

Executive Summary

Introduction

The Sunrise Gas Project Joint Venture, operated by Woodside Energy Ltd (Woodside), proposes to develop the Greater Sunrise gas and condensate field which is located in the Timor Sea approximately 450 km north-west of Darwin and 150 km South of East Timor. Investigations indicate that the Greater Sunrise Gas Field has a 'Scope for Recovery' in the order of 9 trillion cubic feet of gas and 300 million barrels of condensate. **Figure ES1** shows the location of the Sunrise Gas Field and surrounding gas fields.

The Sunrise Gas Project is a joint venture between Woodside (Operator), Phillips STL Pty Ltd, Shell Development (Australia) Pty Ltd and Osaka Gas Australia Pty Ltd. Woodside Energy Ltd is a leading oil and gas company and one of Australia's most successful explorers, developers, and producers of hydrocarbon products. As a participant in, and Operator of, the North West Shelf Joint Venture, Woodside is directly responsible for the management of offshore and onshore assets worth more than \$9 billion. On Western Australia's North-West Shelf, Woodside operates the North Rankin A and Goodwyn A offshore production platforms, the Cossack Pioneer Floating Production Storage and Offtake (FPSO) facility and the Onshore Gas Plant (OGP) on the Burrup Peninsula.

For the Sunrise Project this document addresses the environmental issues associated with the proposed offshore facilities, potential pipelines and related plant that have the potential to cause biophysical or social effects, or which are known to be of public interest. The document has been prepared to provide the Northern Territory Government, agencies of the Commonwealth of Australia and the public with the information necessary to enable an informed appraisal of the environmental acceptability of the proposed project.

Contact Details

The designated operator of the Sunrise Gas Project is:

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Legislative Framework and Regulatory Authorities and Agencies

As the Sunrise Gas Project requires assessment under both the Northern Territory and the Commonwealth environmental assessment legislation, the two government bodies have agreed to facilitate a joint assessment. As such both the Minister for the Environment (Commonwealth) and the Minister for the Environment (Northern Territory) have set the level of assessment for the project as an Environmental Impact Statement (EIS). Furthermore both governments have agreed that the Environment and Heritage Division of the Northern Territory Department of Infrastructure, Planning and Environment (DIPE) will take the lead role in the assessment process. The final guidelines issued for the project reflect the recommendations of both governments. The final documentation will be assessed by each jurisdiction, with each government making its own decision.

Approximately twenty percent of the Greater Sunrise reserves lie within the Zone of Cooperation, which was initially established in 1991 under treaty between the Australian and Indonesian governments to jointly exploit petroleum resources in adjacent territorial waters and which will be continue with the newly elected government in East Timor by means of the Timor Sea Arrangement

(TSA). However, the production facilities will be located largely within Australian waters and the Northern Territory and Commonwealth governments will comment on the EIS within the process outlined above.

All activities associated with the proposal will comply with the legislative requirements established under a combined Territory and Commonwealth Government framework under which the Project will receive environmental, planning and development approvals and authorisations.

Project Justification

Undeveloped reserves of gas contribute nothing to economic development and community living standards. For the economies and citizens of East Timor, the Northern Territory and the rest of Australia to benefit from the Greater Sunrise gas reserves in the Timor Sea, the fields must be developed and commercial sales made to customers.

Development and production of the gas and condensate will benefit the various economies through:

- ❑ The front end engineering and detailed design phases, where Australian and international expertise will apply the latest design concepts and technologies to design world class facilities;
- ❑ The construction phase when capital investments to produce, transport and process the gas are made; and
- ❑ The operations phase when gas is produced and used by customers.

The design phases will provide opportunities for skill and knowledge transfer essential to maintaining regional capability in the oil and gas sector. The construction phase will involve large expenditures concentrated over a short period on the purchase and installation of capital equipment and construction costs. Local construction and service industries will have the opportunity to support the installation of large capital items leading to a boost in short term jobs in the construction industries and in industries supplying inputs to construction.

Once the project enters its operations phase permanent jobs will be created in running the production facilities. The export of condensate and downstream products will generate income through foreign exchange. This will add to national income and the consumption prospects of the Australian and East Timorese communities.

The extraction of natural gas will add to the Commonwealth government's revenue directly through the Petroleum Resource Rent Tax levied on gas and condensate production and to the East Timor Government's revenue through the Production Sharing Contract provisions of the TSA. It will also add indirectly to both Northern Territory, East Timor and Commonwealth governments' revenue by expanding economic activity, employment, income, expenditure and hence the tax base in the Northern Territory, the rest of Australia and East Timor. This in turn will enhance the capacities of both governments to support desirable social expenditures, including infrastructure development.

The development of the Greater Sunrise gas and condensate fields will secure a long-term source of tax revenue for East Timor. Furthermore, there is the potential for East Timorese involvement in logistics and support operations to the offshore facilities. Direct employment opportunities on the facilities will also emerge for those who acquire the necessary skills through appropriate training.

Natural gas is a fuel which produces approximately half the greenhouse gas emissions of other fossil fuel alternatives on a lifecycle basis. In this respect, the development of natural gas supply for domestic and international markets provides tremendous opportunities for continued economic development in Australia and East Timor. To the extent that gas can be utilised in place of alternative fossil fuels, global emissions will be reduced in line with Australia's National Greenhouse Strategy.

Project Description

The Project scope includes the following major components:

- ❑ Construction and operation of offshore production wells production and processing facilities, and subsea infrastructure; and
- ❑ Construction and operation of a hydrocarbon pipeline from the Sunrise facilities to the Phillips Bayu-Undan gas export trunkline.

The Sunrise Field development will consist of either a combination of platform and subsea wells or entirely of subsea wells. Subsea wells will be linked to the production facility by intra-field pipelines and export/import risers.

Two main wellstream processing options are under consideration:

- ❑ Processing by way of processing, compression, utilities and quarters (PCUQ) facilities – the gas would be exported to Darwin via the main export pipeline to the proposed Darwin Liquefied Natural Gas (LNG) terminal or other potential customers (**Figure ES2a**); and
- ❑ Wellstream exported directly to an offshore Floating LNG (FLNG) facility via a series of flowlines and risers – the LNG and condensate would be exported from the FLNG facility to available markets (**Figure ES2b**).

The basis of the PCUQ option is a Production Jack-Up facility bridge-linked to the Wellhead Platform (WHP), both platforms being located in a water depth of 140–400 m.

This option provides for full offshore condensate separation, stabilisation and export, requiring the addition of an Floating Storage Offloading (FSO) facility located approximately 2 km from the PCUQ platform. Condensate production will be transferred to the FSO via an 8 inch subsea flowline. Trading tankers will receive condensate from the FSO on a regular basis, and the gas will be exported via pipeline to Darwin.

Figure ES3 shows that the offshore production facilities are designed to deliver two products; natural gas and condensate. There will be two process trains each having a capacity of 50%. The well production from the wellhead platform and the subsea wells will be manifolded on the wellhead platform and routed across the bridge to the PCUQ platform. All risers, subsea flowlines and export stabilised condensate to FSO vessel will be located on the wellhead platform. The facility will produce export gas routed to a gas pipeline, condensate product routed to FSO and produced water.

Under an O LNG scenario both the Sunrise and Bayu-Undan developments will share a section of export gas pipeline comprising approximately 319 km of export pipeline from a Wye piece to Wickham Point for use by potential gas customers. This shared section of pipeline has already been approved under a separate approval process.

