Tamar Field Development – Environmental Impact Assessment Addendum

Tamar-12 Drilling and Completion and Infield Subsea Infrastructure Installation

October 2025

Prepared for:
Chevron Mediterranean Limited
Herzliya Hills, Bld. A, 2nd Floor
1 Arik Einstein, Herzliya,
4659070 Israel

Prepared by:
CSA Ocean Sciences (Israel) Ltd.
147 Bar Yehuda road, Nesher
3688306 Israel

Tamar Field Development – Environmental Impact Assessment Addendum

Tamar-12 Drilling and Completion and Infield Subsea Infrastructure Installation

DOCUMENT NO. CSA-CML-IL-25-82734-4177-01-REP-01-004

Suggested citation: CSA Ocean Sciences Israel Ltd. (CSA). 2025. Tamar Field Development – Environmental Impact Assessment Addendum Tamar-12 Drilling and Completion and Infield Subsea Infrastructure Installation. Prepared for Chevron Mediterranean Limited. 228 pp. + ES and apps.

Contact information: info@csaocean.com

Internal review process					
Version	Date	Description	Prepared by:	Reviewed by:	Approved by:
INT-01	03/20/2025				
INT-02	03/26/2025	TE review	Same as above		

Client deliverable			
Version	Date	Description	Project Manager Approval
001	04/01/2025	Client deliverable	
002	04/24/2025	Revised client deliverable	
003	04/29/2025	Revised client deliverable	
004	10/23/2025	Revised client deliverable	

The electronic PDF version of this document is the Controlled Master Copy at all times. Any non-PDF or printed copy is considered to be uncontrolled, and it is the holder's responsibility to ensure that they have the current version. CSA does not sanction content of uncontrolled versions. Controlled copies are available to authorized persons upon request from the CSA Document Production Department.

ES-1 BACKGROUND AND TAMAR-12 PROJECT SUMMARY

The Tamar Field is located in the Tamar Lease, which is approximately 90 km west of Haifa in the Levantine Basin. The Tamar Lease covers approximately 250 km^2, of which the Tamar Field covers approximately 100 km^2. The Tamar Field is located at a water depth of approximately 1,600 to 1,700 m and includes a series of completed wells and associated subsea infrastructure. A gas production and transportation system composed of subsea trees, infield flowlines and umbilicals, and pipelines currently link the Tamar Field to the Tamar Offshore Receiving and Processing Platform (Tamar Platform), located approximately 150 km south-southeast of the field.

Chevron Mediterranean Limited (CML, formerly Noble Energy Mediterranean, NEML) has been actively involved in the license area, with the first well, Tamar-1, drilled in 2008. Over the years, six gas wells have been drilled in the Tamar Reservoir (Tamar-2 through Tamar-6, with Tamar-6 being a re-drill/completion of Tamar-1) and one well in the Tamar SW Reservoir (Tamar SW-1). Tamar-2 through Tamar-6 were successfully completed in 2012. In 2013, CML drilled the Tamar SW-1 well, and in 2016, Tamar-8 was drilled.

Additionally, in 2013, the Tamar Platform was installed close to the existing Mari-B Platform. At that time, flowlines and utility lines were laid to connect Tamar Reservoir production to the Tamar Platform via subsea infrastructure. From the Tamar Platform, production is sent to the Ashdod Onshore Terminal (AOT) through a 30-inch pipeline and a bundle of 1 × 10-inch and 2 × 6-inch lines.

The Tamar-12 Project includes the drilling and completion of a single new production well, and the installation of associated subsea infrastructure that will connect the subsea production tree to the existing subsea distribution assembly. This well location was selected to provide both high-confidence production and to improve the delineation and understanding of the reservoir for future development.

ES-2 IMPACT ASSESSMENT SOURCES

CSA (2016) previously provided a description of general activities planned and a breakdown of Environmental Impact Assessment (EIA) Sections (see Section 1.1 of the 2016 document), outlining the completion of the Tamar SW-1 well, the drilling of three additional wells in the Tamar Reservoir (Tamar-7, Tamar-8, and Tamar-9), and the installation of the infrastructure to tie these wells into the existing Tamar subsea equipment. Baseline information was also acquired during an environmental baseline survey conducted in 2014 (CSA, 2014) and an environmental monitoring survey conducted in 2023 (CSA, 2023a). These source documents have been cited extensively in the current assessment. Additional site-specific assessments (e.g., Tamar Noise and Light Study [CSA, 2023b]; Tamar Environmental Impact Assessment Update for the Tamar Third Gathering Line [TTGL] Project [MVI, 2022]) and regionally relevant data sources are also referenced, as appropriate.

The current EIA for Tamar-12 has been prepared for the Ministry of Energy (MoE) and the Ministry of Environmental Protection (MoEP) in accordance with the “Guidelines for Preparing the Environmental Impact Assessment in the Israeli Exclusive Economic Zone (EEZ) – Tamar-12 Project” issued 09 January 2025 (MoE, 2025).

Key Findings of the 2016 EIA:

- CML (formerly NEML) planned to conduct well drilling and completion activities for gas production.
- The development plan for the Tamar Field included the drilling and completion of up to 14 wells.
- Eight initial development drill sites were selected and evaluated in detail in the 2016 EIA.
- The 2016 EIA was intended to encompass all future drilling and completion activities in the field.
- The 2016 EIA comprised six chapters:
  - **Chapter 1:** Described the baseline environment, including site-specific data from the background monitoring survey.
  - **Chapter 2:** Provided reasoning for the location of the proposed plan and possible alternatives. Alternatives included well locations, technologies, and infrastructure for future production.
  - **Chapter 3:** Described the Tamar-12 Project, including the drilling and completion and subsea infrastructure installation program (schedule, drilling unit, installation vessel, support vessels, drilling mud program), underwater noise hazards, light pollution, air quality, hazardous materials, discharges, wastes and decommissioning/abandonment plans.
  - **Chapter 4:** Evaluated potential impacts on the environment from routines activities and accidental events.
  - **Chapter 5:** Presented the guidelines for preservation and prevention of harm to the environment, including management and mitigation strategies.
  - **Chapter 6:** List of EIA Addendum preparers and their respective qualifications.
  - **Chapter 7:** Literature and supporting information.

This Tamar Field Development – Environmental Impact Assessment Addendum evaluates the environmental impacts of CML's proposed expansion drilling and completion activities, and installation of new subsea infrastructure which will connect the new Tamar-12 well to existing Tamar Field infrastructure.

ES-3 IMPACT ASSESSMENT APPROACH

The impact assessment includes both routine activities and accidental events. The following definitions are used:

- **Aspect** – an element of an organization's activities, products, or services that can interact with the environment (International Organization for Standardization, 2004; ISO 14001);
- **Resource –** a component of the natural or human environment that could be affected by any aspect of an organization's activities; and
- **Impact –** any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's environmental aspects (International Organization for Standardization, 2004).

The following aspects and resources were included in the analysis:

Aspects:

- Seafloor disturbance;
- Drilling discharges;
- Routine discharges;
- Air emissions;
- Safety and protection zones;
- Noise hazards;
- Light disturbances;
- Waste and marine debris;
- Support vessel traffic;
- Helicopter traffic;
- Accidental fuel release; and
- Accidental condensate loss (loss of well containment).

Resources:

- Geological, Seismic, and Sedimentological Characteristics
  - Bathymetry and Seafloor Morphology
  - Shallow Stratigraphy
  - Seismicity
  - Sediment Grain Size
  - Geologic Setting
- Geohazards
- Hydrodynamic Regime (Physical Oceanography)
  - Waves
  - Extreme Storms
  - Currents
  - Winds
- Nature and Ecology
  - Benthic Communities
  - Marine Mammals, Sea Turtles, Birds, and Fishes
  - Coastal Habitats and Infrastructure
  - Fishing Areas and Landings
- Seawater and Sediment Quality
  - Water Quality
  - Sediment Quality
- Culture and Heritage Sites
  - Meteorology and Air Quality
  - Existing Meteorological Conditions
  - Air Quality
- Noise
- Marine Transportation System and Infrastructure

The first step in the impact analysis was a screening assessment to identify the resources potentially affected by each aspect. A total of 14 individual resources were identified which may be affected by the Tamar-12 Project:

- Air Quality;
- Water Quality;
- Sediment Quality;
- Benthic Communities;
- Marine Mammals;
- Sea Turtles;
- Seabirds and Migratory Birds;
- Fish and Fishery Resources (including Plankton);
- Fishing and Marine Aquaculture;
- Culture and Heritage Sites;
- Marine Transportation and Infrastructure;
- Coastal Habitats and Infrastructure;
- Nature Reserves/Protected Areas; and
- Acoustic Environment.

