Part B
Environmental values monitoring and reporting programs

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B1 Evidence base background

The evidence base risk assessment provided a summary of the existing operational environmental management programs operating within and surrounding the master planned area (refer Table 4.3 in risk assessment report (Aurecon 2016)).

During the master planning process a detailed list and mapping of the existing environmental value monitoring and reporting programs within and surrounding the master planned area was undertaken to inform the need and drafting content of a priority management measure relating to ongoing environmental values monitoring and reporting.

B2 Existing environmental values monitoring and reporting programs

For the purpose of identifying and documenting the existing environmental values monitoring and reporting programs within and surrounding the master planned area, programs that commenced or operational on or after 2013 have been summarised in Table B1.

The justification for selecting 2013 as the most appropriate year to use as the start date for the summary table of existing background environmental values monitoring and reporting programs is provided below.

- Between 2010 and 2012 there were a number of major flood events and the construction of major projects within Gladstone which resulted in environmental value monitoring programs that were assessing the impacts and compliance, including:
  - Major flood events in 2010 and 2011, and early 2013
  - Dredging and reclamation works associated with the Western Basin Dredging and Disposal Project
  - Construction works and significant marine vessel movements within the port associated with the three liquefied natural gas (LNG) plants on Curtis Island and the Wiggins Island Coal Terminal

  While these monitoring programs provide useful information on the impacts of the flood events and major projects on the environmental values, the findings are not as relevant to master planning as the key objectives of the review of existing programs is to identify potential monitoring gaps, and the existing programs which will be part of an adequacy assessment, for input into the future development of the environmental values monitoring and reporting program (ie the PMM).

- Survey and monitoring programs conducted for various environmental impact statement (EIS) studies within the Gladstone region between 2008 and 2012 is considered to be of secondary importance for input into the master planning process due to the short term monitoring periods for the majority of these EISs
- Some environmental value monitoring data has a period of limited validity in accordance with relevant guidelines (eg five years for sediment quality for National Assessment Guidelines for Dredging (NAGD) 2009), and DoEE and EHP requirements for assessing the current environmental values that require management. Therefore in addition to the above, the value of including these monitoring programs in the summary table will have minimal benefit to the master planning process (eg in identifying current monitoring gaps).

It is recognised that some monitoring programs included in the summary table reference dates prior to 2013, for example seagrass condition monitoring for some seagrass meadows has occurred annually since 2009, and the 2002 seagrass survey provides additional areas which have the potential to support seagrass meadows.

In summary, the 2013 year was selected as it represents a time of transition after the major flood events and major project construction within the Port of Gladstone. As a result the programs from 2013 to date (and to 2018 when the PMM environmental values monitoring and reporting program is likely to be developed) represents the most appropriate period to determine the future monitoring program needs for the master planned area and surrounds.

Table B1 provides a comprehensive list of the existing or recently completed environmental values monitoring and reporting programs of relevance to the master planning process.

Figures 1 to 13 illustrate the monitoring catchment (study area) and/or sampling locations for the relevant monitoring program where spatial data is available.

B3 Input into the development of the environmental values monitoring and reporting program priority management measure

The review and assessment of the environmental values monitoring and reporting programs within and surrounding the master planned area, provides input into the future development of PPM 2 which includes the preparation of an environmental values monitoring and reporting program for the environmental values within and surrounding the master planned area.

Relevant considerations for the preparation of the environmental values monitoring and reporting program include:

- A gap analysis of environmental values monitoring and reporting programs be undertaken in 2018 at the conclusion of the majority of the Gladstone Ports Corporation Ecosystem Research and Monitoring Program (ERMP) and Biodiversity Offset Strategy (BOS) studies
- The adequacy of existing and planned environmental values monitoring and reporting programs to support assessment of the effectiveness of the master plan and port overlay
- Review and amend the environmental values monitoring and reporting program table included in this part of the addendum to the evidence base report be undertaken in 2018 at the conclusion of the majority of the Gladstone Ports Corporation ERMP and BOS studies
- Update of the OUV of the GBRWHA reporting and local expression contributions for the master planned area and surrounding areas
- Consultation with key technical experts to assist in the development of specific environmental value monitoring programs, timeframes and key locations.

B4 References

Aurecon 2016 Priority Port of Gladstone master planning – Risk assessment, Prepared for the Queensland Department of State Development, Aurecon, Brisbane

National Assessment Guidelines for Dredging (NAGD) (2009). Commonwealth Government of Australia. Canberra, 2009

Table B1 Priority Port of Gladstone master planning - environmental values monitoring and reporting programs from approximately 2013 (as at January 2017)

ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
Overarching environmental monitoring programs														
V1	**Port Curtis Integrated Monitoring Program (PCIMP)**	Overarching program - various	The PCIMP objective is to develop a long term mid to far field ambient monitoring program, focussing on water and sediment quality in Port Curtis.	**Independent chair and spokesperson:** Professor Owen Nevin (CQUniversity) **Industry consortium:** Representatives include industry, government, research institutions and other stakeholders. **Overseen by:** Management Committee with guidance from the Technical Sub-Committee (PCIMP TSC) **Sponsors and members:** RioTinto Alcan, QGC, APLNG, GLNG, QAL, NRG, WICET, GPC, QER, Orica, Boyne Smelters, GRC, Cement Australia and CQU	•Shared funding model •Sponsoring members share the cost of monitoring equally •PCIMP has previously funded two Port Curtis Ecosystem Health Report Cards.	2001 to present Ongoing, no end date specified	Quarterly	Regular monitoring including: •Water quality (currently quarterly) •Sediment quality (currently biannually) •Oyster biomonitoring (currently biannually) Previous assessments for: •Intertidal health (eg oil spill assessments) •Seagrass health and sediment assessments	Water quality, sediment and oyster deployment sites located in 13 zones in marine and estuarine environments (including reference sites).	Figure 1: Port Curtis Integrated Monitoring Program water quality and sediment quality monitoring	Two Port Curtis ecosystem health report cards have been released: •Port Curtis Ecosystem Health Report Card 2007 (Storey et al. 2007) •Port Curtis Ecosystem Health Report Card 2008-2010 (Vision Environment 2011)	Voluntary	•Annual reports are not available to the public •Some individual monitoring reports are available on the PCIMP website •PCIMP data is now provided to the Gladstone Healthy Harbour Partnership (GHHP) to contribute to the GHHP report card (refer V3) •Data is available on the web but requires authorised member access	PCIMP website
V2	**Ecosystem Research and Monitoring Program (ERMP)**	Overarching program - various	The ERMP is an over-arching program which funds various projects to examine short, medium and long term impacts on a range of ecological values in Port Curtis and Port Alma.	GPC Projects overseen by the Ecosystem Research and Monitoring Program Advisory Panel (ERMPAP) (independent panel)	GPC ERMP	2011 to 2021	Project specific	Project specific	ERMP survey area (Port Curtis and Port Alma)	Figure 3a and Figure 3b: ERMP and BOS study area	Project specific	Compliance with Commonwealth controlled action approval (EPBC 2009/4904) for the Western Basin Dredging and Disposal Project (WBDDP)	It is a condition of the ERMP that the findings, including related data, of any or all of these studies are made publicly available upon request by any interested parties.	•GPC ERMP •GPC ERMP reports

Table B1 Priority Port of Gladstone master planning - environmental values monitoring and reporting programs from approximately 2013 (as at January 2017)

ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
V3	**Gladstone Healthy Harbour Program (GHHP)**	Overarching program - various	The GHHP is an over-arching program established to help improve decision-making (underpinned by robust marine science incorporating environmental, social, cultural and economic dimensions) about resource allocation and environmental management of the Port of Gladstone.	**CEO:** Paul Birch (Fitzroy Basin Association [FBA]) Projects overseen by an Independent Science Panel (ISP) **Consortium comprising:** •Industry •Research and monitoring agencies •Community groups •Traditional Owners •Commonwealth and State government representatives **GHHP partners:** Australian Government, Australian Institute of Marine Science, Australian Pacific LNG, Boyne Smelters, CQG Consulting, Central Queensland University, CSIRO, Dhou Woolkoom, Fitzroy Basin Association, Gidarjil Development Centre, Gladstone Area Water Board, GPC, Gladstone Regional Council, Gladstone Region Environmental Advisory Network, Griffith University, NRG, Orica, QGC, Queensland Alumina Limited, Queensland government, QER, Rio Tinto Alcan, Santos GLNG Project, The University of Queensland, and WICET	Government and member funded	Established Nov 2013 Ongoing, no end date specified	•Project specific •Annual health report cards	•Environmental indicators (eg water quality) •Social indicators •Economic indicators •Cultural indicators •Iconic species	Port of Gladstone and surrounds	NA - Refer Evidence Base Report Plate 3	Gladstone Harbour Report Card	Government and industry program	•The GHHP has limitations in the collection of some data as the GHHP is reliant on a number of different external parties for data collection •Water quality and sediment data is provided to GHHP by PCIMP for reporting. This data is not publicly available. •Gladstone Harbour Report Cards and Technical Reports provide interpretation of data and are available on the GHHP website •The GHHP shares information about Gladstone Harbour through the GHHP ePortal, an online information management resource accessible to stakeholders and the general community.	•Gladstone Healthy Harbour Partnership website •GHHP publications •GHHP 2015 report card technical report •GHHP ePortal

Table B1 Priority Port of Gladstone master planning - environmental values monitoring and reporting programs from approximately 2013 (as at January 2017)

ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
V4	**Maintenance dredging: Long term monitoring and management plan for sea disposal of maintenance dredged material**	Overarching program - various	•A working management document to be used for the strategic management during maintenance dredging, sea dumping (at East Banks dredged material placement area (DMPA)) and associated works to ensure all reasonable and practicable measures will be implemented to prevent and/or minimise the likelihood of environmental harm being caused during the works •Supports GPC's Sea Dumping Permit	GPC	GPC	2013 to 2018	•Annual maintenance dredging campaign •Various surveys	Various (refer E1, E9, E21, E27, S2, S3, WQ4)	•East Banks offshore DMPA •Maintenance dredging areas, sensitive receptors, and reference areas	Spatial data not available	Compliance reporting to Department of Environment and Heritage (EHP) and Commonwealth Department of Environment and Energy (DoEE)	Compliance with GPC Sea Dumping Permit	•Reports prepared for compliance purposes and for internal use by GPC •Timeframe associated with current approved plan only	•GPC Long term monitoring and management plan for sea disposal of maintenance dredged material 2013-2018 •GPC dredging monitoring
V5	**Biodiversity offset strategy (BOS)**	Overarching program - various	•To meet conditions under Commonwealth controlled action approval to offset residual significant impacts to the values of the Great Barrier Reef World Heritage Area and National Heritage Place, and Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) listed threatened and migratory species. •Various projects under the BOS have been developed to meet these conditions. Not all projects under the BOS have environmental monitoring components.	GPC	GPC	2012 to 2020	Continuous	Various programs: •Coral mapping and restoration (project underway, refer E8) •Declared fish habitat area (FHA) investigations in the Central Queensland region (project underway) •Habitat enhancement and restoration project (project underway) •Acquisition of high value ecological land to protect from development (project underway) •Upper to lower catchment water quality monitoring and improvement of water quality in the Boyne or Calliope Rivers (project underway)	Port Curtis and Port Alma	Figure 3a and Figure 3b: ERMP and BOS study area	Various reports	Condition under Commonwealth controlled action approval (EPBC 2009/4904) for WBDDP	Reports are made available on GPC website	BOS website

Table B1 Priority Port of Gladstone master planning - environmental values monitoring and reporting programs from approximately 2013 (as at January 2017)

ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
V6	**Reef 2050 Integrated Monitoring and Reporting Program Strategy (RIMRep)**	Overarching program - various	A component of the Reef 2050 Long-Term Sustainability Plan (Reef 2050 Plan) to coordinate and integrate existing monitoring, modelling and reporting programs across disciplines within the Great Barrier Reef. Program currently being developed. Objectives include: •Enable the early detection of trends and changes in the Reef 's environment, inform the assessment of key threats and future risks and drive adaptive management. Inform the evaluation of management effectiveness, including efforts to maintain and enhance ecosystem health, marine biodiversity and coastal habitats, water quality, heritage values and social and economic benefits derived from the environment. •Ensure investments are focused on actions that will effectively deliver measurable results •Inform regional stakeholders and the national and international communities on whether the Reef 2050 Plan is on track to addressing key threats and delivering its vision	Great Barrier Reef Marine Park Authority (GBRMPA)	To be determined (TBD)	2015 to 2019	TBD	TBD	TBD	Spatial data not available	Results of the program incorporated into five-yearly Great Barrier Reef Outlook Report	Government commitment	Reports to be five-yearly and available on GBRMPA website	•Great Barrier Reef Marine Park Authority website •Reef 2050 Integrated Monitoring and Reporting Program
V7	**Gas Industry Social and Environmental Research Alliance (GISERA): An integrated study of the Gladstone marine system**	Overarching program - various	The overarching goal of the GISERA marine environmental research program has been to make possible a more accurate prediction and understanding of impacts and trends in water quality as well as ecological responses in primary producers (seagrass) and grazers (turtles) that have been assessed as being vulnerable due to expansion of development in the Port of Gladstone. Another aim of the GISERA marine research program was to develop tools that can be used to determine management options that may lead to the reduction of impacts on these key ecological assets in the future, well beyond Port Curtis and the current phase of development.	GISERA	•GISERA •Commonwealth Scientific and Industrial Research Organisation (CSIRO)	2012 to 2014	Various	Bioptical properties of Gladstone Harbour: •Seagrass distribution •Turtle movement and habitat use	Port Curtis	Spatial data not available	•Results of the program reported in CSIRO published report 'An integrated study of the Gladastone marine system' •Hydrodynamic/ biogeochemical model of Port Curtis; predicting water quality and seagrass growth •Turtle behaviour – habitat use and risk modelling	Voluntary	Report is publicly available on the CSIRO research publications repository	•GISERA website •An integrated study of the Gladstone marine system report •An integrated study of the Gladstone marine system report overview

Table B1 Priority Port of Gladstone master planning - environmental values monitoring and reporting programs from approximately 2013 (as at January 2017)

ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
Individual environmental monitoring programs														
AQ1	**Gladstone air quality monitoring network**	Air quality	Measure local hazardous air pollutants from industrial emissions and air movement to: •Assess the impact of air emissions on the ambient air quality in the Gladstone area •Assess the potential risks to human health associated with those emissions •Develop a baseline to inform future decision making (eg development approvals and regulatory compliance activities)	Department of Science, Information Technology and Innovation (DSITI)	Government	1991 to present Ongoing, no end date specified	Continuous	•Meteorological data •Nitrogen oxides •Sulfur dioxide •Particulate matter less than 10um in aerodynamic diameter (PM10) •Particulate matter less than 2.5um in aerodynamic diameter (PM2.5) •Visibility-reducing particles (aerosols) •Air toxics (organic pollutants) •Ozone •Heavy metals and organic compounds (note: not all parameters monitored at all sites or all times)	Current monitoring sites located at: •Boyne Island (est. 2008) •South Gladstone (est. 1992) •Auckland Point (est. 2009) •Memorial Park (est. 2009) •Clinton (est. 2008) •Boat Creek (est. 2008) •Fisherman's Landing (est. 2016) •Targinnie (Swans Road) (est. 1991) •Aldoga (est. 1999)	Figure 7: Air quality monitoring	Data previously used for: •Benchmarking atmospheric emissions •Community health assessment •Health risk assessment final reports •Clean and healthy air for Gladstone reports •Project final report contributes to National Environment Protection Measure for Ambient Air Quality (Air NEPM) annual reporting of Queensland's air quality against the standards	Compliance with EA conditions	•Hourly air quality data for Gladstone available on EHP website •Monitoring reports are publicly available on Queensland government website and library catalogue •Data also available for decommissioned monitoring sites	•Gladstone Air Quality monitoring network •EHP Gladstone region air quality reports page •EHP hourly air quality data •Queensland government library catalogue
AQ2	**GPC air quality monitoring program**	Air quality	•Ensure compliance with Environmental Authority (EA) conditions •Assess and control dust generation impacts on the community	GPC	GPC	Start date unknown Ongoing, no end date specified	Continuous - complaint driven	•Mass deposition rate of insoluble solids •Mass deposition rate of ash •Mass deposition rate of total solids •Combustible matter •Compositional analysis (%) •Particulate identification	Approximately 11 compliance sites and 14 voluntary sites located at various locations around Gladstone community	Spatial data not available	Internal GPC data and compliance reporting	•Compliance with EA conditions •Additional voluntary monitoring	Internal GPC data Data can be provided upon request	GPC air quality monitoring site
							Monthly	Mass deposition rate of combustible materials	Approximately 11 compliance sites and 14 voluntary sites located at various locations around Gladstone community				Internal GPC data GPC may make some data publicly available in future on the website	
							Continuous	•PM10 •Total suspended particulate matter	12 real time monitors are positioned around RG Tanna Coal Terminal, Barney Point Coal Terminal and in community locations				Internal GPC data Not publicly available	

Table B1 Priority Port of Gladstone master planning - environmental values monitoring and reporting programs from approximately 2013 (as at January 2017)

ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
E1	**Maintenance dredging: Long term monitoring and management plan for sea disposal of maintenance dredged material**	Ecology – benthic macroinvertebrates	Monitor/assess the impacts of sea disposal from maintenance dredging on benthic fauna	GPC	GPC	2013 to 2018	Every 5 years	•Grab sampling (infauna) •Soft sediment and seagrass survey	Sites within and adjacent to the East Banks DMPA	Spatial data not available	Compliance reporting to EHP and DoEE	Compliance with GPC Sea Dumping Permit	Reports prepared for compliance purposes and for internal use by GPC	•GPC Long term monitoring and management plan for sea disposal of maintenance dredge material 2013 to 2018 •GPC dredging monitoring
E2	**GPC Channel Duplication EIS (CD EIS) baseline surveys**	Ecology – benthic macroinvertebrates	•Conduct baseline benthic macroinvertebrate assessments at subtidal locations to assess potential impacts from the GPC Channel Duplication Project •Update broad-scale baseline assessments, last reported in 2002, of benthic macroinvertebrate communities in deep water areas of Port Curtis and adjacent offshore areas •Characterise the benthic macroinvertebrate (epifauna) communities within the survey area •Discuss the implications of the survey results for overall diversity of the survey area and provide information to aid in the decision towards appropriate dredged material placement options	GPC	GPC	Nov 2013	Once-off	Benthic macroinvertebrate community density categories	Sled-net and video capture sites from Western Basin to offshore areas of the GBRMP	Figure 10: Benthic fauna monitoring	Report	Baseline data for CD EIS	EIS not publicly available yet	NA
E3	**GPC Channel Duplication EIS baseline surveys**	Ecology – benthic macroinvertebrates	Conduct baseline macroinvertebrate and sediment analyses in the vicinity of the potential Project impact area against which future monitoring data can be compared to support identification and management of Project impacts	GPC	GPC	2014 to 2015	Once-off	•Taxa abundance •Taxa richness •Taxa diversity •Taxa evenness •Particle size distribution (PSD) •Total organic carbon (TOC)	16 transects from the Western Basin to offshore areas of the GBRMP	Figure 10: Benthic fauna monitoring	Report	Baseline data for CD EIS	EIS not publicly available yet	NA

Table B1 Priority Port of Gladstone master planning - environmental values monitoring and reporting programs from approximately 2013 (as at January 2017)

ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
E4	**GPC Channel Duplication EIS baseline surveys**	Ecology — benthic macroinvertebrates	Conduct baseline macroinvertebrate and sediment analyses in the vicinity of the potential Project impact area against which future monitoring data can be compared to support identification and management of Project impacts	GPC	GPC	Feb 2015	Once-off	•Taxa abundance •Taxa richness •Benthic macroinvertebrate community composition •PSD	60 grab samples from sites between South Trees Island and Facing Island to sites in the Outer Harbour	Figure 10: Benthic fauna monitoring	Report	Baseline data for CD EIS	EIS not publicly available yet	NA
E5	**GPC Channel Duplication EIS baseline surveys**	Ecology — benthic macroalgae	•Conduct baseline benthic macroalgal assessments at subtidal locations to assess potential impacts from the GPC Channel Duplication Project •Update broad-scale baseline assessments, last reported in 2002, of benthic macroalgal communities in deep water areas of Port Curtis and adjacent offshore areas •Characterise the benthic macroalgal communities within the survey area •Discuss the implications of the survey results for overall diversity of the survey area and provide information to aid in the decision towards appropriate dredged material placement options	GPC	GPC	Nov 2013	Once-off	Algae identified into five functional groups via sled-net and video capture	Western Basin to offshore areas of the GBRMP	Figure 10: Benthic fauna monitoring	Report	Baseline data for CD EIS	EIS not publicly available yet	NA
E6	**Western Basin Dredging and Disposal Project – Benthic Photosynthetically Active Radiation (BPAR) at seagrass meadows**	Ecology — BPAR	Monitoring of BPAR as part of light-based management approach to protect seagrass meadows during dredging and dredged material placement	GPC	GPC	2013 to 2016	Quarterly	•Total daily irradiance •Temperature	•Seven sites in WBDDP survey area and two reference sites •Temporary sites added for other projects (eg CD EIS)	Figure 6: Seagrass monitoring	Report	•Compliance with Commonwealth controlled action approval (EPBC 2009/4904) for WBDDP •Baseline data for CD EIS	•Internal GPC data •Some reports made available by GPC	GPC environmental reports page

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ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
E7	**GHHP**	Ecology – coral	•Select appropriate locations at which to establish permanent monitoring sites •Assess and report the condition of coral communities that have adapted to survival in Gladstone Harbour to allow the inclusion of coral community condition in the GHHP 2015 Report Card	GHHP	Government and member funded	Jul 2015	Once-off	•% coral cover •% macroalgae cover •Density of juvenile coral	•Inner harbour reefs around Turtle Island •Mid harbour reefs around North Entrance and west side of Facing Island •Seal Rocks reefs	Figure 8: Reef monitoring	Report	Voluntary	Reports made available on GHHP website	•GHHP publications •GHHP coral investigations
E8	**Biodiversity offset strategy (BOS)**	Ecology – coral	Characterisation of the ecological condition of reefs in Port Curtis and to identify priority reef areas that may be suitable for any future habitat restoration and enhancement projects	GPC	GPC BOS	May 2014	Once-off	•Benthos type •% benthos cover •Taxonomic richness •Community types	•Inner harbour reefs around Turtle Island •Mid harbour reefs around the North Entrance and west side of Facing Island •Reefs on the east side of Facing Island •Seal Rocks reefs	Figure 8: Reef monitoring	Report	Commitment under BOS	•Data available upon request by any interested parties •Reports made available on GPC website	•BOS website •BOS reports
E9	**Maintenance dredging: Long term monitoring and management plan for sea disposal of maintenance dredged material**	Ecology – coral	Assess the impact, if any, on reef habitats in order to validate hydrodynamic modelling predictions of turbid plumes during maintenance dredging	GPC	GPC	2013 to 2018	Every 5 years	Reef condition survey (not limited to): •% cover of major taxa •Taxa richness •% of coral bleaching	TBD. Previous surveys have focussed on reefs around Facing Island.	Spatial data not available	Compliance reporting to EHP and DoEE	Compliance with GPC Sea Dumping Permit	Reports prepared for compliance purposes and for internal use by GPC	•GPC long term monitoring and management plan for sea disposal of maintenance dredge material 2013-2018
E10	**GPC Channel Duplication EIS baseline surveys**	Ecology – coral	Conduct baseline reef surveys in the vicinity of the potential Project impact area against which future monitoring data can be compared to support identification and management of Project impacts	GPC	GPC	2014 to 2015	Once-off	•Substrate of area •Benthos type •% lifeforms •% benthos cover •Health assessment (eg disease, bleaching) •Dominant substrate classification	•Sable Chief Rocks •Gatcombe Head/Oyster Rocks	Figure 8: Reef monitoring	Report	Baseline data for CD EIS	EIS not publicly available yet	NA
E11	**Great Barrier Reef Marine Park Authority (GBRMPA) site inspection**	Ecology – coral	Conduct reef health impact surveys at the Facing Island Reef (Sable Chief Rocks) coral reef site in close proximity to the Port of Gladstone	GBRMPA	GBRMPA	Sept 2013	Once-off	•Benthos type •% lifeforms •% benthos cover •Health assessment (eg disease, bleaching)	Sable Chief Rocks	Figure 8: Reef monitoring	Report	Voluntary	•Internal report for GBRMPA, GPC and the Australian Institute of Marine Science (AIMS)	NA

Table B1 Priority Port of Gladstone master planning - environmental values monitoring and reporting programs from approximately 2013 (as at January 2017)

ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
E12	**GPC dredging reef monitoring - Changes in benthic communities on fringing coral reefs around Facing Island**	Ecology – coral	Investigate coral reef dynamics during the Gladstone Port dredging program	GPC	GPC	2011 to 2013	Once-off	•Benthos type •% lifeforms •% benthos cover	Reefs on Facing Island including: •Gatcombe Head •East Point Ledge •Sable Chief Rocks Reef •North Point Reef •Rundle Island (control site off Curtis Island)	Figure 8: Reef monitoring	Report	Compliance with Commonwealth controlled action approval (EPBC 2009/4904) for WBDDP	Reports are made available on GPC website	GPC coral studies
E13	**ERMP**	Ecology – dolphins	Increase understanding of the status of Australian snubfin and Australian humpback dolphins	GPC and the ERMPAP	GPC ERMP	2014 to 2017	Annually	•Photo-identification •Population genetics •Toxicology analysis •Dietary information	Port Curtis and Port Alma	•Figure 3a and Figure 3b: ERMP and BOS study area •Figure 13: Inshore dolphin monitoring	Annual report	Commitment under ERMP	•Data available upon request by any interested parties •Reports made available on GPC website	•GPC ERMP •GPC ERMP reports
E14	**ERMP**	Ecology – dugong	Increase understanding of habitat use by Dugongs in the Port Curtis and Port Alma region. Examine the movement, behaviour and habitat use and determine any temporal changes in their utilisation of these habitats.	GPC and the ERMPAP	GPC ERMP	2014 to 2017	Quarterly	•GPS/acoustic tagging of Dugong on opportunistic basis in association with tagging of green turtles •Monitoring of Dugong feeding trails in association with low tide helicopter surveys of seagrass	Port Curtis and Port Alma	Figure 3a and Figure 3b: ERMP and BOS study area	Annual report	Commitment under ERMP	•Data available upon request by any interested parties •Reports made available on GPC website	•GPC ERMP •GPC ERMP reports
E15	**GPC Channel Duplication EIS baseline surveys**	Ecology – fish	Conduct baseline fish surveys in the vicinity of the potential Project impact area against which future monitoring data can be compared to support identification and management of project impacts.	GPC	GPC	2014 to 2015	Once-off	•Species abundance •Fish density •Species richness •Diversity •Species eveness	Estuarine survey locations: •Southwest Facing Island (including Gatcombe Heads) •Sand Islet •Wild Cattle Creek •Boyne River •Lilleys Inlet •South Trees Inlet •Fisherman's Landing •The Narrows/ Targinne Creek •Boat Creek South Reef survey locations: •Oyster Rocks •Gatcombe Heads (East Point) •Sable Chief Rocks •Jenny Lind Banks •Seal Rocks	Figure 9: Fish monitoring	Report	Baseline data for CD EIS	EIS not publicly available yet	NA

Table B1 Priority Port of Gladstone master planning - environmental values monitoring and reporting programs from approximately 2013 (as at January 2017)

ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
E16	**Gladfish recreational fish monitoring program**	Ecology — fish	•Support increased understanding of long-term trends in recreational fishing in Gladstone Harbour, The Narrows and adjacent waterways through sourcing additional data for the Infofish database •Promote sustainable fishing practices in Gladstone Harbour, The Narrows and adjacent waterways •Determine trends in recreational fishing	•Infofish •Gladfish •Suntag	QGC	2011 to 2014	Continuous	•Fish growth and movement •Stock assessments •Stock predictions (Barramundi) •Assessing recruitment •Assessing local/regional fishing •Fish survival •Fish health	Suntag recreational fish tagging grids: •Gladstone Harbour •Calliope River •Boyne River •Curtis Island •Lake Awoonga	Figure 9: Fish monitoring	Report	Voluntary	•Data is reliant on citizen science •Several reports available to public on the web •Database is available on the web but requires authorised access	•GladFish website •GladFish case study report •Infofish website
E17	**Qfish fisheries catch data**	Ecology — fish	•Collect long term datasets of commercial fishing catch and effort to manage and report on the status of Queensland fisheries •Provide data to undertake ecological and stock assessments of Queensland fisheries	Department of Agriculture and Fisheries (DAF)	Government	1990 to present Ongoing, no end date specified	Continuous	•Species catch •Fishing effort •Fishing method	Commercial fishery 30 minute reporting grids: •S30 •T30	Figure 9: Fish monitoring	•Reports •Survey database online	Government program	•Data is reliant on commercial fishery reporting •Data is uploaded regularly on public available database	Qfish website
E18	**GPC Channel Duplication EIS baseline surveys**	Ecology — flora	Conduct baseline flora surveys in the vicinity of the potential project impact area against which future monitoring data can be compared to support identification and management of Project impacts.	GPC	GPC	Mar 2015	Once-off	•Species of plant •Height estimate •Species density •Qualitative description of plant health (visual assessment) •Flora species and vegetation communities and their conservation status under the EPBC Act, Nature Conservation Act and Vegetation Management Act •Likely occurrence of conservation significant flora species based on habitat characteristics	•Shoreline from Western Basin reclamation area to Friend Point •Shoreline areas at Port Central and Parsons Point	Figure 12: Flora monitoring	EIS chapter	Baseline data for CD EIS	EIS not publicly available yet	NA
E19	**EHP StrandNet wildlife stranding database**	Ecology — marine megafauna	Collect long term datasets of marine megafauna strandings and deaths in Queensland waters against which future data can be compared to and to allow identification of trends.	EHP	Government	1996 to present Ongoing, no end date specified	Continuous	Reports of sick, injured, dying and dead marine fauna including: • Cetaceans • Dugong • Marine turtles • Pinnipeds Incidental information on sharks, rays, seabirds and other marine animals.	Queensland waters	Spatial data not available	Reports are released semi-regularly	Government program	•Data can be requested from EHP and provided by EHP discretion •Strandings reports available on EHP website	EHP marine wildlife strandings annual reports

