor communication improvements needed. Occasionally boundary blurring might lead to confusion for the reader (reference to the Great Barrier Reef Marine Park in isolation from the area under assessment for example). The Assessment considers almost all elements of World Heritage Area but occasionally misses opportunities for wider connections (limited recognition of the international cooperation context of World Heritage) and some World Heritage obligations could be more explicitly linked to the Assessment (for example giving World Heritage a function in the life of the community). There is very substantial overlap between the different MNES. The gap of a formal assessment of the Great Barrier Reef for National Heritage provides an opportunity for an initiative in the Program Report.	Minor communication improvements are suggested to assist in making wider connections.
105	**Consistency with TOR**	Given the reliance on the (Draft) North-Eastern Shipping Management Plan to ensure no significant shipping impacts on the Great Barrier Reef occur, more information about this draft plan should be provided so that readers can assess whether this reliance is sufficient.	Provide more information about the (Draft) North-Eastern Shipping Management Plan.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
106	**Consistency with TOR**	There is limited discussion of how the Strategic Assessment has met the endorsement criteria in the Terms of Reference.	A table summarising how each endorsement criterion has been met would provide clarity to the assessment process and more clearly demonstrate consistency with the Terms of Reference.
107	**Consistency with TOR**	Demonstration case studies were not published at the time of the review.	Publish demonstration case study reports with other Strategic Assessment documentation.
108	**Breadth and Depth of Assessment**	Nowhere is there a description of a trigger for action in any of the areas identified in the Program. For example (Program page 45) under Environmental Regulation, a five year target is "Regionally-based standards for ecosystem health". Existing guidelines are breached consistently for water quality for example (as described in the Report) but there are no regulatory consequences apparent. It is not made clear in the Program Report how the proposed improvements will provide better protection.	Clarify processes and outcomes for action triggers.
109	**Breadth and Depth of Assessment**	In the case of improving compliance, there is no reference to how this will be achieved that is more than the attempts to improve compliance in the past. It is unlikely that such an outcome will occur in the absence of additional resources but there is no discussion about resourcing the Program (e.g. the five principal activities set out in the proposed Program). This gap potentially undermines confidence in the future of the Program and its capacity to deliver improved outcomes for OUV and other MNES.	Define Program resourcing.
110	**Breadth and Depth of Assessment**	There is a missed opportunity to explore some specific actions that Australia might take on the international stage, under the guidelines of World Heritage. This would represent possibilities for the Convention to work as intended (international cooperation). How could GBRMPA (and Australia) influence the international threats to the GBRWHA OUV? International issues relevant to the Great Barrier Reef include climate change, pollution, shipping and the management of migratory species, marine turtles, whales, dugongs, shorebirds and seabirds. There is an opportunity to explore options around each of these at the international level (bilateral or under various treaties).	Explore some specific actions that Australia might take on the international stage, consistent with the World Heritage framework.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
111	Technical accuracy	It is insufficiently clear the extent to which key conclusions are based more on scientific consensus rather than high-quality data, for the issue of inshore reefs on the southern reef being particularly degraded. Two publications are repeatedly cited to support this conclusion: De'ath *et al*. (2012) and Roff *et al*. (2013). The decline reported by De'ath *et al*. (2012) was largely driven by a dramatic decrease in coral cover in the southern third of the reef, where the data used do not include any inshore reefs, and in the middle third of the reef (still the southern section in terms of the Strategic Assessment) trends for inshore vs. offshore reefs are not reported. The apparent phase change in an inshore reef reported by Roff *et al*. (2013) was reported from a single inshore site (Pelorus Island) relatively far to the north that is directly off the mouth of the Herbert River. Thus, whilst these papers are consistent with the conclusion that inshore southern reefs are particularly degraded, they do not provide conclusive evidence on a regional scale. Regarding the palaeoecological phase shift reported for Pelorus Island, the conflicting view of Browne *et al*. (2012) that inshore turbid reefs have been stable on palaeoecological time scales is not acknowledged anywhere in the reports. It is still the best available science and this comment does not dispute the decline or the need for urgent action; it does, however show the urgent need for better data regarding trends in inshore reef condition. Chapter 7 of the Strategic Assessment does acknowledge that inshore reefs are relatively poorly studied, but this does not come through strongly overall.	There should be more discussion of the more recently established inshore reef monitoring program, and it should be clearer that the decline in inshore southern reefs reflects consensus rather than high-quality data on appropriate spatial and time scales.
112	Technical accuracy	The link between nutrients and COTS outbreaks is the best available science but it is essentially based on two papers (Brodie *et al*. 2005; Fabricius *et al*. 2010) by the same research team. The reports are a bit inconsistent in characterising the strength of the evidence (e.g. "emerging evidence" vs "strong evidence" in various places) but more importantly the assessment appears to accept the link between water quality and COTS without question. The finding that COTS are less abundant in green zones is mentioned in places but not emphasised. This does not detract in any way from the importance of improved water quality, but the assessment appears to a considerable extent to assume that improved water quality will solve the COTS problem. The assessment does refer to the potential direct control of COTS outbreaks, but the assessment would benefit from a more systematic consideration of a "Plan B" if it turns out that water quality improvement is not enough. Given the importance of COTS, it is surprising that the assessment does not identify any knowledge gaps/research needs for COTS – does GBRMPA consider that current scientific understanding is adequate for management?	Describe the limitations in current understanding of COTS outbreaks in more detail, including alternative hypotheses. Evaluate alternative management options water quality improvements are not enough to control COTS. Identify knowledge gaps/research needs for COTS.

