Nerites Multi Client 3D Marine Seismic Survey

ENVIRONMENT PLAN SUMMARY

TGS

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NERITES MULTI CLIENT 3D MARINE SEISMIC SURVEY, ENVIRONMENT PLAN SUMMARY

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1 INTRODUCTION

The geophysical company TGS proposes to undertake a multi-client three-dimensional marine seismic survey ('the survey'), known as Nerites, within the Great Australian Bight (GAB) off South Australia (SA) in the Ceduna sub-basin (**Figure 1**). The survey includes sections of petroleum permits EPP 37, EPP 39, EPP 40, EPP 44 and EPP45.

The survey is scheduled to occur in two stages; the first stage between the beginning of January 2014 and the end of June 2014, and the second between the beginning of October 2014 and the end of June 2015. Combined over the two stages, the total survey duration is intended to be approximately 430 days. Water depths in the survey area range from 750 m to 3,500 m.

This document provides a summary of the Environment Plan (EP) that was accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) as part of the requirements under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Environment Regulations). This EP summary has been prepared as per the requirements of Regulation 11 (7) and (8) of the Environment Regulations.

2 LOCATION OF THE ACTIVITY

The proposed survey is located entirely within Commonwealth waters in the Ceduna sub-basin south of South Australia. The survey area comprises approximately 25,460 km^2, with vessel turning activities and line run-outs (in order to acquire full fold data) during normal operations occurring within a 15 km buffer zone at the northwest and southeast ends of the proposed survey area.

The Nerites survey area includes sections of petroleum permits EPP 37, EPP 39, EPP 40, EPP 44 and EPP45. Boundary coordinates for the survey area are provided in **Table 1**.

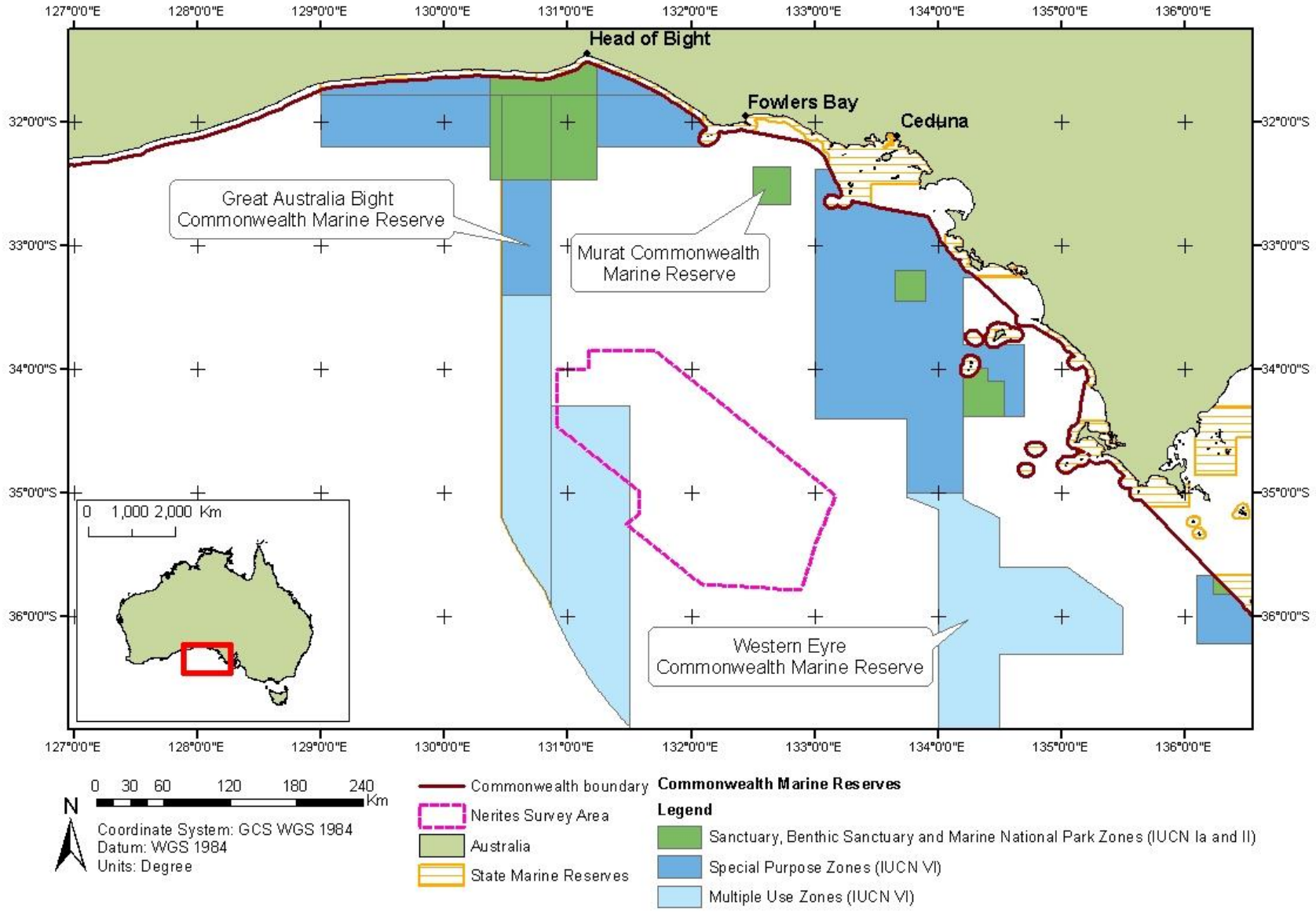
Table 1: Co-ordinates for the Nerites survey area

Longitude	Latitude
132.8898	-35.7862
132.0875	-35.7329
131.4613	-35.2485
131.5690	-35.1522
131.5690	-35.1521
131.5692	-35.1520
131.5693	-34.9898
130.9029	-34.4632
130.9027	-33.9979
131.1661	-33.9957
131.1671	-33.8414
131.6503	-33.8434
133.1662	-35.0181
132.8898	-35.7862

Datum: GDA94

At the closest point, the survey area is located approximately 190 km west of the Eyre Peninsula (SA), 270 km south-west from Ceduna and 180 km away from the nearest mainland (**Figure 1**).