Production from the Greater Sunrise field will commence when suitable gas markets have been established and approved by the appropriate regulatory bodies. This may be as early as mid 2006; however, this date is dependent on the establishment of suitable markets.

While it is recognised that the full field life may range from 30 to 75 years, no specific design allowance is made for extended facilities life beyond a nominal 30 years. Instead, the facilities would be managed and maintained to achieve the life required.

The FLNG option provides for full processing of the wellstream on a large moored barge, including the provisions of utilities, support systems and quarters for both the FLNG and Sunrise Upstream

facilities, and for storage and export of both LNG and condensate. Both the Onshore LNG (OLNG) and FLNG plants fall outside the scope of approvals currently sought for the development of the Greater Sunrise gas fields and the installation of associated pipelines. FLNG and OLNG will be required to follow separate environmental approval processes.

Alternative Options

A broad range of alternatives have been considered by Woodside including:

- The “no-development” option;
- The location of the development sites and pipeline routes,
- Drilling and platform facilities; and
- Process technologies.

The failure to develop the Sunrise Gas Field may have adverse economic implications for Australia where the petroleum exploration and production industry is important to the national economy as a source of energy, employment and income. Similarly, no development would deny East Timor an opportunity to finance the rebuilding of one of the world’s newest and poorest nations. The various economic benefits to both nations are outlined above.

The Sunrise Gas Project was initially a stand-alone project and therefore the early pipeline routes considered were based on a more direct route from Sunrise to landfall at Shoal Bay on the Gunn Peninsula, north-east of Darwin. However, following the agreement to co-operatively develop Timor Sea gas with Phillips (operator of the Bayu-Undan field), a number of pipeline routes were examined that extended from the Sunrise Gas Field to a ‘Wye’ junction with a pipeline from Bayu-Undan to Wickham Point in Darwin Harbour. The pipeline from the Wye junction to Wickham Point (Darwin) is consistent with the route already approved for Bayu Undan.

Various platform drilling rig options have been investigated to minimise the impact of platform facilities, while optimising the platform drilling capability and minimising capital investment in drilling equipment. Similarly, an assessment of three main production concepts was conducted by Woodside. The choice of the preferred offshore platform was based on geotechnical, environmental and technical criteria.

The Sunrise Gas Project can demonstrate that the best available technologies for reduction of environmental impact of discharges and emissions have been given due consideration. In this regard Woodside produced the report entitled ‘*Environmental Design Review*’ in May 2001. Several available technologies have been considered and benefit-cost analysis performed before recommendations were made. Specific greenhouse gas reduction measures to be considered as part of the Sunrise Gas Project are:

- The development and implementation of a greenhouse strategy to minimise emissions of greenhouse gases;
- Design and operational measures to minimise offshore flaring and venting;
- The reduction of methane emissions to negligible levels through the combustion of regeneration offgas;
- Maximising the use of waste heat from gas turbines; and
- To adopt industry best practice in greenhouse efficient technology and practice wherever practicable.

Existing Environment

Physical Environment

The climate of the Timor Sea comprises two distinct seasons, a dry “winter” from April to September and a wet “summer” from October to March, separated by transition seasons of short duration.

The mean annual rainfall for the Sunrise Gas Field is expected to be in the order of 1,700 mm with the vast majority of the rainfall occurring between November and March. The mean summer and winter air temperatures are likely to approximately 28°C and 27°C, respectively.

Although tropical cyclones form in the area generally south of the equator in the eastern Indian Ocean and the Timor and Arafura Seas, most storms affecting the Sunrise area are tropical lows or developing storms passing well to the south of the Sunrise Gas Field.

The seabed in the vicinity of the Sunrise Gas Field lies at 140 m to more than 700 m below the water surface. The south eastern rim of the gas field lies at the top of the steep shelf break where the depth drops to about 300 m over a distance of 15 km. There are four shallow features adjacent to the southern portion of the Greater Sunrise Gas Field, including the Sunrise Banks. These shoals are covered by minimum water depths of approximately 30 to 40 m.

The preferred subsea pipeline alignment passes through water depths ranging from approximately 140 m to 57 m LAT. The route is aligned to avoid shoals and valleys as much as possible.

The development area is situated on the outer shelf and upper slope of the Sahul Platform off the northern margin of Australia in the Timor Sea. The surficial sediments along the pipeline route vary in thickness between 0.5 and 2.5 m and range from carbonate silty to carbonate clayey sand with gravel.

The Timor Trench lies between the Sunrise Gas Field and the island of Timor. Subduction earthquakes associated with the Timor Trench dominate the earthquakes of the Sunrise Gas Project area. However, the design criteria of the offshore facilities provides for seismic events such as earthquakes, which are of low frequency and an intensity not likely to result in damage.

The sea wave climate at Sunrise Gas Field is closely allied to the prevailing wind regimes, with westerly and south-westerly seas prevailing from December to March, shifting predominantly easterly seas from April to November. Predominant swell direction at Sunrise Gas Field is from south-west to west. In summer the one year return period significant wave height is 2.4 and in winter it is 2.8 m.

Tides in the area are semidiurnal, and are expected to flow east-north-east and ebb west-south –west in the upper 100 m of the water column, whilst flooding south-east and ebbing west-north-west in the lower portion of the water column. Maximum tidal range is about 4 m.

Surface current for the Sunrise Gas field are strongly influenced by the semidiurnal tide and to a lesser extent by the wind-driven and drift currents.

Mean monthly surface water temperatures in the vicinity of the Sunrise Gas Field are expected to vary between about 26°C and 30°C.

Biological Environment

Surveys were conducted at three banks and a deep-water location in the vicinity of the Greater Sunrise Gas Field. The survey found that each of the three banks support extensive areas of benthic

communities considered as being both diverse and abundant. The proposed platform location (ie deep water) is generally characterised by a relatively level substrate composed of sand and shell fragments. The area supports sparse epifauna comprised of hydroids, seapens, sea whips and solitary hard corals.

Social Environment

Darwin is the capital city of the Northern Territory and its proximity to major economic growth areas in the Asia Pacific region provides a stable foundation for the Territory to play a major role in the future of the Asia Pacific Region.

Darwin is serviced with a seaport comprising land connections to a major international airport, national highway system, the proposed national rail network and the proposed Bayu-Undan to Darwin natural gas pipeline. Darwin is also equipped with world standard communications systems and has emerging information technology capabilities.

East Timor's proximity to the gas fields is expected to provide opportunity for its local economy. As a landfall, East Timor is 300 km closer to the development area than Darwin. While infrastructure and capability constraints currently prevail, East Timor's capabilities in the area of marine and air support are likely to emerge within the operating life of the project.

Environmental Effects and Management Strategies

A summary of the environmental impacts related to the development of the Greater Sunrise gas and condensate fields is provided in **Table ES1**, which lists:

- ❑ Project component;
- ❑ The source of the impact;
- ❑ The potential or actual environmental impact;
- ❑ The predicted effect of the impact (negligible, minor, moderate, significant or serious); and
- ❑ The duration of the impact (temporary, short-term, medium-term, long-term or permanent).