Table B1 Priority Port of Gladstone master planning - environmental values monitoring and reporting programs from approximately 2013 (as at January 2017)

ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
E20	**Ballast water and biofouling monitoring**	Ecology – pests	Monitor presence of pest species	Department of Agriculture and Water Resources	Department of Agriculture and Water Resources	Dates not specified	Not specified	Shipping (ballast water and hull fouling)	Port Curtis	Spatial data not available	Internal government data	Government program	Internal government data	Australian government marine pests information
E21	**Maintenance dredging: Long term monitoring and management plan for sea disposal of maintenance dredged material**	Ecology – pests	Assess the existing status and potential impacts of introduced marine pests during the 2013 to 2018 maintenance dredging and sea disposal campaign	GPC	GPC	2015	Once-off	Presence of marine pests within the Port of Gladstone	Areas to be dredged, DMPA and adjacent areas	Spatial data not available	Report prepared to support GPC Sea Dumping Permit	Compliance with GPC Sea Dumping Permit	Internal GPC data	•GPC long term monitoring and management plan for sea disposal of maintenance dredged material 2013 to 2018 •GPC dredging monitoring
E22	**Port of Gladstone baseline seagrass surveys**	Ecology – seagrass	•Describe seagrass communities within Port Curtis and the Rodds Bay dugong protection area (DPA) •Establish a baseline from which monitoring programs could be developed •Provide GIS database and maps within and adjacent to areas requiring dredging in the Port and potential dredged material placement areas •Discuss the implications of the survey results for protection of dugongs in the Rodds Bay DPA and during Port development and operational programs	GPC	GPC	2002 to 2014	•Project specific or as required by GPC •Surveys undertaken in 2002, 2009, 2013 and 2014	Seagrass characteristics including: •Seagrass percent cover •Species composition •Above-ground biomass •Percent algal cover •Depth below mean sea level (dbMSL) (subtidal meadows) •Sediment type •Time and position (latitude and longitude) •Spatial data input into GIS	•Port limits •Extended into GBRMP for some years.	Figure 6: Seagrass monitoring	Report	•Baseline data required to inform future port planning and seagrass monitoring programs (2002 and 2009) •Baseline data required for CD EIS (2013 and 2014)	•Internal GPC data •Some reports made available by GPC •Some reports available on the web (eg Seagrass-Watch site)	•GPC environmental reports page •Seagrass-Watch
E23	**Western Basin Dredging and Disposal Project – annual long term seagrass monitoring**	Ecology – seagrass	Routinely monitor the condition of key Port Curtis seagrass meadows (and Rodds Bay reference sites) to complement existing seagrass studies, in light of existing and future potential development of Gladstone and the Port.	GPC	GPC	2002 to 2018	Annually	•Seagrass community types •Changes in biomass •Meadow area •Species composition •Seagrass condition index	13 seagrass meadows between The Narrows and Boyne River mouth, Rodds Bay (reference sites)	Figure 6: Seagrass monitoring	Various reports	•Compliance with Commonwealth controlled action approval (EPBC 2009/4904) for WBDDP. •Some monitoring voluntary	•Internal GPC data •Some reports made available by GPC	GPC environmental reports page

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E24	**Western Basin Dredging and Disposal Project – biannual seagrass monitoring**	Ecology – seagrass	Document the spatial extent and biomass of intertidal and shallow subtidal seagrass meadows and assess seasonal dynamics (growing and senescence) prior to, during and after the WBDDP. Also complement light and temperature data recorded at seagrass meadows.	GPC	GPC	2009 to 2015	Biannually	•Seagrass community types •Changes in biomass •Meadow area •Species composition •Seagrass condition index	WBDDP survey area (The Narrows to Boyne River mouth)	Figure 6: Seagrass monitoring	Report	Compliance with Commonwealth controlled action approval (EPBC 2009/4904) for WBDDP	•Internal GPC data •Some reports made available by GPC	GPC environmental reports page
E25	**ERMP**	Ecology – seagrass	Monitor changes in the density of *Zostera muelleri* seed banks during the pre-dredging, dredging and post-dredging phases of the Western Basin Dredging and Disposal Project (WBDDP).	GPC and the ERMPAP	GPC ERMP	2011 to 2017	Quarterly	Collection and analysis of sediment cores collected from 2011 at seagrass monitoring transects	Port Curtis	Figure 6: Seagrass monitoring	Annual report	Commitment under ERMP	•Data available upon request by any interested parties •Reports made available on GPC website	•GPC ERMP •GPC ERMP reports
			Monitor changes in the proportion of viable *Z. muelleri* seeds in the seed bank before and after the growing season during the post-dredging phase of the WBDDP.				Biannually							
E26	**Western Basin Dredging and Disposal Project – seagrass condition monitoring**	Ecology – seagrass	Monitoring of seagrass condition at permanent transects to act as sentinel or sensitive receptor sites during the WBDDP to monitor variations in seagrass condition throughout the year.	GPC	GPC	2009 to 2016	Quarterly	•Abundance and community composition (seagrass health) •Elemental content of plants (seagrass tissue nutrients) •Meadow reproductive status (seagrass resilience) •Sexual above-ground productivity and asexual growth (seagrass productivity)	•WBDDP survey area •Rodds Bay (reference sites) •Temporary sites added for other projects (eg The Narrows LNG pipeline crossing, CD EIS)	Figure 6: Seagrass monitoring	Report of findings	•Compliance with Commonwealth controlled action approval (EPBC 2009/4904) for WBDDP •Baseline data for CD EIS and The Narrows pipeline crossing project	•Internal GPC data •Some reports made available by GPC	GPC environmental reports page
E27	**Maintenance dredging: Long term monitoring and management plan for sea disposal of maintenance dredged material**	Ecology – seagrass	Monitor/assess the impact, if any, on seagrass meadows as a result of maintenance dredging and sea disposal	GPC	GPC	2013 to 2018	Annually (completed as part of WBDDP requirements)	Refer GPC and WBDDP seagrass monitoring programs (refer E6, E22, E23, E24, E26)	Seagrass meadows in Port Curtis	Figure 6: Seagrass monitoring	Compliance reporting to EHP and DoEE	Compliance with GPC Sea Dumping Permit	Some monitoring completed as part of the other seagrass monitoring programs. Reports prepared for compliance purposes and for internal use by GPC.	•GPC Long term monitoring and management plan for sea disposal of maintenance dredge material 2013-2018

Table B1 Priority Port of Gladstone master planning - environmental values monitoring and reporting programs from approximately 2013 (as at January 2017)

ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
E28	**Gas Industry Social and Environmental Research Alliance (GISERA): An integrated study of the Gladstone marine system**	Ecology – seagrass	•The seagrass component of the integrated study of the Gladstone marine system (refer V7) was designed to complement existing seagrass monitoring of the cover, biomass and extent of seagrass meadows conducted through the WBDDP and as part of the Gladstone Port's long term seagrass monitoring objectives •Measurements of seagrass depth were designed to help parameterise the seagrass growth model (Chapter III of GISERA 'An integrated study of the Gladstone marine system' report) ensuring a realistic depiction of potential seagrass growth in Port Curtis •A detailed survey of Pelican Banks was conducted to better correlate turtle habitat use and seagrass distribution	GISERA	GISERA (CSIRO, Australia Pacific LNG, QGC)	2012 to 2014	Annually	•Physical variables: latitude and longitude, depth, conductivity, temperature, pH, secchi disc depth, Photosynthetically Active Radiation, turbidity, chlorophyll a, blue green algae, DO •Seagrass biomass •Seagrass depth ranges •Seagrass fine-scale distribution (Pelican Banks and to the west of Facing Island only)	•25 sampling sites at seagrass meadows from The Narrows, Wiggins Island, Pelican Banks and Boyne Island (2012) •41 sampling sites at seagrass meadows from The Narrows, Wiggins Island, Pelican Banks and Boyne Island and coastal waters (2013) •Meadows at Pelican Banks and to the west of Facing Island (finescale survey)	•Spatial data not available •Figure 6: Seagrass monitoring (for WBDDP seagrass monitoring)	•Results reported in Chapters 2 and 3 of CSIRO published report 'An integrated study of the Gladstone marine system' (Babcock et al. 2015) •Hydrodynamic/ biogeochemical model of Port Curtis, predicting water quality and seagrass growth	Voluntary	Report is publicly available on the CSIRO research publications repository	•GISERA homepage •An integrated study of the Gladstone marine system report •An integrated study of the Gladstone marine system report overview
E29	**ERMP**	Ecology – shorebirds	Determine the capacity of the study area to support migratory shorebirds and determine the size of the potentially impacted population.	GPC and the ERMPAP	GPC ERMP	2015 to 2017	Annually	•Mapping of tidal flat distribution and exposure •Measure benthic prey availability •Estimates of shorebird populations the area can support •Identify priority areas for management •Identify local movements of shorebirds in the area •Describe how shorebirds move around the study area •Identify patterns of flow of shorebirds to the study area •Size of management units	Port Curtis and Port Alma	Figure 5: Shorebird monitoring	Annual report	Commitment under ERMP	•Data available upon request by any interested parties •Reports made available on GPC website	•GPC ERMP •GPC ERMP reports
E30	**ERMP**	Ecology – shorebirds	Identify changes in the abundances and distribution of shorebirds over 10 years.	GPC and the ERMPAP	GPC ERMP	2011 to 2012	Five surveys per year	•Population censuses of species present •Mapping of feeding and roosting sites •Habitat utilisation relative to the lunar/tide cycles and season •Identification of critical characteristics of important habitat	Port Curtis and Port Alma	•Figure 5: Shorebird monitoring •Figure 3a and Figure 3b: ERMP and BOS study area	Annual report	Commitment under ERMP	•Data available upon request by any interested parties •Reports made available on GPC website	•GPC ERMP •GPC ERMP reports
						2013 to 2018	Annually (summer survey)							
						2019 to 2020	Five surveys per year							

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ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
E31	**GPC Channel Duplication EIS baseline surveys**	Ecology – shorebirds	Conduct baseline shorebird surveys in the vicinity of the potential project impact area against which future monitoring data can be compared to support identification and management of project impacts.	GPC	GPC	2014 to 2015	Once-off	•Time and date •GPS location (latitude/ longitude) •Observers •Stage of tide (i.e. high rising and high falling) •Wind direction •Habitat type and quality •Disturbances •Observed individuals: − Species observed − Number of individuals observed − Age class of group (if possible)	•Shoreline from Western Basin reclamation area to Friend Point •Shoreline areas at Port Central and Parsons Point •Shoreline at Boyne Island	Figure 5: Shorebird monitoring	EIS chapter	Baseline data for CD EIS	EIS not publicly available yet	NA
E32	**Arrow Energy LNG Plant EIS supplementary baseline surveys**	Ecology – shorebirds	Conduct a baseline shorebird assessment to detail potential impacts on migratory shorebirds from the proposed Arrow Energy LNG Plant and associated infrastructure	Arrow energy	Arrow Energy	2012 to 2013	Five surveys	•Time and date •Weather •Stage of tide (ie high rising and high falling) •GPS location •Shorebird behaviour (eg roosting or foraging) •Wind direction and speed •Disturbances •Number of each shorebird species •Additional avifauna observations	23 roosting and/ or foraging sites located around: •Southwestern extent of Curtis Island around Hamilton Point and Boatshed Point •Witt Island •Picnic Island •Fisherman's Landing •Wiggins Island •Calliope River	Figure 5: Shorebird monitoring	•Arrow LNG Plant Supplementary EIS chapter •Technical report	Baseline data for Arrow LNG Plant Supplementary EIS	Supplementary EIS and shorebird technical study are publicly available from the Department of State Development (DSD) website	Arrow LNG Plant Supplementary EIS shorebird technical study
E33	**ERMP**	Ecology – tidal wetlands (mangroves/ saltmarsh/ saltpans)	Monitor the survival and recovery of shorelines, specifically tidal wetlands (mangroves/ saltmarsh/saltpans).	GPC and the ERMPAP	GPC ERMP	2014 to 2021	Annually	•High resolution maps of tidal wetlands •Normalised Difference Vegetation Index (NDVI) mapping of tidal wetland •Shoreline condition monitoring using oblique aerial image data acquisition •Shoreline condition monitoring using boat based video image data acquisition and community volunteers	Port Curtis and Port Alma	Figure 3a and Figure 3b: ERMP and BOS study area	Annual report	Commitment under ERMP	•Data available upon request by any interested parties •Reports made available on GPC website •Public access and data entry portal for display of current and past mapping	•GPC ERMP •GPC ERMP reports
E34	**ERMP**	Ecology – turtles (foraging)	Increase understanding of Green turtle habitat usage in the Port Curtis and Port Alma region.	GPC and the ERMPAP	GPC ERMP	2014 to 2017	Annually	Green turtle tracking using satellite tags to examine the movement, behaviour and habitat use	Port Curtis and Port Alma	Figure 3a and Figure 3b: ERMP and BOS study area	Annual report	Commitment under ERMP	•Data available upon request by any interested parties •Reports made available on GPC website	•GPC ERMP •GPC ERMP reports
E35	**ERMP**	Ecology – turtles (foraging)	Increase the understanding of the Green turtle population in Port Curtis.	GPC and the ERMPAP	GPC ERMP	2016 to 2020	Four surveys per year	Determine the composition by size, sex, growth rates, survivorship, recruitment, and general health of the Green turtle population in Port Curtis	Port Curtis and Port Alma	Figure 3a and Figure 3b: ERMP and BOS study area	Annual report	Commitment under ERMP	•Data available upon request by any interested parties •Reports made available on GPC website	•GPC ERMP •GPC ERMP reports

