

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

for

The Proposed Cengkih Field Development at Block SK320, Offshore, Sarawak

Ref. No.: EV113-117(19A)/25
Date: June 2026

Project Proponent



MUBADALA ENERGY (SK320) LTD.

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Prepared by



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EXECUTIVE SUMMARY

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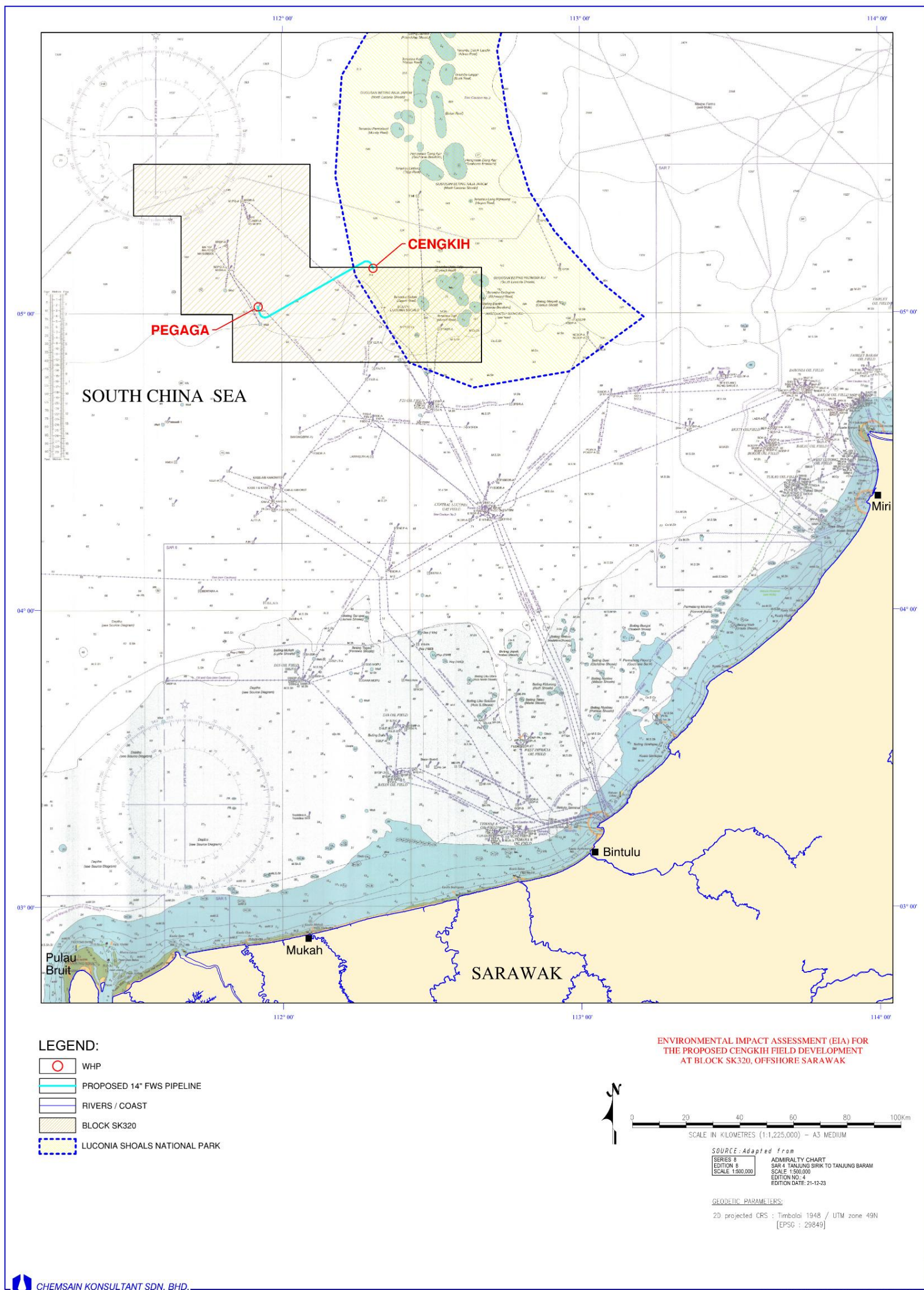
INTRODUCTION

- Block SK320 is located approximately 160 km northwest of Miri, within Malaysia's Exclusive Economic Zone (EEZ).
- Cengkih Field is a non-associated gas discovery within Block SK320 and the Luconia Shoals National Park, lies approximately 230 km offshore Sarawak at an estimated water depth of 120.5 m.
- EIA Scope covers:
 - ❑ A single development well completed with 7" tubing, designed to accommodate offtake rates 120 – 150 MMscf/d;
 - ❑ An unmanned wellhead platform (WHP) with topsides designed for a capacity of 150 MMscf/d to accommodate potential production upside;
 - ❑ A subsea tie-in to the existing Pegaga Integrated Central Processing Platform (ICPP); and
 - ❑ Installation of a 14" x 53 km carbon steel subsea pipeline for gas transportation.

Table ES-1: Coordinates of Project Component

Component	Datum: Timbalai 1948		Datum: WGS84	
	Longitude (E)	Latitude (N)	Longitude (E)	Latitude (N)
Cengkih WHP (Centre of Platform)	112° 18' 12.559"	05° 09' 05.078"	112° 18' 24.74"	05° 09' 02.02"

PROJECT LOCATION



LEGISLATIVE REQUIREMENT



Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015

First Schedule -Item 9 Petroleum

- (a) Development of –
 - (ii) Gas field
- (b) Construction of 30 kilometres or more in length of –
 - (i) Offshore pipeline

STATEMENT OF NEED

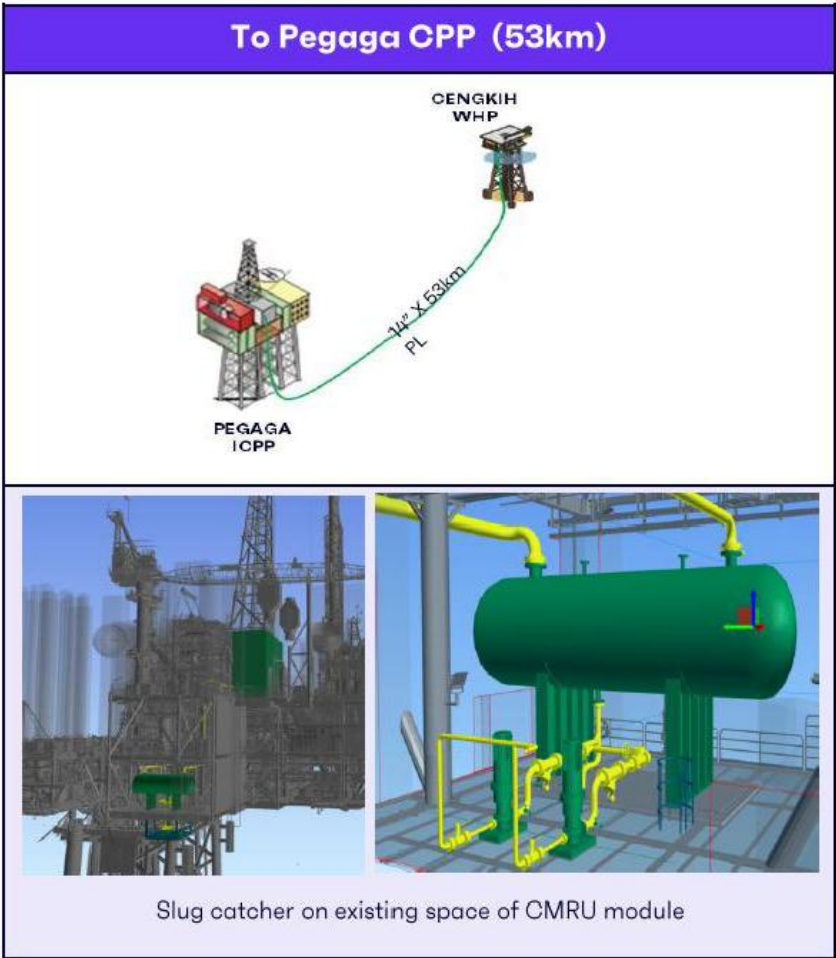


- Driven by the need to monetise discovered gas resources, sustain utilisation of existing infrastructure, and support long-term gas supply in Central Luconia.
- Selected development concept balances technical, economic, and environmental considerations while aligning with national and regional energy strategies.