In summary, the identified potential and actual environmental impacts associated with the Sunrise Gas Project are:

Atmospheric emissions

- ❑ Emission of smoke and particulate from production platform operations, and cargo tank emissions from loading of FSO and shuttle tankers;

Discharges to the Sea

- ❑ Smothering effects of accumulated drilling cuttings on marine biota;
- ❑ Potential anoxia of sediment due to natural degradation and/or burial by drilling muds;
- ❑ Localised reduction in water quality adjacent to off-shore facilities during the construction phase;
- ❑ The potential discharge to the marine environment of hydrocarbons resulting from a condensate or diesel spill, or the release of off-specification production formation water resulting in adverse impacts on the receiving waters;
- ❑ Potential localised elevation of water temperature affecting marine organisms;
- ❑ Contamination of marine environment by anti-fouling agents; and
- ❑ Potential temporary localised reduction in water quality due to release of hydrotest water containing biocides, scale and corrosion inhibitors and oxygen scavengers.

Noise, Vibration, Light and Heat

- ❑ Potential disturbance to marine species due to noise and vibration created by vessels undertaking project related activities; and

Waste to Shore

- ❑ The improper disposal of waste material generated during the drilling, construction and operation phases of the project;

Other Impacts

- ❑ Temporary disruption of fisheries during construction and reduced access to fishing grounds due to the establishment of an exclusion zone around the offshore production facilities; and along the pipeline; and
- ❑ Disturbance to benthic communities that have established on and adjacent to the facility;
- ❑ Disturbance to seabed and potential changes to seabed characteristics from permanent facilities.

The result from the impact identification can be summarised as follows:

- ❑ *Drilling and Associated Activities:* Most of the environmental effects are negligible and of short-term or temporary duration.
- ❑ *Installation/Construction:* Most of the environmental effects are negligible and of short-term or temporary duration.
- ❑ *Commissioning/Operation:* Most of the environmental effects are either negligible, minor or moderate and of short-term duration. A few significant environmental effects have been identified, relating to the potential emission/spill of natural gas and condensate, the duration of this effect deemed long-term.
- ❑ *Decommissioning:* Most of the environmental effects were deemed negligible and of short-term duration.

Mitigation measures and management strategies have been recommended for implementation, based on the APPEA's 'Code of Environmental Practice', and following consultation with all relevant government and non-government organisations, as well as the public. A summary of mitigation measures to be implemented at various stages of the projects are included in **Table ES2a-b**.

The management strategies proposed will ensure that all impacts on the environment will be minimised during the drilling, commissioning, operation and decommissioning phases of the proposal. An Environmental Management System will be developed and implemented by the Proponent. The majority of the environmental management strategies for the Sunrise Gas Project will be implemented with the following Environment Plans:

- ❑ **Drilling Environment Plan:** This plan would cover all aspects of drilling of the Wellhead Platform and subsea production wells and the construction and installation of the Wellhead Platform.
- ❑ **Facility Environment Plan:** This plan would cover all aspects of construction/installation, operation and decommissioning of the Sunrise Gas Project. The Facility EP would contain specific plans for decommissioning, waste management, and ballast water management.

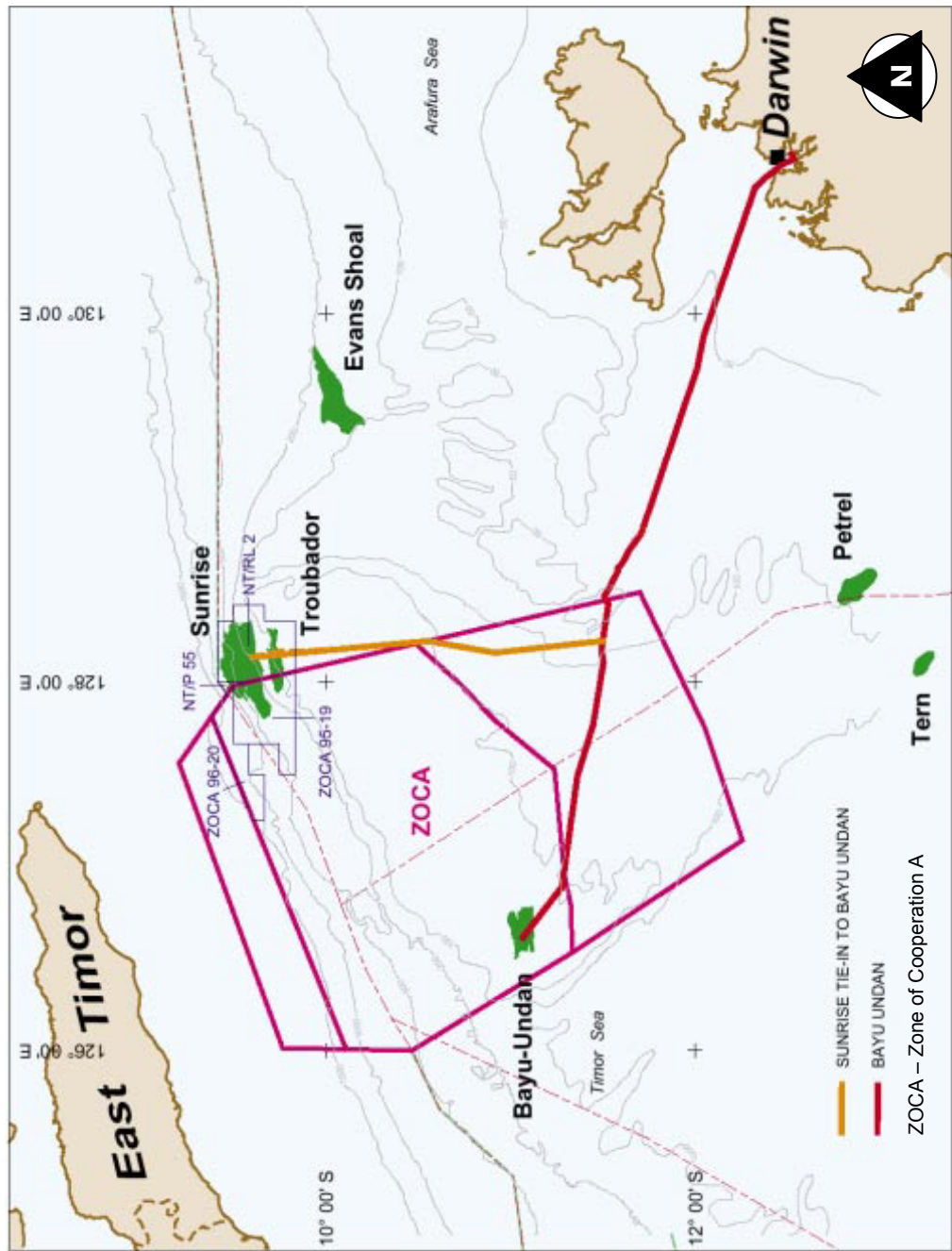
In addition to the Environment Plans, project specific plans would also be implemented. These include:

- ❑ Oil Spill Contingency Plan.
- ❑ Emergency Response Plan.
- ❑ Waste Management Plan

Conclusions

The majority of the identified potential and actual environmental impacts associated with the Sunrise Gas Project are assessed as being negligible or minor in nature with temporary or short term effects. As such, this document demonstrates that the project is not expected to pose a significant

environmental threat to the East Timor Sea. Woodside is, in any case, committed to achieving a level of environmental management and performance that is consistent with national and international standards and statutory obligations during its pursuit of sound business and financial objectives. To minimise any potential threat to the environment, the most economically effective, environmentally sound technology and procedures will be incorporated into the design of this project. The adoption of such a strategy will ensure optimal management of all emissions, discharges and waste. Furthermore, Woodside is committed to ensuring that the development of the Sunrise Gas Project will be undertaken in a manner that minimises impacts on the surrounding biophysical and social environments.



