10 Construction, Installation and HUC Environmental Impact Assessment, Mitigation and Monitoring

Contents

List of Figures

List of Tables

10.1 Introduction

This Chapter of the Shah Deniz 2 (SD2) Project Environmental and Socio-Economic Impact Assessment (ESIA) presents the assessment of environmental impacts associated with the following SD2 Project phases:

- Onshore Construction and Commissioning of Terminal Facilities;
- Onshore Construction and Commissioning of Offshore and Subsea Facilities;
- Platform Installation, Hook Up and Commissioning (HUC);
- Subsea Export & MEG Pipeline Installation & HUC; and
- Subsea Infrastructure Installation & HUC.

The impact assessment methodology followed and the structure of the SD2 Project impact assessment are described in full within Chapters 3 and 9 of this ESIA, respectively.

10.2 Scoping Assessment

The SD2 Project Construction, Installation and HUC Activities and Events have been determined based on the SD2 Project Base Case, as detailed within Chapter 5: Project Description (see Appendix 10A).

Table 10.1 presents the Activities and associated Events that have been scoped out of the full assessment process due to their limited potential to result in discernable environmental impacts. Judgement is based on prior experience of similar Activities and Events, especially with respect to earlier ACG developments. In some instances, scoping level quantification/numerical analysis has been used to justify the decision. Reference is made to relevant quantification, analysis, survey and/or monitoring reports in these instances.

Table 10.1 "Scoped Out" SD2 Project Activities

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
Onshore Construction and Commissioning of Terminal Facilities & Installation & HUC of Subsea Export and MEG Pipelines (Onshore)			
CTer-R1	Operation of construction plant and vehicles including diesel generators (onsite) – disturbance/indirect effect to wildlife	5.5.4.1	• Vehicle movements during construction and commissioning activities within Sangachal Terminal vicinity will be restricted to defined access routes and demarcated working areas, unless in the event of an emergency. • Construction traffic associated with the SD2 Project is expected to use the Baku-Salyan Highway during the construction period. • Off-road driving will be prohibited during construction and commissioning activities within Sangachal Terminal vicinity, outside of designated areas unless specifically authorised. • It is expected that local wildlife in the area will avoid noisy areas. • A Wildlife Management Plan will be prepared for the duration of the construction and commissioning activities carried out within Sangachal Terminal vicinity. **Conclusion:** Vehicles will use existing roads and tracks. With the Wildlife Management Plan in place, there will be a limited discernible impact to wildlife.
CTer-R2	Construction vehicle movements (offsite) – disturbance/indirect effect to wildlife	5.5.4.1	

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
CTer-R3	Construction plant/vehicle refuelling	5.5.3.3	• Plant and vehicles associated with the SD2 Project will be either refuelled at the new SD2 dedicated vehicle refuelling facility, or in the location they are operating using mobile fuel bowsers. • A refuelling procedure will be used during construction and commissioning activities in the Sangachal Terminal vicinity, for construction plant and vehicles which details the pre-checks, level indication monitoring, provision of temporary containment and drip trays, communication, training and spill kit requirements. • The dedicated refuelling area at the Terminal will be located within a bund capable of holding 110% capacity. The area will include lined concrete bunds, sized to contain 110% of the stored fuel capacity. Drainage within the refuelling facility will be routed to an oil water separator system • Drainage within the refuelling facility will be routed to an oil water separator system. The refuelling facility oil water separators will be tested on a daily basis to confirm the total oil content is less than 19mg/l daily average and 10 mg/l monthly average. Wastewater from the refuelling facility that does not meet the applicable discharge standards and separated oil will be collected by road tanker, handled as liquid waste and removed from site. **Conclusion:** No discernible impact to the terrestrial environment is expected
CTer-R4	Erection of temporary structures (e.g. buildings) – visual impact	5.5.2.1	• Temporary and permanent structures will be constructed at and adjacent to the SD2 Expansion Area including temporary construction buildings and SD2 utility and process equipment (including the SD2 flare). • All structures will be of a similar scale to the existing ACG and SD facilities at the Sangachal Terminal. • The existing Terminal is not considered to significantly impact existing views from the communities surrounding the Terminal. • The SD2 temporary and permanent structures are likely to be indistinguishable from the existing facilities in these views (with the exception of the SD2 Flare under non routine flaring conditions at night – refer to Chapter 12 Section 12.3.4) **Conclusion:** There will be limited visibility of the temporary construction and permanent SD2 utility and process structures from sensitive receptors and no discernable impact on human receptors is expected.
CTer-R5	Erection of permanent structures (e.g. pipe racks and structural steel works) – visual impact	5.5.2.1	
CTer-R6 & SubOn-R3	Use of temporary lighting (within SD2 Expansion area and along the Onshore SD2 Export Pipeline Corridor)	5.5.3.1	• Under normal conditions, work areas will not be lit outside of working hours during onshore construction and commissioning activities unless for safety/security reasons. • The existing Terminal is heavily lit and the existing lighting around its perimeter would dominate any light associated with the SD2 Project. • A lighting strategy will be implemented during onshore construction and commissioning activities which will include measures to minimise light spillage and glare to the community. Measures will include use of lighting with cowls that can be angled towards the work area and where safe to do so turning off lights when not in use. **Conclusion**: No discernible impact on human and ecological/biological receptors is expected.
CTer-R7	Use of permanent lighting within the SD2 Expansion Area	5.5.3.1	• Permanent lighting will be installed in the Construction Camp and Facilities areas and the SD2 Expansion Area. **Conclusion:** The existing Terminal is heavily lit. Lighting associated with the SD2 Project would be indistinguishable from the current lighting environment
CTer-R8	Above groundworks (e.g. construction of internal road network within the SD2 Expansion Area) - Alteration to surface water flow	5.5.2.1 5.5.2.2	• Above ground structural groundworks associated with the SD2 Project will result in alterations in surface water flows in the vicinity of the Terminal. • Hydrological modelling has been undertaken to determine the flow conditions and flood risk prior and following the SD2 Project works in the Terminal vicinity. • Modelling has shown that both prior to and following the SD2 Project works, Sangachal Town and Sangachal Power Station[1], which both lie significantly above the level of a major flood event, are not at risk of flooding. • Under existing conditions, sections of the railway and highway are currently at risk of flooding during a major flood event. Modelling showed that the SD2 project works do not increase the likelihood or severity of the existing flood risk in these locations. • The Caravanserai, a State protected monument located to the south of the Terminal, was shown to be located in an area which, at it lowest

[1] Major flood event is defined as 1 in 100 year flood

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
			point, is very close to the level of a major flood event. The modelling demonstrated that the SD2 Project works are predicted to result in a negligible change to flood levels at this location (<2mm increase). **Conclusion:** Overall, the risk of flooding at key receptors was shown to either marginally reduce or remain largely unchanged following the SD2 Project works.
CTer-R9 & SubOn-R1	Movement and temporary storage of spoil (within SD2 Expansion area and along the Onshore SD2 Export Pipeline Corridor) – Dust generation	5.5.2.2	• Earthworks associated with the SD2 Project will result in the generation of dust. • Dust levels recorded during the baseline surveys are considered to be indicative of a semi-desert environment. • Vehicles will travel during construction and commissioning activities at Sangachal Terminal vicinity at speeds that minimise dust and unpaved roads/tracks and road speeds will be established for different road surfaces. Speed limits will be adhered to at all times in the Sangachal Terminal vicinity during onshore construction and commissioning activities. • Construction activities will be suspended at Sangachal Terminal vicinity if excessive dust arises and measures will be taken to control ground prior to resuming activities. • Loose loads of all construction vehicles entering the construction sites within the Sangachal Terminal vicinity will be covered . • Drivers of onsite construction vehicles operated within the Sangachal Terminal vicinity will be provided with dust management training . • Where unsurfaced, the main access routes will be created using compacted well graded granular fill, appropriately designed to ensure good drainage to minimise the potential for erosion. • All unsurfaced roads located within the Sangachal Terminal vicinity will be regularly maintained to ensure the surface remains stable and compacted. • All hardstanding areas (including paved roads) located within the vicinity of Sangachal Terminal will be regularly inspected to ensure areas are kept clean of dust and mud. • A wheel washing facility will be used at Sangachal Terminal to remove excessive mud from vehicles using unpaved roads, leaving the site using the public highway. • Quantity and duration of spoil exposure will be minimised as far as possible and ground disturbing activities will be sequenced to minimise the area disturbed at one time within the vicinity of Sangachal Terminal. **Conclusion:** No discernible impact on human and ecological/biological receptors is expected
CTer-R8	Above groundworks (e.g. construction of internal road network within the SD2 Expansion Area) - Dust generation	5.5.2.1 5.5.2.2.	
CTer-R10 & SubOn-R2	Subsurface groundworks (e.g. construction of open drains system, underground pipework and foundations, pipeline trenching) – Dust generation	5.5.2.2.	
CTer-R10	Subsurface groundworks at the Terminal (e.g. construction of open drains system, underground pipework and foundations) – cultural heritage	5.5.2.2	• The SD2 Expansion Area has been cleared and terraced during the EIW. • An archaeological watching brief will be implemented at the construction sites located within the vicinity of Sangachal Terminal during any clearance works in areas not previously surveyed during the EIW. **Conclusion:** No discernible impact on terrestrial cultural heritage is expected.
CTer-R10	Subsurface groundworks at the Terminal (e.g. construction of open drains system, underground pipework and foundations) – mobilisation of potential contamination	5.5.2.2	• Stockpiles of subsoil located in the vicinity of Sangachal Terminal, will be appropriately shaped and compacted to avoid erosion and sedimentation of nearby open water courses or drains. • Site drainage and pollution hazards maps will be maintained that show potential sources of pollution (e.g. storage areas), pathways (e.g. drains) and receptors (e.g. the Caspian Sea) located within the Sangachal Terminal vicinity • Designated areas within the Sangachal Terminal vicinity will be established away from watercourses for waste cement/ concrete, which will be contained and collected as a waste once solidified. **Conclusion:** No discernible impact on ecological/biological receptors is expected
CTer-R11	Discharge from oil water separators from construction camp facilities to wadi system	5.5.2.1	• The drainage system within the construction camp and construction facilities area will be designed to: • Route wastewater from the vehicle wash and refuelling facilities for reuse or discharged after treatment using an oil water separator. The oil water separators will be designed to treat wastewater from the vehicle wash facility to applicable oil water standards of 19 mg/l daily average and 10 mg/l monthly average. The separators will be tested on a daily basis to confirm the total oil content daily and average standards are met. Wastewater from the vehicle wash and refuelling facilities that does not meet the applicable discharge standards will be collected by road tanker, handled as liquid waste and removed from site.
CTer-R12	Discharge of water from non-oily water separator systems from construction camp facilities to wadi system	5.5.2.1	

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
			• Route canteen waste water to the STP via a dedicated system to separate fats, oil and grease to minimise potential fouling of the STP. The contents of the traps will be collected by road tanker, handled as liquid waste and removed from site. • Surface water flows within the wadi will increase in response to precipitation events. The volume of water discharged from separators into the wadi will not significantly increase the flow conditions currently experienced after a rainfall event. **Conclusion:** No discernible impact on human and ecological/biological receptors is expected
CTer-R13	Discharge of water from the sewage treatment plant into the wadi (when operational after Phase 1)	5.5.2.1	• During construction of the SD2 onshore facilities, sewage will be routed to the new STP when operational or collected by road tanker, handled as liquid waste and removed from site. • Sewage will be treated to comply with applicable project standards: pH (6-9), 5 day BOD of less than 20mg/l, total coliform <400MPN (Most Probable Number) per 100ml, COD of less than 100mg/l, suspended solids of less than 30mg/l and residual chlorine less than 1mg/l (used for irrigation) or less than 0.2mg/l (discharge to the environment). • Treated sewage will be used for irrigation or dust control (preferred option) within the vicinity of Sangachal Terminal. • Residual chlorine content of the sewage discharged from the treatment plant into the wadi will be measured daily. • Samples will be taken from the Sewage Treatment Plant discharge outlet and analysed weekly for pH and daily for BOD, total coliforms, COD and suspended solids against applicable project standards. Assurance monitoring will be completed monthly. • Results from effluent monitoring will be submitted to the MENR monthly. • Sewage sludge will be transported off site for disposal to an appropriately licensed facility • Sumps will be used to provide contingency storage when the STP requires maintenance or is not available. Waste water from the sumps will be collected by road tanker, handled as liquid waste and removed from site. **Conclusion:** No discernible impact on human and ecological/biological receptors is expected.
CTer-R17	Discharge from testing of pipework associated with the construction camp drainage system	5.2.2.1	• Effluent from the pipework testing and chlorination that meets the applicable sewage and oil water performance and monitoring standards presented in Table 5.14 will either be used for irrigation and/or dust control or discharged. Out of spec effluent will be collected by road tanker, handled as liquid waste and removed from site. **Conclusion:** No discernible impact on human and ecological/biological receptors is expected.
CTer-R18	Discharge of onshore plant hydrotest discharge (from all process and utility lines, storage tanks and civil basins/structures)	5.5.2.4	• For each test the system will be filled with freshwater and then emptied. If possible and where practical, the hydrotest water will be temporarily stored and reused. Following the completion of testing the hydrotest water will either be discharged to the site drainage system if it conforms with the applicable standards in Table 5.14 or collected by road tanker, handled as liquid waste and removed from site. **Conclusion:** No discernible impact on human and ecological/biological receptors is expected.
CTer-R19	Open drains discharge during commissioning	5.5.2.4	• The open drains treatment system will be flushed using freshwater to remove any debris within the system prior to start up. Prior to flushing of the complete drainage system, water samples from all drainage sumps will be tested to confirm the oil content. If the oil content of the water in the sumps exceeds 19mg/l daily average[2] the contents of the sump will be collected by road tanker, handled as liquid waste and removed from site. If the total oil content of the water in the sumps is lower than 19mg/l daily average, the sump content will be discharged to the storm water drainage channels. **Conclusion:** No discernible impact on human and ecological/biological receptors is expected
CTer-R20	Produced water discharge during onshore facility commissioning	5.5.2.4	• Off spec produced water during onshore facility commissioning will either be sent to the ACG produced water treatment facilities, tankered off site for 3rd party treatment and disposal or sent to a pond for storage. **Conclusion:** No discernible impact on human and ecological/biological receptors is expected

[2] Note monthly average oil water criteria is not applicable as discharges will be intermittent and of short (~hours) duration.

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
Onshore Construction and Commissioning of Offshore and Subsea Facilities			
CYar-NR1	Construction yard upgrades and expansion works	5.6.2	• Yard extensions, if required, will involve minimal land-take of industrial land adjacent to existing established construction yards. • Yard upgrade works (e.g. systems refurbishment) will be undertaken within existing site buildings/waste/storage areas. • Vessel upgrade work will be completed at an existing port facility. **Conclusion:** Works will be of limited scope and short duration and will be managed by the yard operator in accordance with their HSE requirements and agreements with the Azerbaijani Authorities, resulting in negligible impacts to residential receptors and the terrestrial and marine environment.
CYar-R2	STB01, PLBG, DBA and DSV vessel upgrade works	5.6.2	
CYar-R3	Construction yard utilities (drainage/sewage)	5.6.9.2	• Black and grey water generated at the construction yard(s) will be collected in on site sewer pipes and sumps and then either transferred by road tanker or by sewer pipes to a municipal sewage treatment plant for treatment and disposal. If the construction yard has an operational sewage treatment plant that discharges treated effluent to the environment, the yard operator will be responsible for agreeing the discharge standard with the MENR and maintaining the discharge permit conditions stipulated by the MENR. • Drainage water from areas in the construction yard(s) in which hazardous materials are stored and routinely used will be contained and will be collected by road tanker, handled as liquid waste and removed from site. If the yard operator has an agreement with the MENR for discharge of drainage from areas where hazardous materials are storage or used, they will be responsible for maintaining the discharge permit conditions stipulated by the MENR. **Conclusion:** Discharge of treated sewage and discharge of drainage from areas where hazardous materials are stored or used from the construction yards will be in accordance with MENR requirements.
CTer-R4	Grit blasting/welding and painting of jacket components, piles and pipework	5.6.3	• Grit blasting, welding and painting of jacket components, piles and pipework are required. • The majority of grit blasting and anti corrosion painting of jacket and pile components will be undertaken in a paint shop with a fume extraction and grit recovery system in place. Grit blasting and anti corrosion painting of sections which are too large are to be accommodated within a paint shop, will be undertaken within a temporary enclosure. • Preference to use garnet for grit blasting which is inert, non-hazardous and suitable for disposal under EU legislation in a non-hazardous landfill . **Conclusion:** No discernible impact on ecological/biological receptors is expected
Platform Installation and HUC			
CPlat-R1	Offshore commissioning of the SDB platform complex deluge system	5.6.4	• Discharge of seawater via the SDB-PR open drains caisson at 52m below sea level. **Conclusion:** No chemical/temperature change in seawater and hence no expected impact from discharge.
CPlat-R2	Offshore commissioning of the SDB platform complex foam system	5.6.4	• Discharge of approximately 20 litres of AFFF with 140m^3 of seawater via the open drains caisson at 52m below sea level. • The current foam used by the AGT Region is of very low toxicity (LC_{50} 2.8 g/l for fish, 34.8 g/l for Daphnia) • Readily degradable (28-day degradation 92%) and no bioaccumulation potential. • Small volume will disperse in minutes so little potential for acute toxicity in exposed organisms. • 20 litres of AFFF would require only about 1,500m^3 of seawater to dilute to 96h no-effect level (a volume with an approximate radius of 7m). • The fish most likely to be present for extended periods of time in the SD Contract Area and at the SDB platform complex location are Kilka and Mullet that may be present throughout the year. However, the ASD Contract Area is not exclusively used by these species and the Contract Area is not considered to be of primary importance. **Conclusion:** Limited potential for discernable impact on the marine environment.
CPlat-R3	Jacket buoyancy tank dewatering	5.6.4 5.7.2	• Discharge of treated seawater (including preservation chemicals) will occur during dewatering of the two compartments of the two jacket buoyancy tanks. • Each event will involve a discharge of 187.5m^3 over 3 hours with all compartments emptied over an 8 hour period. • Modelling has indicated that the plume would reach a maximum length of approximately 1.6km, but would be extremely narrow (a few metres at most) (refer to Appendix 10F)

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
			• It was estimated that the plume would reach a dilution in excess of 20,000-fold (a greater dilution than that required to reach the no effect concentration of the preservation chemicals) within 4 hours of the end of the discharge. • **Conclusion:** Impact from these discharges is therefore considered to be insignificant.
Subsea Export & MEG Pipeline Installation & HUC and Subsea Infrastructure Installation & HUC			
SubOff-R5	Permanent presence of the SD2 Export and MEG Pipelines and the subsea infrastructure	5.8 & 5.9	• Permanent seabed disturbance activities include the installation of the SD2 Export and MEG Import pipelines and Subsea Infrastructure. • In total the SD2 Export and MEG Import pipelines will occupy an area of 9.27km^2, 0.0023% of the Caspian Sea. The Subsea Infrastructure will occupy an area of 9.66km^2, 1.1% of the SD Contract Area. • In practice, it is likely that the majority of the organisms within these areas would be sufficiently mobile to re-establish themselves on either side of the pipelines and subsea infrastructure since this would involve movement of only 30cm to 40cm at most. • The concrete coating of the pipelines and coating of the flowlines is chemically inert by design and will have no effect on either the adjacent sediments or water column. • Temporary seabed disturbance activities include anchoring and chain drag associated with the installation vessels. • The primary impact associated with anchor setting and chain drag will be the disturbance and displacement of the sediment. The organisms living in the sediment are too small to be crushed by anchors and chain drag, although a small amount of mortality might occur at the point where the anchor initially impacts the seabed. • The displacement of sediment will not cause significant levels of mortality in benthic organisms. A small proportion of animals may be buried too deeply to recover to a position near the sediment surface, but the majority of organisms will be able to re-establish themselves once the anchor and chain have been moved to their next position. Up to approximately 1,495m^3 of seabed may be excavated prior to jacket installation. This is anticipated to have a localised and very small impact in the context of Contract Area. Organisms are not anticipated to be significantly impacted and will rapidly recover. **Conclusion:** It is considered that impacts are minimised as far as practicable and no discernible impact to the marine environment due to seabed disturbance.
SubOff-R6	Use of installation and HUC vessels & platform installation (seabed disturbance)	5.8.6 & 5.9.3	
All Construction, Installation & HUC Activities			
ALL-R1	Waste Generation	5.5.4 5.6.9 5.7.7 5.8.7 5.9.5	• Waste generated during SD2 construction, installation & HUC activities will be consistent with the type and quantity that have been routinely generated during previous construction works. • Waste at the construction sites, construction yards and onboard the installation and HUC vessels will be segregated at source, stored and transported in fit for purpose containers . • All waste generated during onshore platform and subsea infrastructure construction and commissioning activities will be managed in accordance with the existing AGT management plans and procedures. • Waste minimisation and management plans will be established for the construction, installation & HUC phase and all waste transfers controlled and documented. **Conclusion:** Waste generated during the SD2 Project will be managed in accordance with the existing BP AGT Region management plans and procedures. No discernable impact to the terrestrial or marine environment expected

The SD2 routine and non-routine Activities and their associated Events that have been assessed with the full impact assessment process are presented in Table 10.2.