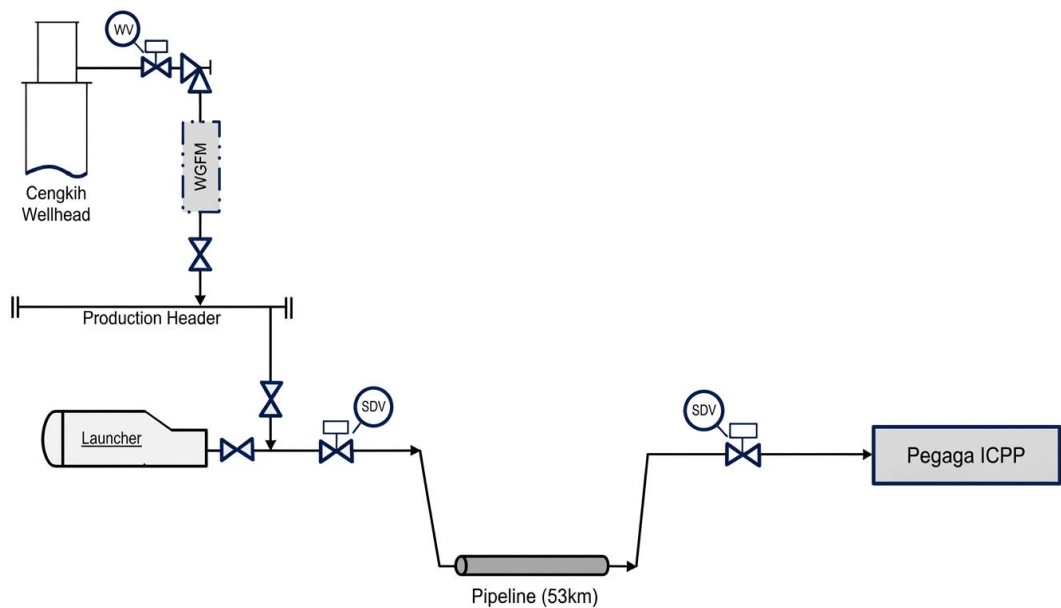
PROJECT DESCRIPTION

- **Wellhead Platform (WHP):** One (1) unmanned 2-slot WHP (initially 1 well), minimum-facility design with no onboard processing and remote operation from Pegaga ICPP.
- **Pipeline:** One (1) 14" x ~53 km subsea export pipeline from Cengkih WHP to Pegaga ICPP.
- **Modification:** Brownfield modification at Pegaga ICPP, including installation of slugcatcher, metering facilities, and debottlenecking (up to ~700 MMscfd).
- **Gas Production:** Single well production of ~120 MMscf/d (design capacity up to 150 MMscf/d), target FGD Q3 2029.
- **Field Development Concept:** Full wellstream exported to Pegaga ICPP for gas and condensate processing using existing facilities.
- **Drilling:** One (1) development well using Tender Assisted Drilling Rig (TADR).
- **Operations:** Normally unattended platform, remotely monitored and controlled, with periodic maintenance visits.
- **Development Approach:** Tie-back to existing infrastructure to minimise new facilities, seabed disturbance, and overall environmental footprint.

CENGIH FIELD DEVELOPMENT CONCEPT



CENGIH BLOCK DIAGRAM

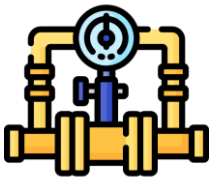


WELLHEAD PLATFORM (WHP)



- **Structure & Design:** One (1) unmanned 2-slot WHP (initially 1 well), minimum-facility platform with ~150 MMscfd design capacity and no hydrocarbon processing onboard.
- **Equipment and System:** Includes wellhead, flowlines, control systems, and chemical injection systems (KHI and corrosion inhibitor) for flow assurance.
- **Power Source:** Hybrid solar and wind system with diesel generator backup
- **Control and Monitoring:** Fully remote-controlled from Pegaga ICPP, with integrated control and safety systems.
- **Operation Philosophy:** Normally unattended installation (NUI) with periodic maintenance visits.

PIPELINE



- **Service:** Wet gas (multiphase) export pipeline transporting full wellstream to Pegaga ICPP.
- **Design Specification:** One (1) 14" diameter pipeline (~53 km) designed for ~120 MMscfd production, with allowance for variability.
- **Operating Conditions:** Arrival pressure at Pegaga ~104–105 barg, suitable for direct commingling without compression.
- **Material & Integrity:** Combination of CRA-clad carbon steel (first ~5 km) and carbon steel with corrosion allowance for remaining length.
- **Installation:** Installed via S-lay method, including engineered crossings for existing pipelines.