Source: Woodside

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Sunrise Gas Field Location and Surrounding Gas Fields

Figure ES1
 Project No.: DE2090.100
 Figure prepared by: T. Lee
 Date Prepared: 16/10/01

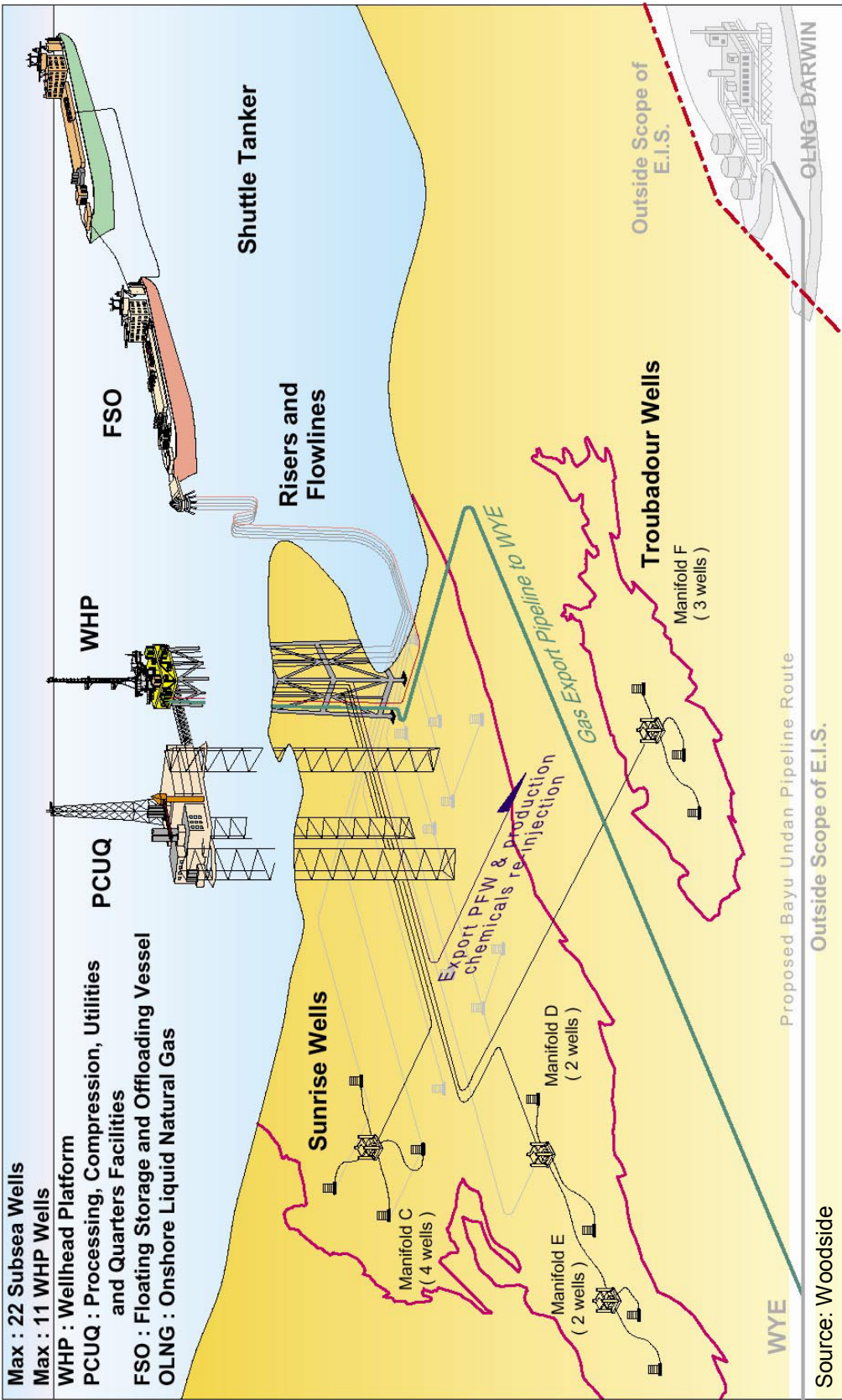
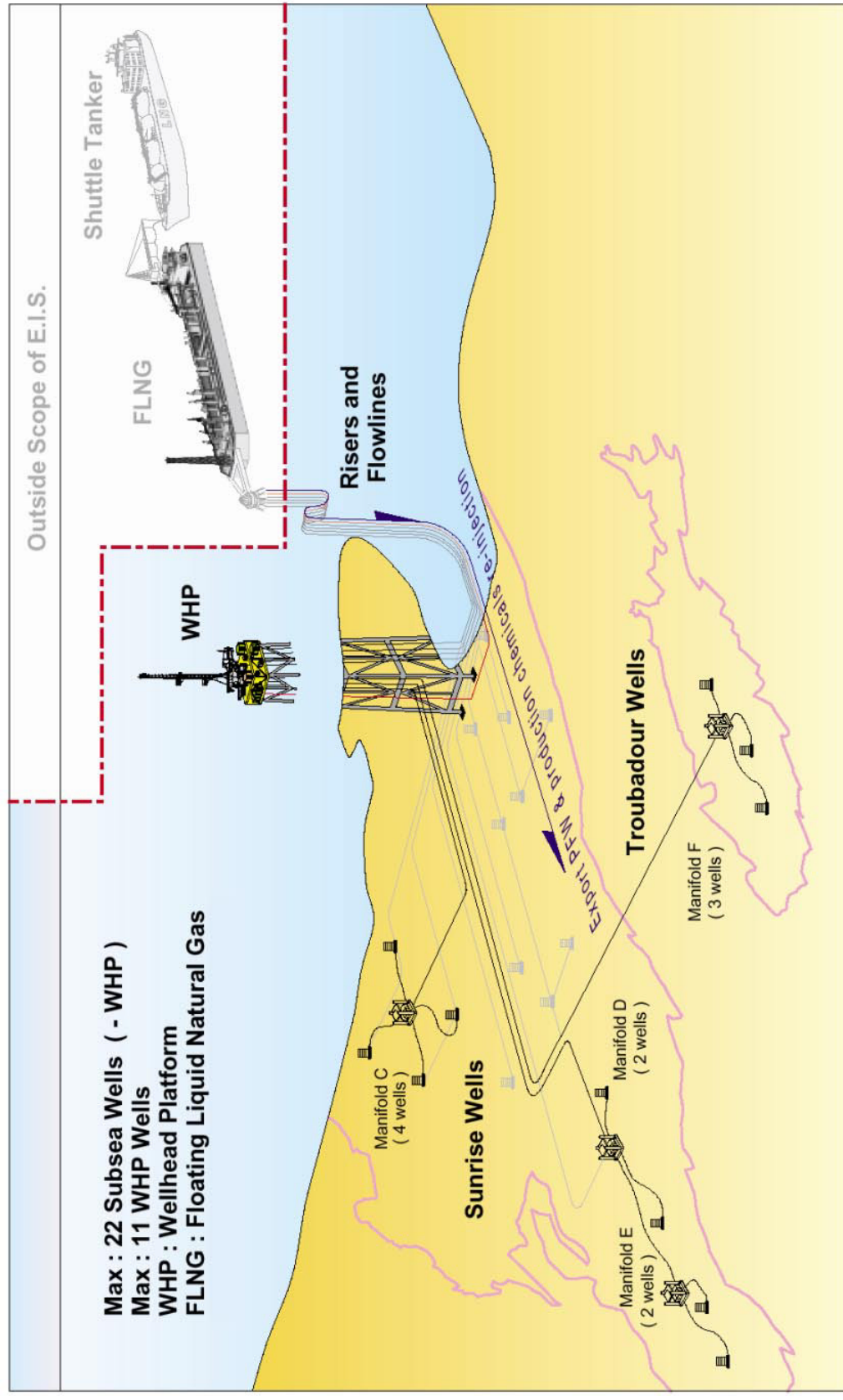