Table 10.2 "Assessed" SD2 Project Construction, Installation and HUC Activities

ID	Activity / Event	Ch. 5 Project Description Reference	Event	Receptor
Onshore Construction and Commissioning of Terminal Facilities				
CTer-R1	Operation of construction plant and vehicles including diesel generators (onsite).	5.5.4.1	Emissions to atmosphere (non GHG)	Atmosphere
			Onshore noise	Terrestrial Environment (Noise)
CTer-R2	Construction vehicle movements (offsite)	5.5.4.1	Emissions to atmosphere (non GHG)	Atmosphere
			Onshore noise	Terrestrial Environment (Noise)
CTer-R14	Piling within the SD2 Expansion Area	5.5.2.2	Onshore noise	Terrestrial Environment (Noise)
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)
CTer-R15	Commissioning and testing onshore power generation turbines, compressors and firewater pumps	5.5.2.3	Emissions to atmosphere (non GHG)	Atmosphere
			Onshore Noise	Terrestrial Environment (Noise)
CTer-R16	Installation of piles, construction and installation of a new condensate holding tank and bund structure and associated earthworks	5.5.2.1	Potential mobilisation of contamination	Terrestrial Environment (Soil, Groundwater and Surface Water)
Onshore Construction and Commissioning of Offshore and Subsea Facilities				
CYar-R6	Use of yard plant (generators and engines) during jacket, bridge and topside fabrication and topside commissioning	5.6.3	Emissions to atmosphere (non GHG)	Atmosphere
			Onshore noise	Terrestrial Environment (Noise)
CYar-R7	Use of yard cooling water system (including dosing of chlorine) during onshore topside commissioning	5.6.7.1	Cooling water discharges to sea	Marine Environment (Water Column and Seabed)
CYar-R8	Topside Commissioning at the construction yard	5.6.7	Emissions to atmosphere (non GHG)	Atmosphere
			Onshore noise	Terrestrial Environment (Noise)
Platform Installation & HUC				
CIns-R1	Use of vessels for jacket, topside and bridge installation	5.7.6	Emissions to atmosphere (non GHG)	Atmosphere
			Treated sewage water	Marine Environment (Water Column and seabed)
			Grey water	
			Drainage water	
			Underwater noise and vibration	Marine Environment (Water Column and seabed)
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)
CIns-R2	Foundation piling and grouting for jackets	5.7.2	Seabed disturbance - benthos	Marine Environment (Water Column and seabed)
			Underwater noise and vibration	
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)

ID	Activity / Event	Ch. 5 Project Description Reference	Event	Receptor
Installation & HUC of Subsea Export and MEG Pipelines (Onshore)				
SubOn-R4	Operation of construction plant and vehicles along Onshore SD2 Export Pipeline Corridor and Pipeline Landfall Area	5.8.6	Emissions to atmosphere (non GHG)	Atmosphere
			Onshore noise	Terrestrial Environment (Noise)
			Disturbance/indirect effect to wildlife	Terrestrial Environment (Ecology)
SubOn-R1	Removal and storage of surface soil layer and vegetation within the Onshore SD2 Export Pipeline Corridor	5.8.3.3	Direct/indirect effect to wildlife	Terrestrial Environment (Ecology)
			Loss of habitat	
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)
SubOn-R2	Onshore SD2 Export Pipeline Corridor trenching (including the movement, temporary storage and disposal of excess spoil)	5.8.3.3	Potential mobilisation of contamination	Terrestrial Environment (Soil, Groundwater and Surface Water)
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)
SubOn-R5	Augur boring associated with onshore pipeline crossings	5.8.3.3.	Onshore noise	Terrestrial Environment (Noise)
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)
			Disturbance/indirect effect to wildlife	Terrestrial Environment (Ecology)
SubOn-R6	Pipeline drying following offshore pipeline pre commissioning	5.8.4	Emissions to Atmosphere (non GHG)	Atmosphere
			Onshore noise	Terrestrial Environment (Noise)
Installation & HUC of Subsea Export and MEG Pipelines (Nearshore Section)				
SubNr-R1	Installation of finger piers	5.8.3.2	Coastal erosion	Nearshore/Coastal Environment
			Seabed disturbance - benthos	
			Potential disturbance/damage to cultural heritage	Marine Environment (Cultural Heritage)
SubNr-R2	Use of vessels during nearshore trenching and pipelay	5.8.3.1 Table 5.23	Emissions to Atmosphere (non GHG)	Atmosphere
			Underwater noise and vibration	Marine Environment (Water column and seabed)
			Treated sewage water	Marine Environment (Water column and seabed)
			Grey water	
			Drainage water	
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)
SubNr-R3	Trenching (from coastline to 12m water depth)	5.8.3.2	Coastal erosion	Nearshore/Coastal Environment
			Seabed disturbance - benthos	
			Potential disturbance/damage to cultural heritage	Marine Environment (Cultural Heritage)
SubNr-R4	Installation of the subsea SD2 export and MEG pipelines	5.8.3.2	Coastal erosion	Nearshore/Coastal Environment
			Seabed disturbance - benthos	
			Underwater noise and vibration	Marine Environment (Water column and seabed)
			Potential disturbance/damage to cultural heritage	Marine Environment (Cultural Heritage)

ID	Activity / Event	Ch. 5 Project Description Reference	Event	Receptor
Installation & HUC of Subsea Export and MEG Pipelines (Offshore Section) and Installation & HUC of Subsea Infrastructure				
SubOff-R1	Use of vessels during offshore pipelay and subsea infrastructure installation	5.9.3	Emissions to atmosphere (non GHG)	Atmosphere
			Treated sewage water	Marine Environment (Water column and seabed)
			Grey water	
			Drainage water	
			Underwater noise and vibration	
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)
SubOff-R2	Installing SD2 export and MEG pipelines, flowlines and infield infrastructure on seabed	5.9.3	Seabed disturbance - benthos	Marine Environment (Water column and seabed)
			Potential disturbance/damage to cultural heritage	Marine Environment (Cultural Heritage)
SubOff-R3	SD2 export pipeline, MEG pipeline and flowline cleaning, hydrotesting and dewatering	5.8.5 Table 5.22 & 5.9.4 Table 5.25	Cleaning and hydrotest discharges to sea	Marine Environment (Water column and seabed)
SubOff-R4	Piling to secure SSIVs	5.9.3	Underwater noise and vibration	Marine Environment (Water column and seabed)
			Potential disturbance/damage to cultural heritage	Terrestrial Environment (Cultural Heritage)

10.3 Impacts to the Atmosphere

Non greenhouse gas (GHG) emissions to the atmosphere from Construction, Installation and HUC activities will be associated with construction plant and vehicles, emissions from commissioning of the onshore SD2 facilities at the Terminal and offshore facilities at the construction yards and use of vessels. GHG emissions associated with the SD2 Project are discussed within Chapter 13 of this ESIA. This section focuses on the assessment of potential air quality impacts.

10.3.1 Mitigation

Existing controls associated with emissions from Construction, Installation and HUC activities include:

- Construction plant and vehicles will be modern and well maintained in accordance with the written procedures based on manufacturer's guidelines, applicable industry code, or engineering standard to ensure efficient and reliable operation;
- Where practicable, mains electricity will be used instead of mobile generators as a power source;
- Diesel supplied to the construction plant and vehicles from the diesel tank farm will be low in sulphur (typically <0.05%); and
- A Community Engagement and Nuisance Management and Monitoring Plan will be implemented and maintained as a mechanism of communicating with the community and responding to community grievances.

10.3.2 Construction and Commissioning Emissions (Terminal, Onshore Pipelay and Pipeline Drying)

10.3.2.1 Event Magnitude

Description

Construction plant and vehicles will be used in the vicinity of the Sangachal Terminal during the following activities:

- Terminal construction works primarily within the SD2 Expansion Area;
- Construction works to enable installation of the SD2 export and MEG pipelines within the nearshore area and subsequent reinstatement;
- Onshore pipelay and subsequent reinstatement within the SD2 Export Pipeline Corridor; and
- Drying of the SD2 export and MEG pipelines following pre commissioning and dewatering.

The estimated number and type of onsite and offsite construction plant and vehicles that are expected to be used for each of these activities are presented in Appendix 5F.

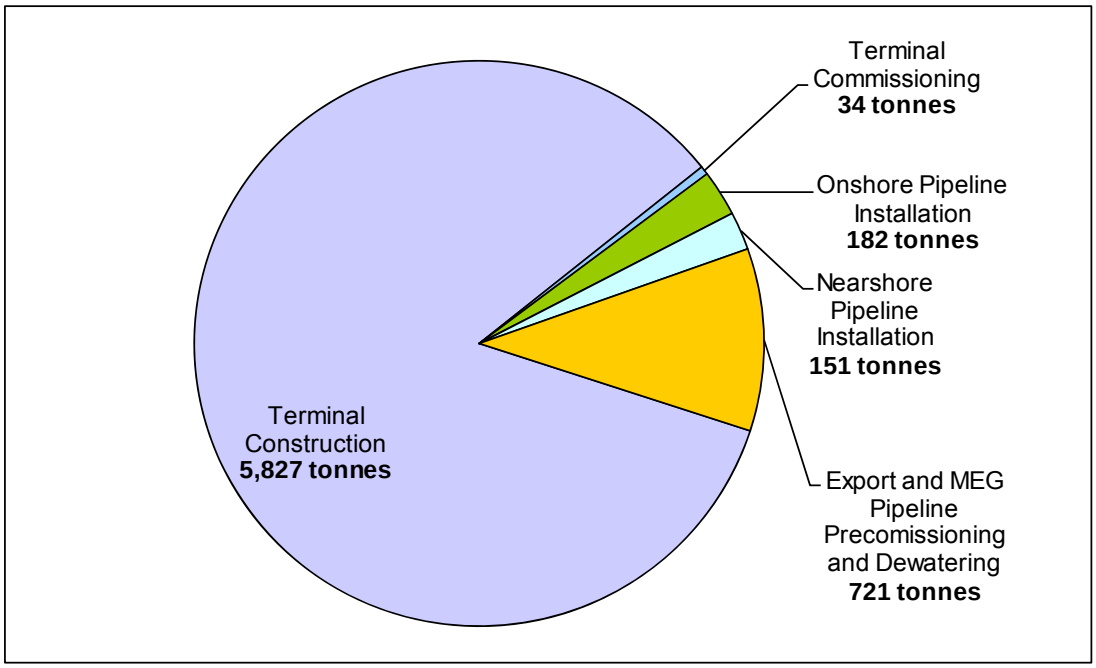
Offsite vehicle movements associated with SD2 Project on the Highway in the vicinity of the Sangachal Terminal expected to increase the existing traffic by a maximum of 1,310 vehicle movements per day.

Emissions during commissioning of the SD2 onshore facilities arise from testing of the SD2 power generator, gas export compressors and diesel users (i.e. firewater pumps and back up air compressor).

Figure 10.1 presents the estimated volume of nitrogen dioxide (NO_2) emissions per source during SD2 Project construction and commissioning activities in the vicinity of the Sangachal Terminal[3].

[3] Basis of the estimate is provided within Appendix 5A

Figure 10.1 Estimated Volume of NO_2 Emissions per Source During SD2 Project Construction and Commissioning Activities (Terminal Vicinity)



Assessment

Construction Emissions

The atmospheric dispersion modelling undertaken for construction plant and vehicles is presented in Appendix 10D. The modelling focuses on NOx (which comprises nitrous oxide (NO) and nitrogen dioxide (NO_2)) as the main atmospheric pollutant of concern, based on larger predicted emission volumes as compared to other pollutants (i.e. SOx and PM_{10}). Modelling of SO_2 and particulates was not deemed necessary as concentrations are expected to be very low based on efficient plant and vehicle operation, regular maintenance and planned use of good quality, low sulphur diesel.

Long term and short term NO_2 concentrations were modelled to assess the contribution of emissions from the onsite construction plant and vehicles in the context of the long term and short term standards for NO_2 (40 and 200 $\mu g/m^3$). These standards are relevant to locations where humans are normally resident (i.e. residential locations). The background concentrations assumed for NO_2 were $6\mu g/m^3$ (long term) and $12\mu g/m^3$ (short term) (refer to Appendix 10D).

The modelling assessment was undertaken based on the period when the highest number of plant and vehicles are predicted to be operating at SD2 Expansion area and assuming all plant onsite, along the SD2 Pipeline Route and at the pipeline landfall area (including the generator used during de watering) was operating simultaneously.

Increases in NO_2 concentrations were predicted for receptor locations in the Terminal vicinity. The increase in NO_2 concentrations at these receptors due to onshore construction plant and vehicles is presented in Figure 10.2. Figure 10.3 shows the predicted increase in long term NO_2 concentrations in the Terminal vicinity.

Figure 10.2 Increase in i) Long Term and ii) Short NO_2 Concentrations Due to Construction Plant and Vehicles (Terminal Vicinity)

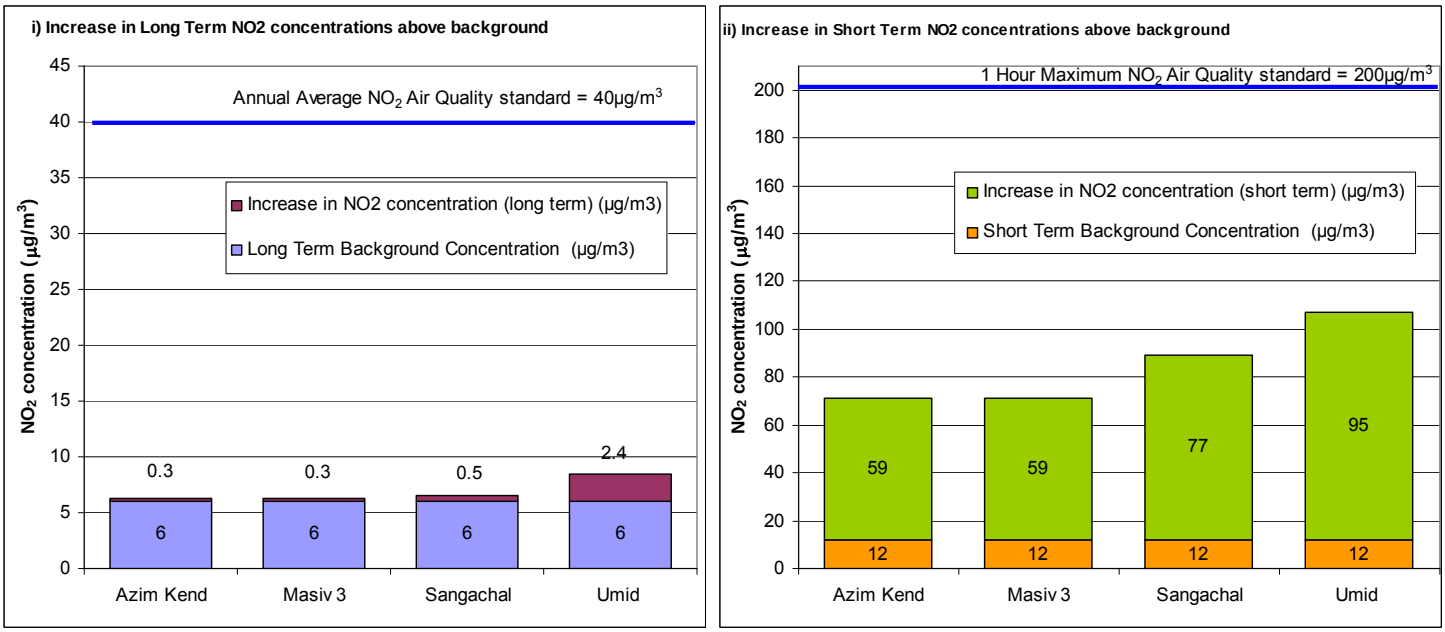
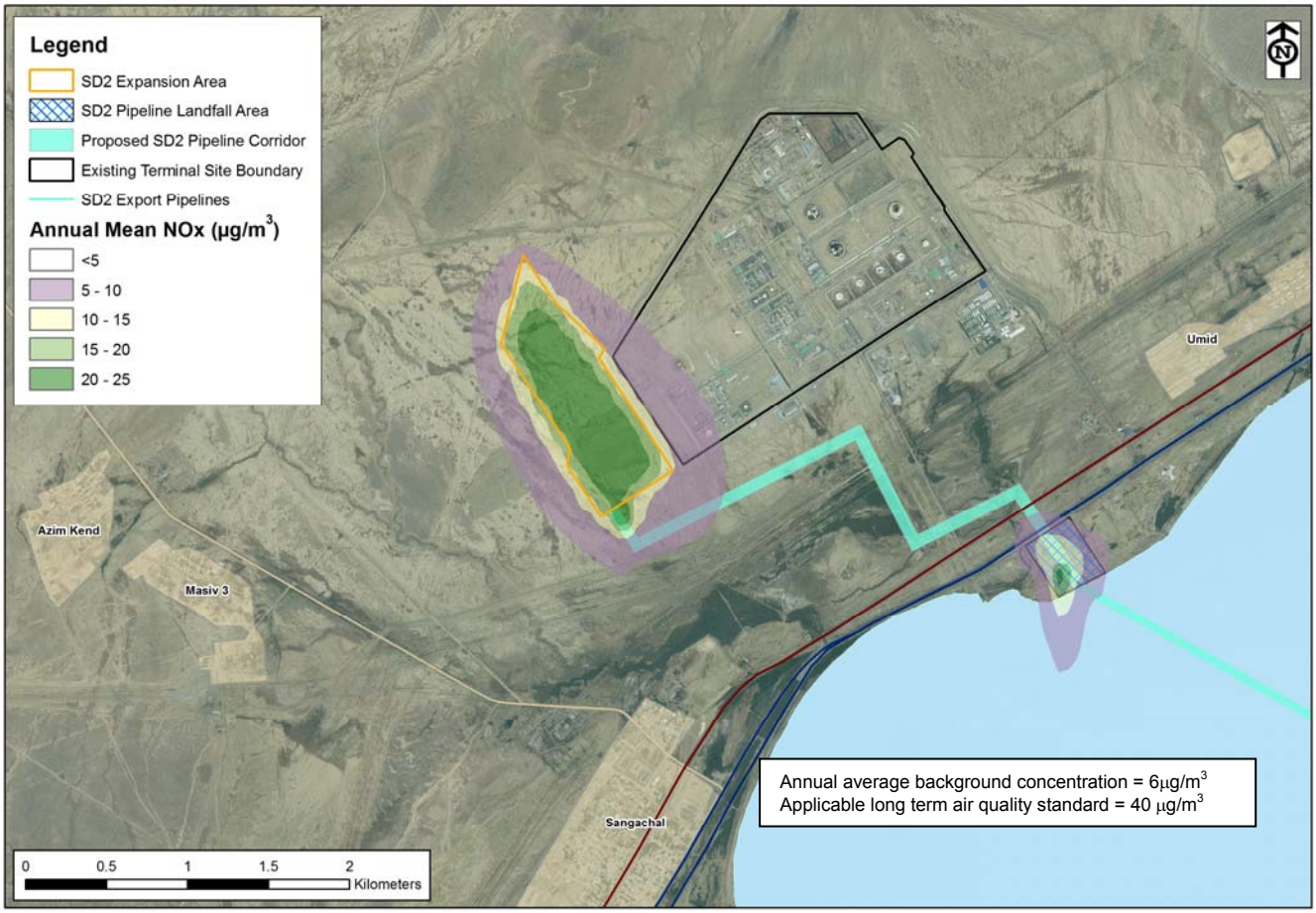


Figure 10.3 Predicted Increase in Long Term NO_2 Concentrations Due to Construction Plant and Vehicles (Terminal Vicinity)



Offsite vehicle emissions were assessed with a screening method. The Design Manual for Roads and Bridges (DMRB) Screening Method, version 1.03c was used, which allows assessment of the mean annual limit values.

The assessment focused on the predicted change in traffic due to the project, rather than absolute concentrations. The greatest increase in traffic flows is expected to occur between April 2014 and May 2016, with an estimated 1,310 vehicle movements per day. The model used the conservative assumption that this level of traffic will continue for an entire calendar year.

The results predicted a change in mean annual NO_2 and PM_{10} concentrations of 1.0µg/m^3 and 0.2µg/m^3 respectively (at a receptor located 20m from Baku-Alyat Salyan Highway (Southbound) and 65m from Baku-Alyat Salyan Highway (Northbound)). At a distance over 150 m from the Highway increases in NO_2 and PM_{10} concentrations were predicted to be less than 0.1µg/m^3.

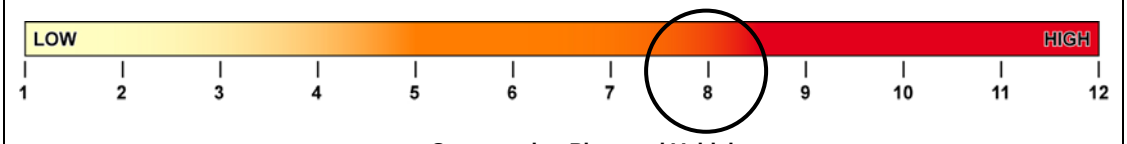
Terminal Commissioning

Commissioning activities will be typically short duration; estimated up to 21 days to test the power generator and up to 24 hours to test the export gas compressors and the diesel users. It is anticipated that loads will vary across the commissioning period. The expected worst case 1 hour increase in NO_2 concentrations under routine operating conditions at Sangachal (immediately downwind of the Terminal) is 9 µg/m^3 (refer to Chapter 11 Section 11.3.3.1. It is considered unlikely that emissions during commissioning result in a significant increase in short term NO_2 emissions.

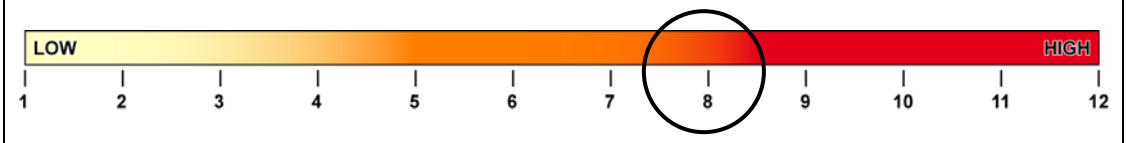
The Event Magnitude associated with emissions from Construction Plant and Vehicles, Terminal Commissioning and Offsite Vehicles is summarised in Table 10.3. In each case a Medium Event Magnitude is predicted.

Table 10.3 Event Magnitude

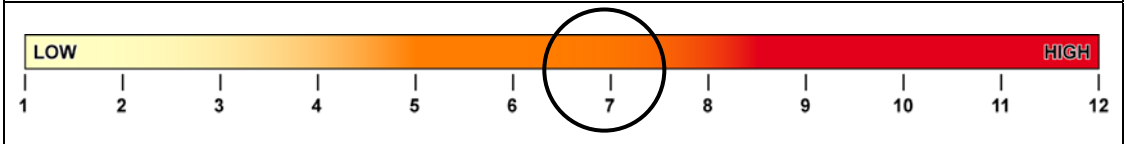
Event Parameter	Construction Plant and Vehicles	Offsite Vehicles	Terminal Commissioning
Extent/Scale	1	1	1
Frequency	3	3	3
Duration	3	3	2
Intensity	1	1	1
Event Magnitude:	**8**	**8**	**7**



Construction Plant and Vehicles



Offsite Vehicles



Terminal Commissioning

10.3.2.2 Receptor Sensitivity

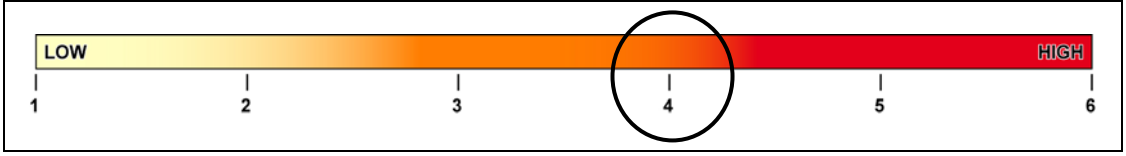
The nearest receptors to the onshore construction activities within the SD2 Expansion Area and along the SD2 Export Pipeline Corridor (refer to Chapter 6 Figure 6.3) are summarised below:

- Sangachal Town approximately 1.2km to the south of the SD2 Expansion Area and the SD2 Export Pipeline Corridor;
- Azim Kend/Masiv 3 approximately 2.2km to the west of the SD2 Expansion Area and the SD2 Export Pipeline Corridor at the pipeline landfall area; and
- Umid approximately 3km to the east of the SD2 Expansion Area and 0.96km to the west of the SD2 Export Pipeline Corridor at the pipeline landfall area.

Table 10.4 presents the justification for receptor sensitivity.

Table 10.4 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Nearest residential receptor (Sangachal Town) is located approximately 1.2km from the SD2 Expansion Area. Umid is located approximately 0.96km from the SD2 Export Pipeline Corridor at the pipeline landfall area.	**3**
Resilience	Modelling results have confirmed that emissions from the use of construction plant and vehicles and from Terminal commissioning activities will not exceed air quality standards and local receptors are not considered to be vulnerable. Existing NO_2 concentrations are well below applicable standards.	**1**



10.3.2.3 Impact Significance

Table 10.5 summarises impacts on air quality associated with Construction Plant and Vehicles (Terminal, Onshore Pipelay and Pipeline Drying), offsite vehicles and Terminal commissioning.

Table 10.5 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Construction Plant and Vehicles (Terminal, Onshore Pipelay and Pipeline Drying)	Medium	Medium	**Moderate Negative**
Offsite Vehicles	Medium	Medium	**Moderate Negative**
Terminal Commissioning	Medium	Medium	**Moderate Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures listed in Section 10.3.1 above and no additional mitigation is required.

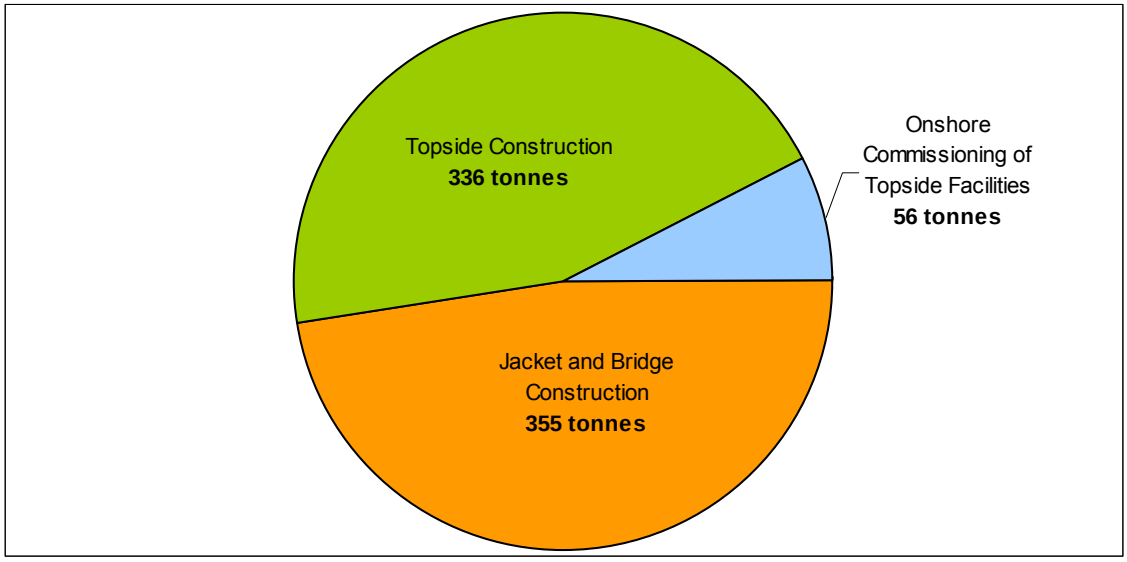
10.3.3 Construction Yard Emissions

10.3.3.1 Event Magnitude

Description

Construction yard emissions will result from use of mobile plant during construction of the SDB jackets, bridge and topsides and commissioning of the SDB power generators onshore. Figure 10.4 presents the estimated volume of nitrogen dioxide (NO_2) emissions per activity[4].

