8

EIS LNG Facility Environmental Values and Management of Impacts

Santos | PETRONAS

Section 8 EIS LNG Facility Environmental Values and Management of Impacts

The respondent comments provided in this section have been collated from all stakeholder submission comments relating to EIS Section 8 LNG Facility Environmental Values and Management of Impacts. Please refer to **Attachment A** for copies of all submissions received.

8.1 Overall Assessment Methodology

No submissions were received for this section.

8.2 Climate

No submissions were received for this section.

8.3 Land

8.3.1 Topography, Geomorphology, Geology, and Soils

Respondent Comment

Department of Environment and Resource Management requested that GLNG provide the mitigation measures proposed to mitigate soil erosion at all stages of construction and during operation of the facility.

Santos Response

The LNG facility EMP has been updated with the following text.

Soil and Erosion Management

- Install, maintain and monitor erosion and sediment control devices (e.g. berms, silt fences, jute matting) so that ground is stable and vegetation cover is maintained;
- Ensure that runoff control devices (e.g. whoaboys) are maintained to prevent erosion;
- Carry out excavation works in accordance with the provisions of the construction EMP which will be developed once the design is finalised and the EPC contract awarded;
- Remove and stockpile topsoil where excavation or subsidence remediation is to occur. Replace topsoil as soon as practicable after works have finished;
- Empty sediment control devices after heavy rain; and
- Sediment control measures will be used to preserve stockpiled soils to prevent siltation of any land surface water or blockage of any existing drainage channels.

Where erosion management structures are impacted they will be reinstated as quickly as practicable or alternative structures erected to retain an adequate level of erosion control.

Refer to **Attachment B3** for the revised LNG facility EMPs.

8.3.1.2 Methodology

Respondent Comment

Department of Environment Water Heritage and the Arts considers that there was a lack of ASS mitigation measures in the EIS. It stated that Santos plan is to develop a Draft Dredge Management Plan

(presumably in Phase 2?) and an Acid Sulfate Soils Management Plan (if required). What will be the trigger for the development of the plan?

Department of Environment Water Heritage and the Arts states that whilst there is some information on ASS in the information below, there is still no clear information on mitigation measures.

- *8.3.1.2 - Some general ASS sampling information but nothing on proposed management.*
- *8.3.1.5 - Some discussion of possible ASS impacts.*
- *8.7.3.3 - Mostly descriptions of ASS marine sediments.*
- *8.17.5 - Nothing substantial there - mostly directing us to Appendix L4.*
- *8.17.9 - Basically saying that ASS is not a problem in LNG facility area.*
- *EIS Appendix L4 – is a repeat of other information - still no detail on management or mitigation of impacts.*

Santos Response

The most significant risk of creating ASS will be during the construction of the Laird Point DMPF should it be required. The extent of this has been investigated and is reported in **Attachment G2**. Disturbance of ASS on the facility site itself is deemed to be minimal and is avoided to all extents practicable during the design phase. Prior to construction, an ASS management plan will be developed which will be based on the recommendations for treatment outlined in **Attachment G2**.

Further investigations for the DMPF have been conducted as part of the EIS Supplement which has included an ASS investigation. Please refer to **Attachment G2** for details on the ASS investigation.

Given the volume of material to be disturbed, the high levels of potential acidity noted, the variability and large range of results, additional sampling will be undertaken in the area proposed for disturbance as part of the main embankment excavation, to provide specific management measures.

Management strategies associated with ASS disturbance during construction of the LNG facility, dredging Port Curtis and constructing a DMPF will be developed in parallel with construction EMPs. The table in EIS Section 8.3.1.5 provides additional details on management and mitigation of potential ASS issues.

A draft Dredge Management Plan has also been developed and is included in **Attachment G9**.

8.3.1.5 Potential Impacts and Mitigation Measures

Respondent Comment

Department of Environment and Resource Management states that GLNG should provide the mitigation measures to prevent and or minimise environmental harm from ASS and PASS. The basis for the proposed mitigation measures should be discussed.

Santos Response

Further detailed assessments and proposed mitigation options for ASS have been developed. They are included in EIS Section 8.3, and Appendices L4, R3, G5, E5, G2, and G6. As is normal practice, an ASSMP will be developed in consultation with DERM prior to actual on site works commencing.

Respondent Comment

Department of Environment and Resource Management states that GLNG should provide the targets, acceptable levels of land rehabilitation and monitoring requirements, as referred to.

Santos Response

Santos will develop a comprehensive rehabilitation plan that incorporates monitoring and benchmark reference sites which will guide on-going environmental management and rehabilitation activities. Reference (or analogue) sites will be established in representative land systems that will be impacted by the GLNG Project. At each site, Santos will determine the floristic and structural characteristics of the remnant vegetation, ground cover percentages, shrub layers and structural characteristics of the vegetation and an assessment of the stability of site (e.g. existing soil erosion). The analogue sites will be used to determine appropriate rehabilitation criteria in consultation with DERM.

Santos commits to progressively rehabilitating land over the life of the project. Santos will implement a rehabilitation program on all land significantly disturbed by the project to:

- Investigate and remediate any contaminated land caused by the authorised petroleum activities;
- Take all reasonable and practicable measures to:
  - Re-establish surface drainage lines;
  - Reinstate the top layer of the soil profile; and
  - Promote the re-establishment of vegetation.
- Rehabilitate disturbed areas to:
  - A stable landform and with a self-sustaining vegetation cover and species that are similar to adjoining undisturbed areas;
  - Ensure that all land is reinstated to the pre-disturbed land use and suitability class;
  - Ensure that the maintenance requirements for rehabilitated land is no greater than that required for the land prior to its disturbance by petroleum activities; and
  - Ensure that the water quality of any residual void or water bodies constructed by petroleum activities meets criteria for subsequent uses and does not have potential to cause environmental harm.
- Maintain rehabilitated areas to ensure and demonstrate the:
  - Stability of landforms;
  - Erosion control measures remain effective;
  - Stormwater runoff and seepage from rehabilitated areas does not negatively affect the environmental values of any waters;
  - Plants show healthy growth and recruitment is occurring; and
  - Rehabilitated areas are free of any declared pest plants.

Monitoring of rehabilitated sites will be undertaken to ensure natural or assisted regeneration is progressing, weeds are appropriately managed and soil erosion is minimised.

Rehabilitation will be considered successful when the site can be managed for its designated land-use (either similar to that of surrounding undisturbed areas, a representative analogue sites or as otherwise agreed in a written document with the landholder and administering authority) without any greater management input than for other land in the area being used for a similar purpose and there is evidence that the rehabilitation has been successful for at least three years.

8.3.2 Land Contamination

Respondent Comment

Department of Environment and Resource Management states that further investigation of the cattle dip area is required, given the high levels of arsenic found in this area as well as in the groundwater.

Santos Response

The cattle dip is not located on Santos land, and is outside the GLNG Project boundary. As such, this site has not been considered a site contamination risk. Therefore, no further investigations have been commissioned. If areas of potential contamination are discovered once earthworks commence Santos will investigate and manage these in accordance with the *Environmental Protection Act 1994* (EP Act).

8.4 Nature Conservation

Respondent Comment

Department of Environment and Resource Management states that a discussion and assessment of the location of the LNG facility (within the site) is required detailing the chosen location. Specific information detailing why impacts on environmental values cannot be avoided should be included.

Santos Response

Detailed environmental assessments and mitigation measures were conducted and developed as part of the EIS and are contained within the EIS Appendices outlined below:

- Land (Appendix L3);
- Land Contamination (Appendix M);
- Nature Conservation (Appendix N3);
- Surface Water (Appendix O3);
- Groundwater (Appendix P1);
- Marine Ecology (Appendix R1);
- Air Quality (Appendix S);
- Greenhouse Gas Emissions (Appendix T);
- Terrestrial Noise (Appendix U1);
- Marine Noise (Appendix U2);
- Visual Amenity (Appendix V);
- Cultural Heritage - Indigenous (Appendix W);
- Cultural Heritage – Non Indigenous (Appendix Y); and
- Social and Community (Appendix Z).

A summary of the mitigation measures from these studies are included in the LNG Facility EMP (**Attachment B3**).

Since the release of the EIS, changes have been made to the LNG facility footprint. As such, updated assessments for Land, Nature Conservation and Noise on the new footprint are included in **Attachments F1, F2** and **F4** respectively. A total of approximately 172.1 ha will be disturbed with the construction of the LNG facility and associated infrastructure. The final location of the LNG facility was determined based upon several environmental factors including noise impacts, visual amenity and ecological values.

The soils and terrain assessment (**Attachment F1**) looked at the engineering and environmental constraints with respect to the future development of the LNG facility site and associated infrastructure. The study identified terrain units for the main geological regimes identified within the area. Descriptions of the terrain units identified, together with an assessment of potential engineering and environmental constraints for site development were determined. These data, by association, have been used to determine potential levels of environmental impacts for the LNG facility site development.

The potential areas of environmental impact identified were addressed and a range of engineering solutions or other management strategies have been recommended in order to successfully mitigate the potential environmental impacts identified.

The updated Nature Conservation assessment (**Attachment F2**) shows that areas of potential disturbance to REs 12.1.2, 12.1.3, 12.2.2 and 12.3.3 have been reduced and that potential disturbance to REs 12.11.6 and 12.11.4 will be increased - primarily as a result of the inclusion of the road corridor linking the facility to Hamilton Point. Of significance is the exclusion of any disturbance to RE 12.2.2 (Microphyll/notophyll vine forest on beach ridges) from the revised footprint. RE 12.2.2 is listed as 'Critically Endangered' under the *EPBC Act* and so reduction of impacts to this community is of benefit to the biodiversity of the bioregion. In addition, the area of disturbance to the 'Endangered' RE 12.3.3 has been reduced by 5.7 ha as a result of footprint redesign.

A noise assessment (**Attachment F4**) carried out noise predictions for worst case, neutral and prevailing weather conditions. Noise reductions were nominated to show the level of noise reduction required to achieve the relevant noise criteria for each weather condition.

The lowest feasible noise emission level from the LNG facility including all proposed feasible mitigation measures to ensure that the LNG facility is designed in accordance with best practice technologies.

The final mitigation measures will be dependant on negotiation with DERM and having regard to the locations of noise onsite reception. This will be formalized in the revised EMPs forming part of the application process for the LNG Plan approval.

Respondent Comment

Department of Environment and Resource Management states that GLNG is to conduct an appropriate and detailed survey to definitively determine the presence of the Water Mouse. An assessment of the proposed mitigation measures should be included where the presence of the Water Mouse is detected.

Santos Response

A targeted survey was undertaken for water mouse on Curtis Island. Methodology utilised to undertake targeted water mouse (*Xeromys myoides*) surveys was to target habitat and search for the presence of the species. The methodology is referenced to and detailed in Section 4.2.2 of Appendix DD (as outlined in EIS Section 8.17.6.2). The field program involved a site investigation conducted over two days and two nights in order to assess the extent and quality of wildlife habitat and to determine the presence, or likely presence, of the water mouse and included targeted diurnal habitat searches and opportunistic surveys.

Potential water mouse habitat was identified, but no water mouse were located. The potential for water mouse presence was assessed and as extremely low. A commitment is made in the LNG facility EMP (**Attachment B3**) to undertake a pre-clearance survey for water mouse in any mangrove / or intertidal habitat to be directly disturbed by proposed construction in accordance with relevant guidelines.

If occurrences of water mouse are found within the LNG facility disturbance footprint, a site specific species management plan will be developed in consultation with DERM. This will include investigating options for avoidance of water mouse habitat at the construction stage. If this is not possible, there is potential for species relocation, although this option is a secondary mitigation measure.

Respondent Comment

Gladstone Regional Council states that limited information has been provided in the EIS with regards to weed management from the facility. A copy of the weed management plan has not been provided in the EIS, nor provided in response to a request by Council officers. Council has concerns regarding weed species moving on and off Curtis Island. There are species on Curtis Island that should not be introduced to the mainland and vice versa.

Santos Response

The weed management section of the LNG facility EMP (**Attachment B3**) includes the following requirements:

- Preparation of a weed management plan;
- Weed inspection of Curtis Island to be undertaken prior to activities beginning and the location of declared plants and other noxious weeds recorded and controlled;
- Prior to shipment to Curtis Island all vehicles, equipment and portable infrastructure (including trailers, generators, workshop and accommodation huts etc.) will be washed at a designated weed washdown area;
- All vehicles will be certified and registered as clean before they are permitted access to Curtis Island;
- Any imported material shall be obtained from weed free areas. A permit will be obtained from all suppliers of gravel, sand, soil, mulch, packing material, machinery, vehicles, water and any other potentially contaminated products, to certify the product is weed/contaminant free;
- Quarantine zones will be established if a declared or important weed is detected on Curtis Island and movement of plant and vehicles represent a risk of spreading a serious weed infestation; and
- Following rehabilitation, weed survey and control will be incorporated into the monitoring plan.

Respondent Comment

Gladstone Regional Council states that limited information has been provided in the EIS on proposals for vector control especially in relation to the Laird Pt dredge disposal area. Notwithstanding Council's previously stated position in relation to the Laird Pt dredge disposal area, Santos needs to work with Council with regards to an agreed management plan for both the LNG facility and the dredge disposal area. The management plan needs to be proactive rather than reactive. Council reiterates that with the know vector issues in this area (Curtis Island and the Narrows); the establishment of construction accommodation in this location is not considered suitable. There will also be issue for worker comfort during construction.

Santos Response

Santos will work closely with the Gladstone Regional Council to develop a vector control management plan applicable for the LNG facility and the DMPF if it proceeds.

Respondent Comment

Gladstone Regional Council states that the EIS states that some endangered plants will be removed from the LNG project site. What is the proposed management plan for any endangered species? Will they be transplanted to another site? Council suggests that it would be best to relocate these plants to within the environmental area of the GSDA on Curtis Island, subject to agreement by the Department of Environment and Resource Management.

Santos Response

Within the LNG facility study area no flora species of conservation significance were recorded (EIS, Section 8.4.4.3 and Appendix N3). Nonetheless, the presence of an ecologist is required prior to clearing to undertake targeted surveys for significant flora and fauna at the pre-construction stage.

The vegetation community of Microphyll/Notophyll vine forest on beach ridges (RE 12.2.2) (listed as Critically Endangered under the *EPBC Act*) was described as being impacted by the LNG facility footprint (EIS Appendix N3, Table 3-1). However, the LNG facility footprint has been adjusted such that this RE is no longer disturbed (**Attachment F2**).

Respondent Comment

Submitter number 1 states that Australia is a signatory to a number of international treaties including: Japan-Australia Migratory Birds Agreement (JAMBA), China-Australia Migratory Birds Agreement (CAMBA), Convention on Wetlands of International Importance (Ramsar Convention), Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), Convention on conservation aspects of the South Pacific (APIA Convention), Conservation aspects of the South Pacific Regional Environment Program (SPREP).

Santos Response

The values of this site have triggered the requirement to obtain *EPBC Act* approvals and the GLNG Project has been declared to be a "controlled action" because of potential impacts on listed migratory species under the EPBC Act which are also the subject of JAMBA and CAMBA.

Surveys for migratory wader birds in the study area were undertaken on three occasions in 2008 for the EIS:

- A study as part of the LNG facility Terrestrial Fauna Study;
- A study as part of the LNG facility Marine Studies; and
- A targeted survey for wading birds to complement studies undertaken for the Terrestrial Fauna Study.

Wader/shorebird species were observed in relatively low numbers within the study area (EIS, Section 8.4.4.4 and Appendix N3). Habitat values appeared to be low for many species due to low foraging potential. There is abundant existing habitat elsewhere on Curtis Island and surrounds. Most of the observed wader species were recorded foraging on more suitable habitat (sand/mudflats) at South End in greater numbers than that seen within the study area.

Potential impacts to migratory wader birds include deterrence from using the saline wetlands in the vicinity of the LNG facility due to noise, light and movement interference. Given that the wader bird habitat in the environs of the LNG facility is considered sub-optimal and that superior habitat is present elsewhere in the region, these impacts are unlikely to have a significant influence on the feeding and migration patterns of birds listed under international treaties.

Respondent Comment

Submitter number 1 states that the construction and operation of LNG plants on Curtis Island will effectively place Australia in breach of some of its treaty obligations through the following impacts: destruction of seagrass beds as a part of the dredging required to accommodate the LNG industry. This will impact on dugongs (the harbour is a listed dugong habitat) and other marine life including turtles, fish, crabs and prawns.

Santos Response

Capital Dredging

The potential impacts of the proposed dredging programme on seagrass have been assessed through additional baseline investigations and hydrodynamic and sediment deposition modelling presented in **Attachments F5** and **G5** of the EIS Supplement. Predicted total suspended solids (TSS) concentrations and deposition rates during dredging have been calculated for six ephemeral seagrass meadows identified by Rasheed *et al.* 2003 on the mainland side of Curtis Island, and for a location within the main seagrass meadow to the north of Fishermans Landing.

The predicted TSS concentration increases generated by dredging range from 0 – 3 mg/L for the majority of seagrass meadows on the eastern side of Port Curtis, while the increase was predicted to be 5mg/L within an area of seagrass surrounding South Passage island. Potential sedimentation rates during dredging were also estimated. The results showed that the potential sedimentation rates arising from dredging ranged from 0.0012 to 0.056 mm/day within seagrass communities on the mainland side of Curtis Island, with lower levels being predicted elsewhere. Baseline investigations of sedimentation rates in seagrass beds (presented in **Attachment G5**) showed that natural deposition rates range from 0.36 – 0.57 mm/day. The predicted percentage increases in deposition rate range from 0.3% - 3% for the majority of seagrass beds on the mainland side of Curtis Island, with the exception of the seagrass surrounding South Passage Island where 10% increases may occur during dredging activity.

The impact assessment found that the impacts arising from increased TSS concentrations and sediment deposition during dredging are expected to be marginal, if any, on seagrass meadows in Port Curtis, with the exception of an area of seagrass surrounding South Passage Island where slight impacts are predicted.

Seagrass monitoring studies conducted in Port Curtis (Chartrand *et al.,* 2009) reported dugong feeding activity on the majority (69%) of intertidal seagrass meadows surveyed. The highest density of dugong feeding trails was observed at the light *Zostera capricorni* meadow at Wiggins Island (west) (Chartrand *et al.,* 2009). Dugong feeding trails were also observed at Quoin Island meadows, Pelican Banks, South Trees and across the intertidal meadows to the north and south of Fisherman's Landing (refer Figure 3.2 **Attachment F5** Turtle and Dugong Management Plan).

The area of seagrass surrounding South Passage Island covers an area of approximately 34 ha which equates to approximately 0.8 % of the seagrass area in Port Curtis. It is anticipated that the slight impacts on seagrass in this area may be recoverable once the dredging has finished. The seagrass meadows in this area have been classified as aggregated patches of *Halophila ovalis* with *Zostera capricorni* seagrass, and contain small biomass and areas compared with other seagrass meadows within the Port Curtis area. The seagrass communities and low biomass present mean that this area is considered to be unlikely to be utilised by dugongs.

Mitigation measures to minimise the potential for impacts on seagrass during dredging are described in **Attachment G9** of the EIS Supplement. In addition a specific Turtle and Dugong Management Plan has been prepared for the project which is provided as **Attachment F5** of the EIS Supplement.

Potential impacts to fish, prawns and crustaceans from construction and operation of the GLNG Project are discussed in EIS Section 8.4.4.5.

It is not considered that the GLNG Project will place Australia in breach of its treaty obligations. This will be a matter considered by the Commonwealth Government through the EPBC Act approval process.

Respondent Comment

Submitter number 1 states that the destruction of mangroves as a part of the construction process will impact on the life cycle of all marine life.

Santos Response

Impacts on mangroves as a result of GLNG Project construction activities may either be direct or indirect. Direct impacts include the clearing and resultant loss of mangroves and saltmarsh/saltpan. Indirect impacts which may occur include degradation of habitat due to increased sedimentation; altered local hydrology; pollution or potential disturbance of acid sulphate soils; and indirect impacts to fauna breeding and feeding activities. Potential pollution impacts and mitigation measures are discussed in **Attachment F3**. Potential acid sulphate soils impacts and mitigation measures are discussed in **Attachment E5**. Potential fauna impacts and mitigation measures are discussed in **Attachment F5** (Dugong and Turtle Management Plan).

Direct Impacts

The area of mangroves to be directly impacted has been calculated as 0.1 ha for the LNG facility and 2.8 ha for the dredge material placement facility. This represents 0.04 % (2.9 ha) of mangroves found within Port Curtis (6,736 ha) (Danaher *et. al*., 2005).

Impacts to marine life from direct loss of mangroves have been offset through changes to the LNG facility and DMPF footprint to minimise impacts to the marine environment. In accordance with the DPI&F Offset Policy and development approvals, Santos is committed to managing development impacts and using offset measures to reduce and balance impacts of fish habitats where appropriate.

Indirect Impacts

Potential indirect impacts to adjacent mangroves and saltmarsh/saltpan in close proximity to the proposed LNG facility, PLF, MOF and haul roads may occur. 18.44 ha of saltmarsh/saltpan and 28.09 ha of mangroves are found adjacent to the LNG Facility and associated infrastructure footprint. In the event that all of these communities are indirectly impacted by construction and operation of the LNG facility, 0.121 % of the mapped saltmarsh/saltpan and 0.169 % of mangroves within the RE subregion may be impacted, or 0.421 % of saltpan/samphire dominated saltpan and 0.417 % of mangrove communities within mapped areas.

Respondent Comment

Submitter number 1 states that there will be negative impact on migratory bird life through the construction and operation of the LNG plant. This can occur in many ways e.g. if the projected 200 metre flare causes migratory birds to lift off, the energy so expended in that single event could prevent those migratory birds from reaching their destinations in the northern hemisphere.

Santos Response

A number of studies have been undertaken of the potential use of the intertidal areas by migratory wader birds (refer to EIS Appendix N2).

A specific discussion of the migratory bird species of Curtis Island is provided in EIS Appendix N2 outlining the values determined from the three separate seasonal migratory birds surveys conducted for this faunal assemblage for this project (URS 2007, URS 2008 and BAAM 2008).

Wader/shorebird species were observed in relatively low numbers within the study area. Habitat values appeared to be low for many species due to low foraging potential. There is abundant existing habitat elsewhere on Curtis Island and surrounds. The majority of the observed waders, both in terms of species and number of individuals, were recorded foraging on more suitable habitat (sand/mudflats) 10 km to the east of the study area at South End. Given the current extent of industrial and shipping activity within Port Curtis, it is unlikely that the construction and operation of the LNG facility will present an additional significant effect on migratory bird migration patterns and energy expenditure.

The very low likelihood of an emergency flare event occurring during the migratory bird season, combined with the low bird population observed in the study area means that the likelihood of liftoff is considered

low. Additionally, construction staff will remain within the LNG facility footprint at all times while on the island.

Respondent Comment

Submitter number 1 states that it is foreseeable that further breaches may occur if members of the construction workplace seek to create their own recreation and trespass on fragile wetlands.

Santos Response

Santos will include controls preventing members of the construction workplace from entering areas other than the construction site. The LNG facility EMP has been updated with the following text:

Marine Flora and Fauna Management

- Provide training for staff regarding the sensitivity of wetland ecosystems.
  - Interpretive signage will be used to notify construction staff of the reasons why trespassing on these ecosystems is prohibited and the impacts this might have; and
  - Fences will be erected around ecologically sensitive areas to visually and physically enforce the need for avoidance of disturbance to these areas.

Refer to **Attachment B3** for the revised LNG facility EMP.

Additionally, construction staff will remain within the LNG facility footprint at all times while on the island.

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) requested that all impacts to tidal fish habitats should be identified and suitably offset in keeping with the Queensland Government Environmental Offsets Policy and QPIF Fish Habitat Management Operational Policy FHMOP005 Mitigation and Compensation for Works or Activities Causing Marine Fish Habitat Loss. QPIF has published Fisheries guidelines for fish habitat impact/ offset calculations (marine plants and other tidal fish habitats and declared Fish Habitat Areas) to assist offset considerations. Please note the estuaries ecosystem services fish habitat mosaic value has been identified as up to $940,000 per hectare over a 20 year production cycle. Ideally the offset should be the addition of a greater area of and similar tidal fish habitats than that lost or impacted.