TIE-IN AT EXISTING PEGAGA ICPP

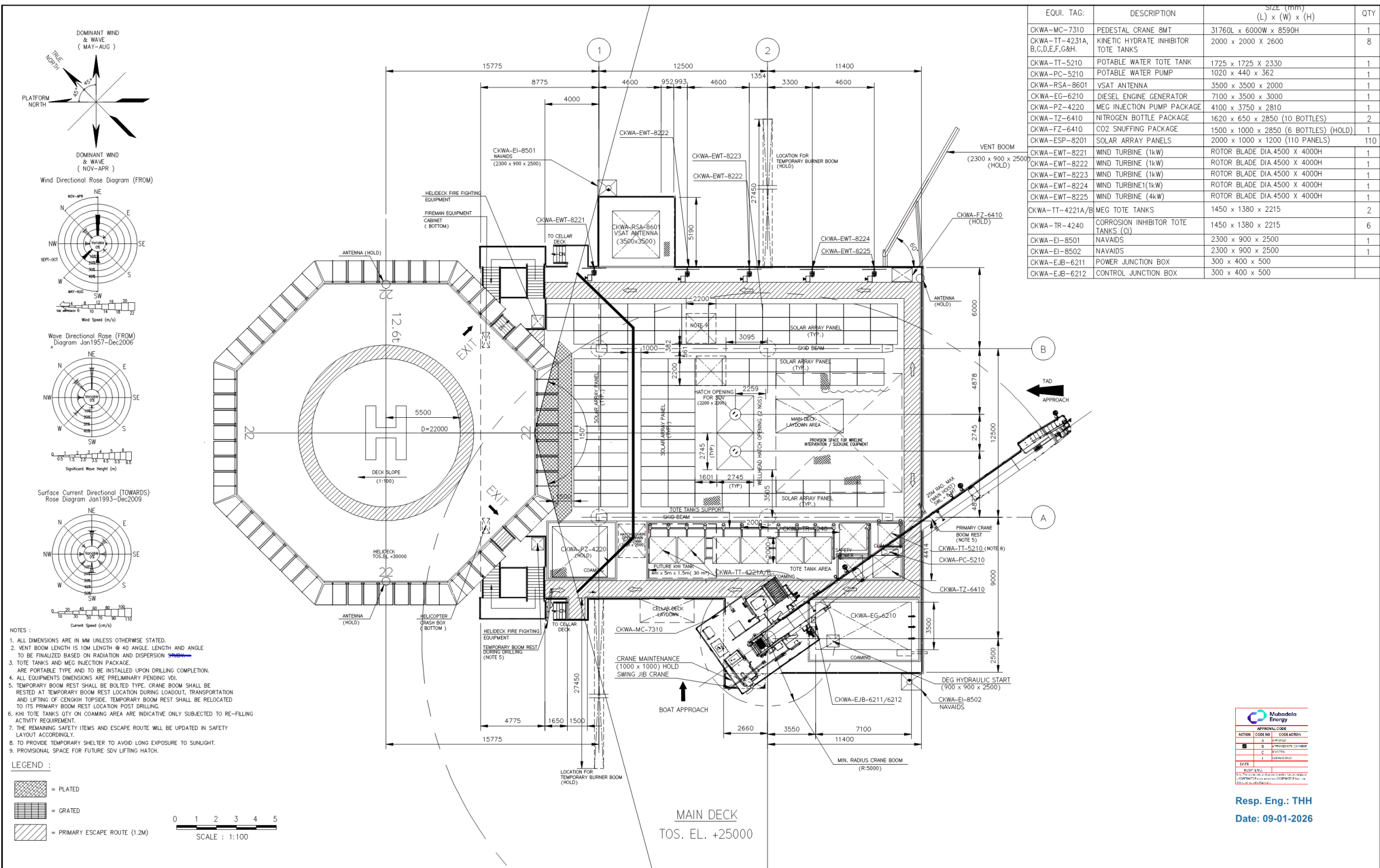


- **Integration:** Cengkih wellstream tied into Pegaga using existing riser slot, with new pig receiver, slugcatcher, and metering facilities.
- **Processing:** Full processing (gas, condensate, water) carried out at existing Pegaga facilities.
- **Capacity Upgrades:** Pegaga to be debottlenecked (~700 MMscfd) and compressor upgraded to accommodate combined production.
- **Handling Systems:** Existing systems have sufficient condensate and produced water handling capacity for Pegaga and Cengkih.
- **Development Approach:** Utilises existing infrastructure to minimise new facilities and environmental footprint.

PROJECT LAYOUT PLAN



PLATFORM OVERALL LAYOUT (MAIN DECK)





Transportation and Offshore Installation

Jacket, piles, boat landing and WHP topside will be fabricated onshore and transported offshore for installation. Jacket installation includes pile driving, followed by topside lifting and placement using heavy lift vessels.

Subsea 14" pipeline (~53 km) will be installed using S-lay method with pipeline crossings where required, and tied-in to Pegaga ICPP.

Drilling and Well Clean-up

One (1) development gas well will be drilled using a Tender Assisted Drilling Rig (TADR). Drilling uses seawater and water-based mud.

Well clean-up and completion will be performed prior to production start-up.

Commissioning and Start-up

Non-hydrocarbon systems (power, utilities, control and safety systems) will be commissioned first, followed by hydrocarbon systems.

Pipeline pre-commissioning includes cleaning, hydrotesting, and dewatering. Hydrocarbons will then be introduced in a controlled manner to initiate production.

Operation and Maintenance

Cengkih WHP will operate as a normally unattended installation (NUI), with full remote monitoring and control from Pegaga ICPP.

Periodic maintenance visits will be conducted (e.g. monthly) using support vessels, ensuring safe and efficient operations.

Decommissioning and Abandonment

Facilities and wells will be decommissioned at end of field life in accordance with PETRONAS and DOE guidelines.

Activities include well plugging, removal or abandonment of WHP and pipeline, ensuring minimal environmental impact.

PROJECT SCHEDULE

Fabrication

Mar-27 to Feb-29



Transportation and Installation

Mar-29 to Apr-29



Drilling

Apr-29 to Jun-29



Hook-up and Commissioning

Jun-29 to Jul-29



First Gas Date (FGD)

Q3 2029



EXISTING ENVIRONMENT

Bathymetry and Seabed Features



Cengkih-Pegaga ICPP (~53 km)

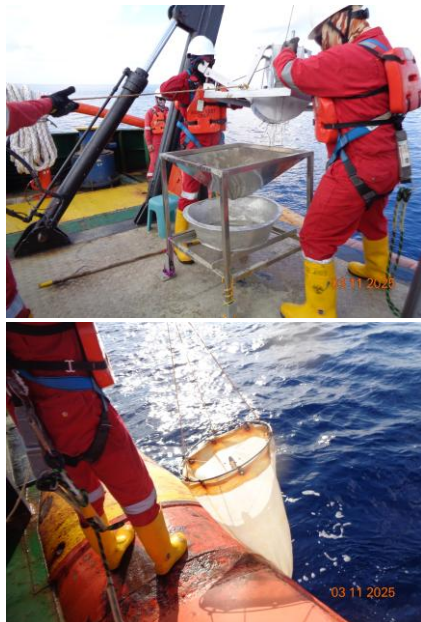
- Located in Central Luconia (carbonate basin) with generally flat seabed and soft clay sediments.
- Pipeline corridor has water depth ~104 to 120 m with minor features (pockmarks, footprints) not constraining design.

Oceanography



- Monsoon-driven currents dominate (NE & SW monsoon), influencing flow direction and variability.
- Moderate currents (~0.2 m/s avg) with stable temperature (27–30°C) and salinity (~32–34 psu).

Environmental Baseline Sampling



❖ Date:

- ❑ 2 – 4 November 2025
- ❑ 31 March – 1 April 2026

- ❖ **Sampling Activities:** Marine water, seabed sediment, planktons and macrobenthos.

Sampling Points:

- ❖ **Cengkih WHP:** Four (4) sampling stations at 600 m radius from the WHP
- ❖ **Control Point:** One (1) sampling station at 5 km NE of the Cengkih WHP
- ❖ **Pipeline:** Five (5) sampling stations with approximately 8.8 km interval along the proposed pipeline.

Sampling Results:

- ❖ **Marine Water:** Tested parameters are in compliance with applicable MMWQS standards (Class 1 and 3), indicating clean, well-oxygenated conditions with no evidence of anthropogenic contamination or nutrient enrichment.
- ❖ **Seabed Sediment:** The concentrations of metals in all the seabed sediment samples are well below the stipulated ERL and ERM of the NOAA Guidelines.
- ❖ **Macrobenthos:** The macrobenthic community exhibits low to moderate diversity with stable ecological indices, indicative of a balanced benthic environment without significant disturbance.
- ❖ **Phytoplankton:** Phytoplankton assemblages demonstrate moderate diversity and low biomass, suggesting stable productivity levels with no occurrence of algal bloom conditions.
- ❖ **Zooplankton:** Zooplankton communities show low to moderate diversity and uniform distribution, reflecting a stable trophic structure within the marine ecosystem.

