

## Public Summary

### Zagreus-1 Exploration Drilling Program – Atwood Osprey

This Environmental Plan public summary for the Chevron Australia Pty Ltd (Chevron) exploration drilling program has been submitted to the Western Australia Department of Mines and Petroleum (DMP) to comply with Regulations 11(7) and 11(8) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations).

#### INTRODUCTION

Chevron is to drill one exploration well, Zagreus-1, within Exploration Permit WA-40-L. The well will be located in the Greater Gorgon Area of the North West Shelf. The permit area is located on the continental slope of northwestern Australia, approximately 180 km north of North West Cape (Figure 1).

Drilling of the Zagreus-1 well is scheduled to start in mid May 2011 and take approximately 54 days to complete, including mobilisation and demobilisation. Drilling operations will be undertaken using the Atwood Oceanics Pacific Pty Ltd Atwood Osprey semi-submersible rig. Drilling operations will be conducted on a 24 hour basis.

#### COORDINATES OF THE ACTIVITY

The Exploration Permit and Zagreus-1 well locations are shown on Figure 1. Table 1 provides the coordinates for Zagreus-1.

**Table 1:**  
**Coordinates of Exploration Well (Datum: GDA94)**

Well Name	Latitude	Longitude
Zagreus-1	20° 08' 7.21 S	114° 06' 58.76 E

#### DESCRIPTION OF ACTIVITY

Chevron is to conduct drilling operations to evaluate deep reservoirs for potential gas reserves within Exploration Permit WA-40-L. The drilling will be undertaken using Atwood Oceanics Pacific Pty Ltd's *Atwood Osprey* semi-submersible rig. The well will be drilled to a total depth of approximately 4,160 m, and after evaluation, will be plugged and abandoned.

All operations will be conducted in accordance with relevant Acts and regulations to meet the requirements of the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act).

The well has been designed in accordance with Chevron Standards, accepted industry practices and DMP regulatory requirements. The well will be suitable for all conditions that might be expected during drilling operations. Drilling will be conducted to a target depth of 2,974 m below the seabed. Cores will also be taken in targeted reservoirs in the well. The well design to be applied to the Zagreus-1 exploration well is as follows:

- ◆ 1067 mm (42") hole drilled for 914 mm (36") casing set at approximately 59 m BML. Drilled using sea water with high viscosity sweeps.
- ◆ 444 mm (17 ½") hole drilled for 340 mm (13 ⅜") casing set at approximately 957 m BML. Drilled using sea water with high viscosity sweeps.

- ◆ 311 mm (12¼”) hole drilled for 244 mm (9⅝”) casing set at approximately 1,841 m BML. This section will be drilled with a synthetic-based drilling fluid (synthetic-based mud (SBM)).
- ◆ 216 mm (8 ½”) hole drilled to approximately 2,974 m BML using SBM.

The upper sections of the well (42 and 17 ½” hole sections) will be drilled riserless, using seawater with high viscosity (bentonite) sweeps. Bentonite is an inert natural clay of very low toxicity, and these fluids are expected to have minimal offshore environmental effect.

The remaining sections of the well will be drilled with a marine riser and Blow-Out Preventers (BOP) installed, using SBM.

The SBM to be used may contain either Saraline 185V base fluid, a linear alpha olefin (LAO) base fluid, or a blend of these two base fluids. These SBMs, which have low environmental toxicity and are readily biodegradable under aerobic conditions, have been previously used during exploration drilling undertaken by Chevron following approval by the Western Australian Department of Mines and Petroleum (DMP).

During top hole drilling, while using seawater with high viscosity sweeps, the cuttings/drilling fluid will be returned at the sea floor. Following connection of the riser, drill cuttings will be returned to the surface and drilling fluid recovered for recycling. After separation from the drilling fluid, cuttings will be discharged overboard. No whole SBM will be discharged during the drilling program.

On completion of the upper hole sections, steel pipe casing will be inserted and the gap between the casing and the hole will be sealed with cement. Cementing fluids are not routinely discharged to the environment during this operation, although very small amounts will be unavoidably released when the cement mixture is circulated to the seabed during grouting of the surface casing strings, during cementing operations.