Figure 1: Nerites survey location and designated marine protected areas within the GAB



3 DESCRIPTION OF THE ACTIVITY

3.1 Survey Parameters

The marine seismic survey proposed is a typical 3D survey similar to most others conducted in Australian marine waters (in terms of technical methods and procedures). No unique or unusual equipment or operations are proposed. The survey will be conducted using a purpose-built seismic survey vessel.

The survey vessel will traverse the sail lines within the survey area at a speed of approximately 8-9 km/hr. As the vessel travels along the survey lines a series of noise pulses (every 10 seconds) will be directed down through the water column and seabed. The released sound is attenuated and reflected at geological boundaries and the reflected signals are detected using sensitive microphones arranged along a number of hydrophone cables (streamers) towed behind the survey vessel. The reflected sound is then processed to provide information about the structure and composition of geological formations below the seabed in an attempt to identify hydrocarbon reservoirs.

The seismic array will comprise a maximum of twelve seismic cables, with a maximum length of 8.1 km. The seismic cables are towed side by side and the spacing will be 100 - 150 m between each seismic cable. The seismic energy source tow depth will be 7 m (+/- 1 m) and the cable tow depth will be 9 m (+/- 1 m). The operating pressure for the seismic energy source will be approximately 2,000 psi and the source will be deployed in two arrays, each with an intended volume of approximately 4,130 cui.

These arrays will be activated alternately, every 25 m (i.e. 50 m per array). It was determined that to image the deeper targets within the Nerites survey area, the minimum source size that would achieve the required output to meet the geophysical objectives of the survey would be 4,130 cubic inches. A 4,130 cui array has been modelled by Curtin University Centre for Marine Science and Technology (CMST) to produce a sound energy level of 229dB re 1µPa2.s (at approximately 1m from the source) (BP, 2011) at frequencies extending up to approximately 200 Hz. These sound pulses decrease to levels in the order of 200 dB re 1µPa (SPL) within 1 km of the source and approximately 150 dB re 1µPa (SPL) within 10 km, dependent on the sound propagation characteristics of the area.

3.2 Survey Vessels

TGS proposes to conduct the survey using a purpose-built seismic survey vessel. At least one support vessel will accompany the seismic survey vessel at all times to maintain a safe distance between the survey array and other vessels and manage interactions with shipping and fishing activities if required. Support vessels will also re-supply the seismic survey vessel with logistical supplies including refuelling as necessary.

4 DESCRIPTION OF THE ENVIRONMENT

4.1 Regional Setting

The survey area lies entirely in Commonwealth marine waters of the South West Marine Region (SWMR) in the Bight Basin (Ceduna & Polda sub-basins) covering water depths between 750 m to 3,500 m. The nearest point of the survey area is located approximately 190 km west of the Eyre Peninsula (SA) and 270 km south west from Ceduna.

The GAB forms part of the Southern Shelf of Australia, which is the northern boundary of the South Australian Basin of the South East Indian Ocean. The Southern Shelf has a maximum width of about 200 km in the central Great Australian Bight and narrows to about 20 km south of Western Australia and on the Bonney Coast of South Australia. The South Australian Basin has an abyssal plain of depth about 5.5 km. Along the Southern Shelf of the GAB and the Bonney Coast, in particular south of the Eyre Peninsula, 25 large and steep canyons connect the continental slope and the abyssal plain over a depth range of 1-5 km (Bye, 1998). The continental shelf is almost featureless, forming a gentle sloping plain out to the shelf break at 125-165 m depth (Edyvane, 1998).

The outline of the continental slope is broken by a major terrace (Ceduna Terrace) and two minor terraces (Eyre and Beachport Terrace) (Willcox *et al*., 1988). The Ceduna Terrace is a sigmoidal shaped feature, up to 130 km wide and 600 km long, and is located between 1,000-2,500 m and is dissected by numerous submarine valleys. The Eyre Terrace lies at depths of 400-1,600 m (Edyvane, 1998).

4.2 Physical Environment

The climate of the coastal area of the GAB is typically semi-arid or Mediterranean and is characterised by hot, dry summers and cool, wet winters. It is largely influenced by mid-latitude anticyclones or high pressure systems, which pass from west to east across the continent.

Mean monthly maximum temperatures on the coast range from 26°C in January to 18°C in July at Eucla and from 28°C in January to 17°C in July at Ceduna (Edyvane, 1998).

A seasonal, atmospheric cyclonic cycle maintains a high pressure ridge over the South Australian Basin in summer, resulting in predominantly south-easterly winds. The south-easterly winds are interrupted by meridional (in a north-south direction) wind patterns, in which hot air is advected southwards over the sea (Bye, 1998). In winter, an anticyclonic centre lies over central Australia inducing westerly winds across the GAB (Bye, 1998). The nearest wind station to the survey area (to the west of the northern part of EPP 37) has an average wind speed of 14.72 knots/7.57 ms^{-1}, and maximum wind speed of 44 knots/22.6 ms^{-1} per annum (BP, 2012).

