1. CONCLUSIONS

This chapter summarises the main findings of the Supplementary Report to the Arrow LNG Plant Environmental Impact Statement (SREIS). The report has been prepared to respond to the Coordinator-General's request to provide additional information and to address issues raised in submissions on the Arrow LNG Plant EIS (EIS) and to reflect refinements to the project description, including those that have arisen out of front-end engineering design (FEED). Consequently the impacts, as presented in the EIS, have also been reviewed.

1.1 The SREIS Process

Details of submissions and consultation, project changes and additional technical studies completed to inform the SREIS are summarised below.

1.1.1 Submissions and Consultation on the EIS

The EIS was placed on public exhibition by the Queensland Coordinator-General from 14 April 2012 to 28 May 2012. Twenty-nine submissions relating to the EIS were received by the Coordinator-General from government agencies and the public during this time. Arrow Energy continued to consult with stakeholders, and held community-wide consultation sessions, during the public exhibition period.

Arrow Energy has considered the issues raised in submissions and has provided a detailed response to 367 separate issues in Part B of the SREIS. In some cases, the information requested from the submitter was available in the EIS and the detailed technical studies in its appendices, and a reference to that information has been given. In other instances, further explanation has been provided on specific points where clarification was requested. Additional information and technical studies have also assisted to address some issues. These studies, contained in Part A of this SREIS, were referenced in the response.

As requested by the Coordinator-General, Arrow Energy has considered each submission and has provided a response to all issues raised in submissions made on the EIS.

1.1.2 Project Changes

Following the finalisation and exhibition of the EIS, Arrow Energy completed FEED for the Arrow LNG Plant. FEED and other investigations led to changes to the project description, as presented in the EIS. Subsequent to FEED, other refinements in the design of the project have been made. The main project changes include:

- Minor changes to the layout of the LNG plant on Curtis Island including the location of ancillary infrastructure (most notably the power generation facilities and refrigerant storage tanks).
- The addition of a propane import pipeline from the Boatshed Point materials offloading facility (MOF) along the haul road to the propane storage tank.
- Realignment of the LNG loading lines from the southern side of the GLNG haul road to the northern side of the haul road.
- Changes to the LNG plant power options. The all electrical option has been discontinued. The all mechanical drive option is unchanged and is being retained in the event the preferred mechanical/electrical option is not taken forward. Under this option, two high voltage electricity cables from the mainland to Curtis Island will be laid in ducts installed by horizontal directional

drilling (HDD) under Port Curtis from the mainland at RG Tanna Coal Terminal to Hamilton Point on Curtis Island. This option provides power during the latter stages of construction and replaces two gas turbines during operation.

- Changes to the flaring strategy. Flaring will be triggered by unscheduled plant upsets and during scheduled shutdowns.
- Changes to the layout of the Boatshed Point MOF to accommodate larger module transport vessels and subsequent re-siting and redesign of the personnel jetty terminal and MOF, with an associated reclamation and increase in dredge volumes.
- The addition of a swing basin in the access channel immediately west of the Boatshed Point MOF and widening of the access channel to the MOF from the Targinie Channel, with associated dredging.
- Changes to the layout of the marine facilities at launch site 1 (mainland launch site) and an increase in land based construction and operation areas.
- Additional options for disposal of dredge material including the approved East Banks Disposal Site (offshore), the Western Basin Reclamation Area and the Wiggins Island Coal Terminal approved disposal sites.
- Identification of potential mainland and Curtis Island pioneer facilities and additional mainland staging areas.
- A change to the preferred water supply option to a mains supply from the mainland to Curtis Island via a pipeline installed by Gladstone Area Water Board.
- A change to the preferred effluent and wastewater disposal option to Gladstone Regional Council's sewer mains from the mainland to Curtis Island.
- Addition of a third, preferred option for the diversion of the ephemeral watercourse on Curtis Island, to be diverted to the west of the LNG plant to a watercourse draining to North China Bay.
- Revised alignment of the feed gas pipeline tunnel from the mainland to Curtis Island, and the location of the reception shaft on Curtis Island.
- Revised layout of the mainland tunnel launch site and access arrangements, and tunnel drainage design.
- Updates to the logistics strategy including for shipping, ferry movements, and heavy vehicle transport.
- Updates to estimates of equipment, plant and materials to be transported to Curtis Island.