At the completion of drilling, the well will be abandoned in accordance with the requirements of the OPGGS Act and industry best practice.

## **DESCRIPTION OF RECEIVING ENVIRONMENT**

### **Natural Environment**

#### ***Bathymetry and Seabed Features***

The Zagreus-1 well is located on the continental slope in water depths of approximately 1,200 m. There are no significant or shallow seabed features apparent in bathymetry data available for this area. The well is located 160 km from Barrow Island and 180 km from the mainland (North West Cape being the closest point). The substrate of the permit area is likely to be typical of that of the continental slope, which mainly consists of muddy sediments, which can form terraces, canyons and steep shelf breaks (DEWHA 2008).

#### ***Metocean Conditions***

The region is generally characterised by two seasons; summer (September–April) and winter (May–August). The climate in winter is dominated by intense anti-cyclonic belts (high pressure systems) which generate strong winds (predominantly from the east and south-east) and infrequent rain. Summer conditions are more variable, with varying wind directions (although south-westerly winds are the most common).

Tropical cyclones occur in the region, with an average of five per year. According to the Bureau of Meteorology, the Australian region tropical cyclone season runs from 1 November to 30 April. These are unpredictable in occurrence, intensity and behaviour, but are most common between December and March. Tropical cyclones can generate extreme seas and swell.

The Zagreus-1 well will be drilled during the winter season and outside of cyclone season.

### ***Benthic Assemblages***

There is limited information concerning the benthic communities of the drilling area, due primarily to the remoteness and water depths of the area. However, the biological productivity of the benthic environment is expected to be limited due to low light availability at depth, low nutrient availability and limited extent of exposed hard substrata. The seabed is likely to comprise predominantly unconsolidated soft sediments inhabited by sparse communities of relatively large benthic species (crustaceans, molluscs and sponges). Infaunal communities are likely to be composed of smaller burrowing invertebrates. Any areas of exposed hard substrate that occur may support more diverse assemblages, including deep water filter feeding organisms, such as hydroids and sponges.

### ***Macrofauna***

Some marine migratory species with broad distributions, such as cetaceans, fish, sharks, sea turtles and seabirds, may traverse the permit area occasionally. According to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters database, eight species listed as Threatened and 14 listed as Migratory may occur in the area. These include two species of shark, five species of marine turtles, one bird (petrel) species and six cetacean species.

However, the permit area does not contain recognised critical habitat for any Threatened or Migratory fish, sharks, sea turtles, cetaceans or seabirds.

### Fish

A number of sharks and pelagic finfish, including mackerels, tunas and billfishes, and the listed longfin mako (*Isurus paucus*) and shortfin mako (*Isurus oxyrinchus*) sharks occur in the waters of the continental slope and would be expected to occur in the permit area. Due to this habitat being widely represented along the North West Shelf, it is not expected that the permit area is of particular significance to sharks and finfish.

### Birds

The Southern Giant Petrel (*Macronectes giganteus*) is listed as Endangered under the EPBC Act and may be found in the permit area. The Southern Giant Petrel breeds in the sub-Antarctic waters during the summer, while in winter most disperse north from 50°S to the tropic of Capricorn and sometimes beyond. The Tropic of Capricorn is located some 400 km south of the permit area; therefore the Southern Giant Petrel is not expected to be present in the permit area in significant numbers during any time of the year.

### Marine Turtles

Five species of marine turtles may occur in the permit area: green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), flatback (*Natator depressus*), hawksbill (*Eretmochelys imbricata*) and loggerhead (*Caretta caretta*) turtles, all of which are listed as Vulnerable under the EPBC Act, with the exception of the loggerhead turtle, which is listed as Endangered. Marine turtles, particularly green turtles, undertake extensive migrations and low numbers of individuals may transit the permit area. Migration and nesting activity generally occurs between September and April. The permit area does not contain any emergent land or shallow sub-tidal features, which is a requirement for nesting and feeding. The nearest known breeding or feeding site of importance to turtles is located at Barrow Island, 160 km to the southeast of the Zagreus-1 well. It is therefore unlikely that significant numbers of turtles will occur within the permit area at any time during the drilling program.