Open seawater temperatures in the GAB vary from a mean summer sea surface temperature of 18°C to a mean winter sea surface temperature of 14°C (decreasing to 11-12°C under the influence of upwellings). Generally, high salinities are a feature of the GAB, with levels of 35.7% being recorded at 100 m depths (Rochford, 1980).

Four major water masses or currents influence the oceanography of the GAB (Edyvane, 1998), these are:

- Leeuwin Current;
- Central Bight water mass;
- West Wind Drift cold water mass; and
- Surface-flowing Flinders Current.

4.3 Biological Environment

4.3.1 Biological Productivity

Offshore of the GAB, winter is characterised by westerly winds, whilst the summer is dominated by south-easterly winds, favourable to upwelling. The Bonney Coast circulation leads to classical upwelling plumes (the Bonney upwelling) which extend poleward to the wide shelf southeast of Kangaroo Island (Lewis, 1981;

Schahinger, 1987). The western coast of the Eyre Peninsula (from Baird Bay to western Kangaroo Island) is responsible for a second important area of summer upwelling (during October and November) which is more diffuse and probably partly maintained by the bottom Ekman transport associated with the eastern boundary current (Griffin *et al.*, 1997). Further, a warm pool develops in the shallow western GAB due to surface heating (Herzfeld and Tomczak, 1997).

These upwellings are sites of significant productivity, as they bring deep, cool, nutrient rich water to the surface, triggering high productivity with phytoplankton blooms, the production of zooplankton blooms and krill swarms, which are important food sources for fish, foraging seabirds and marine mammals.

4.3.2 Biological Communities

The rich marine biodiversity and high levels of endemism of this region are, in part, due to the long east-west extent of the southern coastline and the long period of geological isolation. It is estimated that 85% of fish species, 95% of molluscs and 90% of echinoderms of these waters are endemic, compared to levels of some 10-15% in tropical waters (Wilson and Allen, 1987). Similarly, the marine macroalgal diversity in the region is among the highest in the world, with over 75% endemism among the red algae species (Womersley 1981, 1984).

This bioregion is particularly nutrient-poor, lacking some of the seasonally predictable small upwelling events that occur in neighbouring bioregions. Biological productivity in this bioregion is driven mainly through pulses of mixed water that irregularly wash through the system from the west. Anecdotal evidence from fishers, who track aggregations of school shark through this system, describes pulses of 'dirty water', soon followed by increased availability of baitfish and subsequently squid and, later still, larger predators (DEWHA, 2008). Highly mobile, higher order predators (such as tuna, school sharks, dolphins and seabirds) appear to track the food chains associated with these pulses of productivity as they move through the bioregion. These productivity pulses are highly variable within and between years.

An ecologically important hotspot of productivity occurs on the inner shelf at the Head of Bight (DEWHA, 2008). Satellite images show higher concentrations of chlorophyll in this area, and this is supported by anecdotal observations of higher concentrations of a number of species, which appear to use the relatively sheltered area of mixed seagrass, sand and limestone reef as nursery and feeding grounds. These include juvenile Australian salmon, school shark, Australian sea lion, dolphins and southern right whales. Studies on benthic invertebrates also found the highest values of biomass and species richness at the Head of Bight.

4.3.3 Protected Marine Fauna

A review of the EPBC Act database (Protected Matters search tool) held by DoE (DoE, 2013a) was conducted to identify protected marine fauna species which are likely to occur within, or adjacent to, the survey area. **Table 2** provides an indication of species that may be found in the survey area including a 25 km buffer.

Cetaceans

Nine migratory cetaceans, of which three are threatened, may occur within the survey area. The migration periods of the humpback whale may overlap in timing with the survey. However, given the distances between known migratory pathways and the survey area, encounter rates are expected to be low. The survey overlaps in timing with blue whale foraging aggregations at the Eastern GAB upwelling. However, given the distance between the survey area and known foraging areas, and taking into consideration their lack of clear migratory pathways, it is unlikely that large numbers of blue whales will be encountered during the survey. The Southern right whale aggregates along the south Australian coast between May and October to breed. While the proposed survey overlaps in timing with the breeding period, the distance between the survey area and the closest known aggregation site (Head of Bight, ~245 km) is such that breeding individuals (and calves) are not expected to be encountered during the survey. It is possible that a small number of individuals may pass through the survey area on migration to calving grounds.

Marine reptiles

Three species of threatened migratory marine reptile (all turtles) may be present in the survey area. However, individuals are expected to be transitory only and encounter rates are considered low.

Sharks

One species of migratory shark, the mackerel shark, may transit through the survey area, although encounter probability is expected to be low.

Seabirds

Thirteen species of threatened and/or migratory seabirds may within the survey area, however, individuals are likely to be transitory only.