The next step was to analyze each potential impact by describing and quantifying each impact to the extent practicable. This step included an assessment of the “consequence” (severity) and likelihood of each impact.

Finally, the overall environmental risk posed by each impact was assessed using a risk matrix that combines aspect likelihood and impact consequence. The likelihood of each aspect (taking into account all of the identified management and mitigation measures) was given a score between 1 and 5 based on the definitions in the matrix. The consequence of each potential environmental impact was also rated on a scale of 1 to 5. Each cell in the matrix (i.e., each intersection of likelihood and consequence) was calculated as the product of likelihood and consequence. These risk values were grouped into three risk categories: Low, Moderate, and High.

ES-4 IMPACT DETERMINATIONS – DRILLING, COMPLETION AND SUBSEA INFRASTRUCTURE INSTALLATION AND OPERATION

ES-4.1 Routine Activities

Impacts from routine activities are summarized in **Table ES-1**, summarizing potential impacts to marine resources resulting from proposed expansion drilling and completion activities at a single drill site, Tamar-12, and installation and pre-commissioning of new subsea infrastructure, along with required support vessel and helicopter operations. Impacts from most aspects on most resources were classified to have a Low residual risk. Only impacts from drilling discharges may potentially pose a Moderate residual risk in the vicinity of the drill site, specifically to water quality, fish, sediment quality, and benthic communities.

Table ES-1. Summary of potential impacts, mitigation measures, likelihood, consequence, and residual risk from routine activities associated with the Tamar-12 Project.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Artificial lighting on drillship, installation vessel, and support vessels	Sea turtles	Possible attraction of hatchlings resulting in exposure to discharges and predation	To the extent practicable without compromising safety or work performance, lighting in open deck areas will be shielded (i.e., oriented downward) to minimize excess light emissions into the environment.	3	1	3 Low
	Seabirds and migratory birds	Possible attraction and/or disorientation including circling behavior and collisions with drillship structure	Same as above	3	1	3 Low
	Fishes (pelagic)	Attraction to lights resulting in exposure to discharges and noise	Same as above	3	1	3 Low
Noise from drillship, installation vessel, support vessels, and helicopters	Marine mammals	Behavioral responses such as avoidance; potential for auditory masking	None	3	1	3 Low
	Sea turtles	Behavioral responses such as avoidance; potential for auditory masking	None	3	1	3 Low
	Fishes	Behavioral responses such as avoidance; potential for auditory masking	None	3	1	3 Low
Seafloor disturbance	Sediment quality	Physical disruption and suspension of sediments	None	3	1	3 Low
	Benthic communities	Localized burial and crushing of individual organisms; areal extent within 75 m or less of the drill site from water-based muds (WBM) and cuttings deposition and from seafloor infrastructure installation	None	3	1	3 Low
	Water quality	Mobilization of local sediments, potential mobilization of sediment-bound contaminants, deposition of muds and cuttings	None	3	1	3 Low

Table ES-1. (Continued).

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Drilling discharges	Water quality; fishes	Turbidity within a few tens of meters to a few kilometers from discharge location (i.e., at the wellbore) Limited displacement of benthic/demersal fishes around the wellbore from turbidity and WBM and cuttings deposition	• Selection of low-toxicity, mineral oil-based mud (MOBM) • No discharge of MOBM or MOBM-wetted cuttings • Preferably, all additives to the WBM/Brine will be PLONOR or Gold-rated according to OSPAR guidelines; barite will have a low metals concentration and will comply with the Discharge to Sea Permit thresholds for mercury and cadmium; WBM and brine will be tested in accordance with Discharge to Sea Permit requirements • WBM will be sampled and tested for toxicity per the requirements of the Discharge to Sea Permit • Surface waters in the vicinity of the drillship shall be visually monitored for oil sheen on a daily basis	5	1	5 Mod
	Sediment quality	Deposition of WBM and cuttings particles on the seafloor, causing changes in grain size and mineralogy	No discharge of MOBM or MOBM-wetted cuttings	4	2	8 Mod
	Benthic communities	Localized burial and smothering of benthic organisms; burial impacts are most likely within 75 m of the drill site; anoxia and other benthic impacts may occur due to changes in sediment grain size	Background monitoring survey conducted to verify there are no deepwater corals or other hard bottom communities present	4	2	8 Mod

Table ES-1. (Continued).

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Drillship, installation vessel, support vessel routine discharges (sanitary and grey water, food waste, cooling water, desalination brine, deck drainage)	Water quality; fishes and plankton; marine mammals; sea turtles	Localized, transient impacts on water quality within a few meters to a few hundred meters of the drillship, installation vessel, or other vessels Limited, localized impacts to plankton and fishes encountering the discharge plume; avoidance expected by marine mammals and sea turtles	• Sanitary waste will pass through an IMO-approved sewage treatment plant prior to discharge • Food waste will be macerated to pass through a 25 mm mesh in accordance with MARPOL Annex V requirements, commingled with the grey water and discharged overboard more than 12 nmi from shore • Drainage from hazardous areas will be collected and sent to shore for proper disposal • Bilge water and deck drainage from machinery areas will pass through an oil-water separator prior to discharge (in accordance with MARPOL Annex I requirements) or be retained on board to be disposed of onshore	3	1	3 Low
Pre-commissioning fluid discharges (including monoethylene glycol and dye)	Water quality; fishes; marine mammals; sea turtles; benthic communities	Localized, transient impacts on water quality; limited potential for exposure for demersal/benthic fishes and benthic communities; no potential for exposure for marine mammals and sea turtles	Preferably, all pre-commissioning and preservation fluids will be PLONOR or Gold-rated under the Offshore Chemical Notification Scheme	4	1	4 Mod
Other discharges (ballast water)	Fishes; benthic communities	Potential introduction of AIS in ballast water	All operating project vessels will provide the following documentation for AIS clearance to minimize the risk of introducing AIS: Declaration letter with working areas in the past 5 years, Ballast Water Management Plan and international Ballast Water Management Certificate, International Anti-fouling System certificate and haul cleaning reports	3	1	3 Low

Table ES-1. (Continued).

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Support vessel traffic	Marine mammals; sea turtles	Short-term behavioral disturbance; potential for a vessel to strike a marine mammal or sea turtle	Voluntary use of trained vessel crew or observers to monitor for the presence of marine mammals or sea turtles during vessel transit	3	1	3 Low
Helicopter traffic	Marine mammals; sea turtles; seabirds and migratory birds	Short-term behavioral disturbance of marine mammals, sea turtles, or birds; potential for a helicopter to strike a bird	Maintain recommended minimum altitudes when flying over sensitive coastal habitats such as parks and preserves	3	1	3 Low
Marine debris	Water quality; sediment quality; benthic communities	Potential accumulation of metal debris on the seafloor, with growth of fouling biota	• Drillship and vessel operator's Garbage Management Plan and the additional requirements set by CML will minimize the potential for accidental loss of items overboard • Post-drilling ROV survey to ensure the seafloor is clear of equipment and debris	2-3	1	2-3 Low
	Marine mammals; sea turtles; seabirds and migratory birds; fishes	Potential entanglement, ingestion; leaching of residual chemicals due to accidental loss of debris	Drillship and vessel operator's Garbage Management Plan and the additional requirements set by CML will minimize the potential for accidental loss of items overboard	2-3	1	2-3 Low
Seafloor disturbance	Culture and heritage sites	Possible physical damage to wreck sites	305-m avoidance zone for potential wreck sites and 31-m avoidance zone for other sonar contacts	2	2	4 Low
Drilling discharges	Culture and heritage sites	Possible burial or contamination of wreck sites	305-m avoidance zone for potential wreck sites and 31-m avoidance zone for other sonar contacts	2	2	4 Low
Air emissions (drillship)	Air quality	Localized, transient elevations in air pollutant concentrations near drillship; greenhouse gas emissions	• Routine maintenance and inspection of engines and generators • Compliance with MARPOL Annex VI regulations including the use of low sulfur fuel and meeting the NOx emission limits under Regulation 13 of Annex VI	3	1	3 Low

Table ES-1. (Continued).