Santos Response

Impacts to tidal fish habitats include direct loss of mangroves and saltmarsh on Curtis Island. The construction of the LNG facility, PLF, MOF and haul roads and the dredge material placement facility will involve some direct and indirect impacts to mangroves and saltmarsh. The direct area of mangroves to be disturbed has been calculated as 0.1 ha for the LNG facility and 2.8ha for the dredge material placement facility. This represents 0.04 % (2.9 ha) of mangroves found within Port Curtis (6736 ha). Indirect areas potentially impacted by construction of the LNG facility are 28.1ha and 16.5ha for the DPMF.

The direct area of saltmarsh to be impacted by the Project footprint has been calculated at 0.6 ha for the LNG facility and 26.1 ha for the DMPF. Direct loss of saltmarsh on Curtis Island is estimated at 0.58 % (26.7 ha) of the 4573 ha of saltmarsh found within Port Curtis. Indirect impacts have been estimated at 18.4 ha for the LNG facility and 7.1 ha for the DMPF. Impacts to marine life from direct loss of mangroves and saltmarsh has been offset through changes to the LNG facility and DMPF footprint. In accordance with the DPI&F Offset Policy and development approvals Santos is committed to managing development impacts and using offset measures to reduce and balance impacts of fish habitats where appropriate. In

accordance with the FHMOP 005 (2002) best practice methodologies will be used to remove mangroves directly impacted by the construction of the LNG facility and associated infrastructure and the DMPF.

Santos is committed to providing education to all staff and construction workers on the fisheries values of mangroves and saltmarsh and the protection of these values. Santos will also discuss with DPI&F mitigation and environmental offsets options in accordance with the FHMOP005 and the draft Qld Govt. Environmental Offsets Policy.

Santos has also contracted the Queensland Government Ecofund facility to prepare and Environmental Offsets Management Plan. Detailed information on the offset strategy is in **Attachment B5**.

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) comments that all locally declared weed and pest animal species must be considered in the Weed and Pest Animal Management Plans for each existing or proposed operational area in the GLNG project site.

Santos Response

A commitment has been made in the Construction EMP to develop a pest and a weed management plan for locally declared weed and pest animal species. Similar advice has been included in the EIS **Attachment E3**.

The weed management section of the LNG facility EMP (**Attachment B3**) includes the following requirements:

- Preparation of a weed management plan;
- Weed inspection of Curtis Island to be undertaken prior to activities beginning and the location of declared plants and other noxious weeds recorded and controlled;
- Prior to shipment to Curtis Island all vehicles, equipment and portable infrastructure (including trailers, generators, workshop and accommodation huts etc.) will be washed at a designated weed washdown area;
- All vehicles will be certified and registered as clean before they are permitted access to Curtis Island;
- Any imported material shall be obtained from weed free areas. A permit will be obtained from all suppliers of gravel, sand, soil, mulch, packing material, machinery, vehicles, water and any other potentially contaminated products, to certify the product is weed/contaminant free;
- Quarantine zones will be established if a declared or important weed is detected on Curtis Island and movement of plant and vehicles represent a risk of spreading a serious weed infestation; and
- Following rehabilitation, weed survey and control will be incorporated into the monitoring plan.

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) requested that the proponent should develop an Asian Green Mussel Management Plan to identify potential risk areas and mitigate risk of spread within the Marine facilities of GLNG project site.

Santos Response

EIS Section 8.4.5.3 Marine Ecology outlines mitigation measures which will mitigate the potential impact of the Asian Green Mussel.

"All vessels entering an Australian port from overseas must obtain a quarantine ship clearance from Australian Quarantine and Inspection Service (AQIS); the government agency responsible for the prevention of foreign marine organisms into Australian waters. AQIS introduced new controls on ballast water discharge from 1 July 2001, whereby ships with ballast water that are considered a high risk for introduced marine species and that have not exchanged ballast water mid-ocean, are now not allowed to discharge into Australian waters (up to 12 nautical miles offshore).

A risk assessment of potential marine pest introductions will be carried out for each vessel proposed to be used on the GLNG Project. For vessels that are considered high risk, inspections of the hulls and/or hoppers may be carried out, preferably before they depart for Australian waters.

A quarantine area will be located between the MOF and construction area of the plant. The quarantine area will have a wash down water supply and contained runoff, collection and treatment facility. It is here that all construction modules will be washed down to remove salt spray after the ocean journey as well as any pest species. It is envisaged that a hardstand area will be graded to a sump for washdown water collection and treatment, disposal or recycling. The quarantine area will also support fumigation facilities."

8.4.3.8 Coastal Protection and Management Act 1995

Respondent Comment

WWF Australia states that the GLNG EIS specifies records of mortalities and stranding data to indicate the potential presence of the rare and unique Australian snubfin dolphin (Orcaella heinsohnii) and Indo-Pacific Humpback Dolphin (Sousa chinensis) in Port Curtis. However, WWF-Australia's understanding is that a long-term research project is under way to examine isolated dolphin populations along Queensland Cost, including the Gladstone/Curtis Island region. The project is being led by Daniele Cagnazzi, a PhD student with Southern Cross University's Whale and preliminary results could indicate a number of small, isolated populations of humpback and snubfin dolphins along the Queensland Coast are facing the real threat of extinction.

Santos Response

Daniele Cagnazzi conducted field surveys of inshore dolphin populations within the Port Curtis region between January 2006 and September 2008 (102 separate surveys, mostly between May and September) as part of his PhD research (under review). Inshore dolphin species in Australian waters include the bottlenose dolphin (*Tursiops aduncus*), Indo-Pacific humpback dolphin, (*Sousa chinensis*) and the snubfin dolphin (*Orcaella heinsohni*). The field surveys comprised visual observations and photo-identification. Over the two year period, 156 sightings of pods of *Sousa chinensis* and one pod of *Tursiops aduncus* were observed. No *Orcaella heinsohni* were observed. The mean pod size for *Sousa chinensis* was less than four, although pods up to 15 individuals were observed, associated with social behaviour. Most dolphins were seen close to shore (within 100 - 500 m) in water depths of less than 10 m. Fifty-two dolphins showed permanent identifiable marks.

Although mark-recapture population size analysis cannot be accurate over two years, early analysis suggests that approximately 65 *Sousa chinensis* live in Port Curtis (assuming a population relatively closed to immigration and emigration). Results from his research indicate that there is likely to be some degree of short term movements of *Sousa chinensis* between the Fitzroy River estuary and Port Curtis; presumably through the Narrows.

The key threats to inshore dolphin populations are:

- Fisheries interactions (e.g. of the eight reported *Sousa chinensis* carcasses found in Port Curtis between 2002 and 2005, five showed clear signs of being entangled in fishing gear);
- Boat strike (particularly from fast, planing boats);
- Water pollution;

- Habitat degradation and destruction;
- Noise; and
- Small population sizes (e.g. Gilpin & Soulé 1986; Soulé 1987 note that small populations are at more risk of becoming extinct than larger populations) due to:
  - Demographic variation (natural variations in individual reproductive and mortality rates); and
  - Temporal and spatial variation (natural or anthropogenic fluctuations in environmental conditions or, in extreme circumstances, environmental catastrophes).

The threats to Indo-pacific dolphins that Santos has assessed as potential impacts of the GLNG Project include:

- Water pollution;
- Habitat degradation and destruction;
- Noise; and
- Boat strike.

Water pollution

Mitigation measures for water pollution associated with the GLNG Project include the appropriate treatment of all discharges, and minimising the water quality impacts of dredging through dredge technology selection. A site-specific construction erosion and sediment control plan will be implemented to minimise any potential impacts on receiving surface waters associated with the LNG facility. This is outlined in the LNG facility EMP (**Attachment B3**) and includes reference to correct storage of fuels and chemicals as well as topsoil storage.

Sewage generated during the initial construction phase will be treated to a secondary standard at an on-site sewage treatment plant. Relevant approvals for the plant will be obtained in conjunction with the facility's development approvals. Treated effluent will be loaded into tankers and barged to the mainland for disposal at an existing wastewater treatment plant. Sewage generated during the peak construction phase will be treated onsite in accordance with the applicable regulatory standards and approvals before being discharged to the marine environment. These measures are outlined in the relevant project EMPs as provided in **Attachment B**. Water pollution impacts are therefore anticipated to be low with the use of the appropriate mitigation measures proposed.

Habitat degradation and destruction

Key impacts on seagrasses from dredging include physical removal or burial of vegetation at the dredging/disposal site, increased turbidity and increased sedimentation in adjacent seagrass meadows, temporarily reduced dissolved oxygen concentration, release of nutrients and pollutants from contaminated sediments and hydrographic changes (Erfemeijer and Lewis 2006). Studies conducted for the Gladstone Ports Corporation EIS (2009) recognise that potential smothering of seagrass habitats from increased sediment loads during their construction and maintenance dredging operations may potentially reduce local foraging habitat available. It is therefore recognised that the loss of seagrass habitats may have an impact on dolphin species in the study area, given that the dolphins eat fish associated with seagrass meadows.

For the GLNG Project, the potential impacts of the proposed dredging programme on seagrass have been assessed through additional baseline investigations and hydrodynamic and sediment deposition modelling and are presented in **Attachments F5** and **G5** of the EIS Supplement. There is unlikely to be any direct impact on seagrass meadows from dredging for the GLNG Project. However, minor indirect impacts are anticipated. Specifically, impacts from total suspended solids concentrations and sediment deposition during dredging are expected to be marginal, if any, on seagrass meadows in Port Curtis, with the exception of an area of seagrass surrounding South Passage Island where slight indirect impacts are predicted (~34 ha). This represents approximately 0.8 % of the seagrass area in Port Curtis. Furthermore, the composition and biomass of the seagrass are such that they are considered to be unlikely to be

utilised by dugongs. These impacts are based upon a Cutter-Suction dredging technique, selected by Santos as the preferred dredging option.

In order to minimise habitat degradation and destruction of dolphin habitat a number of mitigation measures will be introduced. These include appropriate discharge quality measures as outlined above; selection of dredging technology that minimises water quality impacts and subsequent habitat degradation as outlined above; and by minimising seagrass habitat directly impacted by dredging activities. Further detail on appropriate mitigation measures are outlined in the relevant EMP (**Attachment B4**). From the results of the investigation and by utilising these mitigation measures it is anticipated that direct impact on seagrass habitat, and in turn dolphin foraging habitat, will be low.

The WBDD Project undertaken by GPC will involve the reclamation of land at Fisherman's Landing and direct removal of seagrasses and benthic habitat. A discussion of potential impacts from the WBDD is in the cumulative impact assessment in Appendix J and the GPC EIS.

Noise

A detailed noise and vibration impact assessment for the proposed LNG facility has been undertaken as part of the EIS (Section 8.10). The construction of the PLF, MOF, access channels and the potential bridge each have the potential to produce underwater noise impacts to dolphins. Normal operating conditions for the PLF and MOF are not expected to produce noise levels significantly above ambient background levels such that there are communication problems or sound levels causing avoidance for marine mammals. Temporary avoidance by dolphins or turtles may occur in the immediate vicinity of the new berth sites during piling and dredging. However, the sound levels from piling operations are not expected to harm marine fauna, even at close range.

Mitigation measures for these are outlined in the Marine Facilities EMP (refer **Attachment B4**) and also Section 8.10.2.4 of the EIS. These measures include undertaking marine mammal observations prior to the commencement of impact pile driving activities in order to prevent a startle response from dugong or dolphin. If observed within the area, the commencement of activities will be delayed and soft start to piling will be considered. Also, sonar devices on dredges will have operating frequencies above 200 kHz to minimise the impact upon dolphin and dugong. By implementing these mitigation strategies it is anticipated that the impact of noise from dredging and pile driving will be minimal and reduced to a level whereby only temporary avoidance of a limited area may occur.

Boat Strike

Varying boats of different speeds are anticipated to be used for the GLNG Project. The final boats to be utilised during the GLNG Project will be dependent upon boat and contractor availability. This issue is recognised to be much broader than the GLNG Project alone, given that most boat strikes occur from faster boats i.e. smaller fishing vessels within Port Curtis. Santos will contribute to any process to assess improvements to speed management of vessels in the Gladstone Harbour. This may target areas of speed restrictions to minimise the potential impact of boat strike to dolphins in the Gladstone Harbour. Further mitigation measures include the implementation of an education program for the construction workforce regarding the risks to dolphins, turtles and dugongs. This program will include instructions on avoiding interaction with these species.

Additionally, a Draft Turtle and Dugong Management Plan is included in **Attachment F5** of the EIS Supplement. This Plan contains measures designed to protect turtles and dugongs from GLNG Project activities. This plan will also apply to inshore dolphins. Further mitigation measures to reduce impacts on marine megafauna are included in the LNG Facility EMP (Section 13.16.4, **Attachment B3**). It is anticipated that utilisation of these mitigation measures will reduce the potential of boat strike to a low level of impact.

Respondent Comment

WWF-Australia states that the GLNG EIS states that 'boat strike, entanglement in fishing gear and incidental capture in QDPI&F shark control nets poses the greater threats' to these species in the region. However, WWF-Australia is concerned that we still know very little about the extent to which certain threats pose to key population and subsequently the impacts of habitat destruction and degradation arising from the proposed development is being severely overlooked and inadequately addressed in the EIS.

Santos Response

Please refer to the above response.

The GBRMPA recognises that population declines in these dolphin species are the result of the cumulative impacts of human-related activities such as: boating, disease, habitat degradation, illegal activities, incidental drowning in commercial fishing, indigenous hunting, ingestion or entanglement in marine debris, and poor water quality (Whale and Dolphin Conservation in the GBRMP). These threats, are affecting inshore dolphins along the Capricorn Coast. The occurrence and intensity of these threats varies regionally and needs to be identified and managed locally.

Dolphin stomach analysis (2 dolphins caught in netting in North Queensland) contained fish remains and some crustaceans. Bottlenose dolphins are known to feed on trawl fish discards, freshwater/estuarine fish and cephalopods (Ross, 2002).

Port Curtis has naturally high turbidity and potential impacts of short term elevated turbidity associated with dredging activities is yet to be described, however, TSS levels predicted from sediment plume modelling (**Attachment G5**) are estimated to be within the natural levels of turbidity expected for Port Curtis.

Key impacts on seagrasses from dredging include physical removal or burial of vegetation at the dredging/disposal site, increased turbidity and increased sedimentation in adjacent seagrass meadows, temporarily reduced dissolved oxygen concentration, release of nutrients and pollutants from contaminated sediments and hydrographic changes (Erfemeijer and Lewis 2006). Studies conducted for the Gladstone Ports Corporation EIS (2009) recognise that potential smothering of seagrass habitats from increased sediment loads during their construction and maintenance dredging operations may potentially reduce local foraging habitat available. It is therefore recognised that the loss of seagrass habitats may have an impact on dolphin species in the study area, given that the dolphins eat fish associated with seagrass meadows. For the GLNG Project, the potential impacts of the proposed dredging programme on seagrass have been assessed through additional baseline investigations and hydrodynamic and sediment deposition modelling and are presented in **Attachments F5** and **G5** of the EIS Supplement. There is unlikely to be any direct impact on seagrass meadows from dredging for the GLNG Project. However, minor indirect impacts are anticipated. Specifically, impacts from total suspended solids concentrations and sediment deposition during dredging are expected to be marginal, if any, on seagrass meadows in Port Curtis, with the exception of an area of seagrass surrounding South Passage Island where slight indirect impacts are predicted (~34 ha). This represents approximately 0.8 % of the seagrass area in Port Curtis. Furthermore, the composition and biomass of the seagrass are such that they are considered to be unlikely to be utilised by dugongs. These impacts are based upon a Cutter-Suction dredging technique, selected by Santos as the preferred dredging option.

In order to minimise habitat degradation and destruction of dolphin habitat a number of mitigation measures will be introduced. These include appropriate discharge quality measures as outlined above; selection of dredging technology that minimises water quality impacts and subsequent habitat degradation as outlined above; and by minimising seagrass habitat directly impacted by dredging activities. Further detail on appropriate mitigation measures are outlined in the relevant EMP (**Attachment B4**). From the results of the investigation and by utilising these mitigation measures it is anticipated that direct impact on seagrass habitat, and in turn dolphin foraging habitat, will be low.

The WBDD Project undertaken by GPC will involve the reclamation of land at Fisherman's Landing and direct removal of seagrasses and benthic habitat. A discussion of potential impacts from the WBDD Project is in the cumulative impact assessment in Appendix J and the GPC EIS.

8.4.4.2 Environmentally Sensitive Areas

Respondent Comment

Department of Environment and Resource Management states that the EIS should recognise the significant coastal wetlands and endangered regional ecosystems (areas of state significance (natural resources)) as significant vegetation communities and recognise mapped regionally important coastal habitats. Sufficient information should be provided to demonstrate that the project is consistent with the State and Regional policies.

Santos Response

Three nationally important wetlands have been recognised as being within close proximity to the LNG project area and are listed under the Directory of Important Wetlands in Australia (DIWA) (EIS Appendix N3). These wetlands and other environmentally sensitive areas within the coastal region of the project area have been recognised and are mapped in: EIS Appendix N3, Figure 2.

Coastal Regional Ecosystems have been identified within the LNG facility and the GSDA section of the Gas Transmission Pipeline, including both the CICSDA option and the GLNG GTP option. These REs have been mapped and ground-truthing undertaken to determine the community and consequently their status. The RE mapping for these locations are included in the following reports: EIS Appendix N3, Figure 1 and Figure 3; **Attachment E4**, Figure 3 and Figure 4; **Attachment F2**, Figure 1. No coastal REs with 'Endangered' status under the VM Act are proposed to be disturbed by the GLNG Project. Within the LNG facility footprint, the vegetation community of Microphyll/notophyll vine forest on beach ridges (RE 12.2.2) (listed as Critically Endangered under the EPBC Act) was described as being impacted by the project (EIS Appendix N3, Table 3-1). However, the LNG facility footprint has been adjusted such that this RE is no longer disturbed (**Attachment F2**).

In addition to legislative requirements, both state and regional policies have been considered throughout the EIS process (e.g. EIS Appendix N3, Section 1.3). The *Coastal Protection Management Act 1995*, the State Coastal Management Plan and the Curtis Coast Regional Coastal Management Plan have been consulted as guiding documents to local and regional policies within the Port Curtis area relating to the LNG facility (EIS Chapter 8.4.3.8; EIS Supplement - **Attachment F5**).

8.4.3 Regulatory Framework

Respondent Comment

Department of Environment and Resource Management has requested that the State Coastal Management Plan – Queensland's Coastal Policy and the Curtis Coast Regional Coastal Management Plan are included as relevant key planning policies. The relevant State and Regional policies should be addressed. Information should be provided to demonstrate how the project is consistent with the relevant State and Regional policies.

Santos Response

The *Coastal Protection Management Act 1995* provides for the protection, conservation, rehabilitation and management of coastal areas. The Act has regard to the goal, core objectives and guiding principles of the National Strategy for Ecologically Sustainable Development and aims to a achieve, in conjunction with

other legislation, a coordinated and integrated management and administrative framework for the ecologically sustainable development of the coastal zone.

Curtis Coast Plan

The *Coastal Protection and Management Act 1995* also establishes the State Coastal Management Plan 2002 which includes policies relating to coastal use and development, physical coastal processes, water quality, Indigenous traditional owner cultural resources and nature conservation. The Curtis Coast Regional Coastal Management Plan (Curtis Coastal Plan), was also developed under the Queensland *Coastal Protection and Management Act 1995*, and provides regional direction for the implementation of the State Coastal Management Plan – Queensland's Coastal Policy in the Curtis Coast region and describes how the coastal zone of the Curtis Coast region is to be managed. This includes the assessment of development such as the LNG facility site.

Section 8.11.5.9 of the EIS provides some discussion on the GLNG Project's expected impacts on Curtis Coast Regional Coastal Management Plan with Tables 8.11.5 – 8.11.7 summarising the desired coastal outcomes for the coastal sites as established in the Curtis Coast Regional Coastal Management Plan and the extent to which the GLNG Project will be consistent with them. As a statutory instrument under the Coastal Act, the Curtis Coastal Plan has the force of law to guide relevant decisions by State and local governments and the Planning and Environment Court. The Curtis Coastal Plan and the State Coastal Plan have the effect of State planning policies under the *Integrated Planning Act 1997* and are mandatory regulatory policies for assessment of projects such as Santos GLNG Project. The abovementioned tables provide an assessment of the project as it relates to the policy objectives.

The State Coastal Management Plan is a key planning document applicable to the assessment of the proposed GLNG Project. There has, however been a recent review of this plan and for the purposes of Santos response to the comments from the Department of Environment and Resource Management it is applicable to discuss the application of the Draft document and policy as the changes stemming from the review were seen by the government to be quite critical, as follows:

The review indicated that significant changes are required to the State Coastal Management Plan and to the legislative framework which supports it, to ensure the regime that protects coastal land and its resources is effective and efficient. The review cites:

- The State Coastal Management Plan and associated legislation are no longer consistent with highly evolved planning, policy and legislative environments; and
- The State Coastal Management Plan is ambiguous and difficult to use.

If adopted by State government, the draft management policy would apply to activities, decisions and works that are not assessable development under the *Integrated Planning Act 1997* and therefore not subject to the Draft State Planning Policy Coastal Protection. A report on the review is available for discussion.

Maritime Development Areas

It should be noted that the Gladstone region contains several major maritime development areas that have been designated for large scale maritime infrastructure, though maritime development areas also include areas for smaller scale development such as individual boat ramps or minor marine infrastructure, it is important to note the following areas earmarked for further development as they may provide key logistical support for this and future LNG projects. They are as follows:

- Port of Gladstone (Fishermans Island) - Forest Rd and Landing Rd;
- Port of Gladstone (Clinton) - Aft Orourke Dr;
- Port of Gladstone (Barney Point) - McFarian Dr and Hopper Dr;
- Port of Gladstone (South Tree) - South Tree Island;
- Port of Gladstone (Wiggins) - Wiggins Island; and
- Port of Gladstone (Facing Island) Strategic Port Land - Facing Island.

State Coastal Management Plan

The following is an assessment of the GLNG Project against the current State Coastal Management Plan policies that are relevant to the project. The plan sets out broad categories for assessment and provides principles and policy to achieve the desired outcomes.

