34. CONCLUSIONS AND RECOMMENDATIONS

This chapter summarises the main findings of the Environmental Impact Statement (EIS), principally the key impacts of the project on the environment and the principal actions Arrow Energy will take to address them. The setting of the project is described in the context of the current and future development of the Gladstone region. Arrow Energy's work program to further define the project and its impacts on the environment is also described.

34.1 The EIS Process

Arrow Energy has prepared this EIS, as required under the *State Development and Public Works Organisation Act 1971* (SDPWO Act). The EIS addresses the final terms of reference prepared by the Coordinator-General of the State of Queensland (Attachment 2, Terms of Reference) and incorporates Arrow Energy's philosophy and commitment to health and safety, the environment, and community.

The EIS has identified and assessed the environmental, social and economic impacts of the Arrow LNG Plant (the project) and has proposed measures to avoid, mitigate and manage any significant adverse impacts. The impact assessment chapters (chapters 10 to 32) have addressed the range of issues and impacts associated with the Arrow LNG Plant. The findings reported in the chapters are based on extensive consultation with regulatory authorities, potentially affected communities and stakeholders in the Gladstone region, and technical specialist studies (appendices 1 to 30).

The project will be located in the Gladstone region, where a number of significant projects are currently planned or under construction. Three other LNG plants have been approved on Curtis Island, in the Gladstone State Development Area, alongside the Arrow LNG Plant site. This context has been taken into account in the impact assessments completed for this EIS, and in particular in the assessment of cumulative impacts, such as those on the transport network, harbour traffic, housing and accommodation, and visual amenity.

Arrow Energy has sought opportunities for cooperation with the other LNG proponents including the sharing of information and infrastructure in an effort to better understand the potential impacts of the project, and to minimise potential impacts of multiple but similar facilities being built in the Gladstone area. Discussions are ongoing on various options to cooperate with other LNG proponents.

A key part of the EIS process has been to identify those impacts that can be avoided through site selection, and the design and construction planning of the project and its various components.

Where avoidance is not possible, management and mitigation measures aim to reduce the magnitude of impacts. Offsets will be provided to address residual impacts where required. The impact assessment chapters document these measures, which have also been compiled in Attachment 6, Environmental Management Plan and Attachment 7, Social Impact Management Plan. Arrow Energy has committed to implementing these measures.

Other measures may be identified as the design and planning for the project progresses. Such measures may present a more effective alternative to those currently proposed (e.g. when further baseline or monitoring information becomes available) or the effectiveness of measures currently being implemented by other projects is reviewed. This cycle of continuous improvement is a key

part of Arrow's Integrated Health, Safety and Environmental Management System and will be applied to the project.

34.2 Key Findings of the EIS

The key findings of the EIS are summarised below, including the notable environmental, social and economic benefits, and other impacts of the Arrow LNG Plant.

34.2.1 Environmental Impacts

The key findings of the environmental impact assessments of the project are as follows:

- **Land resources**. Large-scale topographic alteration of the LNG plant site on Curtis Island will result in an impact of moderate significance. Successful implementation of erosion control plans and rehabilitation plans will reduce the magnitude of this impact although the landform changes will remain throughout the project phases. Acid sulfate soils (ASS) are present in some project areas, although disturbance of these soils is not expected to present significant adverse impacts provided they are effectively managed and treated through implementation of the project's ASS management plan. Some contamination from past activities is present at the LNG plant site on Curtis Island and on the mainland at launch site 1 and at TWAF 7. Further assessment of these sites will be carried out prior to construction and contaminated soils will be managed or remediated to meet current Queensland guidelines.

- **Water resources**. Groundwater and freshwater surface water resources are limited in the project area and of relatively low extractive value (e.g., for agriculture or industry). With the application of the proposed mitigation measures, particularly during construction, impacts to water resources are not significant.