Marine Flora and Fauna Survey (MFFS):

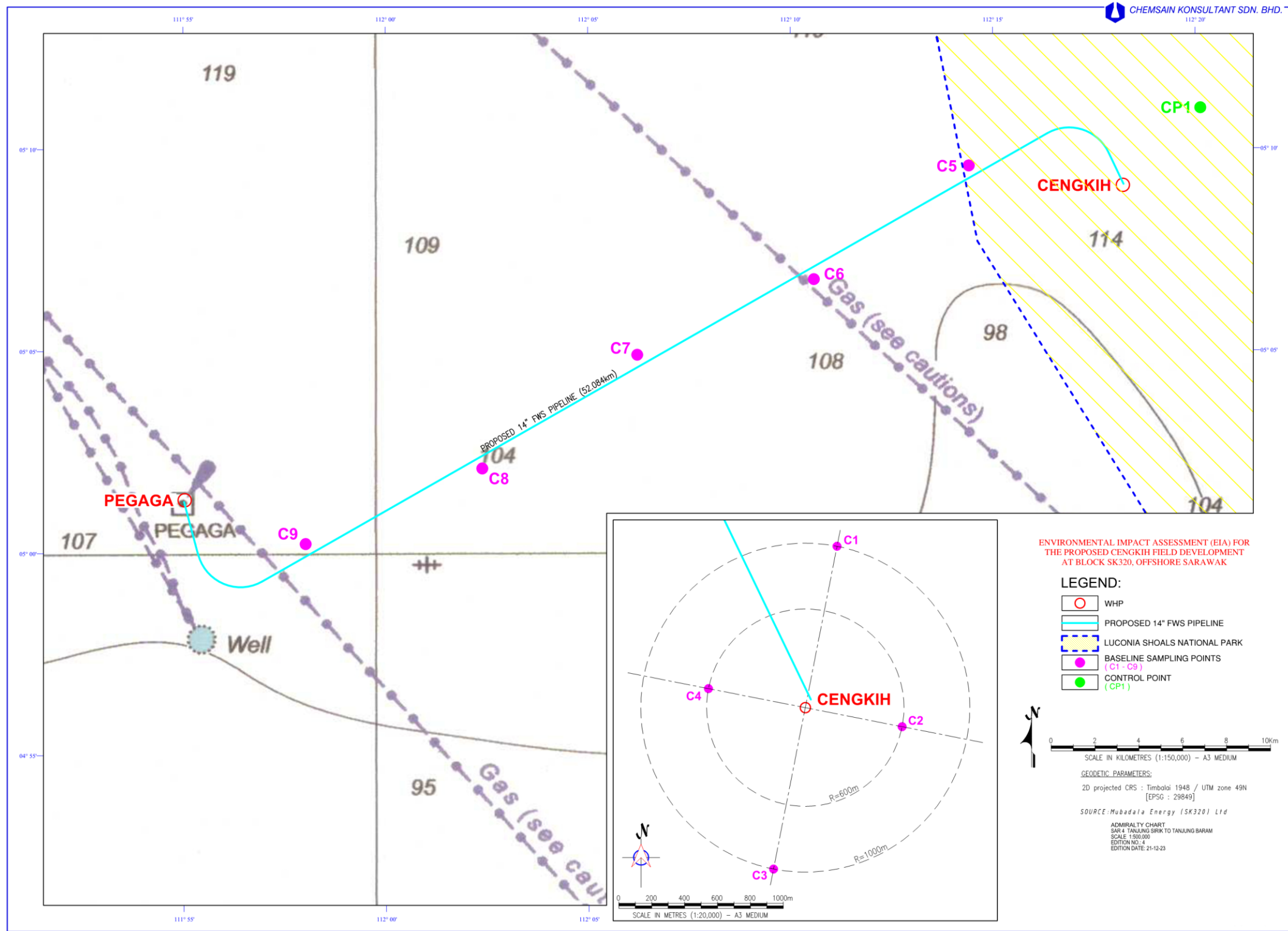
- ❖ **MFFS-Coral:** The survey of 133 sites in LSNP identified extensive mesophotic reefs dominated by hard corals, with low to moderate live cover, moderate diversity, and signs of recovery potential despite generally fair to poor health.
- ❖ **MFFS-Megafauna:** The surveys showed that LSNP supports diverse and seasonally variable marine megafauna including cetaceans, seabirds, and turtles with evidence of ecological importance for feeding and migration, highlighting the area's significance and need for ongoing monitoring.



Environmentally Sensitive Area

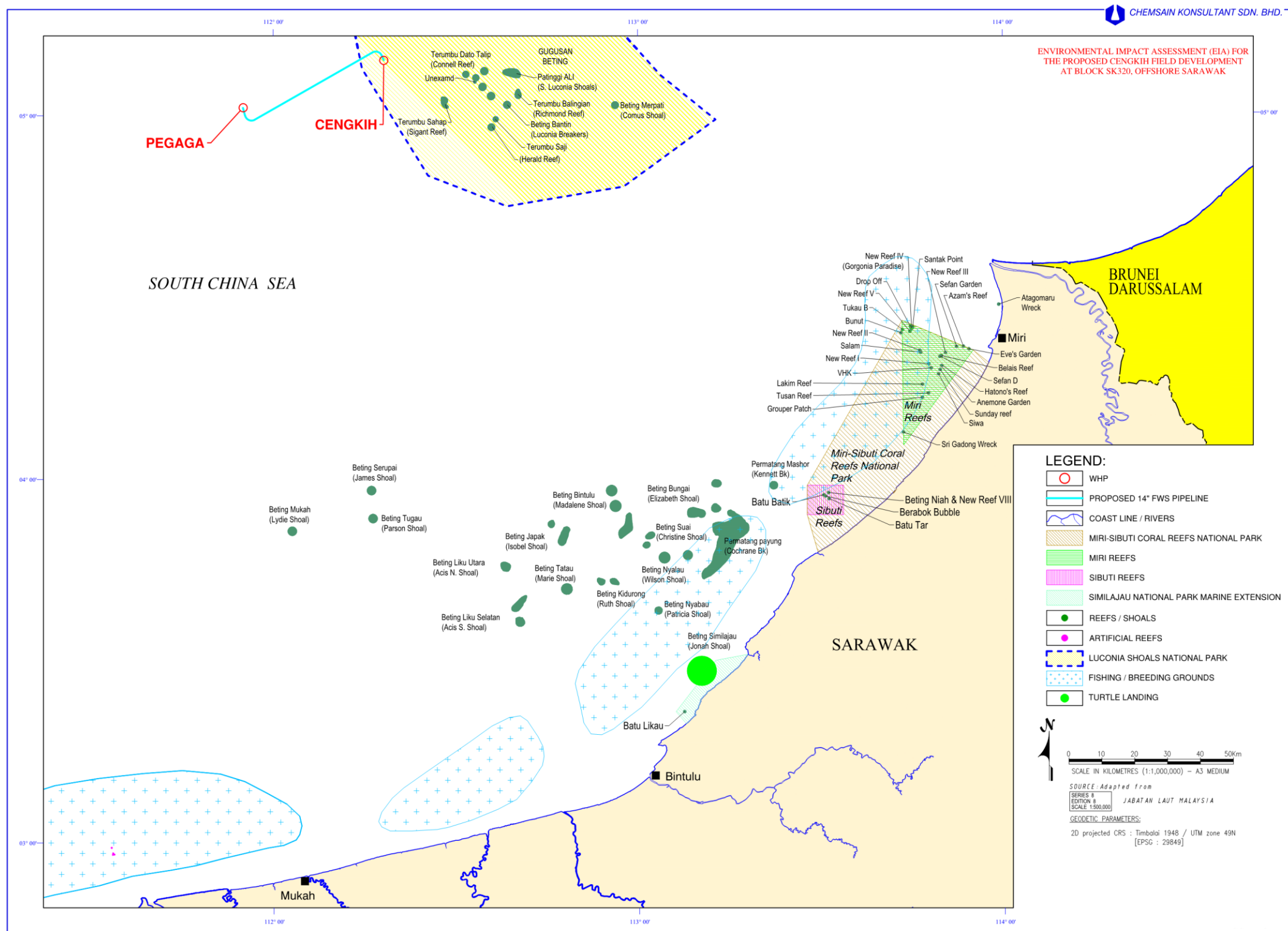
- ❖ **Shoreline:** About 200 km from Miri shoreline.
- ❖ **National Park (NP):** Cengkih WHP is located within the Luconia Shoals NP. The proposed pipeline partially overlaps with the NP.