## Cetaceans

Several species of cetaceans are known to frequent the waters of the North West Shelf, including the blue whale (*Balaenoptera musculus*), which is listed as Endangered, and the humpback whale (*Megaptera novaeangliae*), which is listed as Vulnerable under the EPBC Act.

The humpback, which is the most common whale species in the region, migrates between Antarctic waters and the Kimberley each winter to mate and breed. Humpback whales pass Barrow Island and the Montebello Islands (160 km to the south-east) during their northbound migration from June to mid August, and between mid September until the end of November during their southbound migration.

The permit area is outside (seaward) of the main humpback migration routes and distant from the nearest known whale aggregation areas. Therefore, the likelihood of humpback whales occurring in significant numbers in the permit area is very low.

Blue whale migration patterns are similar to those of the humpback whale, with the species feeding in mid-high latitudes (south of Australia) during the summer months and temperate/tropical waters in the winter for mating and breeding. However, the blue whale tends to be more widely dispersed and rarely present in large numbers outside aggregation areas. The permit area does not include any recognised blue whale migratory routes or known feeding, breeding or resting areas, hence the likelihood of encountering significant numbers of blue whales during drilling operations is very low.

Five additional species listed as migratory species under the EPBC Act may occur in the drilling area on occasion: the Antarctic minke whale (*Balaenoptera bonaerensis*), Bryde's whale (*Balaenoptera edeni*), killer whale (*Orcinus orca*) sperm whale (*Physeter macrocephalus*) and the spotted bottlenose dolphin (*Tursiops aduncus*). Given their widespread distributions and the absence of particular bathymetric features in the area, the permit area is unlikely to represent important habitat for any of these species.

## **Social and Economic Environment**

### ***Petroleum Activities***

The North West Shelf supports extensive petroleum exploration and production activities. The petroleum industry has developed major production operations on Thevenard, Airlie, Barrow and Varanus islands. The nearest land-based production facility is situated on Barrow Island, which is 160 km southeast of the Zagreus-1 well and the nearest offshore facility will be the Atwood Eagle under contract to Chevron on the West Tryal Rocks-4 well, approximately 105 km east of the Zagreus-1 well.

### ***Fisheries***

The permit area overlaps with several authorised commercial fishing zones.

The following Commonwealth managed fisheries are authorised to operate in the area:

- ◆ Western Tuna and Billfish Fishery
- ◆ North West Slope Trawl Fishery
- ◆ Southern Bluefin Tuna Fishery
- ◆ Western Skipjack Tuna Fishery

In addition, state managed fisheries are permitted to operate in waters within and adjacent to the permit area and include:

- ◆ WA Northern Shark Fishery
- ◆ Mackerel Managed Fishery

Consultations with the Australian Fisheries Management Authority (AFMA), the Department of Fisheries (Western Australia), the Western Australian Northern Trawl Owners Association and TunaWest however indicate that fishing activity in the permit area is low due to water depths, remote location, distance offshore and often unpredictable weather.

### ***Shipping***

Commercial vessels traverse the waters of the permit area. However, the Australian Maritime Safety Authority (AMSA) has confirmed that the Zagreus-1 well is not located within or adjacent to any major shipping route, and that shipping densities in the vicinity of the Zagreus-1 well location are low. There are no bathymetric features or navigational hazards that would restrict vessels from avoiding the rig.

The *Atwood Osprey* is a moored semi-submersible rig. The support vessels will provide assistance to the *Atwood Osprey* for the entire campaign, to provide back-up radar coverage and radio communication. In addition, a Notice to Mariners is issued by AMSA for each drilling location. As a result, the likelihood of interaction with ships in the permit area is extremely low.

### ***Recreational and Tourism Activities***

The distance offshore, unpredictable weather, and deep waters of the Zagreus-1 well location are likely to preclude recreational fishing and charter vessel activity in the area. Consultation has not identified any recreational activities in the permit area.