Topic	Coastal management outcome	Response
2.1 Coastal use and development	Use and development of the coastal zone occurs in an ecologically sustainable manner.	This policy addresses the areas of state significance (social and economic) including Strategic Port land and State Development areas. The GLNG liquefaction facility and export terminal is a coastal dependant land use which is proposed to be located within the Curtis Island State Development Precinct and is an appropriate development within that land designation. Support facilities and the pipeline extend into areas designated as Strategic Port land and other State Development Precincts as well as land within the Regional Council jurisdiction. As much as is possible Santos will manage the construction and operational activities utilizing land with appropriate and compatible use designations. The GLNG Project will develop maritime infrastructure of significant importance to the state's economy and accords with the policies associated with the use and development of the coastal zone. Dredging activities will be assessed by the GPC and DERM in accordance with the strategic plan of the port authority to ensure that appropriate mechanisms are developed through management plans to address impacts and avoid or minimise adverse impacts on coastal resources and their values.
2.2 Physical coastal processes	The coast is managed to allow for natural fluctuations to occur, including any that occur as a result of climate change and sea level rise, and provide protection for life and property.	The GLNG liquefaction facility and export facility have undergone an extensive study to identify the most appropriate siting and design within the Curtis Coat Precinct, to ensure that the construction and operation will not cause any significant adverse impacts on the coastal resources of the location nor interrupt the natural cycles of erosion and accretion of beaches.
2.3 Public access to the coast	Opportunities for public access to the coast are maintained and enhanced, consistent with the conservation of coastal resources and provision of public safety.	There will be no net loss of public access to the foreshore and minimal impacts of public useability of coastal waters as a result of the GLNG Project. The project is identified as having a significant economic benefit to the state and will not compromise coastal (natural and cultural) resources. The design of access during the construction and for export activities will be assessed by the GPC, DERM and other key stakeholders to ensure these activities avoid impacting on areas of cultural significance.
2.4Water quality	Water quality in the coastal zone is maintained at a standard that protects and maintains coastal ecosystems and their ability to support human use.	All activities that may have an impact on the quality of surface, groundwater or acid sulphate soils including stormwater and wastewater discharge have been assessed in the EIS. The construction and operation of the GLNG facilities within the coastal management zone will have measures developed with key regulatory agencies to ensure the environmental values and water quality objectives achieve the general environmental values and water quality objectives outlined in the EPP (Water). It is understood that any proposed discharges of industrial wastewater into coastal waters must be assessed using the waste management evaluation procedure for wastewater (set out in the EPP (Water)) and will only be permitted where it is demonstrated no other feasible alternatives exist.
2.5 Indigenous Traditional	The living culture of Indigenous Traditional	Santos is working with traditional owners to assist in establishing protocols for identifying state significant matters of cultural heritage and

Owner cultural resources	Owners and their connection with cultural resources within the coastal zone is valued and continues for future generations of Indigenous Traditional Owners.	protection methods will be put in place to ensure these valuable assets are protected where possible. To this end CHMPs and ILUAs will be developed to manage impacts during the construction and ongoing operation of the facilities for the GLNG Project.
2.6 Cultural heritage	Places, buildings and objects with important cultural heritage values located on the coast are appreciated, conserved, managed and passed on to future generations.	The EIS has assessed matters of cultural heritage significance including places and objects within and adjacent the areas to be developed for the GLNG Project. There will be minimal impacts to the cultural heritage values and mitigation measures will be provided within management plans to ensure these values are understood and avoided during construction and operational activities where possible.
2.7 Coastal landscapes	The scenic and cultural values associated with coastal landscapes are protected.	The proposed LNG facilities will be developed within an area that has been assessed by the state government as being the most appropriate area for developing LNG facilities. This is not an area identified for its regionally significant coastal landscape values. The GLNG Project will not impact areas where these coastal landscape values are of state or regional significance.
2.8 Conserving nature	Coastal ecosystems, including their ecological processes, opportunities for survival, biological diversity and potential for continuing evolutionary adaptation, are maintained, enhanced and restored.	The EIS has established the location of areas considered as important wetland areas. An assessment of the proposed activities associated with the construction and operation of the GLNG Project within these areas has been undertaken in order to minimise or avoided impacts on these coastal wetland areas. All relevant EMPs will incorporate the criteria contained within this policy to ensure that appropriate protection methods are adopted. Assessment of the areas of significance for habitat and biodiversity both terrestrial and marine are included within the appropriate sections of EIS (i.e. ecology and marine ecology). Management plans aimed at protecting the biodiversity values identified during site assessments of these areas will ensure that impacts from construction and operation activities are kept to a minimum.
2.9 Coordinated management	Coastal management is coordinated and integrated across all levels of government and within the community.	The assessment of this project is undertaken in cooperation with many key regulatory agencies and managed by the office of the Coordinator General. The intent of this policy is achieved through the EIS process and further during the assessment of key approvals for the primary components of the project where referral of cross jurisdictional matters provides for a coordinated assessment approach.
2.10 Research and information	Research programs, and data and information collection and management focus on, support and enhance effective coastal management.	Though directed at lead agencies to establish coordinated information and assessment frameworks for monitoring impacts on coastal resources, the studies undertaken within the framework of the EIS for the GLNG Project will provide valuable information to all agencies on the existing environment within the Curtis Coast region.

Respondent Comment

Department of Environment and Resource Management states that the following text from the EIS is incorrect:

"…The MPGBRC Zoning Plan regulates the area from the low water mark of the Great Barrier Reef Marine Park to either the high water mark or the seaward edge of significant mangrove forests." It should state the GBRCMP Zoning Plan regulates the GBRCMP which commences from either HAT or high water and extends to the extent of Queensland Waters.

Santos Response

Santos has amended the text to be consistent with the Queensland Great Barrier Reef Coast Marine Park as described in the *Marine Parks (Declaration) Regulation 2006* (Qld) Schedule 2.

8.4.4 Existing Environmental Values

Respondent Comment

Department of Environment and Resource Management states that the EIS should consider the impacts of the project on the Fitzroy Fish Habitat Area.

Santos Response

The Fitzroy River FHA (FHA-072) is situated at the northern end of the Narrows. Potential impacts to the Fitzroy Fish Habitat Area from construction and operation of the LNG facility and DMPF on Curtis Island, and the excavation for the gas transmission pipeline between Friend Point and Laird Point are considered to be unlikely.

Additional baseline investigations and hydrodynamic and sediment deposition modelling were undertaken to provide further information on the potential impacts of dredging works and discharges from the DMPF and the LNG facility. The results of these investigations are presented in **Attachment G4** and **G5** of the EIS Supplement.

These investigations showed that there are not anticipated to be any detectable water quality or deposition rates changes within the Fitzroy River FHA arising from the project.

8.4.4.4 Terrestrial Fauna

Respondent Comment

Capricorn Conservation Council requested the following regarding China Bay:

- *Prevent access to beach and mangroves during construction and during facility operation; and*
- *Monitor the impact of the LNG facility on species' use of the location.*

Santos Response

A commitment has been made in the Construction and Operational EMPs (EMP B5, Sections 15.15.2 and 15.15.4) to monitor the impact of the LNG facility on significant terrestrial fauna species. This entails monitoring the impact of the facility on local and migratory bird species usage of the areas disturbed including the beaches, tidal zones and mud flats at Friend Point and China Bay. Access to beach and mangroves will be limited to that necessary for construction and operation.

Section 13.16.4 of the LNG facility EMP (Marine Flora and Fauna Management) outlines the following commitments with regards to beach/wetlands access:

- Provide training for staff regarding the sensitivity of wetland ecosystems;
- Interpretive signage will be used to notify construction staff of the reasons why trespassing on these ecosystems is prohibited and the impacts this might have; and
- Fences will be erected around ecologically sensitive areas to visually and physically enforce the need for avoidance of disturbance to these areas.

Respondent Comment

Capricorn Conservation Council requested regarding Friend Point, to rehabilitate any disturbance to beaches and intertidal sand and mudflats to pre-pipeline/bridge conditions.

Santos Response

The Bridge and Services EMP (B5) and the Pipeline EMP (B2) have been updated with the following text:

Flora and Fauna Management

- Rehabilitate any disturbance to beaches and intertidal sand and mudflats to pre-pipeline/bridge conditions.

Refer to **Attachment B5** for the revised EMP.

Respondent Comment

Capricorn Conservation Council requested, in terms of cumulative impacts, that the feasibility of constructing only one shipping terminal to service all four LNG projects be assessed to reduce the environmental impact. Additionally, in suggests that there be a requirement that all four pipelines crossing the narrows be constructed at the same time and in the same place to reduce the environmental impact.

Santos Response

Santos is proactively working with Government to ensure that the alignment for the both the shipping channels and the pipeline are located appropriately with due regard to navigational safety and environmental issues.

Additionally, Santos has undertaken a cumulative impact assessment contained in **Attachment J**.

Respondent Comment

Capricorn Conservation Council requested regarding the LNG facility and pipeline:

- *An offset equivalent to the area cleared should be provided in an area adjacent to or near to the LNG facility. This will provide the owls and cockatoos with secure habitat that will assist in their relocation and for their survival in the future.*
- *While mitigation measures are supported (8.4.4.7) the site will nevertheless cause significant loss of habitat. Every effort must be made to minimise unnecessary clearing and reduce fragmentation.*

Santos Response

Santos has undertaken significant effort to miminise the amount of clearing and fragmentation resulting from the GLNG Project. This has included adjusting the footprint of the LNG facility such that the EPBC listed community has been avoided. A biodiversity offsets package is being developed by Santos in conjunction with Ecofund Queensland (a Queensland government advisory service) as a Biodiversity Offset Management Plan to address the objectives of both the current State & Commonwealth legislative biodiversity offsetting requirements. An analysis has been undertaken to identify the offset requirements for proposed impacts for the CSG field, gas transmission pipeline and LNG facility components of the GLNG Project. Analysis requirements being undertaken for offsets include:

- Extent and size of offsets required to be secured;
- Ecological values required to be offset;

- Options available for pooling or consolidation offset requirements; and
- Options for securing offsets.

Offset assessment and analysis includes the co-ordination of multiple offset requirements and is being carried out under the following policies:

- Vegetation management offsets under the *Vegetation Management Act, 1999* (Qld);
- Fish habitat offsets under the *Fisheries Act, 1992;*
- Protected plants offsets under the *Nature Conservation Act, 1992*;
- Biodiversity offsets under the Draft Policy for Biodiversity Offsets 2008 (Qld); and
- Environmental offsets under the *Environment Protection & Biodiversity Conservation Act, 1999* (Cwth).

The process of developing a suitable Biodiversity Offset Management Plan to implement Regulatory requirements is an iterative process with State and Commonwealth regulatory bodies.

Respondent Comment

Capricorn Conservation Council requested, regarding the cumulative impacts, that there is a coordination of the construction of all four LNG facilities and pipelines to reduce fragmentation of the landscape and retain habitat corridors throughout.

Santos Response

Regardless of the number of proponents, the footprint of the LNG Plants is limited to the LNG precinct within the GSDA.

Santos is working with Government in the creation of a common pipeline corridor to service all LNG projects on Curtis Island. The aim of this process is to reduce the footprint of the activities on Curtis Island.

At this point in time, projects need to be self sufficient until FID. Santos will work with the Government and other proponents of LNG facilities and pipelines to reduce fragmentation and habitat corridor impacts where feasible.

8.4.4.5 Marine Ecology

Respondent Comment

Gladstone Regional Council states that it has general concerns regarding marine plant interference, habitat destruction for fisheries and impacts on a sensitive coastal environment. In relation to dredge material disposal Council considers that the dredge material disposal needs to be in line with the Western Basin Dredging and Disposal Project. Council considers that there should be no dredge spoil deposited at Laird Point.

Santos Response

The GLNG Project includes a stand-alone proposal for the dredging and placement of dredge spoil material required for the project. A plan specific to the GLNG Project has been prepared to manage the project's dredge material if, for some reason, the Western Basin Dredging and Disposal Project (WBDDP) proposed by Gladstone Ports Corporation (GPC) is delayed or does not proceed. This plan is to develop a dredge material placement facility south of Laird Point on Curtis Island.

The GPC is proposing to undertake the WBDDP which seeks to accommodate the long term dredging and dredged material disposal that is required to provide safe and efficient access to the existing and proposed port facilities in the harbour. The WBDD Project involves GPC seeking approval for dredging and dredged material disposal to support the progressive development of the Port of Gladstone through the provision of shipping access to port facilities which will assist in developing new industries, specifically the LNG industry, to be located in the Gladstone region. The two components of the WBDD Project are as follows:

- The inner harbour dredging associated with deepening and widening of existing channels and swing basins and the creation of new channels, swing basins and berth pockets; and
- The disposal of dredged material from the dredging works in an area adjacent to the existing Fisherman's Landing reclamation and the proposed Northern Expansion (Western Basin Reclamation Area).

The WBDDP includes as Stage 1A the dredging required for the GLNG Project and disposal of the dredge material at the Western Basin Reclamation Area. The WBDDP is the subject of a separate EIS as a "significant project" under the SDPWO Act. The WBDDP has also been declared to be a "controlled action" by the Minister for the Environment, Water, Heritage and the Arts under the EPBC Act and is being assessed under the bilateral agreement between the Commonwealth and the State of Queensland. The EIS for the WBDD Project was released for public comment by the CG on 15 November 2009.

If the GPC's WBDD Project is approved and proceeds within an appropriate timeframe, then Santos may decide not to proceed with the GLNG Project's dredging and material placement under its own approvals. Santos may rely on the GPC undertaking the dredging and dredge material disposal for the GLNG Project as part of GPC's Stage 1A approvals for the WBDD Project. In this case the GPC would undertake the dredging required for the GLNG Project and dispose of the dredge material at the Western Basin Reclamation Area as part of the WBDDP. A discussion of potential environmental impacts from the WBDD Project is in the cumulative impact assessment in Appendix J and the GPC EIS.

If for some reason the WBDD Project is delayed or does not proceed, a plan specific to the GLNG Project has been prepared to manage the project's dredge material by placing it at in a proposed dredge material placement facility at Laird Point on Curtis Island.

Laird Point remains a viable standalone option for disposal of dredge material arising from the GLNG Project, and the only viable alternative dredge material placement facility at this time, for the LNG industry.

On this basis, Santos seeks approval of the DMPF at Laird Point subject to the following two conditions:

- The CG being satisfied that the site is not required for another LNG Plant in the short to medium term; and
- The CG being satisfied that the dredge material placement facilities at Fisherman's Landing are not available to be utilised within the time required to commence construction of the GLNG Project.

Santos recognises that an approval to dispose of dredge material at Laird Point would require a material change of use decision by the Coordinator General.

8.4.5 Potential Impacts and Mitigation Measures

Respondent Comment

Department of Environment and Resource Management requested that the changes in light horizons should be investigated and defined to determine the potential impacts to the Flatback turtle nesting area. The mitigation measures to prevent and or minimise the impacts should also be defined.

Santos Response

It is considered that changes in the light horizon caused by light emissions from the GLNG Project are expected to be minimal due to the current levels of lighting from existing industrial areas in Gladstone. A change to the light horizon refers to altered reflected illumination of the night sky above the LNG Facility. Any potential impacts to nesting turtles at the southern end of Curtis Island from the LNG Facility increased light illumination will be mitigated through implementation of measures such as the use of low sodium lighting and light hoods.

Visual assessment (Section 8.12 of the EIS) estimated that the flare stack may be partially visible from Curtis Island South End and Facing island townships. As identified by Figures 8.12.1 of the EIS and Figure 2.1 of the Turtle and Dugong Management Plan (**Attachment F5** of the EIS Supplement), the turtle nesting beach on Curtis Island lies just outside of the range of direct line of sight of the flare stack and associated flaring activities. However, the potential for impacts to hatchling turtles from LNG facility flaring events are likely to be low based on the following:

- There is a recognised spectral intensity that lies outside of the recognised range of the most disruptive light waves for turtle hatchlings;
- The distance from the flare stack to the turtle nesting beach is greater than 8 km;
- There is currently no direct line of site between the stack and turtle nesting beach; and
- Flaring events (estimated to be infrequent, two to three times a year) would have to occur at night and during the turtle hatchling season.

During finalisation of the LNG facility design light glow will be considered with the view of minimising potential impacts to nesting turtles. Potential impacts to nesting turtles and hatchlings from gas flaring activities will only occur during flaring events at night time in the turtle nesting season (flatback turtles - early December to late March, with a peak in mid February). Scheduled maintenance flaring is estimated to occur for a three hour period every 3 years. Emergency flaring is considered to be a rare event. It is considered that the combination of flaring at night and during turtle nesting season will be rare and extremely unlikely to coincide. However, in the event there is a direct line of sight from the flare to nesting turtle populations; or light glow from the LNG facility is considered to potentially impact nesting turtles and hatchling behaviour; or gas flaring occurs at night during turtle nesting season a turtle monitoring program will be initiated and implemented.

Attachment F5 of the EIS Supplement outlines mitigation measures proposed to be undertaken by Santos including:

Ensuring that all lighting with the LNG facility is minimised during design phase by:

- Reduction in the intensity of light glow using low pressure sodium (LPS) lights;
- Using timers to reduce the amount of time the lights are used;
- Installing movement sensor lights;
- Restricting the height of available light or applying shrouds to control direction;
- Following finalisation of the design, other mitigation measures may include the use of light hoods;
- Avoiding flaring where possible for maintenance purposes at night during the turtle nesting and hatchling season; and
- Monitoring the nesting beaches in consultation with DERM for disorientation if upset flaring occurs at night for extended periods during turtle hatchling season.

Respondent Comment

Department of Environment and Resource Management requested there be an investigation assessing populations of migratory species and threatened species that inhabit the inter-tidal and sub-tidal waters of Port Curtis. Such investigations should be conducted by suitably qualified persons. Appropriate mitigation measures should be proposed to prevent and or minimise the impacts to environmental values identified.

Santos Response

A number of studies have been undertaken of the potential use of the intertidal areas by migratory wader birds refer to GLNG EIS Appendix N2.

A specific discussion of the migratory bird species of Curtis Island is provided in EIS Appendix N2 outlining the values determined from the three separate seasonal migratory birds surveys conducted for this faunal assemblage for this project (URS 2007, URS 2008 and BAAM 2008).

Wader/shorebird species were observed in relatively low numbers within the study area. Habitat values appeared to be low for many species due to low foraging potential. There is abundant existing habitat elsewhere on Curtis Island and surrounds. The majority of the observed waders, both in terms of species and number of individuals, were recorded foraging on more suitable habitat (sand/mudflats) 10 km to the east of the study area at South End. Given the current extent of industrial and shipping activity within Port Curtis, it is unlikely that the construction and operation of the LNG facility will present an additional significant effect on migratory bird migration patterns and energy expenditure.

Additionally, construction staff will remain within the LNG facility footprint at all times while on the island.

EIS Section 8.7 and EIS Appendix R1 provide a summary and detailed investigation of the populations of migratory species and threatened species that inhabit the inter-tidal and sub-tidal waters of Port Curtis. A Turtle and Dugong Management Plan (**Attachment F5** of the EIS Supplement) describes estimates of dugong and turtle populations and habitat utilisation within Port Curtis and adjacent ocean beach turtle nesting areas. An assessment of dugong counts from the GPC Western Basin EIS surveys is included in this document. It is considered that pipefish prefer clearer waters and are unlikely to be found within Port Curtis. The Green Sawfish may be present within Port Curtis.

Extensive marine megafauna surveys have been conducted as part of the GPC Western Basin EIS and the BG EIS utilising both aerial and boat based methodology. The results of these studies have identified the presence of Indo-pacific humpback dolphins on numerous occasions during the survey period.

Results from the GPC Western Basin EIS surveys indicate that habitat utilisation by this species within the survey area was high, given that sightings occurred on every boat based survey. The study recognised Rodds Bay as a key habitat for marine fauna species including Indo-Pacific humpback dolphins. From the survey results it is expected that they have a higher presence in areas of important habitat i.e. in close proximity to the port and channels, creek and river mouths, however the requirement to transit between habitat patches needs to be recognised (refer Part 2, Section 8.4.3.8 of the EIS Supplement) for further dolphin assessment that includes recent unpublished PhD research on dolphin populations within Port Curtis (Cagnazzi, under review).

Respondent Comment

Capricorn Conservation Council states that the proponent should provide alternatives to clearing RE 12.2.2 and 12.3.3. Preference should be given to leaving RE 12.2.2 intact and the critically endangered community protected. No details are provided as to the 'biodiversity offset strategy and management plan' for these endangered communities.

Santos Response

Alternatives have been considered for the site location of the LNG facility both throughout Queensland and within the Gladstone Region. These are outlined in EIS Section 2.3.1, Table 2.3.2 and Section 2.3.1.2, Table 2.3.4. Review of each of these alternatives with consideration given to environmental impacts has identified the current LNG facility site as the most appropriate. Within the current footprint, impacts to RE 12.2.2 and 12.3.3 have been avoided and minimised wherever possible. A revision of the LNG facility footprint has further reduced impacts to the Endangered RE 12.3.3 by 5.7 ha, and reduced all direct impacts to Critically Endangered RE 12.2.2 entirely (**Attachment F2**, Section 3.1.1, Table 3-2).

Unavoidable impacts have been analysed (**Attachment F2**, Section 3.1) and will be offset as per the biodiversity offsets strategy (Sections 6.4.5.5, 7.4.5.1 and 8.4.5.1 of the EIS; Section 5.6 Appendix N1, Section 4.2.6 Appendix N2, and Section 3.2.4 Appendix N3). The development of a Biodiversity Offset Management Plan has been undertaken by Santos in conjunction with the 'Ecofund Queensland' state government offset advisory group. The Offset Management Plan being developed specifically addresses the requirements for offsetting under both state and commonwealth legislation. Further specific detail of the Biodiversity Offset Management Plan is provided within the Addendum in **Attachment E4**, Section 3.2.6.

Respondent Comment

Wildlife Preservation Society of Queensland - Policy and Campaigns Manager state that six marine turtles occur in the area. The risk and threat to nesting and foraging is significant. Construction with its associated lighting may result in much higher predation than normal and it is suggested that additional lighting be kept to a minimum during nesting and hatching times.

Santos Response

It is considered that changes in the light horizon caused by light emissions from the GLNG Project are expected to be minimal due to the current levels of lighting from existing industrial areas in Gladstone. A change to the light horizon refers to altered reflected illumination of the night sky above the LNG facility. Any potential impacts to nesting turtles and hatchlings at the southern end of Curtis Island from the LNG facility increased light illumination will be mitigated through implementation of measures such as the use of low sodium lighting and light hoods.

Visual assessment (Section 8.12 of the EIS) estimated that the flare stack may be partially visible from Curtis Island South End and Facing island townships. As identified by Figures 8.12.1 of the EIS and Figure 2.1 of the Turtle and Dugong Management Plan (**Attachment F5** of the EIS Supplement), the turtle nesting beach on Curtis Island lies just outside of the range of direct line of sight of the flare stack and associated flaring activities. However, aggregation of hatchling turtles towards well lit areas associated with the construction phase of the LNG facility and associated infrastructure are likely to be low based on the following mitigation measures (refer **Attachment F5** of the EIS Supplement for further detail):

Ensuring that all lighting with the LNG Facility is minimised during design phase by:

- Reduction in the intensity of light glow using low pressure sodium (LPS) lights;
- Using timers to reduce the amount of time the lights are used;
- Installing movement sensor lights; and
- Restricting the height of available light or applying shrouds to control direction.

During finalisation of the LNG Facility design light glow will considered with the view to minimise potential impacts to nesting turtles.

Potential impacts to internesting turtles and foraging turtles within Port Curtis include interactions with dredge gear, noise and vibration, vessels, reduced water quality and habitat degradation. Mitigation measures are included in the Turtle and Dugong Management Plan to reduce interactions and mitigate habitat degradation for seagrass meadows and reduced water quality.

Respondent Comment

Wildlife Preservation Society of Queensland - Policy and Campaigns Manager state that the threats to six species of marine turtles have not been adequately addressed.

Santos Response

Although six species of turtles have been reported as know to occur in the area (DEWHA database), the loggerhead, green and flat back are reported to occur within Port Curtis (Limpus, 1999). Nesting flatback and green turtles and some intermittent nesting of loggerhead turtles has been reported in previous studies (identified in the Turtle and Dugong Management Plan, **Attachment F5**).

Potential impacts and mitigation measures for construction and operation of the GLNG Project to these three turtle species are discussed in detail in the Turtle and Dugong Management Plan (**Attachment F5**). Potential impacts to internesting turtles and foraging turtles within Port Curtis include interactions with dredge gear, noise and vibration, vessels, reduced water quality and habitat degradation. Mitigation measures are included in the Turtle and Dugong Management Plan to reduce interactions and mitigate habitat degradation for seagrass meadows and reduced water quality.

It is considered that changes in the light horizon caused by light emissions from the GLNG Project are expected to be minimal due to the current levels of lighting from existing industrial areas in Gladstone. A change to the light horizon refers to altered reflected illumination of the night sky above the LNG facility. Any potential impacts to nesting turtles at the southern end of Curtis Island from the LNG facility increased light illumination will be mitigated through implementation of measures such as the use of low sodium lighting and light hoods.

Visual assessment (Section 8.12 of the EIS) estimated that the flare stack may be partially visible from Curtis Island South End and Facing island townships. As identified by Figures 8.12.1 of the EIS and Figure 2.1 of the Turtle and Dugong Management Plan (**Attachment F5** of the EIS Supplement), the turtle nesting beach on Curtis Island lies just outside of the range of direct line of sight of the flare stack and associated flaring activities. However, the potential for impacts to hatchling turtles from LNG facility flaring events are likely to be low based on the following:

- There is a recognised spectral intensity that lies outside of the recognised range of the most disruptive light waves for turtle hatchlings;
- The distance from the flare stack to the turtle nesting beach is greater than 8 km;
- There is currently no direct line of site between the stack and turtle nesting beach; and
- Flaring events (estimated to be infrequent, two to three times a year) would have to occur at night and during the turtle hatchling season.