ENVIRONMENTAL BASELINE SAMPLING LOCATIONS



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SENSITIVE BIOLOGICAL AREAS AND CORAL REEFS



POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Potential Impacts	Significance of Potential Impacts	Mitigation Measures	Reference in EIA report
 Air Quality ➤ Emissions from vessels, drilling rigs and equipment causing short-term local air quality deterioration and minor contribution to greenhouse gases.	Low	<u>Mobilisation / Demobilisation, Installation and Drilling Phase</u> ➤ Employ cleaner fuels such as low-sulphur diesel to reduce SO_x and particulate emissions. ➤ Optimize vessel routing, speed, and loading to reduce fuel consumption and associated emissions. ➤ Maintain engines (including generator sets and cranes) in accordance with manufacturer specifications to ensure efficient combustion, minimise black smoke emissions, and improving fuel efficiency. ➤ Conduct regular inspections and adhere strictly to maintenance schedules and procedures as specified by equipment manufacturers to prevent operational inefficiencies and excessive emissions. ➤ Ensure all vessel engines comply with MARPOL Annex VI requirements ➤ Reduce unnecessary machinery idling and optimise operational efficiency to limit fuel consumption and emissions. ➤ Deploy energy-efficient engines and equipment to reduce overall fuel consumption and emission intensity. ➤ Comply with relevant international air quality and emission standards, such as MARPOL Annex VI.	Section 7.3.1.1, Page C7-11. Section 7.3.2.1, Page C7-14. Section 7.3.3.1, Page C7-17. Section 8.2.1, Page C8-1.
 Noise ➤ Underwater and airborne noise from vessels, drilling and construction disturbing marine fauna (e.g. mammals, fish) and posing occupational noise exposure risks.	Low	<u>Mobilisation / Demobilisation, Installation and Drilling Phase</u> ➤ Workers will be provided with appropriate hearing protection, such as earmuffs, to reduce the risk of hearing loss. ➤ Where possible, engine enclosures will be used to reduce noise emissions from generators and machinery. ➤ Noise management will be implemented in accordance with applicable occupational safety and health requirements, including the Occupational Safety and Health (Noise Exposure) Regulations, 2019. ➤ Exposure to high noise levels will be managed by rotating workers and scheduling adequate breaks. ➤ Defective exhaust mufflers and other noise-generating components will be repaired promptly. to avoid unnecessary noise emissions.	Section 7.3.1.2, Page C7-11. Section 7.3.2.2, Page C7-14. Section 7.3.3.2, Page C7-17. Section 8.2.2, Page C8-2 & C8-3.

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Potential Impacts		Significance of Potential Impacts	Mitigation Measures	Reference in EIA report
			➤ Pre-activity environmental assessments will be conducted to identify the presence of sensitive or protected species. ➤ Where feasible, best practicable piling methods will be adopted and hammer energy optimised to minimise underwater noise generation. ➤ Soft-start procedures will be implemented for selected high-noise activities where applicable, to gradually increase noise levels and allow marine fauna time to move away. Vessel speeds will be kept as low as practicable to minimize propeller and engine noise. ➤ Trained Marine Mammal Observers (MMOs) will be present, where practicable, during offshore works within the Luconia Shoals National Park to observe the presence of marine fauna. ➤ Should any marine mammal be observed within the designated exclusion zone prior to the commencement of piling and drilling activities, the activities shall be delayed until the marine megafauna has moved to a safe distance away from the work area as determined by the MMO. ➤ Prior to commencement of selected high-noise activities, a minimum 30-minute observation period will be conducted. If marine mammals are detected within the exclusion zone, such activities will be delayed, where practicable, until the animals have moved away. ➤ Monitoring for cetaceans will be conducted during operations, particularly during daylight hours and favourable observation conditions. Activities will be adjusted or suspended where necessary to avoid disturbance to protected species. ➤ Standard noise control measures, including equipment enclosures and proper maintenance of machinery, will be implemented to minimise noise emissions. Vessels will be properly maintained and operated efficiently to minimise noise generation, including propeller cavitation.	Section 7.3.1.2, Page C7-11. Section 7.3.2.2, Page C7-14. Section 7.3.3.2, Page C7-17. Section 8.2.2, Page C8-1 & C8-2.

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Potential Impacts		Significance of Potential Impacts	Mitigation Measures	Reference in EIA report
			➤ Unnecessary simultaneous operation of multiple high-noise equipment will be avoided where practicable to reduce cumulative noise levels. ➤ Vessel movements will be optimized to minimize unnecessary activity. Speed limits will be enforced for support vessels to reduce noise generation.	
	Marine Water Quality ➤ Discharges (sewage, oily water, drilling fluids, hydrotest chemicals) and sediment resuspension causing localized turbidity, pollution and short-term water quality degradation.	Low	All Phases ➤ Install and maintain sewage treatment systems on board vessels to treat both grey and black water before discharge outside the National Park. ➤ Implement proper food waste disposal systems to prevent direct discharge into the marine environment. ➤ Comply with the International Convention for the Control and Management of Ships' Ballast Water and Sediments to prevent the introduction of invasive species and contaminants into the marine ecosystem. Treatment systems such as filtration, UV treatment, or chemical dosing will be used to before discharge. ➤ Oil water separators will be used to treat bilge water before discharge. Separator sludge will be properly handled and disposed of. ➤ Install oil-water separators or filters on the deck drainage systems to capture and remove oils, solvents, and chemicals before discharge. Regularly clean the deck areas to minimize the amount of pollutants entering the drainage system. ➤ Crew members will be trained in proper waste disposal procedures, including the handling and treatment of sewage, food waste, ballast water, bilge water, and deck drainage, to ensure compliance with environmental regulations. ➤ Sewage and food waste will be stored in closed containers until treated or transported to onshore facilities for disposal, avoiding any illegal discharge. ➤ Bunding will be provided for fuel, lubricant, mud, and chemical storage areas, as well as machinery spaces.	Section 7.3.1.3, Page C7-12. Section 7.3.2.3, Page C7-14. Section 7.3.3.3, Page C7-18. Section 7.3.4.1, Page C7-36. Section 8.2.3, Page C8-3 to C8-6.