These project changes were reviewed by relevant technical specialists to determine whether the impacts as assessed in the EIS remain valid.

1.1.3 Additional Studies

Arrow Energy commissioned further technical studies to address aspects of the changes made to the project description and to provide additional information to inform the review of impacts as assessed in the EIS. In some cases, the studies responded to specific issues raised in submissions.

Further technical studies carried out are as follows:

- Remodelling of air quality and greenhouse gas impacts, and plume rise, to take account of changes to estimated emissions from, and layout of, the LNG plant.
- Remodelling of noise impacts to take account of changes to projected noise levels from the LNG plant and the revised layout.
- Additional marine water quality sampling and ecological field surveys to take account of changes to project dredging, marine infrastructure design, and logistics requirements.
- Additional hydrodynamic modelling to take account of changes to project dredging and the layout and design of marine infrastructure.
- Assessment of potential impacts of project lighting on marine turtles using Curtis Island and Facing Island nesting beaches.
- Review of available information and observations of marine megafauna (dugongs, dolphins and turtles) in Port Curtis.
- Additional terrestrial ecology studies including surveys for shorebirds, conservation-listed species, fauna habitat and targeted surveys for *Environmental Protection Biodiversity and Conservation Act* (1999)(Cwlth) and other listed species.
- A review of potential social impacts as a result of changes to the peak construction workforce, dredging activities, and air emissions.
- Remodelling of project traffic and transport impacts using updated logistics information.
- Review of the hazards and risks associated with changes to the layout and design of the LNG plant and feed gas pipeline.

These technical studies are included in the appendices to the SREIS and the main outcomes are presented in Part A of the SREIS.

Arrow Energy is undertaking an extensive geotechnical investigation in the project area. A sediment sampling program is incorporated with the investigation, which commenced in June 2012. Preliminary results of available sediment sampling data, which included analysis for contaminants, potential acid sulfate soils (PASS) and particle size, have provided further information on the characteristics of marine sediments at project dredge sites.

1.2 Key Findings of the SREIS

Many of the environmental aspects assessed in the EIS did not require review or reassessment as the project changes did not materially alter the conclusions of the EIS. These include climate change, geology and soils, land contamination, surface water and groundwater, freshwater ecology, landscape and visual impact, Indigenous and non-Indigenous cultural heritage, economics, land use and planning, and waste management. The impacts and management measures for these aspects remain as presented in the EIS.

The technical studies validated the assessments presented in the EIS with the findings used to review and update management measures and commitments. This section summarises the findings of the technical studies and additional management measures proposed to address project impacts.

1.2.1 Validation of Environmental Impacts

The key findings of the technical studies and the revised or new management measures are described below.

Air Emissions, Greenhouse Gas and Plume Rise

There have been no changes to the impacts to air quality as predicted in the EIS. Remodelling with revised project emissions data demonstrated that the impacts are consistent with those of the air quality impact assessment completed for the EIS. The predicted impacts and the management measures presented in the EIS remain valid.

The project changes generally result in a reduction in greenhouse gas emissions compared with those reported in the EIS. In particular, the decision to discontinue the all electrical option and progress the mechanical/electrical and all mechanical options has reduced greenhouse gas emissions. The mitigation measures detailed in the EIS are appropriate for managing greenhouse gas emissions.

Revised assessment of plume heights generated at the LNG plant result in threshold exceedences at lower heights than were presented in the EIS. Arrow Energy will still be required to submit an application for operational assessment of a proposed plume rise to the Civil Aviation Safety Authority.

Noise and Vibration

The project changes result in predicted noise impacts, that in some cases, are different to those reported in the EIS. While construction noise levels are generally consistent with those reported in the EIS, Arrow Energy has adopted a more stringent night-time construction noise criterion of 40 dB(A) (compared to 45 dB(A) in the EIS). All reasonable measures will be taken to minimise the impact of construction noise during the day and to achieve the revised criterion, noisy works will be scheduled to occur during the day time.

Predicted noise levels during operation are lower than those reported in the EIS except at two sensitive receptors where modelling indicated exceedences of project noise level criteria. The application of additional feasible acoustic treatments and management measures will ensure that noise does not constitute an environmental nuisance at these sensitive receptor locations. The vibration impacts described in the EIS for construction and operation of the LNG plant remain valid and are well below the threshold of human detection.

