Tropical Water Quality Hub

National Environmental Science Programme

Final Report

# The establishment of a future NESP dredging research investment framework

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Australian Government

Australian Institute of Marine Science

# The establishment of a future NESP dredging research investment framework

## NESP TWQ Hub Project 1.9

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Cover photographs: The trailing suction hopper dredge Brisbane in the Port of Townsville 2015 (R. Jones).

This report is available for download from the NESP Tropical Water Quality Hub website:
http://www.nesptropical.edu.au

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# ACRONYMS

GBR..... Great Barrier Reef
GBRMPA.....Great Barrier Reef Marine Park Authority
GBRWHA .....Great Barrier Reef World Heritage Area
NESP..... National Environmental Science Programme
TWQ ..... Tropical Water Quality

# ACKNOWLEDGEMENTS

We thank the NESP Tropical Water Quality Hub for funding this research. We are indebted to the managers, scientists, and other research users and stakeholders for their input into the workshop, which formed the basis for the recommendations from this project.

# 1.0 EXECUTIVE SUMMARY

The purpose of this project was to conduct a facilitated workshop with key researchers and stakeholders to establish priorities for future research investment of the NESP Tropical Water Quality Hub (NESP TWQ) into dredging and disposal of dredged sediments in the GBR.

A recent independent review of potential impacts of dredging on the biological values of the Great Barrier Reef (GBR) identified a number of key knowledge gaps that need to be addressed to improve management of dredging[1] activities. That review, together with the findings of the currently underway dredging science node of the Western Australian Marine Institution (WAMSI), informed the subsequent prioritisation of research topics to address the most important knowledge gaps.

The project team synthesised a list of 21 potential research sub-themes for consideration and prioritisation by researchers and stakeholders from industry and government agencies. The initial online survey identified six high priority sub-themes and these were presented and debated among the diverse participants at a subsequent workshop.

Distillation into a list of two high and one secondary priority themes was achieved at the workshop with widespread support. The priority themes will address the gaps in our understanding of ecological thresholds caused by dredging-related pressures, dredging sediment transport pathways and research to understand the risks associated with disposal of dredge material on land.

The priorities, as forwarded to the NESP TWQ, to consider in subsequent funding calls were:

- **Priority 1a: Develop critical ecological tolerance thresholds for light reduction, suspended sediments and sediment deposition to predict ecological impacts of dredging operations**
  The expected outcome of the research is the development of thresholds that take into account other local pressures and natural ecosystem variability. The results will also be applicable across multiple sectors and to other cumulative impact research, and may yield innovative indicators for monitoring. The results may also be immediately use to adaptive management and regulation.
- **Priority 1b: Better quantification of sediment transport pathways over relevant timeframes**
  The expected main outcome of this research is an improved understanding of spatial extent and temporal variability of zones of impacts due to dredging and material placement activities in the context of natural variability in sediment transport pathways, resuspension and deposition dynamics.
- **Priority 2: Assessment of potential impacts and risks associated with disposal of dredge material on land and in reclamation areas**
  The expected outcome of this research is a synthesis of current knowledge to support environmental impact assessments and policy decisions.

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Note that throughout the document the term “dredging” is intended to mean both, dredging and disposal of dredge material.

# 2.0 BACKGROUND

Ports are vital to maintaining growing Australia's import and export trades. Most ports are located in shallow inshore areas and have needed to construct channels, berths and swing basins to allow safe vessel access. Routine maintenance is often required to remove naturally accumulated marine sediments from these navigational areas.

The removal and relocation of natural seabed to construct navigational areas for vessels is known as *capital dredging*, whereas the removal and relocation of mobile sediments that settle into previously constructed navigational areas is known as *maintenance dredging*.

Capital dredging is typically of much longer duration than routine maintenance dredging. Both types of dredging generate elevated suspended sediments (SS) for durations of days to months, depending on the duration of the excavation phase and environmental conditions. The increased SS can result from both the excavation activity as well as subsequent disposal of the material.

Disposal of the excavated material in approved unconfined 'spoil grounds' at sea is common during maintenance dredging. The coarse particles in relocated dredge material (gravels and sands) are rapidly deposited onto the nearby seafloor, while finer sediments (silts and clay) can disperse many kilometres from the excavation sites. Fine sediments at the relocation area can resuspension from the sea floor as a result of currents, tides and wave energy, as is also the case with other mobile fine sediments.

Recent changes to state and federal legislation have led to a discontinuation of sea disposal from capital dredging programs greater than 50,000$m^3$ in the GBRWHA and adjacent state waters. Under these new policies disposal of material derived from capital dredging can occur on existing land or be used for reclamations of coastal and offshore areas. These may facilitate land reclamation in ports, but this process is not without risks, including escape and leaching of sediments into the coastal zone, release of SS as part of discharge water and loss of coastal marine habitats through direct reclamation.

The potential and perceived effects on the World Heritage values of the Great Barrier Reef (GBR) of large capital dredging operations that have been completed or are proposed at Gladstone, Hay Point/Mackay, Abbot Point and Townsville have been raised recently by the government, industry and the public. In response, the Great Barrier Reef Marine Park Authority and the Australian Institute of Marine Science commissioned an independent review by a diverse expert panel to assess the available information relating to the effects of dredging activities in the region. This review was published as a synthesis report in 2015 (McCook et al. 2015) and outlined the current knowledge of the potential physical and chemical effects of dredging on the biological values of the GBRWHA. The expert panel also identified remaining knowledge gaps important for the future improved management of dredging activities in the GBR. The Department of the Environment acknowledged these knowledge gaps by including dredging-related research into the priorities for the Tropical Water Quality Hub of the National Environmental Science Programme (NESP TWQ).

This current NESP report outlines the subsequent process of prioritising NESP TWQ research investment to address current research gaps and improve management decisions on dredging projects in the GBR. The project output is a coordinated research framework, based on best available current knowledge to guide the timing, focus and extent of future investment into dredging management-related research in the GBR.

# 3.0 INCLUSIVE AND CONSULTATIVE APPROACH

It was determined that in order to achieve end-user uptake, both stakeholders and researchers need to contribute to, and agree upon, a research agenda that delivers strategic information to allow the debate to progress towards developing workable 'real life' solutions for the Ports Industry, while simultaneously addressing water quality decline and ecosystem health impacts in the GBR.

The project therefore conducted an inclusive survey of key researchers and stakeholders (Appendix 1) followed by a facilitated workshop (Appendix 2) to prioritise the future knowledge needs for improved management of dredging activities in the GBR. This process resulted in less adversarial debate and more focus on innovative solutions. Outcomes and the research priorities identified during this workshop are presented in this report.