#	Page Reference	Comment	Action
DRAFT Strategic Assessment Report			
113	**Validity of conclusions**	The Conclusions of the Strategic Assessment follow logically from the evidence presented and are consistent with present understanding of the Great Barrier Reef . The Program Report seems particularly weak in identifying outcomes explicitly linked to reversing the deterioration in the Great Barrier Reef condition. All the proposed actions under the Program Report are appropriate and contribute to the prospect of better management but it is not clear that this will suffice to overturn the concerns identified in the Strategic Assessment. There seems to be a great deal of implicit expectations within the forward commitments.	Include stronger additional management actions as forward commitments.
114	**Validity of Conclusions**	Overall: Given the decline in coral cover on the reef, there would seem to be an urgent need for more "restoration ecology" research – for example intensive monitoring of sites for recovery after COTS outbreaks or cyclone damage, testing the efficacy of COTS control, trialling restoration methods, and assessing priority areas to enhance resilience and more confident identification of approach to tipping points. De'ath *et al*. (2012) suggest that COTS control alone would be sufficient to allow coral recovery at a reef scale, which is a testable hypothesis. The urgency of targeted research to apply to reef restoration does not come through sufficiently in the program report.	Highlight the need for restoration ecology research.
115	**Validity of Conclusions**	The decline of southern inshore reefs is rated as having high-quality evidence and high degree of consensus on page 7-11. Consensus is clear, but high-quality evidence more problematic. On page 7-51, the status and trends of inshore fringing reefs are identified as a key information gap.	Lack of data should not become a basis for inaction but the importance of actions to obtain better information for application to understanding resilience, recovery and restoration does not necessarily come through consistently. Consider revising text.
116	**Validity of Conclusions**	There are a number of references to marine pests in the assessment, including identifying information on them as a key gap (page 6-84) and the assessment that marine pest management is a weakness (page 8-31). The only response in the Program Report, however, is to improve the capability to respond to incursions if they occur. The risk of marine pest incursions is likely to increase with reduced reef resilience, and the development of preventative measures seems to be a gap in the Program Report response. There are international guidelines (International Maritime Organisation) and national guidelines on biofouling management, for example, that could be the basis of GBRMPA policy.	Include further discussion and response for marine pests.

SINCLAIR KNIGHT MERZ

SKM

www.globalskm.com