Table 2:EPBC Act protected species that may occur in, or relate to, the survey area and surrounding waters

Category	Scientific name	Common name	Status	Type of presence
Cetaceans	*Balaenoptera musculus*	Blue whale	Endangered; Migratory	Foraging, feeding or related behaviour known to occur within area
	Caperea marginata	Pygmy right whale	Migratory	Species or species habitat may occur within area
	Eubalaena australis	Southern right whale	Endangered, Migratory	Species or species habitat may occur within area
	Lagenorhynchus obscurus	Dusky dolphin	Migratory	Species or species habitat may occur within area
	Megaptera novaeangliae	Humpback whale	Vulnerable, Migratory	Species or species habitat may occur within area
	Balaenoptera bonaerensis	Antarctic minke whale	Migratory	Species or species habitat may occur within area
	Balaenoptera edeni	Bryde's whale	Migratory	Species or species habitat may occur within area
	Orcinus orca	Killer whale	Migratory	Species or species habitat may occur within area
	Physeter macrocephalus	Sperm whale	Migratory	Species or species habitat may occur within area
Sharks (Fish)	*Lamna nasus*	Porbeagle, Mackerel shark	Migratory	Species or species habitat likely to occur within area
Marine Reptiles	*Caretta caretta*	Loggerhead turtle	Endangered; Migratory	Species or species habitat likely to occur within area
	Chelonia mydas	Green turtle	Vulnerable; Migratory	Species or species habitat likely to occur within area
	Dermochelys coriacea	Leatherback turtle	Endangered; Migratory	Species or species habitat likely to occur within area
Birds	*Diomedea antipodensis*	Antipodean albatross	Vulnerable; Migratory	Foraging, feeding or related behaviour likely to occur within area
	Diomedea dabbenena	Tristan albatross	Endangered; Migratory	Species or species habitat may occur within area
	Diomedea exulans (sensu lato)	Wandering albatross	Vulnerable; Migratory	Foraging, feeding or related behaviour likely to occur within area
	Macronectes giganteus	Southern giant-petrel	Endangered; Migratory	Species or species habitat may occur within area
	Macronectes halli	Northern giant-petrel	Vulnerable; Migratory	Species or species habitat may occur within area
	Phoebetria fusca	Sooty albatross	Vulnerable; Migratory	Species or species habitat may occur within area
	Puffinus carneipes	Flesh-footed shearwater	Migratory	Foraging, feeding or related behaviour likely to occur within area
	Thalassarche cauta cauta	Shy albatross	Vulnerable; Migratory	Species or species habitat may occur within area

	Thalassarche chrysostoma	Grey-headed albatross	Endangered; Migratory	Species or species habitat may occur within area
	Thalassarche melanophris	Black-browed albatross	Vulnerable; Migratory	Species or species habitat may occur within area
	Thalassarche melanophris impavida	Campbell albatross	Vulnerable; Migratory	Species or species habitat may occur within area
	Halobaena caerulea	Blue petrel	Vulnerable	Species or species habitat may occur within area
	Pterodroma mollis	Soft plumaged petrel	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

The survey area is not considered a habitat that is critical to the survival of any listed species due to their widespread distribution elsewhere. Similarly, there are no EPBC Act-listed threatened ecological communities in the vicinity of the survey area.

4.4 Socio-economic Environment

4.4.1 Commercial Fisheries

The survey has the potential to interact with several Commonwealth and State managed fisheries.

Commonwealth Fisheries

Commonwealth fisheries are managed by the Australian Fisheries Management Association (AFMA), with Commonwealth fisheries operating from 3 nm of the coast out to 200 nm (the extent of the Australian Fishing Zone, AFZ). The survey area may overlap several Commonwealth managed fisheries:

- Small Pelagic Fishery: Western sub-area zone;
- Southern and Eastern Scalefish and Shark Fishery;
- Southern Bluefin Tuna Fishery;
- Southern Squid Jig Fishery;
- Western Skipjack Fishery; and
- Western Tuna and Billfish Fishery.

State Fisheries

State fisheries are managed by the Primary Industries and Regions South Australia (PIRSA) - Fisheries and Aquaculture in the GAB. The proposed survey area has the potential to overlap a number of State fishing zones within the GAB, these being:

- Abalone Fishery: Western Zone;
- Blue Crab Fishery;
- Charter Boat Fishery;
- Marine Scalefish Fishery;
- Miscellaneous Fishery: The Giant Crab Fishery;
- Prawn Fisheries: Gulf St Vincent, Spencer Gulf and West Coast;
- Rock Lobster Fishery: Northern Zone; and
- Sardine Fishery.

TGS has undertaken extensive consultation (see **section 7**) with these fisheries through the relevant representing associations, and individual licence holders, to ensure that any impacts to their activities are

minimised. The most economically important Commonwealth fishery in the GAB is the Southern Bluefin Tuna Fishery (SBTF).

4.4.2 Petroleum Exploration and Production

Exploration permits EPP 37, EPP 39, EPP 40, EPP 44 and EPP45 and adjacent open acreage areas have been subject to a relatively low level of petroleum exploration activities (seismic survey and exploration drilling) over the past 30 years.

Two wells have been previously drilled in and within the vicinity the survey area.. In 2012, BP undertook a similar seismic survey within the Ceduna basin and covered permit areas EPP 37, EPP 38, EPP 39 and EPP 40, with drilling within these areas proposed to commence in 2015/16 (BP 2013).

There is no petroleum production in the GAB at present.

4.4.3 Shipping

Commercial shipping activity in the GAB has national and international siginifcance, with the majority of vessels mainly passaging between Adelaide and Cape Leeuwin. Due to the difference in vessel speed between the survey vessel and commercial shipping vessels, the survey vessel has potential to lead to necessary avoidance action being taken by shipping vessels. Vessel traffic is greatest at the southern portion of the survey area, and as such, is more likely to be encountered during phase 2 of the survey programme. Consultation with associated stakeholders, such as AMSA, is ongoing to ensure any such interactions are managed appropriately, for example, through the issuing of notices to mariners.

4.4.4 Tourism

Recreational fishing may be undertaken in the area. However, due to the deepwater location of the survey area, and the distance to the coast, there is not expected to be a high level of recreational activity undertaken in the area.

4.4.5 Cultural Heritage

There are no known indigenous cultural heritage values or issues for the waters and seabed within and immediately adjacent to the survey area. Similarly, there are no current or pending Native Title Determinations for the waters and seabed within and immediately adjacent to the survey area.