# 4.0 RANKING KNOWLEDGE-GAP THEMES USING A STAKEHOLDER SURVEY

As preparation for the workshop in August 2015, the project team grouped knowledge gaps into six main themes (Table 1), drawing from the GBR Dredging Synthesis Report (McCook et al. 2015), research priorities from the Dredging Science Node of the Western Australian Marine Institution (WAMSI) (Masini et al. 2011) and the Great Barrier Reef Marine Park Authority Science Strategy and Information Needs 2014-2019 (GBRMPA 2014). The knowledge gaps were limited to those relevant to the GBRWHA and those considered feasible within the duration of the NESP TWQ Hub (i.e. over the next 5 years 2016-2020).

For each of these six overarching themes, information from the source documents was synthesised to provide more detail on potential activities, information or approaches identified as necessary to begin to address the knowledge gaps. This detail is presented in Table 2 as a series of sub-themes.

These 21 sub-themes formed the basis for the questionnaire to prioritise the knowledge gap themes and sub-themes (see Appendix 1 for details). This was to be completed before the workshop in order to focus the discussions at the workshop. Survey participants were asked to:-

1. Rank the six overarching themes of current knowledge gaps from 1-6, with 1 being the most important.
2. Rank the 3 to 4 sub-themes in each Theme
3. Identify missing knowledge gaps or any other issues

The questionnaire was sent to 38 stakeholders and 16 scientists on August 13, 2015, (Appendix 1, Table A1) and 30 responses were recorded over the following week.

For presentation at the workshop, the survey results were analysed and ranked, using different approaches. The ranking of the major themes (survey question 1) was done using two approaches:

- Method 1.1: Simply adding the responses that ranked a major theme as “priority 1” and presenting the result as a proportion of the total responses (n=30) (see Figure and Table 1)
- Method 1.2: Adding the responses that ranked a major theme as priority 1, 2, or 3, using an additional weighting factor (counts for priority 1*3, counts for priority 2*2, counts for priority 3*1) and presenting the results as a proportion of the total weighted responses (180, from n=30*3 + n=30*2 + n=30*1) (see Table 1).

The ranking methods produced slightly different results, but showed clearly that the major themes 1 to 4 were of high importance to the stakeholders and research users. These themes each attracted between 17 and 27% of the first priority counts and 16-22% of the weighted counts of priority 1, 2, and 3.

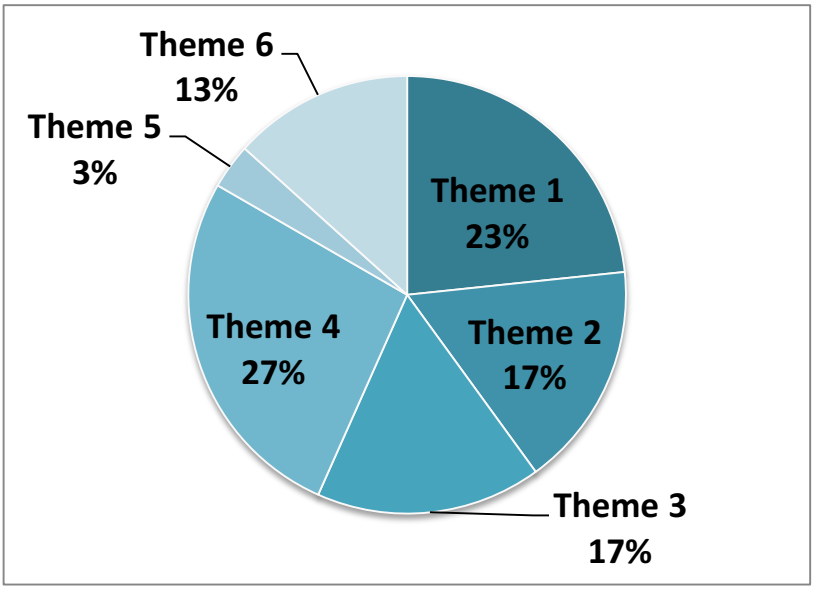


**Figure 1:** Proportion of the six knowledge gap themes ranked as priority 1 in the stakeholder survey.

**Table 1:** Identified knowledge gaps grouped into six main themes, and their ranking in the stakeholder survey.

Note: themes with the same number of response counts were given the same rank.

| **Major knowledge gap theme** | **Ranking (method 1)** | **Ranking (method 2)** |
|---|---|---|
| 1. Improved understanding of the generation, transport, deposition, re-suspension, consolidation, mixing, assimilation and sea bed armouring processes associated with fine sediment movement in the GBR, to be delivered by improved sediment models | 2 | 2 |
| 2. Improved understanding of the relative contribution of key natural and anthropogenic sources/drivers of suspended sediments in the GBR | 3 | 3 |
| 3. Improved understanding of the impacts of dredging activities on suspended sediment concentrations, underwater light (quality and quantity), and sediment deposition including the differential effects of sediment type organic content and particle size, and the potential release of contaminants including nutrients | 3 | 1 |
| 4. Identification of the primary cause-effect pathways and concentration-response relationships for sediment impacts over different time scale on key organisms, processes and habitats and development and testing (in the laboratory and field) of appropriate indicators and monitoring approaches; | 1 | 1 |
| 5. Development and testing of innovative management options, including incorporation of 'impact minimisation windows' for dredging and assessment of cumulative impacts | 5 | 5 |
| 6. Better understanding implications of land disposal of dredged material and opportunities for beneficial reuse of dredge material | 4 | 4 |

While this is an interesting result, the project team considered that these results did not provide enough granularity for a prioritisation of future NESP TWQ Hub dredging research.

Further analysis was carried on the responses to survey question 2, which provides ranking of the sub-themes within each major knowledge gap theme. The ranking of the sub-themes employed again two approaches

- Method 2.1: Ranked by count of 1st priority only (as method 1.1 for major themes)
- Method 2.2: Ranked by sum of weighted of 1st, 2nd and 3rd priority (as method 1.2 for major themes)

The two ranking methods returned the same result for the assessment of the top 6 sub-priorities (Table 2). These priority sub-themes formed the structure for the discussions at the August 2015 stakeholder consultation workshop.

**Table 2.** Identified knowledge gaps grouped into six themes and 21 sub-themes, and their ranking in the stakeholder survey.