Figure ES2a
 Project No.: DE2090.100
 Figure prepared by: T. Lee
 Date Prepared: 16/10/01

Scope of EIS Scenario 1:OLNG

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Max : 22 Subsea Wells (- WHP)
 Max : 11 WHP Wells
 WHP : Wellhead Platform
 FLNG : Floating Liquid Natural Gas

Outside Scope of E.I.S.

Figure ES2b
 Project No.: DE2090.100
 Figure prepared by: T.Lee
 Date Prepared: 16/10/01

Scope of EIS Scenario 2:FLNG

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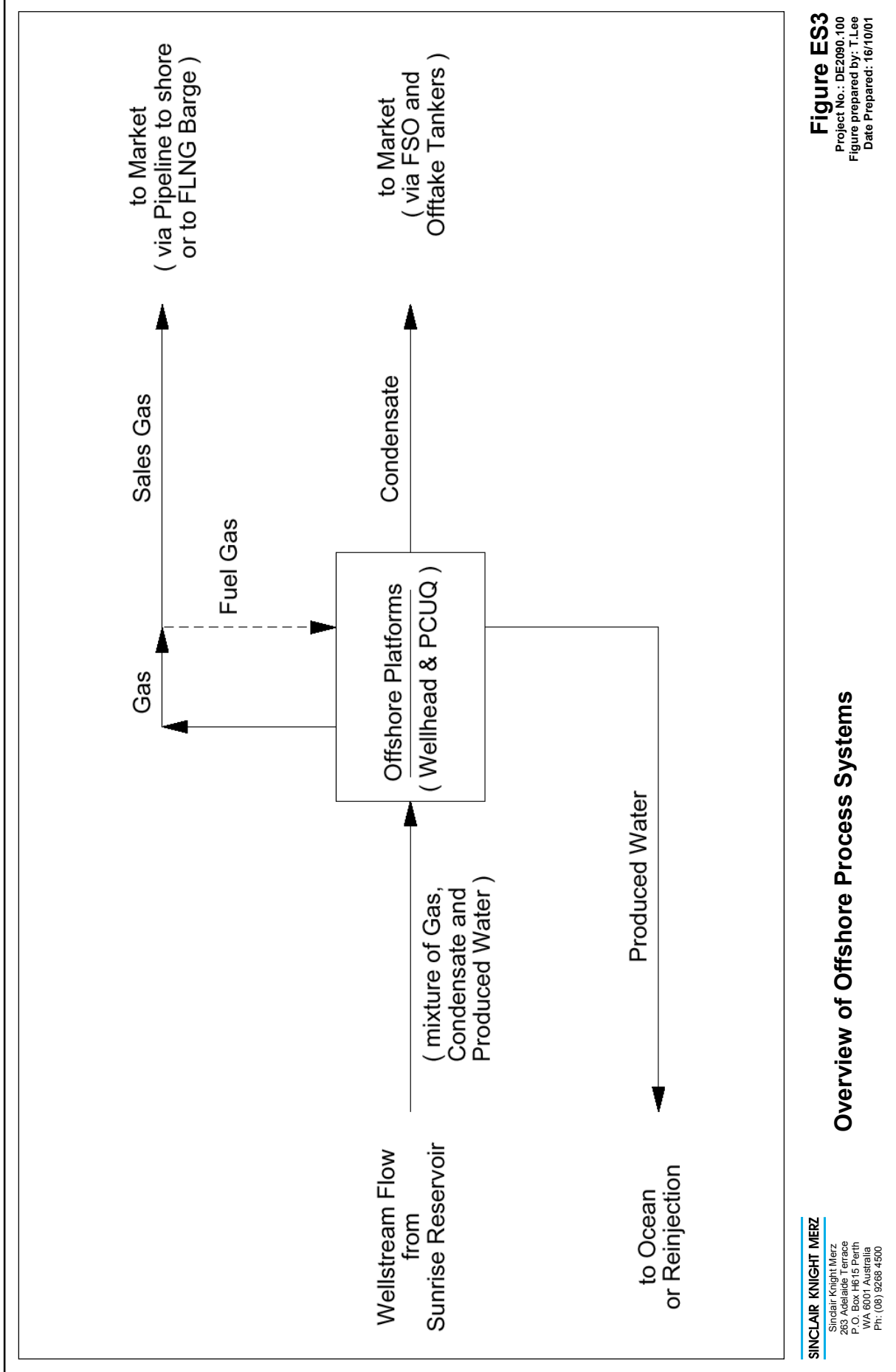


Table ES1b Summary of Potential Environmental Impacts for Installation and Construction

Project Component	Source of Impact	Potential Environmental Impact	Effect	Duration
Subsea Facilities (well heads, manifolds, flowlines, risers, etc.)	<ul style="list-style-type: none"> a) Installation of subsea facilities. b) Anchoring of construction vessel(s) c) Discharge of sewage and greywater. d) Discharge of domestic waste including food scraps. e) Disposal of domestic waste including paper and plastics etc. f) Power generation. g) Refuelling at sea. 	<p>Atmospheric Emissions</p> <ul style="list-style-type: none"> ▪ Greenhouse gases produced by vessel power generation (primarily CO₂). ▪ Atmospheric pollutants (primarily NO_x, SO_x, VOCs and smoke/particulates); <p>Discharges to the Sea</p> <ul style="list-style-type: none"> ▪ Potential significant fuel spill. <p>Noise, Vibration, Light and Heat</p> <ul style="list-style-type: none"> ▪ Potential disturbance to marine organisms and birds. <p>Waste to Shore</p> <ul style="list-style-type: none"> ▪ Improper disposal. 	<ul style="list-style-type: none"> Negligible Negligible Minor Negligible Negligible 	<ul style="list-style-type: none"> Short-term Short-term Temporary Temporary Temporary
PCUQ Platform and FSO	<ul style="list-style-type: none"> a) Transportation of the PCUQ Platform and FSO to site. b) Power generation. c) Installation of the PCUQ Platform and the FSO on site. d) Physical presence of PCUQ Platform and FSO. e) Installation of foundations of the PCUQ platform. f) Lighting. g) Presence of construction and support vessels. h) Installation of mooring for the FSO. 	<p>Atmospheric Emissions</p> <ul style="list-style-type: none"> ▪ Greenhouse gases produced by vessel power generation (primarily CO₂) ▪ Atmospheric pollutants (primarily NO_x, SO_x, VOCs and smoke/particulates). <p>Discharges to the Sea</p> <ul style="list-style-type: none"> ▪ Potential reduction in water quality in the area. <p>Noise, Vibration, Light and Heat</p> <ul style="list-style-type: none"> ▪ Potential disturbance to marine species. ▪ Potential attraction of marine species. <p>Waste to Shore</p> <ul style="list-style-type: none"> ▪ Improper disposal. 	<ul style="list-style-type: none"> Negligible Negligible Negligible Negligible Negligible Negligible Negligible 	<ul style="list-style-type: none"> Short-term Short-term Short-term Short-term Short-term Short-term Short-term Temporary
Subsea Pipeline	<ul style="list-style-type: none"> a) Potential pre-sweep along pipeline route b) Prelay with rock dump. c) Laying of pipeline on seabed. d) Hydrotesting 	<p>Atmospheric Emissions</p> <ul style="list-style-type: none"> ▪ Greenhouse gases produced by vessel power generation (primarily CO₂) and vehicles ▪ Atmospheric pollutants (primarily NO_x, SO_x, VOCs & smoke/particulates). <p>Discharges to the Sea</p> <ul style="list-style-type: none"> ▪ Smothering of benthos. <p>Noise, Vibration, Light and Heat</p> <ul style="list-style-type: none"> ▪ Potential disturbance to marine species. <p>Waste to Shore</p> <ul style="list-style-type: none"> ▪ Improper disposal. <p>Other Impacts</p> <ul style="list-style-type: none"> ▪ Disturbance due to repositioning of anchors. ▪ Temporary disruption of commercial fisheries. 	<ul style="list-style-type: none"> Negligible Negligible Negligible Negligible Negligible Negligible Negligible Negligible 	<ul style="list-style-type: none"> Short-Term Short-Term Temporary Temporary Temporary Temporary Temporary Temporary