Marine Sediment Quality

Further information was obtained on the characteristics of sediments at project dredge sites. The sediment sampling program was carried out in accordance with the National Assessment Guidelines for Dredging (NAGD) and Queensland Acid Sulfate Soils Investigation Team (QASSIT) Guidelines (DERM, 1998) and was implemented as part of the Arrow LNG Plant geotechnical program. Relevant sediment data was also obtained from other sampling programs carried out in the project area. Overall, the sediments at the project dredge sites are categorised as uncontaminated under the NAGD, and are considered suitable for ocean disposal, and by inference to approved onshore disposal sites. These results are consistent with the findings of the EIS. The particle size and distribution of sediment at dredge sites was also reviewed and is consistent with the assumptions used in studies completed for the EIS at Boatshed Point and the LNG jetty. Current results for the Calliope River show lower proportions of silts and clays and impact predictions made in the EIS at this site are therefore conservative. These results, together with results from ongoing geotechnical investigations, will be used to inform the development of the dredge management plan for the project.

Marine sediments were also tested for PASS. Likely volumes of PASS were estimated for each dredge site based on the preliminary results of sediment samples available at the time of writing this report. Arrow Energy has committed to developing an acid sulfate soil management plan which will detail strategies for the management and disposal of these sediments.

The commitments set out in the EIS remain applicable to the management of marine sediments in undertaking marine activities in the project area.

Marine Water Quality

Further data on existing water quality was obtained in the vicinity of projects sites. All water quality results were consistent with results from other recent monitoring studies carried out in Port Curtis and fit within long term ranges reported by the Department of Environment, Heritage and Planning. Impacts to water quality, due to increased dredge volumes, will be spatially the same as those reported in the EIS but will occur over a longer period. Impacts associated with maintenance dredging are consistent with those presented in the EIS. Impacts to water quality from increased volumes of hydrostatic test water discharge are not significant as water quality criteria will be met close to the point of discharge and the discharge will be of limited duration. Overall, project changes will have a negligible influence on the significance of the predicted impacts to marine water quality in the study area. The predicted impacts and the management measures presented in the EIS remain valid.

Arrow Energy will develop project specific water quality criteria in consultation with the regulator that reflect existing water quality conditions in the receiving environment, and will implement these criteria through the conditioning process associated with statutory approvals such as the dredge management plan and specific environmental authorities.

Coastal Processes and Tides

Further hydrodynamic modelling identified minor changes to current velocities within the vicinity of Boatshed Point and the Calliope River. These changes will have a negligible influence on coastal processes in the study area, as they occur over a small area within a large well-mixed dynamic environment. Impacts to other coastal processes remain as assessed in the EIS.

Detailed modelling was carried out to determine the extent of changes to the lowest low tide levels in the Calliope River following the dredging of the bar at the river mouth. Intertidal banks between the river mouth and a point upstream of the Gladstone Power Station may be exposed by up to an additional 0.5 m on the lowest low tide. This represents a lesser impact than the 0.8 m predicted in the EIS. On average, this change is equivalent to a less than 4% increase in exposure time of the river bed for elevations below -1.5 m AHD. This lowering of water levels may restrict upstream access to some vessels on the lowest low tides for a few hours on up to five days each month. Lower reaches of the river (downstream of Gladstone Power Station) which currently experience periodic restricted access, will now be accessible under all tidal regimes.

Preliminary modelling was also carried out to understand the potential maintenance dredging requirements at Boatshed Point and within the Calliope River. This dredging is required to maintain shipping access during operation of the project. Sediment deposition in the Calliope River will be largely outside of dredged areas and at relatively small annual rates in navigable areas. Overall net sand transport within the river will not be affected by project activities.

At the Boatshed Point MOF, the maximum rate of siltation is up to 0.14 m/month in the ferry manoeuvring basin and up to 0.2 m/month near the roll-on, roll-off berth. The maintenance dredging frequency required to manage this material will be determined on an as-needed basis once capital dredging and construction is completed.