Under the *Historic Shipwrecks Act 1976* (Commonwealth), all wrecks older than 75 years are protected. There are no known historic shipwreck sites within or immediately adjacent to the Nerites survey area.

4.4.6 National Heritage

There are no places listed on the Commonwealth Heritage List or the Register of National Estate within or adjacent to the Nerites survey area.

4.4.7 Marine Parks and Reserves

The survey area is located within, or in the vicinity of, several State and Commonwealth managed protected areas (**Figure 1**) including:

- Great Australian Bight Commonwealth Marne Reserve (overlap);
- Western Eyre Commonwealth Marine Reserve (35 km east); and
- Murat Commonwealth Marine Reserve (150 km north).

<u>Great Australian Bight Commonwealth Marine Reserve</u>

The Great Australian Bight (GAB) Commonwealth Marine Reserve encompasses the former designated Marine Mammal Protection Zone (IUCN VI) and Benthic Protection Zone (IUCN VI) first declared in 1998. The current GAB Commonwealth Marine Reserve comprises three zoning types; Marine National Park Zone, Multiple Use Zone and Special Purpose Zone, covering an area of 45,926 km^2 in total. The Nerites survey area overlaps with the GAB Commonwealth Marine Reserve Multiple Use Zone, which allows oil and gas activities to be undertaken.

Environmental sensitivities of the GAB Commonwealth Marine Reserve include important foraging areas for the Australian sea lion, great white shark, sperm whale and shearwaters, and globally important seasonal calving habitat for the threatened southern right whale. The reserve also includes three Key Ecological Features (KEFs); ancient coastline 90-120 m (high productivity), benthic invertebrate communities of the eastern GAB (communities with high species diversity), and areas important for small pelagic fish (species group with an important ecological role).

Western Eyre Commonwealth Marine Reserve

The Western Eyre Commonwealth Marine Reserve has a depth range of 15 – 6,000 m and an area of 57,946 km^2 and was designated to protect it's major conservation values including important foraging areas for the Australian sea lion, great white shark, blue whale, sperm whale and migratory birds, important seasonal calving habitat for the threatened southern right whale, examples of the westernmost ecosystems of the Spencer Gulf Shelf Province and the easternmost ecosystems of the Great Australian Bight Shelf Transition and examples of the easternmost ecosystems of the Southern Province. The reserve also include five KEFs.

Murat Commonwealth Marine Reserve

The Murat Commonwealth Marine Reserve has a depth range of approximately 15 – 70 m and an area of 938 km^2 all of which is designated as Marine National Park Zone. Key sensitivities of the reserve include important foraging areas for the Australian sea lion, great white shark and migratory sea birds, examples of the ecosystems of the Great Australian Bight Shelf Transition and in particular, the Murat meso-scale bioregion and Eucla meso-scale bioregion and provides protection for Yatala Reef, in addition to two KEFs.

4.4.8 Other Protected Areas

There are no World Heritage Properties within or adjacent to the Nerites survey area.

> The nearest World Heritage area is the Australian Fossil Mammal Sites (Naracoorte), located onshore approximately 840 km east of the proposed survey (SEWPaC, 2013a).

There are no listed National Heritage places within or adjacent to the Nerites survey area.

> The nearest National Heritage site is the Whale Bone Area and the Point Fowler Structure, Fowlers Bay Conservation Reserve (designated places of archaeological significance), located approximately 220 km north-east of the survey area (SEWPaC, 2013c).

There are no listed Wetlands of International Importance (declared Ramsar wetlands) within or adjacent to the Nerites survey area.

> The closest site is the Coorong and Lower Lakes Ramsar site, located approximately 650 km east to north-east of the proposed survey area.

4.4.9 Defence Activities

The Commonwealth Department of Defence (DoD) training areas do not extend into any offshore waters of the GAB. The closest training areas are in the Investigator Strait (a body of water lying between the Yorke Peninsula and Kangaroo Island) used for military flying and firing, and waters off Port Lincoln used for firing and naval operations (over 200 km east from the survey area). Consultation with defence and governmental stakeholders, such as DoD is ongoing (see **section 7**).

5 IDENTIFICATION AND ASSESSMENT OF ENVIRONMENTAL RISKS AND IMPACTS

The environmental risks and potential environmental impacts of the proposed Nerites survey have been determined on the basis of TGS's previous seismic survey experience in Australian waters and the outcomes of an environmental risk assessment (**Table 3**). The risk assessment indicates that the potential impacts arising for the proposed Nerites survey can be categorised as having **Low** to **Medium** risk levels. No risks were assessed as **High**.

A summary of the key sources of environmental risk (aspects) for the proposed activity include:

- Discharge of underwater seismic pulses;
- Light generation from vessels;
- Interactions of vessels with marine fauna;
- Anchoring or grounding of vessels used for the activity;
- Dragging or loss of cables, cable fluid and associated equipment;
- Emissions to atmosphere from vessels;
- Discharge of ballast water and vessel biological fouling;
- Routine discharge of wastewater and waste to ocean from survey and support vessels;
- Accidental discharge of hydrocarbons and chemicals to ocean from survey and support vessels;
- Vessel collisions resulting in fuel and oil spills, and/or damage to benthic habitats;
- Interactions with commercial fishing, shipping and defence activities; and
- Operation of the survey and support vessels within, or in the vicinity of, protected and heritage areas.