During finalisation of the LNG facility design light glow will be considered with the view to the minimising potential impacts to nesting turtles. Potential impacts to nesting turtles and hatchlings from gas flaring activities will only occur during flaring events at night time in the turtle nesting season (flatback turtles - early December to late March, with a peak in mid February). Scheduled maintenance flaring is estimated to occur for a three hour period every 3 years. Emergency flaring is considered to be a rare event. It is considered that the combination of flaring at night and during turtle nesting season will be rare and extremely unlikely to coincide. However, in the event there is a direct line of sight from the flare to nesting turtle populations; or light glow from the LNG facility is considered to potentially impact nesting turtles and hatchling behaviour; or gas flaring occurs at night during turtle nesting season a turtle monitoring program will be initiated and implemented.

Attachment F5 of the EIS Supplement outlines mitigation measures proposed to be undertaken by Santos including:

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- Installing movement sensor lights;
- Restricting the height of available light or applying shrouds to control direction;
- Following finalisation of the design, other mitigation measures may include the use of light hoods;

- Avoiding flaring where possible for maintenance purposes at night during the turtle nesting and hatchling season; and
- Monitoring the nesting beaches in consultation with DERM for disorientation if upset flaring occurs at night for extended periods during turtle hatchling season.

Respondent Comment

WWF-Australia view that the Environmental Impact Statement (EIS) fails to adequately assess the direct and cumulative impacts to globally and regionally important marine species such as the flatback turtle (Natator depressus), green turtle (Chelonia mydas), snubbfin dolphins (Orcaella Heinsohnii) and Indo-Pacific humpback dolphins (Sousa chinensis) associated with the Curtis Island and the Gladstone Region

Santos Response

Global and regional significance of marine turtles found or likely to be found within Port Curtis are discussed in the Turtle and Dugong Management Plan (**Attachment F5** of the EIS Supplement). Although six species of turtles have been reported as know to occur in the area (DEWHA database), the loggerhead, green and flat back turtles are reported to occur within Port Curtis (Limpus, 1999). Nesting flatback and green turtles and some intermittent nesting of loggerhead turtles has been reported in previous studies (identified in the Turtle and Dugong Management Plan, **Attachment F5**).

Potential impacts and mitigation measures for construction and operation of the GLNG Project to these three turtle species are discussed in detail in the Turtle and Dugong Management Plan (**Attachment F5**). Potential impacts to internesting turtles and foraging turtles within Port Curtis include interactions with dredge gear, noise and vibration, vessels, reduced water quality and habitat degradation. Mitigation measures are included in the Turtle and Dugong Management Plan to reduce interactions and mitigate habitat degradation for seagrass meadows and reduced water quality.

It is considered that changes in the light horizon caused by light emissions from the GLNG Project are expected to be minimal due to the current levels of lighting from existing industrial areas in Gladstone. A change to the light horizon refers to altered reflected illumination of the night sky above the LNG Facility. Any potential impacts to nesting turtles at the southern end of Curtis Island from the LNG Facility increased light illumination will be mitigated through implementation of measures such as the use of low sodium lighting and light hoods.

Visual assessment (Section 8.12 of the EIS) estimated that the flare stack may be partially visible from Curtis Island South End and Facing island townships. As identified by Figures 8.12.1 of the EIS and Figure 2.1 of the Turtle and Dugong Management Plan (**Attachment F5** of the EIS Supplement), the turtle nesting beach on Curtis Island lies just outside of the range of direct line of sight of the flare stack and associated flaring activities. However, the potential for impacts to hatchling turtles from LNG facility flaring events are likely to be low based on the following:

- There is a recognised spectral intensity that lies outside of the recognised range of the most disruptive light waves for turtle hatchlings;
- The distance from the flare stack to the turtle nesting beach is greater than 8 km;
- There is currently no direct line of site between the stack and turtle nesting beach; and
- Flaring events (estimated to be infrequent, two to three times a year) would have to occur at night and during the turtle hatchling season.

Following finalisation of the LNG Facility design an assessment of light glow will be made with the view to assessing potential impacts to nesting turtles. Potential impacts to nesting turtles and hatchlings from gas flaring activities will only occur during flaring events at night time in the turtle nesting season (flatback turtles - early December to late March, with a peak in mid February). Scheduled maintenance flaring is estimated to occur for a three hour period every 3 years. Emergency flaring is considered to be a rare event. It is considered that the combination of flaring at night and during turtle nesting season will be rare

and extremely unlikely to coincide. However, in the event there is a direct line of sight from the flare to nesting turtle populations; or light glow from the LNG Facility is considered to potentially impact nesting turtles and hatchling behaviour; or gas flaring occurs at night during turtle nesting season a turtle monitoring program will be initiated and implemented.

Attachment F5 of the EIS Supplement outlines mitigation measures proposed to be undertaken by Santos including:

Ensuring that all lighting with the LNG Facility is minimised during design phase by:

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- Using timers to reduce the amount of time the lights are used;
- Installing movement sensor lights;
- Restricting the height of available light or applying shrouds to control direction;
- Following finalisation of the design, other mitigation measures may include the use of light hoods;
- Avoiding flaring where possible for maintenance purposes at night during the turtle nesting and hatchling season; and
- Monitoring the nesting beaches in consultation with DERM for disorientation if upset flaring occurs at night for extended periods during turtle hatchling season.

The Dredge Management Plan incorporates mitigation measures to be implemented to avoid interactions with marine fauna, including turtles.

The threats (direct, indirect and cumulative) that Santos has assessed as potential impacts of the GLNG Project include:

- Water pollution;
- Habitat degradation and destruction;
- Noise; and
- Boat strike.

Mitigation measures for these impacts include the following:

Water pollution

Mitigation measures for water pollution associated with the GLNG Project include the appropriate treatment of all discharges, and minimising the water quality impacts of dredging through dredge technology selection. A site-specific construction erosion and sediment control plan will be implemented to minimise any potential impacts on receiving surface waters associated with the LNG facility. This is outlined in the LNG facility EMP (**Attachment B3**) and includes reference to correct storage of fuels and chemicals as well as topsoil storage.

Sewage generated during the initial construction phase will be treated to a secondary standard at an on-site sewage treatment plant. Relevant approvals for the plant will be obtained in conjunction with the facility's development approvals. Treated effluent will be loaded into tankers and barged to the mainland for disposal at an existing wastewater treatment plant. Sewage generated during the peak construction phase will be treated onsite in accordance with the applicable regulatory standards and approvals before being discharged to the marine environment. These measures are outlined in the relevant project EMPs as provided in **Attachment B**. Water pollution impacts are therefore anticipated to be low with the use of the appropriate mitigation measures proposed.

Habitat degradation and destruction

Key impacts on seagrasses from dredging include physical removal or burial of vegetation at the dredging/disposal site, increased turbidity and increased sedimentation in adjacent seagrass meadows, temporarily reduced dissolved oxygen concentration, release of nutrients and pollutants from contaminated sediments and hydrographic changes (Erfemeijer and Lewis 2006). Studies conducted for

the Gladstone Ports Corporation EIS (2009) recognise that potential smothering of seagrass habitats from increased sediment loads during their construction and maintenance dredging operations may potentially reduce local foraging habitat available. It is therefore recognised that the loss of seagrass habitats may have an impact on dolphin species in the study area, given that the dolphins eat fish associated with seagrass meadows.

For the GLNG Project, the potential impacts of the proposed dredging programme on seagrass have been assessed through additional baseline investigations and hydrodynamic and sediment deposition modelling and are presented in **Attachments F5** and **G5** of the EIS Supplement. There is unlikely to be any direct impact on seagrass meadows from dredging for the GLNG Project. However, minor indirect impacts are anticipated. Specifically, impacts from total suspended solids concentrations and sediment deposition during dredging are expected to be marginal, if any, on seagrass meadows in Port Curtis, with the exception of an area of seagrass surrounding South Passage Island where slight indirect impacts are predicted (~34 ha). This represents approximately 0.8 % of the seagrass area in Port Curtis. Furthermore, the composition and biomass of the seagrass are such that they are considered to be unlikely to be utilised by dugongs. These impacts are based upon a Cutter-Suction dredging technique, selected by Santos as the preferred dredging option.

In order to minimise habitat degradation and destruction of dolphin habitat a number of mitigation measures will be introduced. These include appropriate discharge quality measures as outlined above; selection of dredging technology that minimises water quality impacts and subsequent habitat degradation as outlined above; and by minimising seagrass habitat directly impacted by dredging activities. Further detail on appropriate mitigation measures are outlined in the relevant EMP (**Attachment B4**). From the results of the investigation and by utilising these mitigation measures it is anticipated that direct impact on seagrass habitat, and in turn dolphin foraging habitat, will be low.

Respondent Comment

WWF-Australia state that long term research and monitoring is recommended to adequately assess the status of key marine species in the area including distribution, abundance, movement patterns and genetic structure. Furthermore consideration of the EIS should be postponed for at least an additional six - twelve months to allow this important information to be integrated and risk assessments revised based on current concerns.

Santos Response

Results from aerial and boat based surveys by the GPC Western Basin Project and BG LNG proposal and unpublished PhD research by Cagnazzi are discussed below. Danielle Cagnazzi conducted field surveys of inshore dolphin populations within the Port Curtis region between January 2006 and September 2008 (102 separate surveys, mostly between May and September) as part of his PhD research (under review). Inshore dolphin species in Australian waters include the bottlenose dolphin (*Tursiops aduncus*), Indo-Pacific humpback dolphin, (*Sousa chinensis*) and the *Snubfin dolphin* (Orcaella heinsohni). The field surveys comprised visual observations and photo-identification. Over the two year period, 156 pods of Sousa chinensis and one pod of *Tursiops aduncus* were observed. No *Orcaella heinsohni* were observed. The mean pod size for *Sousa chinensis* was less than four, although pods of up to 15 individuals were observed, associated with social behaviour. Most dolphins were seen close to shore (within 100 - 500 m) in water depths of less than 10 m. Fifty-two dolphins showed permanent identifiable marks. Although mark-recapture population size analysis cannot be accurate over two years, early analysis suggests that approximately 65 *Sousa chinensis* live in Port Curtis (assuming a population relatively closed to immigration and emigration), Previous studies by Cagnazzi (2009) have indicated that there is likely to be some degree of short term movements of *Sousa chinensis* between the Fitzroy River estuary and Port Curtis; presumably through the Narrows.

Extensive marine megafauna surveys have also been conducted as part of the GPC Western Basin EIS and the Queensland Curtis LNG EIS (GHD, 2009; QCLNG, 2009). In particular, studies for the GPC Western Basin EIS were conducted over a nine month survey period utilising both aerial and boat based

methodology. The results of these studies have identified the presence of Indo-pacific humpback dolphins on numerous occasions during the survey period. Results from the GPC Western Basin EIS surveys indicate that habitat utilisation by this species within the survey area was high, given that sightings occurred on every boat based survey. The study recognised Rodds Bay as a key habitat for marine fauna species including Indo-Pacific humpback dolphins. From the survey results it is expected that they have a higher presence in areas of important habitat i.e. in close proximity to the port and channels, creek and river mouths, however the requirement to transit between habitat patches needs to be recognised. Potential impacts identified were both direct and indirect. These included the removal or degradation of foraging habitat, boat strike, decline in water quality and disturbance or displacement from increased noise.

Assessment of dugongs and turtles are discussed in the Draft Dugong and Turtle MP in **Attachment F5** of the EIS Supplement.

Respondent Comment

WWF-Australia considers that habitat degradation, sedimentation and physical disturbance, is an almost certain major impact on the marine turtles known to nest and forage in the area (e.g. Natator depressus and Chelonia mydas). It is proposed that 8 million cubic metres of sediment will be dredged to accommodate a materials offloading facility. This is equivalent to the entire annual sediment flow into the Great Barrier Reef and is therefore likely to alter the basin to mainly soft sediments and silts. These impacts alongside the associated construction of the bridge, road and service corridor to Curtis Island and its frequent use by large vessels represents a significant impact, particularly on the foraging habitat of the marine turtles.

Santos Response

It is proposed that 6.8 Mm^3 of material will be dredged during capital dredging activities for the approach channel, PLF, MOF and swing basin. Santos preferred position is to use a MOF and haul road in the vicinity of Hamilton Point and China Bay for access for at least the initial construction phase of the LNG facility, as the bridge and road is not currently considered by Santos to be economically viable.

Dredging requirements for the material offload facility amount to 100,000 m^3. It is proposed that this portion of the dredge spoil be managed within the LNG facility site, and is separate to the capital dredging works for the channel swing basin and berth pocket which will be disposed of at Laird Point in the event a DMPF at Fisherman's Landing is unavailable.

Dredging of sediment changes the bathymetry in the footprint of capital dredging and possibly reduces the extent of soft sediment exposing bare rock. Previous studies indicate that decolonisation of benthic communities occurs adjacent to dredged areas. Potential impacts to sediment and benthic communities from prop wash are addressed in the DDMP (**Attachment G9** of the EIS Supplement) and mitigation of potential impacts includes the use of a dedicated shipping channel.

Marine turtles found within Port Curtis include green, flatback and loggerhead turtles. Green turtles forage on seagrass meadows, whilst flatback turtles tend to forage on benthic invertebrates such as hydroids. Potential impacts to soft coral communities are addresses in the Soft coral loss report in **Attachment F5**. Potential impacts to seagrass meadows are addressed in the Turtle and Dugong Management Plan (**Attachment F5**). Green turtles have been observed foraging on seagrass meadows at Pelican Banks and Wiggins Island. Potential impacts from elevated TSS from capital dredging are expected to be low (**Attachment G5**). Potential impacts to soft coral communities around Hamilton Point are expected to be low to moderate, with some deposition of sediment expected on these communities. Response to deposition by soft corals communities in not well researched, therefore future monitoring has been recommended.

Mitigation measures during construction phase of the project include soft start procedures for all piling and trenching activities will be employed to minimise potential impacts that include avoidance behaviour

of marine fauna to the area. Mitigation of potential impacts to turtles and dugong are addressed in **Attachment F5**.

Respondent Comment

WWF-Australia considers that light during construction and operation is likely to cause flatback turtle hatchling disorientation in nesting beaches. This poses a risk through disorientation of hatchlings, potential disorientation with respect to their return to their natal nesting beach as adults, and potentially increased predation of hatchlings. With respect to risks associated with light pollution Section 8.4.6.4 of the EIS states 'that construction activities will occur on the port side of Curtis Island, as the nearest turtle nesting beach is on the seaward side of Curtis Island - no impacts on turtle nesting is expected'. However with this Hodges and colleagues (2007) have shown light inducted disorientation to occur even when the light source is 18km away from the nearest nesting site. Therefore whilst EIS underscores the risks associated with light pollution it does not adequately attempt to mitigate the potential impact from the proposed development when fully operational.

Santos Response

Assessment of visual impacts (Section 8.12 of the EIS) concludes it is unlikely that there will be a direct line of sight from the LNG facility and associated gas flaring to nesting sites. Following finalization of the LNG facility design and in the event that significant light glow effect or a direct line of sight is established a turtle nesting monitoring program will be implemented. Details of a potential turtle nesting monitoring program are provided in the Turtle and Dugong Management Plan (**Attachment F5**) of the EIS Supplement.

Further, the likelihood that irregular and infrequent gas flaring will occur during nesting season, however, as stated, in the event that interference to nesting turtles results from the LNG facility a monitoring program will be implemented.

The Dugong and Turtle Management Plan (**Attachment F5** of the EIS Supplement) protocols to mitigate light pollution during construction and operation of the LNG facility. These protocols may include:

- Assessing light intensity levels in near shore areas and on vessels, and where practicable avoiding light spill through the use of shielding, directional/downward facing lighting and other techniques; and
- Taking particular care during the nesting season of the following three species of marine turtles known to nest on Curtis and Facing Islands:
  - Loggerhead turtles: nesting between late October and early December;
  - Flatback turtles: nesting between late November and late January; and
  - Green turtles: nesting between late November and late January.

Respondent Comment

WWF-Australia states that whilst the EIS identifies 'direct impacts for whales, dolphins dugongs and turtles from vessel movements and general operations through boat strike, entanglement in lines or being captured by suction pressure associated with the dredge head', the EIS fails to assess the indirect impacts of habitat destruction & degradation and the cumulative impacts of all activities on the long term survival of these key marine species. WWF-Australia maintains that these risks to a globally and regionally important listed marine species have not been adequately addressed for the proposed development. On the basis of this level of risk, approval for the proposed development on Curtis Island should be denied.

Santos Response

The threats to these species (direct, indirect and cumulative) that Santos has assessed as potential impacts of the GLNG Project include:

- Water pollution;
- Habitat degradation and destruction;
- Noise; and
- Boat strike.

Mitigation measures for these impacts include the following:

Water pollution

Mitigation measures for water pollution associated with the GLNG Project include the appropriate treatment of all discharges, and minimising the water quality impacts of dredging through dredge technology selection. These measures are outlined in the relevant project EMPs as provided in **Attachment B**.

Habitat degradation and destruction

It is recognised that the loss of seagrass habitats may have an impact on dolphin species in the study area, given that the dolphins eat fish associated with seagrass meadows. Studies conducted for the Gladstone Ports Corporation EIS (2009) recognise that potential smothering of seagrass habitats from increased sediment loads during their construction and maintenance dredging operations may potentially reduce local foraging habitat available.

In order to minimise habitat degradation and destruction of dolphin habitat a number of mitigation measures will be introduced. These include appropriate discharge quality measures as outlined above; selection of dredging technology that minimises water quality impacts and subsequent habitat degradation as outlined above; and by minimising seagrass habitat directly impacted by dredging activities.

There is unlikely to be any direct impact on seagrass meadows from dredging for the GLNG Project.

The WBDD Project undertaken by GPC will involve the reclamation of land at Fisherman's Landing and direct removal of seagrasses and benthic habitat and indirect impacts. A discussion of potential impacts from the WBDD Project is in the cumulative impact assessment in Appendix J and the GPC EIS.

Noise

Noise impacts on dolphins are expected to occur from dredging activities. Mitigation measures for these are outlined in the Marine Facilities EMP (refer **Attachment B4**).

Boat Strike

Varying boats of different speeds are anticipated to be used for the GLNG Project. The final boats to be utilised during the GLNG Project will be dependent upon boat availability and contractor requirements.

This issue is recognised to be much broader than the GLNG Project alone, given that most boat strikes occur from faster boats i.e. smaller fishing vessels within Port Curtis. Santos will willingly contribute to any process to assess improvements to speed management of vessels in the Gladstone Harbour. This may target areas of speed restrictions to minimise the potential impact of boat strike to dolphins in the Gladstone Harbour. Further mitigation measures include the implementation of an education program for the construction workforce regarding the risks to dolphins, turtles and dugongs. This program will include instructions on avoiding interaction with these species.

Global and regional implications for turtles and dugongs are addressed in the Turtle and Dugong Management Plan (**Attachment F5** of the EIS Supplement).

Several sub-populations of turtle species exist for Loggerhead, Green and Flatback turtles in Australia. The only species of marine turtle that breed exclusively in southern Queensland is the loggerhead turtle. All other species breed in locations outside of Queensland. The only major breeding population of loggerhead turtles in the South-West Pacific occurs on Queensland beaches, mainly on islands offshore of southern Queensland such as Capricorn Bunker Islands, Sandy Cape and Swains Complex.

Loggerhead turtles are reported to breed intermittently on beaches of southern Curtis Island and Facing Island. Potential impacts to these breeding turtles will be monitored as part of the Turtle and Dugong Management Plan. Green turtles have four main breeding areas within Australia and are known to breed in other areas in the Indo-Pacific (Limpus, 2004). Limpus (2004) also reports that the southern GBR stock of green turtles is large by global standards and that overall the population is not showing signs of decline. Limpus (1997) estimated a breeding population of 8,000 female turtles in the southern GBR around the Capricorn Bunker Group and the Coral Sea Islands Territory. Occasional nesting of green turtles is reported on Curtis and Facing Islands.

As turtles are known to return to their natal beach to nest, the protection of nesting turtles is vital. Impacts to foraging of green turtles is likely to be minimal due to the main foraging seagrass meadows being situated at Pelican Banks (Rasheed *et al.,* 2003), southern Curtis Island. Green turtles have been sighted foraging on seagrass meadows adjacent to Wiggins Island however, potential impacts to these meadows are anticipated to be minimal (Rasheed *et al*., 2003). Seagrass biomass and area within Port Curtis is currently attributed to environmental influences such as freshwater flows and associated increases in turbidity and nutrients (causing algal growth) rather than from anthropogenic disturbances (Rasheed *et al*. 2008). Sub-tidal seagrass meadows are shown to respond differently to intertidal meadows within Port Curtis, with recent increases in biomass in sub-tidal meadows (Rasheed *et al.*, 2008). The implications of this to dugong and green turtles are discussed in the Turtle and Dugong Management Plan.

Flatback turtles are only known to breed in Australia and are one of two species without a global distribution. In Queensland flatbacks nest on inshore islands with other major nesting areas in the Kimberly region of WA and Torres Strait. Curtis Island is considered a major rookery for the flatback turtle (Dobbs, 2001). Mitigation of potential impacts, including a monitoring program for nesting turtles is discussed in detail in the Turtle and Dugong Management Plan (**Attachment F5** of the EIS Supplement).

8.4.5.1 Terrestrial Flora

Respondent Comment

Department of Environment Water Heritage and the Arts consider that further discussion on offsets is required.

Santos Response

A biodiversity offsets package is being developed by Santos in conjunction with Ecofund Queensland (a Queensland government advisory service) as a Biodiversity Offset Management Plan to address the objectives of both the current State & Commonwealth legislative biodiversity offsetting requirements. An analysis has been undertaken to identify the offset requirements for proposed impacts for the CSG field, Gas Transmission Pipeline and LNG facility components of the GLNG Project. Analysis requirements being undertaken for offsets include:

- Extent and size of offsets required to be secured;
- Ecological values required to be offset;
- Options available for pooling or consolidation offset requirements; and
- Options for securing offsets.

Offset assessment and analysis includes the co-ordination of multiple offset requirements and is being carried out under the following policies:

- Vegetation management offsets under the Vegetation Management Act, 1999 (Qld);
- Fish habitat offsets under the *Fisheries Act, 1992;*
- Protected plants offsets under the *Nature Conservation Act, 1992;*
- Biodiversity offsets under the Draft Policy for Biodiversity Offsets 2008 (Qld); and
- Environmental offsets under the *Environment Protection & Biodiversity Conservation Act, 1999* (Cwth).

Further steps to be undertaken within a suitable timeframe as part of the process include:

- Identification of suitable offset options;
- Assessment of properties;
- Landholder liaison and negotiation to secure required offsets;
- Offset validation and preparation of specific Biodiversity Offset Management Plan(s); and
- Liaison to finalise contractual arrangements and covenants.

In addition to the objectives outlined above and those previously stated within the EIS (Sections 6.4, 7.4, 8.4 and Appendices N1, N2 and N3), the Biodiversity Offset Management Plan will be implemented over an appropriate time frame to accomplish the following specific aims:

- Identification of suitable potential offset areas with ecological values analogous to impacted ecological communities;
- Assessment of the ecological value and equivalence of offsets to ensure suitable offset extent, species assemblage, floristic structure and ecological integrity utilising an appropriate biometric field methodology;
- Development of appropriate management prescriptions to ensure long term viability of offsets (such as pest control, livestock management, access exclusion, ameliorative plantings and fire regime management);
- Placement of appropriate covenants for future conservation and management of offsets; and
- Development of appropriate monitoring and maintenance activities and performance review processes to ensure long term viability of the offsets.

The process of developing a suitable Biodiversity Offset Management Plan is an iterative process with State and Commonwealth regulatory bodies and it is anticipated offset requirements will be incorporated into regulatory approvals.

Respondent Comment

Department of Environment and Resource Management requested discussion of the 100,000m^3 of 'waste' material associated with the dredging for the MOF.

Santos Response

The 100,000 m^3 stated in the EIS is in relation to the estimated amount of dredge material to be removed from the sea floor to support the development and operation of the MOF. It is proposed that this material be managed within the LNG facility site, and is separate to the capital dredging works for the channel swing basin and berth pocket which will be disposed of at Laird Point in the event a DMPF at Fisherman's Landing is unavailable.

Respondent Comment

Department of Environment and Resource Management requested that potential impacts and mitigation measures associated with the dredging for the MOF, and subsequent land-based use of the dredged material should be discussed.

Santos Response

The impacts and mitigation measures associated with dredging of the MOF and subsequent land based use of the dredge material are addressed in **Attachment G** of the EIS Supplement.

