# ANGEL PROJECT - COMMISSIONING AND OPERATIONS ENVIRONMENT PLAN SUMMARY

#### **GENERAL**

The Angel Reservoir is a gas-condensate field located on the North West Shelf (NWS) about 50km east of the North Rankin Alpha (NRA) platform within the production licence WA-3-L permit. The licence is operated by Woodside Energy Ltd (WEL) on behalf of the six equal Joint Venture partners - Woodside, BP Developments Australia Pty Ltd, Japan Australia LNG (MIMI) Pty Ltd, BHP Billiton Petroleum (NWS) Pty Ltd, Chevron Australia Pty Ltd and Shell Development (Australia) Pty Ltd.

WEL is expecting to produce first gas from the Angel facility in the third quarter in 2008. This Environment Plan covers the topsides well clean up, commissioning and operational activities.

The platform will be capable of processing 800 MMscf/d of gas from 3 subsea satellite wells, each tied back separately via 14" corrosion resistant alloy lined flowlines. The processed gas will be exported via a 49km, 30" carbon steel pipeline tied into the NWS first trunkline and commingled with production from the NRA facility for onshore processing. The export pipeline ties into the existing 1TL in the vicinity of NRA. Remote operation and power is supplied from NRA.

#### **CO-ORDINATES OF THE ACTIVITIES**

Table 1: Angel Wells, Platform and Pipeline Locations

Well/Platform/Pipeline	e GDA 1994 MGA Zone 50		Nearest Coast (Dampier Archipelago – Legendre Island)
	Northing N	Easting E	km
AP2	459 113.3E	7 845 652.9N	99
AP3	458 571.2E	7 842 615.7N	96
AP4	456 675.6E	7 841 394.1N	95
Centre of Angel platform	457 825.0E	7 843 948.0N	98
End of export pipeline	409 804.2E	7 834 057.5N	~120

### **DESCRIPTION OF RECEIVING ENVIRONMENT**

The Angel Project is located in a subtropical offshore region with average summer temperatures of ~28°C and winter temperatures of ~23°C. The average annual rainfall is ~315mm and generally falls during the summer months. Prevailing winds are predominantly WSW (April-Oct) changing to ESE (May-Sep). On average, 3-4 cyclones are experienced on the NWS (usually Nov-Apr). The major drift current in the North West Shelf region is the Leeuwin Current. The Angel seabed water temperature is around 23°C while surface temperatures may vary from 19-31°C.

Most of the surrounding seabed is flat, featureless and consists of fine to medium silts and sands of varying depths in part overlying a limestone pavement with occasional calcarenite sub/outcrops typical of the NWS. Sampling along the pipeline route shows a dominance of finer particles in the size fraction of <250µm and generally low in metal, total petroleum hydrocarbons and organic carbon content.

Baseline surveys (2002, 2006) of the platform site and export pipeline route respectively concluded the biota and sediments were typical of the NWS, well represented regionally and comprise largely polychaete worms and crustaceans. None of the benthic assemblages observed were of regional conservation significance.

Coral reef systems can be found around the Montebello Islands (~140 km SW of the Angel area, Dampier Archipelago (~95km SW) and the Ningaloo Reef (~400 km SSW).

A variety of endangered and/or vulnerable whales and turtles may travel through the project area such as humpback whales during northbound migrations (Jul-Aug) and southbound to the summer feeding grounds (Aug-Sept). Southbound cow/calf pairs can be as late as early October, but tend to be closer to shallower water. The Angel area is not a known cetacean aggregation, feeding or resting area nor is it close to one. There are no reef structures or landfalls typically associated with high marine productivity, bird or turtle nesting sites or other known areas of biological significance in the vicinity.

The Angel area lies within Zone 2 of the Pilbara Trawl Fishery and Zone 1 of Pilbara Trap Managed Fishery where the fishing intensity is low. There are no sites of historical or cultural significance, known tourist activity or recreational fishing in the immediate vicinity of the Angel project. The platform site is close to the shipping lane for vessels en route to the Lombok Straits.

## **DESCRIPTION OF ENVIRONMENTAL HAZARDS**

Potentially high environmental risks associated with the Angel commissioning and operations include flaring, the discharge of treated formation water and significant hydrocarbon leaks from wellhead /pipeline/flowline/riser failure. High hazards (before mitigation) are summarised in Table 2 below.

Medium impact hazards include the drains discharges, diesel management during commissioning and fugitives / topsides leaks. The management and control of the medium and minor impact hazards (such as accommodation effluent, hydraulic fluid leaks, waste disposal, lights, noise, bird guano etc) are addressed within the Plan.

### SUMMARY OF MANAGEMENT APPROACH

This Environment Plan is aligned with the WEL Environment Management System and policy. In addition, Woodside employs a structured approach to the management of environmental issues via a formal and documented Environmental Management Sub Process System (EMS) which is part of the Woodside Management System and is based on the elements of the ISO 14001: 2004 standard.

### **CONSULTATION AND APPROVALS**

WEL referred the Angel project to the Department of Environment, Water, Heritage and the Arts (DEWHA) in Sept 04 (EPBC 2004,1805) under the *Environment Protection and Biodiversity Conservation Act 1999.* The Minister determined the project as a whole to be a 'controlled action' and to be assessed at the level of 'Preliminary Documentation'. During this process, public consultation was sought and subsequently the Karratha community has also been updated through the Karratha Liaison Group. To date, Angel Drilling, Construction and Installation, and Trunkline Tie-in Environment Plans have been approved by the Designated Authorities.

Representatives from DEWHA, DoIR and AMSA have been consulted during the approvals process and the WA Fishing Industry Council is updated of activities in the area.