- **Coastal processes and marine water quality**. Tides, water velocities and deposition rates will be changed through the dredging of approximately 1 million m^3 of material in Port Curtis, with the majority of dredging planned for the Calliope River (approximately 900,000 m^3). The dredging will widen and deepen the river bed, lower the bar at the river mouth and reduce low tide levels up the river. Rates of sediment deposition will increase in the Calliope River. Plumes of suspended sediment generated during dredging will affect local water quality. Impacts will be greatest in the Calliope River, where ongoing maintenance dredging will be required. Overall, impacts are expected to be short term and are not predicted to be significant. A dredge management plan will be developed including actions to be taken should impacts exceed the predicted environmental criteria established for the project.

- **Terrestrial and freshwater ecology**. Approximately 250 ha of vegetation will be cleared from the project area on Curtis Island and other project sites leading to habitat loss and fragmentation, with a reduction in connectivity between habitats. Risks of pest introduction and spread will also increase in these areas. Impacts on Curtis Island are significant (high residual impact for some community types). The construction camp will be located to avoid approximately half of a small area of semi-evergreen vine thicket community at Boatshed Point that contains a potentially new species of the tuckeroo (*Cupaniopsis* sp. Indet). A wildlife corridor of 20 m will also be established on the eastern side of Boatshed Point to maintain connectivity between this community and the adjacent Environmental Management Precinct. Where impacts are unavoidable, offsets will be provided. Offsets will include the two areas of endangered *Eucalyptus tereticornis* (forest red gum) woodland to open forest on alluvial plains community, within the LNG plant site, and the *Cupaniopsis* sp.indet population and associated semi-evergreen vine thicket on Boatshed Point.

- **Marine habitat**. The construction of the mainland marine facilities and tunnel launch site, LNG jetty, materials offloading facility and integrated personnel jetty on Curtis Island will directly remove or bury marine habitats. This includes an estimated 58 ha of saltmarsh at the mainland tunnel launch site, and approximately 5 ha of benthic habitat or mudflats, and 6 ha of mangroves at Curtis Island. Residual impacts are high for 'saltpan vegetation including grassland, herbland and sedgeland on marine clay plains' at the mainland tunnel launch shaft, as they are part of a state-listed coastal wetland and are feeding habitat for migratory shorebirds protected under international agreements. A marine offsets strategy will be established to compensate for the loss of marine and estuarine habitat as a result of the project and will reduce the significance of impacts to negligible in most cases.

- **Marine wildlife**. Increased noise and lighting from the project in Port Curtis are likely to disturb marine fauna or modify their behaviour. An increase in shipping traffic is likely to cause an increase in boat strike, which has the potential to injure or kill marine fauna. The likelihood of a boat strike resulting in dugong, turtle or cetacean mortality is high with impacts of moderate significance. Project vessels will comply with all applicable vessel speed limits set within Port Curtis and the project will consider fitting propeller guards (or equivalent) to high speed vessels. A shipping activity management plan will be developed in consultation with all port users to ensure consistency of measures to reduce the significance of impacts on marine wildlife. Soft-start procedures and fauna spotters will be used during pile-driving. Most impacts are minor, although impacts on marine turtles will remain of moderate significance.

  Lighting will be designed to minimise impacts on marine wildlife and where practical, routine planned maintenance flaring at night will be avoided during sensitive turtle reproductive periods. Impacts of site lighting will be negligible in most cases, although for marine turtle, these remain at minor significance.

- **Greenhouse gas**. The predicted greenhouse gas CO_2-e emissions for the project are estimated to be equivalent to 4.25% of Queensland emissions, 2.08% of Australian energy sector emissions, and 0.028% of global emissions from fossil fuel consumption, for the worst-case Arrow LNG Plant operational year when compared to 2007 emissions. As such, greenhouse gas emissions from the project are negligible on a global scale.

- **Noise and vibration, water and air quality**. The project is expected to meet relevant noise and vibration, and air quality emission limits. Stormwater and wastewater discharges to Port Curtis are expected to meet relevant water quality criteria. As such, impacts will not be significant to the nearest residences, other sensitive receptors near the LNG plant, and the marine environment. In the case of noise, appropriate acoustic mitigation to reduce noise will be an important feature of the LNG plant design.