Figure 10.4 Estimated Volume of NO_2 Emissions per Construction Yard Activity



Construction Yard Plant and Vehicles

As stated within Chapter 5: Section 5.6.1, it has been assumed for the purposes of this ESIA that fabrication of the SDB jackets and topsides will be constructed at a combination of the following construction yards:

- Baku Deep Water Jacket Factory (BDJF) yard;
- Construction yards located on the western fringe of the Bibi Heybet oil field; and
- Pipe coating and storage yard.

At each yard, the majority of power required for construction activities such as steel cutting, rolling and shaping will be provided from the Azerbaijan national grid. Onsite plant and equipment used including cranes, generators and vehicles, will consume diesel and gasoline resulting in emissions to atmosphere (refer to Appendix 5A). The anticipated use of mobile plant and expected diesel consumption is calculated based on historic records from yards used during ACG and SD jacket and topside construction.

Onshore Commissioning of Main Platform Generators and Topside Utilities

It is anticipated that onshore commissioning at the topside construction yard will take place over a 10 month period. The most significant emission source is the main platform generators operated as follows (using diesel) during onshore commissioning:

- Each generator run separately and intermittently for a week, for up to 8 hours a day at a maximum load of approximately 26%;
- Synchronisation tests of 8 hour duration, running 3 of the 4 generators together at a maximum load of approximately 26%; and

[4] Basis of the estimate is provided within Appendix 5A

- Generators run separately and intermittently for approximately 6 months during commissioning of the compression system and topside utilities.

Assessment

A dispersion modelling assessment was undertaken to assess the potential magnitude of impacts from the construction yard emissions to any nearby receptors (see Appendix 10E). The assessment considered NO_2 emissions, comparing the short term and long term average modelled concentrations at ground level to the long term and short term standards for NO_2 (40 and 200 µg/m^3). Short and long term background concentrations of NO_2 were assumed to be 12µg/m^3 and 6 µg/m^3 respectively.

Construction Yard Plant and Vehicles

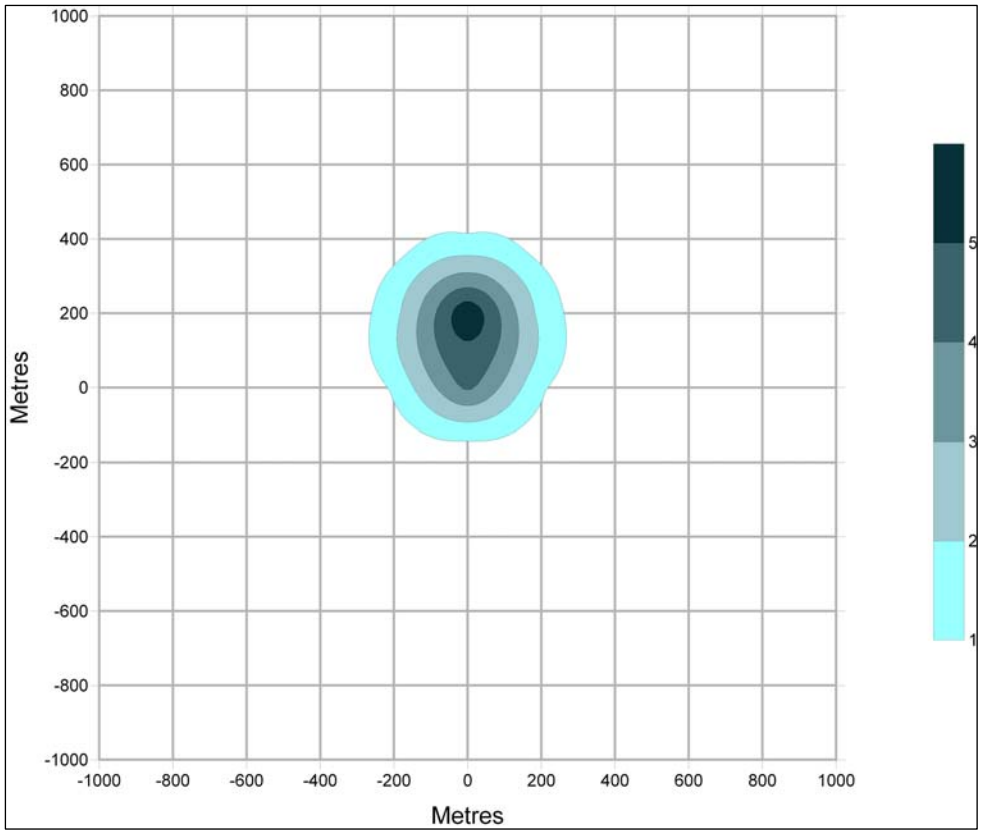
The worst case modelling results demonstrated that construction plant emissions are predicted to result in a maximum short term ground level NO_2 concentration of 6.0µg/m^3 from the centre of the yard, extending up to a distance of 200m away. This reduces to 3.0µg/m^3 at 250m and returns to background concentrations at distances over 400m under high wind speeds (15m/s) (Figure 10.5 below).

For typical wind speeds conditions (5 m/s) the increase in NO_X concentration is predicted to be approximately 6µg/m^3 up to 30 m from the centre of the site, reducing to background concentrations at a distance over 200 m. This value is converted into an annual average (long term) concentration value by assuming that 100% of NO_X is converted to NO_2 and applying assumptions about the frequency of occurrence of the wind speed and the period of time the construction activities will occur. This enables a prediction that the maximum annual average increase in NO_X concentrations will be 1.5µg/m^3, and less than 1µg/m^3 over 200m away from the site boundary, which will result in levels that easily comply with the mean annual ambient air limit of 40µg/m^3.

Under all conditions assessed, the modelling predicted no exceedances of ambient air quality standards in the vicinity of the yards and no discernible increase in short term or long term concentrations of NO_2 more than 400m from the centre of the yard[5].

[5] Historically in Azerbaijan ambient concentrations of NO_2, SO_2, CO and PM_{10} have also been assessed against specific 24 hour and 1 hour standards. These standards were not derived using the same health based criteria as the IFC, WHO and EU guideline values and the standards derived are not widely recognised. Appendices 10D and 10E, however, do show that the historic standards will not be exceeded during onshore construction and commissioning operations.

Figure 10.5 Increase in Short Term NOx Concentrations From Construction Yard Plant (15 m/s Wind Speed)



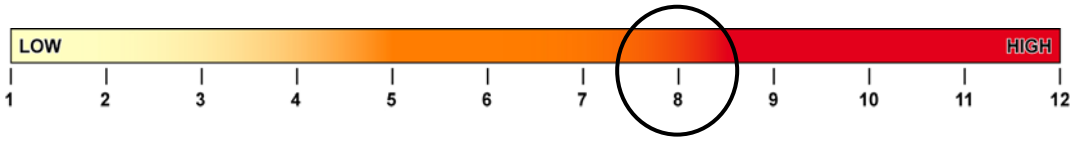
Onshore Commissioning of Main Platform Generators and Topside Utilities

The maximum increase in NO_2 concentrations during onshore commissioning was predicted to be between 30-40µg/m^3, located approximately 500m to 1.5km from the emission source. It is assumed that 50% of short term NO_X is converted into NO_2, thus emissions from the generators at full load are predicted to lead to a maximum increase in 1 hour ground level NO_2 concentration of 15-20 µg/m^3 which represents approximately 10% of the short-term ambient NO_2 limit of 200 µg/m^3**.**

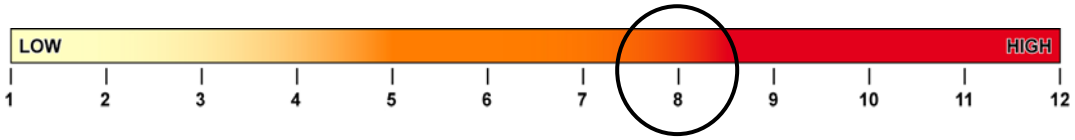
Table 10.6 presents the justification for assigning a score of 8, which represents a Medium Event Magnitude.

Table 10.6 Event Magnitude

Parameter	Construction Yard Plant and Vehicles	Onshore Commissioning of Main Platform Generators and Topside Utilities
Extent/Scale	1	1
Frequency	3	3
Duration	3	3
Intensity	1	1
Total	**8**	**8**



Construction Yard Plant and Vehicles



Onshore Commissioning of Main Platform Generators and Topside Utilities

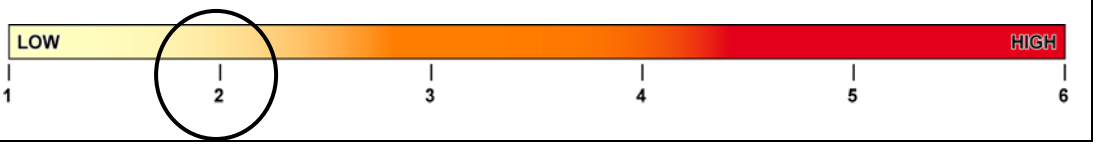
10.3.3.2 Receptor Sensitivity

All candidate construction yards are currently operational, are located within an industrial setting and have been used previously for ACG/SD/COP construction works. Residential properties are not located within close proximity (no residents within 1.5 km) to the construction yard site boundaries.

Table 10.7 presents the justification for assigning a score of 2, which represents Medium Receptor Sensitivity.

Table 10.7 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	All construction yards are located in established industrial areas and there are no residential areas within close proximity of the construction yards site boundaries.	1
Resilience	Modelling results have confirmed that emissions from construction yard sources will not exceed air quality standards and local receptors are not considered to be vulnerable.	1
Total		**2**



10.3.3.3 Impact Significance

Table 10.8 summarises impacts on air quality associated with emissions from Construction Yard Plant and Vehicles and Onshore Commissioning of Platform Generators and Topside Utilities.

Table 10.8 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Construction Yard Plant and Vehicles	Medium	Low	**Minor Negative**
Onshore Commissioning of main Platform Generators and Topside Utilities	Medium	Low	**Minor Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

10.3.4 Vessel Emissions

10.3.4.1 Event Magnitude

Description

As stated within Chapter 5: Section 5.7.6 and 5.8.3.1, a number of vessels will be used during Construction, Installation and HUC phase to support the installation of the jackets, bridge and topsides, SD2 export and MEG subsea pipelines and the SD2 subsea infrastructure within the Contract Area.

Assessment

NO_X is the main atmospheric pollutant of concern, based on the larger predicted emission volumes as compared to other pollutants (sulphur oxides or SOx, CO and non methane hydrocarbons) and the potential to impact human health and the environment.

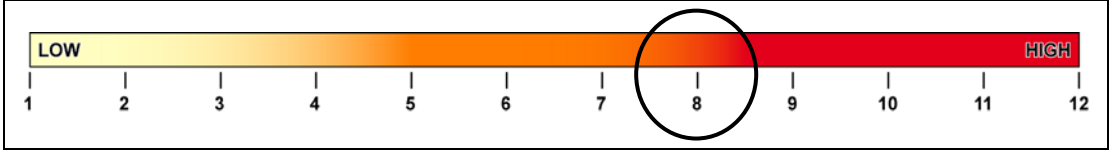
NO_X emissions from vessels used during construction, installation and HUC activities are anticipated to total approximately 6,630 tonnes. These will occur throughout the installation and HUC activities which take place across a large geographic area. They are expected to disperse rapidly and will result in increases in NO_2 concentrations that will be indiscernible from background levels at onshore receptors.

Based on efficient operation, regular maintenance, planned use of good quality, low sulphur fuel and previous experience, routine operation of the vessels will not result in plumes of visible particulates from vessel engine exhausts.

Table 10.9 presents the justification for assigning a score of 8 to vessel activities during installation and HUC, which represents a Medium Event Magnitude.

Table 10.9 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Increases in concentrations of pollutant species will be indiscernible from background concentrations at onshore receptors	1
Frequency	Emissions will occur continuously.	3
Duration	Emissions will continue throughout the installation and HUC period.	3
Intensity	Modelled long and short term concentrations of key pollutant, NO_2, are predicted to be significantly below relevant ambient air quality standards.	1
Total		**8**



10.3.4.2 Receptor Sensitivity

Table 10.10 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 10.10 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	There are no permanently present (i.e. resident) human receptors within 50km of the installation activities.	1
Resilience	Changes in air quality onshore associated with vessel emissions will be indiscernible. Onshore receptors will be unaffected.	1
Total		**2**

10.3.4.3 Impact Significance

Table 10.11 summarises impacts on air quality associated with support vessels during the installation and HUC phase.

Table 10.11 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Vessel Engines	Medium	Low	**Minor Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

10.4 Impacts to the Terrestrial Environment Associated with Onshore Noise

This section presents the potential noise impacts to the terrestrial environment from Construction, Installation and HUC activities including use of construction plant and vehicles, piling within the SD2 Expansion Area and commissioning of the onshore SD2 facilities at the Terminal and offshore facilities at the construction yards.

10.4.1 Mitigation

Existing controls associated with noise due to the operation of onsite construction plant and vehicles within the SD2 Expansion Area, onshore SD2 Export Pipeline Corridor, pipeline landfall area and construction yards include:

- Onshore construction plant and vehicles will be modern and well maintained in accordance with written procedures based on the manufacturer's guidelines, applicable industry code, or engineering standards to ensure efficient and reliable operation;
- All construction vehicles and mechanical plant equipment operated in the vicinity of Sangachal Terminal will be fitted with effective exhaust silencers;
- Noisy plant operated in the vicinity of Sangachal Terminal will be located as far as possible from sensitive receptors and where appropriate and practical will be located behind barriers (for example, site huts, acoustic partitions etc.) to provide shielding in order to reduce noise levels at sensitive receptors;
- Continuous noise emitting machinery located in the vicinity of Sangachal Terminal will be housed in a suitable acoustic enclosure;

- Compressors operated in the vicinity of Sangachal Terminal will be fitted with properly lined and sealed acoustic covers that are kept closed whenever in use and pneumatic percussive tools will be fitted with mufflers or silencers;
- Where practicable, mains electricity will be used instead of mobile generators as a power source;
- Onsite personnel of the Sangachal Terminal will be trained in how to minimise noise;
- Where practicable, rotary drills and bursters actuated by hydraulic, chemical, or electrical power will be used for excavating hard or extrusive material in the Sangachal Terminal vicinity;
- When selecting large plant that is used for extended periods within the Sangachal Terminal vicinity, preference will be given to plant that is compliant with EU Noise Directives 2000/14/EC and 2005/88/EC where possible;
- Steel works at the construction yards are planned to be undertaken in fabrication sheds, where practicable and feasible;
- Grit blasting at the construction yards is planned to be undertaken in sheds or within enclosures where practicable;
- All platform generators will be operated for a minimum duration to complete commissioning at the construction yards;
- The main platform generators incorporate appropriate noise reduction measures[6,] and are housed in a generator room/sound reduction enclosure to safeguard the health and safety of personnel on the platform;
- A noise monitoring programme will be established prior to and during terminal construction and commissioning and onshore SD2 export pipeline works and the results provided externally;
- A Community Engagement and Nuisance Management and Monitoring Plan will be implemented and maintained as a mechanism of communicating with the communities surrounding the Sangachal Terminal (i.e. Sangachal, Azim Kend, Masiv 3 and Umid) and responding to community grievances; and
- Where possible communities will be warned in advance of any particularly noisy activities to be undertaken within the vicinity of Sangachal Terminal; when unavoidable, noisy operations will be undertaken during normal daylight working hours.

10.4.2 Construction and Commissioning Emissions (Terminal, Onshore Pipelay and Pipeline Pre-Commissioning)

10.4.2.1 Event Magnitude

Description

As described within Section 10.3.2 above construction plant and vehicles will be used in the vicinity of the Sangachal Terminal during the terminal construction works, onshore and nearshore pipeline installation and SD2 export and MEG pipelines pre commissioning (including dewatering and drying). The estimated number and type of onsite and offsite construction plant and vehicles that are expected to be used for each of these activities are presented in Appendix 5F. In addition up to 7,000 piles will be installed across the SD2 Expansion Area during Phase 2 (Civil Works) of the Terminal Construction programme (approximately 18 installed per day over a 390 day period.

Commissioning of the SD2 onshore facilities will include testing of the SD2 power generator, gas export compressors and diesel users (i.e. firewater pumps and back up air compressor).

[6] Measures include acoustic lagging of combustion air inlet ducting and exhaust ducts and fitting of a suitable splitter silencer to the gas turbine combustion air intake vent.

Assessment
Terminal Construction Plant and Vehicles

Modelling was undertaken to estimate the increase in noise levels at receptors in the Terminal vicinity due to the onsite plant and vehicles (refer to Appendix 10B for the full modelling assessment) at sensitive receptors (i.e. residential locations). The assessment was undertaken in accordance with guidance provided within BS5228:2009[7]. Source noise levels for the proposed onsite plant and vehicles were also derived from BS5228:2009.

The anticipated type and number of plant on site (including piling rigs) was calculated based on the number per phase and the anticipated phasing as shown in Chapter 5 Figure 5.9. To obtain a realistic scenario it was assumed that 50% of plant was located at the boundary of the works (i.e. closest to the receptor being assessed), operating for 6 hours per day (50% of the working day).

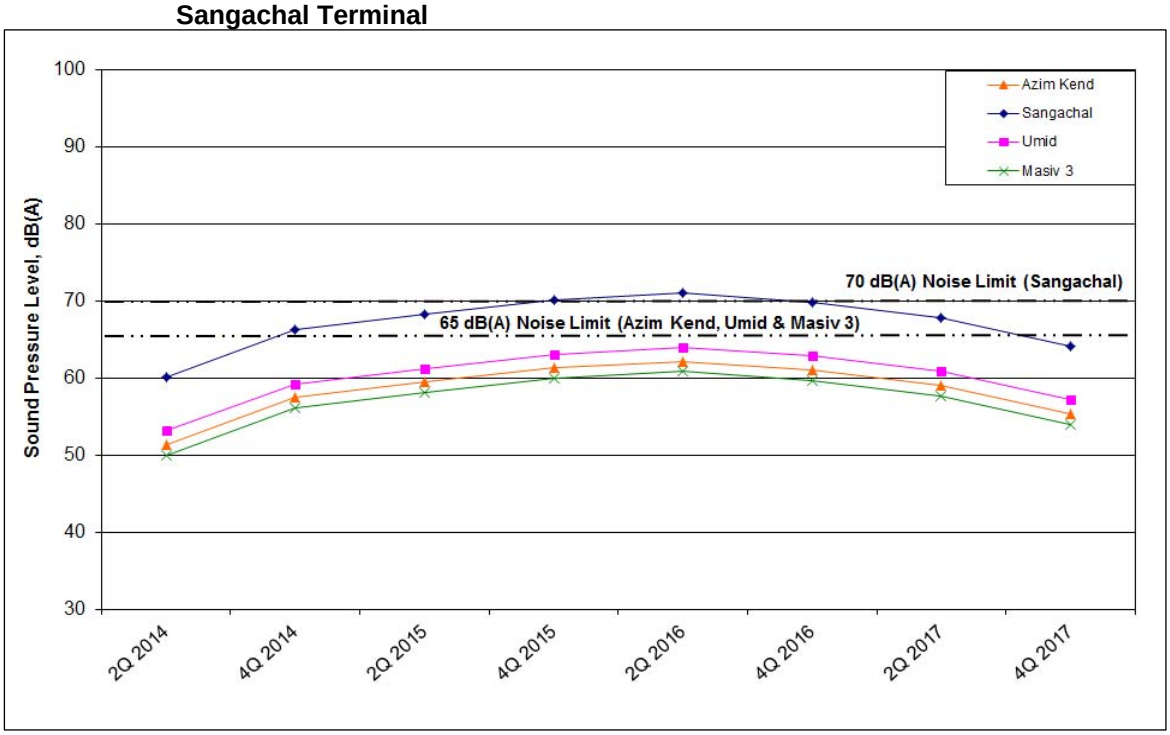
Noise levels were predicted across the construction period and results were compared to noise limits derived for each receptor based on allowable increase in noise levels above the existing ambient noise levels at the receptors (refer to Chapter 6 Section 6.4.6) using the ABC methodology from BS5228:2009.

The results of the modelling showed that:

- Noise levels are expected to be below the relevant 65dBL_{Aeq} limit value at Umid, Azim Kend and Masiv 3 for the duration of the construction programme; and
- Noise levels are expected to be below the relevant 70dB L_{Aeq} limit value at Sangachal for the majority of the construction programme. A slight exceedance of 1dB(A) during peak activity (2Q 2016) was predicted however this is unlikely to be perceptible and is not considered significant

Figure 10.6 shows the noise levels predicted at the four receptors in the Terminal vicinity across the construction period.

Figure 10.6 Predicted Construction Noise Levels at Receptors in the Vicinity of the Sangachal Terminal



[7] British Standards Institute (BSi), (2009): 'BS5228 – Noise Vibration Control on Construction and Open Sites', BSi, London

The assessment is considered to represent a reasonable worst case. Construction noise by its nature will vary and, while there may be short durations where the predicted worst case noise levels are reached, for the majority of the construction programme noise levels will likely be lower than forecast.

Onshore & Nearshore Pipelay

Modelling was also undertaken to estimate the increase in noise levels at receptors in the Terminal vicinity due to the onshore and nearshore pipelay activities (refer to Appendix 10B for the full modelling assessment) using the same approach as used for onsite plant. Noise levels were predicted at a number of locations along the pipeline corridor from the pipeline landfall area to the boundary of the Sangachal Terminal. Predicted noise levels varied between 37dB (at Azim Kend) and 50dB (at Sangachal and Umid), which is unlikely to be significantly perceivable at the communities No exceedances of the relevant 65 and 70dBL_{Aeq} limits were predicted.

SD2 Export and MEG Pipeline Pre-Commissioning and Drying

It is anticipated that a number of generators and compressors will be required at the pipeline landfall area and at the Sangachal Terminal during pre-commissioning, dewatering and drying of the SD2 Export and MEG Pipelines. Modelling was completed assuming:

- Use of five 335hp generators and two 540hp air compressors at the pipeline landfall area during pre-in line inspection (ILI) gauging and ILI pigging; and
- Use of two 335hp generators and one 540hp air compressors at the SD2 Expansion during dewatering and air drying.

The results of the assessment are presented in Table 10.12 and show that no exceedance of the relevant 65 and 70dBL_{Aeq} construction noise limits are predicted at any receptor during pipeline pre-commissioning and drying. Noise from pre-commissioning and drying activities is unlikely to be perceivable at receptors.