A summary of the potential environmental impacts associated with the above sources of environmental risk include:

- Disturbance to marine fauna including cetaceans, turtles and fish;
- Disturbance to the seabed and benthic habitats and communities;
- Reduced air quality from atmospheric emissions as a result of operation of machinery and use of internal combustion engines;
- Introduction of invasive marine species as a result of ballast water discharge and vessel biological fouling;
- Marine pollution from routine discharges including sewage, grey water, bilge water and other putrescible wastes (i.e. food scraps);
- Marine pollution from accidental discharges including spills of hydrocarbons and hazardous materials;
- Disturbance to social and community values due to interactions with commercial fishing vessels, shipping and military aircraft; and
- Disturbance to heritage and conservation values due to operation of vessels within, or in the vicinity of, protected areas.

The environmental aspects of the Nerites survey that have the potential to cause significant environmental effects have been determined through an evaluation of the proposed activity, the surrounding environment including specific sensitivities and values, and legislative requirements. These environmental aspects are:

- Accidental discharge of hazardous materials;
- Accidental fuel and oil spills from the survey and support vessels; and
- Vessel collisions, resulting in fuel and oil spills.

Table 3: Summary of the environmental risk assessment for the Nerites survey

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
Disturbance to marine fauna	Discharge of underwater seismic pulses	Behavioural and physiological effects on fish	• Use of soft-starts on every start up • Application of 2 km low power zone • EPBC Act Policy Statement 2.1 – Part A Standard Management Procedures • EPBC Act Policy Statement 2.1 – Part B Additional Measurement Procedures including: ○ Use of four MFOs • Recording and reporting of marine fauna sightings, including cetaceans and turtles	Low
		Behavioural and physiological effects on cetaceans		Low
		Behavioural effects and physiological on marine turtles		Low
		Physiological effects on benthic invertebrates		Low
		Physiological effects on plankton		Low
	Light generation from vessels	Behavioural effects on marine fauna	• Minimisation of survey and support vessel external lighting to levels required for navigation, vessel safety and safety of deck operations	Low
	Vessel interactions	Behavioural and physiological effects on marine fauna	• Australian National Guidelines for Whale and Dolphin Watching • Guidelines for Extrication of Maritime Turtles • Recording and reporting of any vessel interactions with marine fauna • Specific vessel-whale interaction procedures for non-acoustic energy source operations	Low
Disturbance to benthic habitats	Deployment and retrieval of anchors	Localised physical damage to benthic habitats	• Adherence to requirements of Vessel Bridge Routines – Anchoring and Anchor Watch Checklist • No anchoring within survey area, except in emergency situations • All measures will be taken to avoid areas of sensitive habitat	Low
	Vessel grounding	Physical damage to benthic habitats	• Vessel Bridge Routines – Navigation in Critical Waters • Vessel Collision, Grounding, Hull Damage Procedures • Vessel Environmental Management Procedures • Survey and support vessels will use approved navigation systems and depth sounders • Standard maritime safety / navigation procedures	Low
	Equipment damage, dragging or loss	Localised physical damage to benthic habitats	• Vessel Environmental Management Procedures	Low

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
			• Vessel Back Deck Operations – Deployment and Recovery of Cables • Vessel Back Deck Operations – Cable Maintenance Using the Workboat • Use of survey and support vessels with experienced operators and crew • Lost in-water equipment will be recovered, where possible • Recording / reporting of incidents involving loss of equipment (e.g. cable loss)	
Reduced air quality from atmospheric emissions	Operation of machinery and vessels powered by internal combustion engines	Localised reduction air quality Greenhouse gas emissions	• Compliance with PSPPS Act and Marine Orders - Part 97: Marine pollution prevention - air pollution • Optimisation of fuel use to increase efficiency and minimise emissions • Use of low sulphur diesel fuel (if/when available) • Implementation of a preventive maintenance system (PMS) • Adherence to the requirements of Vessel Bridge Routines – Chief Engineer's Standing Order	Low
Introduction of invasive marine species (IMS)	Discharge of ballast water from vessels	Introduction and establishment of IMS and displacement of native marine species	• No routine discharge of ballast water from survey or support vessels • Australian / Vessel Ballast Water Management Requirements (if/when required)	Low
	Biofouling of vessel hulls and other niches	Introduction and establishment of IMS and displacement of native marine species	• All necessary AQIS clearances to operate unrestricted anywhere in Australian waters • Hull inspection / cleaning • Reporting of known or suspected introduced species to FishWatch	Low
Marine pollution from routine discharges	Discharge of sewage, grey water and putrescible wastes	Localised reduction in water quality due to nutrient enrichment	• Compliance with PSPPS Act and Marine Orders - Part 96: Marine Pollution Prevention - Sewage • Vessel Environmental Management Procedures • Vessel Bridge Routines – Chief Engineer's Standing Order • Vessel Waste Disposal Procedures • Maceration / disinfection of sewage and putrescible wastes prior to disposal • Discharge of non-comminuted / disinfected sewage only at distance of >12 nm from nearest land • Discharge of comminuted / disinfected sewage only at distance of >3 nm from nearest land • If support vessel is unable to treat/store grey water (i.e. wastewater from sinks and	Low