- **Landscape and visual impacts**. Extensive clearance of vegetation and installation of project infrastructure on Curtis Island, particularly at the LNG plant site, will alter the landscape and views of this area. The headland of Boatshed Point will be protected from clearing and earthworks to preserve the landform and areas of vegetation that help screen lower parts of the LNG plant and the construction camp. The site is also backed by the prominent feature of Ship Hill, which assists by providing a backdrop to the LNG plant and ancillary facilities. Several of the viewpoints assessed will experience moderate impacts after mitigation and overall, the perception of Curtis Island as a natural landscape will diminish. Development of the Arrow LNG Plant site will occur after construction has commenced at the other three LNG plant sites on the island and as such, it will be constructed within an already modified landscape and is expected to assimilate to some extent with the built features of the industrial

precinct. Lighting impacts will be moderate from some viewpoints although other LNG facilities constructed on Curtis Island will provide a lit context against which Arrow LNG Plant lighting will appear less noticeable.

- **Indigenous and non-Indigenous cultural heritage**. Features of local significance have been identified within and close to the project area. The potential exists for further cultural heritage material to be uncovered. Appropriate agreements and procedures will be put in place to manage both existing cultural heritage material and to respond appropriately should new artefacts be discovered during construction. Records of all new discoveries will be made. With the implementation of proposed mitigation measures, the significance of residual impacts is low.
- **Road transport**. Increased road traffic associated with the project, along with the cumulative impacts of other projects, will affect existing road users and road infrastructure. Options for mainland launch sites concentrate traffic north of Gladstone, avoiding central business district and residential areas. Some connecting roads may become congested (at certain periods of peak traffic) and two to three intersections will be significantly affected. Arrow Energy will develop a traffic management plan in consultation with the Department of Transport and Main Roads, Gladstone Regional Council and other LNG proponents to minimise cumulative impacts to the road network that may include contributions to intersection upgrades. A detailed logistics strategy has yet to be developed for moving plant and materials to and from Curtis Island. Further assessment of potential impacts will be required including of the impacts of heavy vehicle and shipping movements required to transport LNG plant components, equipment and other materials to the LNG plant site on Curtis Island. During front end engineering and design (FEED), the project will complete logistics studies enabling these impacts to be identified and assessed in the supplementary report to the EIS.
- **Shipping**. Vessels required to support construction and operation of the project may increase congestion in the harbour, impacting vessel movements, including commercial shipping, commercial fishing and recreational boat users, and create a perceived safety risk with changed harbour conditions. A shipping activity management plan will be developed and implemented in consultation with Gladstone Regional Council, Gladstone Ports Corporation, Marine Safety Queensland, Regional Harbour Master (Gladstone), and all contractors operating within the Gladstone port. The plan will include measures to mitigate potential impacts associated with marine construction traffic and LNG shipping operations. Implementation of the shipping activity and emergency response plans, and compliance with the Port of Gladstone port procedures manual along with Royal Dutch Shell plc's experience in LNG shipping, will ensure residual risks associated with vessels entering and departing the Port of Gladstone are very low.
- **Waste management**. The volumes of waste generated by the project will be minimised in accordance with the principles of the waste hierarchy - avoidance, reuse, recycling, and treatment and disposal. Waste management facilities within the Gladstone region are currently sufficient to handle the waste generated by the project and consequently, with implementation of the proposed mitigation measures, residual environmental risks associated with the management of project waste are low.

34.2.2 Socio-economic Impacts

The project will stimulate economic activity at a regional, state and national level, both directly (via construction activities and the production and export of LNG) and indirectly (e.g., through increased household consumption and increased government fees and taxation revenues). A

peak workforce of 3,715 is expected during stage 1 construction with the majority of workers to be sourced from outside Gladstone and accommodated in a construction camp on Curtis Island. A further 2,330 jobs during stage 2 of construction and up to 600 long-term jobs during the project's operational phase will be created.