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Air emissions (installation vessel, support vessels and helicopters)	Air quality	Localized, transient elevations in air pollutant concentrations along installation and transportation routes; greenhouse gas emissions	• Routine maintenance and inspection of engines and generators • Compliance with MARPOL Annex VI regulations including the use of low sulfur fuel and meeting the NOx emission limits under Regulation 13 of Annex VI	3	1	3 Low
Physical presence and exclusion zone (drilling and completion)	Fishing activities	Exclusion of fishing vessels from 500-m buffer zone around drillship	• Provide Notice to Mariners in advance of proposed activities	1	1	1 Low
Physical presence and exclusion zone (subsea installation)	Fishing activities	Exclusion of fishing vessels from 500-m buffer zone around installation vessel	• Provide Notice to Mariners in advance of proposed activities	1	1	1 Low
Support vessel traffic	Fishing activities	Potential interactions with fishing vessels or gear during routine vessel traffic between shore base (Haifa) and the project area	• Provide Notice to Mariners in advance of proposed activities	3	1	3 Low
Safety and protection zones	Marine transportation system and infrastructure	Exclusion of vessels from 500-m buffer zone around drillship and installation vessel	• Provide Notice to Mariners in advance of proposed activities • Use standard navigation markings	2	1	2 Low
Support vessel traffic	Marine transportation system and infrastructure	Project vessel movement and interaction with other marine traffic, including port traffic	• Provide Notice to Mariners in advance of proposed activities	2	1	2 Low

ES-4.2 Accidents

Two accidental spill scenarios were evaluated in the CSA (2016) document and remain relevant for the Tamar-12 Project: a fuel release and a condensate release from a well loss of containment event. The diesel fuel release scenario assumed an instantaneous release of 16,500 bbl from the drillship. The condensate release scenario assumed a well loss of containment resulting in the release of of oil with API 35, continuing for a period of 30 days.

Within these two different accidents, four time periods representative of various climatic conditions were used in the model:

- Scenario 1 – 9 December 2010 to 8 January 2011, a period that included an extreme winter storm;
- Scenario 2 – 26 January to 25 February 2008, typical winter conditions;
- Scenario 3 – 17 July to 16 August 2008, typical summer conditions with persistent northwesterly winds and swell; and
- Scenario 4 – 25 September to 25 October 2007, autumn conditions typical of the transition seasons and including at least one episode of strong easterly to northeasterly wind.

The models predict that diesel fuel would evaporate rapidly, with approximately 45% of the spill evaporating in the first 36 to 46 hours in each of the assessed scenarios. At the end of 30 days, all four scenarios show 45.6% evaporation, from 0% to approximately 39.1% oil remaining on the sea surface, and between ~3% and 15% dispersed. A release of 16,500 bbl of diesel fuel is predicted to reach the shoreline after 12 days under Scenario 4, after 11 days under Scenario 3, after 6 days under Scenario 3, or essentially not at all under Scenario 1; modeling results indicate that oil deposited on the coast will range from 0.014% to 50.9%, with the length of coastline affected ranging from 2.9 to 234 km, primarily affecting the coastlines of Lebanon and Israel.

The condensate release scenario assumed a well loss of containment of condensate (API gravity of 35), resulting in the release rate of continuing for a period of 30 days. The model predicts that nearly approximately 43% of the spill would evaporate between 36 and 54 hours following initiation of the spill. At the end of 30 days, all four condensate spill scenarios show 45.4% evaporation, with 24.9% to 43.3% oil remaining on the sea surface, and approximately 9% to >12% dispersed in the water column. A spill is predicted to reach the shoreline after 25 days under Scenario 1, after 6 days under Scenario 2, after 11 days under Scenario 3, or after 14 days under Scenario 4. The percentage of the spill deposited on the coastline ranges from <0.1% (Scenario 1) to 18.6% (Scenario 2). Simulation results indicate the coastlines affected include the southwestern coast of Cyprus and a small portion of northern Israel under Scenario 1, Israel and southern Lebanon under Scenario 2, Lebanon under Scenario 3, and northern Israel and Lebanon under Scenario 4. The locations and magnitude of shoreline deposition are highly seasonally dependent. Total length of affected shoreline was 16.5, 223, 95, and 133 km for Scenarios 1, 2, 3, and 4, respectively. Impact hotspots included Paphos, Cyprus (up to 86 bbl km^{-1}) under Scenario 1; Zichron Yaakov (up to 500 bbl km^{-1}) under Scenario 2; a 20 km stretch of coastline south of Jieh (between 500 and 1,000 bbl km^{-1}) under Scenario 3; and Haifa Bay, the northern coast of Israel, and a 15 to 20 km section of the Lebanese coast south of Jieh (~100 bbl km^{-1}, with localized hot spots of up to 195 bbl km^{-1}) under Scenario 4.

ES-5 DECOMMISSIONING

At the end of the production life of the Tamar-12 well (or possibly at the end of life for all Tamar Field wells), CML will initiate decommissioning of wells and subsea infrastructure. Prior to decommissioning, in accordance with the MoE guidelines. CML will conduct an environmental impact assessment and will obtain approval from appropriate Ministry authorities. Sources of potential impact resulting from future decommissioning are similar to those identified for drilling and subsea infrastructure emplacement, including vessel or infrastructure discharges, physical presence, exclusion zones, vessel movement, air emissions, vessel sound emissions, light emissions, solid waste, helicopter traffic/sound emissions, and seafloor disturbance. These sources of impact potentially affect a suite of environmental resources, including physical/chemical, biological, and environmental/social attributes. Decommissioning operations are expected to be temporary and short term in nature, producing limited, localized impacts. The decommissioning assessment, to be conducted prior to decommissioning, will fully outline decommissioning options and expected impacts from each.

Table of Contents

Page

Executive Summary **ES-1**
List of Tables ..... **vii**
List of Figures ..... **x**
List of Acronyms and Abbreviations ..... **xiii**
1 Description of the Existing Conditions in the Offshore Environment to which the Application Refers **1-1**

1.1 General 1-1
1.1.1 Resources Expected to be Affected 1-1
1.1.2 Project Description and Project Area (General) 1-1
1.1.3 Existing Offshore Environment at the Development and Production Site 1-3
1.1.4 Existing Onshore and Offshore Environment of the Potential Impact Area 1-4
1.1.5 Environmental Monitoring Plan Updates for the Tamar Field 1-5
1.1.6 Bathymetric Maps, Sediment Pollutants, and Sonar Targets Suspected of Being Sensitive Habitat 1-5
1.1.7 Other Marine Uses of the Project Area 1-11

1.2 Application Boundaries and Range of Impact 1-11
1.2.1 Detailed Application Zone 1-11
1.2.2 Range of Impact 1-11

1.3 Maps and Orthophotos 1-12
1.3.1 Location of Production Well 1-12
1.3.2 Distances from Wellsite to Selected Onshore Areas 1-14
1.3.3 General Bathymetric Map 1-14
1.3.4 Regional Bathymetric Maps 1-16
1.3.5 Marine Aquaculture Activity 1-17
1.3.6 Habitat and Sedimentological Map 1-17
1.3.7 Other Marine Uses Map 1-18

1.4 Geological, Seismic, and Sedimentological Aspects 1-20
1.4.1 General Geographic Location of Production Well 1-20
1.4.2 General Geological/Geomorphological/Bathymetric Map 1-21
1.4.3 Regional Geological/Geomorphological/Bathymetric Maps 1-26
1.4.4 Dispersion Area of Drilling Muds and Cuttings 1-26
1.4.5 Bedrock Infrastructure 1-26
1.4.6 Active Geological Faults 1-29