Table 10.12 Predicted Construction Noise Levels LAeq (dB) During Pre-ILI and ILI Pigging at Pipeline Landfall Area and Pipeline Dewatering and Air Drying at the Sangachal Terminal

	Plant Noise During Pre-ILI and ILI Pigging at Pipeline Landfall Area LAeq (dB)	Plant Noise During Pipeline Dewatering and Air Drying at the Sangachal Terminal LAeq (dB)
Masiv 3	24.1	30.1
Sangachal	28.9	34.6
Umid	36.1	26.6
Azim Kend	22.8	28.8

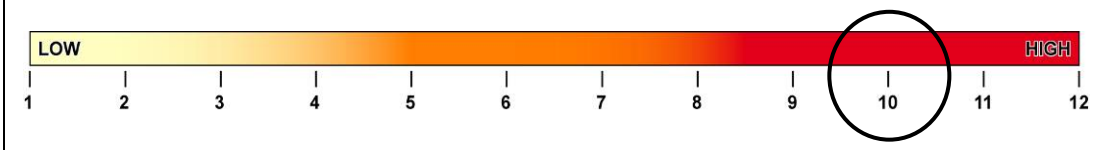
Terminal Commissioning

Terminal commissioning was modelled assuming operation of the SD2 power generator for up to 21 days and of the export gas compressors for up to 24 hours. The modelling showed that the highest noise levels (28.2 dB (A)) were predicted at Azim Kend, Sangachal and Masiv 3. No exceedance of the relevant 65 and 70dBL_{Aeq} construction noise limits were predicted at any receptor during terminal commissioning. Noise from commissioning activities is unlikely to be perceivable at receptors.

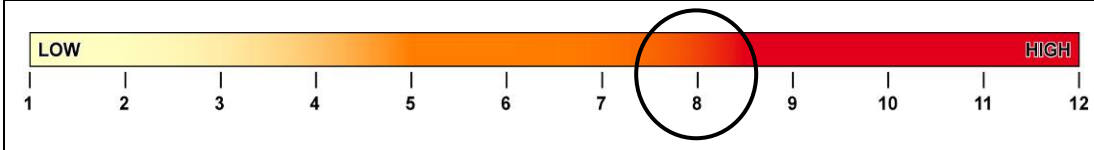
Event Magnitude is summarised in Table 10.13

Table 10.13 Event Magnitude

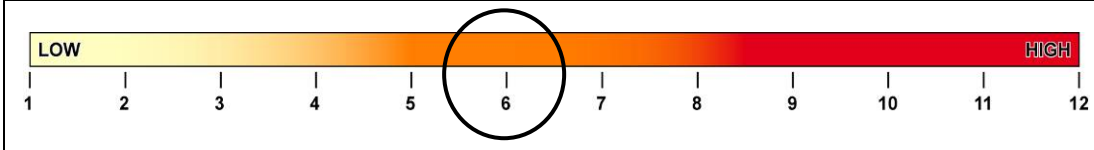
Parameter	Terminal Construction Plant and Vehicles	Onshore & Nearshore Pipelay	SD2 Export and MEG Pipeline Pre-Commissioning and Drying	Terminal Commissioning
Extent/Scale	3	3	1	1
Frequency	3	1	1	1
Duration	3	3	3	2
Intensity	1	1	1	1
Total	**10**	**8**	**6**	**4**



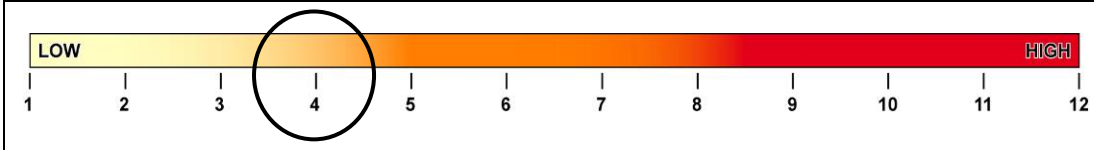
Onsite Construction Plant and Vehicles



Onshore & Nearshore Pipelay



SD2 Export and MEG Pipeline Pre-Commissioning and Drying



Terminal Commissioning

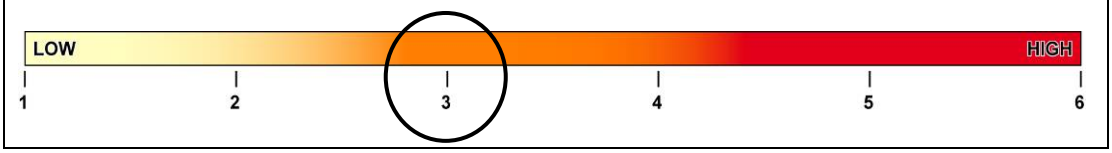
10.4.2.2 Receptor Sensitivity

Human Receptors

Table 10.14 presents the justification for assigning a score of 3 to human receptors, which represents Medium Sensitivity.

Table 10.14 Human Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Nearest residential receptors to Terminal construction works are located approximately 1.2km to the south west within Sangachal Town.	2
Resilience	Modelling results have indicated that construction noise, under realistic worst case assumptions, will meet applicable construction noise limits at receptors in the vicinity of Sangachal Terminal except for a slight exceedance at Sangachal during peak activity at the Terminal. This exceedance is unlikely to be perceptible and is not considered significant	1
Total		**3**



Biological/Ecological Receptors

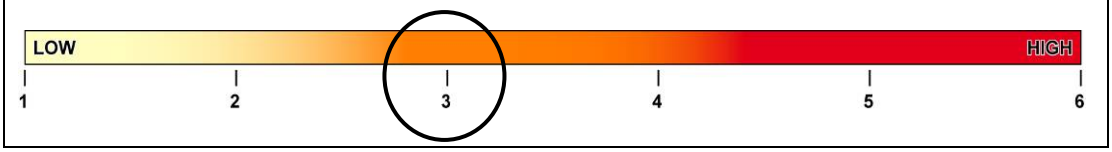
Noise from onsite plant and vehicles has the potential to impact breeding birds. Of the bird species recorded during bird surveys undertaken in the Terminal vicinity between 2008 and 2011 (refer to Chapter 6 Section 6.4.7.4), a total of 25 species (approximately 18% of all species recorded) are considered to be resident (breeding and occurring all year round). Of these, five species[8] are ground nesting, and have been recorded in the semi-desert habitat in the vicinity of the Sangachal Terminal. While the data collected during these surveys does not include the precise locations of nests, the breeding bird species do not tend to nest in the same location each year. It is therefore not appropriate to state the number of breeding birds that use the SD2 Project area as this will vary from year to year. There is no evidence within the surveys completed to date to indicate that the habitat within the SD2 Project area is if unique value to breeding birds.

Breeding birds are most sensitive to disturbance during the breeding season (typically mid March – end August). They are most sensitive to sudden unexpected and loud noise such as hammering. Studies have shown, however, that birds frequently become habituated to anthropogenic noise including construction noise with no recorded effect on behaviour or breeding success[9]. Equally, impacts to breeding success due to noise impacts have also been recorded. The survey results obtained within the Terminal vicinity suggest that the breeding birds are habituated to the industrial noise from the Terminal and Highway traffic noise and may likely also therefore adapt to construction noise.

Table 10.15 presents the justification for assigning a score of 3 to biological/ecological receptors, which represents Medium Receptor Sensitivity.

Table 10.15 Biological/Ecological Receptor Sensitivity

Parameter	Explanation	Rating
Presence	25 species of residential birds have been recorded during surveys undertaken between 2008 and 2011 in the Terminal vicinity; approximately 18% of these species are breeding birds. Of these, 5 ground nesting breeding nesting bird species were identified. None of these species are rare or threatened.	1
Resilience	While ground nesting birds have been identified within the areas affected by the SD2 Project works there is no evidence to indicate that areas have unique value to these species. It is likely that birds in the area are already tolerant to existing industrial noise and would become habituated to construction noise. It is expected that any disturbance to ground nesting bird breeding would stabilise as they adapt to the construction noise and the ecological functionality of the overall ground nesting bird population will be maintained	2
Total		**3**



10.4.2.3 Impact Significance

Table 10.16 summarises impacts of noise associated with Terminal Construction and Commissioning activities.

[8] These include Chukar *Alectoris chukar*, Red-capped lark *Calandrella cinerea*, Lesser short-toed lark *Calandrella rufescens*, Calandra lark *Melanocorypha calandra* and Crested lark *Galerida cristata*.

[9] Melissa Anne Lackey, (2009), Avian Response to Road Construction Noise with Emphasis on the Endangered Golden-Cheeked Warbler.

Table 10.16 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Terminal Construction Plant and Vehicles	High	Medium (Humans)	**Major Negative**
		Medium (Biological/Ecological)	
Onshore & Nearshore Pipelay	Medium	Medium (Humans)	**Moderate Negative**
		Medium (Biological/Ecological)	
SD2 Export and MEG Pipeline Pre-Commissioning and Drying	Medium	Medium (Humans)	**Moderate Negative**
		Medium (Biological/Ecological)	
Terminal Commissioning	Low	Medium (Humans)	**Minor Negative**
		Medium (Biological/Ecological)	

The following monitoring and reporting requirements related to construction noise will form part of the BP SD2 Construction Phase ESMS:

- A noise monitoring programme will be established prior to and during construction works implemented in the vicinity of Sangachal Terminal, as part of the Nuisance Management Plan; and
- Results from noise monitoring surveys implemented in the vicinity of Sangachal Terminal will be provided to nearby communities through the community engagement process that will be managed by the construction contractor.

10.4.2.4 Additional Mitigation Measures

The assessment above has demonstrated, through noise modelling, that noise from construction plant and vehicles may result in a Major Negative impact to human and biological/ecological receptors. The assessment was based on reasonable worst case assumptions using currently available estimates of numbers and types of construction plant and phasing details. Mitigation already adopted to minimise noise levels is detailed in Section 10.4.1.

To further minimise noise from construction plant and vehicles at the Terminal the following requirements will be included within the Community Engagement and Nuisance Management and Monitoring Plan:

- Prior to construction commencing within the Sangachal Terminal vicinity, a detailed assessment will be undertaken of all plant and vehicles proposed, and the construction programme to specifically identify the activities which result in the highest noise levels and their duration;
- The main construction and installation contractors will complete work plans detailing forecast activities at an agreed frequency. Should very noisy activities be identified the contractor will (following procedures set out in the relevant Community Engagement and Nuisance Management and Monitoring Plan) liaise with the affected communities warning them that a period of high noise will be experienced and the duration of the activity expected; and
- Noise monitoring will be undertaken at community receptors during construction activities implemented in the vicinity of Sangachal Terminal. If noise levels recorded indicate exceedance of the relevant noise limits (65dB Azim Kend, Masiv 3 and Umid and 70 dB Sangachal) the following will be undertaken:
    - The reason for the non-compliance will be established, where possible;
    - Any action that taken immediately following the survey will be recorded;
    - If necessary recommendations will be made for further actions, which may include:
        - Further surveys to identify the reason for the non-compliance;

- Noise control recommendations including, for example:
  - Requirement for equipment maintenance;
  - Selection of alternative equipment; and
  - Screening of equipment.

With these additional mitigation measures in place it is expected the impact associated with terminal construction plant and vehicles will reduce to Moderate Negative.

10.4.3 Construction Yard Noise

10.4.3.1 Event Magnitude

Description

Noise at the selected construction yards during the construction of the SD2 jackets, topsides and bridge will arise from the use of plant and machinery. The majority of activities such as steel rolling and cutting and shaping will be undertaken in workshops. Mobile plant will be used to move materials around the yards. The anticipated use of mobile plant is calculated based on historic records from yards used during ACG and SD jacket and topside construction.

Onshore commissioning of Onshore Commissioning of Main Platform Generators and Topside Utilities will also be undertaken at the topside yard as described within Section 10.3.3.1 above.

Assessment

Construction Yard Plant

A noise modelling assessment was undertaken to determine the potential magnitude of impacts from onshore construction noise to any nearby receptors (see Appendix 10B).

Using reasonable worst case assumptions regarding plant and operating times across the construction period, predictions of potential noise impact from the construction activities at increasing distances from the source were undertaken and compared to the daytime and nightime limit values of 55dB L_{Aeq} and 45dB L_{Aeq} respectively.

The noise screening afforded by the buildings and perimeter fencing around each of the yards was assumed conservatively to provide 5dBA of attenuation. No account was taken for current operations at the construction yards.

The modelling demonstrated that 150m from the noise source, the daytime limit of 55dB will be met and at 450m, the night time limit of 45dB L_{Aeq} will be met. These limits are applicable to residential dwellings, where people are normally present. The modelling predicted no exceedances of the relevant noise limits at a distance of 450m or more from noise sources at the construction yard.

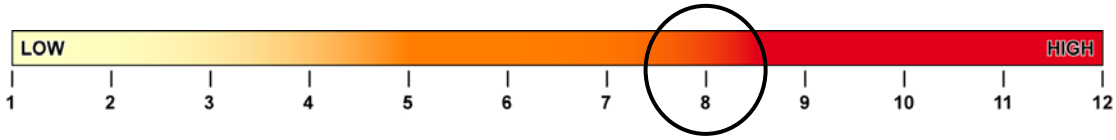
Commissioning of Main Platform Generators and Topside Utilities

Noise modelling was undertaken to determine the likely magnitude of noise impacts from the operation of platform generators at the yards to any nearby receptors (see Appendix 10C). Worst case impacts were considered based on the operation of four generators running concurrently for 8 hours and an allowance of 15dB L_{Aeq} was made for the screening afforded by the generator housing and acoustic controls associated with the platform generators. The modelling demonstrated that at 1750m or more from three generators the most stringent limit (night time limit of 45dB L_{Aeq}) will be met.

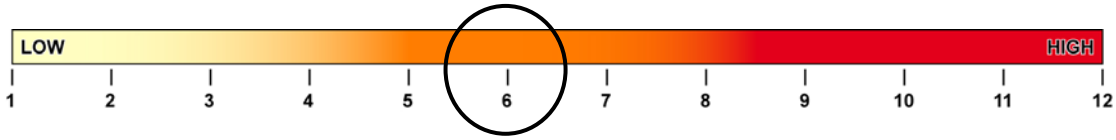
Event Magnitude is summarised in Table 10.17.

Table 10.17 Event Magnitude

Parameter	Construction Yard Plant	Platform Commissioning and Topside Utilities
Extent/Scale	1	**3**
Frequency	3	1
Duration	3	1
Intensity	1	1
Total	**8**	**6**



Construction Yard Plant



Platform Commissioning and Topside Utilities

10.4.3.2 Receptor Sensitivity

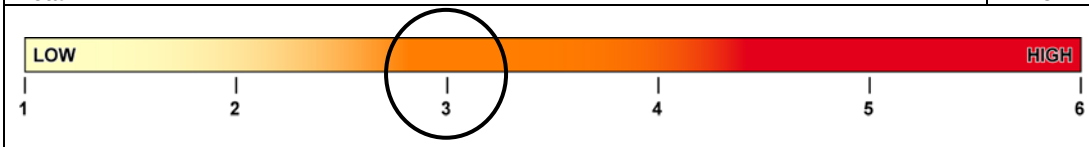
Human Receptors

Both of the candidate construction yards are currently operational and located within an industrial setting. They have been used previously for ACG/SD construction works. The BDJF yard is the most remote. Residential properties are located within 500m – 1km of the Bibi Heybet yard boundaries.

Table 10.18 presents the justification for assigning a score of 3 to human receptors, which represents Medium Receptor Sensitivity.

Table 10.18 Human Receptor Sensitivity

Parameter	Explanation	Rating
Presence	All construction yards are located in established industrial areas. Residential properties are located within 500m to 1km of the boundaries of the Bibi Heybet yard.	2
Resilience	Local receptors are not considered to be vulnerable to construction yard plant and machinery noise associated with SD2 Project works, given the existing operations at the yard and in the immediate yard vicinity.	1
Total		**3**

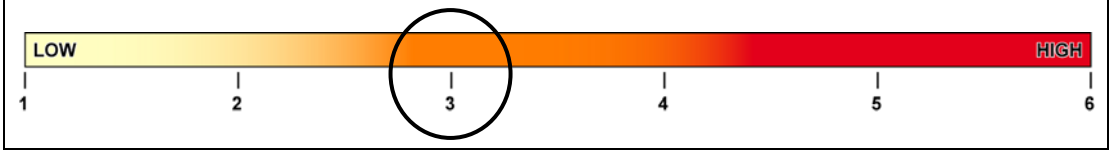


Biological/Ecological Receptors

Table 10.19 presents the justification for assigning a score of 3 to biological/ecological receptors, which represents Medium Receptor Sensitivity.

Table 10.19 Biological/Ecological Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Bird species that may occasionally be present at the yard and adjacent areas are mobile and would not be present for long periods of time, with the exception of the lagoons, which are adjacent to the BDJF yard and support populations of overwintering and residential bird species. Terrestrial ecological receptors are very limited given the industrial nature of the yards and their surroundings.	2`
Resilience	Given the existing industrial activities in and around the yards, species are expected to be unaffected or marginally affected by construction noise associated with the SD2 Project works.	1
Total		**3**



10.4.3.3 Impact Significance

Table 10.20 summarises impacts human receptors from noise due to construction yard plant operations and platform generator commissioning.

Table 10.20 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Construction Yard Plant	Medium	Medium (Human)	**Moderate Negative**
		Medium (Biological/Ecological)	
Platform Commissioning and Topside Utilities	Medium	Medium (Human)	**Moderate Negative**
		Medium (Biological/Ecological)	

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

10.5 Impacts to the Terrestrial Environment (Ecology)

This section presents the potential impacts to terrestrial ecology from onshore pipeline installation within the onshore SD2 export pipeline corridor.

10.5.1 Mitigation

Existing control measures associated with terrestrial ecology include:

- A construction corridor will be established along the SD2 Pipeline Corridor route and the perimeter of the corridor will be defined. Works outside this perimeter will be strictly controlled by BP in order to minimise the area of ground disturbed;
- Surface soil layer removal and vegetation clearance near to the wetlands, rivers or stream banks will be minimised within the Sangachal Terminal vicinity;
- Prior to removal, vegetation will be inspected to detect the presence of wildlife and activities ceased until appropriate action is taken to ensure any wildlife encountered is not harmed within the Sangachal Terminal vicinity;
- Areas for laydown of soil or loose construction materials will be indentified to minimise impacts to habitats and potential for erosion and sedimentation into watercourses or drains located within the Sangachal Terminal vicinity;
- Checks for wildlife will be undertaken prior to backfilling of the onshore pipeline trench. Any reptiles and mammals in the trench will be removed;
- Records will be maintained of all landscape management works implemented in the Sangachal Terminal vicinity;

- A Restoration and Landscape Management Plan will be prepared for Sangachal Terminal vicinity and will include details of the amount of spoil generated, reused, disposed of and the contamination potential of the spoil. The Plan will also cover details of restoration to restore all areas of disturbed land used on a temporary basis during the SD2 Project works to a condition which is similar to that at preconstruction; and
- An Ecological and Wildlife Management Plan will be developed for Sangachal Terminal vicinity and implemented to manage the relocation of any mammals, reptiles or any IUCN or Azerbaijan Red Data Book listed species encountered within the areas affected by the SD2 Project works.

10.5.2 Onshore Pipeline Installation

10.5.2.1 Event Magnitude

Description

Onshore pipeline installation comprises open cut trenching within the proposed onshore SD2 export pipeline corridor and augur boring at pipeline crossings as discussed in Chapter 5 Section 5.8.3.3. The proposed onshore onshore SD2 export pipeline corridor is approximately 4.4km in length and it is anticipated that a Right of Way (RoW) of approximately 80m in width will be established. During clearance works the vegetation and surface soil will be removed and stored for later reinstatement of the corridor, in order to maintain the environmental characteristics of the area.

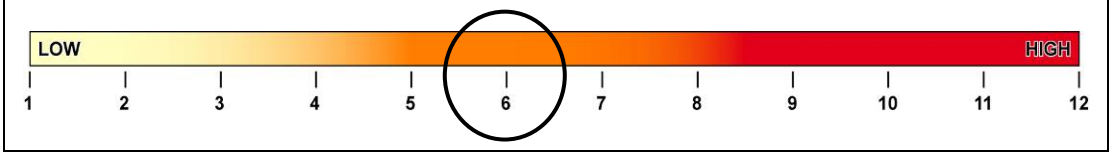
Assessment

The proposed onshore SD2 export pipeline corridor route will pass through predominantly desert/semi-desert habitat and along the eastern fringes of the wetland area south of the Terminal. The pipeline installation works will require the removal of vegetation and surface soil from an area of approximately 35 hectares (ha). The impact will be temporary as it is planned to reinstate the area affected along the route to its pre construction condition. This approach is consistent with previous pipeline installation and reinstatement activities completed for the earlier ACG and SD projects. Surveys completed following previous works have shown reinstatement has been successful and no significant impacts to terrestrial ecology have been recorded.

Event Magnitude is summarised in Table 10.21.

Table 10.21 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	It is anticipated that surface soil and vegetation will be removed from an area of approximately 35ha in total.	1
Frequency	The activity will occur once	1
Duration	Onshore pipeline construction activities are planned to take place over a period of approximately 22 months..	3
Intensity	Soil and vegetation removed during pipeline installation works will be reinstated following the works to their pre construction condition.	1
Total:		**6**



10.5.2.2 Receptor Sensitivity

Local vegetation in the vicinity of the onshore SD2 export pipeline corridor (refer to Section 6.6.4.5.1) is characterised by floral species which are typical for the area surrounding the Terminal and are neither rare nor threatened. The main vegetation assemblages are dominated by low perennial shrubs (including *Salsola nodulosa*, *Salsola dendroides*, *Suaeda*

dendroides, *Salsola ericoides* and *Artemisa lerchiana*). One Azerbaijan Red Data Book listed species (*Iris acutiloba*) was recorded during surveys in 2004, 2005 and 2008. This species occurs at survey locations to the north east of the Terminal (i.e. not within areas likely to be affected by the pipeline installation works associated with SD2 Project work).

The main wetland habitats are reedbeds, reedmace stands, rush dominated marshes and tamarisk/alhagi scrub (chal-meadow). The area is dynamic in nature and dependant on seasonal water flow through the Shachkaiya Wadi system in addition to smaller contributions from local sources (i.e. existing leaks from water pipelines – refer to Chapter 6 Section 6..4.4.2). Other than this seasonal change, surveys undertaken during 2002, 2010 and 2011 have not shown any significant alterations in the wetlands over time (e.g. in terms of species present and extent of wetlands), other than as a direct result from third party construction activities. The habitat is not considered unique and the area affected by the pipeline installation works is not critical to the function of the habitat as a whole.

The bird surveys undertaken in the Terminal vicinity, as discussed in Section 10.4.2.2 above, have identified breeding birds within the area surrounding the Terminal. However, the habitat within the proposed onshore SD2 export pipeline corridor is not considered critical to breeding birds. They have been recorded throughout the area surrounding the Terminal and use no area exclusively for feeding or nesting.

Faunal surveys have confirmed the presence of the following in the Terminal vicinity:

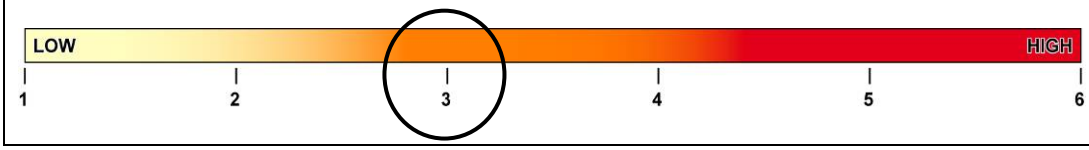
- Euphrates jerboa *(Allactaga elater)* - IUCN Least Concern;
- Grey hamster (*Cricetulus migratorius*) - IUCN Least Concern;
- Marbled polecat (*Vormela peregusna*) – IUCN Vulnerable and Azerbaijan Red Data Book listed;
- Wolf (*Canis lupus*) - no designated conservation status in Azerbaijan;
- Sunwatcher Agama (*Phrynocephalus helioscopus*) - no designated conservation status in Azerbaijan Azerbaijan Red Data Book listed; and
- Spur-thighed tortoise (*Testudo graeca*) - IUCN Red Data List Vulnerable and Azerbaijan Red Data Book listed.

These species have all been found in low numbers (one or two individuals on any occasion) and, with the exception of the spur-thighed tortoise, have not been recorded consistently in surveys undertaken between 2002 and 2011. While spur-thighed tortoise have been consistently recorded in the area, the precise distribution of the tortoise has not been determined. The likely reason for the consistent records of this species is due to the relocation programme that was undertaken prior to and following the previous ACG and SD projects where spur-thighed tortoise were collected prior to the works and then reintroduced once the works were completed. The majority of suitable habitat (i.e. areas which have a mixture of scrub and short vegetation, offering both protection and food supplies) for this species lies outside the area to be affected by the pipeline installation works. The areas to be affected are not considered to be critical or of particular importance for this species. Spur-thighed tortoise are most sensitive during the breeding and egg laying periods which are between April and July.