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ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
E36	**Gas Industry Social and Environmental Research Alliance (GISERA): An integrated study of the Gladstone marine system**	Ecology – turtles (foraging)	•The turtle component of integrated study of the Gladstone marine system (refer V7) was designed to better understand the risk of boat strike from commercial vessels operating in the Port of Gladstone •This data was an input into risk modelling of Green turtle populations in relation to shipping movements in the Port of Gladstone to inform potential management decisions in relation to risk minimisation	GISERA	GISERA (CSIRO, Australia Pacific LNG, QGC)	2013 to 2014		Green turtle tracking using acoustic and satellite tags to examine the movement, behaviour and habitat use	Tagging at Pelican Banks and Wiggins Island	Spatial data not available	•Results reported in Chapters 4 and 5 of CSIRO published report 'An integrated study of the Gladstone marine system' •Turtle behaviour – habitat use and risk modelling	Voluntary	Report is publicly available on the CSIRO research publications repository	•GISERA homepage •An integrated study of the Gladstone marine system report •An integrated study of the Gladstone marine system report overview
E37	**ERMP**	Ecology – turtles (internesting)	Increase understanding of Flatback turtle habitat usage in the Port Curtis and Port Alma region	GPC and the ERMPAP	GPC ERMP	2013 to 2017	Annually	Flatback turtle tracking using satellite tags to examine movement, behaviour and habitat use	Port Curtis and Port Alma	Figure 3a and Figure 3b: ERMP and BOS study area	Annual report	Commitment under ERMP	•Data available upon request by any interested parties •Reports made available on GPC website	•GPC ERMP •GPC ERMP reports
E38	**ERMP**	Ecology – turtles (light)	•Monitor the sea-finding ability of hatchling Flatback turtles at nesting beaches on Curtis Island •Collection and analysis of quantitative data to advise decision making on rookeries and management of artificial light sources associated with the WBDDP and LNG facilities on Curtis Island	GPC and the ERMPAP	GPC ERMP	2013 to 2014	Once-off	Impact of artificial light on the orientation of hatchlings in selected nesting beaches within the ERMP region	•Curtis Island - South End Beach •Facing Island - Settlement Beach, Ocean Beach 1, Ocean Beach 2	Figure 4: Marine turtle nesting and hatchling monitoring	Annual report	Commitment under ERMP	•Data available upon request by any interested parties •Reports made available on GPC website	•GPC ERMP •GPC ERMP reports
E39	**ERMP**	Ecology – turtles (nesting)	Monitor marine turtle nesting populations on index beaches in the Port Curtis and Port Alma region and surrounds.	GPC and the ERMPAP	GPC ERMP	2013 to 2017	Annually	•Quantification of demographic parameters for the nesting female, including nesting success, clutches laid per female per nesting season, number of eggs per clutch, adult breeding frequency, and adult recruitment •Quantification of demographic parameters for hatchling production, including habitat specific incubation success, hatchling emergence success, hatchling mortality while crossing the beach and sources of mortality	Curtis Island and Peak Island	•Figure 4: Marine turtle nesting and hatchling monitoring •Figure 3a and Figure 3b: ERMP and BOS study area	Annual report	Commitment under ERMP	•Data available upon request by any interested parties •Reports made available on GPC website	•GPC ERMP •GPC ERMP reports
N1	**GPC noise monitoring**	Noise	Monitor noise at GPC facilities based on noise complaints. Comply with *Environmental Protection (Noise) Policy 2008*.	GPC	GPC	Dates not specified	As required - complaint driven	Not specified	Gladstone community	Spatial data not available	Internal GPC data	Compliance with EA conditions	Internal GPC data	NA

Table B1 Priority Port of Gladstone master planning - environmental values monitoring and reporting programs from approximately 2013 (as at January 2017)

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N2	ERMP	Noise (underwater)	Investigate the effects of noise and pressure associated with Project related activities (such as dredge vessel movement, pile driving, dredging and material placement) on the biology and ecology of marine megafauna.	GPC and the ERMPAP	GPC ERMP	2013 to 2014	Annually	•Ambient aquatic noise during dredging works •Ambient aquatic noise during no dredging	Port Curtis and Port Alma	•Figure 11: Underwater noise monitoring •Figure 3a and Figure 3b: ERMP Program and BOS study area	Annual report	Commitment under ERMP	•Data available upon request by any interested parties •Reports made available on GPC website	•GPC ERMP •GPC ERMP reports
N3	GPC Channel Duplication EIS baseline surveys	Noise (underwater)	Collect baseline underwater noise monitoring data in the vicinity of the potential Project impact area against which future monitoring data can be compared to support identification and management of Project impacts.	GPC	GPC	2014 to 2015	Once-off	Ambient noise monitoring including: •Temporal and spatial variations in overall underwater noise levels •Spectral variations in underwater noise levels •Major noise contributors of various origins •Correlations with other natural environment parameters such as weather, sea states and tides	•Port Central •Channel/West Banks •Outer Harbour •Western Basin	Figure 11: Underwater noise monitoring	Report	Baseline data for CD EIS	EIS not publicly available yet	NA
S1	Port Curtis Integrated Monitoring Program (PCIMP)	Sediment quality	•Monitor the far field condition of the benthic marine environment in Port Curtis by: - Examining the concentration and spatial distribution of nutrients, metals and metalloids and fluoride at all sites - Analysing particle size at all sites •Align with the PCIMP water quality monitoring program objectives	Refer V1	Refer V1	2001 to present Ongoing, no end date specified	Biannually (currently)	•Total metals: aluminium, arsenic, cadmium, chromium, cobalt, copper, gallium, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, tin, uranium, vanadium, zinc •Nutrients •Particle size distribution	Sample sites located in 13 zones in marine and estuarine environments (including reference sites)	Figure 1: Port Curtis Integrated Monitoring Program water quality and sediment quality monitoring	PCIMP internal report	Voluntary	•Individual sediment quality reports are not available to the public •PCIMP data is now provided to the GHHP to contribute to the GHHP report card (refer V3) •Data is available on the web but requires authorised member access	PCIMP website
S2	Maintenance dredging: Long term monitoring and management plan for sea disposal of maintenance dredged material	Sediment quality	•Ascertain the contaminant status of material to be disposed of at sea through maintenance dredging •Ascertain the contaminant status of material that has been placed within the East Basks DMPA	GPC	GPC	2013 to 2018	Every 5 years	Contaminants in sediment (TBD)	Areas to be dredged, including shipping channels, berths, and DMPA	Spatial data not available	•Report prepared to support GPC Sea Dumping Permit in accordance with National Assessment Guidelines for Dredging (NAGD) 2009 •Sampling and Analysis Plan (SAP)	Compliance with GPC Sea Dumping Permit	Reports prepared for compliance purposes and for internal use by GPC	•GPC long term monitoring and management plan for sea disposal of maintenance dredged material 2013 to 2018 •GPC dredging monitoring

Table B1 Priority Port of Gladstone master planning - environmental values monitoring and reporting programs from approximately 2013 (as at January 2017)

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S3	**Maintenance dredging: Long term monitoring and management plan for sea disposal of maintenance dredged material**	Sediment quality	•Monitor accumulation of material at East Banks DMPA and remaining capacity •Monitor siltation rates within areas to be dredged for maintenance dredging	•GPC •Maritime Services Queensland (MSQ)	•GPC •MSQ	2013 to 2018	Annually -completed after each major maintenance dredging campaign	•Accumulation of material at DMPA and remaining capacity •Siltation rates	•DMPA •Shipping channel (siltation)	Spatial data not available	Report prepared to support GPC Sea Dumping Permit	Compliance with GPC Sea Dumping Permit	Reports prepared for compliance purposes and for internal use by GPC	•GPC long term monitoring and management plan for sea disposal of maintenance dredged material 2013 to 2018 •GPC dredging monitoring
WQ1	**Queensland government water quality monitoring**	Water quality	Collect a long term dataset of water quality monitoring in estuaries and inshore waters in the Central Queensland area from 1993 to assess the quality of these waters with respect to both condition and long-term trend. Data collected also serves as: •Input to EISs •Input to licensing decisions •Use by natural resource management (NRM) bodies •Use as base data for deriving water quality guidelines	•DSITI •EHP •(former) Environmental Protection Agency (EPA)	Government	1993 to present Ongoing, no end date specified	Monthly (approximately)	•Conductivity •Temperature •pH •Dissolved oxygen (DO). •Turbidity •Secchi depth •Nutrients	•Regular sites at the mouth of rivers that flow into Gladstone Harbour (ie Boyne, Calliope and Fitzroy) •Sites within the Port of Gladstone for previous targeted monitoring programs	Figure 2: Marine and estuarine water quality monitoring	•Internal Queensland government data •Various reports published over time as required (eg Comparison of current and historical water quality 2011, analysis of water quality in relation to fish health in Gladstone Harbour 2012, Post flood event monitoring reports 2013)	Government program	•Continuous monitoring data not available (data may be provided upon request) •Some reports are available on the Queensland government website (reports may also be provided upon request) •Some historical raw data available on Queensland Government open data portal	•EHP Gladstone region water quality reports •Queensland Government datasets
WQ2	**GPC wharf water quality monitoring**	Water quality	To record ambient readings of water quality physicochemical parameters at key GPC port infrastructure sites to provide a continuous and long term dataset.	GPC	GPC	2015 to present Ongoing, no end date specified	Continuous	•Temperature •Conductivity •pH •Turbidity •DO	•Fisherman's Landing •Clinton Wharf •Boyne Wharf	Spatial data not available	GPC internal monitoring data	Voluntary	GPC internal monitoring data	NA
WQ3	**GPC stormwater quality monitoring**	Water quality	Monitor releases of stormwater to the Port of Gladstone at GPC operational licenced discharge points.	GPC	GPC	Start date unknown Ongoing, no end date specified	•Once per stormwater discharge event (physical parameters) •Twice yearly and when pH <6.5 (metals and sulfate)	•DO •pH •Suspended solids •Total petroleum hydrocarbons (TPH) •Dissolved metals (Hg, Zn, Cu, Ag, Ni, Pb, Cr, Cd, and sulfate)	•Barney Point Coal Terminal - Six locations •RG Tanna Coal Terminal - Five locations	Spatial data not available	GPC internal monitoring data	Compliance with Environmental Authority (EA) conditions	GPC internal monitoring data	NA
							Upon discharge (up to 4 times/ year)	•DO •Suspended solids •pH •Oil and grease	Port Central, and extraction sites (Ticor and Byelee)					

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WQ4	**Maintenance dredging: Long term monitoring and management plan for sea disposal of maintenance dredged material**	Water quality	•Measure the behaviour of sediments and water quality within the dredge plume and adjacent areas to validate hydrodynamic modelling predictions •Measure bioaccumulation and bioavailability of contaminants through deployment of oysters	GPC	GPC	2013 to 2018	•Before, during and after maintenance dredging •Oyster deployment TBD	•Trace metals •Nutrients •Turbidity •Bioaccumulation and bioavailability of contaminants (oysters)	•Water: Areas to be dredged, East Banks DMPA and adjacent areas •Oysters: East Banks DMPA	Spatial data not available	Report prepared to support GPC Sea Dumping Permit	Compliance with GPC Sea Dumping Permit	•Reports prepared for compliance purposes and for internal use by GPC •PCIMP data may be used for background assessments	•GPC long term monitoring and management plan for sea disposal of maintenance dredged material 2013 to 2018 •GPC dredging monitoring
WQ5	**GPC Channel Duplication EIS baseline surveys**	Water quality	Conduct baseline water quality monitoring in the vicinity of the potential Project impact area against which future monitoring data can be compared to support identification and management of Project impacts and to compare results to predictive modelling.	GPC	GPC	2014 to 2015	Continuous	•Turbidity •Temperature •pH •Conductivity •DO •Sedimentation •BPAR	Eight sites located from The Narrows, Port of Gladstone, Outer Harbour and open coastal waters east of Facing Island	Figure 2: Marine and estuarine water quality monitoring	Report	Baseline data for CD EIS	EIS not publicly available yet	NA
							Monthly	•Total suspended solids (TSS) •Chlorophyll a •Nutrients •Total and dissolved metals						
							Quarterly	•TPH (C6-C40) •Polycyclic aromatic hydrocarbon (PAH) •Organochlorine Pesticides (OCP)/ Organophosphate Pesticides (OPP) •Herbicides						

Table B1 Priority Port of Gladstone master planning - environmental values monitoring and reporting programs from approximately 2013 (as at January 2017)

ID	Program name	Monitoring type	Objective	Responsible entity	Funding source	Timeframe and/or end date	Frequency	Monitoring parameters	Spatial scope	Figure reference	Program outputs	Requirement	Data availability	Additional information (refer attached information links table)
WQ6	**Port Curtis Integrated Monitoring Program (PCIMP)**	Water quality	•Monitor the far field health of estuarine and marine water quality in Port Curtis •Ensure a broad spatial sampling coverage of water bodies in Port Curtis and maintain a longitudinal study of water quality •Include adequate sampling frequency to detect and understand annual temporal changes •Collect data on key water quality parameters including: -Document the physiochemical water quality parameters at all sites -Examine the concentration and spatial distribution of nutrients and chlorophyll a at all sites •At all sites assess the concentration and spatial distribution of dissolved and total metals and metalloids, metals and metalloids accumulated by oysters (in soft tissues) and fluoride accumulated by oysters (in shell growth) •Compare results to trigger values reported in the Australian Water Quality Guidelines (AWQG) (ANZECC/ ARMCANZ 2000) and Queensland Water Quality Guidelines (QWQG) (EHP 2009) •Provide a baseline for analysing any future water quality changes in Port Curtis •Allow identification of cumulative impacts of a variety of activities in Port Curtis •Compare monitoring data temporally between zones within Port Curtis	Refer V1	Refer V1	2001 to present Ongoing, no end date specified	Quarterly (currently)	2013/2014 sampling: •Total metals: aluminium, arsenic, cadmium, chromium, cobalt, copper, gallium, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, tin, uranium, vanadium, zinc •Total suspended solids •Chlorophyll a •Cyanide species •Fluoride •Nutrients •Orthophosphate-P •Dissolved organic carbon •Total organic carbon •Bioaccumulation of metals through the deployment of oysters (biannually)	Sample sites located in 13 zones in marine and estuarine environments (including reference sites)	Figure 1: Port Curtis Integrated Monitoring Program water quality and sediment quality monitoring	PCIMP internal report	Voluntary	•Individual water quality reports are not available to the public •PCIMP data is now provided to the GHHP to contribute to the GHHP report card (refer V3) •Data is available on the web but requires authorised member access	PCIMP website
WQ7	**Gas Industry Social and Environmental Research Alliance (GISERA): An integrated study of the Gladstone marine system**	Water quality	Asses the optical properties of waters in the study area to support the development and improvement of biogeochemical models for both the pelagic and benthic environments within the Port of Gladstone.	•GISERA	•GISERA (CSIRO, Australia Pacific LNG, QGC)	2012 to 2013	Annually	Bioptical properties of Gladstone Harbour waters: •Secchi depth •Total suspended matter •Pigment analysis •Particulate and detrital absorption •Coloured Dissolved Organic Matter	•34 sampling sites from The Narrows to Outer Harbour (2012) •43 sampling sites from The Narrows to coastal waters east of Facing Island (2013)	Spatial data not available	•Results reported in Chapters 1 and 3 of CSIRO published report 'An integrated study of the Gladstone marine system' •Hydrodynamic/ Biogeochemical model of Port Curtis, predicting water quality and seagrass growth	Voluntary	Report is publicly available on the CSIRO research publications repository	•GISERA homepage •An integrated study of the Gladstone marine system report •An integrated study of the Gladstone marine system report overview
W1	**GPC waste monitoring program**	Waste	Monitoring of waste streams for compliance with environmental management system	GPC	GPC	Dates not specified	Not specified	Waste tracking certificates	Gladstone	Spatial data not available	Internal GPC data	Compliance with waste management plan	Monitoring by GPC has ceased	NA