1.5 Hydrodynamics Regime 1-31
1.5.1 Waves 1-31
1.5.2 Statistical Distribution of Wave Properties 1-31
1.5.3 Extreme Storms 1-31
1.5.4 Wave Regime 1-31
1.5.5 Winds 1-32
1.5.6 Currents 1-32

1.6 Nature and Ecology 1-33
1.6.1 Pelagic and Benthic Habitats 1-33
1.6.2 Coastal Biota and Natural Values 1-39
1.6.3 Marine Mammals, Sea Turtles, Birds, and Fishes 1-39
1.6.4 Nature Reserves and Sensitive Habitats 1-45

Table of Contents
(Continued)

Page

1.6.5 Natural Values and Ecology Details 1-47
1.6.6 Fishing Areas 1-49

1.7 Seawater and Sediment Quality 1-49

1.7.1 Seawater Quality 1-49
1.7.2 Total Suspended Solids 1-50
1.7.3 Chlorophyll 1-51
1.7.4 Water Chemical Properties 1-52
1.7.5 Sediment Chemical Properties 1-54
1.7.6 Hard Substrate and Fauna Chemical Properties 1-61

1.8 Culture and Heritage Sites 1-61
1.9 Meteorology and Air Quality 1-61

1.9.1 Existing Meteorological Conditions 1-61
1.9.2 Special Meteorological Conditions 1-61
1.9.3 Air Quality 1-62

1.10 Noise 1-62
1.11 Infrastructure and Marine Transportation System 1-63

2 Location and Technological Alternatives and the Justifications for the Selected Alternative 2-1

2.1 General 2-1
2.2 Location Alternatives 2-1

2.2.1 Well Location Alternatives 2-1
2.2.2 Subsea Infrastructure Location Alternatives 2-2
2.2.3 Completion Philosophy and Details of Well Planning 2-2
2.2.4 Well Clearance and Environmental Sensitivity 2-3

2.3 Technological Alternatives 2-4

2.3.1 Drilling Vessel, Blowout Preventer, Drilling Muds/Fluids 2-5

2.4 Layout Alternatives 2-9

2.4.1 Infrastructure Components 2-9
2.4.2 Umbilical Installation Methodology 2-9

2.5 Summary 2-9

3 Describing the Operations Resulting from Implementing the Application 3-1

3.1 Description of the Application 3-1

3.1.1 General 3-1
3.1.2 Description of the Drilling Process 3-4
3.1.3 Hydrocarbon Blowout Preventers 3-8
3.1.4 Testing the Drilling String 3-15
3.1.5 Subsea Field Development 3-15
3.1.6 Production Tests 3-16

3.2 Noise Pollution 3-16

3.2.1 Mechanical Equipment and Noise Levels 3-16

Table of Contents
(Continued)

Page

3.3 Light Pollution 3-17
3.3.1 Drilling Rig and Installation Vessel 3-17
3.3.2 Support Vessels 3-17
3.4 Air Quality 3-18
3.4.1 Sources of Air Pollution 3-18
3.4.2 Monitoring, Detection, and Control Measures 3-18
3.4.3 Air Pollutant Emission Estimates 3-18
3.4.4 Failures 3-20
3.4.5 Emergency Shutdowns 3-20
3.5 Hazardous Materials 3-20
3.6 Sources of Discharges to the Sea 3-20
3.6.1 Discharge Sources – General 3-20
3.6.2 Drill Cuttings 3-26
3.6.3 Drilling Mud and Cement Surplus 3-27
3.6.4 Information About the Quality of Discharges to the Sea 3-32
3.7 Waste 3-32
3.8 Decommissioning/Abandoning Wells and Infrastructure 3-33
3.8.1 Abandonment Chronology 3-34
3.8.2 Decommissioning Process 3-34
3.8.3 Bathymetry Post-Abandonment 3-34
3.8.4 Chemicals 3-34
3.8.5 Pre-and Post-Abandonment Schematics 3-35
3.8.6 Principles of Decommissioning Plan 3-35

4 Evaluating the Expected Environmental Impact of Implementing the Application, and the Means of Prevention or Mitigation 4-1

4.1 Estimating Potential Impacts on the Marine Environment 4-4
4.1.1 Drilling Platform Maximum Range of Impact 4-4
4.1.2 Muds and Cuttings Degree of Impact 4-4
4.1.3 Muds and Cuttings Disposal Alternatives 4-4
4.1.4 Muds and Cuttings Mitigation Measures 4-4
4.1.5 Muds and Cuttings Maximum Impact Range 4-4
4.1.6 Muds and Cuttings Dispersion Modeling 4-5
4.1.7 Impact Estimate of Subsea Production System 4-5
4.2 Production Tests 4-6
4.2.1 Precautionary Measures 4-6
4.2.2 Drilling Fluids Maximum Impact Range 4-6
4.3 Environmental Impact of an Oil Pollution Incident at Sea in an Extreme-Case Scenario 4-6
4.3.1 Changes in Current Fields and Movement of the Oil Slick 4-7
4.3.2 Current Regime 4-7
4.3.3 Oil Spill Modeling – Worst-Case Scenario 4-7
4.3.4 Oil Spill Modeling – Four Common Sea States 4-8
4.3.5 Total Oil Quantity During a 30-day Uncontrolled Discharge 4-8

Table of Contents
(Continued)

Page

4.3.6 Oil Spill Dispersion 4-12
4.3.7 Oil Spill Dispersion Model Information 4-16

4.4 Light Disturbances 4-20
4.4.1 Potential Impacts 4-20
4.4.2 Mitigation Measures 4-22
4.4.3 Impact Significance 4-22

4.5 Noise 4-23
4.5.1 Impact of Noise on Animals 4-24
4.5.2 Impact Significance 4-29
4.5.3 Noise Levels in Sensitive Habitats 4-29
4.5.4 Noise Assessment Instructions 4-32

4.6 Natural Values and Ecology 4-32
4.6.1 Impact on Habitats 4-32
4.6.2 Description of Rehabilitation 4-49

4.7 Culture and Heritage Sites 4-49
4.7.1 Impacts of Seafloor Disturbance 4-49
4.7.2 Impacts of Drilling Discharges 4-50
4.7.3 Impacts of Accidental Spills 4-50
4.7.4 Mitigation Measures 4-50
4.7.5 Impact Significance 4-51

4.8 Air Quality 4-51
4.8.1 Project Emissions 4-51
4.8.2 Mitigation Measures 4-53
4.8.3 Emissions from Expected Malfunctions 4-54
4.8.4 Air Pollutant Emissions 4-55

4.9 Waste 4-55
4.10 Hazardous Materials 4-56
4.10.1 Measures for Mitigating Risk 4-56
4.10.2 Measures in Case of Hazardous Material Discovery 4-56
4.10.3 Emergency Procedures 4-57

4.11 Earthquake Preparedness 4-57
4.11.1 Responding to Early Earthquake and Tsunami Warnings 4-57
4.11.2 Means to Prevent Damage 4-57
4.11.3 Emergency Procedures for Earthquake Incidents 4-58

4.12 Fishing and Marine Aquaculture 4-58
4.12.1 Impacts on Fishing Activity 4-58

4.13 Safety and Protection 4-61
4.13.1 Exclusion Zone 4-61
4.13.2 Impacts of Project-Specific Vessel Traffic 4-62

4.14 Monitoring and Control Program 4-62
4.14.1 Monitoring and Control Measures 4-63
4.14.2 Technique for Obtaining Representative Samples 4-64

Table of Contents
(Continued)

Page

4.14.3 Calibration and Maintenance Activities....4-65
4.14.4 Environmental Baseline Report....4-68

4.15 Decommissioning Operations....4-68

4.15.1 Discharges....4-68
4.15.2 Seafloor Disturbance....4-68
4.15.3 Waste Management....4-69

5 Proposal for Application Provisions....5-1

5.1 Proposals for Determining the Application's Provisions....5-1

5.1.1 Chevron Mediterranean Ltd. Environmental Health & Safety Management....5-1
5.1.2 Environmental Policy....5-2
5.1.3 Summary of Potential Impacts and Mitigation Measures....5-2