Table 10.22 presents the justification for assigning a score of 3 for Biological/Ecological Receptor Sensitivity, which represents Medium Receptor Sensitivity.

Table 10.22 Biological/Ecological Receptor Sensitivity

Parameter	Explanation	Rating
Presence	No rare or protected plant species or breeding bird species have been recorded in the areas to be affected by the pipeline installation works during recent surveys undertaken in 2004-2005 and 2008-2011 (refer to Chapter 6 Table 6.1). Surveys have recorded a number of faunal species with conservation status which include the spur-thighed tortoise, which is classified as vulnerable in the IUCN Red Data List, and also included within the Azerbaijan Red Data Book.	2
Resilience	The areas affected by the pipeline installation works will be temporarily impacted by soil and vegetation removal. Surveys have shown that the areas affected by the works are not critical to ground nesting birds and faunal species, which have been recorded in the Terminal vicinity. The affected areas will be reinstated and would stabilise, and ecological functionality of habitats will be maintained.	1
		3



10.5.2.3 Impact Significance

Table 10.23 summarises impacts on terrestrial ecology associated with the Onshore Pipeline Installation works.

Table 10.23 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Onshore Pipeline Installation	Medium	Medium (Biological/ecological receptors)	**Moderate Negative**

The following monitoring and reporting requirements related to terrestrial ecology will form part of the BP SD2 Construction Phase ESMS:

- An Ecological and Wildlife Management Plan, and restoration and Landscape Management Plan will be prepared, and implemented, which defines the activities and actions to be taken to minimise the impact to local wildlife and habitats during the SD2 Project.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures as listed in Section 10.5.1 above and no further mitigation is required.

10.6 Impacts to the Terrestrial Environment (Soils, Groundwater and Surface Water)

This section presents the potential impacts to the terrestrial environment associated with mobilisation of contamination within soils, groundwater or surface water due to onshore pipeline installation activities and works associated with the SD2 Condensate Tank.

10.6.1 Mitigation

Existing control measures associated with minimising mobilisation of contamination during SD2 construction, installation and HUC activities will include:

- Stockpiles of subsoil located within the Sangachal Terminal vicinity will be appropriately shaped and compacted to avoid erosion and sedimentation of nearby open water courses or drains;

- Site drainage and pollution hazards maps will be maintained that show potential sources of pollution (e.g. storage areas), pathways (e.g. drains) and receptors (e.g. the wetland areas, streams and Caspian Sea) located within the Sangachal Terminal vicinity;
- Designated areas within the Sangachal Terminal vicinity will be established away from watercourses for waste cement/concrete which will be contained and collected as a waste once solidified;
- Analytical testing will be undertaken on excavated soil, surface or ground water encountered that is potential contaminated, based on visual assessment, at a frequency of 1 sample per 500m^3 to classify the material with regard to re-use and disposal options. Soil and water parameters to be tested and acceptability criteria handling of the soil are defined in Appendix 10G; and
- Dust management and suppression measures will be implemented within the Sangachal Terminal vicinity.

10.6.2 Onshore Pipeline Installation and Condensate Tanks Works

10.6.2.1 Event Magnitude

Description

Onshore pipeline installation comprises open cut trenching and augur boring at pipeline crossings as discussed in Section 10.5.2.1 above. The SD2 Condensate Tank area is located within the existing Sangachal Terminal (refer to Figure 6.1). Works in this area will comprise the installation of piles, foundations, the construction and installation of a new condensate holding tank and bund structure, and associated earthworks.

Assessment

Onshore Pipeline Installation

For the majority of the pipeline route to the Terminal each pipeline will be trenched and installed at a depth of 2.5m below ground level. All soil removed from the trench being excavated will be placed aside and stored so that it will be used later for trench backfilling and reinstatement of the pipeline route, in order to maintain the environmental characteristics of the area.

To control surface water flow, temporary berms and dykes will be constructed, and dewatering of excavations.

The onshore pipelines will need to cross the Baku-Salyan Highway, the railway and various third party pipeline/service lines. Over 60 crossings of existing utilities and pipelines have been identified and combined into groups. It is currently planned to drill the augured sections at a depth of approximately 1.5m below the existing service or pipeline. For each section it will be necessary to excavate launch and reception pits for the auguring and casing equipment at a depth of 3-5m below ground level. All soils excavated from the pits will be placed aside and stored so that it may be used for later reinstatement of the route, in order to maintain the environmental characteristics of the area.

While monitoring to date (refer to Chapter 6 Section 6.4.3) has not indicated any significant or widespread contamination in the SD2 Pipeline Corridor area, it is possible that localised areas of contaminated surface soil and spoil are present which may become mobilised by physical disturbance. Localised contamination of third party origin has been observed within the wetland area south of the Terminal. The onshore SD export pipeline corridor route will pass through the eastern fringes of the wetland area and dewatering of excavations.

SD2 Condensate Tank Area Works

The SD2 Condensate Tank area is located within the existing Sangachal Terminal boundary. Due to historical leakage from produced water holding ponds within and adjacent to the SD2 Condensate Tank area contamination may be locally present. Groundwater is not generally present but waterlogged soils may be encountered locally as a result of this historical leakage.

Soil sampling in 2012 and 2013 within the proposed SD2 condensate tank have indicated that the soil can be classified as category 1. However should category 2 soil, groundwater, ponded surface water or other materials be encountered within the existing Sangachal Terminal property boundary, then they will be classified and managed in accordance with existing BP waste management procedures.

In the event category 2 soil/water (pending event soil/water analysis) is encountered outside of the Sangachal Terminal property boundary the following handling practices will be adopted:

- The soil, surface water, groundwater or other materials will be relocated to an area that is of comparable environmental quality and function;
- The relocation of the soil, surface water, groundwater or other materials to areas that are of comparable environmental quality and function will be undertaken in a manner that will not degrade the environmental further and will promote the natural degradation of contaminants; and
- The following details will be recorded in the event category 2 soil/water is encountered: contaminants detected, handling methods adopted to prevent further environmental degradation, location and quantity of contaminated material detected.

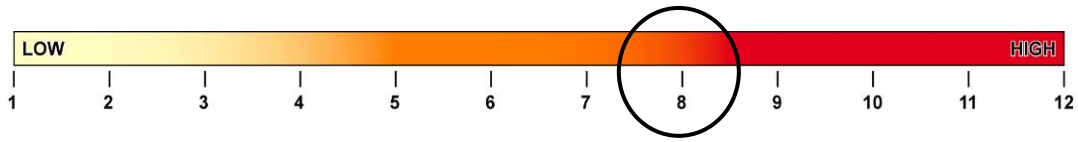
If category type 2 soil/water is encountered within the Sangachal Terminal property boundary then the soil will either be handled in the same manner as material encountered outside of the Sangachal Terminal property boundary or classified as a waste and managed with existing BP AGT Region management plans and procedures.

It is anticipated that areas of contamination within the onshore SD2 export pipeline corridor will be limited. Within the wider wetland area, there are known areas of historic third party contamination and the existence of further localised pockets of such contamination cannot be excluded. However, the above-defined methods and general good construction management practices will be adopted to minimise the potential for mobilisation of contamination.

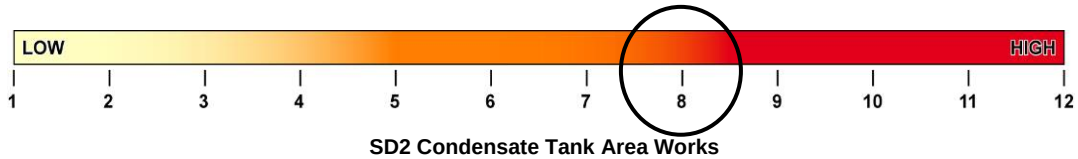
Event Magnitude is summarised in Table 10.24.

Table 10.24 Event Magnitude

Parameter	Onshore Pipeline Installation	SD2 Condensate Tank Area Works
Extent/Scale	1	1
Frequency	3	3
Duration	3	3
Intensity	1	1
Event Magnitude:	**8**	**8**



Onshore Pipeline Installation



SD2 Condensate Tank Area Works

10.6.2.2 Receptor Sensitivity

Relevant receptors include soil and surface water in the vicinity of the Sangachal Terminal and the onshore SD2 export pipeline corridor. Monitoring undertaken to date (Chapter 6 Section 6.4.4) has confirmed that there is no groundwater bearing unit within 20m of the surface.

As reported in Chapter 6, recent soil quality survey results in and adjacent to the onshore SD2 export pipeline corridor (during 2006, 2008 and 2010) indicate no significant contamination. Analysis of soil and water samples have shown no exceedances of relevant standards or limit values (Appendix 10G) (with the exception of elevated levels of arsenic and iron, which are considered to be naturally occurring and consistent with regional data).

Petroleum hydrocarbon concentrations were low, with only one sample within the onshore SD2 export pipeline corridor itself recording a total greater than 100mg/kg. The hydrocarbon within this area was of high molecular weight (suggesting weathering of historic contamination) and highly localised. Therefore, the potential for distribution is considered low.

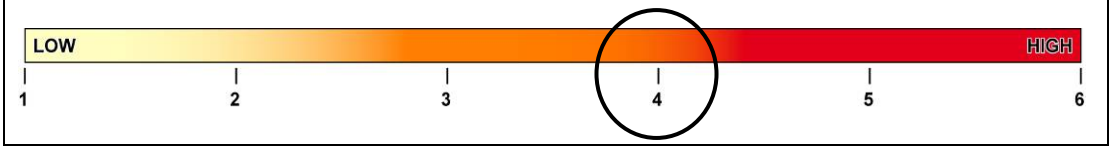
Within the wider wetland areas south of the Terminal, areas of localised hydrocarbon contamination were observed during 2011 and 2012 surveys. All of these appeared to be associated with the release of oil from third-party sources. Other localised spills were observed in the vicinity of the third-party pipelines but no ongoing leaks were visible.

Available analytical data for soil and water in the SD2 Condensate Tank area indicates that the concentrations of potential contaminants of concern are low (soil petroleum hydrocarbon concentrations <40mg/kg). Elevated concentrations of arsenic and iron are recorded but are considered to be naturally occurring. The local presence of elevated concentrations of contamination in soil or groundwater cannot be excluded but its extent and distribution will be strongly limited by the low permeability geological conditions in this area. The risk of mobilisation of any such contamination will be mitigated by the measures presented in Section 10.6.2.1, above.

Table 10.25 presents the justification for assigning a score of 4 to soil and surface water which represents Medium Sensitivity.

Table 10.25 Receptor Sensitivity (Soil and Surface Water)

Parameter	Explanation	Rating
Presence	Pipeline corridor area has moderate value as it is used for local grazing. Surface water bodies not used for public water supply. Used seasonally by herders for watering animals.	2
Resilience	Soil and surface water quality is expected to be largely unaffected by works within the onshore SD2 export pipeline corridor and Condensate Tank Area. Localised contamination was observed within the third party pipeline corridor and wetland area south of the Terminal.	2
		4



10.6.2.3 Impact Significance

Table 10.26 summarises the impact on soil and surface water from the onshore pipeline installation and SD2 Condensate Tank Area works.

Table 10.26 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Onshore Pipeline Installation SD2 Condensate Tank Area works	Medium	Medium	**Moderate Negative**

The following monitoring and reporting requirements related to mobilisation of contamination will form part of the BP SD2 Construction Phase ESMS:

- A Pollution Prevention Management Plan for the terminal construction and onshore pipeline installation will be prepared and implemented;
- Quarterly surface water sampling will be completed within the wetland area for those parameters listed in Appendix 10G; and
- Records (to include, analytical results, photographs, coordinates of the location encountered, action taken and quantities of material) of type 2 soil/water encountered will be maintained and reported to the MENR upon completion of the onshore pipeline construction.

It is considered that impacts are minimised are far as practicable and necessary through the implementation of the existing control measures as listed in Section 10.6.1 above and no additional mitigation is required.

10.7 Impacts to the Terrestrial and Coastal Environment (Cultural Heritage)

This section presents the potential impacts to the cultural heritage due to piling within the SD2 Expansion are and onshore pipeline installation activities.

10.7.1 Mitigation

Existing controls associated with cultural heritage include:

- A watching brief, with representatives from the Institute of Archaeology and Ethnography (IoAE), will be maintained to identify any artefacts of archaeological importance and a chance finds procedure will be in place for construction and commissioning activities implemented within the Sangachal Terminal vicinity;

- Any findings will be reported by the Watching Brief Archaeologists immediately and any corrective measures required will be agreed with an archaeological specialist in liaison with the Ministry of Culture and Tourism and the Institute of Archaeology and Ethnography; and
- In the event archaeological resources are found during excavation work as assessment will be made by the archaeological watching brief on what controls and changes to the excavation work are required and whether work in the area needs to be suspended to allow for more detailed archaeological assessment of the area.

10.7.2 Piling within the SD2 Expansion Area and Onshore Pipeline Installation

10.7.2.1 Event Magnitude

Description

Piling

As discussed within Chapter 5 Section 5.5.2.2, piling will be undertaken across the lower, middle and upper terraces to support the majority of the foundations across the SD2 Expansion Area. A total of approximately 6,750 piles are planned, varying between 450-900mm in diameter and 10-15m in length.

Onshore Pipeline Installation

Onshore pipeline installation comprises open cut trenching and augur boring at pipeline crossings as discussed in Section 10.5.2.1 above.

Assessment

Piling

The nearest cultural site to the SD2 Expansion Area is the medieval Caravanserai however areas where piling is planned to take place are located a minimum of 1,350m from the Caravanserai. As vibrations from piling activities are not expected to travel more than 50m from the source it is considered unlikely that the Caravanserai would be affected by piling activities.

Onshore Pipeline Installation

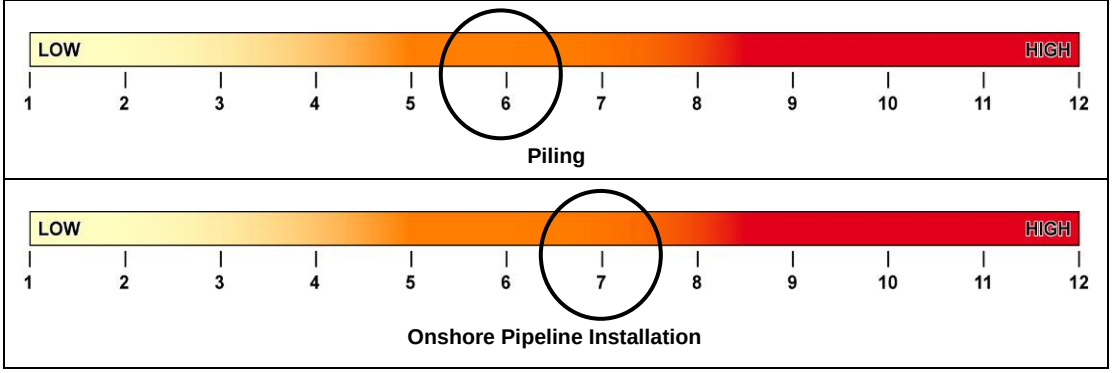
For the majority of the route to the Terminal each pipeline will be trenched and installed at a depth of 2.5m below ground level. The onshore pipeline installation will be conducted within an 80 m RoW along a 4.4km corridor. As a result, approximately 35.2 hectares will be subject to disturbance.

In addition it is planned to use auger boring for pipeline crossings and to drill the augured sections at a depth of approximately 1.5m below the existing service or pipeline. For each section it will be necessary to excavate launch and reception pits for the auguring and casing equipment at a depth of 3-5m below ground level.

Table 10.27 presents that justification for assigning a score of 6 to piling and 8 to onshore pipeline installation works which represents a Medium Event Magnitude.

Table 10.27 Event Magnitude

Parameter	Piling	Onshore Pipeline Installation
Extent/Scale	1	1
Frequency	3	1
Duration	1	3
Intensity	1	2
Event Magnitude:	**6**	**7**



10.7.2.2 Receptor Sensitivity

During the 2011 archaeological baseline survey, no archaeological sites were identified within the lower, middle or upper terrace areas in the SD2 Expansion area. The nearest archaeological sites are Sangachal 10, 12, and 13 (comprising ceramic scatter) located to the northwest of the upper terrace area. However, a number of Isolated Finds, primarily consisting of Medieval Period pot sherds, were identified in the northeast corner of the upper terrace. In addition, a chance find consisting of an isolated Medieval Period potsherd was recovered from the lower terrace area. The recovery of these isolated finds is indicative of human activity in these areas during the Medieval Period. However, the lack of identified archaeological sites and/or features in these areas, during both the baseline survey and watching brief archaeological monitoring during EIW, suggest there is a low potential for encountering any archaeological sites in these areas.

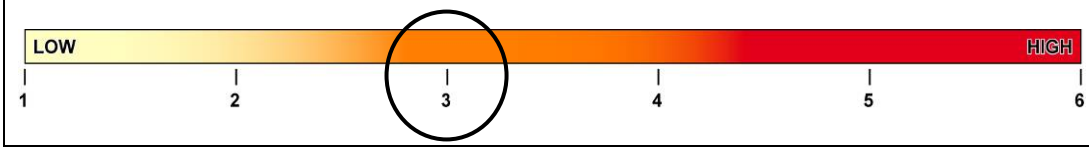
The onshore SD2 Pipeline Corridor was subject to varying levels of investigation during the 2011 archaeological baseline survey. The portion of the proposed route north of the third party pipeline corridor was surveyed and no archaeological sites were identified. A series of isolated finds, consisting predominately of Medieval Period pot sherds, were identified in this area. The portion of the onshore SD2 Pipeline Corridor between the third party pipeline corridor and Baku-Salyan Highway was not intensively surveyed due to the presence of extensive vegetation and standing water.

Based on the available data, the archaeological potential of the onshore SD2 Pipeline Corridor is interpreted as being low to moderate. There is no evidence to suggest the presence of any large, extensive settlements, and as such, the potential for this type of site being present is low. However, the onshore SD2 Pipeline Corridor is located along a historic trade route running from the Sangachal Caravanserai to Karachi Caravanserai (north of the Sangachal Terminal). There is, therefore the potential to encounter small campsites on the route between two caravanserais, within the un-surveyed portions of the SD2 Pipeline Corridor. The Medieval Period isolated finds already identified along the proposed onshore SD2 Pipeline Corridor attests to past human activity in the area.

Table 10.28 present the justification for assigning a score of 3 to cultural heritage which represents Medium Sensitivity.

Table 10.28 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	There are no State protected monuments or archaeological sites within the SD2 Expansion Area and SD2 Export Pipeline Corridor. There is no evidence to suggest the presence of a large, extensive archaeological site in the onshore SD2 Export Pipeline Corridor, although he potential remains for the presence of small archaeological sites.	1
Resilience	If any archaeological sites are present within the upper, middle, or lower terraces of the SD2 Expansion area, pilling activities could result in negative impacts to these sites.	2
		3



10.7.2.3 Impact Significance

Table 10.29 summarises impacts on cultural heritage from piling activities with the SD2 Expansion Area.

Table 10.29 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Piling Activities with the SD2 Expansion Area	Medium	Medium	**Moderate Negative**
Onshore Pipeline Installation			

The following monitoring and reporting requirements related to cultural heritage will form part of the BP SD2 Construction Phase ESMS:

- An Archaeology and Cultural Heritage Management Plan will be prepared detailing how the SD2 Project will be managed in relation to potential cultural heritage impacts; and
- An Archaeology and Cultural Heritage Close Out Report will be issued to the MoCT and IoAE at completion of construction activities.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures (which includes the use of a watching brief and a chance finds procedure) and no additional mitigation will be warranted.

10.8 Impacts to the Marine Environment (Water Column and Seabed)

Potential impacts to the marine environment may arise due to cooling water discharge at the construction yards, SD2 Export and MEG Import pipelines and Subsea Infrastructure HUC pre-commissioning discharges, cement discharges, other vessel discharges and underwater noise and vibration from piling and vessels.

10.8.1 Mitigation

Existing controls associated with construction yard cooling water discharge include:

- The system will be designed to meet a temperature specification for the discharge at the edge of the mixing zone, or 100m if a mixing zone is not defined, no greater than 3 degrees more than the ambient water temperature; and
- Neutralising agent dosing will be controlled and checked to ensure neutralisation is effective and residual chlorine content is maintained at less than 1mg/l in the construction yard cooling water discharge.

Existing controls associated with SD2 Export and MEG Import pipelines and Subsea Infrastructure HUC pre-commissioning discharges include:

- Hydrotest water used during export pipeline and flowline pre –commissioning will be dosed with chemicals which are not persistent in the marine environment.

Existing controls associated with cement discharges include:

- Cementing chemicals are of low toxicity (UK OCNS "Gold" and "E" categories or equivalent toxicity to those chemicals previously approved for use);
- Cement is designed to set in a marine environment preventing widespread dispersion; and
- The volume of cement used to cement jacket piles into position is calculated prior to the start of the activity. Sufficient cement is used to ensure that the piles are cemented securely while minimising excess cement discharges to the sea.

Existing controls associated with other vessel discharges include the following:

- Depending on the availability of the system, black water will either be:
  - Contained onboard for transfer to shore;
  - Once onshore, black water will be managed in accordance with the existing AGT management plans and procedures; or
  - Black water will be treated to applicable MARPOL 73/78 Annex IV: Prevention of Pollution by Sewage from Ships standards: Five day BOD of less than 50mg/l, suspended solids of less than 50mg/l (in lab) or 100mg/l (on board) and coliform 250MPN (most probable number) per 100ml. Residual chlorine as low as practicable.

- Depending on the availability of the system, galley food waste will either be:
  - Contained and shipped to shore for disposal; or
  - Sent to vessel maceration units designed to treat food wastes to applicable MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships particle size standards prior to discharge.
- Vessel ballast tanks are designed to ensure that oil and chemicals do not come into contact with ballast water;
- Deck drainage and washwater will be discharged to sea as long as no visible sheen is observable;
- Support vessels will be subject to periodic performance reviews, the scope of which includes environmental performance indicators[10].

Existing control measures associated with underwater noise and vibration from piling and vessels include:

- The frequency of pile driving will be gradually increased to minimise underwater noise impacts to marine species;
- It is planned to begin piling the jacket pin piles and foundation piles using vibration piling as far as practical prior to using impact piling to minimise underwater noise impacts to marine species; and
- Support vessels are subject to periodical performance review which includes environmental performance. Corrective actions will be undertaken to address any performance gaps.

[10] The scope of environmental performance reviews are expected to include, but may not be limited to, the following: energy efficiency and diesel usage, sulphur content of diesel used, ballast water management, waste management, sewage treatment plant operation and management of bilge water.

10.8.2 Construction Yard Cooling Water Discharge

10.8.2.1 Event Magnitude

Description

Construction yard cooling water discharge is discussed in Chapter 5: Project Description Sections 5.6.7.1 and 5.6.9.2.

During onshore commissioning, seawater will be supplied to the topsides via a temporary seawater abstraction system from the quayside. The seawater system will be designed to operate at a flow rate of approximately 600m^3/hr for a period of up to 6 months and will be of a similar design to that approved for previous ACG projects. Seawater will be abstracted from the construction yard quayside and discharged to sea after use. The temperature difference between the seawater intake and discharge will be constant and independent of season as the energy demand on the seawater cooling system when in use will be constant.

Two treatment packages will be used for the temporary cooling water system to inhibit biological growth and corrosion within the seawater system:

- A chlorine/copper anti fouling system, which involves pulse dosing of abstracted seawater at concentrations of 50 ppb chlorine and 5ppb copper; and
- A continuous dosing system, which involves injection of sodium hypochlorite into the abstracted seawater at a concentration of 2mg/l. Prior to discharging the cooling water, a neutralising agent (sodium thiosulphate) will be added. Neutralisation agent dosing will be controlled and checked to ensure neutralisation is effective and residual chlorine content is maintained at less than 1mg/l.