### ***Marine Protected Areas***

There are no marine protected areas within the permit area. The nearest marine protected areas are the Barrow Island Marine Management Area (160 km from the well location) and Muiron Islands Marine Management Area (170 km from the well location).

### ***Defence Practice Areas***

The permit area overlaps with the Learmonth military restricted airspace area. The Learmonth RAAF base is maintained in an operational condition to allow it to receive an operational squadron at short notice (Department of Defence 2011). The base also regularly serves as a refuelling station for RAAF aircraft.

Any plans by the Department of Defence to re-activate Learmonth Airport to a fully operational military condition will be managed by Chevron through regular liaison with the Department of Defence during drilling operations.

### ***Cultural Heritage***

No features of cultural heritage importance were identified within the permit area or any area that may be affected by the drilling program.

## **MAJOR ENVIRONMENTAL HAZARDS AND MANAGEMENT APPROACH**

A risk analysis was undertaken for all aspects of the program, in accordance with the procedures outlined in the Australian and New Zealand Standards (AS/NZS ISO 31000:2009) (Risk Management) and HB 203:2006 (Environmental Risk Management), and based on the Chevron Integrated Risk Prioritization Matrix. The risk analysis has enabled Chevron to determine likelihood and severity of risks associated with the survey and to evaluate the resultant environmental risks and effects (Table 1).

The risk analysis indicates that the risks of significant adverse environmental impacts from the program are very low.

The environmental management approaches relevant to key aspects of the program and the residual risk after management implementation are summarised in Table 1. The drilling program will be conducted in accordance with all legislative and regulatory requirements. Chevron's overall environmental objective for the program is to avoid or minimise environmental risks to as low as reasonably practicable (ALARP).

**Table 1: Summary of Potential Major Environmental Risks and Management Approach**

Aspect (Stressor)	Event/ Incident	Potential Environmental Impact	Risk Level AND Management Approach
<b>PLANNED OPERATIONS</b>			
Physical disturbance of seabed	Discharge of cuttings	Smothering of sensitive or ecologically important benthic communities	Very low risk. Cuttings discharged near the surface to maximise dispersion. Volume of base fluid on cuttings <10% by dry weight (measured and recorded daily) averaged over each hole section drilled.
	Drilling of wells	Loss of sensitive or ecologically important benthic communities	Very low risk. N/A.
	Anchors on seabed	Potential localised disturbance to benthic habitat	Very low risk. Minimal anchor slippage before anchor set at predetermined tension from mooring analysis. Adherence to anchoring procedures.
Waste discharges	Discharge of whole drilling fluid	Acute/chronic toxicity effects to marine life Reduction in water quality leading to adverse effects on marine life	Very low risk. Seawater with high viscosity sweeps discharged at seabed during riserless drilling. Recycling or return of recovered SBM to shore based storage, no discharge of whole SBM to sea. Selection of fluids with acceptable toxicity and biodegradation characteristics, approved by DMP.
	Discharge of cuttings with adhered drilling fluid	Acute/chronic toxicity effects to benthic communities	Very low risk. Volume of base fluid on cuttings <10 % by dry weight (measured and recorded daily) averaged over each hole section drilled Selection of fluids with acceptable toxicity and biodegradation characteristics, approved by DMP.