Overall, the changes to the project description have a negligible influence on the predicted impacts to coastal processes and the hydrodynamic environment in the study area. The predicted impacts and the management measures presented in the EIS remain valid.

Marine Ecology

There are no changes from the findings reported in the EIS to the direct impacts associated with the removal of marine habitats (mangroves, saltpan vegetation, seagrasses, benthic zone and intertidal mudflats, and reef and rock substrate). As such, no new mitigation measures are proposed. Similarly, indirect impacts on marine habitats associated with dredging activities at the mainland launch site and the LNG jetty have not changed from those presented in the EIS. An increase in the volume of material to be dredged at Boatshed Point could have a temporary, localised impact on the seagrasses located to the east. The management measures in the EIS, including the development and implementation of a dredge management plan (and an associated water quality and seagrass monitoring program) remain appropriate to mitigate the potential impacts to these habitats. Commitments in the EIS also remain adequate to address the impact on marine fauna of direct and indirect loss of habitat. These measures include marine offset strategies and water quality monitoring that was committed to in the EIS.

The changes in the lowest low tide levels in the Calliope River (due to dredging of the bar at the river mouth) will increase the area and time of exposure of intertidal areas in the river. The additional exposure will be infrequent. The changes are small and impacts to intertidal habitats are unlikely to be detectable. The intertidal area that mangroves inhabit is well above the region affected by the drop in the lowest low tide levels and will not be affected.

Available information was reviewed on the use of Port Curtis by marine megafauna (dugong, cetaceans and marine turtles). This information, together with revised data on project ferry and barge movements, has led to a reduction in the likelihood of boat strike on these species from that predicted in the EIS. Managing vessel speeds through speed restrictions remains the foremost mitigation measure. Opportunistic observation, pre-start observation and observation leading to shutdown commitments for pile driving and dredging activities all seek to limit the impact to marine megafauna. The impacts of noise from pile driving on dugong, cetaceans and marine turtles have also been reduced. Arrow Energy has committed to evaluating the use of bubble curtains for each method of piling, and deploy where they are demonstrated to be effective in aiding the rapid attenuation of underwater noise and deterring marine fauna from approaching, or remaining at, pile driving sites. These measures, together with those described in the EIS, are appropriate to manage potential underwater noise impacts on these species.

The detailed study of the potential impacts of LNG plant lighting on marine turtle hatchlings and adults found that the residual impacts of project lighting on turtles using beaches on Curtis and Facing islands will be reduced to an acceptable level with the implementation of a detailed light mitigation plan. Light from the plant will increase the extent of horizon illumination at some locations on Facing Island and Curtis Island beaches which will add to the existing artificial illumination in Port Curtis. This includes an increase in the amount of glow observable from turtle nesting beaches, which could increase the degree of misorientation and disorientation in hatchlings emerging and going to sea. The proposed flaring strategy will effectively minimise the impact of flaring on marine turtles in the Port Curtis region.

Arrow Energy has made several new commitments to further minimise these impacts. A light mitigation plan will be developed to include specific light management and reduction measures and routine light audits. Arrow Energy will also participate in monitoring programs established to

assess the impact of current and future industrial lighting in the Gladstone region on hatchlings emerging on the beaches of Curtis and Facing islands.

Terrestrial Ecology

Additional fieldwork has confirmed that no significant flora species listed under state or federal legislation are likely to occur within the project area.

The fieldwork confirmed that there are two areas of the EPBC Act listed vegetation community 'littoral rainforest and coastal vine thickets of eastern Australia' ('critically endangered') immediately adjacent to project infrastructure. These communities will not be cleared.

Further information on the impacts on endangered, vulnerable and near threatened (EVNT) fauna species has been provided, particularly for water mouse. Water mouse presence was confirmed around Boatshed Point, in mangroves to the east and west. The limited clearing of mangroves and adjoining habitat is unlikely to significantly impact water mouse. The modification of shoreline habitat will contribute to the isolation of one small patch of known habitat for water mouse to the west of Boatshed Point. In the context of overall cumulative impact, the potential isolation of this local population is not significant. Other EVNT species were either considered unlikely to be present within the project area, or not significantly impacted by the project. Further fieldwork, planned for the wet season in early 2013, is expected to validate these findings and inform the development of detailed environmental management plans.