8.4.5.3 Marine Ecology

Respondent Comment

Department of Environment Water Heritage and the Arts requested that the impacts to the extent of mangroves being removed, loss of intertidal habitat and discussion of potential timeframes needs to be better specified.

Santos Response

The loss of mangroves and intertidal areas due to removal is shown in EIS Table 8.4.8 (LNG facility) and discussed in EIS Section 8.4.5.3. The loss of intertidal and mangrove areas for the DMPF is estimated on EIS Section 8.4, page 8.4.52.

Potential impacts from the LNG facility and associated infrastructure (including the MOF, PLF and DMPF) to mangroves and inter-tidal habitats are further quantified in **Attachment F5** of the EIS Supplement including an estimate of area to be directly impacted (loss) and areas that may be potentially indirectly impacted.

Respondent Comment

Port Curtis Coral Coast Aboriginal Corporation state that there will be extensive dredging, significantly increased marine traffic and this will no doubt have a marked impact on the dugong nursery area, turtles, dolphins and other marine species in the Narrows area.

Submitter number 45 states there will be extensive dredging; significantly increased marine traffic and this will no doubt have a marked negative impact on the dugong nursery area, turtles, dolphins, seagrasses, mudflats, mangroves and other marine species in the Narrows area.

Santos Response

Potential impacts from the proposed construction and operation of the GLNG Project are not expected to significantly impact marine areas within the Narrows. Some elevated TSS may occur as a result of trenching the gas transmission pipeline however sediment plume modelling (**Attachment G5**) suggests that TSS levels will be in accordance with natural levels of TSS found in the highly turbid environment of Port Curtis. Previous monitoring studies of suspended sediment plumes undertaken for typical dredging operations show localised, but short-lived, increases in suspended sediment (WBM, 2004). Recorded turbidity plumes are limited in duration and extent from the disturbed site and the measured turbidity is moderate and within the limits set by licence conditions. Visible plumes can extend for some distance however the suspended sediment concentrations are generally only slightly elevated above background levels.

A Turtle and Dugong Management Plan has been developed as **Attachment F5** to the EIS Supplement. Potential impacts and mitigation measures for nesting turtles from lighting and gas flares has been

addressed in this plan with no anticipated impacts to nesting turtle populations. Mitigation measures to avoid interactions with marine fauna from capital and maintenance dredging operations are addressed in the Dredge Management Plan (**Attachment G9** of the EIS Supplement) and the Turtle and Dugong Management Plan (**Attachment F5**).

Respondent Comment

Department of Environment and Resource Management requested a detailed assessment to support the statement that "no significant impacts are expected" from clearing salt marsh or mangrove communities. Information should include the potential impact expected resulting from the increases that TSS will have on the surrounding seagrass meadows.

Santos Response

Loss to fisheries habitat will occur through direct impacts to mangroves and saltmarsh. The direct loss (i.e. through clearing for the LNG facility, PLF, MOF and haul roads) has been calculated to impact 0.61 ha of saltmarsh/saltpan and 0.12 ha of mangroves. This is equivalent to 0.004 % of the mapped saltmarsh/saltpan and 0.001 % of mangroves within the RE subregion. Potential indirect impacts to adjacent mangroves and saltmarsh/saltpan in close proximity to the proposed LNG facility, PLF, MOF and haul roads may occur. 18.44 ha of saltmarsh/saltpan and 28.09 ha of mangroves are found adjacent to the LNG facility and associated infrastructure footprint. In the event that all of these communities are indirectly impacted by construction and operation of the LNG facility, 0.121 % of the mapped saltmarsh/saltpan and 0.169 % of mangroves within the RE subregion may be impacted (EIS Appendix F5). The construction of the DMPF and the subsequent infilling with dredge spoil is calculated to result in the total loss of 2.79 ha of mangrove and 26.06 ha of saltpan communities. This represents 0.017 % of the mangroves and 0.171 % of the saltpan communities within the subregion. It is not expected that there will be any recovery in these areas directly impacted. 16.47 ha of mangrove and 7.10 ha of saltpan communities are calculated as potentially impacted by the construction and operation of the DMPF representing 0.099 % of the mangroves and 0.047 % of the saltpan communities within the subregion. Estimates of the extent of indirect potential impacts are not possible given possible accretion and re-colonisation of mangroves over time due to changes in surface water run-off, impacted soil adjacent to mangrove communities, smothering of pneumatophores and other possible indirect potential impacts (EIS Appendix G7).

According to the most recent monitoring studies conducted in 2007 by Chartrand *et. al*. (2009) significant meadows of *Halophila* and *Halodule* within Port Curtis are located in the subtidal areas north and south of Fisherman's Landing (meadow 9 & 7), adjacent to Wiggins Island (meadow 4) and on the southern side of Quoin Island (48 & 49). Light *Zostera capricorni* seagrass meadows are found north and south of Fisherman's Landing (meadow 8 & 9), with moderate meadows found at Pelican Banks (meadow 43) and Wiggins Island (meadow 5) (Chartrand *et al.*, 2009) (refer Figure 3.2 of **Attachment F5**, Turtle and Dugong Management Plan).

Ephemeral seagrass meadows were identified on the mainland side of Curtis Island during monitoring undertaken in 2002 (Figure 1) (Rasheed *et al.*, 2003), however ongoing monitoring of these meadows has not been undertaken by PCIMP possibly due to their ephemeral and highly patchy nature.

The potential key impacts on seagrasses from the GLNG Project are primarily from dredging and include physical removal or burial of vegetation, increased turbidity and increased sedimentation in adjacent seagrass meadows, temporarily reduced dissolved oxygen concentration, release of nutrients and pollutants from contaminated sediments and hydrographic changes (Erfemeijer and Lewis 2006).

The potential impacts of the proposed dredging programme on seagrass have been assessed through additional baseline investigations and hydrodynamic and sediment deposition modelling presented in **Attachments F5** and **G5** of the EIS Supplement. Predicted total suspended solids (TSS) concentrations and deposition rates during dredging have been calculated for six ephemeral seagrass meadows

identified by Rasheed *et al*. 2003 on the mainland side of Curtis Island, and for a location within the main seagrass meadow to the north of Fishermans Landing.

The predicted TSS concentration increases generated by dredging range from 0 – 3 mg/L for the majority of seagrass meadows on the eastern side of Port Curtis, while the increase was predicted to be 5mg/L within an area of seagrass surrounding South Passage island. Potential sedimentation rates during dredging were also estimated. The results showed that the potential sedimentation rates arising from dredging ranged from 0.0012 to 0.056 mm/day within seagrass communities on the mainland side of Curtis Island, with lower levels being predicted elsewhere. Baseline investigations of sedimentation rates in seagrass beds (presented in **Attachment G5**) showed that natural deposition rates range from 0.36 – 0.57 mm/day. The predicted percentage increases in deposition rate range from 0.3 % - 3 % for the majority of seagrass beds on the mainland side of Curtis Island, with the exception of the seagrass surrounding South Passage Island where 10% increases during dredging activity.

The impact assessment found that the impacts arising from increased TSS concentrations and sediment deposition during dredging are expected to be marginal, if any, on seagrass meadows in Port Curtis, with the exception of an area of seagrass surrounding South Passage Island where slight impacts are predicted.

The area of seagrass surrounding South Passage Island covers an area of approximately 34 ha which equates to approximately 0.8% of the seagrass area in Port Curtis. It is anticipated that the slight impacts on seagrass in this area may be recoverable once the dredging has finished. The seagrass meadows in this area have been classified as aggregated patches of *Halophila ovalis* with *Zostera capricorni* seagrass, and contain small biomass and areas compared with other seagrass meadows within the Port Curtis area. The seagrass communities and low biomass present mean that this area is considered to be unlikely to be utilised by dugongs. Further potential indirect impacts to seagrass meadows may occur as a consequence of the GPC Western Basin Dredging and Disposal Project (GHD, 2009).

Mitigation measures to minimise the potential for impacts on seagrass during dredging are described in **Attachment G9** of the EIS Supplement. In addition a specific Turtle and Dugong Management Plan has been prepared for the project which is provided as **Attachment F5** of the EIS Supplement.

Respondent Comment

Capricorn Conservation Council requested that the capital dredging works be timed to coincide with GPC's Western Basin Dredging / Reclamation Project or other LNG companies' dredging activities. This would spatially reduce the disturbance.

Santos Response

The GLNG Project includes a stand-alone proposal for the dredging and placement of dredge spoil material required for the project. A plan specific to the GLNG Project has been prepared to manage the project's dredge material if, for some reason, the Western Basin Dredging and Disposal Project (WBDD) proposed by Gladstone Ports Corporation (GPC) is delayed or does not proceed.

The GPC is proposing to undertake the WBDDP which seeks to accommodate the long term dredging and dredged material disposal that is required to provide safe and efficient access to the existing and proposed port facilities in the harbour. The WBDDP includes as Stage 1A the dredging required for the GLNG Project and the QCG LNG Project and disposal of the dredge material at the Western Basin Reclamation Area. The EIS for the WBDD Project was released for public comment by the CG on 15 November 2009. A discussion of potential environmental impacts from the WBDD Project is in the cumulative impact assessment in Appendix J and the GPC EIS.

If the GPC's WBDD Project is approved and proceeds within an appropriate timeframe, then Santos may decide not to proceed with the GLNG Project's dredging and material placement under its own approvals. Santos may rely on the GPC undertaking the dredging and dredge material disposal for the GLNG Project as part of GPC's Stage 1A approvals for the WBDD Project. In this case the GPC would undertake the

dredging required for the GLNG Project and QCG Project concurrently and dispose of the dredge material at the Western Basin Reclamation Area as part of the WBDD Project.

A discussion of potential environmental impacts from the WBDD Project is in the cumulative impact assessment in Appendix J and the GPC EIS.

Respondent Comment

Capricorn Conservation Council requested that the proponent must explain the impact that dredging and bridge construction will have on the mollusc Gyrineum jucunum, Urocampus carinirostris, and the green sawfish that occur in the harbour.

Santos Response

Gyrineum jucundum is one of a group of species that typically lives in sandy environments on the continental shelf. This species is apparently an Indo-Pacific species, with the Bishop Museum having several specimens from Japan. There are some shell dealers offering it for sale from various places. These species were not recorded during the sub-tidal or intertidal field surveys conducted in 2008. Clarification is being sought as to why they are listed as present on the Central Qld University Centre for Environmental Management newsletter (Issue 4 July/August 2007).

The pipefish *Urocampus carinirostris* is known to inhabit Zostera seagrass beds. The potential impacts of the proposed dredging programme on seagrass have been assessed through additional baseline investigations and hydrodynamic and sediment deposition modelling presented in **Attachments F5** and G5 of the EIS Supplement. Predicted total suspended solids (TSS) concentrations and deposition rates during dredging have been calculated for six ephemeral seagrass meadows identified by Rasheed *et al.* 2003 on the mainland side of Curtis Island, and for a location within the main seagrass meadow to the north of Fishermans Landing.

The predicted TSS concentration increases generated by dredging range from 0 – 3 mg/L for the majority of seagrass meadows on the eastern side of Port Curtis, while the increase was predicted to be 5mg/L within an area of seagrass surrounding South Passage island. Potential sedimentation rates during dredging were also estimated. The results showed that the potential sedimentation rates arising from dredging ranged from 0.0012 to 0.056 mm/day within seagrass communities on the mainland side of Curtis Island, with lower levels being predicted elsewhere. Baseline investigations of sedimentation rates in seagrass beds (presented in **Attachment G5**) showed that natural deposition rates range from 0.36 – 0.57 mm/day. The predicted percentage increases in deposition rate range from 0.3 % - 3 % for the majority of seagrass beds on the mainland side of Curtis Island, with the exception of the seagrass surrounding South Passage Island where 10% increases during dredging activity.

The impact assessment found that the impacts arising from increased TSS concentrations and sediment deposition during dredging are expected to be marginal, if any, on seagrass meadows in Port Curtis, with the exception.

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) states that it is understood that the LNG facilities might be justified on local, regional and state economics and employment. However, QPIF is concerned that the impacts on tidal fish habitat from the proposals are not suitably avoided, minimised or mitigated, and that these areas appear to be targeted for impact. QPIF would raise serious concerns with the lack of qualified justification for the impacts and suggested dismissal of those impacts based upon percentage of total areas in Port Curtis. The components of the proposal by their very nature must impact to some degree upon the tidal lands and fish habitats of Port Curtis.

QPIF recommends greater attention should be given to the minimisations of these impacts and further investigation of alternatives. Results of the alternative investigation should include a list of the impacts and comparison of those impacts.

Santos Response

Alternatives to the project and predicted impacts are presented in Table 2.3.4. of Section 2 of the EIS. The direct loss (i.e. through clearing for the LNG facility, PLF, MOF and haul roads) has been calculated to impact 0.61 ha of saltmarsh/saltpan and 0.12 ha of mangroves. This is equivalent to 0.004 % of the mapped saltmarsh/saltpan and 0.001 % of mangroves within the RE subregion. However, potential indirect impacts to adjacent mangroves and saltmarsh/saltpan in close proximity to the proposed LNG facility, PLF, MOF and haul roads may occur. 18.44 ha of saltmarsh/saltpan and 28.09 ha of mangroves are found adjacent to the LNG facility and associated infrastructure footprint. In the event that all of these communities are indirectly impacted by construction and operation of the LNG facility, 0.121 % of the mapped saltmarsh/saltpan and 0.169 % of mangroves within the RE subregion may be impacted. Although these mangrove and saltmarsh communities contribute to overall productivity of marine ecosystems, these intertidal areas will not necessarily act as fish habitat due to irregular inundation.

In accordance with the DPI&F Offset Policy and development approvals Santos is committed to managing development impacts and using offset measures to reduce and balance impacts of fish habitats where appropriate. In accordance with the DPI&F FHMOP 005 (2002) best practice methodologies will be used to remove mangroves directly impacted by the construction of the LNG facility and associated infrastructure and the DMPF.

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) considers that the EIS does not appropriately identify the habitats within or adjacent to the construction footprint to Friend Point and across the Narrows, the impacts of this construction technique upon those habitats or how these will be appropriately avoided or minimised. Impact comparison and greater information should be provided for the alternatives or a combination of the alternatives to justify the preferred option.

Santos Response

The intertidal and sub-tidal habitats adjacent to Friend Point and across the Narrows, potential impacts and mitigation measures are discussed in EIS Appendix R1 and G. Appendix G includes discussion on the World Heritage Values of the area. Project alternatives are discussed in EIS Section 2.

Santos preferred option for access to Curtis Island is by barge and ferry rather than a bridge and road. The preferred option would eliminate or reduce these impacts.

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) consider that the EIS has not appropriately identified the impacts of the facility or construction or shown that these impacts have been minimised or avoided. QPIF recommends an appropriate buffer should be provided between tidal fish habitats and facilities not requiring access to tidal lands.

Santos Response

The LNG facility and DMPF have been set back from the foreshore to allow for sufficient buffer of mangroves to the foreshore (Figure 1-1 of the Mainland Marine Facilities Report).

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) considers that the EIS does not appropriately identify the habitats within or adjacent to the materials offloading facility construction footprint, the direct and indirect impacts of this facility upon those habitats or how these will be appropriately avoided or minimised. Impact comparison and greater information should be provided for the alternatives including piled structures or movement of the facility back to terrestrial lands with no reclamation.

Santos Response

The intertidal and sub-tidal habitats within and adjacent to the construction footprint, potential impacts and mitigation measures are discussed in EIS Appendix R1 and G. Appendix G includes discussion on the World Heritage Values of the area. Project alternatives are discussed in EIS Section 2.

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) consider that the EIS does not appropriately identify the habitats within or adjacent to the haul road construction footprint, the impacts of this facility upon those habitats or how these will be appropriately avoided minimised. Impact comparison and greater information should be provided for the alternatives including location on non tidal lands. The ability to minimise impacts by sharing arrangements for these MOFs should be investigated and discussed.

Santos Response

The intertidal and sub-tidal habitats within and adjacent to the construction footprint, potential impacts and mitigation measures are discussed in EIS Appendix R1 and G. Appendix G includes discussion on the World Heritage Values of the area. Project alternatives are discussed in EIS Section 2. Santos is in discussion with the relevant government agencies to minimise potential impacts through appropriate Project design and sharing arrangements.

8.4.6.1 Terrestrial Ecology

Respondent Comment

WWF-Australia refers to the habitat destruction and degradation Section 8.4.6.1 which states that 'due to the migratory nature of whales, dolphins it is expected that they will not be impacted from increased turbidity or sedimentation generated from capital or maintenance dredging'. However, WWF-Australia would consider it an almost certain major impact based on the current scientific knowledge relating to the Snubfin and Indo-Pacific Dolphins. Both species exhibit preference for the inshore estuarine, mangrove and seagrass environment. Habitat destruction and degradation arising from coastal development such as sedimentation and physical disturbance to these habitats combined with the associated noise and chemical pollution could have a major impact on the species. One of the critical features of the Snubfin dolphin is that they exist in small and highly localised groups, making them particularly vulnerable to site-specific threats. For example, the loss of seven Snubfin dolphins from Ellis beach during the period from 1996-2001 seems to have eliminated this local population.

Santos Response

Refer Part 2, Section 8.4.3.8 of the EIS Supplement for detailed discussion.

These threats have been recognised within the GLNG EIS and are discussed in section 8.4.4.5 and 8.4.5.3. Additionally, a Draft Turtle and Dugong Management Plan has been developed in **Attachment**

F5 of the EIS Supplement. This Plan contains measures designed to protect turtles and dugongs from Santos activities. This plan will also apply to inshore dolphins.

8.5 Surface Water

8.5.4.6 Existing Water Quality

Respondent Comment

Department of Environment and Resource Management states that the proponent should refer to the determination of watercourses to DERM for the purposes of the Water Act 2000.

Santos Response

It is understood that the comment relates to the statement "Furthermore, no recognised watercourses are anticipated to be impacted by the project" which was included in section 8.5.4.6 of the EIS. Santos notes that watercourse surveys have yet to be undertaken by DERM to determine whether recognised watercourses as defined in the Water Act 2000 are present within the Santos area of interest on Curtis Island.

8.5.5 Potential Impacts and Mitigation Measures

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) states that appropriate stormwater management is fully supported by QPIF. Stormwater outlets should not discharge into tidal fish habitats. Outlet structures should be located on the landward side of terrestrial vegetation buffers for final buffering before sheet flows into tidal fish habitats.

Santos Response

Santos will incorporate these recommendations into the design and siting of stormwater outlet structures for the LNG facility.

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) states that QPIF supports alternatives to effluent disposal into tidal fish habitat waters. The irrigation area and supporting retention pond should be large enough and managed appropriately to ensure no discharge to adjacent areas. The irrigation area and retention pond should be buffered to provide a safe guard between the irrigation area and tidal fish habitats.

Santos Response

Additional investigations have been conducted in regards to the discharge of effluent into the marine environment from the LNG facility. For information refer to **Attachment F3** of the EIS Supplement. The proposed effluent disposal through land irrigation has proven to be not feasible, with all treated effluent now being discharged to Port Curtis via a single outfall point. Near-field and far-field modelling of this discharge has been undertaken which indicates minimal impacts on receiving water quality.

8.5.5.1 Construction Phase

Respondent Comment

Department of Environment and Resource Management states that a stormwater management plan is required to be in place prior to construction. The plan should be consistent with the detailed construction information that has been requested.

Santos Response

The site based Stormwater Management Plan (SWMP) will provide a set of best practice management procedures to control the severity and extent of soil erosion and contaminate transport during the construction phase of the LNG facility on Curtis Island. Development of the SWMP will follow guidelines set out in the DERM publication:

'Best Practice Urban Stormwater Management – Erosion and Sediment Control', Queensland EPA, 2008.

The guidelines specifically inform policies 2.4.1 'Water Quality' and 2.4.4 'Stormwater Management' of the State and Regional Coastal Management Plans (Coastal Management Plans) and the implementation of water sensitive urban design (WSUD) principles to address erosion and sediment control from both the construction phases and permanent phases of urban land development.

Respondent Comment

Department of Environment and Resource Management states that the Supplement EIS should detail the erosion and sediment control techniques that will be used to minimise sediment movement and potential erosion from construction of the LNG facility.

Santos Response

As detailed in the requirements for the SWMP, an erosion and sediment control plan (ESCP) will be developed for the construction phase of the LNG facility. The ESCP will utilise the guiding principles and relevant ESC techniques as described in *'Best Practice Urban Stormwater Management – Erosion and Sediment Control',* Queensland EPA, 2008.

Respondent Comment

Gladstone Regional Council states that (on page 8.5.7) sewage from the accommodation facility will be treated to a secondary standard at an on-site package sewage treatment plant. It then states that treated effluent will be loaded into tankers and barged to the mainland for disposal at an existing wastewater treatment plant.

It is not clear from a review of the traffic impact assessment that tankers have been quantified and vehicle trips have been incorporated in the traffic impact assessment.

Santos Response

It is now proposed that treated sewage from the accommodation facility and the LNG plant will be discharged into Port Curtis. Therefore, no tanker trips are proposed. For detail on this project, see **Attachment F3**.

Respondent Comment

Gladstone Regional Council states that the council does not support this method of disposal of treated effluent. Sewage should be treated on-site to Class A standard such that it can be reused as irrigation water, and non-potable water supply for construction.

Santos Response

Additional investigations have been conducted in regards to the discharge of effluent into the marine environment from the LNG facility. For information refer to **Attachment F3** of the EIS Supplement. The proposed effluent disposal will no longer be through land irrigation, with all treated effluent now being discharged to Port Curtis via a single outfall point. Near-field and far-field modelling of this discharge has been undertaken which indicates minimal impacts on receiving water quality.

8.5.5.2 Operational Phase

Respondent Comment

Department of Environment and Resource Management states that the Supplement EIS should provide much more detail on the irrigation system for disposal of plant effluent and the associated environmental impacts and mitigation of these impacts.

Santos Response

The wastewater flow chart proposed for the LNG facility has been revised since the preparation of the EIS. Plant effluent will now no longer be disposed via land irrigation and will now be discharged into Port Curtis. Near-field and far-field modelling of this discharge has been undertaken which indicates minimal impacts on receiving water quality.

The environmental impact and mitigation measures for the disposal of plant effluent are presented in **Attachment F3** of the EIS Supplement.

Respondent Comment

Department of Environment and Resource Management requested an assessment of the proposed stormwater quantity and quality, which will protect and enhance the environmental values, to be discharged.

Santos Response

A site–based Stormwater Management Plan (SWMP) will provide a set of best practice management procedures to control the severity and extent of contaminate transport in stormwater during the operational phase of the LNG facility on Curtis Island. Development of the SWMP will follow guidelines set out in the DERM publication:

'Best Practice Urban Stormwater Management – Erosion and Sediment Control', Queensland EPA, 2008.

The specific details of the stormwater management system are being refined as part of the FEED process.

8.6 Groundwater

No submissions were received for this section.

8.7 Coastal Environment

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) considers that the EIS does not suitably address alternatives to this proposal and this must be undertaken to accurately assess impacts. It is noted that tidal fish habitats are adjacent to the haul road.

Santos Response

Substantial assessment of the impacts of this project has been undertaken. In particular, tidal fish habitat matters are addressed in **Attachments F3, F5, G5** and **G7**. Please refer to the Draft Dugong and Turtle MP in **Attachment F5** of the EIS Supplement. Refer to EIS Section 2.3 for a description of the various alternatives associated with the construction and operation of the LNG facility.

Respondent Comment

Submitter numbers 45 and 46 requested that immediate involvement of the Commonwealth Government to ensure all relevant Commonwealth legislation is complied with, including, but not limited to, the EPBC Act.

Santos Response

The Commonwealth Minister for Environment, Water, Heritage and the Arts has declared each component of the project as a controlled action under the EPBC Act. The approval of the Commonwealth Minister is required under the EPBC Act for the GLNG Project. Santos has undertaken, and continues to undertake, consultation with the Commonwealth Government in relation to the regulatory requirements for the GLNG Project.

Respondent Comment

Submitter number 46 states a need to establish Queensland Government Legislative LNG Industry Environmental standards for the Gladstone LNG Precinct that satisfies Commonwealth Government legislative requirements.

Santos Response

Santos notes that the environmental management of the precinct as a whole is a matter for the State and the Commonwealth but recognise that this EIS (and the environmental assessments by others) will inform them of potential impacts and management of the impacts.