Aspect (Stressor)	Event/ Incident	Potential Environmental Impact	Risk Level AND Management Approach
	Discharge of soapy SBM tank wash	Acute/chronic toxicity effects to benthic communities Reduction in water quality leading to adverse effects on marine life	Very low risk.  Automated tank wash system for cleaning of SBM tanks to ensure minimal loss of SBM.  Discharge water to the sea contains <1% residual SBM.
	Discharge of hydrate management fluid (glycol and possibly methanol)	Acute/chronic toxicity effects to benthic communities Reduction in water quality leading to adverse effects on marine life	Very low risk.  35 L or less of glycol used each week while the BOPs are connected.  Less than 92.5 L of glycol discharged per wellhead disconnect.  Less than 50 L of methanol discharged per well, if used.
	Disposal of sewage and putrescible wastes	Reduction in water quality leading to adverse effects on marine life	Very low risk.  Treated galley waste to be macerated to less than 25mm before discharge to sea in accordance with MARPOL 73/78.  Sewage to be treated onboard in accordance with MARPOL 73/78 prior to discharge.
	Disposal of grey water	Reduction in water quality leading to adverse effects on marine life	Very low risk.  Grey water to be treated onboard in accordance with MARPOL 73/78 prior to discharge
	Disposal of solid wastes (garbage)	Reduction in habitat/ water quality from incorrect disposal	Very low risk.  Mainland recycling or disposal of wastes in accordance with the Waste Management Plan and MARPOL 73/78
	Disposal of deck drainage	Reduction in water quality leading to adverse effects on marine life.	Very low risk.  Closed deck drainage system to holding tanks where clean water discharged overboard, and contaminated water directed to oil-water separator and discharged in accordance with MARPOL 73/78. Drill floor drainage treated and discharged in accordance with MARPOL 73/78.
	Discharge of cementing fluids	Reduction in habitat / water quality.	Very low risk.  N/A.
	Discharge of cooling water	Effects to marine life from elevation in sea temperature	Very low risk.  Cooling water discharged above sea level.

Aspect (Stressor)	Event/ Incident	Potential Environmental Impact	Risk Level AND Management Approach
	Discharge of hydraulic fluid	Reduction in habitat / water quality.	Very low risk Low volume of low toxicity, biodegradable hydraulic fluid. Highly diluted.
	Discharge of oily water	Acute/chronic toxicity effects to marine life	Very low risk. Discharge in accordance with MARPOL 73/78. No discharge of oily (>15 ppm hydrocarbons) bilge water.
Physical Interaction	Movement of rig/support vessels/ helicopter	Disturbance/ casualty to sensitive fauna from collision	Very low risk. Adherence to procedures for moving the rig. Cetacean watch is maintained on all transits to/from port and during drilling activities. All vessels to maintain a minimum distance of no closer than 300 m from cetaceans.
	Presence of rig at well site	Displacement / disruption of other users of marine environment	Very low risk. Notice to Mariners posted. Liaison with relevant authorities, fishermen and other commercial mariners to minimise conflict. Compliance with APPEA Code of Environmental Practice 2008.
Light spill	Artificial lighting from rig and support vessels	Alteration of sensitive marine fauna behaviour due to attraction to and/or deterrence of artificial lighting.	Very low risk. Lighting minimum required to meet safety regulations. Compliance with APPEA Code of Environmental Practice.
Noise and vibration emissions	Noise from drilling	Disruption to behaviour patterns (attraction/ deterrence) of sensitive marine fauna	Very low risk. Reporting of sightings of cetaceans and marine turtles to DSEWPaC.
	Noise from rig/ support vessel movements/ positioning	Disruption to behaviour patterns of sensitive marine fauna	Very low risk. Maintain cetacean watch on all transits.
	Noise from helicopter	Behavioural disturbance to sensitive bird species	Very low risk. Compliance with EPBC Regulation 8.07 and APPEA Code of Environmental Practice 2008.