No areas defined as important habitat for shorebirds under EPBC Act guidelines will be cleared for the project. There is potential for disturbance and habitat degradation to potentially important roosting habitat at the Clinton ash ponds (an unnatural environment that is disturbed and actively being used for fly-ash disposal from the nearby Gladstone Power Station). Areas of potential roosting habitat were also identified on the mainland and Curtis Island, although no birds were present at the time of the survey. Further survey work being undertaken later in 2012 and early 2013 will establish the importance of these areas.

Twelve new commitments have been included in the SREIS, and a number of existing commitments have been enhanced to protect terrestrial ecology values. A management buffer will be established around the EPBC Act listed vine thicket community located northeast of Boatshed Point, along with further fire and weed control measures. The need to protect EPBC Act listed communities and relevant mitigation measures will be explained in workforce inductions. Other new commitments include those to minimise light emitted from the LNG plant, including limiting light spill to areas of sensitive water mouse and shorebird habitat. Arrow Energy has committed to designing infrastructure to reduce impacts on shoreline habitat, where possible, and reduce the risk of unnecessary clearing by demarcating disturbance areas. Arrow Energy will develop a shorebirds management plan for approval prior to construction.

Traffic and Transport

No notable changes to the assessment of the rail network, alternative local transport, or shipping impacts are expected from changes to the project. Remodelling confirmed that road linkages would operate satisfactorily, though may require upgrade at a later time to account for baseline traffic growth (rather than project related impacts). Some intersections are also likely to require upgrade due to baseline traffic growth. Subject to the provision of upgrades required to accommodate baseline traffic growth, with one exception, these intersections are anticipated to operate within acceptable limits for the nominated construction and operation years – 2014, 2016, 2024 and 2026. The Hanson Road/Alf O'Rourke Drive/Blain Drive intersection is expected to

require upgrading as a direct result of project construction activities, particularly those associated with the construction and operation of the mainland launch site.

A final road impact assessment will be undertaken in conjunction with the development of a road use management plan, logistics plan and traffic management plan. The final assessment will be prepared in consultation with Department of Transport and Main Roads and Gladstone Regional Council, and will be used as the basis for entering into infrastructure agreements with those agencies. Such agreements will establish road maintenance contributions. Traffic and transport commitments remain as presented in the EIS.

Hazards and Risks

The introduction of the propane import pipeline and associated unloading and transport of propane during commissioning (and potentially during operation) introduce new hazards and risks not discussed in the EIS. Additional typical design and safety controls are proposed to manage these potential hazards and risks. The typical controls outlined in the EIS otherwise remain appropriate. The realignment of the LNG loading lines and relocation of the tunnel reception shaft containing the feed gas line was found to reduce the risks associated with an uncontrolled release of flammable gas and LNG. The updated fatality risk contours were found to be generally consistent with those presented in the EIS. The project description changes result in only minor changes to the hazards and risks identified in the EIS and there are no increases in residual or cumulative risks.

1.2.2 Validation of Social Impacts

The review of changes to the project description has found that overall the changes will lead to little variation in the potential impacts identified in the social impact assessment completed for the EIS.

Of note is the reduction in the peak construction period from 21 months to 12 months. As a result, there will be minor reductions in the impacts relating to potential incidences of anti-social behaviour and demand for medical services. In addition, extension to the likely duration of dredging may result in increased community concern about environmental impacts associated with dredging activities and the disruption to recreational boating activities.

Overall, the changes are minor and the mitigation measures contained in the social impact assessment and Social Impact Management Plan (SIMP) remain appropriate. The SIMP has been updated to include advances that Arrow Energy has made in the area of social performance since the EIS was finalised.

1.2.3 Validation of Impacts on Matters of National Environmental Significance

The impacts on matters of national environmental significance (MNES) likely to be affected by the project have been reviewed and some additional mitigation measures proposed to address impacts to MNES, which have not changed from that presented in the EIS. Two documents (one for each referral) present the results of further investigations undertaken to verify the findings presented in the EIS. The key findings of the review are described below.

- Great Barrier Reef World Heritage Area. Some loss of terrestrial vegetation and fauna habitat will disturb marine fauna habitat and adversely affect visual amenity. However, the project is unlikely to have a significant impact to the World Heritage and National Heritage values of the Great Barrier Reef World Heritage Area with the implementation of the management and mitigation measures outlined in both the EIS and SREIS.