The workforce requirements are likely to lead to both positive and adverse socio-economic impacts as follows:

- The project is likely to generate adverse impacts on housing and accommodation, and may adversely affect some businesses in the Gladstone region. Competition for, and draw of labour to the Arrow LNG Plant and its supply chain will exacerbate regional skills shortages and may increase labour costs for local businesses. Demand may also increase on local and regional infrastructure and services.

  Increases in housing costs (due to demand generated by other projects) could be sustained during the project, with housing less available and affordable for local residents. Reduced availability of temporary accommodation (hotels, motels and apartments) may also occur. Arrow Energy will develop a housing strategy to minimise impacts from the project on Gladstone housing and accommodation in cooperation with state and local government bodies. The strategy will include options for the provision of company facilitated housing.

- Arrow Energy has committed to actions to manage any adverse impacts on socio-economic values in the Gladstone region as a result of the project (see Attachment 7, Social Impact Management Plan).

- The project is expected to provide the following major benefits at the regional, state and national levels:

  – Diversifying the regional, state and national economies and advancing Queensland and Australia as a global energy producer through substantial and sustained investment in the Gladstone and Queensland economies over the next 35 years or more.

  – Contributing to the growth in Gladstone’s economy through increased employment opportunities (directly through job creation at the LNG plant, and indirectly through the provision of goods and services), stimulating other industry development, and supporting the viability of some local small businesses.

  – Improving the balance of trade through the export of a high value product.

34.2.3 Matters of National Environmental Significance

The matters of national environmental significance (MNES) likely to be affected by the project have been assessed and mitigation measures proposed to address impacts to MNES (see Attachment 4, Matters of National Environmental Significance). MNES likely to occur within the project area include:

- Great Barrier Reef World Heritage Area. Activities within the World Heritage area, such as dredging and vegetation clearance, are unlikely to have a significant effect on the health and functioning of the ecosystem, or cause any values to be lost, degraded or damaged. Various attributes of the Great Barrier Reef World Heritage Area within Port Curtis will be modified as a result of the project, but with successful mitigation impacts are not significant. LNG carriers will, by necessity, travel through these areas and will comply with applicable maritime law and will traverse the marine park via designated navigation routes with pilotage as required within port boundaries.

- Threatened ecological communities. The critically endangered community "Littoral rainforest and coastal vine thickets of eastern Australia" occurs on Hamilton Point. This area is not within the footprint of the project and will not be impacted.
- Listed threatened species. No terrestrial flora or fauna species listed as critically endangered, endangered or vulnerable under the *Environment Protection and Biodiversity Conservation Act 1993* (Cwlth) were identified through field surveys within the study area for the project. However, based on habitat preference and distribution, some threatened species may occur within the project area (11 fauna and 4 flora species).
- Terrestrial fauna species are likely to be impacted primarily through vegetation clearance and loss of habitat and marine species through dredging and clearing of seabed habitat for the construction of marine facilities. Some effects from construction activities are unavoidable; however, the actual extent of habitat loss is low in both percentage and absolute terms. Lighting impacts from construction and operation of the LNG facility may disorientate some turtle species nesting near Southend. Mitigation measures are proposed to manage lighting, and the timing of flaring at the LNG plant, which will reduce the significance of these impacts.
- Listed migratory species. Eleven species of migratory shorebird were recorded within Port Curtis. There were no areas of core habitat identified for migratory species within the project area, or areas likely to be disturbed or degraded as a result of the project. Marine migratory species (dolphins, dugongs and cetaceans) may be disturbed during dredging for, and construction of, marine infrastructure, although no core areas of habitat are likely to be affected.

The project is unlikely to have a significant impact on MNES, as implementation of the proposed mitigation measures will reduce the significance of impacts for each matter.