Respondent Comment

Submitters number 45 and 46 requested a total ban on fishing and crabbing activities to all Project Contractors, sub contractors and employees in the area from Hamilton Point to the start of the protected area, near Grahams Creek starting immediately.

Santos Response

Whilst being accommodated on site Santos contractors, sub-contractors and employees will not be permitted to fish or crab.

8.7.4 Potential Impacts and Mitigation Measures

Respondent Comment

Department of Environment and Resource Management requested:

- *Details on the type of treatment and disposal method for the RO waste stream from backwashing;*
- *The provision of information on the characteristics and quantities of any chemicals that will be added to the desalination treatment and may be discharged in the reverse osmosis concentrate. The potential impacts on receiving waters should be identified along with the proposed mitigation measures; and*
- *A detailed description and location of the intake line, including a description of the potential for entrainment or entrapment of marine organisms. The proposed mitigation measures to minimise these impacts should also be described.*

Santos Response

Santos has conducted an additional investigation regarding the wastewater and brine discharge associated with the desalination plant on Curtis Island. This assessment is provided in **Attachment F3**.

Respondent Comment

Department of Environment and Resource Management requested a detailed discussion describing the adoption of assumptions for the dredge plume modelling. A range of scenarios should be used to assess the potential impacts.

Santos Response

The dredge plume has been remodelled as part of the EIS Supplement. The assumptions adopted and scenarios used to assess impacts for the dredge plume modelling are discussed in Appendix A of **Attachment G5** to the EIS Supplement.

Respondent Comment

Department of Environment and Resource Management requested further information on the equilibrium state of the dredge plume. This information should be supported by the identification of likely time of other dredging projects for Port Curtis.

Santos Response

The dredge plume has been remodelled as part of the EIS Supplement. The results of this modelling are presented in **Attachment G5** of the EIS Supplement. The report provides a discussion of the equilibrium state of the dredge plume for TSS concentrations and sediment deposition on the basis of the proposed dredging scenarios.

Respondent Comment

Department of Environment and Resource Management requested a detailed discussion on how the modelling results will be used to develop measures to prevent and or minimise the impacts on environmental values.

Santos Response

A discussion on how the modelling results have been used to develop measures to prevent and or minimise the impacts on environmental values is presented in **Attachment G5** of the EIS Supplement. The results of the modelling have also been used to inform the development of a Draft Dredge Management Plan which is provided as **Attachment G9** of the EIS Supplement. Importantly, the modelling results were instrumental in deciding on the CSD as the preferred dredging option.

Respondent Comment

Department of Environment and Resource Management requested the details of the proposed discharge, including: the characterisation of the discharge; the background water quality; and the proposed mitigations measures to avoid and or minimise impact to environmental values.

Santos Response

This information is provided in **Attachment G4** of the EIS Supplement. The results of the modelling have also been used to inform the development of a Draft Dredge Management Plan which is provided as **Attachment G9** of the EIS Supplement.

Respondent Comment

Department of Environment and Resource Management states that although it is likely that the area can provide adequate settling capacity through the entire project, the EIS should provide objective information in this regard and detail contingency measures if additional storage is needed.

Santos Response

An assessment of the storage capacity for the dredge management placement facility is provided in **Attachment G4** of the EIS Supplement. The analysis found that there is sufficient capacity for the material generated during the capital dredging works.

8.7.4.1 Dredging Impacts

Respondent Comment

Department of Environment and Resource Management requested more definitive information on what types of impacts are expected on dugongs and turtles. Such information (and the modelling) should show the seagrass meadows that are to be impacted by the dredge plume, the duration of the impact and the potential behavioural change of the fauna (e.g. avoidance of the area, and changes in breeding patterns).

Santos Response

According to the most recent monitoring studies conducted in 2007 by Chartrand *et. al.* (2009) significant meadows of *Halophila* and *Halodule* within Port Curtis are located in the subtidal areas north and south of Fisherman's Landing (meadow 9 & 7), adjacent to Wiggins Island (meadow 4) and on the southern side of Quoin Island (48 & 49). Light *Zostera capricorni* seagrass meadows are found north and south of Fisherman's Landing (meadow 8 & 9), with moderate meadows found at Pelican Banks (meadow 43) and Wiggins Island (meadow 5) (Chartrand *et. al.*, 2009) (refer Figure 3.2 of **Attachment F5**, Turtle and Dugong Management Plan).

The potential impacts of the proposed dredging programme on seagrass have been assessed through additional baseline investigations and hydrodynamic and sediment deposition modelling presented in **Attachments F5** and **G5** of the EIS Supplement. Predicted total suspended solids (TSS) concentrations and deposition rates during dredging have been calculated for six ephemeral seagrass meadows identified by Rasheed *et al.* 2003 on the mainland side of Curtis Island, and for a location within the main seagrass meadow to the north of Fishermans Landing.

The predicted TSS concentration increases generated by dredging range from 0 – 3 mg/L for the majority of seagrass meadows on the eastern side of Port Curtis, while the increase was predicted to be 5mg/L within an area of seagrass surrounding South Passage island. Potential sedimentation rates during dredging were also estimated. The results showed that the potential sedimentation rates arising from dredging ranged from 0.0012 to 0.056 mm/day within seagrass communities on the mainland side of Curtis Island, with lower levels being predicted elsewhere. Baseline investigations of sedimentation rates in seagrass beds (presented in **Attachment G5**) showed that natural deposition rates range from 0.36 – 0.57 mm/day. The predicted percentage increases in deposition rate range from 0.3 % - 3 % for the majority of seagrass beds on the mainland side of Curtis Island, with the exception of the seagrass surrounding South Passage Island where 10 % increases during dredging activity.

The impact assessment found that the impacts arising from increased TSS concentrations and sediment deposition during dredging are expected to be marginal, if any, on seagrass meadows in Port Curtis, with the exception of an area of seagrass surrounding South Passage Island where slight impacts are predicted.

The area of seagrass surrounding South Passage Island covers an area of approximately 34 ha which equates to approximately 0.8% of the seagrass area in Port Curtis. It is anticipated that the slight impacts on seagrass in this area may be recoverable once the dredging has finished. The seagrass meadows in this area have been classified as aggregated patches of *Halophila ovalis* with *Zostera capricorni* seagrass, and contain small biomass and areas compared with other seagrass meadows within the Port Curtis area. The seagrass communities and low biomass present mean that this area is considered to be unlikely to be utilised by dugongs.

Mitigation measures to minimise the potential for impacts on seagrass during dredging are described in **Attachment G9** of the EIS Supplement. In addition a specific Turtle and Dugong Management Plan has been prepared for the project which is provided as **Attachment F5** of the EIS Supplement.

8.7.4.6 LNG Facility Discharge Impacts

Respondent Comment

Department of Environment and Resource Management requested the design details of the desalination plant, intake and discharge structures. The approach to the design should be described to show how potential impacts including those due to reverse osmosis concentrate discharge are to be avoided or minimised. Storage and handling of chemical should be addressed. Where impacts are identified, the EIS should detail the proposed mitigation measures to manage those impacts. Clarification should also be made to the approvals required for the plant and associated infrastructure.

Santos Response

This information is provided in Section 8 and **Attachment F3**.

Respondent Comment

Department of Environment and Resource Management requested information to demonstrate appropriateness of the CORMIX program to model the near-field mixing of the dense reverse osmosis

concentrate with bay water. This could include examples of where the model has been successfully used for other similar applications and statements about the reliability of the model in this application.

Santos Response

CORMIX is an industry standard accepted model for the modelling of near field impacts of discharges to estuarine waters. CORMIX has been used to model discharges from a variety of industrial sources including the Gladstone Pacific Nickel project, and the Coffs Harbour Ocean Outfall project. More detail is provided in **Attachment F3**.

Respondent Comment

Department of Environment and Resource Management requested further information on the reverse osmosis concentrate diffuser design including its proposed depth and jet/port angles and an assessment of the suitability of the design.

Santos Response

The detail of the diffuser design for the project is being developed as part of the FEED process and has not been finalised. Modelling was undertaken for a variety of potential diffuser designs. The optimum designs were found to be as follows:

- Wastewater discharge only –- a 5m long diffuser, with 0.05 m diameter orifices located 0.5m in from each end of the diffuser and every 1m along the diffuser (i.e. 5 parts in total), facing in alternate directions. This configuration will have an exit velocity from each outfall port of the order of 1.0 m/s, which will encourage maximum initial mixing; and
- Combined wastewater and brine discharge - a 12m long diffuser, with 0.05 m diameter orifices located 0.5m in from each end of the diffuser and every 1m along the diffuser (i.e. 12 parts in total), facing in alternate directions.

The diffuser design has not been finalised, but the diffuser attributes defined above, were shown through modelling to achieve the most efficient mixing of the discharge.

Respondent Comment

Queensland Health notes that the only discharge to the marine environment is brine waste from the Reverse Osmosis Plant at the LNG facility into Port Curtis. The brine will have a salinity of about double the local sea water. The brine will be diluted by a factor of 30 within 3 metres of discharge.

Santos Response

Since the completion of the EIS Santos proposes an additional discharge comprising treated effluent from an on-site sewage treatment plant. Santos has undertaken additional investigations to assess the potential impacts of the treated effluent and brine discharge, either as separate discharges or in combination. The combined discharge was predicted through modelling to have the least impact on Port Curtis water quality, which was assessed to be minor. Specifically in relation to the comments above, combining the waste and brine discharge would dilute the salinity of the discharge significantly. The assessment is provided in **Attachment F3**.

8.8 Air Quality

Respondent Comment

Submitter number 4 states that they are not satisfied with the plans Santos has to address the air quality of the proposed Plant and the associated impacts on their residence at Tide Island.

Santos Response

As part of the EIS Supplement further air modelling has been conducted to add in an additional receptor for Tide Island. Refer to **Attachment J** for details. These identify that cumulative NO_2 concentrations are predicted to be below Queensland air quality objectives.

Respondent Comment

Queensland Health is of a strong view that to prevent background creep, the cumulative effects from all industries in the Gladstone region need to be considered and strategies developed to maintain the 24-hour average and the annual average of PM10 concentration at levels which are as low as reasonably possible and below those recommended by the EPP (Air) 2008.

Santos Response

Impacts on ground-level concentrations of particulate matter due to the LNG facility are low with a maximum 24-hour average incremental contribution to the ground-level concentration of PM_{10} of 20 $\mu g/m^3$ predicted at any of the receptor locations assessed due to emissions from the facility. Refer to Section **Attachment J** for further information.

Respondent Comment

Department of Environment and Resource Management requested a reassessment of the potential impacts using the current versions of the Gladstone Airshed Modelling System, Calpuff and TAPM and include all future known industries proposed for the region.

Santos Response

GAMS is known as the Gladstone Airshed Modelling System (GAMS). DERM managed the creation and use of GAMS, with the version that is available to the public being released in 2004. GAMS was obtained from DERM for this project to ensure that the existing industrial sources were included in the dispersion modelling for NO_2 and SO_2, and so that the modelling approach used in this assessment was consistent with previous work in the Gladstone region. The versions of TAPM and Calpuff utilised are dictated by the version of GAMS used.

Respondent Comment

Department of Environment and Resource Management request concentrations and mass emission rates formaldehyde, benzene, toluene and xylene are specified for the release points (stacks and flare) with the methodology used for estimation identified.

Santos Response

VOC emissions and modelling results have been presented in the supplement air quality assessment. Refer to **Attachment J** for further information. It is noted that formaldehyde, benzene, toluene and xylene are included in the VOC suite of analyses.

The results of this assessment show that the VOC emissions from the LNG facility are extremely low, and their impacts to ambient air quality are small.

Respondent Comment

Department of Environment and Resource Management requested to use the latest Air Quality Objectives as specified in EPP Air and compare the modelled results against these objectives.

Santos Response

As presented in the GLNG EIS air quality assessment for the CSG fields (EIS Section 6.8), the gas transmission pipeline (EIS Section 7.8) and the LNG facility on Curtis Island (EIS Section 8.8) and EIS Appendix S air quality impacts have been assessed against the EPP(Air) 2008 ambient air objectives.

Respondent Comment

Department of Environment and Resource Management requested that the correct NOx emission standards of individual units proposed for the project are specified.

Santos Response

The correct emission standard suggested by DERM has been adopted. Refer to the cumulative impacts assessment in **Attachment J**.

Respondent Comment

Department of Environment and Resource Management requested clarification on which process (OCP and C3MR) was selected for the LNG facility and the final expected emissions at the site.

Santos Response

OCP design has been selected for the LNG facility (this is presented in the EIS). Emissions associated with this design are also presented in the EIS Chapter 8.8.

Respondent Comment

Department of Environment and Resource Management requested that concentration values of all major emission sources in terms of mg(N)/m^3 (dry) at the O_2 reference level are specified.

Santos Response

Concentration values for all major emission sources in terms of mg(N)/m3 (dry) at the O_2 reference level have been provided. Refer to the cumulative impacts assessment in **Attachment J**.

8.8.4 Existing Environmental Values

Respondent Comment

Department of Environment and Resource Management requested that the status of the proposed methane emission control technologies and the heat recovery units of the gas turbines be clarified.

Santos Response

The following provides a summary of the proposed methane emission control technology and heat recovery units of the gas turbines:

- Methane emission control technologies considered for the AGRU vent; and
- WHRU (waste heat recovery unit) from gas turbines.

Recovery of waste heat from two of the refrigeration gas turbines is included in the design for providing the primary source of heat to the circulating hot oil heat transfer fluid. Additional heat for start-up and control is provided from a fired heater. A separate waste heat recovery system recovers waste heat from power generation gas turbines for regeneration of the molecular sieve dryers.

8.9 Greenhouse Gas Emissions

Respondent Comment

Submitter number 14 states that the airshed is a concern as Santos and notes that they will produce approximately 900,000 tonnes of CO_2 per year during their initial stage of one train which equates to a total increase in Queensland's emissions of 3% (1 train for 1 company). There is a minimum of 10 trains being proposed for Gladstone by a couple of companies therefore increasing the total of CO_2 emissions for Queensland is 30%. Where does this leave air quality? This should be a cumulative effect, not an individual one.

Santos Response

Climate change is considered a global issue, with the GLNG Project to produce a low carbon intensity energy product to supply the growing Asia-Pacific economies. As set out in the EIS, the GLNG Project will contribute to an increase in Queensland and Australia's GHG emissions. However, this increase in emissions should be considered in a global context. This project compares favourably with the other LNG plants and will deliver an energy product that is greater than 40% more efficient than coal when being combusted for energy production in the country of use.

Santos has set objectives to ensure that the GLNG Project is a leader in sustainable energy development. Santos approach to sustainability includes four key focus areas: environment, community, our people and economic.

8.10 Noise and Vibration

Respondent Comment

Submitter number 4 states that after reading your EIS, we are not satisfied with the plans Santos have to address the Noise Pollution and Vibration that will impact on our residence at Tide Island.

Santos Response

As part of the EIS Supplement, additional noise modelling has been conducted to add in an additional receptor for Tide Island. Refer to **Attachment F4** for details.

Based on the current plant design and noise mitigation provided by Bechtel, the noise criteria would be achieved at all noise sensitive receivers, except Tide Island, during prevailing weather conditions. During neutral weather conditions there is a 6 dBA exceedance of the noise criteria at Tide Island.

Santos will consider additional noise mitigation measures following consultation with Tide Island residents. Options available include double glazing or air conditioning at noise sensitive places.

8.10.2 Marine Noise

Respondent Comment

WWF-Australia states that underwater noise associated with the construction, possible blasting and on-going operation of the proposed development is likely to affect the dolphin, dugong and flatback turtle nesting population and foraging individuals using the anticipated result as reduced nesting frequency. The Narrows and Calliope River have been identified as major foraging areas for Green Turtles, the noise and seabed disturbance associated with laying the gas transmission pipeline and developing the LNG facility is likely impact this behaviour. This stressor and its impact have not been adequately addressed in the documentation and studies.

Santos Response

An assessment of potential marine noise impacts on marine fauna (including dolphin, dugong and turtle) as a result of proposed development activities (including dredging, pipeline construction and LNG facility construction) has been undertaken as part of the GLNG EIS. Results of this assessment are summarised in EIS Section 8.10.2, with a full technical report provided in Appendix U2 of the EIS report.

The findings of the marine noise assessment included the following:

- Sound pressure levels produced underwater from construction and ongoing operations of the proposed Gladstone LNG Project are not predicted to have any long term detrimental effects upon marine fauna identified within the area. Short term avoidance of areas surrounding pile driving or dredge activities is expected;
- Short term avoidance of areas surrounding piling activities is expected inside a range of 350 m from the pile. It is recommended that soft start procedures for piling operation, or a noise-replicating recording to simulate soft start piling, be used when commencing work if whale sharks, humpback whales, turtles or dolphins are observed within a 350 m radius of the area around piling operations;
- The areas where short term avoidance would be expected during project construction activities do not contain any significant seagrass beds and the avoidance areas would only affect migration across a small part of Port Curtis. The overall impact of dredging operations for the GLNG Project caused by underwater noise is similar to that caused by a single ship traversing Port Curtis; and
- The use of sonar having a transducer operating frequency above 200 kHz is recommended to minimize interference with dolphin and dugong.

Part 2, Section 8.4.3.8 (dolphins) and **Attachment F5** of the EIS Supplement (turtles and dugong) discusses potential impacts and mitigation measures in detail.

8.11 Land Use and Infrastructure

Respondent Comment

Gladstone Regional Council states that it has concerns regarding the loss of recreational use and amenity of Laird Point. It is currently used by many residents and tourists for various recreational activities. This recreational area must remain open to public use. The Gladstone Harbour Protection and Enhancement Strategy and Curtis Coast Regional Coastal Management Plan highlights the need for maintaining public access to coastal areas. There needs to be consideration for public access for fishing, boating and other recreational activities.

Santos Response

The site forms part of the Curtis Island Industrial Precinct under the GSDA development scheme. The purpose is to provide for the establishment of LNG facilities and related infrastructure.

For the Curtis Island Industry Precinct, the proposed LNG facility is considered by the GSDA development scheme to be a use that is considered highly likely to meet the purpose of the precinct. Schedule 7 of the development scheme states that “high impact industry limited to natural gas (liquefaction and storage)” is a land use designation that is highly likely to meet the precinct’s purpose.

Laird Point remains a viable standalone option for disposal of dredge material arising from the GLNG Project, and the only viable alternative dredge material placement facility at this time, for the LNG industry.

On this basis, Santos seeks approval of the DMPF at Laird Point subject to the following two conditions:

- The CG being satisfied that the site is not required for another LNG Plant in the short to medium term; and
- The CG being satisfied that the dredge material placement facilities at Fisherman's Landing are not available to be utilised within the time required to commence construction of the GLNG.

GLNG recognises that an approval to dispose of dredge material at Laird Point would require a material change of use decision by the Coordinator General.

A significant portion of Curtis Island remains available for recreation use.

8.11.5 Potential Impacts and Mitigation Measures

Respondent Comment

Submitter number 1 states that it is proposed to locate the LNG plant on Curtis Island i.e. a non industrialised sub tropical island.

Santos Response

The site forms part of the Curtis Island Industrial Precinct under GSDA development scheme. The purpose is to provide for the establishment of LNG facilities and related infrastructure.

For the Curtis Island Industry Precinct, the proposed LNG facility is considered by the GSDA development scheme to be a use that is considered highly likely to meet the purpose of precinct. Schedule 7 of the development scheme states that “high impact industry limited to natural gas (liquefaction and storage)” is a land use designation that is highly likely to meet the precinct’s purpose.

Respondent Comment

Submitter number 1 states that Curtis Island contains a National Park. It is submitted that locating heavy industry next to or near to a National Park on a sub tropical island that is only 20 miles long, when there are alternative mainlands sites available, is an incompatible activity and should not occur.

Santos Response

The site forms part of the Curtis Island Industrial Precinct under GSDA development scheme. The purpose is to provide for the establishment of LNG facilities and related infrastructure.

For the Curtis Island Industry Precinct, the proposed LNG facility is considered by the GSDA development scheme to be a use that is considered highly likely to meet the purpose of precinct. Schedule 7 of the development scheme states that "high impact industry limited to natural gas (liquefaction and storage)" is a land use designation that is highly likely to meet the precinct's purpose.

A significant portion of Curtis Island remains available for recreation use. The site is not within a national park. The GSDA development scheme preserves a large area of Curtis Island outside of the development area as an environmental management area.

Respondent Comment

Submitter number 1 states that there are environmental "no go" zones on Curtis Island due to the fragility of the environment. It is submitted that locating heavy industry on a sub tropical island that is only 20 miles long, when there are other alternative sites available, should not occur.

Santos Response

The site forms part of the Curtis Island Industrial Precinct under GSDA development scheme. The purpose is to provide for the establishment of LNG facilities and related infrastructure.

For the Curtis Island Industry Precinct, the proposed LNG facility is considered by the GSDA development scheme to be a use that is considered highly likely to meet the purpose of precinct. Schedule 7 of the development scheme states that "high impact industry limited to natural gas (liquefaction and storage)" is a land use designation that is highly likely to meet the precinct's purpose. The GSDA development scheme preserves a large area of Curtis Island outside of the development area as an environmental management area.

Respondent Comment

Submitter number 1 states that the location of an LNG plant on a non industrialised sub tropical island will create a precedent that will then be used to justify future industrial development of Curtis Island and potentially on the other non-industrialised tropical or sub tropical islands. It is submitted that this precedent should not be permitted for all of the reasons outlined in this submission.

Santos Response

The site forms part of the Curtis Island Industrial Precinct under GSDA development scheme. The purpose is to provide for the establishment of LNG facilities and related infrastructure.

For the Curtis Island Industry Precinct, the proposed LNG facility is considered by the GSDA development scheme to be a use that is considered highly likely to meet the purpose of precinct. Schedule 7 of the development scheme states that "high impact industry limited to natural gas (liquefaction and storage)" is a land use designation that is highly likely to meet the precinct's purpose.

A significant portion of Curtis Island remains available as a National Park as well as for recreation use. The GSDA development scheme preserves a large area of Curtis Island outside of the development area as an environmental management area.

Respondent Comment

Submitter number 1 states that Gladstone residents, living in a sea side/harbour city, already have extremely limited waterfront access - the Gladstone Ports Corporation (i.e. Queensland Government) owns most of the waterfront land (over 30 km).

Santos Response

Santos does not propose restricting access to any mainland waterfront areas (outside the Port area) as part of its project.

Respondent Comment

Submitter number 1 states that The Gladstone Harbour has traditionally been a recreational resource for the population of Gladstone and the surrounding areas for sailing, outriggers, power boating, jet skiing, fishing, crabbing, prawning, etc.

Santos Response

Santos recognises the recreational values of the area and is committed to managing its project in a way that does not unreasonably impact upon these values. For example, Santos will not allow its workforce to fish or crab in the locally important areas adjacent to Curtis Island whilst they are accommodated on site.

Respondent Comment

Submitter number 1 states that the advent of LNG bulk carriers can only reduce the harbour amenity currently available to Gladstone residents.

Santos Response

For impacts to the local residents from this aspect of the Project please refer to the Social Impact Assessment Section of the EIS. The additional impact on shipping volumes from this Project is very minor.

Respondent Comment

Submitter number 1 states that it is foreseeable that harbour access will be progressively reduced as has happened historically, with consequent adverse impact on the residents of Gladstone and surrounding areas.

Santos Response

For impacts to the local residents from this aspect of the community please refer to the Social Impact Assessment Section of the EIS. Harbour access is a matter for Maritime Safety Queensland and the Gladstone Ports Corporation.

Respondent Comment

Submitter number 1 states that the LNG industry should be directed to an alternate location where it will not adversely impact on the amenity of the residents of Gladstone and surrounding areas.

Santos Response

The site forms part of the Curtis Island Industrial Precinct under GSDA development scheme. The purpose is to provide for the establishment of LNG facilities and related infrastructure.

For the Curtis Island Industry Precinct, the proposed LNG facility is considered by the GSDA development scheme to be a use that is considered highly likely to meet the purpose of precinct. Schedule 7 of the development scheme states that "high impact industry limited to natural gas (liquefaction and storage)" is a land use designation that is highly likely to meet the precinct's purpose.