5.2 Provisions for Addressing Operations....5-8
5.3 Other Provisions....5-9

5.3.1 Drilling Execution Stages, Installation of Infrastructure, and Production Testing....5-9
5.3.2 Treating Hazardous Materials....5-10
5.3.3 Mitigating Harm to Soil, Seawater, and Shores....5-11
5.3.4 Protecting Flora and Fauna....5-12
5.3.5 Collecting Data....5-12
5.3.6 Actions if Data Indicate Potential Environmental Harm....5-13
5.3.7 Establishing Various Monitoring Systems....5-13
5.3.8 Measures Preventing/Mitigating Light Pollution....5-13
5.3.9 Measures Mitigating Air Pollutant Emissions....5-14
5.3.10 Measures Preventing or Reducing Noise....5-14
5.3.11 Measures for Mud and Cuttings Disposal....5-14
5.3.12 Measures for Treating Discharges....5-15
5.3.13 Methods of Waste Treatment and Removal....5-16
5.3.14 Establishing Safety and Protection Zones....5-16
5.3.15 Preparing Emergency Procedures....5-16
5.3.16 Operations to be Performed at Well Decommissioning....5-17
5.3.17 Reporting....5-18
5.3.18 Changes to the Development Plan....5-18

6 List of Preparers and Qualifications....6-1
7 Literature Cited....7-1

Table of Contents
(Continued)

Page

Appendices

Appendix A: Application Zone Maps, 1:5,000 scale A-1
Appendix B: Listing of Side-scan Sonar Contacts, Tamar-12 Drill Site and Umbilical Route B-1
Appendix C: Mud System C-1
Appendix D: Specifications of Representative Project Vessels and Aircraft D-1
Appendix E: Safety Data Sheets E-1
Appendix F: Ecological Information for Drilling, Completion, and Pre-Commissioning Discharges F-1
Appendix G: Drilling Effluent Testing Results G-1
Appendix H: Guidelines for Preparing the Environmental Impact Assessment in the Israeli Exclusive Economic Zone (EEZ) – Tamar-12 Project H-1
Appendix I: Modeling of Drilling Mud and Cuttings Discharges I-1
Appendix J: Worst-Case Discharge Scenario J-1
Appendix K: Tamar Field 2023 Monitoring Survey Report K-1
Appendix L: Israeli Antiquity Authority Approval Letter L-1
Appendix M: List of Preparers and Qualifications M-1

List of Tables

		Page
ES-1	Summary of potential impacts, mitigation measures, likelihood, consequence, and residual risk from routine activities associated with the Tamar-12 Project	ES-4
1-1	Resident, visiting and vagrant marine mammal species potentially occurring in the application zone based on Kerem et al. (2012), ACCOBAMS (2012), Notarbartolo di Sciara and Birkun (2010) and IUCN (2023)	1-40
1-2	Updated listing of sea turtle species potentially occurring in the Application Area (From: IUCN, 2025)	1-42
1-3	Updated listing of seabird species occurring in Israeli waters (Adapted from: BirdLife International, 2025)	1-43
1-4	Updated shorebird species occurring in Israel that are on the Annex II list (From: IUCN, 2025)	1-45
1-5	Infaunal density and relative abundance (proportion in %) of the five most abundant uniquely identified taxa in the composite infauna sample collected during the 2023 Tamar Field Environmental Monitoring Survey and in the individual infauna samples collected during the 2014 Tamar Field Environmental Baseline Survey	1-48
1-6	Diversity metrics of the infaunal community of the composite infauna sample from the 2023 Tamar Field Environmental Monitoring Survey and of the individual infauna samples from the 2014 Tamar Field Environmental Baseline Survey	1-48
1-7	Station concentrations of total suspended solids (TSS) in seawater samples collected throughout the water column in the Tamar Field during the February 2014 Tamar Background Monitoring Survey (From: CSA, 2014)	1-50
1-8	Concentrations of total suspended solids in seawater samples collected during the 2023 Tamar Field Environmental Monitoring Survey (EMS)	1-51
1-9	Concentrations of total organic carbon, total phosphorus, total nitrogen, nitrate, nitrite, and ammonium in seawater samples collected during the 2023 Tamar Field Environmental Monitoring Survey (EMS)	1-53
2-1	Summary of alternatives for well and subsea infrastructure location, drillship, drilling technologies, drilling program, muds and cuttings treatment, blowout preventer selection, and infrastructure components, installation, and pre-commissioning for the Tamar-12 Project	2-10
3-1	Approximate durations of drilling for Tamar-12 sections (intervals)	3-14
3-2	Estimated per-well cement products consumed and remaining in the well for Tamar-12 drilling	3-14
3-3	Estimated air pollutant emissions from drilling, completion, subsea infrastructure installation, and all support vessels, Tamar-12 well	3-19
3-4	Estimated pollutant emissions from helicopters during drilling and completion and subsea infrastructure installation operations (Sikorsky S-76C++) based on emissions calculations by the Swiss Federal Office of Civil Aviation (From: Rindlisbacher and Chabbey, 2015)	3-19

List of Tables (Continued)

Table		Page
3-5	Summary of estimated discharge frequencies, average daily rate, and total quantity for drilling and completion and subsea infrastructure installation operations, Tamar-12 (drilling and completion drillship and installation vessel only)	3-23
3-6	Types of routine discharges from a representative drillship (exclusive of drilling muds, cuttings, and cement) during Tamar-12 Project drilling and completion activities	3-24
3-7	Estimated routine discharges from the drillship during Tamar-12 drilling and completion activities, exclusive of drilling muds, cuttings, and cement	3-24
3-8	Estimated volumes (m^3) of chemicals[1] to be discharged during infrastructure pre-commissioning activities	3-25
3-9	Estimated volumes (m^3) of black water and grey water to be discharged during the Tamar-12 Project	3-25
3-10	Estimated cuttings discharges for the Tamar-12 well	3-26
3-11	Proposed drilling program for the Tamar-12 well	3-28
3-12	Estimated water-based mud (WBM) and seawater total material consumed (and discharged) during drilling of the Tamar-12 well	3-28
3-13	Estimated cement products consumed, remaining in the well, and discharged for the Tamar-12 well	3-29
3-14	Estimated total material consumed (and discharged) during Tamar-12 well completion	3-30
4-1	Impact matrix showing potential interactions between aspects and resources	4-2
4-2	Risk assessment matrix for impact analysis	4-3
4-3	Estimated seafloor footprint of proposed infrastructure for the Tamar-12 Project	4-5
4-4	Trajectory and weathering model results at the end of 30 days for a condensate spill from Tamar SW-1 under four environmental scenarios (From: CSA, 2016)	4-9
4-5	Summary of spill-related impacts resulting from a condensate release and diesel fuel spill, offshore Israel (From: CSA, 2016)	4-13
4-6	Summary of potential impacts from light hazards	4-22
4-7	Criteria for permanent threshold shift (PTS) and temporary threshold shift (TTS) onset for cetaceans in response to non-impulse sounds (From: National Marine Fisheries Service, 2024)	4-25
4-8	Sound sources associated with the Tamar-12 Project and calculated distances to the current U.S. National Marine Fisheries Service criterion for behavioral response to non-impulsive, continuous sources	4-26
4-9	Acoustic criteria for non-impulsive sources for sea turtles (From: Finneran et al., 2017)	4-27

List of Tables
(Continued)