34.3 Safety

The project will pursue the goal of no harm to people by ensuring that risks are within tolerable levels and as low as reasonably practicable. Project specific health, safety, security and environment (HSSE) plans will be developed by Arrow Energy and the FEED contractor to supplement information provided in the Shell HSSE & SP Control Framework and the Arrow Health Safety and Environment Management System (HSEMS), and will detail HSE principles and minimum standards to be applied during all phases of the project lifecycle as described below.

Phase 1 Pre-FEED. The Concept Design HSE Case and preliminary Quantitative Risk Assessment (QRA) for the LNG plant were prepared during this phase. The EIS impact assessments are based on the work completed during this phase of project development.

Phase 2 FEED. This phase involves updating the risk registers and documentation (such as the QRA) prepared in the concept design phase, as the LNG plant design and site layout is further refined. Emergency response plans, including for medical emergency response will be developed in this phase.

Phase 3 Construction and commissioning. This phase involves managing non-routine tasks, hazardous activities by performing appropriate risk assessments, developing detailed method statements, and executing them under the permit to work system relevant to the activities.

Phase 4 Operations and maintenance. This phase includes implementation of the Arrow HSEMS, HSEMS performance reviews, and HSEMS technical reviews. Non-routine operations and maintenance activities will be executed under the operations phase permit to work system.

Phase 5 Decommissioning. The final phase includes the preparation of detailed HSEMS plans for decommissioning, including hazard identification exercises and health hazard risk reviews.

The proponents of the four LNG projects on Curtis Island (Gladstone LNG, Queensland Curtis LNG, Australia Pacific LNG and Arrow LNG Plant) are in discussion with Maritime Safety Queensland, the Regional Harbour Master (Gladstone), Gladstone Ports Corporation and Gladstone Regional Council regarding the development of a joint LNG maritime safety management plan. This plan will set out a range of requirements such as operational procedures, incident reporting, and crew requirements.

34.4 Ongoing and Future Work

This section describes the work Arrow Energy is planning to better understand potential impacts and to respond to changes to the project that emerge during the design process. Any major changes to the project will be assessed as part of the supplementary report to the EIS.

This EIS has assessed the environmental, social and economic impacts of the Arrow LNG Plant. As the design of the project progresses through FEED and into the detailed design phase, changes may occur to the way the project will be constructed and operated. At the time of writing this EIS, some elements of the project design were not finalised. For example, the selection of both a mainland launch site and Curtis Island materials offloading facility (MOF) has not been finalised. The choice of these sites will in turn influence the logistics strategy for the project, with the potential for changes to transport and marine impacts.

Additional studies and assessments currently planned or underway include:

- Geotechnical investigations that will further characterise sediment and soils to be disturbed by dredging of the Calliope River channel and in construction and operation of launch site 1.
- Further traffic modelling and assessment, including heavy vehicle movements (that also reflects the detailed logistics strategy) and the choice of mainland launch site and Curtis Island MOF and integrated personnel jetty.

The EIS has also indicated where further baseline information and assessments may be required as the design of the project progresses. Studies will include for example, detailed mapping of acid sulfate soils at project sites, ecological surveys to better understand potential impacts on Calliope River riparian communities, and ongoing baseline monitoring of groundwater at the LNG plant site. Nonetheless, the EIS presents a comprehensive assessment of the project impacts, in accordance with the Coordinator-General's terms of reference. Where relevant, the results of these further studies will be incorporated into the supplementary report to the EIS.

34.5 Conclusion

The assessments carried out for the Arrow LNG Plant, as detailed in this EIS, show that impacts of the proposed development are manageable with implementation of the mitigation measures set out in Attachment 6, Environmental Management Plan, and Attachment 7, Social Impact Management Plan.

The site selection and design activities for the project have resulted in a number of potential environmental impacts being avoided or substantially reduced. Cumulative impacts of

development in the Gladstone region are unlikely to be exacerbated due to the timing of the project. The project involves significant investment in Queensland, with benefits realised in the region, state and nationally. On this basis, the project should proceed.