Abbreviations

Abbreviation	Meaning
AIMS	Australian Institute of Marine Science
ANZECC	Australian and New Zealand Environment Conservation Council
AWQG	Australian Water Quality Guidelines
APLNG	Australia Pacific Liquefied Natural Gas
BOS	Biodiversity Offset Strategy
BPAR	benthic photosynthetically active radiation
CD EIS	Port of Gladstone Gatcombe and Golding Cutting Channel Duplication Project Environmental Impact Statement
CQU	Central Queensland University
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAF	Department of Agriculture and Fisheries
DoEE	Department of Environment and Energy (Commonwealth)
DMPA	dredged material placement area
DPA	Dugong Protection Area
DSITI	Department of Science, Information Technology and Innovation
est.	established
EA	Environmental Authority
EHP	Department of Environment and Heritage Protection
EPA	Environmental Protection Agency
EPBC	*Environment Protection and Biodiversity Conservation Act 1999*
ERMP	Ecosystem Research and Monitoring Program
ERMPAP	Ecosystem Research and Monitoring Program Advisory Panel
FBA	Fitzroy Basin Association
GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
GISERA	Gas Industry Social and Environmental Research Alliance
GHHP	Gladstone Healthy Harbour Partnership
GIS	geographic information system
GLNG	Gladstone Liquefied Natural Gas Project
GPC	Gladstone Ports Corporation
GRC	Gladstone Regional Council
ISP	independent science panel
MSQ	Maritime Safety Queensland
NAGD	National Assessment Guidelines for Dredging
NRM	natural resource management
NRG	NRG Gladstone Power Station

Abbreviation	Meaning
OCP	organochlorine pesticides
OPP	organophosphate pesticides
PAH	polycyclic aromatic hydrocarbon
PCIMP	Port Curtis Integrated Monitoring Program
PSD	particle size distribution
QAL	Queensland Alumina Limited
QER	Queensland Energy Resources
QGC	QGC Pty Ltd
QWQG	Queensland Water Quality Guidelines
RIMRep	Reef 2050 Integrated Monitoring and Reporting Program Strategy
SAP	sampling and analysis plan
TBD	to be determined
TPH	total petroleum hydrocarbons
TOC	total organic carbon
TSS	total suspended solids
WBDDP	Western Basin Dredging and Disposal Project
WICET	Wiggins Island Coal Export Terminal Pty Ltd

Figures

Figure number	Figure title
Figure 1	Port Curtis Integrated Monitoring Program water quality and sediment quality monitoring
Figure 2	Marine and estuarine water quality monitoring
Figure 3a	Ecosystem Research and Monitoring Program and Biodiversity Offset Strategy study area
Figure 3b	Ecosystem Research and Monitoring Program and Biodiversity Offset Strategy Port Curtis study area
Figure 4	Marine turtle nesting and hatchling monitoring
Figure 5	Shorebird monitoring
Figure 6	Seagrass monitoring
Figure 7	Air quality monitoring
Figure 8	Reef monitoring
Figure 9	Fish monitoring
Figure 10	Benthic fauna monitoring
Figure 11	Underwater noise monitoring
Figure 12	Flora monitoring
Figure 13	Inshore dolphin monitoring

Environmental monitoring programs table identifiers

Prefix	Monitoring type
AQ	Air quality
E	Ecology
N	Noise
S	Sediment
W	Waste
WQ	Water quality
V	Various

Information Links

Program / webpage	URL
Arrow LNG Plant Supplementary EIS shorebird technical study	http://eisdocs.dsdip.qld.gov.au/Shell%20Australia%20LNG%20(aka%20Arrow%20LNG%20Plant)/SEIS/Appendices/appendix-18-final-shorebird-technical-study.pdf
Australian Government marine pests information	http://www.agriculture.gov.au/pests-diseases-weeds/marine-pests
BOS	BOS overview: http://www.gpcl.com.au/environment/bos BOS reports http://www.gpcl.com.au/envirodocs-desc?j={Biodiversity%20Offset%20Strategy}&y=1
EHP Gladstone region water quality	https://www.ehp.qld.gov.au/gladstone/water-quality.html#water_quality
EHP marine wildlife strandings annual reports	https://www.ehp.qld.gov.au/wildlife/caring-for-wildlife/strandnet-reports.html
GBRMPA website	http://www.gbrmpa.gov.au/
GBRMPA Reef 2050 Integrated Monitoring and Reporting Program	http://www.gbrmpa.gov.au/managing-the-reef/reef-2050/reef-integrated-monitoring-and-reporting-program

Program / webpage	URL
GHHP	GHHP publications: http://ghhp.org.au/publications GHHP coral investigations: https://dims.ghhp.org.au/repo/data/public/26521b GHHP 2015 report card technical report: http://ghhp.org.au/assets/pdf/tech-report/2015%20Report%20Card%20Technical%20Report_FINAL-20160211202711.pdf GHHP ePortal: http://data.ghhp.org.au/
GISERA	GISERA homepage: www.gisera.org.au An integrated study of the Gladstone marine system report: https://publications.csiro.au/rpr/pub?pid=csiro:EP152793 An integrated study of the Gladstone marine system report overview: https://gisera.org.au/wp-content/uploads/2017/01/An-integrated-study-of-the-Gladstone-marine-system.pdf
GladFish	Gladfish overview: http://infofishaustralia.com.au/gladfish-case-study/ Gladfish 2013 report: http://infofishaustralia.com.au/wp-content/uploads/2016/08/Gladfish-2013-report-final.pdf
GPC air quality monitoring overview	http://www.gpcl.com.au/environment/compliance-and-monitoring/air-quality-monitoring-program
GPC coral studies	http://www.gpcl.com.au/envirodocs-desc?j={Coral}&y=1
GPC dredging monitoring	http://www.gpcl.com.au/operations/dredging
GPC environmental reports	http://www.gpcl.com.au/envirodocs-desc?j=*&y=1
GPC ERMP overview	http://www.gpcl.com.au/environment/ermp
GPC ERMP reports	http://www.gpcl.com.au/envirodocs-desc?j={Ecosystem%20Research%20and%20Monitoring%20Program}&y=1
GPC Long term monitoring and management plan for sea disposal of maintenance dredge material 2013-2018	http://gpcl.com.au/SiteAssets/Dredging%20Plans/Long_Term_Monitoring_and_Management_Plan_for_Sea_Disposal_of_Maintenance_Dredge_Material_2013_2018.pdf
Infofish website	http://infofishaustralia.com.au/
PCIMP	http://www.pcimp.com.au

Program / webpage	URL
Qfish website	http://qfish.fisheries.qld.gov.au/
Queensland Government air quality monitoring	Gladstone air quality monitoring network: https://www.qld.gov.au/environment/pollution/monitoring/air-monitoring/gladstone/ EHP Gladstone region air quality reports page: https://www.ehp.qld.gov.au/gladstone/air-quality.html EHP hourly air quality data: https://www.ehp.qld.gov.au/air/data/search.php
Queensland Government dataset search	https://data.qld.gov.au/
Queensland Government library catalogue	https://www.qld.gov.au/environment/library
Seagrass-Watch publications	http://www.seagrasswatch.org/publications.html

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Australian and New Zealand Environment Conservation Council/Agriculture and Resources Management Council of Australia and New Zealand 2000, *National Water Quality Management Strategy, Paper No. 4,* Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1, The Guidelines (Chapters 1-7) pp. 3.1: 1-3, 4.4: 10-11.

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Department of Environment and Heritage Protection 2009, *Queensland Water Quality Guidelines*, Version 3, ISBN 978-0- 9806986-0-2.

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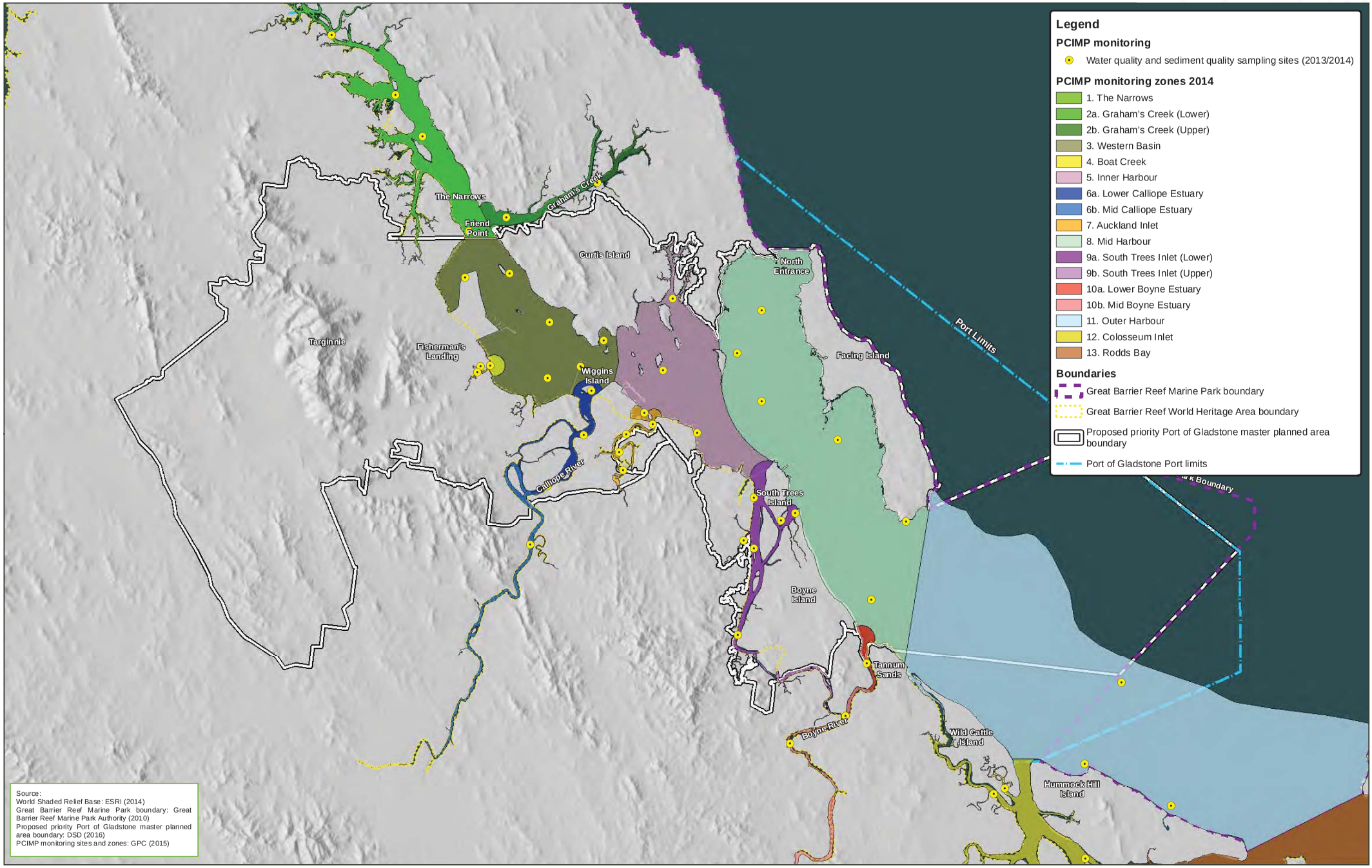

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Priority Port of Gladstone master planning environmental monitoring programs

Figure 1: Port Curtis Integrated Monitoring Program water quality and sediment quality monitoring

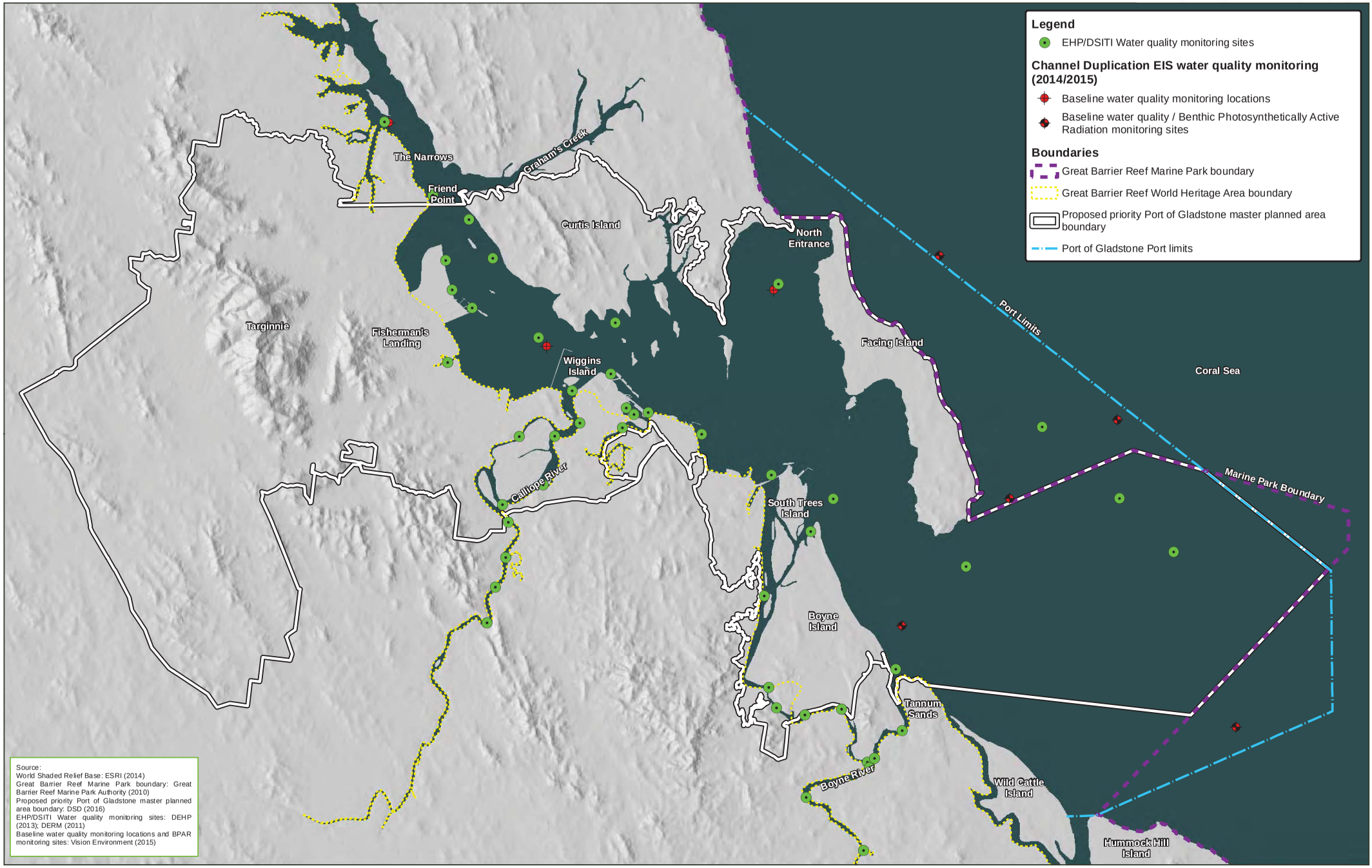

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Figure 2: Marine and estuarine water quality monitoring