Aspect (Stressor)	Event/ Incident	Potential Environmental Impact	Risk Level AND Management Approach
	Noise from VSP	Disruption to behaviour patterns of sensitive marine fauna Physiological damage to sensitive marine fauna	Very low risk. No VSP operations start if cetaceans observed within 3 km of rig. Soft-start procedures implemented over 20 minutes. VSP operations stop if a whale is seen within 500 m of acoustic source. Day-time start for VSP where possible. Night-time VSP (if unavoidable) must be preceded by 2 hours of 'cetacean free' observations during daylight when no cetaceans are sighted.
Atmospheric emissions	Emissions from engines	Reduction in air quality	Very low risk. Engines are maintained to manufacturers' specifications.
	Waste incineration emissions	Reduction in air quality	Very low risk. Onboard incineration in accordance with the rig's Waste Management Plan and MARPOL 73/78.
Quarantine	Movement of rig into Australian waters	Introduction of exotic marine species	Very low risk. Compliance with AQIS Australian Ballast Water Management Requirements 2001 and National Biofouling Management Guidance for the Petroleum Production and Exploration Industry 2009. Vessel and rig hull cleaning and inspection prior to departing Singapore
<b>UNPLANNED OPERATIONS</b>			
Physical disturbance of the seabed	Failure in drilling fluid system	Smothering of sensitive benthic communities	Very low risk. Adherence to Petroleum Guidelines – Drilling Fluid Management (DoIR 2006).
Leaks and spills	Spill of chemical to sea	Acute toxic effects to marine fauna	Very low risk. Compliance with storage and handling procedures and spill contingency plan. Bunding in storage areas and drains plugged as per rig requirements.
	Failure in drilling fluid system	Acute toxic effects to marine fauna	Very low risk. Volumes of base fluid on discharged cuttings <10 % by dry weight of base fluid on cuttings averaged over each hole section drilled.

<b>Aspect (Stressor)</b>	<b>Event/ Incident</b>	<b>Potential Environmental Impact</b>	<b>Risk Level AND Management Approach</b>
	Loss of drilling fluid during transfer	Acute toxic effects to marine fauna/ reduction in water quality	<p>Very low risk.</p> <p>Bulk Fluid Transfer Procedure.</p> <p>Restrict procedure to daylight wherever possible.</p> <p>All transfers in accordance with procedures.</p> <p>Reinforced hoses with dry break couplings and safety break away couplings.</p> <p>Continuous monitoring of pressures and flow rates.</p>
	Loss of diesel during refuelling	Acute toxic effects to marine fauna/ reduction in water quality	<p>Very low risk.</p> <p>Strict adherence to rig's refuelling procedure</p> <p>Operation restricted to daylight wherever possible.</p> <p>Approved Marine Oil Pollution Plan (MOPP).</p> <p>Australian Marine Oil Spill Centre (AMOSC) oil spill resources available offsite.</p> <p>Reinforced hoses with dry break couplings and safety break away couplings.</p> <p>Continuous monitoring of pressures and flow rates.</p>
	Loss of diesel through rupture of support vessel or rig fuel tanks	Acute toxic effects to marine fauna/habitat/ reduction in water quality	<p>Very low risk.</p> <p>Approved MOPP.</p> <p>Well-lit rig will include all required navigation lighting and radar.</p> <p>The standard 500 m radius exclusion zone will be established around the drilling rig.</p> <p>Notice to Mariners warning of the presence of the rig will be broadcast.</p> <p>Support vessels provide back-up radar coverage and radio communication.</p>
	Loss of well control	Acute toxic effects to marine fauna/ reduction in water quality	<p>Low risk.</p> <p>Rated BOPs installed for the well.</p> <p>BOP stack tested as per schedule.</p> <p>Approved MOPP in place and supplemented by Oil Spill Operational Response Plan (OSORP).</p> <p>AMOSC oil spill resources available offsite.</p>

## **CONSULTATION**

Consultations have been undertaken with the following stakeholders:

- ◆ Australian Fisheries Management Authority (AFMA)
- ◆ Australian Maritime Safety Authority (AMSA)
- ◆ Western Australia Department of Fisheries
- ◆ Commonwealth Fisheries Association
- ◆ Australian Southern Bluefin Tuna Industry Association
- ◆ A. Raptis and Sons
- ◆ JAMACLAN Marine Services
- ◆ TunaWest
- ◆ Recfishwest
- ◆ Western Australian Fishing Industry Council
- ◆ Western Australian Northern Trawl Owners Association
- ◆ Western Australia Seafoods.