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Potential Impacts		Significance of Potential Impacts	Mitigation Measures	Reference in EIA report
			➤ All vessel wastewater discharges will comply with applicable MARPOL requirements. ➤ No discharge will be permitted within Luconia Shoals National Park. ➤ Pre-installation surveys will be conducted, and critical biological periods such as spawning seasons will be avoided where practicable. ➤ Solid and scheduled wastes will be segregated, stored appropriately, and transported to DOE-licensed facilities for disposal. Waste generation and handling will be recorded in a waste management plan. ➤ Preference will be given to low toxicity chemicals, and overall chemical usage will be minimised. ➤ Hydrotest water will be discharged through diffusers to promote rapid dilution and ensure compliance with applicable guidelines. ➤ Water quality and marine life monitoring will be conducted during installation activities to promptly detect and address potential impacts. ➤ Water-based mud (WBM) will be used where practicable. Drill cuttings and fluids will be treated and disposed of onshore where feasible. Synthetic-based mud (SBM) residues will be treated prior to discharge to minimise toxicity. ➤ All engine and machinery areas will be bunded to contain potential spills, with drainage directed to oil separation systems. ➤ Liquid fuels and oils will be stored and transported in closed systems to prevent the risk of leaks and spills. ➤ The oil separator will be regularly maintained to ensure effective operation. ➤ Oily discharges from the oil separator will be recorded and equipment performance routinely inspected. ➤ All re-fuelling operations at sea will be conducted under controlled and supervised conditions, preferably during calm sea conditions.	Section 7.3.1.3, Page C7-12. Section 7.3.2.3, Page C7-14. Section 7.3.3.3, Page C7-18. Section 7.3.4.1, Page C7-36. Section 8.2.3, Page C8-3 to C8-6.

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Potential Impacts		Significance of Potential Impacts	Mitigation Measures	Reference in EIA report
			Spill containment equipment, including absorbents materials, will be provided on the semi-submersible to address any potential spills promptly and effectively.	
	Waste Management Generation of hazardous and non-hazardous wastes (oily waste, chemicals, drill cuttings, domestic waste) with potential pollution risk if not properly managed.	Low	<u>Mobilisation / Demobilisation, Installation and Drilling Phase</u> <u>Non-Hazardous Waste</u> - Ensure proper segregation of recyclable, biodegradable, and general waste. - All non-hazardous wastes will be returned to shore for disposal at licensed onshore facilities. - Food waste from kitchens will be macerated to less than 25 mm particle size before discharge into the sea. However, discharge will be in compliance with relevant regulations and prohibited in sensitive areas like the LSNP. <u>Hazardous/Scheduled Waste</u> - Use designated storage containers with secondary containment. - Maintain a waste logbook for tracking and reporting waste management activities. - All hazardous/scheduled wastes generated offshore will be transported to shore for proper storage and disposal at DOE-licensed facilities. - Management of these wastes will align with the Environmental Quality (Scheduled Wastes) Regulation, 2005. - All chemicals onboard will have Safety Data Sheets (SDS) to ensure safe handling and disposal. <u>Pigging Waste</u> - Manage chemical residues and sludge in accordance with the Environmental Quality (Scheduled Wastes) Regulation, 2005. - Prohibit the discharge of scheduled waste under all circumstances. <u>Drilling Waste</u> - Treat and reuse WBMs where possible to reduce waste discharge.	Section 7.3.2.4, Page C7-15. Section 7.3.3.4, Page C7-19. Section 8.2.7, Page C8-11 to C8-13.

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Potential Impacts		Significance of Potential Impacts	Mitigation Measures	Reference in EIA report
			➤ Use biodegradable and non-toxic additives that degrade naturally in the marine environment without accumulating in sediments or organisms. ➤ Opt for low-toxicity viscosifiers and weighting agents, such as natural bentonite and barite certified for minimal ecological impact. ➤ Prioritize non-persistent and water-soluble chemicals that disperse rapidly and pose lower risks to marine life. ➤ Choose eco-friendly corrosion inhibitors and lubricants, avoiding those containing heavy metals or hazardous compounds. ➤ Implement rigorous testing and certification standards, ensuring selected chemicals meet international environmental guidelines, such as those outlined by Internationally recognised industry guidance. ➤ Ensure that SDS for all chemicals used in drilling activities are readily accessible on the vessel to inform personnel of hazards, safe handling practices, and emergency measures. ➤ Only trained and certified personnel shall be responsible for the handling, storage, and application of drilling fluids to ensure safe practices and minimize environmental risks. Regular training sessions should be conducted to maintain up-to-date knowledge of chemical handling protocols. ➤ Transport synthetic-based mud waste to onshore DOE-licensed facilities for treatment and disposal. ➤ Optimize drilling operations to reduce the volume of cuttings and waste fluids. ➤ In the Luconia Shoals National Park, enforce zero discharge protocols for hazardous waste and produced water. Operation Phase ➤ The proposed mitigation measures for waste management (during mobilisation / demobilisation, installation and drilling phase) and Marine Water Quality section are applicable and shall be implemented.	Section 7.3.2.4, Page C7-15. Section 7.3.3.4, Page C7-19. Section 8.2.7, Page C8-11 to C8-13.

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Potential Impacts		Significance of Potential Impacts	Mitigation Measures	Reference in EIA report
	Marine Ecology ➤ Disturbance to marine habitats and fauna from noise, seabed disturbance, turbidity and lighting, leading to temporary displacement and minor localized ecological impacts.	Low	All Phases ➤ The mitigation measures proposed for Marine Water Quality shall be carried out. ➤ For Benthic Communities: ○ Ensure pipeline installation is precise and minimizes sediment disruption. ➤ For National Park: ○ Avoid sensitive or ecologically significant benthic habitats, such as coral reefs or seagrass beds. ○ Adhere to strict waste management protocols to prevent contamination within the Luconia Shoals National Park (LSNP). ○ Conduct regular environmental monitoring during and post-installation to ensure seabed recovery. ➤ For Fish, Flora, and Fauna: ○ Prohibit indiscriminate waste disposal. ○ Develop and implement a waste management plan to address all waste streams. ○ Promote the use of low-toxicity drilling fluids and chemicals. ➤ Marine Flora and Fauna Survey: ○ Conduct a detailed survey to document baseline ecological conditions and potential species at risk. ○ Incorporate survey results into comprehensive impact mitigation plans. ➤ Prior to commencement of offshore works, the Project Proponent shall submit the required marine ecology impact assessment information and reports to Sarawak Forestry Corporation (SFC), as applicable, and maintain close coordination and consultation with SFC throughout project execution in accordance with regulatory requirements.	Section 7.3.2.5, Page C7-16. Section 7.3.3.6, Page C7-36. Section 8.2.8, Page C8-13 & C8-14.