Table		Page
4-10	Relative risk of auditory impacts on fishes exposed to shipping noise and other continuous sound sources (From: Popper et al., 2014)	4-28
4-11	Summary of potential impacts from underwater noise	4-29
4-12	Calculations of received sound levels at the seafloor from drilling-related noise	4-31
4-13	Calculated accumulated sound levels at the seafloor from drilling operations	4-32
4-14	Summary of potential impacts from seafloor disturbance	4-34
4-15	Areal extent of seafloor deposition of drilling discharges for two seasonal scenarios at a representative drill site	4-36
4-16	Maximum extent of thickness contours resulting from drilling discharges for two seasonal scenarios at a representative drill site	4-36
4-17	Summary of potential impacts of drilling discharges on nature and ecology	4-40
4-18	Summary of potential impacts of other discharges on nature and ecology	4-43
4-19	Summary of potential impacts of support vessel traffic	4-46
4-20	Summary of potential impacts of helicopter traffic	4-47
4-21	Summary of potential impacts of marine debris	4-48
4-22	Summary of potential impacts on culture and heritage sites	4-51
4-23	Total estimated air pollutant emissions from one drillship and three support vessels during drilling and completion of the Tamar-12 well	4-52
4-24	Total estimated air pollutant emissions from project vessels during subsea infrastructure installation activities during the Tamar-12 Project	4-52
4-25	Summary of potential impacts on air quality	4-54
4-26	Summary of daily emission rates, in kilograms, for project vessels proposed for the Tamar-12 Project	4-55
4-27	Estimated installation vessel days and support vessel trips to and from Cyprus for the subsea installation phase of the Tamar-12 Project	4-59
4-28	Summary of potential impacts on fishing and marine aquaculture	4-60
4-29	Summary of potential impacts of safety and protection zones	4-61
4-30	Summary of potential impacts of support vessel traffic on marine transportation systems and infrastructure	4-62
5-1	Summary of potential impacts, mitigation measures, likelihood, consequence, and residual risk from routine activities associated with the Tamar-12 Project	5-3

List of Figures

		Page
1-1	Tamar Block and Field, displaying the proposed Tamar-12 drill site location and associated subsea infrastructure	1-2
1-2	Map displaying the bathymetric data in the Tamar-12 Project Area, along with identified sonar contacts	1-6
1-3	Seabed morphology in the Tamar-12 Project Area from side-scan sonar data provided by Chevron Mediterranean Limited	1-7
1-4	Grain size distribution according to classifications by Shepard (1954) for sediment samples collected within the Tamar Field during the 2023 Tamar Field Environmental Monitoring Survey	1-8
1-5	Total petroleum hydrocarbon (TPH) concentrations within the Tamar Field sediments in 2014 (left) and 2023 (right), presented in ppm (µg g^{-1})	1-9
1-6	Sediment barium (Ba) concentrations within the Tamar Field in 2014 (left) and 2023 (right), presented in ppm (µg g^{-1})	1-10
1-7	Overview of the proposed Tamar-12 drill site location within the Tamar Field, offshore Israel	1-13
1-8	Bathymetry of the Tamar Field and Tamar-12 Project Area relative to regional maritime boundaries, submarine cables, mariculture sites, shipping fairways, and marine protected areas off the Israeli coastline at a scale of 1:1,250,000 (left), and 1:250,000 (right)	1-15
1-9	Sonar contacts identified in the Tamar-12 Project Area, displayed with interpretation of seabed morphology and identified geohazards	1-16
1-10	Geohazards identified with 500 m of the proposed Tamar-12 drill site location	1-17
1-11	Existing and planned infrastructure within a 2-km radius around the east side (left), and west side (right) of the application zone (1:20,000 scale)	1-19
1-12	Project Area and the Israeli Exclusive Economic Zone (EEZ) displaying all regional earthquakes magnitude 2.5 or above for the period 1975-2025, at a scale of 1:1,200,000 (left), and 1:200,000 (right)	1-23
1-13	Geological folds and faults in the Eastern Mediterranean Sea and the Israeli exclusive economic zone (From: Geological Survey of Israel, 2023)	1-24
1-14	Relative hazard of landslides along the Israeli coast and offshore waters (From: Geological Survey of Israel, 2023)	1-25
1-15	3D seismic data profile (southwest to northeast) illustrating the stratigraphy around the proposed Tamar-12 drill site location	1-27
1-16	3D seismic data profile (northwest to southeast) illustrating the stratigraphy around the proposed Tamar-12 drill site location	1-28
1-17	Top hole prognosis, illustrating the stratigraphy around the proposed Tamar-12 drill site location	1-30
1-18	Benthic habitat types within the Tamar Field, Tamar-12 Project Area, and the Israeli exclusive economic zone (EEZ) as identified by the Strategic Environmental Assessment (Adapted from: State of Israel, 2021)	1-36

List of Figures
(Continued)

Figure		Page
1-19	Benthic habitats of the Tamar Field, Tamar-12 Project Area, and the Israeli exclusive economic zone (EEZ) displaying vulnerability levels as identified by the Strategic Environmental Assessment (Adapted from: State of Israel, 2021)	1-37
1-20	Pelagic habitats identified by the Strategic Environmental Assessment (From: IOLR, 2024)	1-38
1-21	Grain size classifications for sediment samples collected within the Tamar Field during the 2014 Tamar Field Environmental Baseline Survey (CSA, 2014) and the 2023 Tamar Field Environmental Monitoring Survey (CSA, 2023a)	1-56
1-22	2014 versus 2023 seafloor sediment barium (Ba) concentrations (ppm [mg kg^{-1}]) within the Tamar Field	1-57
1-23	2014 versus 2023 seafloor sediment arsenic (As) concentrations (ppm [mg kg^{-1}]) within the Tamar Field	1-58
1-24	2014 versus 2023 seafloor sediment copper (Cu) concentrations (ppm [mg kg^{-1}]) within the Tamar Field	1-59
1-25	2014 versus 2023 seafloor sediment nickel (Ni) concentrations (ppm [mg kg^{-1}]) within the Tamar Field	1-60
2-1	Schematic section through the Tamar main well cluster	2-3
3-1	Locations of the proposed Tamar-12 well and proposed new infield umbilical in relation to existing infrastructure in the Tamar Field	3-2
3-2	Example of a dynamic positioning (DP) drillship	3-3
3-3	Representative schematic diagram for completion of the Tamar-12 well	3-6
3-4	Time vs. depth plot for drilling the Tamar-12 well (Provided by CML)	3-7
3-5	Schedule for drilling and completion activities for the Tamar-12 Project	3-8
3-6	Typical blowout preventer (BOP) stack	3-9
3-7	Representative wellbore schematic for the Tamar-12 well	3-12
3-8	Simplified diagram showing major discharge sources, types, and pipe diameters for the Tamar-12 Project	3-21
4-1	Spill fate parameters for a condensate spill from Tamar SW-1 for four different scenarios representing various climatic conditions (From: CSA, 2016)	4-10
4-2	Total amounts of condensate deposited on the coast at the end of 30 days after a spill from Tamar SW-1 for four different scenarios representing various climatic conditions (From: CSA, 2016)	4-11
4-3	Domain and bathymetry (m) for the circulation model	4-18
4-4	Measured spectral density levels at 20 Hz for various drilling rigs (*Discoverer*, Δ, solid line; *Kulluk*, ☼, dotted line; *Polar Pioneer*, ○) during drilling showing modeled sound level decay with range (From: Austin et al., 2018)	4-31
4-5	Cumulative deposition thickness for drilling discharges from a representative drill site for the winter (December to February) scenario	4-35

List of Figures (Continued)

Figure **Page**

4-6 Cumulative deposition thickness for drilling discharges from a representative drill site for the summer (July to September) scenario.....4-35