### CONTACT

Further information can be provided by contacting Michelle Manook (Corporate Communications) at Woodside Energy Ltd (ph (08) 9348 7181 or email Michelle.Manook@woodside.com.au).

Table 2: High (before Mitigation) Environmental Risks and Controls

Hazard		Potential Impacts	Risk Ranking*	Mitigating Factors and Controls
Flaring	Increased green- house gases, VOCs, soot and smoke	Reduced air quality and increased global warming	High	Commissioning: The Strategy is based around minimal flaring. Deliberate continuous flaring is restricted to early commissioning activities when a small stream of pipeline gas is backflowed into the topsides. Subsequent well clean up flows are exported, flaring only if necessary to prevent pressure excursions/trips. Planned ESD testing and unplanned process trips will result in intermittent flaring.
	Silloke			Operations: Minimised flared volumes through design such as:
				<ul> <li>The Glycol Flash Drum off-gas first passes through the Glycol Stripping Column providing the preferential source of stripping gas. So supplementary stripping gas from the fuel gas system is minimal, greatly reducing operational flaring;</li> </ul>
				Normal platform start up does not rely on flaring - all gas is exported;
				<ul> <li>Number of items of equipment minimised, hence increased reliability and potentially less leak points/fugitives;</li> </ul>
				Flare Knock Out drum liquids returned to the process via flowline risers;
				Remote power supply from NRA;
				<ul> <li>Multi-jet sonic HP flare selected for its track record, long life and low purge requirement;</li> </ul>
				<ul> <li>Entrainment of hydrocarbons into the glycol system minimised by structured packing in the Glycol Contactor, hydrocarbon skimming lines and by superheating and insulating the offgas stream from the Glycol Still Column to prevent condensation. This reduces the liquid entering the flare system thus the likelihood of smoke emissions due to heavy ends.</li> </ul>

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Hazard	Risk	Potential	Risk	Risk   Mitigating Factors and Controls   Mitigating Factors and Controls
Produced Water (PW)	Discharge resulting in acute and chronic toxicity, bioaccumulation and tainting.	Benthos; plankton; comm- unities attached to the infrastruct ure; fish; marine marine mand seabirds	High	<ul> <li>Operations: Design factors to minimize and monitor potential impacts include:</li> <li>The PW system is separated from the glycol drains, avoiding glycol contamination</li> <li>No corrosion inhibitor and no routine biocides or emulsifiers/de-emulsifiers used upstream thus minimising PW toxicity</li> <li>Tie ins for future treatment facilities if required have been provided</li> <li>Continuous on-line Jorin analyser to monitor oil in water concentrations and response strategy in place</li> <li>Provision of manual sampling points at various locations</li> <li>Troubleshooting procedures and competent, trained operators</li> <li>Studies and modeling of existing asset discharges and Angel design volumes suggest any impacts will be limited to the near vicinity of the discharge.</li> <li>Angel comit to the following measures to ensure risk is reduced to ALARP:</li> <li>Compliance with legislative requirements as a minimum;</li> <li>Establishment of environmental baseline data;</li> <li>Periodic full chemical characterisation, ecotoxicity testing and dispersion modelling; and</li> <li>Privingmental assessment of future discharge rates and compositions and channes to current design.</li> </ul>
Potential loss of large quantities of hydrocarbons from wellhead, pipeline or risers risers risers s	Corrosion, trawl board (anchor damage, vessel collision, buckling, overpressure etc resulting in significant failure	Increased green- house gases, loss of renewable resources, impact on biota and habitats, loss of water quality	HIgh	Well failure prevention through provision of numerous primary and secondary barriers (SSSV, Production Master Valve, Swab Valve, Tree Cup, Production Shutdown Valve, Production Wing Valve etc)  ESD system design and Cause and Effects actions to limit inventory affected  Routine and emergency procedures and strategies - Maintenance Strategy, Emergency Response Plan (ERP), Blowout Response Plan , Oil Spill Contingency Plans, Production/Operations Procedures, Specific controls for work-over or re-entry operations  Exclusion zone around wellheads with no anchoring in exclusion area gazetted and shown on navigational charts  Continuous monitoring of wellhead flow temperature, pressure, sand and flow rates  Routine ROV surveys  Populine Enowlines and Flissers:  Design (including flowlines designed as stainless steel and pipeline as carbon steel, external concrete coating, external corrosion protection, armouning in dropped object hazard zone, welding procedures and hydrate inhibition protection over pipeline crossings etc)  Periodic inspections (including routine ROV and post cyclone, NDT, inspections based on KPI exceedences eg intelligent pigging etc)  Periodic inspections (including routine ROV and post cyclone, NDT, inspections based on KPI exceedences eg intelligent pigging etc)  Periodic inspections (including routine ROV and Road Beacon (RACON). AMSA advises the recommended shipping route northwards to Lombok Straits is shown on Riser splash zone corrosion protection via corrosion resistant alloy (Monel) external cladding  Pipeline Integrity Management Plan and Maintenance Strategy  Automatic Identification System (AIS) and Radar Beacon (RACON). AMSA advises the recommended shipping route northwards to Lombok Straits is shown on example as reduced acknowled assistants afform. Flowline (APS) located outly edopped object protection zone for normal laydown area. Other flowline is consistent to itser location. Flowline (APS) located outly endopped object protection or laydown areas with respect to riser location.
*Before Mitigation	ination			The approved Oil Spiil Contingency Plan (ERP 3210), Pipeline ERP Plan and Angel ERP are in place. Angel Is ~100km from the nearest shallow water/coastline.

\*Before Mitigation