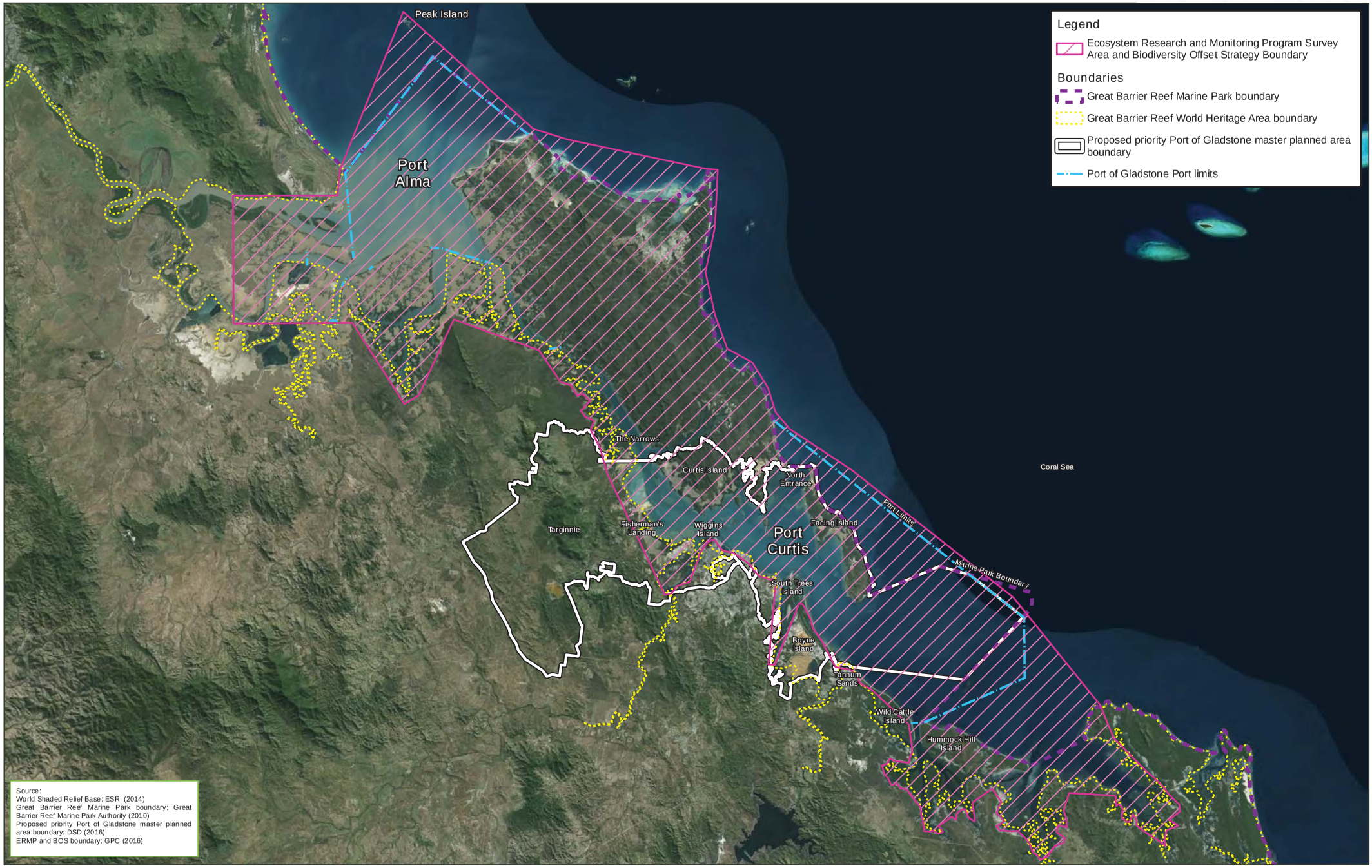

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Figure 3a: Ecosystem Research and Monitoring Program and Biodiversity Offset Strategy study area

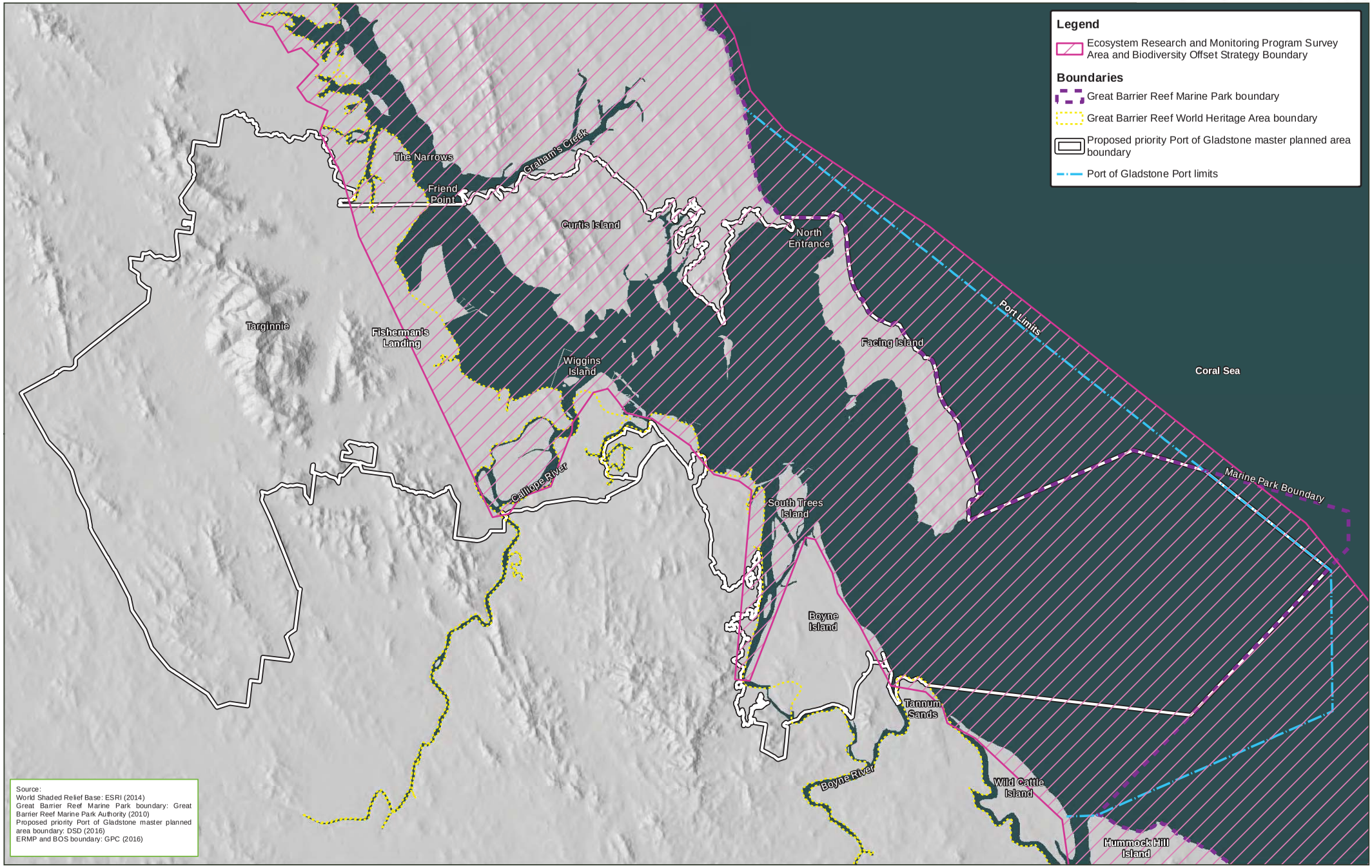

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Figure 3b: Ecosystem Research and Monitoring Program and Biodiversity Offset Strategy Port Curtis study area

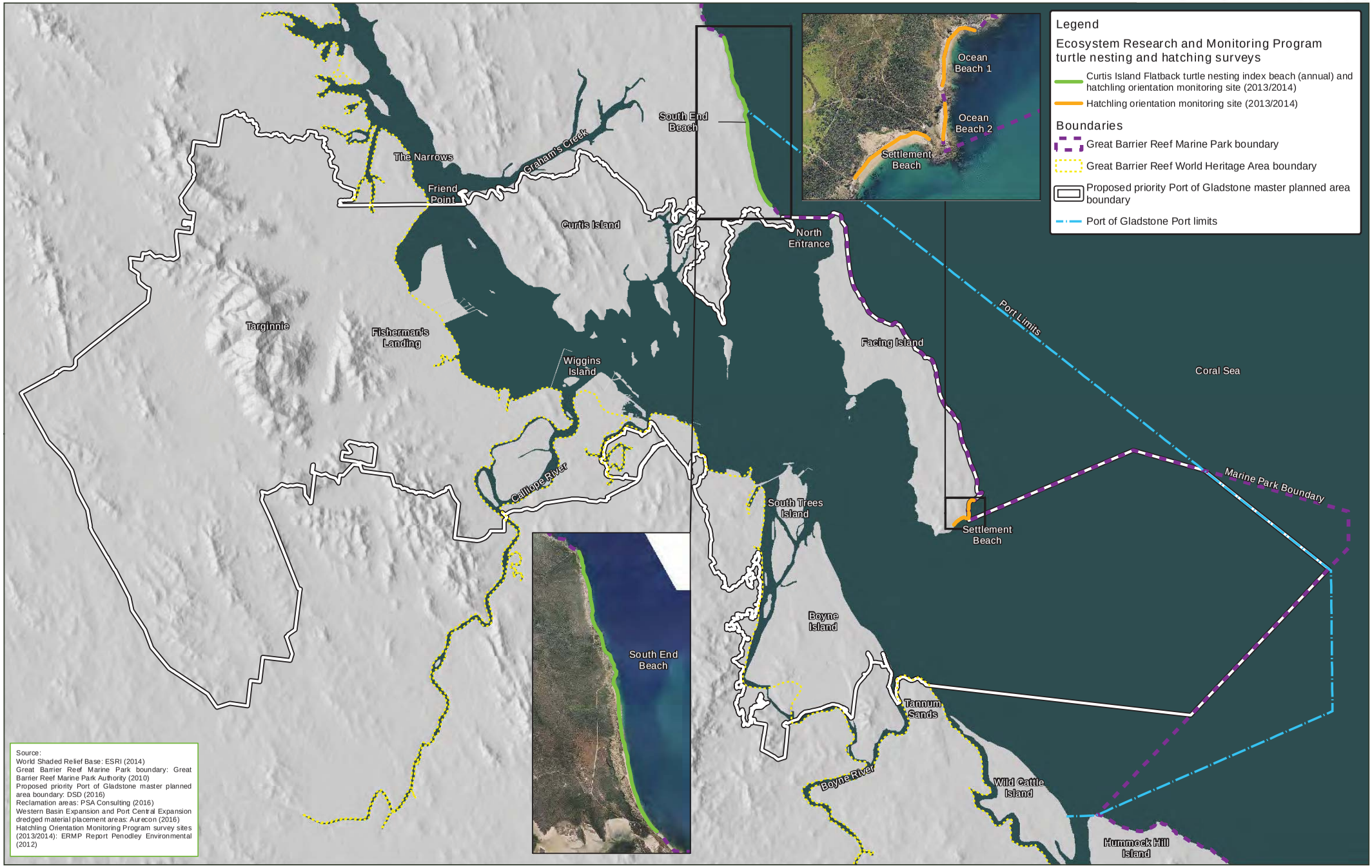

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Figure 4: Marine turtle nesting and hatchling monitoring

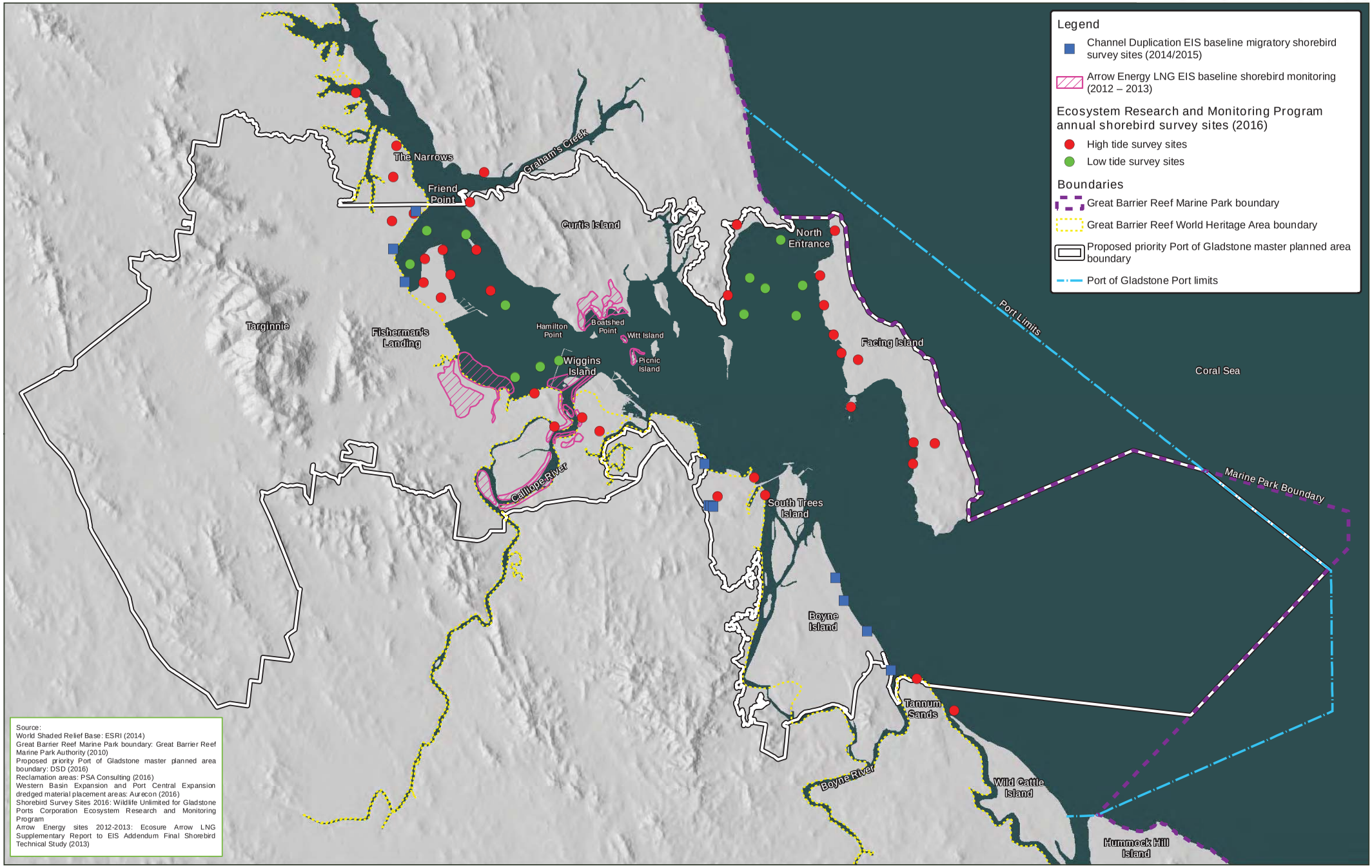

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Figure 5: Shorebird monitoring