The top-ranked 6 sub-themes are in bold font, listed with their survey rank (1 = highest) in the right column. For some activities a potential use statement is provided for context [in square brackets].

| **Theme/sub-theme** | **Top six sub-themes, as ranked by survey** |
|---|---|
| Theme 1. Improved understanding of the generation, transport, deposition, re-suspension, consolidation, mixing, assimilation and sea bed armouring processes associated with fine sediment movement in the GBR, to be delivered by improved sediment models | |
| 1.1 Field assessments to more accurately characterize sediment release rates during dredging activities (and disposal) and to provide source terms for coupled sediment transport and hydraulic models, recognising these will vary according to the types of dredges (trailer suction, cutter-suction, back-hoe), production rate and activity of the dredges (overflow rates etc), and sediment types (consolidated, sands/muds etc).<br>[*To create 'library' of ranges of suitable values to improve certainty in applied source terms*] | |
| **1.2 Better quantitative understanding of sediment resuspension, deposition, consolidation and armouring processes during dredging and disposal activities to provide input parameters for coupled sediment transport and hydrodynamic models and improve prediction of long-term (>12 months) sediment dispersion. [*To improve prediction spatial extent and temporal variability of zone of impacts*]** | **3** |
| 1.3 Development of a standard approach to be adopted in modelling studies for representing Great Barrier Reef broad-scale circulation processes in dredge plume models.<br>[*To improve consistency of approach between models and aid interpretation*] | |
| 1.4 Consistent approaches and frequency/duration of detailed oceanographic and sediment dynamics monitoring before and after dredging and disposal at disposal sites and surrounding areas, to quantify dispersion processes (including the influence of extreme conditions such as major storms or tropical cyclones).<br>[*To validate spatial and temporal extent of zone of impact]* | |

| | |
|---|---|
| Theme 2.: Improved understanding of the relative contribution of key natural and anthropogenic sources/drivers of suspended sediments in the GBR | |
| **2.1 Development of more accurate descriptions of natural sediment transport pathways , resuspension and deposition dynamics including relevant timescales, to develop a better understanding of the natural variability of turbidity and sedimentation in the inshore Great Barrier Reef. [*To improve differentiation and comparison of influences of natural or dredge related activities near coral reefs, mixed filter feeder habitats and seagrass meadows*]** | **4** |
| 2.2 Review of approaches to assess chronic effects associated with dredging activities and to distinguish those from effects of natural and other anthropogenic processes (monitoring to date has focused on acute impacts). [*To improve differentiation and comparison of influences of natural or dredge derived activities on coral reefs, mixed filter feeder habitats and seagrass meadows*] | |
| **2.3 Understanding the regional-scale significance of dredging activities in the context of shifted baselines and cumulative impacts, e.g. using long-term, large-scale scenario analyses, combining models with data from field observations and experiments and incorporation of this information into the EIA and compliance monitoring process. [*To enable assessment of potential impacts in the context of other drivers of environmental change*]** | **5** |
| Theme 3. Improved understanding of the impacts of dredging activities on suspended sediment concentrations, underwater light (quality and quantity), and sediment deposition including the differential effects of sediment type, organic content and particle size, and the potential release of contaminants including nutrients | |
| **3.1 Comprehensive analyses/compilation and synthesis of the existing data/information from dredging monitoring and impact assessments across northern Australia, much of which has not been utilised as fully as possible;** | **2** |
| 3.3 Detailed biogeochemical measurements at dredge material placement sites to clarify effects (and scales) of dredging activity on nutrient and organic matter dynamics and budgets; | |
| 3.4 Improved knowledge of the biogeochemistry (for example metal release) and potential impacts of acid sulphate soils, the long-term effectiveness of management measures, and the capacity to effectively manage large PASS volumes in short times. | |
| Theme 4. Identification of the primary cause-effect pathways and concentration-response relationships for sediment impacts over different time scale on key organisms, processes and habitats, and development and testing (in the laboratory and field) of appropriate indicators and monitoring approaches | |
| **4.1 Develop critical tolerance thresholds for light reduction, suspended sediments and sediment deposition, for a range of key species to inform more biologically relevant management thresholds during dredging (expansion of recent work with seagrass in Gladstone to other species and habitats). Work should integrate laboratory and field-based approaches and include interacting (co-occurring) stressors (natural variability in background conditions), respite periods and age-specific variations (e.g. vulnerability of recruitment stages),** | **1** |
| 4.2 Research into potential effects of dredging pressures on fish health; | |
| 4.3 Identification of the effects of increased suspended sediments on pelagic food webs and processes, microbial communities and related biogeochemical processes, and on habitats such as mangroves and intertidal mudflats within the context of impact prediction and monitoring | |
| 4.4 Development of practical tools (e.g. bio-indicators) to adequately assess sublethal levels of stress in relevant marine organisms (lab an field) associated with dredging and sediment disposal activities. | |

| Theme 5. Development and testing of innovative management options, including incorporation of 'impact minimization windows' for dredging and assessment of cumulative impacts | |
|---|---|
| 5.1 Improved identification and understanding of impact minimisation windows i.e. periods when dredging activities could have greater biological effects (i.e. sensitive periods of coral spawning and recruitment, seagrass growth seasons etc) or periods where the zone of influence may be greater (e.g. certain tidal phases);<br>[*To improve certainty around operational management options and improve utilisation of dredgers*] | |
| 5.2 Further development/enhancements of preventative measures to minimise impacts of dredging to megafauna and other species of conservation concern (e.g. turtle deflectors, impact minimisation windows)<br>[*To improve certainty around operational management options and improve utilisation of dredgers*] | |
| 5.3 Novel approaches for water quality monitoring coupled to integration of water quality platforms (wave-gliders, telemetry, modelling approaches, acoustic monitoring, satellite imagery, mobile sentinel stations) into operational planning and dredge material management plans, and development of techniques for water quality analyses into threshold development; Includes the development of tools and techniques to quantify sediment deposition at ecologically relevant levels and time frames i.e. (hours to weeks), allowing identification of sediment deposition fields around dredging activities.<br>[*To validate spatial and temporal extent of zone of impact]* | |
| 5.4 Development of standard approaches and protocols for observational programs to meaningfully inform conditional approvals and compliance monitoring in accordance with conditions specified in a permit, licence or approval.<br>[*Leading to more relevant and achievable monitoring compliance criteria*] | |
| Theme 6. Better understanding implications of land disposal of dredged material and opportunities for beneficial reuse of dredge material | |
| **6.1 More detailed synthesis of potential impacts and risks associated with disposal of dredge material on land and in reclamation;** | **6** |
| 6.2 Improved knowledge and technology for dewatering dredged material for reclamation or land-based disposal, including understanding of tailwater treatment and impacts; | |
| 6.3 Testing and defining the effectiveness of potential dredge material mitigation measures, including defining innovative approaches and new treatment technologies for the beneficial reuse of dredge material. | |

Additional gaps and issues identified by survey participants (in question 3 of the survey) included:

- Identification of community views and acceptance of different impacts of dredging activities and material disposal
- Research on fish health, fish disease and flow-on effect to fisheries and socio-economic effects
- Identification of chemical standards for sediments for disposal on land
- Development of innovative approaches to monitor for turtles prior to dredging/disposal to prevent any incidents
- Inclusion of research on interaction between environmental pressures from dredging (eg. light reduction, nutrient availability)
- Traditional owners could be engaged in participating in that research as 'cultural advisors/supervisors'
- Improved GBR monitoring: Even distribution of monitoring sites across the marine park and coastline and increased monitoring in highly valued (socio & economic) inshore areas

# 5.0 OUTCOMES OF THE WORKSHOP TO REFINE AND FINALISE THE KNOWLEDGE GAP THEMES AND PRIORITIES FOR FUTURE NESP INVESTMENT

The facilitated workshop to prioritise the future knowledge needs for improved management of dredging activities in the GBR was held in Townsville on August 21, 2015 and was attended by 31 participants, including researchers, federal and state department staff, government agencies, ports and consultants (see Appendix 2, Table A2).