8.11.5.7 Impacts on State Planning Policy

Respondent Comment

Queensland Department of Community Safety states that it is satisfied with the EIS approach to Landslide hazard areas. The range of procedures and management strategies employed to minimise the risk of landslide will achieve SPP 1/03 compliance, thus DCS requires no further information regarding landslide hazard mitigation.

Santos Response

Santos notes the comment and thanks the Department of Community Safety for its comment.

8.11.5.9 Impacts on Curtis Island Regional Coastal Management Plan

Respondent Comment

Submitter number 43 states that initially this project proposed a bridge crossing to facilitate the movement of equipment and workers. This appears now to be less accepted with all equipment and personnel being moved by ship. Again there appears to be little real understanding presented in relation to vessel movements; mooring requirements and parking requirements for workers located on the mainland. If the bridge is re-introduced as part of the infrastructure requirement, adopted construction must accommodate commercial and recreational vessel passage into the Narrows.

Santos Response

The EIS presented and assessed two options for access to the LNG facility from the mainland (EIS Section 3.11). The two options in the EIS were:

- Bridge and Road – the provision of road access to Curtis Island by way of an access road and bridge from the mainland crossing Port Curtis between Friend Point and Laird Point with construction access for the first train being by barge and ferry; and
- Barge and Ferry – access to the site on Curtis Island by barge and ferry for the life of the GLNG Project (for both construction and operation) on the assumption that the access road and bridge is not constructed.

The EIS described the establishment of a working group by the Queensland CG to develop engineering designs for the proposed bridge and road option. The working group, comprising the Department of

Infrastructure and Planning (DIP), Gladstone Port Corporation Limited (GPC), Santos and the BG Group/Queensland Gas Company (QGC) joint venture, engaged consultants to prepare concept designs of the potential road and bridge that could provide access from the mainland to Curtis Island.

The EIS stated that a decision on which option is to be adopted would be made during FEED when it would be expected that greater clarity will be available on the likelihood and timing of the access road and bridge option.

Since the EIS was submitted, Santos has participated in further concept design work within the working group and has undertaken further technical, commercial and environmental assessment of the proposed bridge and has considered the public submissions. This work concluded that:

- Construction of a bridge is not commercially viable and can not be justified in the context of the first three to four LNG projects on Curtis Island;
- It is highly unlikely that all proposed projects for Curtis Island will proceed;
- The environmental impacts of the barge and ferry option are less than the impacts of the bridge option; and
- Based on the community consultation undertaken by Santos and the public submissions on the EIS, the majority of the community do not support the bridge option.

On this basis, Santos preferred option for the GLNG Project is to access the site on Curtis Island by barge and ferry. Santos does not, at this time, support the construction of a bridge to Curtis Island as a preferred mode of transport for construction and operation of the GLNG Project.

8.12 Visual Amenity

Respondent Comment

Submitter number 4 states they are not satisfied with the plan Santos has to address the Visual Pollution that will impact on our residence at Tide Island.

Santos Response

The GLNG Project will utilise appropriate visual mitigation measures such as minimising tree clearance and retaining foreshore vegetation to act as a buffer to block views between Tide Island residents and the LNG facility. A commitment has been made to these mitigation measures in the LNG facility EMP (**Attachment B3**).

Respondent Comment

Gladstone Ports Corporation state that considerations need to be given within this section for the potential of Hamilton Point being developed into port related industries and what impact will have on the visibility of the proposed LNG facility. Hamilton Point has been identified with the GSDA Development Scheme and GPC 50 year Strategic Plan as being developed for bulk container or break bulk trade. Therefore, Hamilton Point will not be a long term solution for a visual buffer to the LNG facility and a long term visual pollution solution needs to be developed.

Santos Response

Should Hamilton Point be developed it will remove the natural visual buffer and replace it with a man made buffer (e.g. industrial structures). At this stage Hamilton Point is a visual buffer, and should it be developed (removed) for a future port facility then the developers would need to factor in mitigation at that time.

8.13 Cultural Heritage

Respondent Comment

Submitter number 45 states that a Cultural Heritage Management Plan (CHMP) has been executed; however the CHMP does not deal with the water and area below the low tide mark, which will clearly be impacted by this project. To date there is no agreement between the parties on how this important area will be utilised and managed.

Santos Response

Santos is committed to having a harmonious and productive relationship with the Traditional Owners.

In the event an Indigenous Land Use Agreement is not obtained within the timeframe permitted under the GLNG Project schedule, Santos will seek a separate Approved Cultural Heritage Management Plan over the area outside of the PCCC claim area but within the project area (being generally the water area).

8.13.1 Indigenous Cultural Heritage

Respondent Comment

Port Curtis Coral Coast Aboriginal Corporation and Submitter number 45 state that the project impact area is rich in Archaeological evidence of its use by our PCCC ancestors, and still provides a critical role in the maintenance of our traditional and cultural practices today. The changes in the way the land and is accessed, will impact on our ability to met our cultural obligations to future generations, due continuing reduction in areas where we can undertake our cultural responsibilities.

Santos Response

An approved CHMP is in place to manage any potential impacts of the GLNG Project on cultural heritage in the PCCC claim area. The plan was negotiated and agreed with PCCC applicant group and approved by the Cultural Heritage Unit of State Government.

Respondent Comment

Port Curtis Coral Coast Aboriginal Corporation (PCCCAC) and submitter number 45 state that they wish to place on the record their fervent opposition to the construction of any bridge to Curtis Island in the Laird Point/Kangaroo Island area, due to strong PCCC cultural reasons. PCCCAC state that the whole area is part of PCCCAC's cultural existence and it is requested that the proponent respect and observe PCCCAC's lore on this Project.

Santos Response

Santos will have ongoing engagement with the Port Curtis Coral Coast Aboriginal Corporation (PCCCAC) around Cultural heritage. This engagement is governed by the CHMP and directly involves the Port Curtis Coral Coast (PCCC) people in the management and protection of cultural heritage.

Santos recognises the importance of the issues raised by the PCCCAC in relation to the bridge.

The EIS presented and assessed two options for access to the LNG facility from the mainland (section 3.11 of the GLNG EIS). The two options in the GLNG EIS were:

- Bridge and Road – the provision of road access to Curtis Island by way of an access road and bridge from the mainland crossing Port Curtis between Friend Point and Laird Point with construction access for the first train being by barge and ferry; and
- Barge and Ferry – access to the site on Curtis Island by barge and ferry for the life of the GLNG Project (for both construction and operation) on the assumption that the access road and bridge is not constructed.

The EIS stated that a decision on which option is to be adopted would be made during FEED when it would be expected that greater clarity will be available on the likelihood and timing of the access road and bridge option.

Since the EIS was submitted, Santos has participated in further concept design work within the working group and has undertaken further technical, commercial and environmental assessment of the proposed bridge and has considered the public submissions. This work concludes that:

- Construction of a bridge is not commercially viable and can not be justified in the context of the first three to four LNG projects on Curtis Island;
- It is highly unlikely that all proposed projects for Curtis Island will proceed;
- The environmental impacts of the barge and ferry option are less than the impacts of the bridge option; and
- Based on the community consultation undertaken by Santos and the public submissions on the EIS, the majority of the community do not support the bridge option.

On this basis, Santos preferred option for the GLNG Project is to access the site on Curtis Island by barge and ferry. Santos does not, at this time, support the construction of a bridge to Curtis Island as a preferred mode of transport for construction and operation of the GLNG Project.

Respondent Comment

Port Curtis Coral Coast Aboriginal Corporation and submitter number 45 state there is an extraordinary amount of project work in the Gladstone Harbour/Curtis Island Precinct and seek assurances that the cumulative impacts of all projects are being monitored in a responsible manner.

Santos Response

Santos will have ongoing engagement with the PCCCAC around Cultural heritage. This engagement is governed by the CHMP and directly involves PCCC people in the management and protection of cultural heritage. Refer to the Cumulative Impacts in **Attachment J** of the EIS Supplement.

Respondent Comment

Port Curtis Coral Coast Aboriginal Corporation and submitter number 45 state that it would also have a debilitating effect on PCCC group members to enjoy and continue our Cultural obligations in the area.

Santos Response

A CHMP is in place which has the direct involvement of the PCCCAC in the management and protection of cultural heritage. Santos is committed to managing a productive and harmonious relationship with the Traditional Owner groups.

Respondent Comment

Submitter number 45 states that the PCCC people do not oppose the Project, as it will bring much needed employment opportunities and provide an economic stimulus for the general Gladstone community, including PCCC claim group members.

PCCC does however seek to be able to ensure that the Project impacts are appropriately managed, and that we as PCCC people be able to, in partnership with the Project Proponent seek to ameliorate the potential impacts, if possible, on PCCC Cultural Values and the environment.

Santos Response

Santos thanks PCCCAC for their statement and will take all reasonable steps to meet this request. A CHMP is in place which has the direct involvement of the PCCC group in the management and protection of cultural heritage.

8.14 Social and Community

Respondent Comment

Gladstone Regional Council states that:

Throughout the assessment of social impacts the EIS document poses inconsistencies and bases largely on what Council considers to be ill conceived ideas, particularly in respect of the development of a construction accommodation facility (CAF) on Curtis Island. The result of this concept within the EIS document is that effectively the EIS is saying that the proposal poses no social impacts to the Gladstone Region. Council believes the imported worker figures will be far higher, and these are then to be supposedly 'exclusively housed' in the CAF on Curtis Island. Council considers that there will be no economic benefits to local small business from the FIFO/DIDO workers from the island. It is considered that ultimately the stated CAF camp proposal is flawed, based on unrealistic assumptions, and is not acceptable. This document is yet to be released publicly and it is of particular concern that Santos are unwilling to release what is understood to be a comprehensive study (based in the methodology and construction undertaken as part of the study) until after all submissions regarding the EIS have been lodged. It is considered essential that Council receives a full version (not an abbreviated form) of this comprehensive study, to be aware of findings and recommendations that the Hornery Institute has made. The information used is outdated (2004) and is based purely on Gladstone city. This is interesting when the EIS states that the proponent will have to look further afield to provide services for their workforce. The issue of the cumulative effects of the project on the recreation and facilities have been totally ignored. Since the assessment of social impacts has been largely based on the premise of a large scale CAF, all impacts on social and community services is effectively considered to be nil, which is a preposterous presumption.

Santos Response

The assumptions in the SIA are based on experiences in the study area from past projects and a reasonable prediction of the availability of local skills for the GLNG Project. For most large scale industrial construction projects in the area over the past decade, the vast majority of workers were sourced locally, often between 80-90%. The GLNG Project reduced that portion to 35% based on types of skills required and other projects requiring similar skill sets. This was done to give a worst case scenario; however, by housing all workers in a CAF the potential impacts of non-residential workers was mitigated.

Further discussions and data collection since the EIS submission have resulted in Santos exploring an alternative strategy for workforce accommodation based on the following scenario:

- 65 % imported, 35 % locally sourced workforce (same as SIA);
- 80 % imported in CAF, 20 % imported in Gladstone and area; and

- 35 % locals are able to commute daily to the work site on Curtis Island.

Refer to **Attachment F6** for a further assessment of the social impacts associated with this revised accommodation strategy.

If the situation on the ground warranted it, a return to the 100 % CAF accommodation option for non-residential workers could be required to reduce the impact on the local housing market.

Respondent Comment

Gladstone Regional Council states that it expects that a supplement EIS will be required and in fact expects that complete sections such as social impacts and transportation will need to be rewritten as a result.

Santos Response

Social and traffic supplements assess new scenarios. 100 % CAF scenario presented in EIS SIA will remain as a scenario, and assessment of that scenario will not change. Additional scenarios have also been considered and assessed. See **Attachments F6** and **J** for the CAF and cumulative social impacts respectively. The CAF Supplement examines a revised accommodation strategy where local workers are able to commute daily. In addition, approximately 20 % of the imported workers are accommodated in the Gladstone area while approximately 80 % will be accommodated in the CAF on Curtis Island. This scenario identified some localised impacts however overall the wider impacts remain low.

Respondent Comment

Gladstone Ports Corporation states that it is acknowledged that there is a requirement within the Terms of Reference for any EIS to address the cumulative impacts of the proposed development. It is becoming apparent that as more industries move into the Gladstone region that a coordinated approach from a regulatory authority is necessary to ensure that an acceptable community outcome is achieved.

Santos Response

The GLNG EIS addressed the cumulative impacts that could be expected from the construction and operation of the GLNG Project. Since that time a number of the projects included in the cumulative impact assessment have advanced with further information becoming available and also a number of new projects have been announced. As a consequence of this a further cumulative impact assessment has been undertaken and is provided in **Attachment J**.

The objective of the cumulative impact assessment is to assess the potential for impacts from the GLNG Project to have compounding or synergistic interactions with similar impacts from other projects proposed or under development within the sphere of influence of the GLNG Project.

Respondent Comment

Queensland Police Service requested that the GLNG engages in crime prevention projects with QPS and other stakeholders.

Santos Response

See EIS Section 8.14.6.7 (Anti-social behaviour) and commitment to close liaison with stakeholders to manage anti-social behaviour. Santos will consult with QPS and other stakeholders on potential crime prevention projects throughout the study areas.

Respondent Comment

Submitter number 43 makes the statement "with a great deal of concern I note that the EIS document concludes that there will be virtually no impacts on Gladstone city and its surrounds on the basis that the document asserts that all impacts will be contained on Curtis Island at the proposed construction accommodation facility without proper foundation. It remains in my view completely unrealistic given the number of workers involved; assumptions made in relation to fly in/fly out; drive in/drive out; assumptions in relation to the number of families who will relocate to Gladstone for the duration of the construction period (and potentially for some, the operational phase); and assertions that workers will not want to access services on the mainland for recreational, health or social service purposes."

Santos Response

The SIA was based on a worker accommodation strategy where all construction workers were housed in the CAF on Curtis Island. Additional assessment of the impacts listed was not necessary because the workers were isolated from the population for the duration of their work rotation. This would result in all other potential social impacts (positive and negative) becoming low level impacts. There is no indication that this strategy is unrealistic given that it occurs in numerous instances throughout Australia where development exists away from population centres.

The social supplement will assess a new scenario (see response to issue 40.2).

For assessing the make up of normal construction workforces in Gladstone, the same model used in the SIA and explained in Appendix D of the SIA will be used in the supplement.

Respondent Comment

Submitter number 43 considers that there is a significant under estimation of impacts on services such as health; community services; housing; recreational facilities; education; transport; social infrastructure (built and support services).

Santos Response

The SIA was based on a worker accommodation strategy where all construction workers were housed on the CAF including locally sourced workers. Additional assessment of the impacts listed was limited because the workers were isolated from the population for the duration of their work rotation. This would result in all other potential social impacts (positive and negative) becoming low level impacts.

The social supplement will assess a new scenario.

Workers housed in the CAF are not anticipated to have a significant impact on local services and infrastructure. This is due to CAF location in isolation from the community and policies regarding access. Limited change from the EIS SIA is anticipated as a result as discussed in **Attachment F6**.

Respondent Comment

Submitter number 43 states that given the number of workers proposed, impacts on the local hospital will be significant and should be addressed in the document.

Santos Response

The SIA was based on a worker accommodation strategy where all construction workers were housed on the CAF. Additional assessment of the impacts listed was not necessary because the workers were isolated from the population for the duration of their work rotation. This would result in all other potential social impacts (positive and negative) becoming low level impacts.

Santos will provide on site medical services to address worker needs and will coordinate with local medical and emergency service providers in the area. Santos will also construct a helicopter pad to assist in the emergency extraction of workers should such a situation warrant. Additionally, the social supplement will assess a new scenario (see response to Section 8.14 above).

8.14.4 Accommodation Study

Respondent Comment

Submitter number 1 states that accommodating LNG construction workers on Curtis Island will minimise the financial benefits to Gladstone, and reduce house purchases/rentals, purchase of goods and services, money spent on entertainment, etc.

Santos Response

These issues have been assessed in the f EIS Social Impact Assessment (Appendix Z) and Economic Impact Assessment (Appendix FF) sections of the EIS for the LNG facility and Pipeline components. The likely impacts with regard to social and economic issues for the Gladstone community are addressed in detail and demonstrate that all potential impacts will be reduced as a result of CAF location on Curtis Island. Local procurement opportunities were identified in the SIA as well as in the Social Supplement (**Attachment F6**).

Respondent Comment

Submitter number 1 states that it is submitted that a construction workforce should not be accommodated on Curtis Island.

Santos Response

Santos notes the comment. The impacts of accommodating the construction work force on Curtis Island has been assessed in **Attachment F6** and the EIS SIA (Appendix Z). Santos assessed the CAF on Curtis Island in order to reduce potential impacts. This assessment was developed based on the following variables:

- CAF location isolated from the population on Curtis Island;
- Lack of direct land based transportation corridors onto Curtis Island;
- Lack of direct land based transportation access to South End and other Curtis Island populated areas (track later identified through community consultation);
- Lack of private and public docking facilities for marine traffic at the LNG facility site;
- Santos policies regarding transport restrictions for workers on their work rotation;
- Santos policies regarding worker access to the community;
- Santos policies with regard to local hiring and definitions of locals; and
- The potential housing supply issues that could occur in Gladstone from other projects proposed or approved for development in the area, and the direct and indirect impact on the local housing markets.

The option of not having the CAF on Curtis Island was also considered but not assessed because the daily commute would impact the project as follows:

- Increased potential for health and safety incidents due to fatigue;
- Reduction in the amount of productive hours;

- Delayed schedules; and
- Increased marine and land traffic.

8.15 Economics

No submissions were received for this section.

8.16 Rehabilitation and Decommissioning

Respondent Comment

Submitter number 20 states that there has been no mention of decommissioning and return of use of the site after the toxic LNG plant is redundant. Considering that this plant is expecting a relatively short life this issue should be addressed as there will be significant remedial work required to return this site to its natural state.

Santos Response

Refer to rehabilitation / decommissioning in EIS Section 8.16 and EMPs. Decommissioning and rehabilitation will be consistent with industrial zoning as a final land use and approved by GSDA.

Respondent Comment

Wildlife Preservation Society of Queensland - Policy and Campaigns Manager states that there is concern about the decommissioning of infrastructure and rehabilitation of mine sites after operations cease. While this has been addressed, Wildlife Queensland is of the opinion that the Queensland Government must have adequate financial arrangements in place with the proponents to ensure appropriate rehabilitation can occur if there is failure by the proponents to do so.

Santos Response

As outlined in EIS Section 6.16.3.2 Santos will lodge a "Financial Assurance" form with the Department of Environment and Resource Management (DERM) to ensure compliance with the relevant approvals and that rehabilitation has occurred to satisfactory levels.

8.17 Marine Dredging and Material Placement Facility

Respondent Comment

Department of Environment and Resource Management has requested that there be discussion and assessment of whether the proposed disposal of dredge spoil at Laird Point would impact on future use of the area by other LNG projects.

Santos Response

The GLNG EIS stated that:

- The Queensland Government and the GPC are presently reviewing the dredged material management plan for Port Curtis to plan for the long term dredging and dredged material disposal that may be required to provide safe and efficient access to existing and proposed port facilities in the harbour for the foreseeable future. The plan considers dredging and dredged material disposal

required for industrial and port related projects currently proposed for Gladstone. As part of the plan, the GPC is considering a single dredged material disposal area which will be large enough to accommodate the combined dredged material from all of these projects in a manner which is consistent with GPC's long term port development objectives;

- The GPC and the Queensland Government proposes to undertake an environmental assessment of the overall plan and to obtain the necessary approvals before adopting and implementing the plan. If the plan is approved, the dredging and the associated dredged material placement for the GLNG Project will be undertaken in accordance with the plan provided the timing of the approval is consistent with the GLNG Project requirements (the EIS for GPC's WBDD Project was placed on public exhibition on 15 November 2009); and
- If for some reason, the GPC's strategic dredging and disposal project is delayed or does not proceed, a plan specific to the GLNG Project has been prepared to manage the project's dredge material. The EIS (Section 2.3.9) identified a range of sites on and around Curtis Island for the potential location of a dredge material placement facility, with the emphasis being on land-based placement and the containment of fine material. Laird Point was put forward as the proposed site because of its smaller footprint due to wall heights (as compared to Boatshed point site); reduced visual amenity impact and greater distance from seagrass meadows (as compared to Boatshed point site). The Laird Point site was assessed in section 8.17 of the EIS. Results of further investigations relating to the proposed DMPF at Laird Point in response to EIS submissions are provided in **Attachment G** of the EIS Supplement.

On 18 August 2009 (since the EIS was prepared), the Queensland Government and Australia Pacific LNG announced Laird Point on Curtis Island as the site for Australia Pacific LNG's proposed LNG Plant. This site is the same area proposed for the dredge material placement facility at Laird Point for the GLNG Project.

The Gladstone Port Corporation's submission on the GLNG Project stated that the option for disposal of dredge material at Laird Point impacts significantly on the site nominated for the Australia Pacific LNG. In particular the submission stated that the greater percentage of the site is impacted by unconsolidated material that would require a significant period from placement to use for to use for industrial purposes.

Santos recognises the conflict in proposed land use of the site for the APLNG Plant and the proposed DMPF at Laird Point. If the site was used for the DMPF, it is unlikely that the site would be able to be used for the construction of an LNG Plant in the short to medium term. Whilst the site may be able to be used over the longer term for a facility with the implementation of suitable engineering works, it is not likely that this would meet the time frame requirements for the APLNG Plant.

Despite the announcement by the Queensland Government and APLNG, it is not a foregone conclusion that the site will ultimately be used for the construction of an LNG Plant as the development of the site, as for all proponents currently, will depend on a range of factors. For example, it is recognised that at some point in the future there may be consolidation of the LNG projects in the Gladstone area and that not all currently proposed LNG projects are likely to proceed. If this occurs, it is possible that the Laird Point site may not be required for the construction of an LNG Plant in the short to medium term.

Further, in the event that the GPC proposal to use Fisherman's Landing reclamation area for the disposal of the dredge material does not proceed or is delayed, Laird Point remains a viable standalone option for disposal of dredge material arising from the GLNG Project, and the only viable alternative dredge material placement facility at this time, for the LNG industry.

On this basis, Santos is seeking approval of the DMPF at Laird Point subject to the following two conditions:

- The CG being satisfied that the site is not required for another LNG Plant in the short to medium term; and
- The CG being satisfied that the dredge material placement facilities at Fisherman's Landing are not available to be utilised within the time required to commence construction of the GLNG Project.

Santos recognises that an approval to dispose of dredge material at Laird Point would require a material change of use decision by the Coordinator General.

Respondent Comment

Department of Environment Water Heritage and the Arts considers that only a desktop search was undertaken of the proposed dredge material placement facility.

The vegetation section doesn't describe field survey techniques, but says the results are from 'field survey results and interpretation of air photos'. EPBC listed vegetation does not appear to be specified - could only find reference to Regional Ecosystems.

The fauna section states that two on ground fauna surveys were done over 18 days but no methodology was described. Also EPBC listed species are not specified.

Santos Response

Field surveys of the dredge material placement facility were undertaken as part of the EIS (Section 18.17.6.1).

The approach for field methodology is described in EIS Section 8.17.6.1, with specific detail on methodology provided in EIS Appendix N3.

Flora Survey Approach

The flora survey employed an assessment of floral taxa and vegetation communities in keeping with the methodology employed by the Queensland Herbarium for the survey of Regional Ecosystems and vegetation communities (Neldner *et al.* 2005). Preliminary identification of the vegetation communities of the study area was conducted prior to the commencement of fieldwork via interpretation of 1:100,000 Regional Ecosystems coverage Version 5.0 for the region (EPA, 2008a).

Preliminary vegetation community definition was used to identify locations for representative field survey plots to ground truth communities and obtain floristic and structural data.

A number of standard botanical assessment methods were employed including secondary transects, quaternary sample plots, and random meander searches. Vehicle traverses of the study site were also undertaken throughout the survey period to identify changes in landform and community boundaries. Community structural formation classes were assessed according to Specht (1970). Regional ecosystem (RE) classification of communities was determined as per Sattler and Williams (1999) and in accordance with the Regional Ecosystems Description Database (REDD) (EPA, 2005). Further RE clarification of cryptic vegetation communities that were not floristically matched to the RE classification scheme was determined from consultation with a Queensland Herbarium Botanist. Final vegetation mapping was undertaken utilising field survey data and aerial photograph interpretation of stereo pair images at a scale of approximately 1:7,000 (Aerometrix, 2005).