Table ES1c Summary of Potential Environmental Impacts for Commissioning and Operation

Project Component	Source of Impact	Potential Environmental Impact	Effect	Duration
Wellhead Platform, Processing, Utilities and Quarters (PCUQ) and Subsea Facilities	a) Potential blowout of wellhead.	<p>Atmospheric Emissions</p> <ul style="list-style-type: none"> Significant emission of greenhouse gases due to export compression. Significant emission of greenhouse gases due to power generation. Significant emission of greenhouse gases due to flaring. Significant emission of smoke and particulates. <p>Discharges to the Sea</p> <ul style="list-style-type: none"> Potential significant hydrocarbon contamination from condensate spill. Potential significant hydrocarbon contamination from diesel spill. Potential significant hydrocarbon from PFW discharge. Potential reduction in local water quality. Potential reduction in water quality due to hydrotesting <p>Noise, Vibration, Light and Heat</p> <ul style="list-style-type: none"> Potential disturbance to marine species. <p>Waste to Shore</p> <ul style="list-style-type: none"> Improper disposal. <p>Other Impacts</p> <ul style="list-style-type: none"> Creation of hard substrate that could be colonised by marine pest species. Recolonisation of a different community to that originally found in the area. 	Minor	Long-term
	b) Hydrotesting of facilities.		Minor	Long-term
	c) Potential rupture of flowline or riser.		Minor	Short-term
	d) Potential diesel spill.		Negligible	Long-term
	e) Potential condensate spill.		Moderate	Temporary
	f) Emergency shutdown of facility.		Minor	Temporary
	g) Discharge of Produced Formation Water (PFW).		Negligible	Long-term
	h) Discharge of cooling water.		Negligible	Short-term
	i) Disposal of waste associated with maintenance of the platforms.		Negligible	Short-term
	j) Disposal of oily water, waste oil, etc.		Negligible	Short-term
	k) Discharge of sewage and greywater.		Negligible	Short-term
	l) Disposal of domestic waste including food scraps.		Negligible	Short-term
	m) Potential collision of shuttle tanker or supply vessels with platforms.		Negligible	Long-term
	n) Operational noise.		Negligible	Long-term
o) Power generation and compression turbines producing greenhouse gases emission to air.	Negligible	Long-term		
p) Hazardous materials	Minor	Long-term		
FSO and Shuttle Vessels	a) Potential spill during condensate transfer to shuttle tankers.	<p>Atmospheric Emissions</p> <ul style="list-style-type: none"> Cargo tank emissions from loading of FSO and shuttle tankers. <p>Discharges to the Sea</p> <ul style="list-style-type: none"> Contamination of marine environment by anti-fouling agents. Introduction of marine pest species from offtake tanker de-ballasting and hullfouling. Potential significant hydrocarbon contamination from condensate spill. <p>Other Impacts</p> <ul style="list-style-type: none"> Interference with shipping. 	Negligible	Long-term
	b) Ballast water discharge from offtake tankers once on site.		Negligible	Long-term
	c) TBT and other antifoulant paints on tankers.		Moderate	Long-term
	d) Vessel hulls fouled with exotic marine organisms.		Moderate	Long-term
	e) Cargo tank venting to atmosphere.		Moderate	Temporary
	f) Potential collision with shuttle tankers or supply vessels.		Minor	Temporary
	g) Power generation emissions.		Negligible	Long-term
	h) Discharge of sewage and greywater.		Negligible	Long-term
	i) Disposal of domestic waste including food scraps.		Negligible	Long-term
	j) Disposal of domestic waste including food scraps.		Negligible	Long-term
Subsea Pipeline	a) Potential rupture of pipeline.	<p>Atmospheric Emissions</p> <ul style="list-style-type: none"> Potential emissions of natural gas in the event of a leak. <p>Discharges to the Sea</p> <ul style="list-style-type: none"> Potential reduction in local water quality due to release of hydrotest water (biocides, corrosion inhibitors and oxygen scavengers).. <p>Other</p> <ul style="list-style-type: none"> Physical presence of pipeline. 	Significant	Long-term
	b) Hydrotesting of pipeline.		Negligible	Temporary
	c) Physical Presence of the pipeline.		Negligible	Long-term