List of Acronyms and Abbreviations

3D	three-dimensional
ABP	annular pressure buildup
ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area
AIS	Alien Invasive Species
AoI	Area of Influence
AOT	Ashdod Onshore Terminal
AUV	autonomous underwater vehicle
bbl	barrel(s)
BHA	Bottom Hole Assembly
BML	below mud line
BOEM	U.S. Bureau of Ocean Energy Management
BOP	blowout preventer
BSEE	Bureau of Safety and Environmental Enforcement
CCC	criterion continuous concentrations
CFR	(U.S.) Code of Federal Regulations
CH_4	methane
CL	confidence limit
CML	Chevron Mediterranean Limited.
CO	carbon monoxide
CO_2	carbon dioxide
CoC	chain-of-custody
CSA	CSA Ocean Sciences Inc.
CTD	conductivity-temperature-depth (Instrument)
DO	dissolved oxygen
DP	dynamic positioning
EBS	environmental baseline survey
EDS	emergency disconnect system
EEZ	Exclusive Economic Zone
EHS	Environment, Health, and Safety
EIA	Environmental Impact Assessment
EMS	environmental monitoring survey
ERL	effects range low
ERM	effects range median
EUCEQS	European Commission Environmental Quality Standard
FAD	Fish Aggregating Devices
FFPI	Fossil Fuel Pollution Index
FLET	flowline end termination
GHG	greenhouse gas
H_2S	Hydrogen Sulphide
IJS	Intermediate Jumper Structure
IMO	International Maritime Organization
IOLR	Israel Oceanographic & Limnological Research
IPIECA	International Petroleum Industry Environmental Conservation Association
IUCN	International Union for Conservation of Nature
LBB	Levantine Basin Baseline
LWD	Logging While Drilling
MARPOL	International Convention for the Prevention of Pollution from Ships
MASP	maximum anticipated surface pressure
MAWP	maximum anticipated wellhead pressure
MCL	Maximum Contaminant Level
MEG	monoethylene glycol

List of Acronyms and Abbreviations (Continued)

MEPC	Marine Environment Protection Committee
MEWQS	Mediterranean Environmental Water Quality Standards
$MIYP_{70}$	Minimum Internal Yield Pressure (at 70%)
MM	Middle Miocene
MMSCFD	Million Standard Cubic Feet per Day
MOBM	Mineral Oil-Based Mud
MoE	Ministry of Energy
MoEP	Ministry of Environmental Protection
MPA	Marine Protected Area
MPCV	multi-purpose construction vessel
MPD	Managed Pressure Drilling
MVI	Marine Ventures International, Inc.
MWD	Measurement While Drilling
NCEP	National Center for Environmental Predictions
NEML	Noble Energy Mediterranean Ltd.
NMFS	U.S. National Marine Fisheries Service
NO_x	Nitrogen Oxides
OEMS	Operational Excellence Management System
OGP	International Association of Oil & Gas Producers
OSCP	Oil Spill Contingency Plan
OSPAR	Convention for the Protection of Marine Environment in the Northeast Atlantic
OWS	oil-water separator
PAH	polycyclic aromatic hydrocarbons
PM	particulate matter
PNEC	predicted no effect concentration
ppm	parts per million
PTS	permanent threshold shift
RDIF	Reservoir Drill-in-Fluid
ROV	remotely operated vehicle
SCSSV	Surface-Controlled Subsurface Safety Valve
SDA	subsea distribution assembly
SDS	safety data sheet
SEA	Strategic Environmental Assessment
SOLAS	International Convention for Safety of Life at Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SO_x	sulfur oxides
SPL	sound pressure level
TN	total nitrogen
TOC	total organic carbon
TOG	total oil and grease
TP	total phosphorus
TPH	total petroleum hydrocarbons
TSS	total suspended solids
TTGL	Tamar Third Gathering Line
TTS	temporary threshold shift
TVD	total vertical depth
USEPA	United States Environmental Protection Agency
UXO	unexploded ordnance
VOC	volatile organic compounds
WBM	water-based mud

1 Description of the Existing Conditions in the Offshore Environment to which the Application Refers

1.1 GENERAL

This chapter summarizes the current marine environment which may be adversely affected by Chevron Mediterranean Limited's (CML) proposed activities of the Tamar-12 Project. This chapter also provides a brief overview of the components of the Tamar-12 Project as a basis for identifying potential impact producing factors and subsequently assessing potential impacts and offering viable mitigation measures.

1.1.1 Resources Expected to be Affected

Key characteristics of the baseline environment which are relevant to potential impacts from the Tamar-12 Project include:

- Air quality (including greenhouse gas contribution);
- Water quality;
- Sediment quality;
- Benthic communities;
- Marine mammals;
- Sea turtles;
- Seabirds and migratory birds;
- Fish and fishery resources (including plankton);
- Fishing and marine aquaculture;
- Culture and heritage sites;
- Marine transportation and infrastructure;
- Coastal habitats and infrastructure;
- Nature reserves/protected areas; and
- Acoustic environment/noise.

1.1.2 Project Description and Project Area (General)

1.1.2.1 Project Area

Tamar Field is located in the Levantine Basin, about 90 km west of Haifa, at a water depth of approximately 1,600 to 1,700 m.

The field development was carried out in two stages. Initially, five production wells (Tamar-2 through Tamar-6) were drilled and began producing gas in 2013. Later, in 2017, the Tamar-8 well was drilled and started producing gas, and in 2023, the Tamar SW-1 well (drilled in 2013) was completed and began production. Currently, there are six producing wells in the field (Tamar-2, -4, -5, -6, -8, and Tamar SW-1), while Tamar 3 is currently not producing (**Figure 1-1**).

The subsea transmission system for gas delivery includes infield flowlines connecting the wellheads to the manifold and from there to the Tamar Platform via two 16-inch diameter and approximately 150 km long gathering lines.

The Tamar Production Platform is a fixed platform in the Mediterranean Sea, located approximately 25 km offshore Israel in about 235 m of water.

In the third quarter of 2024, a third, 20-inch, gathering line was installed between the Tamar Field and the Tamar Platform. The 20-inch pipeline is planned to be connected and commissioned during 2025.

Additionally, the installation of the monoethlyene glycol (MEG) Reclamation Unit (MRU) on the Tamar Platform will be executed in 2025. The MRU will handle formation water production and remove degradants introduced along with well production fluids from the MEG stream.