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

	Seabed and Sediment Quality ➤ Localised seabed disturbance and sediment deposition from installation and drilling activities, including smothering and temporary alteration of benthic habitats.	Low	➤ Plan and execute installation activities as efficiently as practicable to minimise the overall duration of seabed disturbance, allowing natural recolonisation and habitat recovery to occur more rapidly. ➤ Deploy anchors only at pre-determined, surveyed locations to avoid unnecessary seabed damage. ➤ Implement anchor handling procedures to prevent dragging, which can smother or displace benthic organisms and increase sediment resuspension. ➤ Utilise chemicals with low toxicity, high biodegradability, and minimal bioaccumulation potential for pipeline cleaning, conditioning, and hydrotesting. ➤ Maintain and submit SDS for all chemicals used to DOE prior to offshore application. ➤ Treat hydrotest water prior to discharge using filtration, neutralisation, or equivalent processes to remove harmful contaminants. ➤ Ensure discharge of treated hydrotest water meets DOE effluent quality standards. ➤ Select discharge points and use diffusers or controlled release methods to ensure sufficient dilution and dispersion of treated hydrotest water, thereby reducing localised impacts on marine fauna and benthic communities. ➤ Optimise the location during the design stage to minimise permanent seabed coverage and associated habitat loss. <u>Drilling Fluid and Drill Cutting Management</u> ➤ Ensure drilling fluids are carefully selected with environmental friendliness as one of the key criteria. ➤ Use WBM wherever technically feasible, particularly for top-hole and riserless sections, to minimise hydrocarbon introduction to the marine environment. ➤ Where SBM is required, select low-toxicity base fluids and additives with high biodegradability and low bioaccumulation potential. ➤ Choose drilling fluid additives (e.g., viscosifiers, lubricants, shale inhibitors) based on environmental screening data, prioritising those with minimal potential to harm marine life.	Section 7.3.3.5, Page C7-19 to C7-36. Section 8.2.4, Page C8-6 to C8-8.
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POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Potential Impacts		Significance of Potential Impacts	Mitigation Measures	Reference in EIA report
			➤ For drill cuttings, discharge drill cuttings at a depth of 3-5 m below the sea surface to promote dispersion in the water column and reduce localised accumulation on the seabed. ➤ Operate solids control equipment to maximise recovery of drilling fluids from cuttings, thereby reducing the volume of contaminated solids discharged. ➤ Maintain up-to-date SDS for all chemicals used onboard including all drilling fluids and additives and ensure it is readily accessible to all personnel involved. <u>Training Provision</u> ➤ Ensure all personnel involved in the handling, mixing, and transfer of drilling chemicals receive at least basic training in safe chemical handling, spill prevention, and emergency response. ➤ Provide task-specific training on the correct use, inspection, and maintenance of Personal Protective Equipment (PPE) to prevent occupational exposure. <u>Spill Prevention and Response</u> ➤ Equip all chemical storage and transfer areas with secondary containment to prevent accidental release to deck drains or overboard discharge. Maintain spill kits in strategic locations on the drilling rig, and ensure trained crew are available to respond immediately to any accidental releases.	Section 7.3.3.5, Page C7-19 to C7-36. Section 8.2.4, Page C8-6 to C8-8.

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Potential Impacts		Significance of Potential Impacts	Mitigation Measures	Reference in EIA report
	Fishing Community ➤ Temporary restriction of fishing grounds, navigation interference and potential reduction in catch due to vessel activities and localized environmental disturbance.	Low	All Phases ➤ Establish clear communication channels between project vessels and local fishermen via marine radios and stakeholder engagement. Vessels will use Automatic Identification Systems (AIS) to broadcast their positions and avoid navigational conflicts. ➤ Define and demarcate exclusion zones around project vessels and operational areas. Information on these zones will be disseminated through Notices to Mariners and community engagement. A safety zone of 500 m will be maintained around installation sites. ➤ No discharge of oily or hazardous substances into the marine environment, including from deck washing. Use containment systems to capture runoff for treatment and proper disposal. ➤ Regularly inspect vessels and equipment for leaks. Spill response equipment will be maintained on board, and personnel will be trained in spill response procedures. ➤ Ensure compliance with applicable MARPOL requirements pollution prevention. ➤ Establish a grievance mechanism for fishermen to report concerns related to project activities. ➤ Implement a 500-m safety zone around installation sites to ensure the safety of fishing vessels. ➤ Issue Notices to Mariners and communicate activity schedules to local fishermen and authorities. ➤ Deploy navigation aids such as marker buoys and warning lights around work areas. ➤ Inform and involve fishing communities in planning and scheduling activities to minimize disruptions. ➤ Provide clear guidance on alternative fishing areas during temporary exclusions.	Section 7.3.1.4, Page C7-13. Section 7.3.2.6, Page C7-16. Section 7.3.3.7, Page C7-36. Section 7.3.4.2, Page C7-37. Section 8.2.5, Page C8-8 & C8-9.

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Potential Impacts		Significance of Potential Impacts	Mitigation Measures	Reference in EIA report
	Marine Navigation & Traffic ➤ Increased vessel traffic causing navigational hazards, possible collisions and temporary disruption to other marine users.	Low	<u>During Mobilisation / Demobilisation, Installation and Drilling Phase</u> ➤ Issue Notices to Mariners (NTM) to inform all marine users about the project activities, vessel routes, and schedules. Establish clear communication systems, including VHF radio channels, between project vessels, port authorities, and other marine users. ➤ Ensure all vessels are equipped with: ○ Global Positioning System (GPS) and radio navigation systems for precise positioning. ○ Radar beacons (RACONS) and range lights for enhanced visibility. ○ Fog signals to improve safety during low-visibility conditions. ➤ Install temporary navigation markers or buoys at critical points, such as the Cengkih field, to guide vessels safely. ➤ Strictly adhere to the Merchant Shipping Order (Collision Regulations) 1984. Train vessel crews on collision avoidance procedures and ensure compliance with international maritime safety standards. ➤ Collaborate with the Marine Department of Malaysia and local port authorities to ensure seamless coordination of vessel movements. Monitor and manage vessel traffic using Automatic Identification System (AIS). ➤ Establish temporary exclusion zones (500 m) around the Project site and along vessel routes to prevent interference from unauthorized vessels. Use patrol boats to enforce the exclusion zones.	Section 7.3.1.5, Page C7-13. Section 7.3.2.7, Page C7-17. Section 7.3.3.8, Page C7-36. Section 8.2.6, Page C8-10 & C8-11.

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Potential Impacts	Significance of Potential Impacts	Mitigation Measures	Reference in EIA report
Accidental/Emergency Events			
 Diesel Spill from Vessel Collision ➤ Accidental hydrocarbon release from vessel collision leading to short-term, localized marine pollution and ecological disturbance.	Medium	➤ Ensure that all equipment and cargo are properly secured before being lifted or transferred to prevent accidental drops. Regularly inspect securing methods to ensure they are fit for purpose. ➤ Install safety nets or barriers around the deck and other high-risk areas to catch any small objects that may fall during loading, unloading, or transportation. ➤ Implement strict procedures for handling and securing tools and materials during operations. All personnel should be trained on safe lifting techniques and the use of securing devices. ➤ Assess the weight and stability of objects being lifted to ensure they can be safely handled in various sea conditions, minimizing the risk of accidental drops. ➤ Use monitoring equipment (such as radar or sonar) to track dropped objects in the water. This allows for early detection of any lost items and can help in quick recovery efforts. ➤ Conduct regular inspections of the equipment and cargo storage areas to ensure all items are properly secured throughout the operation. ➤ In the event of a dropped object, activate recovery operations immediately. This may involve using remotely operated vehicles (ROVs) or divers to retrieve the lost equipment from the seabed. ➤ Mark areas where objects have been dropped and establish exclusion zones to prevent vessels from coming into contact with hazardous materials or obstructed zones. ➤ Use materials that are less likely to cause environmental harm if lost or dropped into the sea. For example, consider biodegradable or non-toxic materials where possible for non-critical items. ➤ Train all personnel involved in handling, securing, and moving objects to ensure they understand the risks of dropping items	Section 7.3.6, Page C7-38 to C7-52. Section 8.2.9, Page C8-14 to C8-17.