The workshop started with two scene setting presentations (see Appendix 2 for a copy of the workshop agenda).

The top six priority sub-themes identified by survey of stakeholders and scientists were presented, debated and refined among the workshop participants. Despite the diverse backgrounds of participants, distillation into a list of two high and one secondary priority themes was achieved at the workshop with widespread support (Table 3).

The top priority themes will address the gaps in our understanding of: (i) ecological thresholds of key species to dredging-related pressures and (ii) dredging sediment transport pathways. Also considered a high priority is research to understand the risks associated with disposal of dredge material on land and reclamations.

**Table 3.** Final list of priority research themes and directions for future research as agreed by participants of the facilitated dredging workshop.

These research themes were refined and prioritised at the workshop from the sub-themes that were previously ranked by survey. Table 3 includes three immediate priorities and two additional themes for future research.

| Priority | Research sub-theme |
|---|---|
| **Priority 1a** | Develop critical ecological tolerance thresholds for light reduction, suspended sediments and sediment deposition to assess ecological impacts of dredging operations and inform future adaptive management to minimise impacts.<br><br>Developed from survey sub-theme 4.1<br><br>The expected outcome of the research is the development of 'site-realised' thresholds that take into account other local pressures. The results will also be applicable to other cumulative impact research, and may yield innovative indicators for monitoring.<br>NESP proponents need to prioritise research activities in consultation with end-users with regard to the following approaches and considerations:<br>• Review of existing information to inform and improve project scope and design<br>• Relevant timeframes (short-term acute to long-term chronic exposures), respite periods (ecological windows for dredging) |

| | |
|---|---|
| | • Relevant species/habitats, including age-specific variations (e.g. vulnerability of recruitment stages), and sediment types in terms of exposure to dredged or disposed sediment<br>• Selection of response endpoints that are ecologically meaningful, relevant to EIA, and accepted by stakeholders<br>• Integration of laboratory and field-based approaches and ideally include interacting (co-occurring) stressors (natural variability in background conditions). |
| **Priority 1b** | Better quantification of sediment transport pathways over relevant timeframes<br><br>Developed from survey sub-themes 1.2 and 2.1<br><br>The expected main outcome of this research is an improved prediction of spatial extent and temporal variability of zones of impacts due to dredging in the context of natural variability in sediment transport pathways, resuspension and deposition dynamics.<br>NESP proponents need to prioritise research activities in consultation with end-users with regard to the following approaches and considerations:<br>• Review of existing information to inform and improve project scope and design<br>• Development of more accurate descriptions of the natural variability of turbidity, sedimentation and light availability in the inshore Great Barrier Reef<br>• Quantification of sediment resuspension, deposition, consolidation and armouring processes and light availability during dredging and disposal activities to provide input parameters for coupled sediment transport and hydrodynamic models and improve prediction of long-term (>12 months) sediment dispersion<br>• Use of best available observational data and boundary condition as model inputs, e.g. from ports compliance monitoring and eReefs, and, if required, performance of regional field observations to collect additional data<br>• Selection of outputs from models that are ecologically meaningful, relevant to EIA, and accepted by stakeholders. |
| **Priority 2** | Assessment of potential impacts and risks associated with disposal of dredge material on land and in reclamation areas<br><br>Developed from survey sub-theme 6.1<br><br>The expected outcome of this research is a synthesis of current knowledge to support environmental impact assessments and policy decisions.<br>NESP proponents need to prioritise research activities in consultation with end-users with regard to the following approaches and considerations:<br>• Collation of knowledge and experiences from Australian and international land disposal and reclamation activities<br>• Identification of innovative or best management practices, and assessment of the potential to translate these into the GBRWHA context of cumulative impacts on coastal habitats |

| | |
|---|---|
| | • Assessment of technical capacity and capability for adopting best management practices in the GBR Region<br>• Assessment of the suitability of GBRWHA coastal areas for disposal/reclamation, including an ecological risk assessment, land tenure, exclusion of future uses, social consideration and health implications. |
| **Priorities for future research** | Comprehensive analyses/compilation and synthesis of the existing data/information from dredging monitoring and impact assessments across northern Australia<br><br>Developed from survey sub-theme 3.1<br><br>The expected outcome of this research is a synthesis of current knowledge to support environmental impact assessments and policy decisions.<br>NESP proponents need to prioritise research activities in consultation with end-users with regard to the following approaches and considerations:<br>• Production of an inventory of data and information from past dredging activities in the GBRWHA, with explicit consideration of availability, data sharing requirements, formats etc.<br>• Identification of priority research questions for subsequent data analyses. |
| **Priorities for future research** | Understanding the regional-scale significance of dredging activities in the context of other cumulative impacts.<br><br>Developed from survey sub-theme 2.3<br><br>This research is the logical progression of the identified high priority research under 1a and 1b and will combine understanding of exposure under natural and dredging scenarios with ecological thresholds and responses. It will enable a better assessment of potential impacts of dredging and disposal activities in the context of other drivers of environmental change<br>NESP proponents need to prioritise research activities in consultation with end-users with regard to the following approaches and considerations:<br>• Application of long-term, large-scale scenario analyses to assess the impacts of dredging and disposal in the context of natural variability and other cumulative impacts on the ecological values of the GBRWHA<br>• Assessment of regional community views on the socio-economic and cultural impacts of dredging and disposal operations<br>• Recommendations for the incorporation of this information into the EIA and compliance monitoring processes. |

Additional major discussion points at the workshop were:

1. Additional gaps identified by survey respondents (question 3 in survey)
2. Preferences of stakeholder and research users for engagement during future NESP TWQ dredging projects
3. Discussion about access to existing datasets relevant to dredging research.