Assessment

Dispersion modelling was carried out to assess the distance within which the cooling water plume would exceed a temperature of more than 3ºC above ambient. Modelling was undertaken assuming a temperature difference between the intake and discharge flows of 50ºC (worst case) and 10ºC (typical case). The modelling showed that for worst case 50ºC temperature difference the cooling water plume would reach 3ºC above ambient within 4m from the point of discharge For the typical 10ºC scenario modelling showed the cooling water plume reach 3ºC above ambient within 0.5m of the discharge. Figure 10.7 illustrates the extent of cooling plume for the worst case 50ºC temperature difference scenario.

Figure 10.7 Predicted Cooling Water Plume Temperature Above Ambient at Distance from Discharge (50ºC Temperature Difference Scenario)

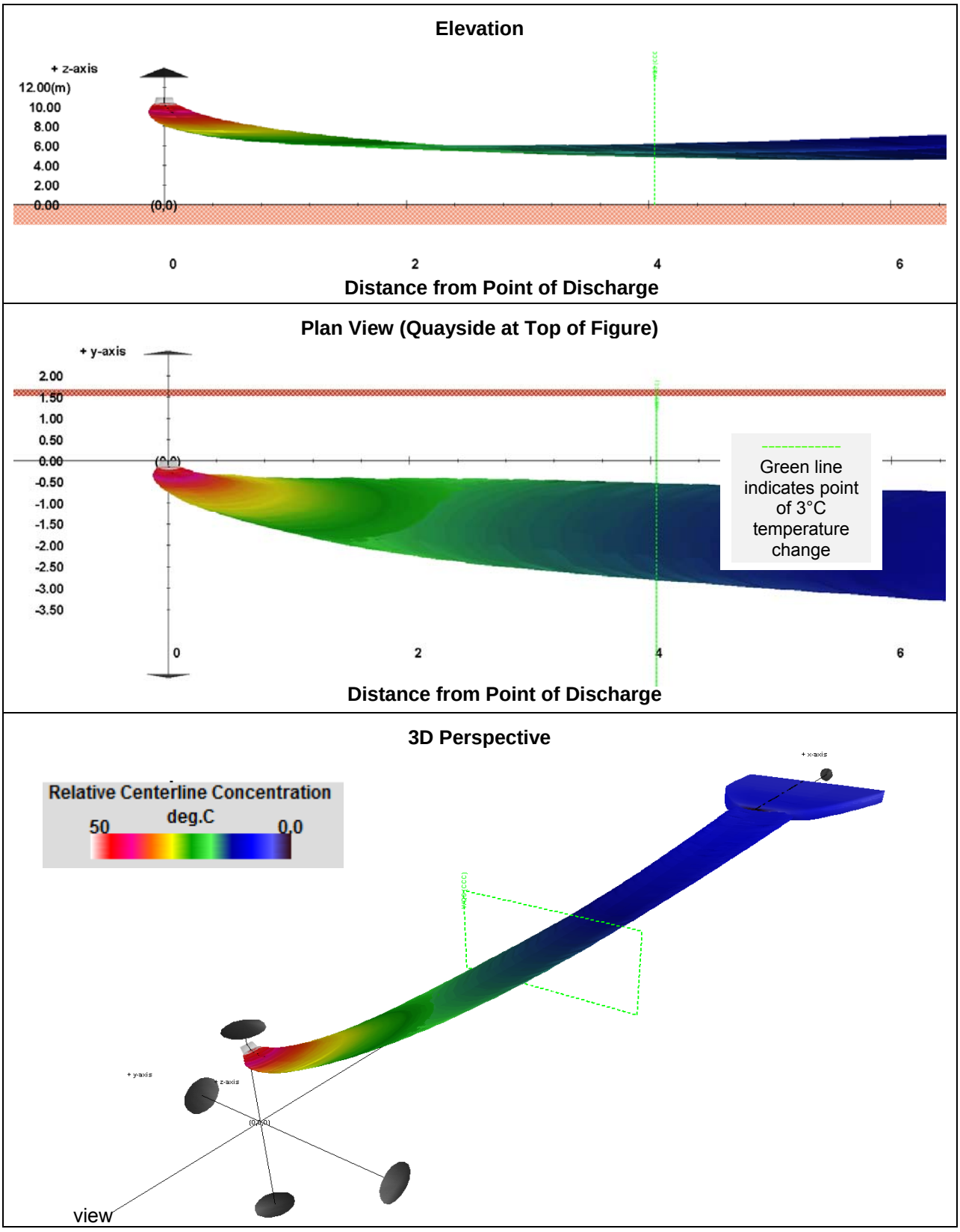
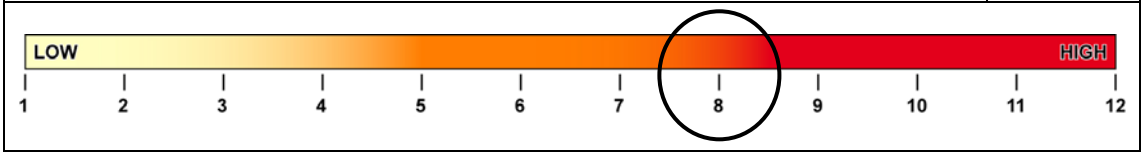


Table 10.30 presents the Event Magnitude for construction yard cooling water discharge. A Medium level Event Magnitude is assigned.

Table 10.30 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Cooling water discharges will be diluted to an acceptable level within 4m of the point of discharge.	1
Frequency	Discharge of cooling water will take place continuously.	3
Duration	The discharge will be continuous for 6 months during topside commissioning.	3
Intensity	Discharges will be consistent with project standards and with previously approved practices and will contain no harmful persistent materials.	1
		8



10.8.2.2 Receptor Sensitivity

The discharge will take place close to the quayside adjacent to a construction yard in an industrial setting.

Due to the location of the construction yards within heavily industrialised areas, the presence of seals or threatened species of fish is extremely unlikely. The benthos of the coastal zone is largely dominated by pollution-tolerant invasive species, with few native species present. No plankton studies have been carried out in the vicinity of the construction yards, but it is probable that species diversity is lower than in open waters; and that communities will tend to be dominated by organisms which are tolerant of, or can competitively exploit, water which will often be of poorer quality than open coastal water.

In summary, no sensitive, rare or threatened species are anticipated to be present in the vicinity of the construction yards, and the species most likely to be present and dominant will be those tolerant of the discharges and emissions historically associated with shipping and industrial activity.

Table 10.31 presents the biological/ecological Receptor Sensitivity.

Table 10.31 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Seals and fish are not expected to be present consistently or in significant numbers near the discharge source. No significant exposure of benthos or plankton.	1
Resilience	The species likely to dominate in the area of the construction yards are expected to be predominantly invasive species with a high tolerance to anthropogenic impacts.	1
		2

10.8.2.3 Impact Significance

Table 10.32 summarises impacts to biological/ecological receptors from construction yard cooling water discharge.

Table 10.32 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Cooling water discharge from onshore construction yard	Medium	(Biological/Ecological) Low	**Minor Negative**

The following monitoring and reporting requirements related to construction yard cooling water discharge will form part of the BP SD2 Construction Phase ESMS:

- Neutralising agent flow and dose pump records will be maintained during construction yard cooling water discharge;
- Weekly sampling and analysis of the residual chlorine content of the construction yard cooling water discharge will be undertaken; and
- Flow and dose pump records and weekly chlorine content sampling results will be managed by the construction contractor during construction yard cooling water discharge.

It is considered that the impacts are minimised as far as practicable and necessary through the implementation of the existing control measures (see Section 10.8.1.) and no additional mitigation is required.

10.8.3 SD2 Export and MEG Import Pipelines and Subsea Infrastructure HUC Discharges

10.8.3.1 Event Magnitude

SD2 Export and MEG Import Pipelines and Infield Flowlines Pre-Commissioning Discharges

Description

Following installation, pre-commissioning activities for the SD2 export and MEG pipelines and the infield flowlines will include flooding, cleaning and gauging (FCG), hydrotesting, leak testing, pre in line inspection (ILI) gauging and ILI pigging and dewatering using treated seawater. The following Base Case chemicals, at the indicated dosage rates, are currently planned to be used:

- 1000ppm Hydrosure HD5000 (combined biocide, corrosion inhibitor and oxygen scavenger); and
- 100ppm Tros Seadye (dye).

In the event that different chemicals are required, the SD2 Project Management of Change Process (see Section 5.16) will be followed.

A summary of the expected volume and location of treated seawater discharges associated with SD2 export and MEG pipeline and the infield flowline pre-commissioning is presented in Chapter 5 Tables 5.22 and 5.25, respectively. All discharges during pre-commissioning will be either a temporary pig trap on the seabed adjacent to the SDB-PR platform or via the SDB-PR platform seawater caisson at a depth of 52m below sea level.

Up to approximately 90 separate discharge events ranging from $1m^3$ (discharge from onshore 6" MEG pipeline section during hydrotesting) to $49{,}858m^3$ (discharge from 32" gas export pipelines during ILI pigging) are expected to take place over eight years.

Assessment

The potential environmental impact of the treated seawater (including preservation chemicals) discharges was assessed by:

- Conducting toxicity tests (OSPAR methodology) on seawater dosed with the TROS and Hydrosure products at the levels specified above; and
- Conducting dispersion modelling (DREAM model) on a range of scenarios representing the range and type of discharges.

Ecotoxicity values were expressed as a percentage of preservation chemicals in seawater. Tests were conducted with both phytoplankton (*Skeletonema costatum*) and zooplankton (*Acartia tonsa*), and the lowest LC/EC_{50} (representing greatest sensitivity) from these tests was selected as the basis for assessing environmental impact. The concentration corresponding to a 'no-effect' level was estimated by applying a safety factor of 10 (appropriate for short-duration discharges) to the selected value; for the purposes of modelling, the 'no-effect' concentrations were then expressed as a minimum dilution factor (refer to Table 10.33 lowest value and minimum dilution are highlighted).

Table 10.33 EC/LC_{50} Values and No-effect Dilution Factors for the SD2 Export and MEG Import Pipelines and Infield Flowlines Preservation Product

	Replicate	LC/EC50 (% treated water in seawater)	
		Acartia	Skeletonema
Hydrosure HD5000	1	0.14	0.12
	2	0.12	0.15
	Ave.	**0.13**	**0.135**
No Effect Dilution Factor		**7,692**	**7,407**

A total of 16 scenarios were modelled, each covering dilution factors up to 8,000-fold. In some instances, the treated seawater will be in the SD2 Export and MEG Import pipeline and infield flowlines for up to two years; to assess the extent to which toxicity might decay over time, additional ecotoxicology studies are in progress using stored samples which will be tested at intervals.

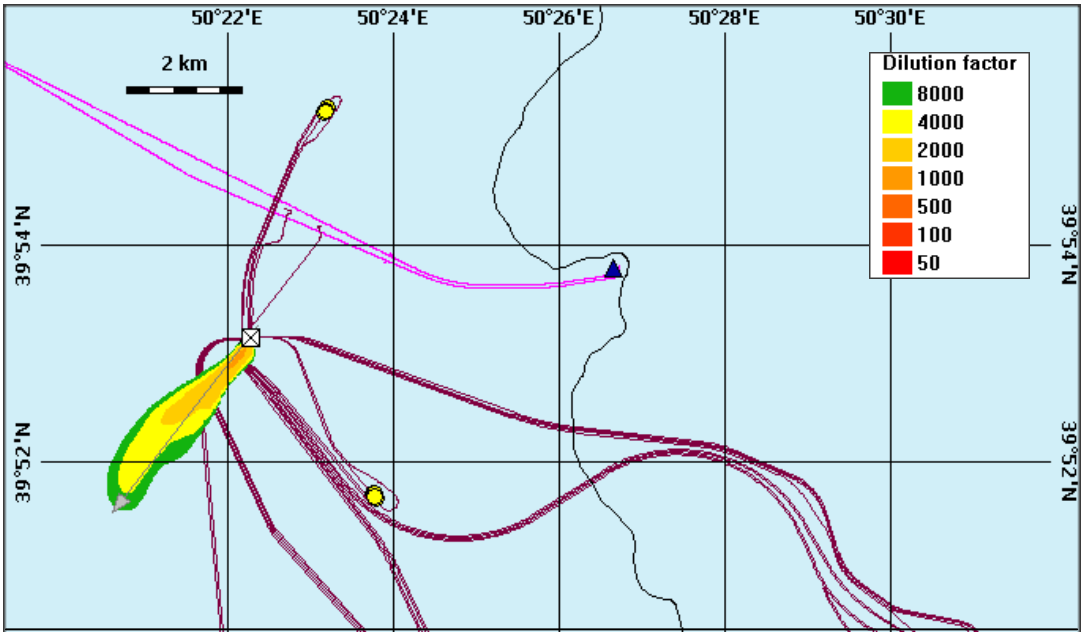
The results of three scenarios, representing small, medium-sized and large discharges, are presented in Figures 10.8 to 10.11. Table 10.34 summarises these scenarios.

Table 10.34 Summary of Small, Medium and Large Discharge Scenarios

Operation	Scenario	Pipeline	Discharge Volume (m^3)	Discharge Duration per Discharge (hr)	Port Diameter (m)	Depth BMSL (m)	Discharge Orientation	Location
Flood, Clean and Gauge	1	Gas	9,002	11	0.23	95 (seabed)	Vertically upward	Temporary Pig Trap
Hydrotest and Leak Test	6	Gas	330	12	1.05	52	Vertically downward	SDB-PR caisson
Dewatering	11	Gas	49,858	60	1.05	52	Vertically down	SDB-PR caisson

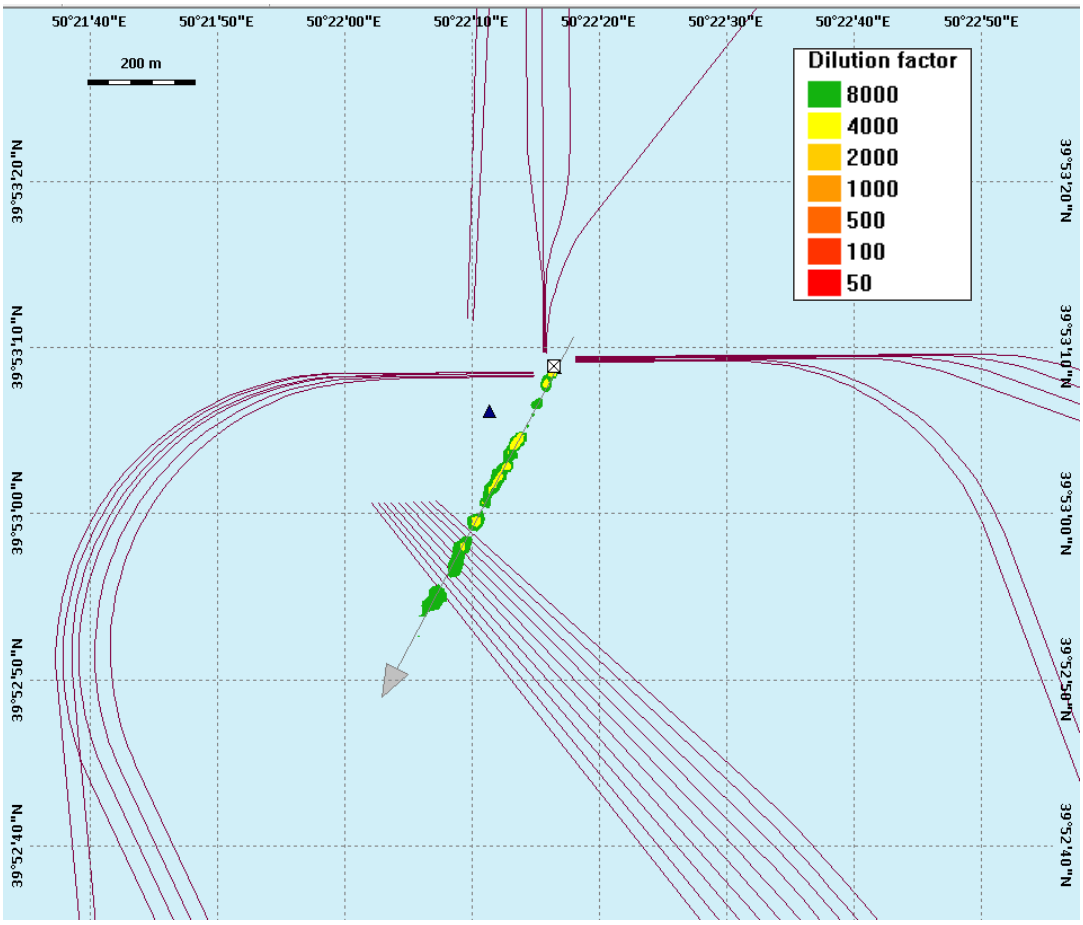
The plume arising from Scenario 1, a discharge at the seabed of 9,000m^3 over a period of 12 hours was estimated to be approximately 1,000m wide and approximately 3.75km long (refer to Figure 10.8 which shows extent of the plume at the end of the discharge event).

Figure 10.8 Snapshot of Plume at End of Discharge Period, Scenario 1



The plume arising from Scenario 6, a discharge of 330m^3 from the SDB-PR platform caisson over 12 hours, is very shallow and thin at the 8,000-fold dilution contour, and extends approximately 500m from the SDB-PR platform caisson at the end of the discharge (refer to Figure 10.9). Dilution to 8,000-fold is rapid and complete by the end of the discharge period.

Figure 10.9 Snapshot of Plume at End of Discharge Period, Scenario 6



The plume arising from Scenario 11, a discharge of 49,858m^3 from the SDB-PR platform caisson over a period of 60 hours, extends over a distance of approximately 4.5km at the 8,000-fold dilution at the end of the discharge period in summer and approximately 3.1km in winter (refer to Figures 10.10a and 10.10b respectively).

Figure 10.10a Snapshot of Plume at End of Discharge Period, Scenario 11 (summer)

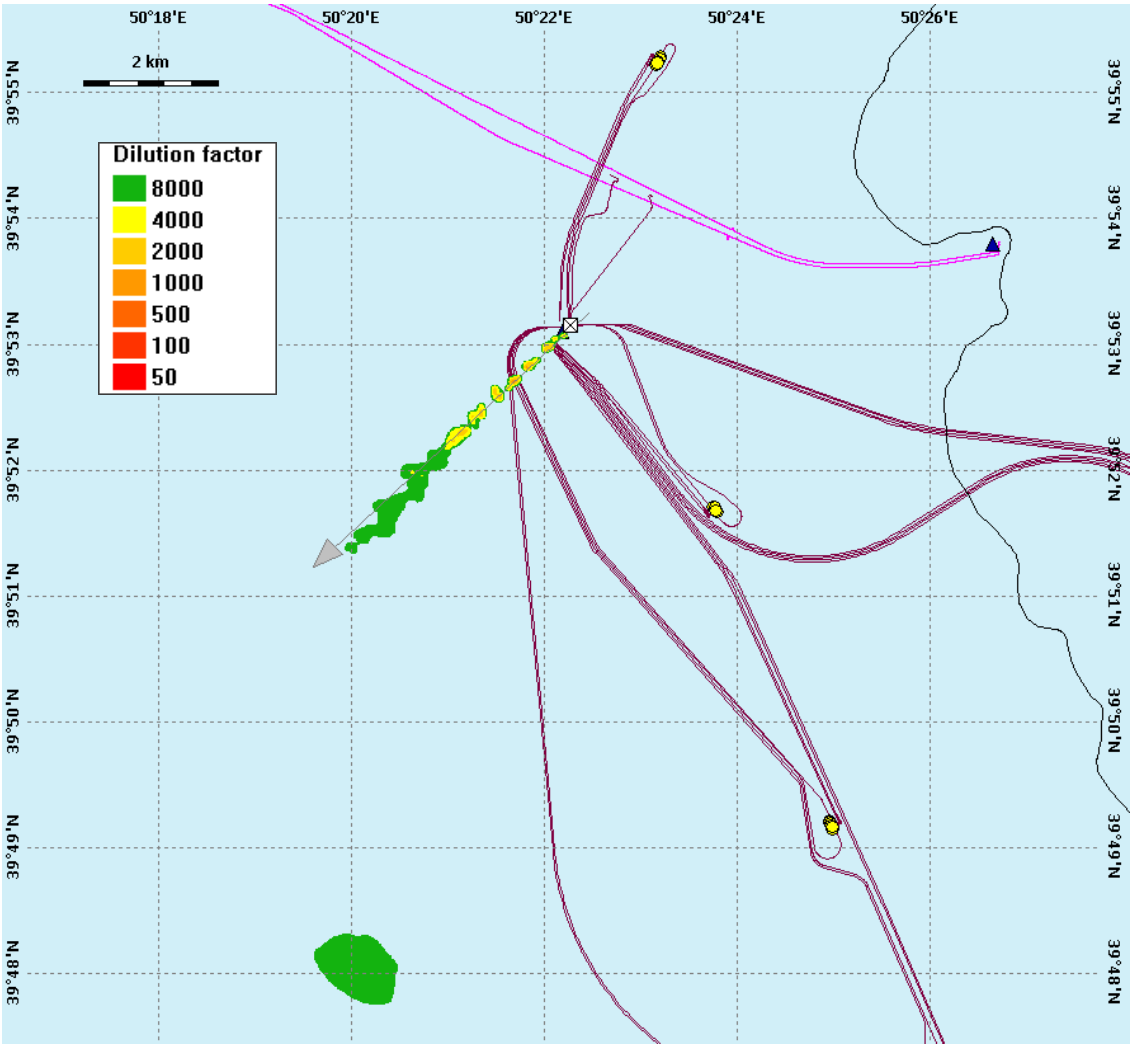
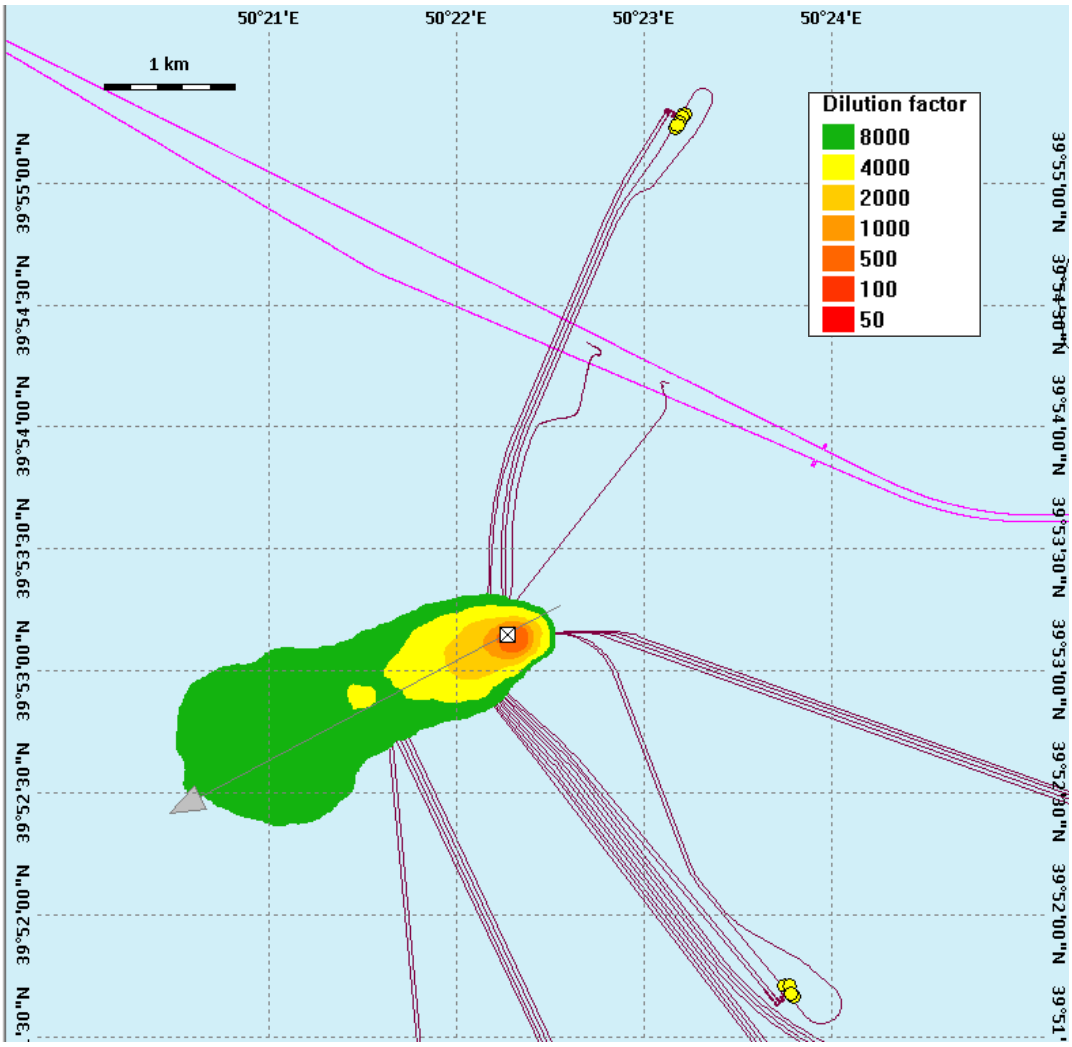


Figure 10.10b Snapshot of Plume at End of Discharge Period, Scenario 11 (winter)

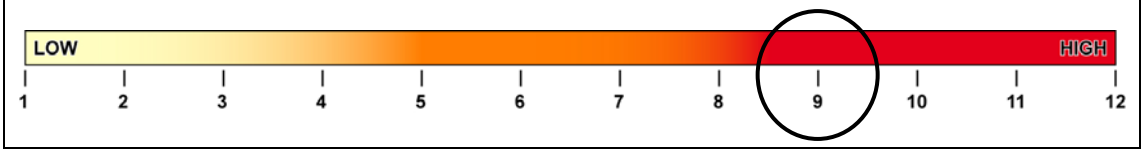


The range of plume sizes and orientation, the short duration of individual events, and the fact that the plumes do not reach the seabed or sea surface, indicate that impact of individual discharges will be transient, and small relative to the scale of the receiving environment. The product is degradable and non-bioaccumulative, and will not give rise to persistent or cumulative impacts.