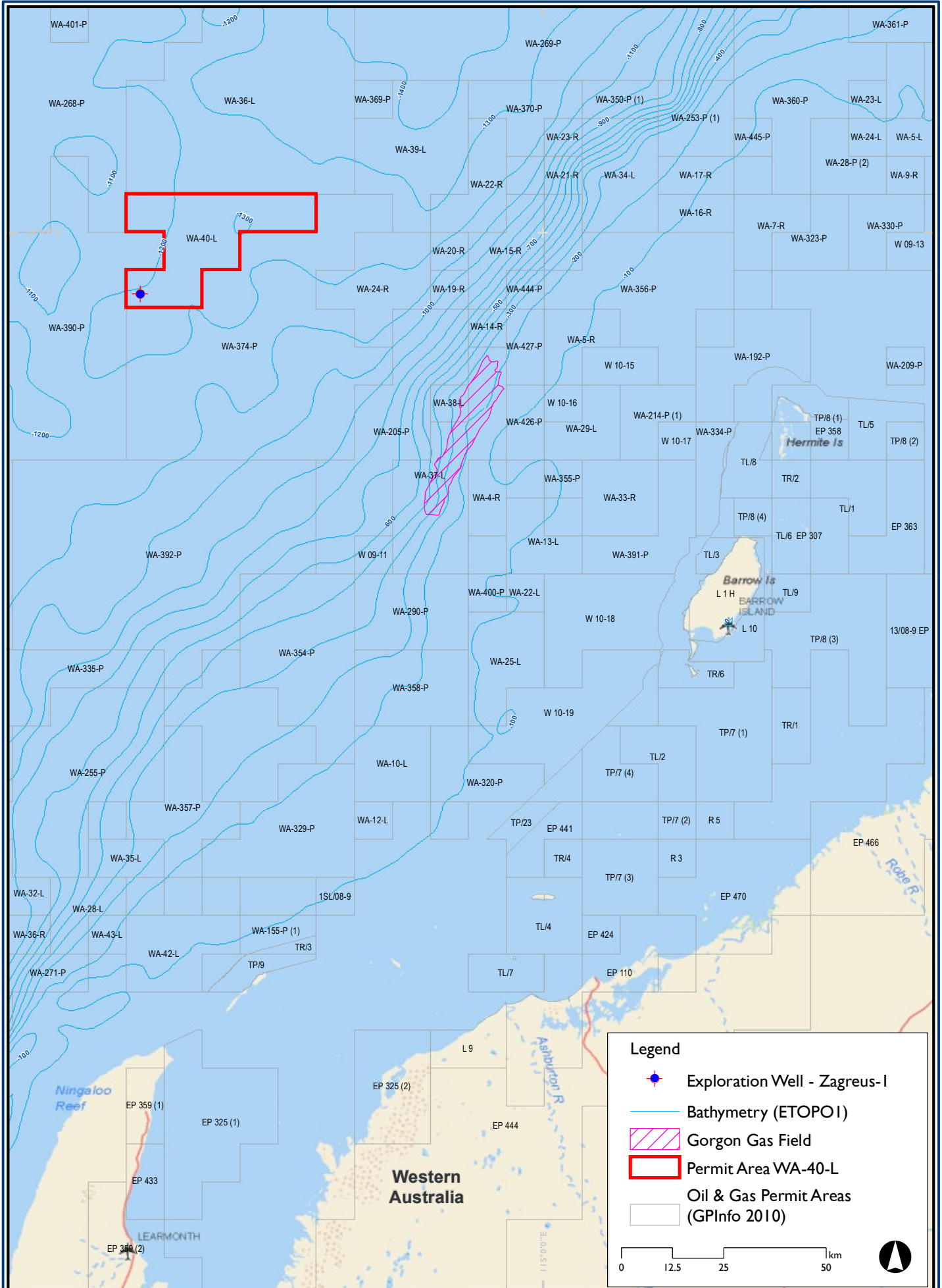
The consultations have confirmed that commercial and recreational fishing activity in the area is absent or at very low levels, and that the drilling area does not overlap with the any main international shipping routes.

## **CONTACT DETAILS**

The proponent is Chevron Australia Pty Ltd.

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 Source: ESRI Resource Centres, GP Info, Bathymetry derived from ETOPO1 global relief model, Woodside



Figure 1

Proposed Well Location