Table ES1d Summary of Potential Environmental Impacts for Decommissioning

Project Component	Source of Impact	Potential Environmental Impact	Effect	Duration
Wellhead Platform, Wells and Associated Subsea Facilities	<ul style="list-style-type: none"> a) Plugging and abandonment of wells. b) Removal of well head. c) Removal of flowlines, manifolds and risers. d) Vessel and rig movements. 	<p>Discharges to the Sea</p> <ul style="list-style-type: none"> ▪ Potential discharge of residual hydrocarbons. ▪ Noise, Vibration, Light and Heat ▪ Disturbance to noise sensitive marine life. <p>Waste to Shore</p> <ul style="list-style-type: none"> ▪ Improper disposal. <p>Other</p> <ul style="list-style-type: none"> ▪ Disruption of benthic communities that have established on and adjacent to the facilities. 	<ul style="list-style-type: none"> Negligible Negligible Negligible Negligible 	<ul style="list-style-type: none"> Short-term Short-term Short-term Permanent
PCUQ Platform and FSO	<ul style="list-style-type: none"> a) Removal of Wellhead Platform components and equipment. b) Jackup and removal of the PCUQ. c) Disconnection of FSO from flowlines. d) Movement of FSO offsite. 	<p>Discharges to the Sea</p> <ul style="list-style-type: none"> ▪ Potential hydrocarbon contamination by oil spillage. ▪ Noise, Vibration, Light and Heat ▪ Disturbance to noise sensitive marine life. <p>Waste to Shore</p> <ul style="list-style-type: none"> ▪ Improper disposal. <p>Other</p> <ul style="list-style-type: none"> ▪ Disruption of benthic communities that have established on and adjacent to the facility. 	<ul style="list-style-type: none"> Negligible Negligible Negligible Negligible 	<ul style="list-style-type: none"> Short-term Short-term Short-term Permanent
Subsea Pipeline	<ul style="list-style-type: none"> a) Abandonment of subsea pipeline. b) Removal of subsea pipeline. c) Potential discharge of residual hydrocarbons 	<p>Discharges to the Sea</p> <ul style="list-style-type: none"> ▪ Potential hydrocarbon contamination by oil spillage. ▪ Noise, Vibration, Light and Heat ▪ Disturbance to noise sensitive marine life and terrestrial fauna. <p>Waste to Shore</p> <ul style="list-style-type: none"> ▪ Disposal (abandonment of subsea pipeline) ▪ Disposal (removal of subsea pipeline) <p>Other</p> <ul style="list-style-type: none"> ▪ Disruption of benthic communities and habitats that have been established on and adjacent to the pipeline. 	<ul style="list-style-type: none"> Negligible Negligible Negligible Moderate Negligible 	<ul style="list-style-type: none"> Short-term Short-term Short-term Permanent Medium Term

Table ES2a Summary of Mitigation Measures for Drilling and Associated Activities

Component	Mitigation Measures
Drilling Rig	<ul style="list-style-type: none"> ▪ Ensure the drilling rig has adequate safety systems such as blowout preventers, alarms and automated shutdown devices which meet regulatory and industry standards and for which adequate maintenance and testing programs are in place; ▪ Ensure the drilling rig has safe operating procedures in place which meet regulatory and industry standards including chemicals and waste management aspects, etc; ▪ Ensure the drilling rig has efficient solids control and mud circulation systems which maximise recycling of drilling fluids; ▪ Ensure the drilling rig has adequate comminution, containment, drainage and monitoring systems to prevent overboard discharges of unpermitted effluents (e.g. oil, or chemical contaminated effluents, whole food scraps and sewage, etc).
Drilling Fluids	<ul style="list-style-type: none"> ▪ Where practicable and possible low toxicity water-based drilling fluid formulations will be used; ▪ Where required lubricity or other fluid properties cannot be achieved using a water-based drilling fluid, a synthetic fluid which is of proven low toxicity will be used.
Crew Induction	<ul style="list-style-type: none"> ▪ Regulatory requirements for drilling operations. ▪ Environmental considerations and special procedures to be used for environment protection in the permit area. ▪ Safety procedures with particular regard for appropriate conduct on vessels and safe use of equipment.
Wildlife Protection	<ul style="list-style-type: none"> ▪ Spotting reports of endangered species ▪ Specifying routes and/or operating procedures for supply vessels and helicopters, which minimise impact on wildlife
Spills Prevention	<ul style="list-style-type: none"> ▪ Safety systems including blowout preventers. ▪ Contained oil and chemical, packaging and storage areas. ▪ Containment around oil and chemical use areas and equipment such as the pipe deck, mud tanks, pumps etc. ▪ Efficient oil/water separators in biges (and ballast tanks where not segregated from containment sources). ▪ Safe fuel transfer procedures from supply vessel to drilling rig eg checking product transfer hoses for leaks, monitoring tank levels etc.
Chemicals and Hazardous Materials	<ul style="list-style-type: none"> ▪ Provision of Material Safety Data Sheets and handling procedures for hazardous chemicals and materials. ▪ Provision of appropriate absorbent material and spill clean-up equipment. ▪ Use of low impact chemicals and materials as far as practicable.
Emergency Response	<ul style="list-style-type: none"> ▪ Oil and chemical spills. ▪ Fire prevention ▪ Diesel or bunker fuel spill.
Waste Management	<p>A project-specific waste management plan will be adopted to address:</p> <ul style="list-style-type: none"> ▪ Discharges to Sea ▪ Solid and Hazardous Waste <p>The release of contaminants to the sea from deck wash will be minimised by ensuring the following:</p> <ul style="list-style-type: none"> ▪ Absorbents and containers are available in the rig to clean up small accumulations of oil and grease around work areas and decks. ▪ Accumulations of oil, grease and other contaminants are collected and removed from the deck prior to every washdown. ▪ Oil-contaminated deck drainage is diverted to a settling tank to allow separation of oil from water
Discharges to Sea	<ul style="list-style-type: none"> ▪ No waste will be disposed overboard except for (a) comminuted sewage and food wastes, (b) drilling cuttings and adherent water-based drilling fluids, (c) excess water-based drilling fluids at the completion of a well or if different properties apply and (d) uncontaminated (in as much as is practicable) deck washdown wastes. ▪ The total volume of discharges will be minimised and recirculation of drilling fluids optimised. ▪ Drill cuttings and fluid discharges will be analysed to avoid oil contamination. ▪ Discharges from essential operations such as grouting of the conductor and surface casing strings for eg cement mixture circulation to seabed, surplus cement fluid etc. To achieve optimal dispersal stage discharges will be implemented eg disposal of excess fluid at the end of well. ▪ Where small amounts of oil additives are added to drilling fluid on a one-off basis, consultation will take place with the Designated Authority on the disposal method – disposal to sea may be considered if concentrations are low, the site environment is suitable and or additional treatment (oil separation) is undertaken.
Air Emissions and Energy Use	<ul style="list-style-type: none"> ▪ Minimise emissions from fired machinery and optimise fuel use efficiency. ▪ Minimise flaring and emissions from production tests. ▪ Optimise flare burner characteristics to ensure maximum burning of all hydrocarbons produced during production test.

Component	Mitigation Measures
Solid and Hazardous Waste	<ul style="list-style-type: none"> ▪ Segregate waste as much as possible and ensure safe storage and labelling of maintenance, chemical packaging, batteries, waste lube oils and other industrial waste for return to shore, recycling and on treatment and disposal in an approved manner. ▪ Collection of all solid domestic waste for return to shore and approved disposal.
Physical Presence of Rig	<ul style="list-style-type: none"> ▪ Advance notification of the presence of the rig to local fishermen and other relevant parties. ▪ Ensure radio watch on shipping traffic and fishing vessels. ▪ Notification of the Australian Maritime Safety Authority of the rig location and anchor distances. ▪ Adequate lighting of the rig.

Table ES2b Summary of Mitigation Measures during Installation and Construction

Component	Mitigation Measures
General Measures	<p>Installation of the platforms will occur over a very short period of time thereby minimising any impacts on the surrounding environment. Mitigation measures will focus on issues such as waste management, air and noise emissions and restriction of the development of the defined project area</p> <ul style="list-style-type: none"> ▪ Charts of the route and notification will be given to marine users prior to construction/installation. ▪ Navigation and safety lighting will be provided to ensure that any shipping or recreational activities are able to clearly identify the presence of activity. ▪ Woodside will confine activities to the minimum development area required to minimise the area impacted. ▪ Work areas will be kept to a minimum with pipeline laying restricted to at most a 10 km width corridor. Within this corridor pipe laying operations will occur with a 1 km corridor in as much as is possible. Any pre-lay rock armour that may be required will be confined to a much smaller area usually 10 m in width. ▪ Woodside will endeavour to minimise all disturbance to marine life and fisheries. However, as no breeding areas are affected by the development impacts will be kept to a minimum. ▪ Minimise all air emissions and discharges. Efficient planning of vehicle and vessel movements will minimise fuel usage. ▪ All waste will be managed in accordance with a project-specific waste management plan and in accordance with current waste legislation. ▪ Any rock dumping along the pipeline route will be kept to a minimum.
Support Vessels	<p>All marine support activities must comply with maritime laws and implement good environmental working standards. These will include the following:</p> <ul style="list-style-type: none"> ▪ All support services are conducted in accordance with relevant legislation and the operating companies requirements. ▪ Refuelling and similar operations will be conducted in accordance with port authority requirements and all hoses, fittings and fail-safe devices will be fully operational. ▪ Efficient oil/water separation in bilges and disposal of clean bilge water in offshore areas, where permitted.