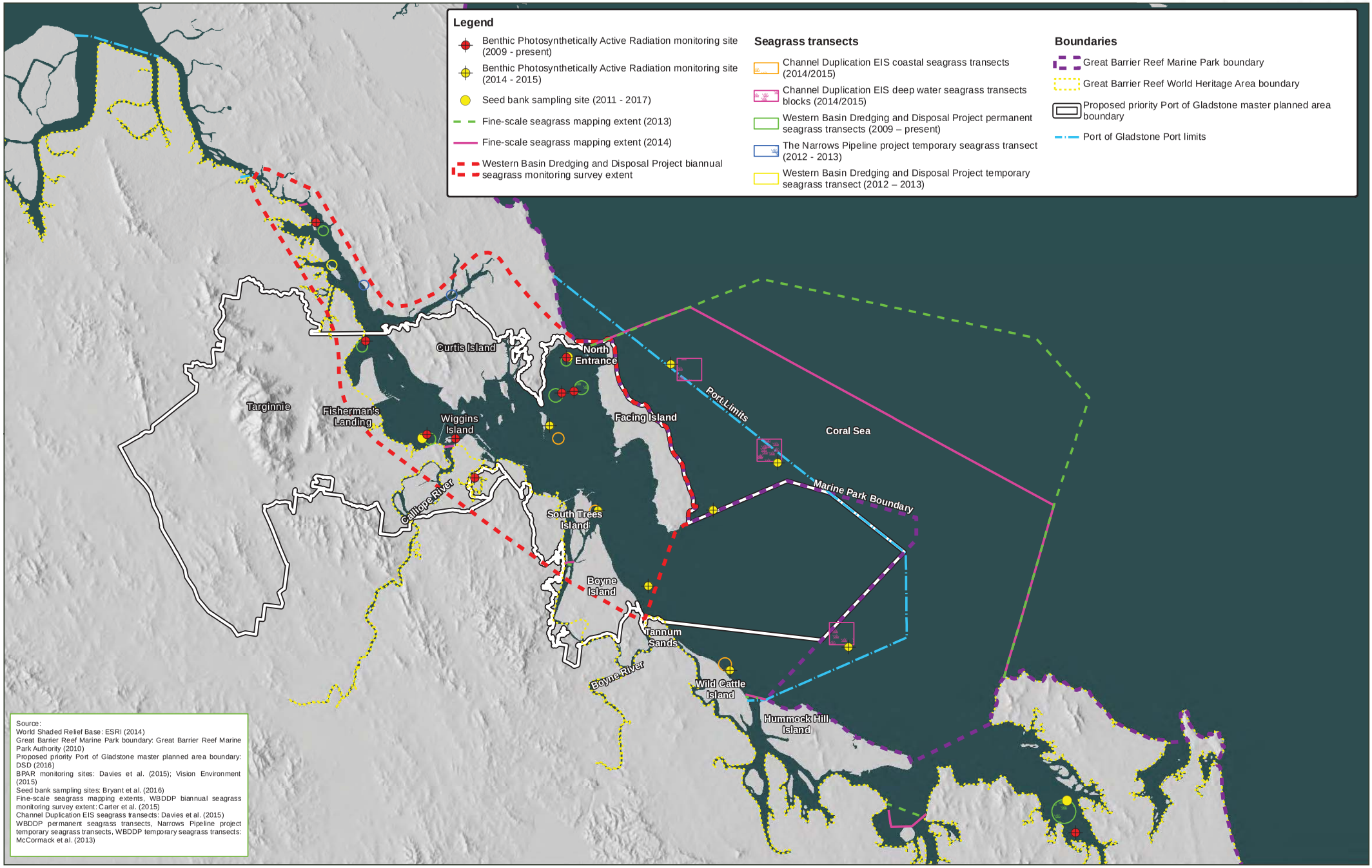

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Figure 6: Seagrass monitoring

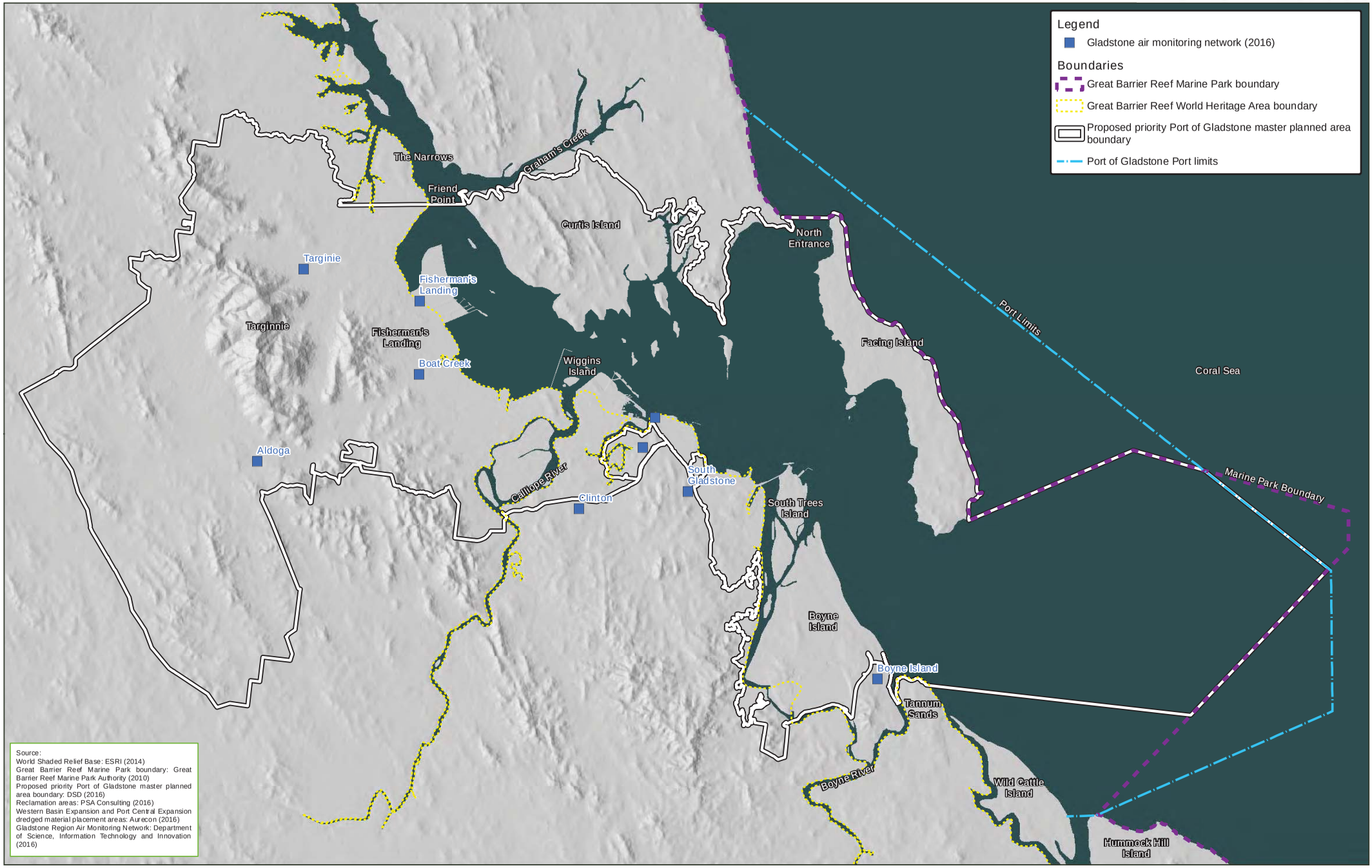

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Figure 7: Air quality monitoring