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
			showers) biodegradable soaps and detergents will be used (where possible) • Vessel Waste Log will be maintained to record waste management practices	
	Discharge of bilge water	Localised reduction in water quality	• Compliance with PSPPS Act and Marine Orders - Part 91: Marine Pollution Prevention - Oil • Vessel Environmental Management Procedures • Vessel Bridge Routines – Chief Engineer's Standing Order • Containment and onshore disposal of bilge water contaminated with hydrocarbons, except if the oil content is <15 ppm • Containment and onshore disposal of bilge water contaminated with chemicals, except if chemical has a low toxicity	Low
	Discharge of other wastes i.e. domestic or hazardous wastes	Toxic effects on marine fauna and flora Reduction in water quality Physical impacts on marine fauna i.e. from plastics	• Compliance with PSPPS Act and Marine Orders - Part 95: Marine Pollution Prevention - Garbage • Vessel Environmental Management Procedures • Vessel Waste Disposal Procedures • Survey vessel Garbage Management Plan • No discharge of plastics or plastic products of any kind from survey and support vessels • No discharge of domestic wastes or maintenance wastes from survey and support vessels • All waste receptacles aboard survey and support vessels will be covered with tightly fitting, secure lids • All solid, liquid and hazardous wastes (other than sewage, grey water and putrescible wastes) will be incinerated or compacted (if possible) and stored in designated areas and sent ashore for recycling, disposal or treatment • Incinerators used are compliant with MARPOL and IMO requirements • All storage facilities and handling equipment will be in good working order and designed in such a way as to prevent and contain any spillage as far as practicable • Vessel Waste Log will be maintained to record quantities of wastes transported onshore, and detailed records of waste accidentally discharged	Low
Marine pollution from accidental	Hazardous materials	Toxic effects on marine fauna and flora	• Compliance with PSPPS Act and Marine Orders - Part 94: Marine Pollution Prevention - Packaged Harmful Substances	Low

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
discharges		Localised reduction in water quality	• Vessel Environmental Management Procedures • Vessel Waste Disposal Procedures • All chemical and hazardous wastes will be segregated into clearly marked containers prior to onshore disposal • All storage facilities and handling equipment will be in good working order and designed in such a way as to prevent and contain any spillage • Tested / implemented Shipboard Oil Pollution Emergency Plan (SOPEP) for both survey and support vessels • Material Safety Data Sheet (MSDS) readily available for all hazardous substances aboard survey and support vessels • Spill response bins/kits will be located in close proximity to hydrocarbon storage areas for prompt response in the event of a spill or leak. Kits checked for their adequacy and replenished as necessary. Personnel trained in use of this equipment	
	Oil and chemical spills	Toxic effects on marine fauna and flora Reduction in water quality	• Adherence to the requirements of the Navigation Act 1912, and specifically Marine Orders – Part 30: Prevention of collisions • Adherence to the requirements of COLREGS • Vessel contractor's Environmental Management Procedures • Vessel contractor's Deck and Engine Maintenance General Procedures • Vessel contractor's Planned Maintenance System • Adherence to Vessel contractor's Deck and Engine Maintenance General Procedures and Planned Maintenance System • Adherence to the requirements of Vessel Back Deck Operations – Deployment and Recovery of Cables. • Adherence to the requirements of Vessel Back Deck Operations – Cable Maintenance Using the Workboat.	Low
	Vessel collisions, grounding, sinking and spill during refuelling	Physical damage to benthic habitats Toxic effects on marine fauna and flora Reduction in water quality	• Adherence to the requirements of the Navigation Act 1912, and specifically Marine Orders - Part 30: Prevention of collisions • Adherence to the requirements of COLREGS • Vessel Collision, Grounding, Hull Damage Procedures • Support Vessels Procedures • Refuelling procedures (including supervision and shut off)	Medium

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
			• Survey and support vessels will use approved navigation systems and depth sounders • Standard maritime safety / navigation procedures • Hydrocarbons located above deck will be stored with some form of secondary containment to contain leaks or spills • Pre-approval of refuelling by TGS' Vessel Operations Manager • The survey vessel has an implemented and tested SOPEP • All cargo will be pre-slung • Refuelling will only be carried out in daylight hours and within weather limit guidelines and in daylight hours • Recently certified transfer hoses and fittings • Quick release dry break couplings will be used on ends of all bulk hydrocarbon transfer hoses. • TGS approval of vessel to be used in vessel to vessel transfer • AMSA will be advised prior to any refuelling	
Oil spill response	Implementation of oil spill response strategies	Disturbance to habitats and fauna Toxicity to marine fauna and flora Additional vessel presence (noise, emissions, discharges, collision risk)	• SOPEP in place • Consultation log detailing MAO discussions with AMSA and DoT relating to interfaces between SOPEP/AMSA NATPLAN, WestPlan MOP and DoT MOSCP • Consultation log detailing discussions with AMSA and DoT to ensure all aspectes of oil spill response are accounted for • Implementation of NATPLAN • Management of wastes in compliance with the NATPLAN document Management and Disposal of Oil Spill Debris; • Oil spill reports demonstrating reporting of spills to AMSA and DoT • Vessel records of oil spill drills carried out • Assessment of implementation of SOPEP, AMSA NATPLAN, WestPlan MOP and DoT MOSCP • Stakeholder consultation • Insurance policies to cover costs of environmental monitoring or clean up post spill	Low
Disturbance to social	Interaction with commercial	Disruption to commercial fishing	• Adherence to the requirements of the Navigation Act 1912, and specifically Marine	Low