- Threatened ecological communities. Two small areas of the critically endangered ecological community 'littoral rainforest and coastal vine thickets of eastern Australia' were confirmed in the vicinity of Boatshed Point and Hamilton Point, although not within the project footprint. Management measures and commitments have been proposed to avoid disturbance to the Boatshed Point community and minimise and mitigate the risks of indirect impacts, including edge effects such as weed infestations and fire.
- Listed threatened species. Water mouse was confirmed as present in mangroves east and west of Boatshed Point. The limited clearing of mangroves is unlikely to significantly impact water mouse although the project is likely to reduce connectivity to adjacent undisturbed areas to the east for the sub-population west of Boatshed Point. Connectivity to the west is already disturbed by construction for other LNG proponents. In the context of overall cumulative impact of this highly disturbed stretch of the Curtis Island shoreline, the isolation and potential eventual loss of this local population does not represent a significant impact.
- Listed migratory species - birds. No migratory shorebird habitat defined as 'important' under EPBC Act guidelines will be cleared. Birds using potentially important roosting habitat at the Clinton ash ponds could be disturbed and the habitat further degraded. This area will most likely be remediated as part of fly-ash disposal and reclamation associated with operation of the Gladstone Power Station. This reclamation process is an ongoing activity at Clinton ash ponds.

  The project is unlikely to significantly impact listed migratory bird species that are not shorebirds or not marine birds and the conclusions of the EIS on this matter are unchanged.
- Listed migratory species – marine fauna. There is a risk of minor significance of impact (reduced from moderate in the EIS) to the endangered loggerhead turtle, vulnerable flatback and green turtles, Australian snubfin dolphin, Indo-Pacific humpback dolphin and dugong due to potential vessel strikes, and a risk of minor significance of impact to the loggerhead and green turtles due to underwater noise.

The EIS and SREIS include management measures and commitments to avoid and minimise impacts to threatened and/or migratory marine fauna. These measures should be considered in context with the range of measures being implemented or proposed to address the cumulative potential impacts to marine values presented by all developments occurring in Port Curtis.

No offsets for MNES are proposed for the project as offsets are only required under the Commonwealth Government's Environmental Offsets Policy (2012) when a project is likely to have a significant impact on MNES. Offsets may be required under the Queensland Government Environmental Offsets Policy (2008) for the clearing of mangroves and saltpan vegetation (i.e., marine plants), which would provide direct benefit for the water mouse and migratory shorebirds.

Consistent with the findings of the EIS, the project is unlikely to have a significant impact on MNES. Implementation of the proposed mitigation measures will reduce the significance of impacts for each matter.

1.3 Additional Management Measures

The commitments made by Arrow Energy in the EIS have been reviewed to ensure they remain appropriate for addressing the identified impacts. Some revisions have been made to existing commitments and 38 new commitments have been included in the SREIS.

The additional commitments largely relate to impacts on social and ecological (terrestrial and marine) values that were reviewed following project changes and in light of further information, including targeted field surveys carried out since the EIS was finalised. The Strategic Environmental Management Plan and Social Impact Management Plan for the project have both been updated to include the revised and new commitments.

1.4 Conclusion

The site selection and design activities for the project have resulted in a number of potential environmental impacts being avoided or substantially reduced. The assessments undertaken for the Arrow LNG Plant, as detailed in the EIS, and reviewed and validated in this SREIS, show that the potential impacts of the proposed development are manageable through the implementation of mitigation and management measures set out in the updated Strategic Environmental Management Plan (Attachment 3) and updated SIMP (Attachment 4). Cumulative impacts of development in the Gladstone region are unlikely to be exacerbated due to the timing of the project.

Arrow Energy has made several additional commitments to those set out in the EIS in response to the outcomes of the investigations and studies undertaken for the SREIS. Information has also been provided in the SREIS on the various management and monitoring plans to be developed for the project, as well as environmental offset requirements.

This supplementary report to the EIS provides further information on the project and its potential impacts. It confirms the conclusions of the EIS, completes Arrow Energy's response to the Coordinator-General's request to provide additional information (including on project changes), and addresses comments made in submissions on the EIS.