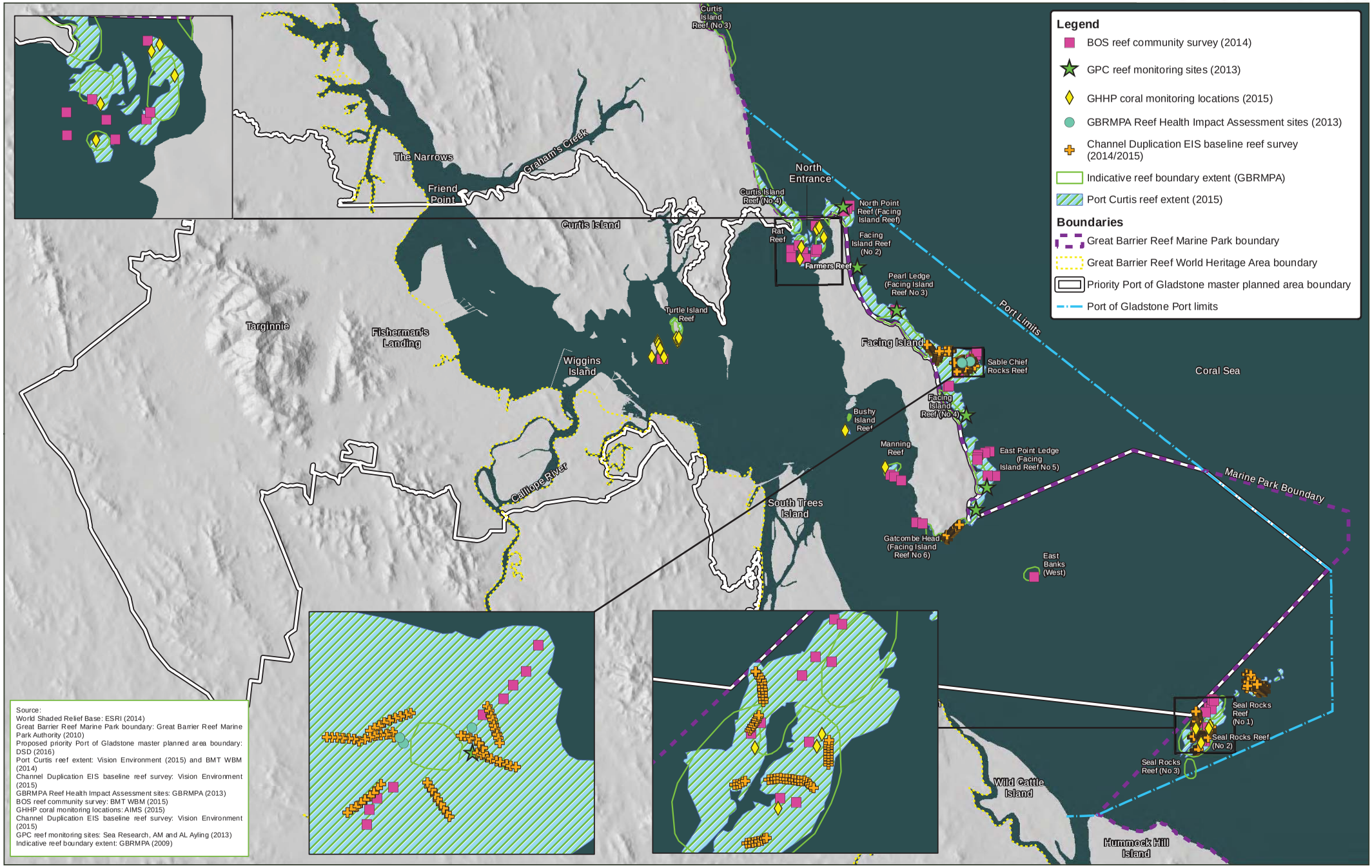

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Figure 8: Reef monitoring

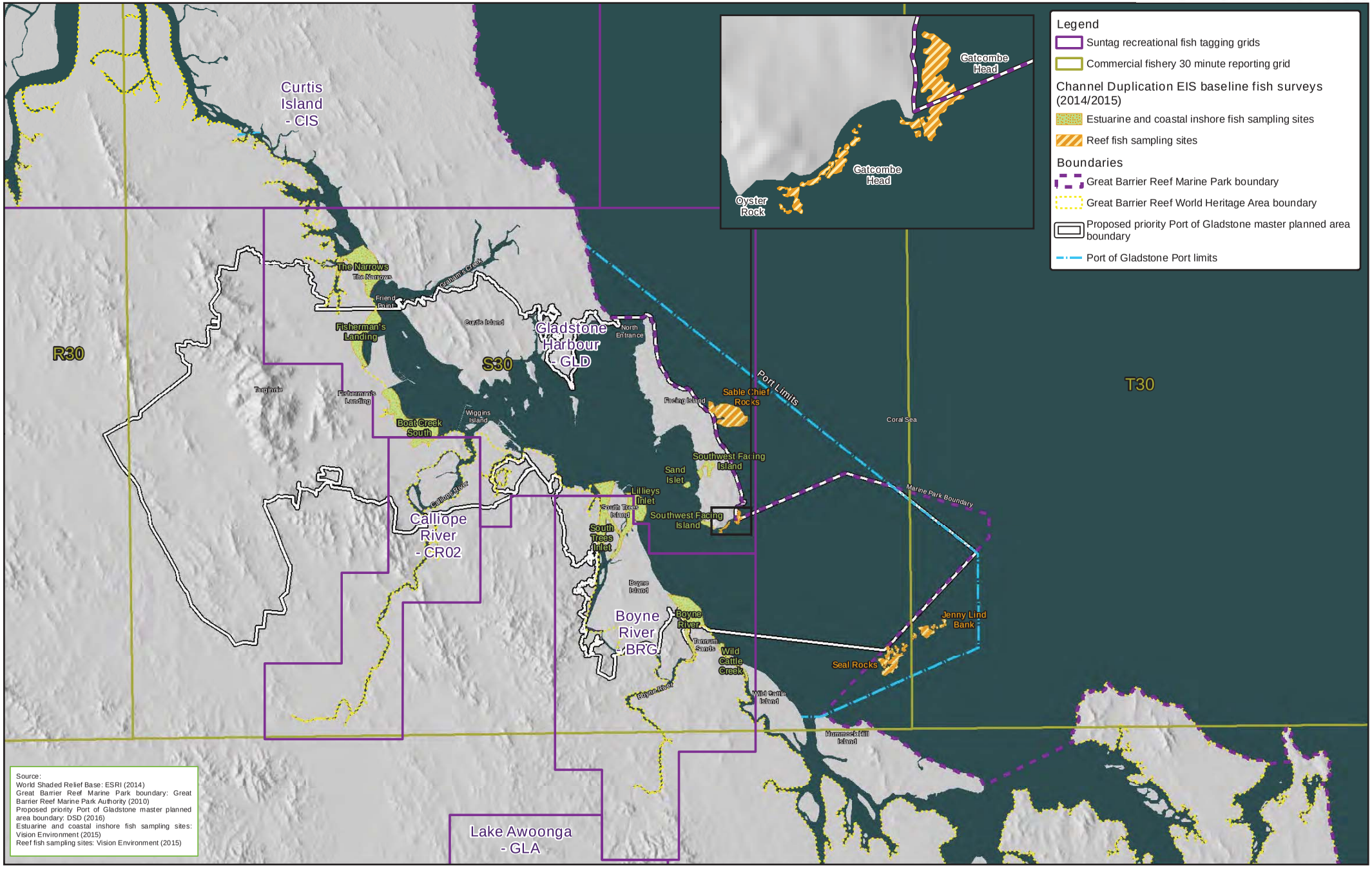

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Figure 9: Fish monitoring

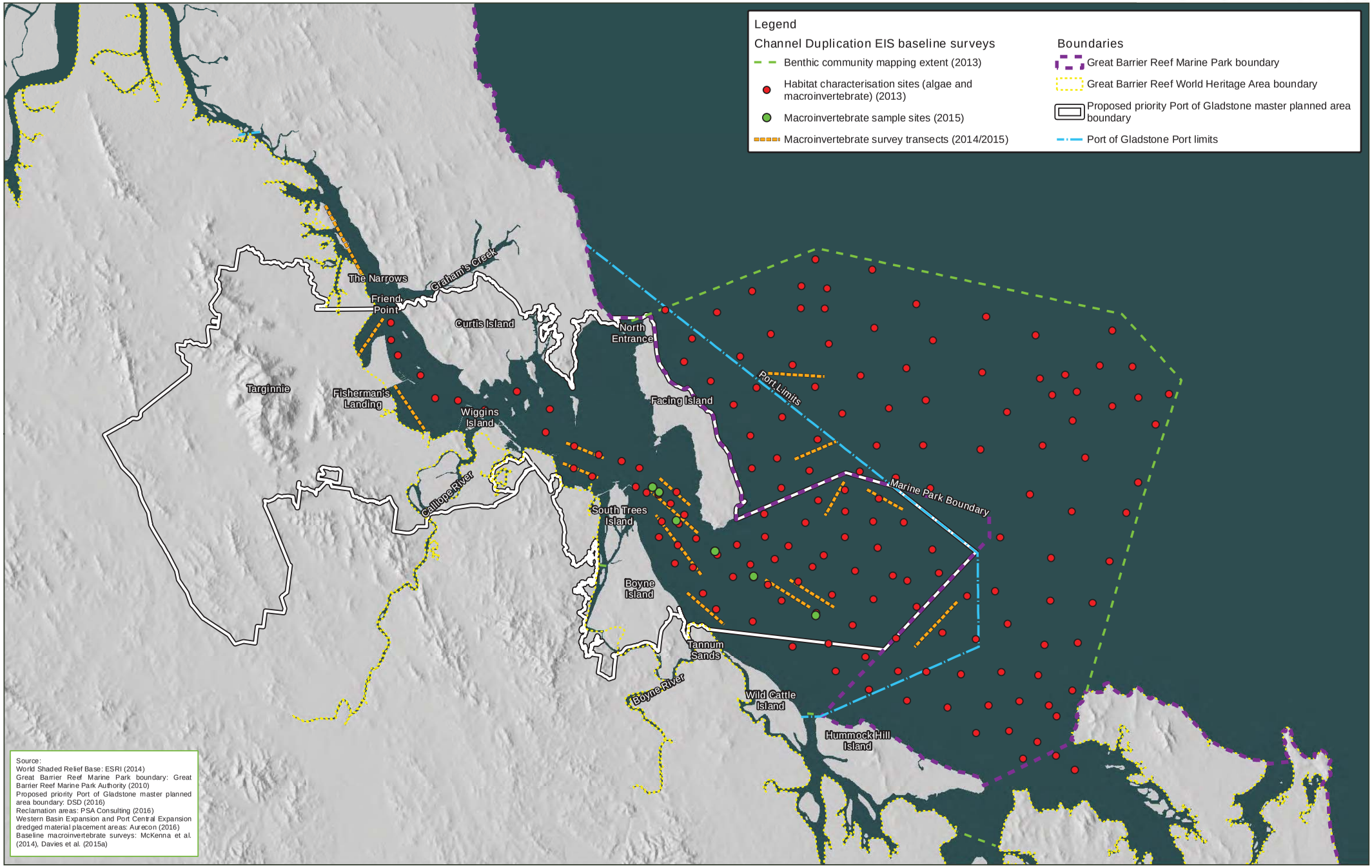

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Figure 10: Benthic fauna monitoring

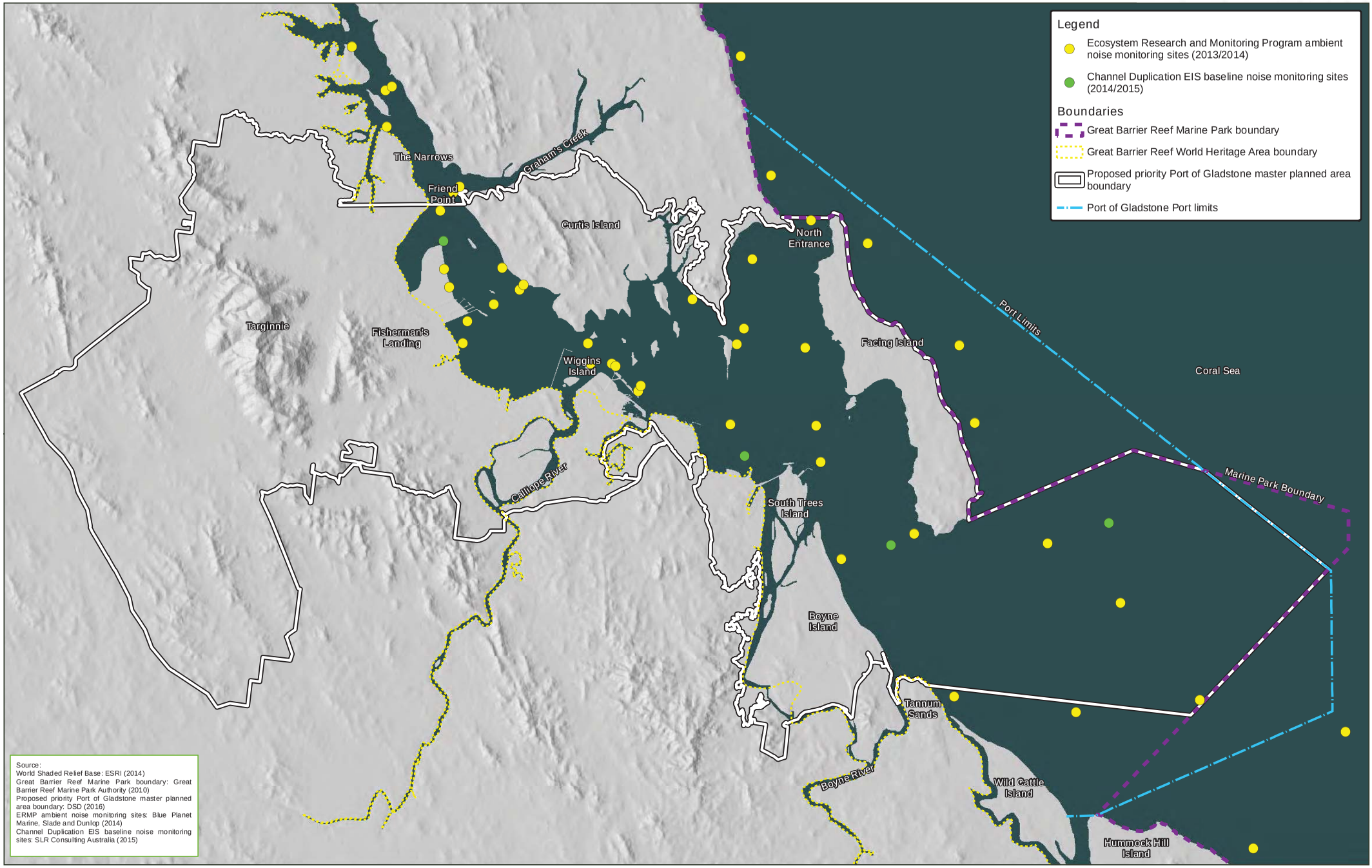

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Figure 11: Underwater noise monitoring

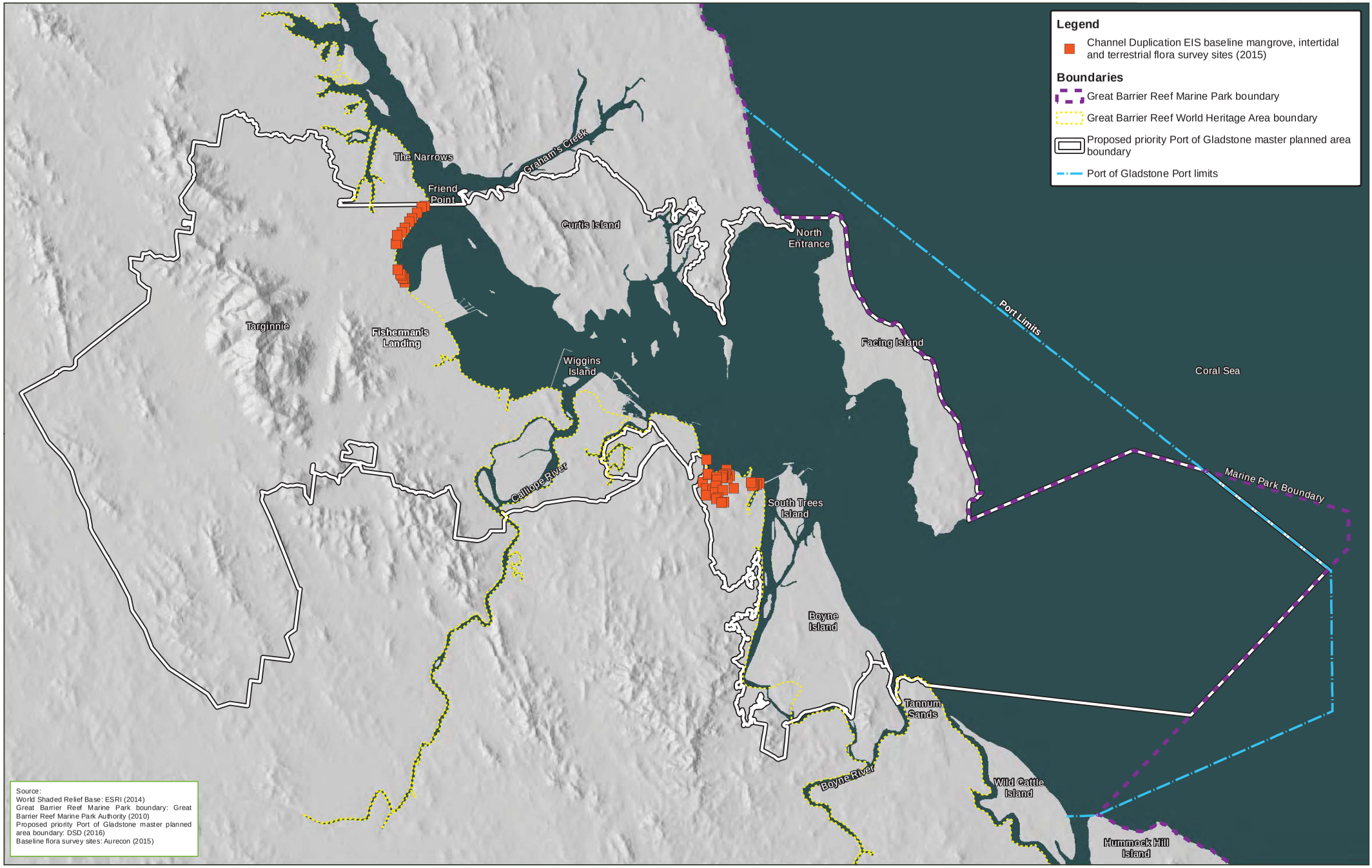

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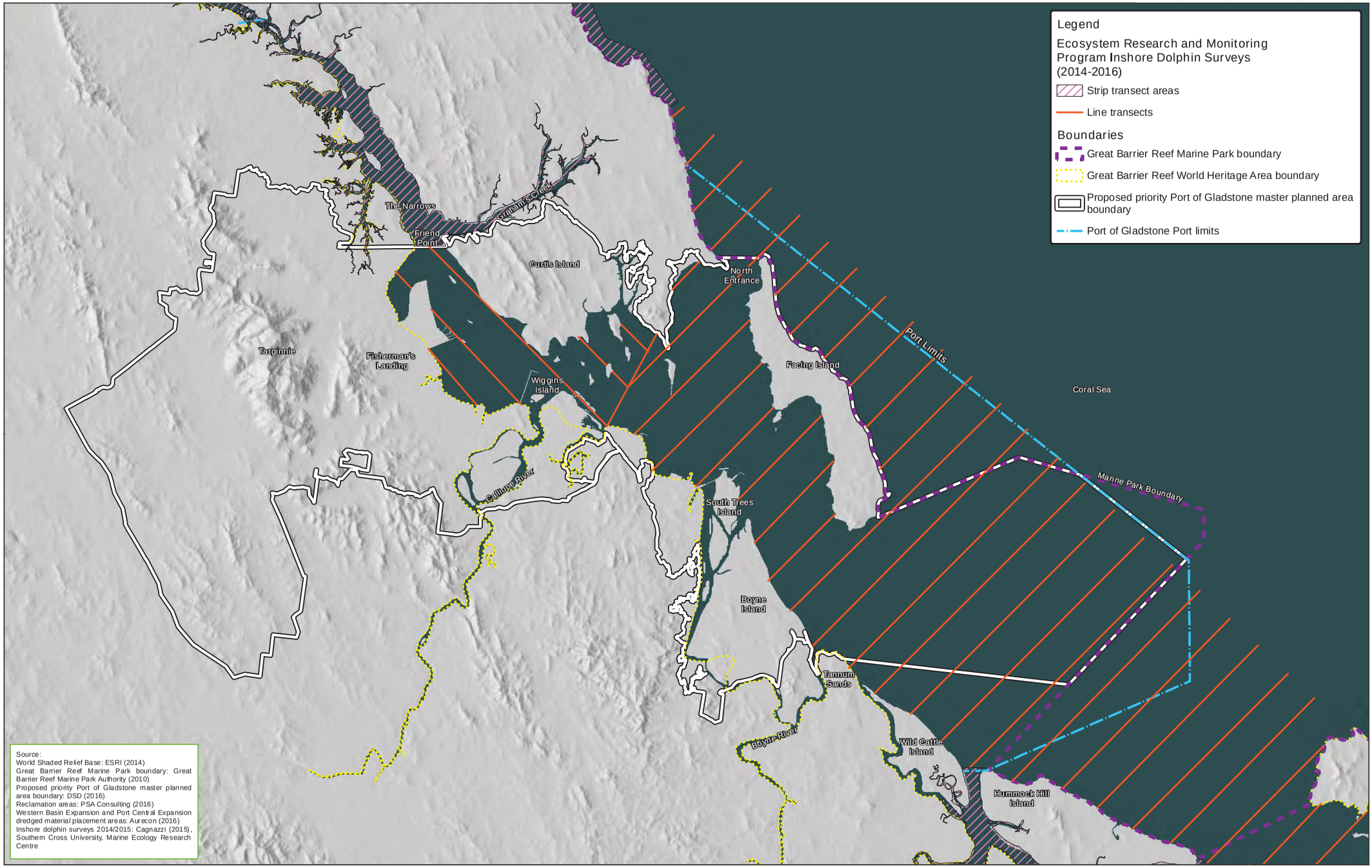
Figure 12: Flora monitoring



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Coordinate system: GDA 1994 MGA Zone 56

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Figure 13: Inshore dolphin monitoring