Table ES2c Summary of Mitigation Measures for Commissioning, Operation & Decommissioning

Component	Mitigation Measures
Commissioning	Consideration will be given to controlling and minimising where possible the use of biocides and toxic chemicals contained within the hydrotest water. The chemicals used in the pressure testing will be carefully selected with regard to toxicity.
General Operation and Maintenance procedures	<ul style="list-style-type: none"> ▪ Any areas of spillage and leakage will be promptly reported and necessary maintenance works and control measures undertaken immediately. ▪ All monitoring devices and alarms will be operative. ▪ Adequate process surveillance will be undertaken. ▪ Personnel will be adequately informed of procedures. ▪ Oil Spill Prevention. ▪ Navigation and safety lighting will be provided to ensure that any shipping or recreational activities are able to clearly identify the presence of activity
Spills	<ul style="list-style-type: none"> ▪ Hoses for diesel/ oil/ chemical transfer to be fitted with high reliability breakaway self-sealing couplings. ▪ Mooring hawser to be fitted with quick release hook and load monitoring cell. ▪ Consider designing all flowlines for 1 in 10,000 year storms - provided with shutdown valves and HP/LP sensors. ▪ Spill kits available for clean-up of minor spills. ▪ Facilities for disposal of tanker cleaning products during operation and decommissioning should be considered in design. ▪ Process spill and leak detection, alarm, shutdown and isolation devices will be maintained in good operating conditions. ▪ Efficient containment and separation of contaminated run-off decks, machinery areas and oil/chemical storage areas. ▪ An Oil Spill Contingency Plan (OSCP) has been prepared by Woodside for the Timor Sea. If necessary this OSCP will be amended to meet the specific requirements of the field development.
Emergency Response	Woodside will ensure that the ERP are tested and reviewed at regular intervals and the operational personnel are appropriately informed of emergency procedures and trained to effectively implement them.
Hydrocarbon Loading	<ul style="list-style-type: none"> ▪ All regulatory requirements will be observed including standards for design and application of hardware eg flanges, valves, couplings, fittings etc ▪ Marine operating procedures define acceptable ocean conditions for the tanker to be connected to the transfer hose and for the export of condensate to take place ▪ The transfer hose will be flushed with seawater in the tanker prior to disconnecting in the event of rough weather ▪ Pressure sensors will be installed to detect and trigger alarms for stopping the transfer of condensate to the tanker in the event of a high or low pressure trip. ▪ Flowlines and hoses are certified and tested prior to use. ▪ Dry break couplings will be fitted to hoses. ▪ All fittings and hoses will be routinely inspected and maintained. ▪ All spillages, leaks or points of excessive wear will be properly reported and the necessary maintenance work and control measures undertaken without delay. ▪ All monitoring devices and alarm systems will be fully operative
Chemicals and Hazardous Materials Management	<ul style="list-style-type: none"> ▪ Hydrate Inhibitor Chemical Use ▪ Self-Equalising Subsea Shutdown Valve (SSSVs) ▪ Scale Inhibitor Injection ▪ Minimise need to dose demulsifier/anti-foam agent in separator ▪ Minimise need to dose anti-foaming agent in dehydration and stabiliser ▪ Minimise environmental impact of biocide, corrosion inhibitor, chemical scavenger and dye use in hydrotest water ▪ Minimise environmental impact of release of hydraulic fluid from subsea control systems.
Waste Management	<ul style="list-style-type: none"> ▪ A project-specific waste management plan will be adopted to address: <ul style="list-style-type: none"> ▪ Waste will be labelled appropriately for return to shore where disposal at landfill, or if possible reuse, recycling or recovery will take place. ▪ Discharges to Sea ▪ Solid and Hazardous Waste ▪ As much as possible waste will be segregated into distinct waste streams eg packaging, chemicals, industrial waste, batteries etc and stored in appropriate locations. ▪ Waste will be labelled appropriately for return to shore where disposal at landfill, or if possible reuse, recycling or recovery will take place. ▪ Solid domestic waste will be returned to shore and disposed at an approved landfill.



Component	Mitigation Measures
Discharges to Sea	<ul style="list-style-type: none"> ▪ Discharges will meet oil –in-water standards ▪ Treatment facilities to be of sufficient design capacity to handle PFW, and other oily waters from dirty work areas (deck area drainage, machinery space drainage etc ▪ The effluent discharges from treatment facilities will be monitored by appropriate techniques prior to discharge, and monitoring equipment will undergo periodic checking in accordance with statutory requirements ▪ Cooling water releases will be controlled to avoid thermal effects ▪ As a minimum sewage and food scraps will be comminuted prior to discharge in offshore waters and in accordance with P(SL)A requirements.
Air Emissions/Energy Use	<ul style="list-style-type: none"> ▪ Flaring will be minimised. ▪ Fugitive emission from process equipment will be minimised ▪ Emissions from fired machinery will be minimised and fuel use optimised
Noise, Vibration, Light and Heat	<p>Woodside will attain occupational health standards for noise emissions by installing silencers, cladding and other appropriate noise attenuation controls where practicable. Due to the distance of the facility offshore noise will not be a major issue. Methods for minimising noise, vibration, light and heat impacts are also included.</p>
Marine Support Vessels	<p>All marine support activities must comply with maritime laws and implement good environmental working standards. These will include the following:</p> <ul style="list-style-type: none"> ▪ Goods and materials are properly packaged, labelled for transportation and transfer. ▪ Refuelling and similar operations will be conducted in accordance with port authority requirements and all hoses, fittings and fail-safe devices will be fully operational. ▪ Efficient oil/water separation in biges and disposal of clean bilge water in offshore areas, where permitted. ▪ Comminution of sewage and food waste and disposal in offshore areas only where permitted and containment of sewage and food wastes for onshore disposal when in nearshore waters.
Physical Presence	<p>A 500 m safety exclusion zone will be maintained around the facility and no vessels are allowed to enter or anchor within the zone without the permission. To reduce the risk of collision with vessels using the area, fisheries and shipping are made aware of the presence of facility, flowlines and 500 m exclusion zone. The facility is marked on the Australian navigational charts. Notices issued to shipping and appropriate navigation marker lights are displayed.</p>
Decommissioning	<p>A decommissioning plan will be developed by Woodside in accordance with the guidelines currently being drawn up by the DBIRD. This plan will take into account the concerns and views of other marine users as well as the current and future values of the area. The disposal or reuse/recycling of structures and equipment and the safe decommissioning of wells will also be considered.</p>