Re 1. Additional gaps identified by survey respondents:

| **Issue raised by survey respondent** | **Summary of workshop discussion** |
|---|---|
| Identification of community views and acceptance of different impacts of dredging activities and material disposal | Embed in thresholds and land disposal projects (agreed priority 2) |
| Research on fish health, fish disease and flow-on effect to fisheries and socio-economic effects | Was considered important but a lower priority for projects that will address agreed priority 1a. |
| Identification of chemical standards for sediments for disposal on land | Covered by Contaminated Land Act |
| Development of innovative approaches to monitor for turtles prior to dredging/disposal to prevent any incidents | Monitoring alone will not prevent incidents but turtle exclusion devices are used and turtles are less affected by dredging than other species. |
| Inclusion of research on interaction between environmental pressures from dredging (e.g. light reduction, nutrient availability) | Considered in agreed additional priorities for future research "Understanding the regional-scale significance of dredging activities in the context of other cumulative impacts" |
| Traditional owners could be engaged in participating in that research as 'cultural advisors/supervisors' | The NESP TWQ Hub has an *Indigenous Engagement and Participation Strategy* to ensure research leaders consider opportunities for the relevant engagement of Traditional Owners in projects, see http://nesptropical.edu.au/wp-content/uploads/2015/09/NESP-TWQ-Hub-Indigenous-Engagment-Strategy-FINAL-COMPLETE.pdf |
| Improved GBR monitoring: Better distribution of monitoring sites across the marine park and coastline and increased monitoring in highly valued (socio & economic) inshore areas | Considered in the development of the Reef integrated monitoring and reporting program (RimRep), see http://www.gbrmpa.gov.au/managing-the-reef/reef-2050/reef-integrated-monitoring-and-reporting-program |

Re 2. Engagement

Meaningful engagement is an acknowledged part of the NESP contract. Most stakeholders prefer regular face-to-face contact, compared to just being sent written research outputs. But it could be a balance of an annual conference and regular face-to-face contact with a small group of 'research associates'. Quarterly meetings were suggested as a likely workable frequency. Projects should 'self-organise' and agree early on which mechanism is likely to work for the individual researchers and end-users involved.

Re 3. Data availability

Discussions about the availability of data collected by the port and consultancy sectors and improved data sharing arrangements were part of a number of sub-theme discussions. Representatives from the ports sector indicated inherently cooperative attitudes towards data

sharing but also a reluctance to make raw data public, e.g. on websites, and would prefer to engage with researchers to be confident in the person's ability to interrogate the data.

The workshop agreed that data sharing is an important issue and formulated a future dredging research priority to address this:

> Comprehensive analyses/compilation and synthesis of the existing data/information from dredging monitoring and impact assessments across northern Australia.

In addition, the following key suggestions were made:

- Future projects to address the identified research priorities 1a, 1b and 2 should identify questions in consultation with research users and include (i) a review of existing information and literature and (ii) a review of potentially relevant data holdings, which should be assisted by port authorities and regulators
- Future projects should use best available data, e.g as model inputs, including using data from ports compliance monitoring and eReefs.

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# APPENDIX 1: STAKEHOLDER SURVEY

**Table A1. NESP survey distribution list**

| Name | Affiliation |
|---|---|
| Dr Damien Burrows | JCU – NESP TWQ Hub Steering Committee |
| Karina McLachlan | Department of Environment – Federal |
| Dr Kirstin Dobbs | GBRMPA |
| Bruce Elliot | GBRMPA |
| Paul Brims | Department of Transport and Main Roads – Qld |
| Dr Ray Masini | Environmental Protection Authority – WA |
| Alan Vico | Ports North |
| Rick Morton | Rick Morton Consulting |
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| Kevin Kane | North Queensland Bulk Ports Corporation |
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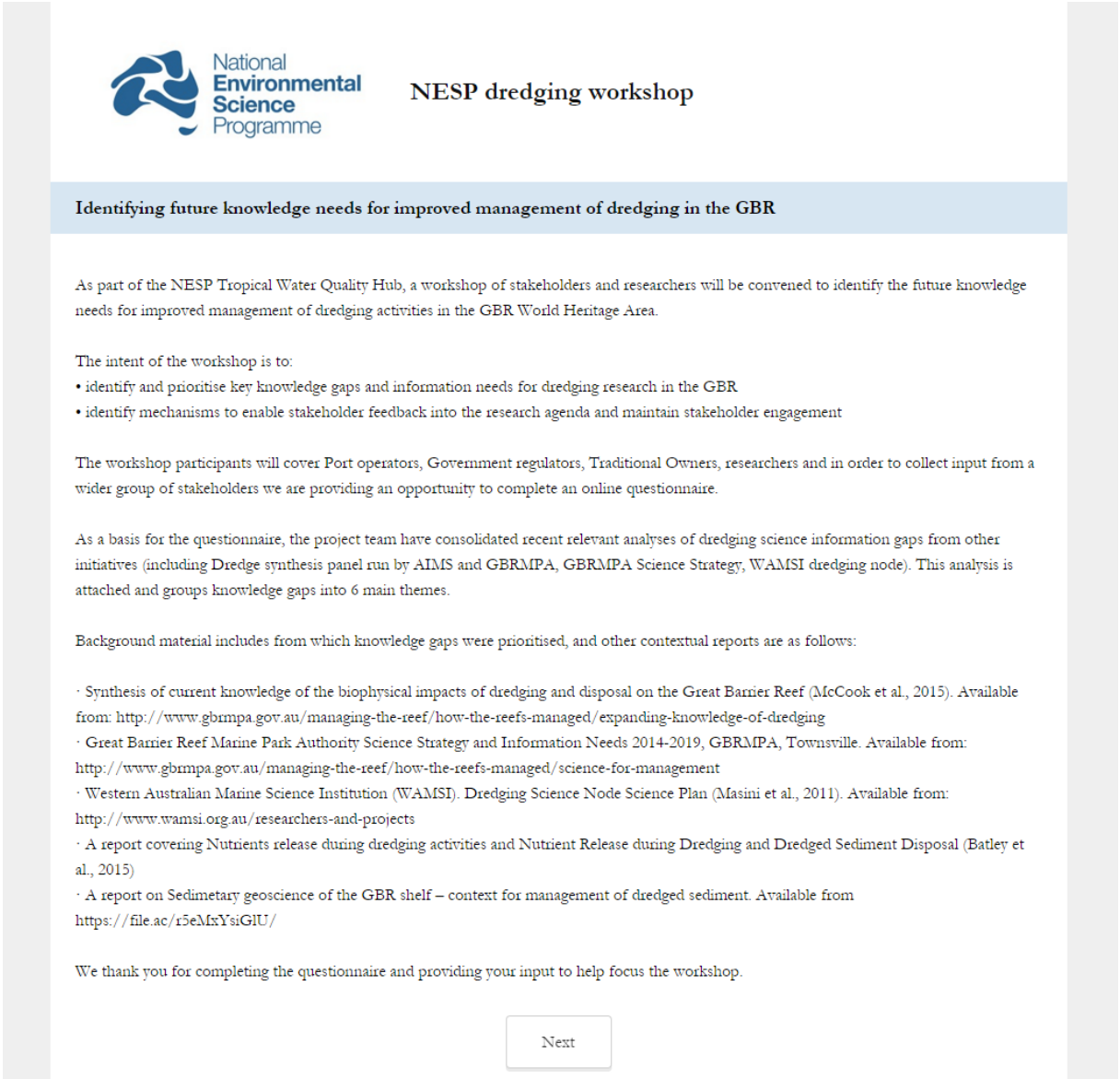
| Gordon Dwane | Gladstone Ports Corporation |
| Mark Gibbs | AECOM |
| Dr Chaojiao Sun | CSIRO |
| Dr Katharina Fabricius | AIMS |
| Dr Andrew Hoey | JCU |
| Dr Peter Ridd | JCU |
| Dr Susan Sobtzick | JCU |
| Dr Dirk Erler | SCU |
| Prof John Rolfe | CQU |
| Dr Laurence McCook | |
| Dr Stephen Lewis | JCU |
| Dr Frederieke Kroon | AIMS |
| Dr Mark Baird | CSIRO |
| Mr Scott Wiseman | Queensland Seafood Industry |
| Ms Wendy Tubman | North Queensland Conservation Council |
| Dr Gilly Llewellyn | WWF Australia |
| Mr Steven Neale | Worley Parsons |
| Mr Vern Veitch | Townsville City Council |
| Mr Stefan Sawynok | Australian National Sportfishing Association QLD Inc |
| Ms Judy Lynne | Sunfish Queensland |
| Mr Col McKenzie | Association of Marine Park Tourism Operators |
| Mr Allen Grundy | Explore Whitsundays |
| Mr Tony Brown | True Blue Sailing Whitsundays |
| Mrs Frances Gala | Traditional Owner |
| Mr Phil Rist | Traditional Owner |
| Ms Cheryl Grant | Traditional Owner |
| Mr Paddy Creek | Traditional Owner |
| Mrs Tracylee Forester | Traditional Owner |
| Mr Errol Neal | Traditional Owner |
| Mr Kerry Blackman | Traditional Owner |