Table 10.35 presents the justification for assigning score of 9, which represents a High Event Magnitude.

Table 10.35 Event Magnitude (Pre-commissioning Discharges)

Parameter	Explanation	Rating
Extent/Scale	Some discharge plumes will extend up to 4.5km.	3
Frequency	Discharges will occur up to 90 times over eight years.	3
Duration	Discharge durations will be short, and less than 24 hours in most instances.	2
Intensity	Discharges will be consistent with project standards and with previously approved practices and will contain no persistently harmful materials.	1
		9



Subsea Infrastructure Installation Discharges (MEG Discharges During Subsea Infrastructure Installation)

Description

It is anticipated that the production trees, manifolds, spools, SSIVs and umbilicals are installed pre-filled with MEG. The spools and equipment will be fitted with pressure caps to minimise losses of fluids to sea. However, it is anticipated that small volumes of MEG, of between 10.74 and 13.84m^3, will be discharged to sea at the seabed during installation in the vicinity of each manifold and the associated production trees.

Assessment

MEG is of very low toxicity to aquatic organisms, and CICADs[11] estimates a no-effect concentration of approximately 890mg/l. The discharges have been modelled, and the plume dimensions at the required dilution have been estimated. Figure 10.11 illustrates the steady-state dimensions of the plume under weak current conditions two hours after discharge commences. The no-effect concentration is reached within 20m of the point of release. One hour after the end of the discharge, the concentration of MEG does not exceed 500 mg/l at any point. Under typical current conditions, MEG concentrations were diluted to concentrations of less than 890 mg/l within 2 m of the point of discharge.

Figure 10.11 Dimensions of MEG Discharge Plume Two Hours After Discharge Commences

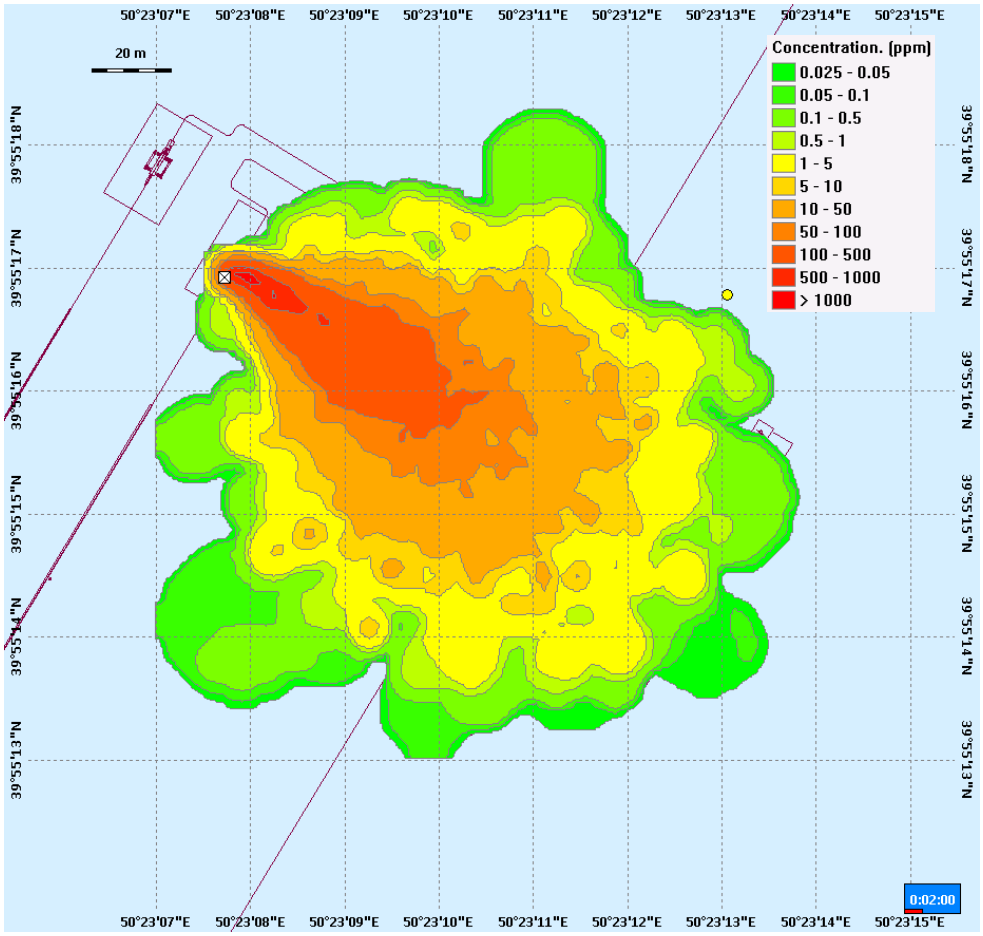
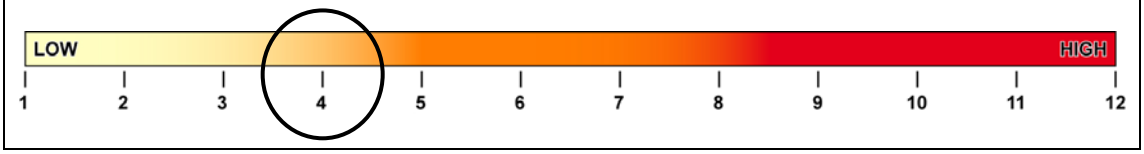


Table 10.36 presents the justification for assigned a score of 4, which represents a Low Event Magnitude

[11] WHO, 2000, ETHYLENE GLYCOL: Environmental aspects, Concise International Chemical Assessment Document 22, Geneva

Table 10.36 Event Magnitude (MEG Discharges During Subsea Production System Installation)

Parameter	Explanation	Rating
Extent/Scale	Discharges will impact only a small area (less than 20m from the release point)	1
Frequency	Discharges will occur once per cluster	1
Duration	Discharges duration is approximately 4 hours	1
Intensity	Discharges will be consistent with project standards and with previously approved practices and will contain no persistently harmful materials.	1
		4



10.8.3.2 Receptor Sensitivity

Dispersion modelling has indicated that the treated seawater used during pre-commissioning and MEG discharges will not impact the seabed or the photic (productive) zone. Treated seawater plumes are predominantly long and narrow, and residence time within a plume for fish would be too short to result in either acutely or chronically toxic exposure. Productive phytoplankton populations will not be present in the volumes of water occupied by the plumes. Seals, as air-breathers, are unlikely to be affected by exposure.

Zooplankton are most likely to be exposed and affected, if vertically migrating populations are present at the times at which discharges take place. Water-column surveys in the SD2 Contract Area in recent years have indicated a substantial decline in native and endemic species, to the extent that the zooplankton community is dominated by two invasive species; the copepod *Acartia tonsa* and the ctenophore *Menmiopsis leydii.* Both species are widespread and comparatively abundant, and are therefore not considered vulnerable at a population level to the proposed discharges.

Table 10.37 presents the biological/ecological Receptor Sensitivity.

Table 10.37 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Fish, seals and phytoplankton unlikely to be exposed. Effects on are zooplankton possible.	1
Resilience	Community dominated by widespread and abundant invasive species.	1
		2

10.8.3.3 Impact Significance

Table 10.38 summarises impacts to biological/ecological receptors from SD2 Export and MEG Import pipelines, and Subsea Infrastructure HUC discharges.

Table 10.38 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Pipeline and Flowline Pre-commissioning Discharges	High	(Biological/Ecological) Low	**Moderate Negative**
MEG Discharge During Subsea Infrastructure Installation	Low	(Biological/Ecological) Low	**Negligible**

10.8.3.4 Additional Mitigation, Monitoring and Reporting

The assessment above has demonstrated, with reference to numerical modelling, that pipeline hydrotest discharges will result in a Moderate Negative impact to biological/ecological receptors.

Prior to the commencement of pipeline and flowline hydrotest activities, a hydrotest management plan will be prepared and subsequently maintained. This plan will establish, and regularly update, a schedule of hydrotest events together with a detailed set of commissioning procedures. The MENR will be informed of the hydrotest schedule and will be notified of any changes to the schedule.

Experience gained during the commissioning of the ACG Phase 3 pipelines demonstrated that, in most instances, it is not technically practicable to undertake a programme of field sampling and analysis during hydrotest activities; this constraint applies particularly to events which involve the discharge of degraded hydrotest chemicals after the fluid has been in a pipeline for a period of several months. Accordingly, the following measures will be undertaken for the SD2 Project to provide the most effective and practicable monitoring and assurance:

- The amounts of chemicals used, together with the dosage rates and water flow rates during all pipeline filling, top-up and pressure testing activities will be rigorously recorded;
- The actual volumes of hydrotest water released during each pipeline discharge event will be rigorously recorded; and
- Laboratory samples (seawater dosed with chemicals at the rate recorded during offshore pipeline fill activities) will be prepared and stored onshore under simulated pipeline conditions. These samples will be periodically subject to toxicity testing.

The information collected as a result of these hydrotest monitoring and assurance measures will be collated, interpreted, and issued in the form of a final close-out report to the MENR once all pipeline and flowline commissioning activities have been completed.

It is considered that the impacts are minimised as far as practicable and no additional mitigation is required.

10.8.4 Other Discharges

Other discharges to sea will result from the operation of vessels associated with the installation of the SDB platform complex, SD2 export and MEG pipelines, and subsea infrastructure (refer to Chapter 5 Sections 5.7.7., 5.8.7 and 5.9.5) and will comprise ballast water, treated black water, grey water and drainage.

10.8.4.1 Event Magnitude

Description and Assessment

Other discharges to sea will result from the operation of vessels associated with the installation of the SDB platform complex, SD2 export and MEG pipelines, and subsea infrastructure (refer to Chapter 5 Sections 5.7.7., 5.8.7 and 5.9.5). These will comprise:

- **Ballast Water** – Support vessels will occasionally take up and discharge ballast water during installation support activities.

  Vessel ballast tanks are designed to ensure that ballast water does not come into contact with oil or chemicals. Uptake and discharge are not considered to present a significant environmental hazard;

- **Treated Black Water** –Treated black water will be rapidly diluted close to the point of discharge. Total suspended solids, BOD and coliforms at the proposed treatment level do not pose any risk of environmental impact;

- **Grey Water** - Grey water will be discharged directly to sea. Grey water (from showers, laundry etc) will contain only dilute cleaning agents (soaps, detergents) and the impact of discharge will be minimal. Environmental factors are considered prior to selecting any chemical for use, including cleaning fluids such as detergents; and

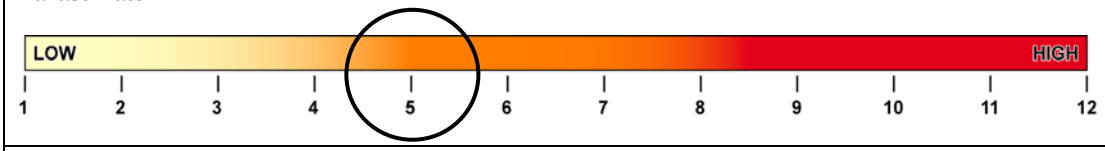
- **Drainage** - Drainage (including deck drainage and washdown water) will be discharged directly to sea, provided no visible sheen is observable. No contaminated water will be discharged and so no environmental impact is anticipated.

Event Magnitude is summarised in Table 10.39.

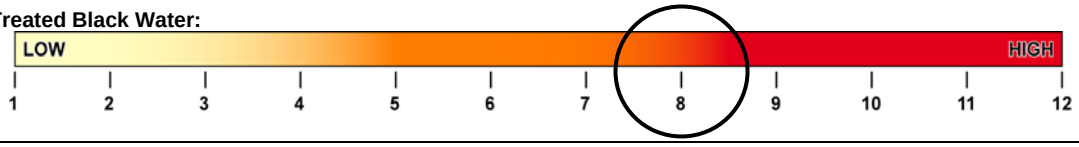
Table 10.39 Event Magnitude

Event Parameter / Discharge	Ballast Water	Black Water	Grey Water	Drainage
Scale	1	1	1	1
Frequency	2	3	3	3
Duration	1	3	3	3
Intensity	1	1	1	1
Event Magnitude	**5**	**8**	**8**	**8**

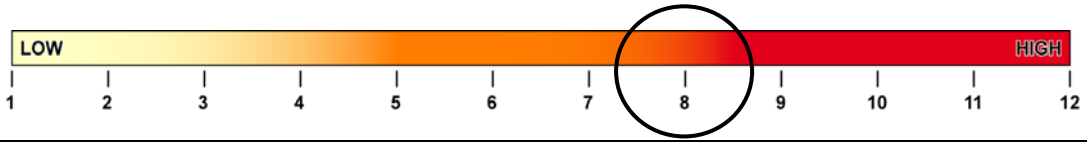
Ballast Water:



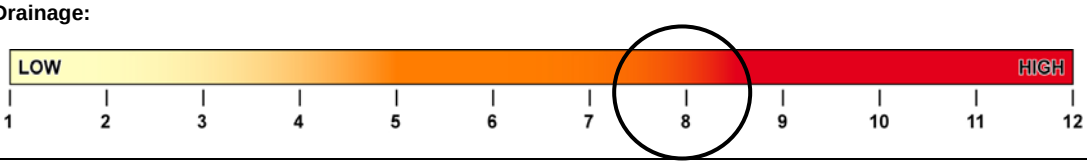
Treated Black Water:



Grey Water:



Drainage:



10.8.4.2 Receptor Sensitivity

All of the discharges are low in volume and do not contain toxic or persistent process chemicals (with the exception of chlorination of treated black water). Receptors are not considered to be sensitive to these small discharges.

Table 10.40 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 10.40 Receptor Sensitivity (All Receptors)

Parameter	Explanation	Rating
Resilience	The extremely low level of exposure is equivalent to high resilience.	1
Presence	There is no significant presence of rare, unique or endangered species (i.e. the risk of exposure for any such species is close to zero).	1
Total		**2**

10.8.4.3 Impact Significance

Table 10.41 summarises the impact of other discharges to sea on seals, fish, zooplankton, phytoplankton and benthic invertebrates.

Table 10.41 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Other Discharges to Sea **Ballast Water**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Treated Black Water**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Grey Water**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Drainage**	Medium	(All Receptors) Low	**Minor Negative**

The following monitoring and reporting requirements related to vessel ballast water, treated black water, grey water and drainage discharges will form part of the BP SD2 Construction Phase ESMS:

- Black Water:
  - Onboard vessels samples will be taken from the sewage discharge outlet and analysed monthly for total suspended solids, thermotolerant coliforms and BOD. Water samples should meet the following sewage standards: five day BOD of less than 50mg/l, suspended solids of less than 50mg/l (in lab) or 100mg/l (on board) and coliform 250MPN (most probable number) per 100ml. Residual chlorine will be as low as practicable;
  - Daily visual checks will be undertaken when discharging from vessels to confirm no floating solids are observable; and
  - Vessel sewage sampling results, recorded daily observations and estimated volumes of treated black water discharged daily (based on POB).
- Grey water and Drainage:
  - Daily visual checks undertaken when discharging grey water and drainage from vessels to confirm no visible sheen; and
  - Daily observations and estimated volumes of grey water and drainage discharged daily from vessels will be recorded .

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures (refer to Section 10.8.1) and not additional mitigation is required.

10.8.5 Underwater Noise and Vibration

10.8.5.1 Event Magnitude

Description

Underwater noise will result from the driving the jacket and SSIV foundation piles and vessel movements during nearshore and offshore pipelay and during installation of the subsea infrastructure as described in Chapter 5 Sections 5.6.4, 5.6.8, 5.7.2 and 5.9.3.

Assessment

Using the same approach as discussed in Chapter 9 Section 9.4.1.1 an analysis of the propagation of underwater noise was undertaken in order to estimate distances at which various acoustic impacts on marine species may occur (refer to Appendix 9C). The assessment identified relative distances at which representative audiological injury and behavioural thresholds for seals and fish (denoted as either hearing-specialist or hearing-generalist depending on their biology e.g. whether or not they have swim bladders and a physiological connection between the swim bladder and the inner ear) were reached for each activity. Thresholds for acoustic impact criteria are available for pinnipeds covering lethality; physical injury including deafness; and behavioural reactions while for fish, they cover lethality and behavioural reactions only.

Thresholds exist for both mild and strong behavioural responses. The mild behaviour response threshold indicates that the seals and fish may be aware of the sounds but does not imply that they will move or be impacted. This assessment therefore, focuses on the thresholds for auditory injury and strong behavioural reactions against which to assess potential impacts to fish and seals.

Figure 10.12 presents a summary of the effect of underwater noise from piling, nearshore and offshore pipelay, and subsea infrastructure installation to audiological injury and strong behavioural thresholds.

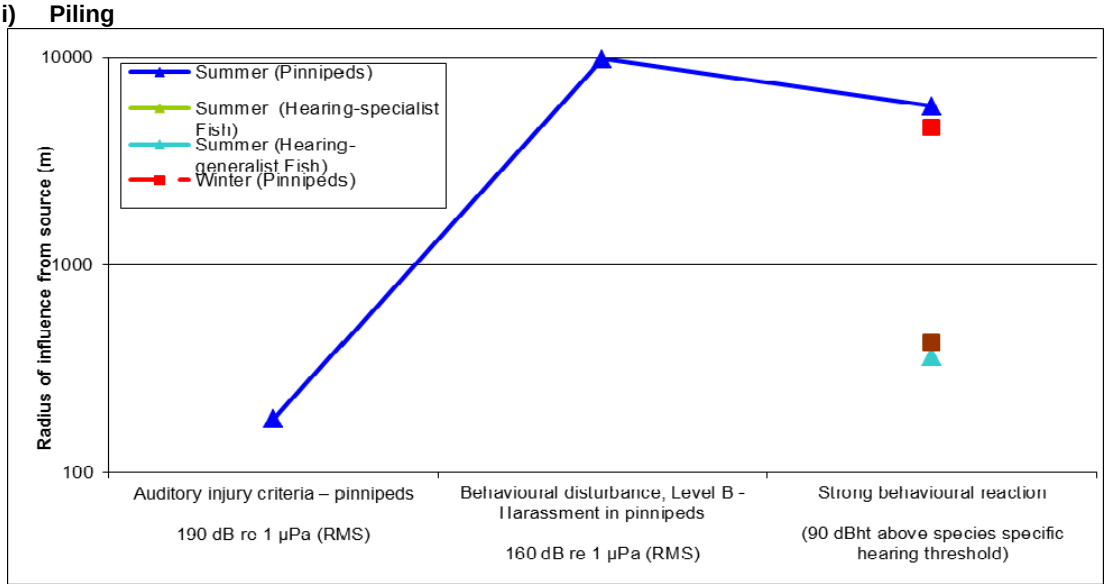
During piling activities the assessment showed that the maximum extent for auditory injury for seals was found to be 180m, while strong behavioural reactions may be evident up to 5.8km from the piling site during winter. The maximum distance at which strong behavioural reactions may be observed is 12.9km for hearing specialist fish, while hearing-generalist fish react at a maximum distance of 420m

Pipelaying activities in the nearshore and offshore environment is predicted to result in strong behavioural reactions in seals up to a distance of 570m from the source, while the corresponding ranges for hearing- generalist fish and hearing-specialist fish are 40m and 670m, respectively.

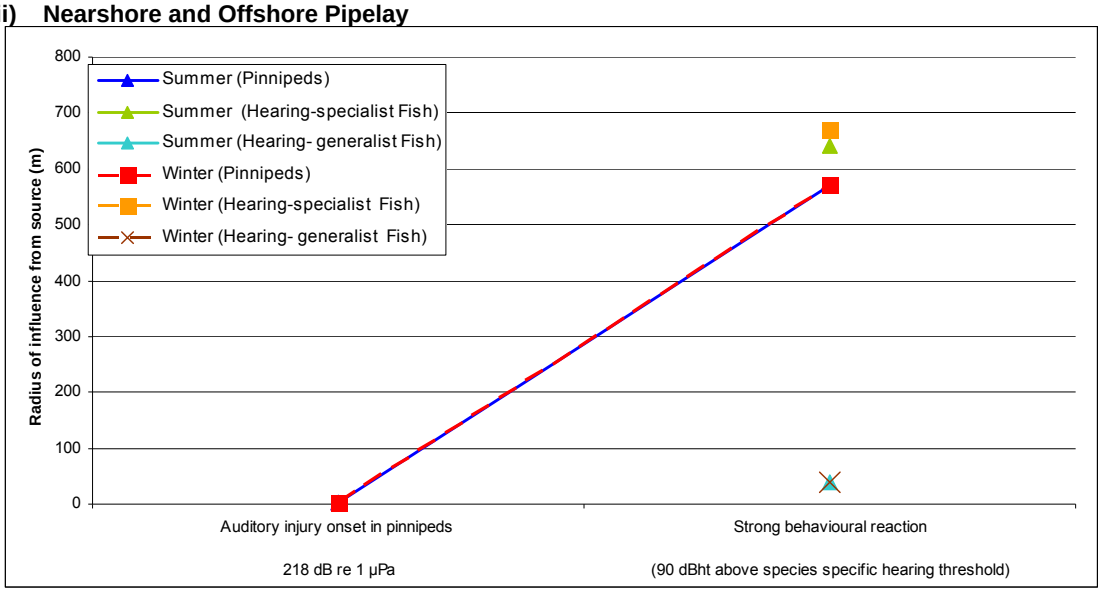
Subsea installation activities involving a crane barge and a survey vessel operating close together are predicted to result in strong behavioural reactions in seals up to 60m, while corresponding ranges for hearing-generalist fish and hearing-specialist fish are 20m and 82m, respectively.