Taxonomic nomenclature used for the description of floral species is according to Henderson (2002). Introduced species (as per Henderson, 2002) are signified in all text by an asterix (*). Any additional changes in Taxonomic nomenclature have been incorporated as described in Jessup (2002, 2003, 2005). Field references utilised for the identification and description of floral species include: Anderson (2003); Brooker and Kleinig (1994); Johns (2006); Milson (2000); and, Stanley and Ross (1986, 1989, 1995).

Nomenclature

Taxonomic nomenclature used for the description of floral species is according to Henderson (2002). Introduced species (as per Henderson, 2002) are signified in all text by an asterix (*). Any additional changes in Taxonomic nomenclature have been incorporated as described in Jessup (2002, 2003, 2005). Field references utilised for the identification and description of floral species include: Anderson (2003); Brooker and Kleinig (1994); Johns (2006); Milson (2000); and, Stanley and Ross (1986, 1989, 1995).

Specimen Identification

Where available, fruiting and/or flowering specimens were taken to assist with identification, where plant species were not identified in the field. For those species not field identified, samples were pressed and dried and positive identifications of plant specimens were subsequently made under laboratory conditions or forwarded to the Queensland Herbarium for identification. All identifications were made by qualified botanists with experience identifying flora taxa of central Queensland coastal ecosystems.

Secondary Plots

Field surveys employed five modified-secondary sample plots within the study site. Secondary plots were comprised of 10x50m (500 m^2) transects.

Descriptive site information recorded at secondary transects included; location, orientation, aspect, slope, soil type, landform, disturbance, fire history and general notes on ecological integrity. Several time-encoded digital photographs were taken at each plot as a visual reference. Locations of transects were recorded using a handheld GPS unit.

Floristic analysis included plant identification and species diversity characterisation of all flora present. Relative abundance was assigned for all species recorded.

Structural analysis included recording the height class and life form of the dominant species within each strata present. Height of each strata was recorded using a hand help laser hypsometer. Foliage projection cover (FPC) of the mid and upper strata was calculated along each transect, where foliage projection intersected the 50 m centre tape. FPC of the ground layer was determined using ocular estimation of cover within five 1 m subplots spaced at 10m intervals along the primary transect.

Quaternary Plots

Three quaternary plots were utilised to ground truth vegetation units and confirm dominant characteristic species.

Descriptive site information recorded at quaternary sites included; location, orientation, aspect, slope, soil type, landform, disturbance, fire history and general notes on ecological integrity. Several time encoded digital photographs were taken at each plot as a visual reference. Locations of transects were recorded using a handheld GPS unit.

Floristic analysis included determination of the dominant species within the mid and canopy strata. Structural analysis included recording the height class and life form of the dominant species within the mid and canopy strata. Height of each strata was recorded using a hand help laser hypsometer.

Meander Searches

Following assessment of each secondary plot and selected quaternary plots, an area of approximately 1 ha surrounding each plot was searched for 20 minutes utilising the random meander technique (Cropper, 1993). Care was taken to avoid sampling in different vegetation types to those of the plots. Meander searches were employed to:

- Identify additional less abundant species not recorded within survey plots;
- Identify any potential significant threatened or species not identified within the survey plot;
- Confirm the representativeness of plot locations; and
- Confirm boundaries and ecotonal areas between vegetation communities.

Methodology for the fauna survey referred to for the DMPF survey is also referenced to and outlined in Section 2.4 of EIS Appendix N3.

Survey Design

Preliminary identification of vegetation communities and habitat of potential significance within the LNG facility study area was conducted prior to the commencement of fieldwork via interpretation of 1:7000

colour aerial photography (Aerometrix, 2005); 1:100,000 Regional Ecosystems mapping Version 5.0 (EPA, 2008a); and 1:100,000 habitat Ecomaps (EPA, 2008b).

Fauna survey transect sites were selected to target and characterise key habitats within the LNG facility study area. Fauna surveys were undertaken in keeping with standard methods for the systematic survey of terrestrial fauna in eastern Australia (Eyre *et al*., 1997 and EPA, 1999) and a number of non standard observational methods. A detailed aquatic survey was not undertaken due to the prevalent site conditions including the ephemeral nature of the streams present. However an aquatic habitat assessment was conducted to characterise habitat values present.

Surveys were conducted in accordance with the conditions of the following:

- Queensland Department of Primary Industries (DPI) Scientific Purpose (registration number 046);
- DPI Animal Ethics Committee (AEC) (approval number CA 2006/06/124); and
- Queensland EPA Scientific Purposes Research Permit (number WISP02056304).

Fauna Nomenclature

Taxonomic nomenclature used for description of fauna species follows Stanger et al (1998), with the exception of recently published taxonomic revisions. Feral species are denoted by an asterix (*). Field references used for the identification and description of fauna species include Allen *et al.* (2002), Churchill (1998), Cogger (2000), Menkhorst and Knight (2001), Morecombe (2004), Robinson (1998), Simpson and Day (2004), Strahan (2008), Triggs (2004) and Wilson (2005).

Respondent Comment

Department of Environment Water Heritage and the Arts requests clarification regarding whether the 2 day targeted water mouse survey (EIS Section 8.17.6.2) was looking for individuals or their habitat.

Santos Response

The targeted survey focussed on identifying signs of the water mouse or potential water mouse habitat. In addition, an assessment of habitat quality was undertaken in an attempt to provide an indication of potential usage by water mouse.

Respondent Comment

Submitter number 14 states that they have grave concerns with regards to the wellbeing of Curtis Island. What is in this spoil, what is in the area when the spoil settles? What affect is all this dredging going to have on North Entrance and other areas of Gladstone Harbour, especially The Narrows which is heritage listed. I also have to mention the dugong population, Irrawaddy dolphin, turtles, crabs, fish etc.

Santos Response

Please refer to EIS Supplement **Attachments** including **G4** (Surface Water), **G5** (Port Curtis Water Quality), and **G9** (Draft Dredge Management Plan).

The various studies undertaken indicate that the extent of direct impact is minimal provided the mitigation measures as outlined are implemented.

Respondent Comment

Submitter number 19 states that it had (to the best of public knowledge) been planned that the Gladstone Harbour dredging would be done by the Gladstone Ports Corporation, and a change at this late stage is a denial of natural justice to those persons that may wish to make submissions on the Santos EIS.

Santos Response

The GLNG Project includes a stand-alone proposal for the dredging and placement of dredge spoil material required for the project. A plan specific to the GLNG Project has been prepared to manage the project's dredge material if, for some reason, the Western Basin Dredging and Disposal (WBDD) Project proposed by Gladstone Ports Corporation (GPC) is delayed or does not proceed.

The GPC is proposing to undertake the WBDD Project which seeks to accommodate the long term dredging and dredged material disposal that is required to provide safe and efficient access to the existing and proposed port facilities in the harbour. The WBDD Project includes as Stage 1A the dredging required for the GLNG Project and the QCG LNG Project and disposal of the dredge material at the Western Basin Reclamation Area. The EIS for the WBDD Project was released for public comment by the CG on 15 November 2009.

If the GPC's WBDD Project is approved and proceeds within an appropriate timeframe, then Santos may decide not to proceed with the GLNG Project's dredging and material placement under its own approvals. Santos may rely on the GPC undertaking the dredging and dredge material disposal for the GLNG Project as part of GPC's Stage 1A approvals for the WBDD Project. In this case the GPC would undertake the dredging required for the GLNG Project and QCG Project concurrently and dispose of the dredge material at the Western Basin Reclamation Area as part of the WBDDP.

Laird Point remains a viable standalone option for disposal of dredge material arising from the GLNG Project, and the only viable alternative dredge material placement facility at this time, for the LNG industry.

On this basis, Santos seeks approval of the DMPF at Laird Point subject to the following two conditions:

- The CG being satisfied that the site is not required for another LNG Plant in the short to medium term; and
- The CG being satisfied that the dredge material placement facilities at Fisherman's Landing are not available to be utilised within the time required to commence construction of the GLNG Project.

Santos recognises that an approval to dispose of dredge material at Laird Point would require a material change of use decision by the Coordinator General.

Respondent Comment

Submitter number 19 states that the spoil will destroy island habitat in the area in which it will be dumped, thus destroying local eco systems etc. The run off from the spoil dump during future tropical storm events will destroy additional habitat/ eco systems. The spoil may be toxic, and could leach into surrounding areas, water table, and potable water supplies life, thus resulting in dead wildlife and a reduction in local biodiversity, etc.

Santos Response

The dredge material placement facility (DMPF) proposed at Laird Point has been further refined in the EIS Supplement. Studies undertaken on the proposed dredge material from Port Curtis, and the proposed DMPF are presented in the EIS and the EIS Supplement (**Attachment G**) and provide assessments of the potential impacts of the proposed activities. The design of the DMPF, which is discussed specifically in **Attachment G4**, will contain surface run off and control discharges into the environment, as it will be held within a dam structure to remove fine sediment. Water quality testing will

be undertaken routinely, and discharges will need to meet standards to minimise the potential for environmental impacts. The groundwater within the footprint of the facility is of low quality, and of limited value. Impacts on the local ecology will be minimised wherever possible.

Respondent Comment

Submitter number 19 states that it will create a precedent for Curtis Island to become a spoil dump ground for future dredging programs, and be contrary to Government undertakings to look after the environment on Curtis Island and in Gladstone Harbour. Using an area close to a National Park as a spoil dump, particularly when that spoil may contain toxic chemicals etc, is inappropriate land use.

Santos Response

The EIS has investigated the waste elements for the dredging activities within the Curtis Island region as well previous studies have been undertaken to identify the most appropriate receiving area for spoil. This location falls within the State Development Area of Gladstone (Curtis Island Precinct) and is approved for industrial purposes in particular those associated with the exportation of LNG. The dredging works are a likely consequence of developing the land for the approved purpose. This EIS Supplement provides a more detailed assessment of the likely impacts of these works should the state government decide to approve this or similar projects within this region. Refer to **Attachment G4** which assesses the DMPF and **Attachment G9** which provides the Draft Dredge Management Plan.

Respondent Comment

Queensland Department of Infrastructure and Planning notes that the dredge material placement facility proposed in the EIS is at Laird Point and a separate project (Western Basing Dredging Project) is examining longer term disposal options from a whole port perspective. It is noted that the ultimate solution for the disposal of dredge spoil is likely to be part of a supplement EIS.

Santos Response

The GLNG Project includes a stand-alone proposal for the dredging and placement of dredge spoil material required for the project. A plan specific to the GLNG Project has been prepared to manage the project's dredge material if, for some reason, the Western Basin Dredging and Disposal Project (WBDDP) proposed by Gladstone Ports Corporation (GPC) is delayed or does not proceed.

The GPC is proposing to undertake the WBDDP which seeks to accommodate the long term dredging and dredged material disposal that is required to provide safe and efficient access to the existing and proposed port facilities in the harbour. The WBDDP includes as Stage 1A the dredging required for the GLNG Project and the QCG LNG Project and disposal of the dredge material at the Western Basin Reclamation Area. The WBDDP is a "significant project" under the State Development and Public Works Organisation Act 1971 (Qld) and a "controlled action" under the EPBC Act. The EIS for the WBDD Project was released for public comment by the CG on 15 November 2009.

If the GPC's WBDD Project is approved and proceeds within an appropriate timeframe, then Santos may decide not to proceed with the GLNG Project's dredging and material placement under its own approvals. Santos may rely on the GPC undertaking the dredging and dredge material disposal for the GLNG Project as part of GPC's Stage 1A approvals for the WBDD Project. In this case the GPC would undertake the dredging required for the GLNG Project and QCG Project concurrently and dispose of the dredge material at the Western Basin Reclamation Area as part of the WBDDP.

Laird Point remains a viable standalone option for disposal of dredge material arising from the GLNG Project, and the only viable alternative dredge material placement facility at this time, for the LNG industry.

On this basis, Santos seeks approval of the DMPF at Laird Point subject to the following two conditions:

- The CG being satisfied that the site is not required for another LNG Plant in the short to medium term; and
- The CG being satisfied that the dredge material placement facilities at Fisherman's Landing are not available to be utilised within the time required to commence construction of the GLNG Project.

Santos recognises that an approval to dispose of dredge material at Laird Point would require a material change of use decision by the Coordinator General.

Respondent Comment

Submitter number 17 states that the dredging of in excess of 8M cubic meters will have impacts within the Port Curtis harbour. We know very little about our mangroves, mud crabs, prawns, and fisheries despite their huge contribution to commercial and recreational fisheries in Port Curtis. We know even less about our dugongs and dolphins and other macro fauna they are not valued appropriately.

Santos Response

Potential impacts and mitigation measures for marine habitats and marine fauna from capital and maintenance dredging are discussed in detail in **Attachment F5** and in the Draft Dredge Management Plan (**Attachment G9**).

Respondent Comment

Submitter number 17 states that in addition to their concerns about the immediate effects of dredging they have major reservations about the ability to properly manage the acid sulphate soils (ASS) during the medium and long term storage of the huge amount of dredge spoil. In the absence of sufficient knowledge of the significant ecosystems of the Port Curtis Harbour and the lack of proven ability to properly manage ASS impacts of such a large scale dredging, this project should not proceed.

Santos Response

Acid sulphate soils have had significant study undertaken on their likelihood in the Project area and on possible mitigation measures if required. These studies are provided in **Attachments E5, F1** and **G2**.

Respondent Comment

Gladstone Ports Corporation states that a detailed review has not been undertaken of this section due to the commitment of Government to assess the dredging of the Western Basin under a separate EIS process currently being undertaken by the Gladstone Ports Corporation.

Santos Response

The GLNG Project includes a stand-alone proposal for the dredging and placement of dredge spoil material required for the project. A plan specific to the GLNG Project has been prepared to manage the project's dredge material if, for some reason, the Western Basin Dredging and Disposal Project (WBDD) proposed by Gladstone Ports Corporation (GPC) is delayed or does not proceed.

The GPC is proposing to undertake the WBDDP which seeks to accommodate the long term dredging and dredged material disposal that is required to provide safe and efficient access to the existing and proposed port facilities in the harbour. The WBDDP includes as Stage 1A the dredging required for the GLNG Project and the QCG LNG Project and disposal of the dredge material at the Western Basin

Reclamation Area. The EIS for the WBDD Project was released for public comment by the CG on 15 November 2009.

If the GPC's WBDD Project is approved and proceeds within an appropriate timeframe, then Santos may decide not to proceed with the GLNG Project's dredging and material placement under its own approvals. Santos may rely on the GPC undertaking the dredging and dredge material disposal for the GLNG Project as part of GPC's Stage 1A approvals for the WBDD Project. In this case the GPC would undertake the dredging required for the GLNG Project and QCG Project concurrently and dispose of the dredge material at the Western Basin Reclamation Area as part of the WBDDP.

Laird Point remains a viable standalone option for disposal of dredge material arising from the GLNG Project, and the only viable alternative dredge material placement facility at this time, for the LNG industry.

On this basis, Santos seeks approval of the DMPF at Laird Point subject to the following two conditions:

- The CG being satisfied that the site is not required for another LNG Plant in the short to medium term; and
- The CG being satisfied that the dredge material placement facilities at Fisherman's Landing are not available to be utilised within the time required to commence construction of the GLNG Project.

Santos recognises that an approval to dispose of dredge material at Laird Point would require a material change of use decision by the Coordinator General.

Respondent Comment

WWF-Australia state that 8 million cubic metres of sediment planned to be dredged to allow for a materials offloading facility (equivalent to the entire annual sediment flow onto the Great Barrier Reef) - it is WWF-Australia's view that the EIS fails to adequately assess the risk from dredging and sedimentation on the marine benthic community and coastal and near shore habitats, including appropriate modelling.

Santos Response

All dredged material will be placed in a Dredge Management Facility, not discharged into the Great Barrier Reef.

Since the preparation of the EIS, the estimated dredging area and volume of dredge spoil to be removed have been refined. The revised dredging programme comprises two components as follows:

- Deepening of the approach channel in Port Curtis to -13.5m LAT.

  The approach channel will be dredged to a depth of -13.5 m LAT over a length of 1500m and a channel width of 200m giving a dredge footprint of 300,000 m^2. The existing bed levels vary between -6.6m LAT and -12.1m LAT. Therefore up to 6.9 m of material must be removed to achieve the required depth. This equates to a volume of approximately 1.1 million m^3 of sand. (HR Wallingford 2009 attachment G9 of the EIS Supplement);

- Creation of a new berthing and manoeuvring area at the proposed LNG facility providing depths of -13.5m LAT.

  The new berth and manoeuvring area will also be dredged to -13.5 m LAT. The dredge footprint is approximately 620,000 m^2. Approximately 5.7 million m^3 of sand and rock will be removed to lower the existing beds levels (between +0.7 m LAT and -10.2 m LAT) to the required depth. (HR Wallingford 2009 **Attachment G9** of the EIS Supplement).

A total volume of approximately 6.8 million m^3 of material will be dredged of which the majority (84%) will be from the berthing and manoeuvring area.

Additional investigations have been undertaken as part of the EIS Supplement to provide additional information on the potential impacts of capital dredging works proposed for the GLNG Project on water quality and sensitive habitats within Port Curtis. The results of the investigations are presented in **Attachments G5** and **F5** of the EIS Supplement.

Modelling predictions also indicate that dredging has the potential to have marginal, if any, impacts on subtidal communities. However it should be noted that the modelling results are based on dredging within the swing basin. Whilst the vast majority of dredging activity (5.7 Mm^3) will occur in this location, dredging will also be required for the approach channel (1.1 Mm^3) which will require operation of the CSD in closer proximity to the intertidal communities for a period of approximately 8 weeks. During this period sub-tidal communities surrounding Hamilton Point may experience elevated TSS concentrations and minor to moderate impacts are considered possible. The potential for any adverse impacts to arise will be minimised by limiting periods of continuous dredging activity within the approach channel.

Further discussion on potential impacts to turtles and dugong are discussed in detail in **Attachment F5**. Measures to reduce the potential impacts of the dredging activity are presented in the Draft Dredge Management Plan (**Attachment G9**).

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) considers that the EIS does not appropriately identify the direct and indirect impacts of this dredging and this must be undertaken to accurately assess impacts.

Santos Response

Additional investigations have been undertaken as part of the EIS Supplement to provide additional information on the potential impacts of capital dredging works proposed for the GLNG Project on water quality and sensitive habitats within Port Curtis. The results of the investigations are presented in **Attachments G5** and **F5** of the EIS Supplement.

Hydrodynamic and deposition modelling has been undertaken for the capital dredging works and the potential impacts on nearby sensitive receptors in the form of seagrass and sub-tidal communities.

The impact assessment found that dredging activity using a CSD has the potential to have a slight impact on an area of seagrass surrounding South Passage Island, with impacts on other seagrass areas in Port Curtis being marginal if any. It is anticipated that the slight impacts on seagrass that may arise during dredging may be recoverable once the dredging has finished. The seagrass meadows in the affected area have been classified as aggregated patches of *Halophila ovalis* with *Zostera capricorni* seagrass, contain small biomass and represent only 0.8 % of the total seagrass area within Port Curtis. The seagrass communities and low biomass present mean that this area is considered unlikely to be utilised by dugongs.

Modelling predictions also indicate that dredging has the potential to have marginal, if any, impacts on subtidal communities. However it should be noted that the modelling results are based on dredging within the swing basin. Whilst the vast majority of dredging activity (5.7 Mm^3) will occur in this location, dredging will also be required for the approach channel (1.1 Mm^3) which will require operation of the CSD in closer proximity to the intertidal communities for a period of approximately 8 weeks. During this period sub-tidal communities surrounding Hamilton Point may experience elevated TSS concentrations and minor to moderate impacts are considered possible. The potential for any adverse impacts to arise will be minimised by limiting periods of continuous dredging activity within the approach channel.

Further discussion on potential impacts to turtles and dugong are discussed in detail in **Attachment F5**. Measures to reduce the potential impacts of the dredging activity are presented in the Draft Dredge Management Plan (**Attachment G9**).

The potential impacts on the marine environment arising from the GPC's WBDDP are set out in the GPC EIS which was placed on public exhibition on 15 November 2009 and are discussed in Appendix J.

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation considers that with 100,000 cubic metres of spoil, the EIS does not appropriately identify the direct and indirect impacts of this dredging and this must be undertaken to accurately assess impacts.

Santos Response

From July to October 2009 Santos carried out a number of environmental assessments to investigate the potential impacts of the proposed project related dredging, refer to **Attachment G** for results of these assessments. Included in these assessments is the Santos proposed Draft Dredge Management Plan (**Attachment G9**) which provides management and mitigation to control and minimise potential impacts on the environment.

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation considers that the EIS does not suitably address alternatives or the direct and indirect impact of the spoil disposal or causeway into the Narrows and this must be undertaken to accurately assess impacts. Please note QPIF does not accept that deep water dumping is a last alternative or that introduction of saline soil and water to terrestrial lands should be avoided.

Santos Response

From July to October 2009 Santos has undertaken a number of environmental assessments to investigate the potential impacts of the DMPF, (refer to **Attachment G** for results of these assessments). Included in these assessments is Santos proposed Dredge Management Plan (DMP) in **Attachment G9**. These attachments include assessment of potential impacts on fauna and flora, water quality and marine ecology from construction and operations proposed. Where impacts are predicted to be more than minor, management and mitigation measures are proposed to minimise potential impacts.

8.17.3.3 Dredge Material Pipeline

Respondent Comment

Gladstone Ports Corporation states that the route nominated for the material pipeline along the foreshore would not be acceptable to the adjoining land owner (QGC) in the event of simultaneous construction activities.

Santos Response

Santos recognises the need to work with the proponents of other developments to coordinate construction activities appropriately including the dredge material placement processes.

8.17.6.2 Terrestrial Fauna

Respondent Comment

Department of Environment Water Heritage and the Arts requested clarification on whether the targeted survey was for the Water Mouse or for Water Mouse habitat? The methodology used to determine the presence of Water Mouse populations is not clear.

Santos Response

Methodology utilised to undertake targeted water mouse (*Xeromys myoides*) surveys was to target habitat and search for the presence of the species. The methodology is referenced to and detailed in Section of 4.2.2 of EIS Appendix DD and included the following:

Survey Effort and Site Selection

The field program involved a site investigation conducted over two days and two nights in order to assess the extent and quality of wildlife habitat and to determine the presence, or likely presence, of the target at-risk species known from, or predicted to occur, within the local area. This was undertaken in accordance with DERM's Queensland Parks and Wildlife Service's Scientific Purposes Permit No. WISP02791605 and Queensland Department of Primary Industries and Fisheries' (DPIF) Animal Ethics Committee Certification No. CA 2005/10/81.

The general survey approach was to visit and sample representative faunal habitats over the study area, recording the target fauna species by observations of actual animals, recognition of characteristic vocalisations, and/or identification of animal signs. Where no animal observations/signs were recorded, habitat was assessed for suitability of the target species occurrence. This involved the following specific techniques:

Survey Techniques

Diurnal Habitat Searches and Assessment

Active diurnal searches for traces of water mouse activity (nesting mounds and feeding areas) were undertaken in suitable habitat (mangroves with adjacent salt marsh). In addition, wading birds were recorded in the area throughout the study period. Searches of suitable habitat were conducted for traces of powerful owl activity (owl pellets) and suitable tree hollows for roosting.

Incidental (Opportunistic) Records

During the survey period, fauna observations were continuous and species records were obtained outside of the systematic methodology of the survey. All of the incidental vertebrate fauna species observed during the field survey are listed in Appendix 1.

Respondent Comment

Department of Environment Water Heritage and the Arts asked if there will be a targeted survey for Yakka Skink?

Santos Response

While this species is known to utilise open woodland habitat of the region, there are no records for this species on Curtis Island. In addition the woodland habitat of the LNG facility site has limited habitat potential for this species due to extensive grazing impacts and weed intrusion in the ground cover (Section 3.4.9 of EIS Appendix N3; and Section 2.2.3 of EIS Appendix N3). Fauna pre-clearing surveys as per mitigation recommendations in Section 4.2.1 of EIS Appendix N3 will be implemented in the Fauna

Management Plan of the LNG facility EMP (Section 13.16.3) to identify and relocate any individuals of this reptile species that may be present.