| | |
|---|---|
| Mr Tim Jaffer | Traditional Owner |
| Mr Ray Wallis | Traditional Owner |
| Mr Gavin Singleton | Traditional Owner |
| Ms Lauren Bowyer | Traditional Owner |
| Ms Melissa George | Traditional Owner |
| Dr Britta Schaffelke | AIMS – project team |
| Dr Richard Brinkman | AIMS – project team |
| Dr Andrew Negri | AIMS – project team |
| Dr Ross Jones | AIMS – project team |
| Dr Michael Rasheed | JCU – project team |

**Screenshots of the online survey:**

1. Introduction to survey



National Environmental Science Programme

NESP dredging workshop

**Identifying future knowledge needs for improved management of dredging in the GBR**

As part of the NESP Tropical Water Quality Hub, a workshop of stakeholders and researchers will be convened to identify the future knowledge needs for improved management of dredging activities in the GBR World Heritage Area.

The intent of the workshop is to:
• identify and prioritise key knowledge gaps and information needs for dredging research in the GBR
• identify mechanisms to enable stakeholder feedback into the research agenda and maintain stakeholder engagement

The workshop participants will cover Port operators, Government regulators, Traditional Owners, researchers and in order to collect input from a wider group of stakeholders we are providing an opportunity to complete an online questionnaire.

As a basis for the questionnaire, the project team have consolidated recent relevant analyses of dredging science information gaps from other initiatives (including Dredge synthesis panel run by AIMS and GBRMPA, GBRMPA Science Strategy, WAMSI dredging node). This analysis is attached and groups knowledge gaps into 6 main themes.

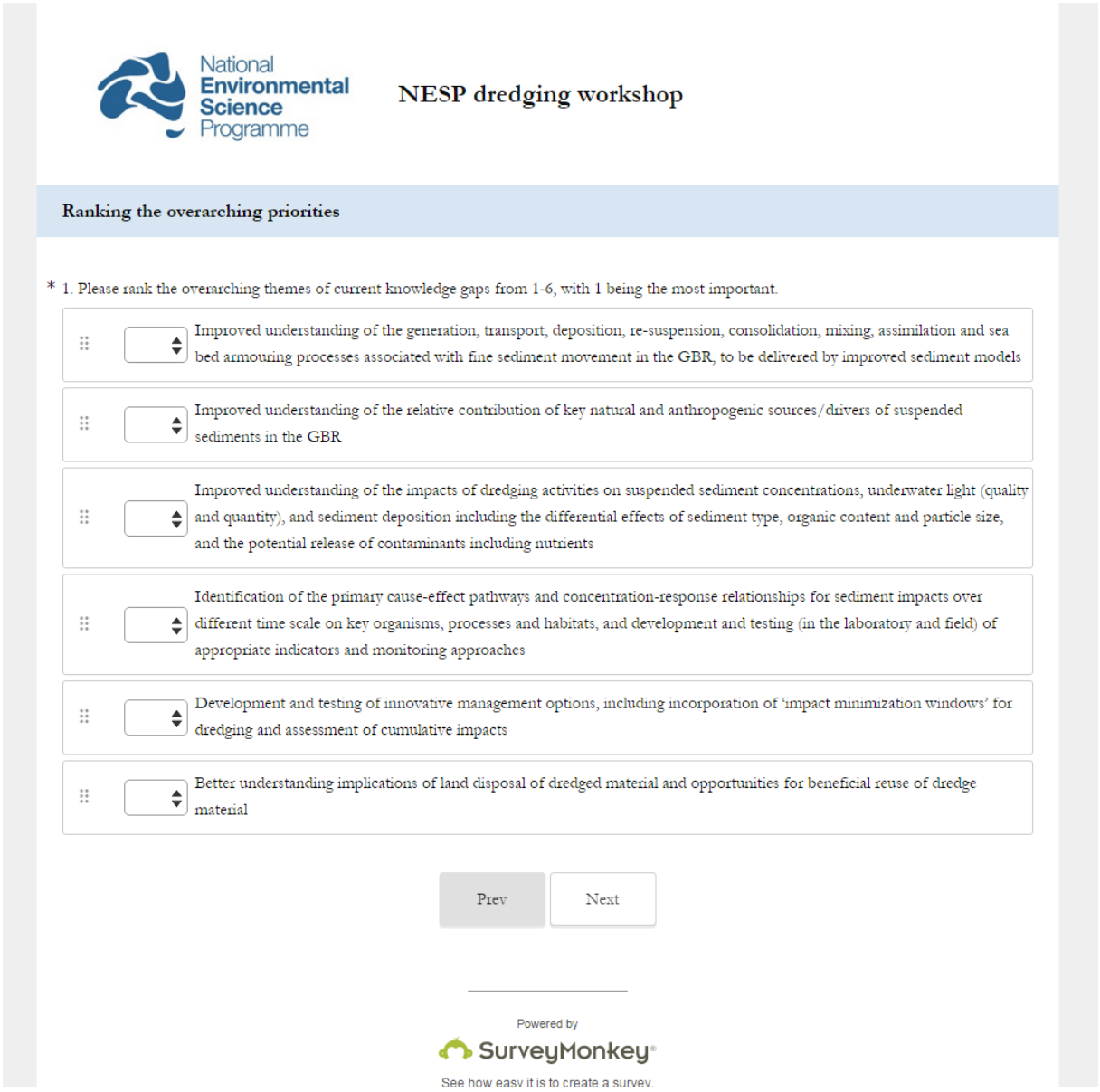
Background material includes from which knowledge gaps were prioritised, and other contextual reports are as follows:

· Synthesis of current knowledge of the biophysical impacts of dredging and disposal on the Great Barrier Reef (McCook et al., 2015). Available from: http://www.gbrmpa.gov.au/managing-the-reef/how-the-reefs-managed/expanding-knowledge-of-dredging
· Great Barrier Reef Marine Park Authority Science Strategy and Information Needs 2014-2019, GBRMPA, Townsville. Available from: http://www.gbrmpa.gov.au/managing-the-reef/how-the-reefs-managed/science-for-management
· Western Australian Marine Science Institution (WAMSI). Dredging Science Node Science Plan (Masini et al., 2011). Available from: http://www.wamsi.org.au/researchers-and-projects
· A report covering Nutrients release during dredging activities and Nutrient Release during Dredging and Dredged Sediment Disposal (Batley et al., 2015)
· A report on Sedimetary geoscience of the GBR shelf – context for management of dredged sediment. Available from https://file.ac/r5eMxYsiGlU/

We thank you for completing the questionnaire and providing your input to help focus the workshop.

Next

2. Ranking the major knowledge gap themes



3. Ranking the subthemes in each major theme (example page shown for Theme 1)

National Environmental Science Programme

**NESP dredging workshop**

**Ranking priorities**

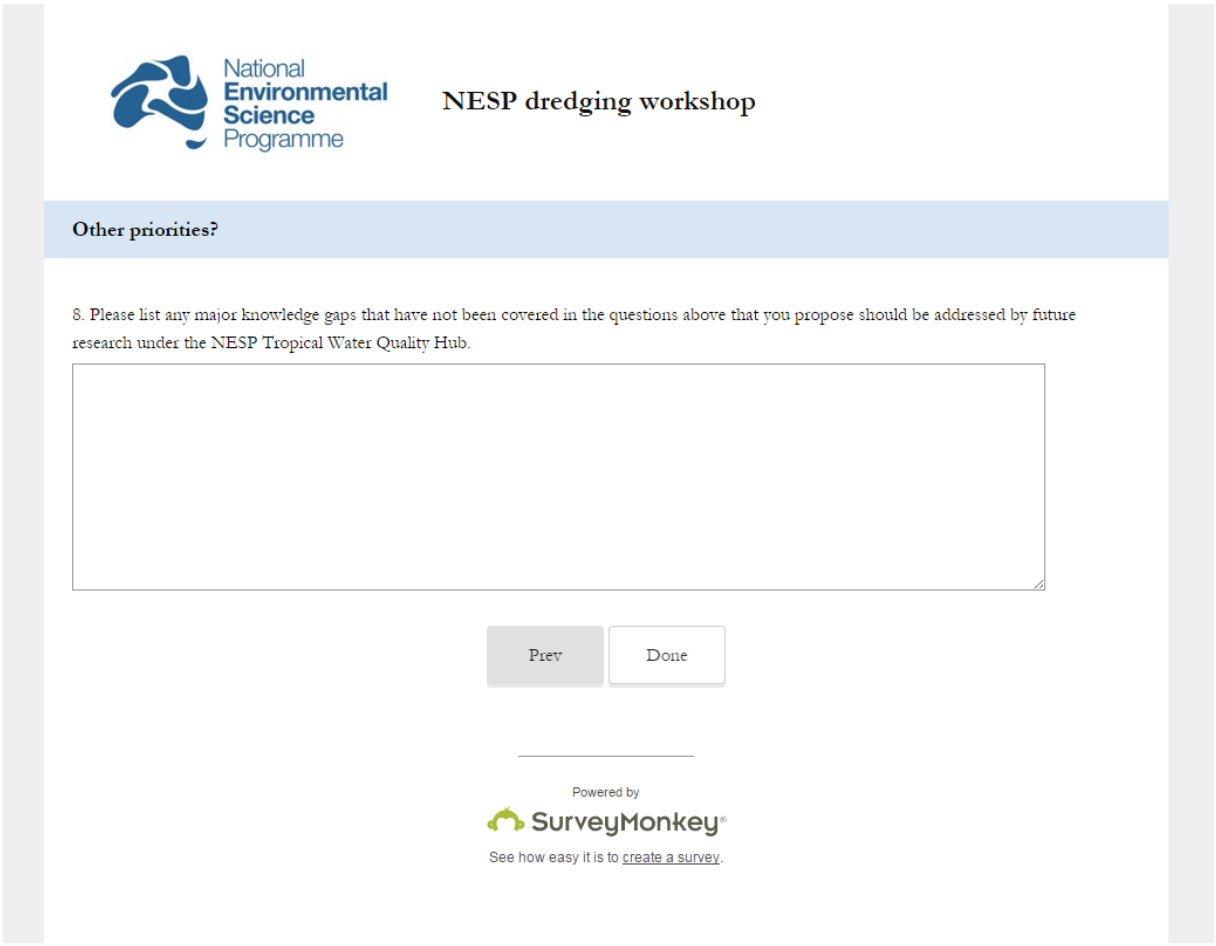
**Improved understanding of the generation, transport, deposition, re-suspension, consolidation, mixing, assimilation and sea bed armouring processes associated with fine sediment movement in the GBR, to be delivered by improved sediment models**

* 2. Of the overarching theme listed above, please rank the four sub-themes in order of importance, 1 being the most important.