Figure 10.12 Summary of Effect of Underwater i) Piling, ii) Nearshore and Offshore Pipelay and ii) Subsea Infrastructure Installation Noise Relative to Audiological Injury and Strong Behavioural Thresholds

i) Piling



ii) Nearshore and Offshore Pipelay



iii) Subsea Infrastructure Installation

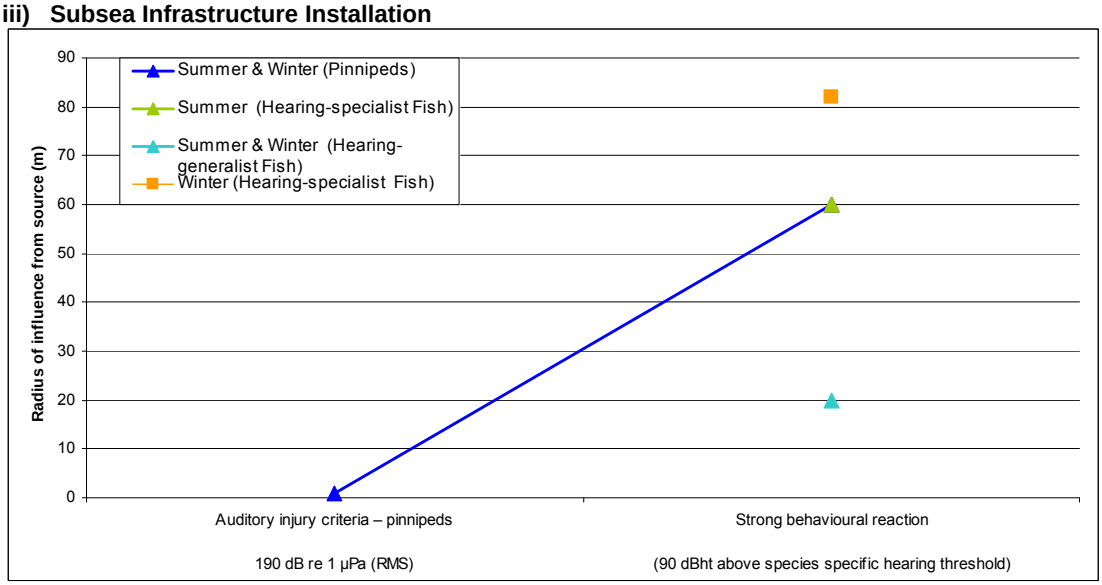
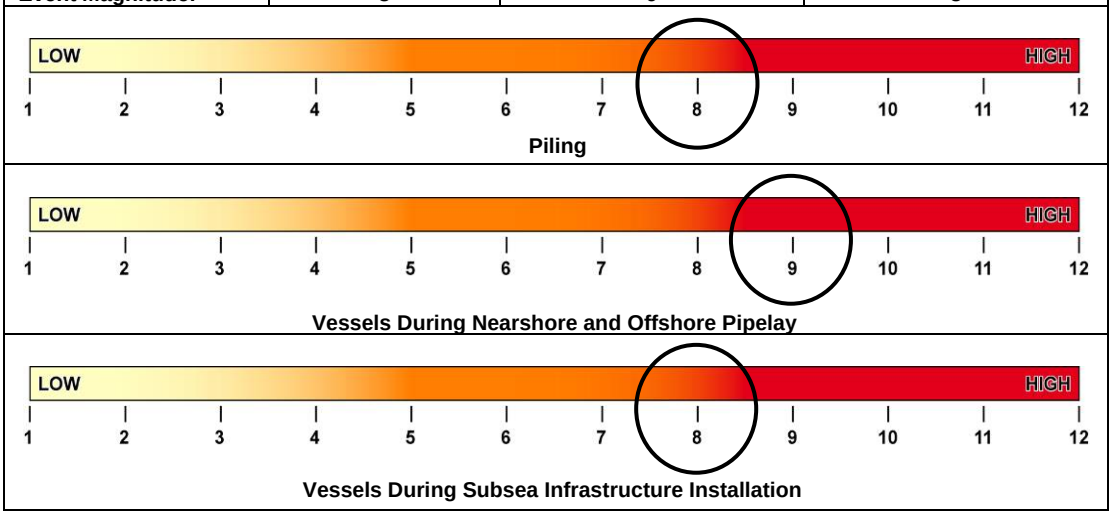


Table 10.42 presents the justification for assigning a score of 7 and 10 to piling and vessel activities respectively, which represents a Medium and High Event Magnitude, respectively.

Table 10.42 Event Magnitude

Parameter	Piling	Nearshore and Offshore Pipelay	Subsea Infrastructure Installation
Extent/Scale	3	2	1
Frequency	2	3	3
Duration	1	3	3
Intensity	2	1	1
Event Magnitude:	**8**	**9**	**8**



10.8.5.2 Receptor Sensitivity

The only relevant biological receptors to underwater noise are seals and fish[12]. Recent data indicates that Caspian seals, an endangered species. Migrate through the SD Contract Area (refer to Chapter 6 Section 6.7.2.5 and Appendix 6D). The number varies throughout the year with the maximum numbers of up to 4,000 seals migrating through the SD Contract Area during the spring months which significantly reduces to individual seals during the winter months.

Sturgeon, another endangered species, are known to migrate through the SD Contract Area in March/April and September to November but are not common and do not use the area exclusively (refer to Chapter 6 Section 6.7.2.4. and Appendix 6C). Shad also migrate through the SD Contract Area in autumn. Goby species are present throughout the year in the Central and Southern Caspian including the SD Contract Area, however fish such as kilka and mullet are semi migratory primarily present in the SD Contract Area during the winter months. No species is present exclusively within the Contract Area.

Table 10.43 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

[12] Plankton cannot sense the low frequency sound generated because the wavelength is longer than the organism and benthic invertebrates do no have sophisticated sound-sensing apparatus.

Table 10.43 Receptor Sensitivity

Parameter	Explanation	Rating
Resilience	Possibility that species may be temporarily affected by underwater piling and vessel noise during pipelay and subsea infrastructure installation but effect would be short term and limited. Ecological functionality will be maintained.	1
Presence	Both fish and seals are likely to be present for limited periods of time in the SD Contract Area. However, the SD Contract Area is not exclusively used by these species	1
Total		**2**

10.8.5.3 Impact Significance

Table 10.44 summarises impacts to seal and fish associated with jacket and SSIV foundation piling and vessel movements

Table 10.44 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Jacket and SSIV foundation piling	Medium	(Biological/Ecological) Low	**Minor Negative**
Nearshore and Offshore Pipelay	High	(Biological/Ecological) Low	**Moderate Negative**
Subsea Infrastructure Installation	Medium	(Biological/Ecological) Low	**Minor Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures (refer to Section 10.81) and not additional mitigation is required.

10.9 Impacts to the Nearshore/Coastal Environment

This section assesses the potential for impacts in the nearshore/coastal environment from the construction and presence of two finger piers and nearshore pipeline installation works.

10.9.1 Mitigation

Existing controls related to impacts in the nearshore/coastal environment include:

- A baseline survey of the SD2 Pipeline Corridor in the nearshore area has been completed;
- Vessels and equipment will be subject to periodic performance reviews, the scope of which includes environmental performance indicators[13] ; and
- A process will be established to promote the selection of hydraulic fluids used on the trenching equipment that has the best environmental performance.

[13] The scope of environmental performance reviews are expected to include, but may not be limited to, the following: energy efficiency and diesel usage, sulphur content of diesel used, ballast water management, waste management, sewage treatment plant operation and management of bilge water.

10.9.2 Nearshore Pipeline Installation

10.9.2.1 Event Magnitude

Description

Finger Piers

As discussed in Chapter 5 Section 5.8.3.2, it is anticipated that two temporary finger piers 4-5m wide (10m at the base) will be constructed, extending out approximately 145m to approximately 3m water depth. The berms will be constructed from aggregate and are expected to remain in place for up to two years when they will be removed and the area will be reinstated.

Nearshore Pipeline Installation Works

To install the SD2 export and MEG in the nearshore it is proposed to excavate three trenches from the coastline to 3m water depth either side of the finger piers using excavators. Each trench will be 2.5m deep and 2m wide.

From the 3m to 12m water depth (approximately 7,450m), each trench (approximately 5m wide and 2.5m deep) will be excavated using a cutter suction dredger (CSD) (or a barge based excavator). An alternative option of combining the three trenches into one is also being considered. The single trench would be approximately 34-40m wide and 2.5m deep.

The dredger will removed approximately 1,000,000m^3 of material and deposit it approximately 500m from the trench via a floating pipeline. A spreader pontoon will be connected to the end of this pipeline in order to dispose the dredged material evenly over this area. This form of disposal will lead to ridges being created on the seabed. Should these not be removed from natural backfilling, the material will be removed later by the CSD and used as backfill to cover the pipelines in the trenches, thereby restoring the original seabed as far as practicable.

Assessment

The nearshore baseline coastal processes are described in Chapter 6 Section 6.6.1.

Installation of the pipelines within the nearshore environment will follow the same approach as that adopted for previous ACG Phases 1 and 2, and SD Stage 1 projects, where pipelines were installed within 500m of the SD2 export pipeline route. Previous modelling studies and pre and post surveys undertaken for these previous projects have therefore informed the assessment of the finger berm and nearshore pipeline installation within this section.

Finger Piers

Previous studies have shown that the nearshore location associated with the SD2 export corridor is dynamic. As the pipeline landfall area faces south east, significant profile changes and major littoral transport events are expected to occur due to wind driven waves and currents resulting from discrete storm events generally from a north easterly direction.

The presence of 145m long finger piers and the associated cofferdam crossing the active littoral transport zone perpendicular to the coastline means significant interruption to the natural littoral sediment fluxes will occur, especially under storm conditions. The finger piers will act as a barrier, effectively blocking the north to south net drift within the intertidal and part of the sub tidal zones. This will lead to accretion of sediment on the eastern side of the piers, and erosion along the coastline to the western side of the structures. Local scour effects and locally enhanced suspended sediment concentrations, within the shallow active zone may also occur, due to wave breaking particularly under extreme storm wave conditions.

Depending on the incident wave angle some local sheltering and focussing of waves may be experienced as a result of the finger piers. Due to the predominant northerly winds it is most likely that sheltering will most frequently be experienced in the area west of the finger piers. Localised sheltering may lead to morphological changes and adjustment of the coastline profile in the immediate vicinity of the finger piers.

The construction of the finger piers will also cause a barrier to the typically weak mainly coastal parallel currents, with the structures acting to deflect the flows of offshore currents around the end of the piers. Local acceleration of flows may be experienced, with slacker variable flows expected in the shelter of the structure.

Decommissioning of the finger piers will result in a temporary increase in suspended sediment due to loss of the pier material into the water and re- suspension of bed sediments. This is anticipated to be localised and will occur over a short duration.

Nearshore Pipeline Installation Works

Trenching will lead to the suspension of sediment due to disturbance of the seabed. Generally under this procedure high suspended sediment concentrations are generated from the physical disturbance and/or removal and deposition of sediment. Depending on the machinery used, overflow and splashing during the trenching operations may also lead to high levels of suspended sediment. Therefore benthic habitat could also be indirectly impacted as a result of increased turbidity in the Bay during trenching activities.

Monitoring surveys were undertaken during trenching operations for ACG Phases 1 and 2. Findings of the surveys showed the extension of the plume of turbid water during the trenching operations was estimated to be approximately 0.3km^2 on the two days of plume monitoring. For comparison, the total area of Sangachal Bay measured from the point of the Peninsula to the south, and Primorsk Harbour in the north, is around 35km^2. The area of visibly increased turbidity was stretching typically from 100 to 300m from the trenching activities. Downstream the plume extended beyond this. Although this survey represents only a limited sample, given the similar nature and scale of the trenching planned for the SD2 Project, the impact magnitude is assessed as moderate given the localised extent of the observed plumes.

Tables 10.45 and 10.46 present the justification for assigning a score of 8 for finger pier and a score of 6 for the nearshore trenching, which represents a Medium Event Magnitude.

Table 10.45 Event Magnitude (Finger Piers)

Parameter	Explanation	Rating
Extent/ Scale	Interruption to littoral drift patterns. Down drift erosion and updrift accretion impacting on the beach profile affecting an overall area less than 50 hectares.	1
Frequency	Continuous	3
Duration	For the duration that the finger peirs are in place (~2 years estimated).	3
Intensity	Low intensity with the shoreline morphology and beach profiles adjusting over time.	1
Total		**8**

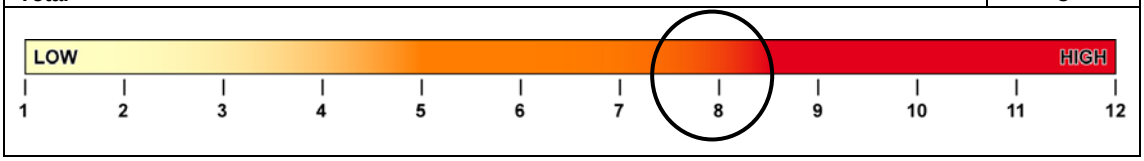
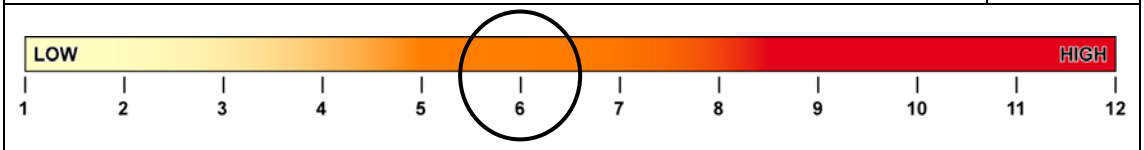


Table 10.46 Event Magnitude (Nearshore Trenching)

Parameter	Explanation	Rating
Extent/ Scale	Nearshore impact. High levels of suspended sediment and direct sea bed disturbance impacting an overall area less than 50 hectares.	1
Frequency	Trenching for each of the four pipelines required.	2
Duration	Up to one month per pipeline expected.	2
Intensity	Previous monitoring of trenching effects demonstrates low intensity impacts.	1
Total		**6**



10.9.2.2 Receptor Sensitivity

The receptors present in and adjacent to the SD2 Export Subsea Pipeline corridor are common in local coastal waters. Sangachal Bay is a shallow water environment which is regularly disturbed by wave action, and the biological communities are adapted to periodic turbidity. Seagrass detached by wave action is frequently observed on the shoreline, and the seagrass beds are clearly able to sustain natural stresses which are considerably greater than the effects of finger pier construction or pipeline trenching. The capacity of seagrass to regenerate and colonise is illustrated by the way in which this plant responded to the sea level rise in the late 20th century. Much of the area where seagrass is presently most abundant was dry shoreline in the 1980s, and the main area of seagrass rapidly colonised new habitat as the water level rose. The benthic community present in the Bay is typical of local coastal waters; it comprises a small number of native species, but has also been colonised by a number of alien and invasive species. Regular surveys in the Bay have indicated that neither seagrass nor benthic invertebrates have suffered permanent adverse effects due to pipeline installation.

Table 10.47 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 10.47 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	The receptors present in the pipeline corridor are common in Sangachal Bay and in adjacent coastal waters. No rare or vulnerable marine species are present.	1
Resilience	Biological communities with the Bay have experienced no lasting impact from previous pipeline installation activities, and are considered resilient.	1
		2

10.9.2.3 Impact Significance

Table 10.48 summarises impacts to the coastal environment associated with the presence of the finger berms and nearshore pipeline trenching.

Table 10.48 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Construction of finger berms	Medium	Low	**Minor negative**
Nearshore pipeline installation works	Medium	Low	**Minor negative**

The following monitoring and reporting requirements related to finger berm construction and nearshore pipeline installation works will form part of the BP SD2 Construction Phase ESMS:

- Fish population surveys will be undertaken one year prior to trenching activities, during trenching and once trenching has been completed; and
- Pre and post trenching seabed surveys will be undertaken. Post trenching seabed surveys will be undertaken one and three years after completion of trenching activities. The surveys will include drop down video work to confirm seabed distribution.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures (refer to Section 10.9.1) and not additional mitigation is required.

10.10 Impacts to the Coastal and Marine Environment (Cultural Heritage)

This section presents the potential impacts to cultural heritage within the coastal and marine environment due to seabed disturbance during SD2 Project installation activities.

10.10.1 Mitigation

Existing controls associated with coastal and marine cultural heritage include:

- Data collected from previous surveys including 3D seismic and detailed bathymetry surveys and any further seabed surveys completed prior to pipeline and subsea infrastructure installation will be reviewed by a marine cultural heritage specialist to identify potential sites of cultural heritage value which lie within the areas affected by the works;
- In the event that a potential site is identified an assessment of the potential importance of the feature will be undertaken by a marine cultural heritage specialist; and
- Based on the importance of the feature, the pipeline and subsea infrastructure will be repositioned to avoid significantly impacting the feature.

10.10.2 Seabed Disturbance

10.10.2.1 Event Magnitude

Description

Seabed disturbance within the coastal and marine environment will arise from installation of SD2 platform complex and the subsea SD2 export and MEG pipelines and the subsea infrastructure as discussed in Chapter 5 Sections 5.7.2, 5.7.3, 5.8.3.1, 5.8.3.2 and 5.9.3.

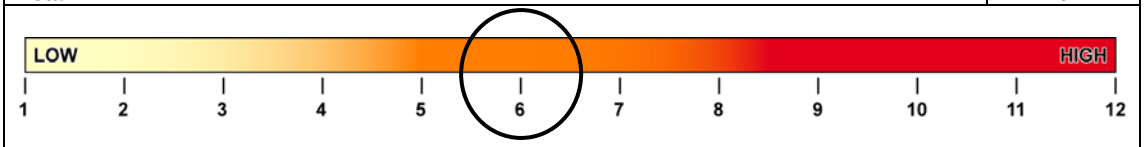
Assessment

The Caspian Sea contains a variety of known and anticipated cultural heritage. This cultural heritage includes shipwrecks that date back at least 2,000 years, artefacts from marine losses and submerged terrestrial archaeological resources. The latter reportedly include entire historic communities that were submerged by tectonic activities. Although reported by professional archaeologists and non professional divers, the exact locations of offshore cultural heritage sites are known in only a few instances. It is not known whether there have been any marine cultural heritage sites identified previously in the areas of potential seabed disturbance. Prior to the commencement of installation works, pre-construction pipeline and anchor surveys will be completed. These will be reviewed by a marine cultural heritage specialist to identify potential sites, which can then be subsequently avoided during installation works.

Table 10.49 presents the justification for assigning a score of 8, which represents a Medium Event Magnitude.

Table 10.49 Event Magnitude

Parameter	Explanation	Rating
Extent/ Scale	Disturbance will be limited to areas of anchor setting and the area occupied by the SDB Platform Complex, SD2 Export and MEG Import pipelines and Subsea Infrastructure.	1
Frequency	The number of individual events resulting in seabed disturbance will be greater than 50.	3
Duration	Disturbance events will be of short duration.	1
Intensity	Following review of pre-construction and anchor surveys it is expected that installation works will avoid significant physical disturbance to marine cultural heritage sites (if present)	1
Total		**6**



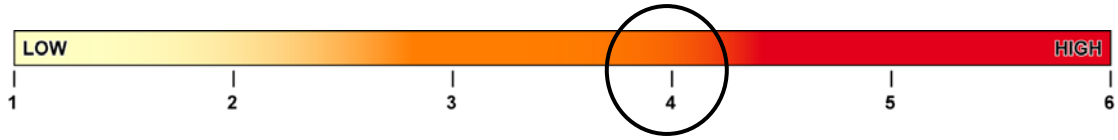
10.10.2.2 Receptor Sensitivity

Marine cultural heritage sites often are assessed to be of national or regional value, when they are present. This is because every shipwreck is unique and most shipwrecks contain unique information. For this assessment, the receptors are considered to be at minimum of regional value, understanding that individual receptors might be of national or international value.

Table 10.48 presents the justification for assigning a score of 4, which represents Medium Receptor Sensitivity for any cultural heritage in the area impacted by seabed disturbance.

Table 10.50 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Lacking baseline data, the receptors are considered to be at minimum of regional value, understanding that individual receptors might be of national or international value.	2
Resilience	Marine cultural heritage can be permanently damaged by impacts to the seabed from anchoring, cable/chain placement, pipelay, and other seabed disturbances, although complete destruction is unlikely.	2
		4



10.10.2.3 Impact Significance

Table 10.51 summarises impacts on cultural heritage from seabed disturbance.

Table 10.51 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Offshore project impacts to cultural heritage	Medium	Medium	**Moderate Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures (refer to Section 10.10.1) and no additional mitigation is required.

10.11 Summary of SD2 Construction, Installation and HUC Residual Environmental Impacts

For all construction, installation and HUC phase environmental impacts assessed it has been concluded that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and additional mitigation measures set out for noisy construction activities at the Terminal. With the implementation of the Nuisance Management Plan noisy construction activities at the Terminal should be no more than moderate negative.

Table 10.52 summaries the residual environmental impacts for the construction, installation and HUC phase of the project.

Table 10.52 Summary of SD2 Project Construction, Installation and HUC Residual Environmental Impacts

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Emissions from Construction Plant and Vehicles (Terminal, Onshore Pipelay and Pipeline Drying)	1	3	3	1	3 1	Medium	Medium	Moderate Negative
	Emissions from Offsite Vehicles	1	3	3	1	3 1	Medium	Medium	Moderate Negative
	Emissions from Terminal Commissioning	1	3	2	1	3 1	Medium	Medium	Moderate Negative
	Emissions from Construction Yard Plant and Vehicles	1	3	3	1	1 1	Medium	Low	Minor Negative
	Emissions from Onshore Commissioning of Main Platform Generators and Topside Utilities	1	3	3	1	1 1	Medium	Low	Minor Negative
	Vessel Emissions	1	3	3	1	1 1	Medium	Low	Minor Negative
Terrestrial Environment	Terminal Construction Plant and Vehicles (Noise)	3	3	3	1	2 1 1 2	High	Human: Medium Biological / Ecological: Medium	Major Negative - reduced to Moderate Negative following additional mitigation
	Onshore & Nearshore Pipelay (Noise)	3	1	3	1	2 1 1 2	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative
	SD2 Export and MEG Pipeline Pre-Commissioning and Drying	1	1	3	1	2 1 1 2	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative
	Terminal Commissioning (Noise)	1	1	2	1	2 1 1 2	Low	Human: Medium Biological / Ecological: Medium	Minor Negative
	Construction Yard Plant (Noise)	1	3	3	1	2 1 2 1	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Terrestrial Environment	Platform Commissioning and Topside Utilities (Noise)	3	1	1	1	2 1 2 1	Medium	Human: Medium Biological / Ecological: Medium	Moderate Negative
	Onshore SD2 Export Pipeline Installation (Ecology)	1	1	3	1	2 1	Medium	Medium	Moderate Negative
	Onshore Pipeline Installation (soils, groundwater and surface water)	1	3	3	1	2 2	Medium	Medium	Moderate Negative
	SD2 Condensate Tank Area Works (soils, groundwater and surface water)	1	3	3	1	2 2	Medium	Medium	Moderate Negative
	Piling within the SD2 Expansion Area (Cultural Heritage)	1	3	1	1	1 2	Medium	Medium	Moderate Negative
	Onshore Pipeline Installation (Cultural Heritage)	1	1	3	2	1 2	Medium	Medium	Moderate Negative
Marine Environment	Construction Yard Cooling Water Discharge	1	3	3	1	1 1	Medium	Low	Minor Negative
	Pipeline and Flowline Pre-commissioning Discharges	3	3	2	1	1 1	High	Low	Moderate Negative
	MEG Discharge During Subsea Infrastructure Installation	1	1	1	1	1 1	Low	Low	Negligible
	Ballast Water (Vessels)	1	2	1	1	1 1	Medium	Low	Minor Negative
	Treated Black Water (Vessels)	1	3	3	1	1 1	Medium	Low	Minor Negative
	Grey Water (Vessels)	1	3	3	1	1 1	Medium	Low	Minor Negative
	Drainage (Vessels)	1	3	3	1	1 1	Medium	Low	Minor Negative
	Piling – Jackets and SSIVs (underwater noise)	3	2	1	2	1 1	Medium	Low	Minor Negative
	Vessels During Nearshore and Offshore Pipelay (underwater noise)	2	3	3	1	1 1	High	Low	Moderate Negative
	Vessels During Subsea Infrastructure Installation (underwater noise)	1	3	3	1	1 1	Medium	Low	Minor Negative
Nearshore/Coastal Environment	Construction of Finger Piers	1	3	3	1	1 1	Medium	Low	Minor Negative
	Nearshore Pipeline Installation Works	1	2	2	1	1 1	Medium	Low	Minor Negative
	Seabed disturbance (cultural heritage)	1	3	1	1	2 2	Medium	Medium	Moderate Negative