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
and community values	fisheries	vessels Potential direct and indirect noise impacts on target species Restriction of access to fishing grounds, loss/damage to gear Recreational take of finfish species from survey vessels	Orders - Part 30: Prevention of collisions • Adherence to the requirements of COLREGS • Notification of activity details to relevant fisheries stakeholders prior to survey commencement • Support Vessels Procedures • Vessel Back Deck Operations – Deployment and Recovery of Cables • Vessel Back Deck Operations – Cable Maintenance Using the Workboat • Vessel Collision, Grounding, Hull Damage Procedures • Use of a support vessel to manage vessel interactions • Use of standard maritime safety procedures • Compliance with AMSA administered marine safety regulations and marine notification requirements • Strict adherence to equipment handling and acquisition procedures • Fishermen and other mariners alerted of vessels presence and extent of towed array. Establishment of a vessel exclusion zone around the survey vessel. Display of appropriate navigational beacons and lights, radar watch, radio contact • In-water equipment lost will be recovered (where possible). Detailed records will be maintained of equipment lost overboard • Recreational fishing from the survey and support vessels will be prohibited	
	Interaction with shipping	Disruption to shipping activities	• Adherence to the requirements of the Navigation Act 1912, and specifically Marine Orders - Part 30: Prevention of collisions • Adherence to the requirements of COLREGS • Consultation with AMSA prior to the survey commencing to determine the level of commercial shipping in the vicinity of the survey area • Support Vessels Procedures • Vessel Back Deck Operations – Deployment and Recovery of Cables • Vessel Back Deck Operations – Cable Maintenance Using the Workboat • Vessel Collision, Grounding, Hull Damage Procedures • Use of a support vessel to manage vessel interactions • Use of standard maritime safety procedures	Low

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
			• Compliance with AMSA administered marine safety regulations and marine notification requirements • Strict adherence to equipment handling and acquisition procedures • Shipping alerted of vessels presence and extent of towed array. Establishment of a vessel exclusion zone around the survey vessel. Display of appropriate navigational beacons and lights, radar watch, radio contact • In-water equipment lost will be recovered (where possible). Detailed records will be maintained of equipment lost overboard	
	Interaction with defence activities	Disruption to aircraft participating in defence activities within the Learmonth Airspace	• Consultation with Department of Defence prior to the survey commencing • Adherence to the requirements of Helicopter Operations Procedures e.g observance of flight plan / bypass restricted areas • Department of Defence will be advised of any aviation activity 2 -3 weeks prior to their commencement.	Low
Disturbance to heritage and conservation values	Operation of vessels within protected and heritage areas	Disturbance to heritage and conservation values	• Implementation of the performance objectives, standards and measurement criteria described in this EP • Ensuring that all contractor personnel are aware of and comply with the accepted EP	Low

6 MANAGEMENT APPROACH

The Nerites survey will be managed in compliance with the EP as accepted by NOPSEMA under the Environment Regulations, other relevant environmental legislation and TGS's corporate policies. The objective of the EP is to ensure that potential adverse impacts on the environment associated with the Nerites survey, during both routine and non-routine operations, are identified, and will be reduced to ALARP and will be of an acceptable level.

The design and execution of the Nerites survey will be conducted under the framework of the TGS Environmental Policy, TGS Health, Safety and Environmental (HSE) Management System, and the survey vessel operator HSE&Q Management System. The seismic programme will be supported by a project-specific HSE Plan (that includes Emergency Response (ER) procedures), the survey vessel operator's Emergency Response Procedures, and a TGS Emergency Preparedness Bridging Document (incorporated within the HSE Plan). To ensure TGS's environmental objectives and management standards are achieved, the survey vessel operator will be required to comply with all relevant requirements of TGS's HSE systems/policies and standards.

The EP includes specific performance objectives and standards, and identifies the key controls and mitigation measures (**Table 3**) to be implemented to achieve the performance objectives. These various commitments are communicated to all personnel involved in the Nerites survey. The implementation strategy detailed in the EP identifies the roles/responsibilities and competency/training requirements for all personnel (TGS and contractors) in relation to implementing controls, managing non-conformance, emergency response and meeting reporting requirements during the survey. The EP also details the types of auditing that will be undertaken and the reporting requirements for environmental incidents, and reporting for overall compliance of the survey.

The vessel master(s) will be responsible for the day to day operation of the survey vessel, including any potential emergency situation. In the event of a fuel or oil spill to sea, the vessel Shipboard Oil Pollution Emergency Plan (SOPEP) will be activated, supported as required by applicable established, statutory Oil Spill Contingency Plans.

7 CONSULTATION

Consultation with stakeholder groups, primarily within the commercial fishing industry, concerning the Nerites survey has taken place during the preparation of this EP, and prior to the commencement of the survey.

TGS received feedback on the proposed activity from a range of stakeholders, including government agencies (including AMSA), NGOs and commercial fisheries. During the consultation process, where stakeholders have raised queries, TGS has conducted additional meetings and provided additional information in response to the stakeholder queries. Furthermore, between the 30th October and 1st of November, TGS undertook a roadshow within South Australia targeting and engaging relevant stakeholders, in particular fisheries and local councils. The key objectives of this roadshow are:

- To inform key stakeholders about the project in more detail;
- To understand any concerns and to uncover any potential / perceived issues; and
- To describe how environmental issues will be dealt with, especially in relation to fishing and cetaceans.

The consultation process has allowed for the development of a communication and engagement strategy for each relevant stakeholder through which TGS will maintain communication with identified stakeholders to ensure they are informed of relevant aspects of the survey or changes that may affect them.

7.1 Pre-survey Consultation

Prior to commencement of the survey TGS will consult a number of additional stakeholders, primarily within the offshore E&P industry. These consultations will include, as far as possible, other geophysical companies operating in Australian waters, plus titleholders of petroleum titles adjacent to the Nerites survey area. The primary objective of this consultation will be to ascertain if there are any other seismic survey proposed for areas adjacent to the survey area, over the same time period. In addition, Notices to Mariners covering survey activities will be issued via the Australian Hydrographic Service (notified 14 days prior to activity commencing).

8 CONTACT DETAILS

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