| | |
|---|---|
| ⠿ ▲▼ | Field assessments to more accurately characterize sediment release rates during dredging activities (and disposal) and to provide source terms for coupled sediment transport and hydraulic models, recognising these will vary according to the types of dredges (trailer suction, cutter-suction, back-hoe), production rate and activity of the dredges (overflow rates etc), and sediment types (consolidated, sands/muds etc). |
| ⠿ ▲▼ | Better quantitative understanding of sediment resuspension, deposition, consolidation and armouring processes during dredging and disposal activities to provide input parameters for coupled sediment transport and hydrodynamic models and improve prediction of long-term (>12 months) sediment dispersion. |
| ⠿ ▲▼ | Development of a standard approach to be adopted in modelling studies for representing Great Barrier Reef broad-scale circulation processes in dredge plume models. |
| ⠿ ▲▼ | Consistent approaches and frequency/duration of detailed oceanographic and sediment dynamics monitoring before and after dredging and disposal at disposal sites and surrounding areas, to quantify dispersion processes (including the influence of extreme conditions such as major storms or tropical cyclones). |

Prev Next

4. Identifying any other priorities or issues



# APPENDIX 2: CONSULTATION WORKSHOP

**Workshop agenda:**

National Environmental Science Programme

Australian Government

Australian Institute of Marine Science

## NESP Consultation Workshop – Dredging Research Priorities Agenda

Friday, 21 August 2015
ATSIP Seminar Room, James Cook University Townsville

| | |
|---|---|
| 9.30am-9.45am | Welcome and introductions<br>NESP TWQ Hub context – *Damien Burrows*<br>Purpose of the workshop |
| 9.45am-10am | Overview of Dredge Synthesis Report – *Laurence McCook* |
| 10am-10.15am | Overview of WAMSI – *Ross Jones* |
| 10.15am-10.30am | Morning tea |
| 10.30am-12 pm | Prioritisation of identified research themes |
| 12pm-12.30pm | Lunch |
| 12.30pm-1.30pm | Complete prioritisation |
| 1.30pm-2pm | Discussion of other knowledge gaps, including those identified through survey |
| 2pm-2.30pm | Discussion of mechanisms for maintaining stakeholder engagement while research projects are undertaken |
| 2.30pm-3pm | Summary dot points<br>Next steps: workshop report<br>Other funding opportunities<br>Closing remarks |
| 3pm-3.30pm | Afternoon tea |

**Table A2. Participants of the NESP dredging workshop held on Friday, 21 August 2015**

| Name | Affiliation |
|---|---|
| Dr Britta Schaffelke | AIMS – project team |
| Dr Richard Brinkman | AIMS – project team |
| Dr Andrew Negri | AIMS – project team |
| Dr Ross Jones | AIMS – project team |
| Dr Michael Rasheed | JCU – project team |
| Sharon Barnwell | AIMS – project team, workshop support |
| Dr Damien Burrows | JCU – NESP TWQ Hub Steering Committee |
| Karina McLachlan | Department of Environment – Federal |
| Dr Kirstin Dobbs | GBRMPA |
| Bruce Elliot | GBRMPA |
| Paul Brims | Department of Transport and Main Roads – Qld |
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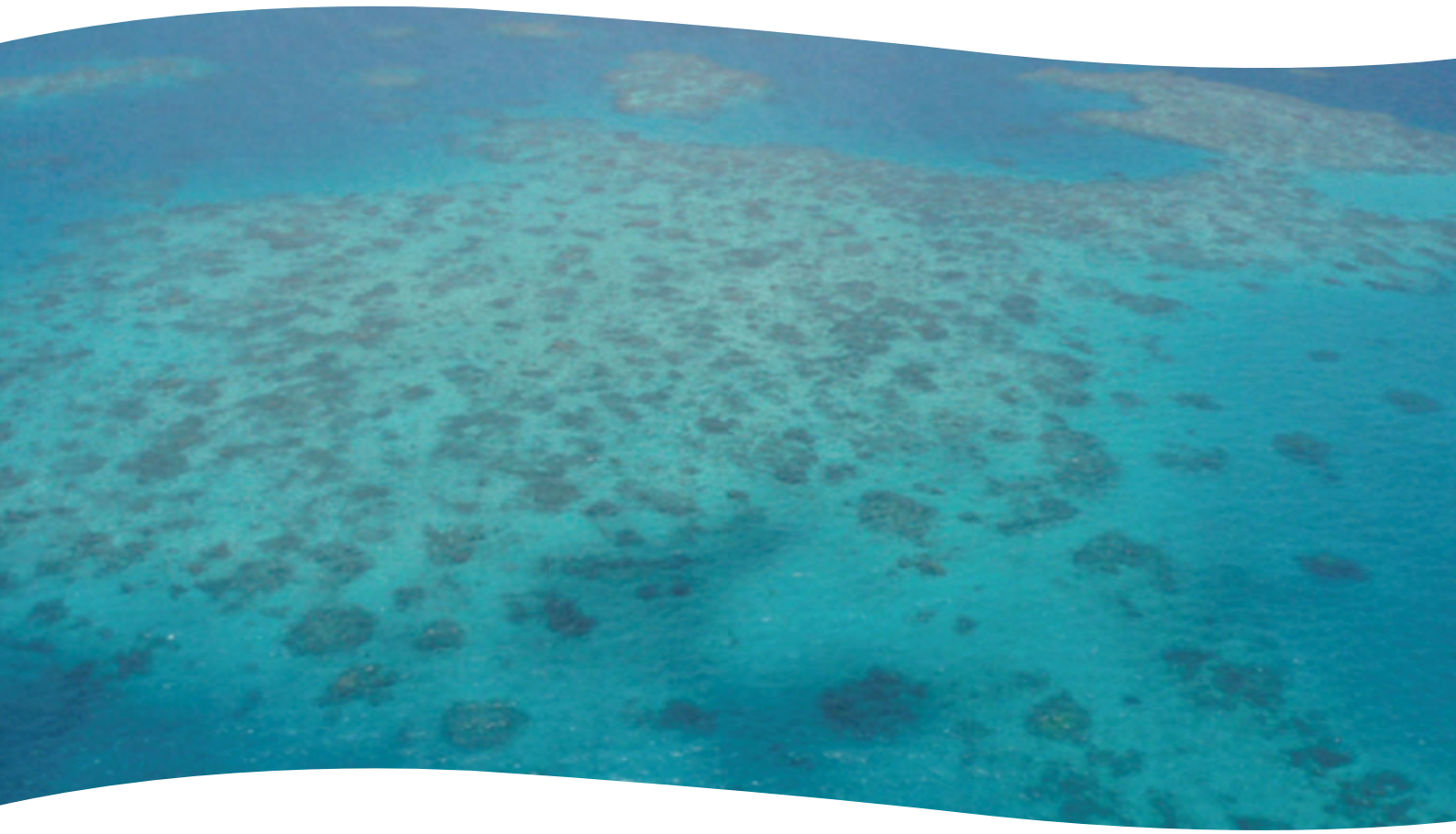

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