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Potential Impacts		Significance of Potential Impacts	Mitigation Measures	Reference in EIA report
			into the ocean and the importance of maintaining strict safety protocols. ➤ Conduct regular emergency response drills that include scenarios involving dropped objects, ensuring that all crew members are familiar with the actions to take in the event of an object loss. ➤ After any incident involving dropped objects, conduct a thorough investigation to identify the cause, review the response, and implement measures to prevent recurrence. ➤ Continuously review and update safety and operational procedures to address new risks, technology advancements, and lessons learned from previous incidents.	Section 7.3.6, Page C7-38 to C7-52. Section 8.2.9, Page C8-14 to C8-17.
	Hydrocarbon, Drilling Fluid/Chemical Spill ➤ Accidental discharge of drilling fluids/chemicals causing localized water quality deterioration and short-term toxicity to marine organisms.	Medium	➤ Ensure spill response kits and materials are readily available on-site. ➤ Establish clear communication and reporting procedures for any accidental spills. ➤ Maintain compliance with international best practices and regulatory guidelines for spill management and response. ➤ All refuelling-at-sea operations should be manned, and crew changes via vessels should be conducted during calm sea conditions, following industry best practices to minimize the risk of spills. ➤ All personnel must be adequately trained in handling oil spills, ensuring preparedness for quick and efficient response in the event of a spill. ➤ All spills should be treated as scheduled waste in compliance with the Environmental Quality (Scheduled Wastes) Regulations, 2005 to ensure proper disposal and avoid environmental contamination. ➤ Any accidental release of drilling fluids or operational chemicals, if any, will be managed using established spill prevention, containment, and response procedures, with residuals recovered and managed as scheduled waste in accordance with applicable regulations and Project procedures.	

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Potential Impacts		Significance of Potential Impacts	Mitigation Measures	Reference in EIA report
			➤ An Oil Spill Contingency Plan and Emergency Response Procedure (ERP) should be developed and maintained, detailing the procedures to follow in the event of a spill. ➤ Prior to mobilization, all vessels should undergo checks and independent audits to ensure that spill prevention procedures, such as the Shipboard Oil Pollution Emergency Plan (SOPEP), are in place and adhered to. ➤ In the event of a spill incident, the spill prevention procedures and Oil Spill Contingency Plan should be activated immediately. All major oil spills must be recorded, reported, and notified to PETRONAS promptly, with a detailed incident investigation report submitted within the timeframe required by PETRONAS and relevant authorities. Minor spills must also be documented, notified, and reported as outlined in Project Proponent's Oil Spill Contingency Plan.	Section 7.3.6, Page C7-38 to C7-52. Section 8.2.9, Page C8-14 to C8-17.
	Pipeline Leak and Damage (Unauthorized Anchoring) ➤ Condensate leakage from pipeline damage leading to localized marine contamination and temporary ecological disturbance.	Medium	➤ Advanced leak detection technologies are employed to identify anomalies in real-time, ensuring swift action if needed. ➤ Use of corrosion-resistant materials and coatings to minimize the risk of degradation. ➤ Regular application of cathodic protection systems and internal chemical treatments. ➤ Periodic inspections, including inline inspection tools (pigs) and external surveys, to detect early signs of wear or damage. ➤ Clearly marked pipeline routes on navigational charts to avoid accidental anchoring or fishing activities. Deployment of protective structures, such as concrete mattresses or rock covers, to shield pipelines in high-risk areas. ➤ Comprehensive spill response plans and equipment to minimize environmental impact in the unlikely event of a leak.	
	Well Blowout ➤ Uncontrolled release of hydrocarbons resulting in temporary offshore exposure with potential wide spatial extent but generally transient and non-persistent impacts.	Medium	➤ Use advanced well-casing and cementing techniques to ensure well integrity. Regularly monitor pressure, flow rates, and equipment conditions. ➤ Ensure that Blowout Preventer systems are well-maintained, inspected, and tested according to regulations.	

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Potential Impacts		Significance of Potential Impacts	Mitigation Measures	Reference in EIA report
			➤ Conduct detailed risk assessments during drilling and production phases to identify and mitigate potential hazards. ➤ Provide comprehensive training for personnel on blowout prevention and response. Conduct regular emergency response drills. ➤ Deploy specialized equipment and techniques, such as capping stacks, to regain control of the well. ➤ Use chemical extinguishers, water, or other methods to suppress fires associated with the blowout. ➤ Implement a structured, tiered-response system tailored to the severity of the situation: Tier I (immediate local response), Tier II (regional response) and Tier III (national/international response). ➤ Establish real-time monitoring to assess the spread of pollutants and take immediate action. ➤ Clean up spills and restore affected habitats. Employ bioremediation or chemical treatment for hydrocarbon-contaminated areas. ➤ Investigate the cause of the blowout to prevent future incidents. Share findings and best practices across the industry.	Section 7.3.6, Page C7-38 to C7-52. Section 8.2.9, Page C8-14 to C8-17.

PROPOSED MONITORING PROGRAMME

Performance Monitoring (PM)

PM Item	PM Plan	Frequency
Drilling fluids & cuttings	Monitor usage, record cuttings volume, ensure Oil On Cuttings compliance, verify treatment performance, maintain waste tracking.	Daily during drilling End-of-well reporting
Waste management	Track waste inventory (hazardous & non-hazardous), monitor recycling/disposal records, audit storage compliance.	Ongoing throughout Project
Spills & leaks	Report & investigate spills, document response actions, maintain spill register, implement corrective actions.	Ongoing throughout Project
Mitigation measures	Monitor effectiveness of mitigation systems, verify EMP implementation	Ongoing throughout Project

Compliance Monitoring (CM)

Potential Impact	CM Plan	Frequency
Oil / oily discharge (vessels)	Maintain discharge records, ensure ≤15 ppm oil content, verify International Oil Pollution Prevention certificate, inspect oily water separator & alarms, audit Oil Record Book.	Ongoing throughout Project
Waste management	Ensure compliance with Scheduled Wastes Reg. 2005, maintain waste inventory, verify disposal via licensed contractors, comply with MARPOL Annex V (garbage).	Ongoing throughout Project
Spills	Report & investigate spills, notify authorities as required, implement corrective actions (CAPA) and track closure.	Ongoing throughout Project

Impact Monitoring (IM)

Project Activity	IM Plan	Frequency
Installation & Drilling	Post-EIA monitoring (10 stations) of marine water, sediments & biology; conduct Marine Flora & Fauna Monitoring (MFFM) vs baseline.	Post EIA: once every 6 months MFFM: Annually
Operation & Maintenance	Continue Post-EIA monitoring at stations; ongoing MFFM to assess long-term ecological changes.	Post EIA: once every 6 months MFFM: Annually

STUDY FINDINGS

The EIA study found that although Project activities may initially pose medium risks, the impacts are mostly localised, short-term, and reversible; with proper mitigation and compliance measures, residual impacts are reduced to low (ALARP) levels, making the Project environmentally acceptable provided the EMP is effectively implemented.