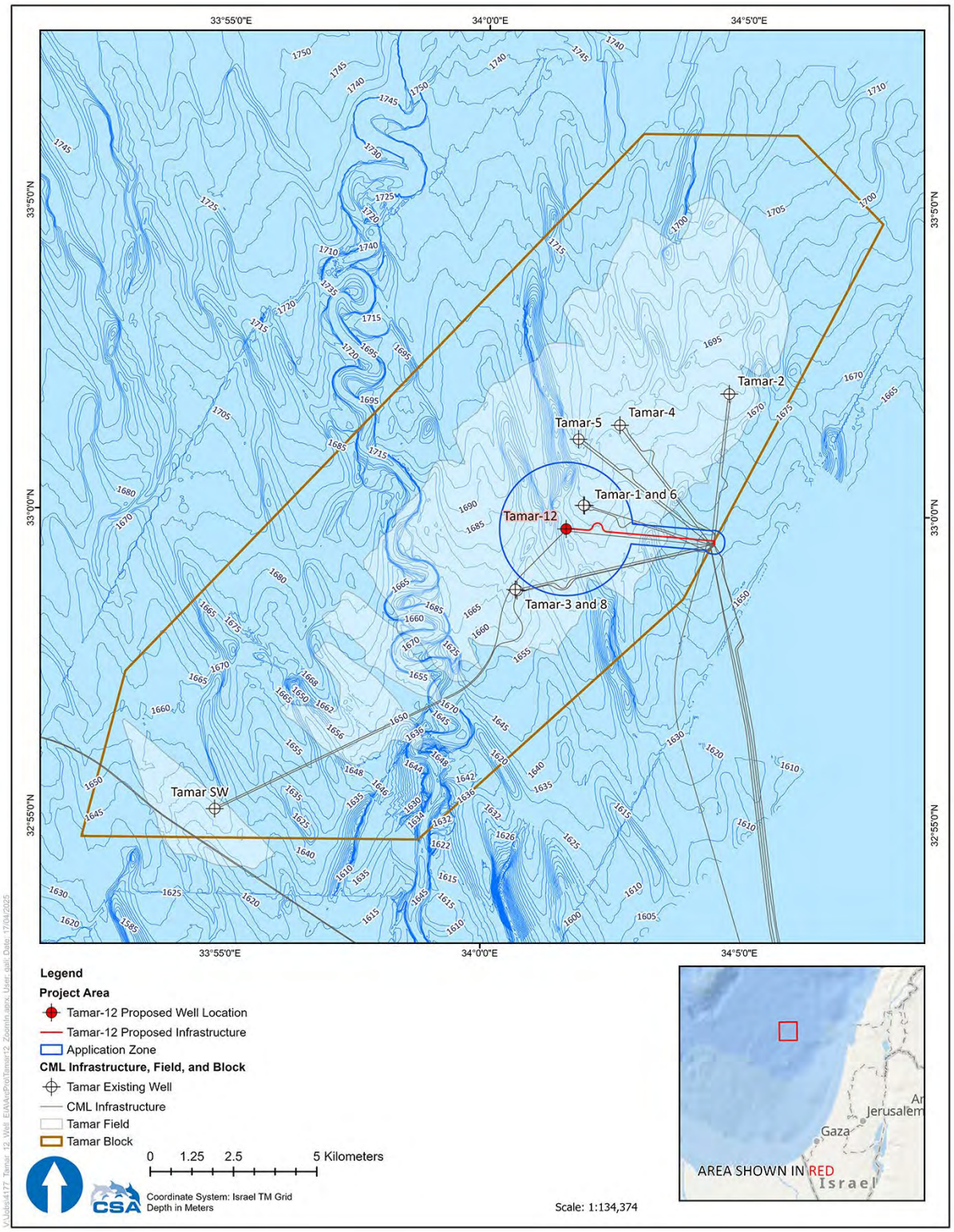


Figure 1-1. Tamar Block and Field, displaying the proposed Tamar-12 drill site location and associated subsea infrastructure. Proposed new infrastructure is shown in red and boundaries of Application Area are marked in blue.

1.1.2.2 Project Description – Tamar-12 Well Development

The next development well, Tamar-12, aims to support continued safe, reliable production from the Tamar Field. It will provide redundancy in the system and maintain production capacity in the coming years. The location of the Tamar-12 drill site is shown in **Figure 1-1** relative to the existing well sites and subsea infrastructure.

The design of the new Tamar-12 well will be similar to the original Tamar wells, incorporating lessons learned, best practices, and updated execution procedures. Key Performance Indicators will be the same as in previous wells (including design life), with CML also considering implementation of a big-bore, high-rate capability not applied to earlier wells. Managed Pressure Drilling (MPD) may also be used (see **Section 2.3**). MPD, if utilized, will not affect discharges to the sea.

The development of the well includes drilling, completion, and connecting the well into the existing infrastructure (**Figure 1-1**). Tamar-12 leverages existing subsea infrastructure put in place for the Tamar SW-1 tieback, allowing for simple integration into the distribution system infrastructure.

1.1.3 Existing Offshore Environment at the Development and Production Site

Descriptions of the existing environmental conditions at the development and production site which may be affected by the proposed activities have been included in previous EIAs for the Tamar Field; key findings are summarized below. New information for the Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- Environmental Impact Assessment Tamar Field Development Project Offshore Israel (CSA, 2012).
  - CML, formerly Noble Energy Mediterranean Ltd. (NEML), planned to develop a subsea gas production and transportation system connecting the deepwater Tamar Gas Field to a new offshore receiving and processing platform (Tamar Platform) located in proximity to the existing Mari-B Platform.
  - The initial phase of the development plan for the Tamar Field included: drilling and completion of up to six wells; installation of infield flowlines from each well to a subsea manifold within the Tamar Field; and installation of dual 16-inch subsea pipelines from the subsea manifold approximately 150 km to the Tamar Platform where the gas will be processed.
  - A description of the environment within Tamar Field is provided in Chapter 3.
- Tamar Field Development Project Environmental Impact Assessment for Tamar-7, -8, -9 Drilling and Completion; Tamar SW-1 completion (CSA, 2016).
  - Drilling and completion of three wells in the Tamar Reservoir (Tamar-7, Tamar-8, and Tamar-9).
  - Completion of the Tamar SW-1 well.
  - Installation of subsea infrastructure (i.e., umbilical and utility lines, pipelines) to tie these wells into the existing Tamar subsea equipment.
  - A summary of the environmental conditions within the Tamar Field and the regional environment, including activities and studies completed throughout the field prior to 2016, is presented in Section 1.2.

Proposed Project:

- CML is proposing to drill and complete one well (Tamar-12) and connect to the existing infrastructure (**Figure 1-1**) within the previously surveyed Tamar Field.
- The Israel Ministry of Energy (MoE, then Ministry of National Infrastructure, Energy and Water Resources) implemented a Strategic Environmental Assessment (SEA) to characterize available environmental data, map offshore habitats, and characterize environmental vulnerability (Geo-prospect Ltd. and IOLR, 2015).

    - A Strategic Environmental Survey was conducted by Israel Oceanographic and Limnological Research (IOLR) as part of the SEA which found that the deep-sea zone of the economic waters of Israel has a very low combined ecological sensitivity (IOLR, 2015).
- The 2016 SEA habitats mapping data set has been updated with new benthic and pelagic habitats (State of Israel, 2021; IOLR, 2024) and an accompanying map set depicting vulnerability to offshore oil and gas activities.
    - No hard bottom or sensitive habitats were indicated in the deep-sea area of the Tamar Field.
- 2023 Tamar Field Environmental Monitoring Survey (CSA, 2023a).
    - Comprehensive field-wide environmental monitoring survey (EMS) of the developed portion of the Tamar Field.
    - Assessed the post-drilling extent of barium concentrations within 5 km of active wellsites in the Tamar Field (Tamar-2 through Tamar-6, Tamar-8).
    - Determined metal concentrations directly around the Tamar Manifold.
    - Results of the monitoring survey are provided in Chapter 5.
- 2014 Tamar Field Background Monitoring Survey Report (CSA, 2014).
    - Tamar Field-wide survey to describe the environment within the Tamar Field before any additional drilling or construction activity was conducted.
    - Results are summarized and compared with the 2023 Tamar Field Environmental Monitoring Survey in CSA (2023a).

1.1.4 Existing Onshore and Offshore Environment of the Potential Impact Area

Descriptions of the existing conditions in the onshore and offshore environment which may be affected by the proposed activities have been included in previous EIAs for the Tamar Field; key findings are summarized below. New information for the Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- Environmental Impact Assessment Tamar Field Development Project Offshore Israel (CSA, 2012).
    - A description of the onshore and offshore environment is provided in Chapter 3.
    - Section 3.1 provides a summary of the broader regional setting.
- Tamar Field Development Project Environmental Impact Assessment for Tamar-7, -8, -9 Drilling and Completion; Tamar SW-1 completion (CSA, 2016).
    - A summary of the broad, regional environment is presented in Section 1.2.
- Tamar Environmental Impact Assessment Update for the Tamar Third Gathering Line (TTGL) Project (MVI, 2022).
    - Installation of a third gathering line (i.e., 20-inch pipeline) from the existing Tamar Field manifold to the existing Tamar Platform with associated subsea equipment (i.e., subsea isolation valve [SSIV] skid, SSIV umbilical, intermediate jumper structures, jumpers).
    - Re-installation of a third boarding valve skid and replacement of existing header valves.
    - Installation of additional rich and lean MEG storage on the Tamar Platform topside.
    - Chapter 1 provides a summary of the baseline environmental conditions along the pipeline corridor.

Proposed Project:

- Strategic Environmental Survey (IOLR, 2015) found that the deep-sea zone of the economic waters of Israel has a very low combined ecological sensitivity.

- In the Israeli nearshore (coastal) area there are vulnerable habitats which are indicated in the 2016 SEA and were updated in 2018 (Ministry of Energy, 2018), 2020 (Ministry of Energy, 2020), 2021 (IOLR, 2021; State of Israel, 2021) and 2024 (IOLR, 2024) accompanied by map sets depicting vulnerability to offshore oil and gas activities (State of Israel, 2021).
    - The habitats described as highly vulnerable in the 2016 SEA include the coastal abrasion tables, the underwater canyon in Achziv, all underwater kurkar ridges, chemosynthetic communities that exist in methane vents and deep corals found on hard substrates of biogenic origin.
    - The updates include pockmarks in deep water (700-1,000 m) opposite the Dor disturbance, expansion of rocky habitat at Rosh Carmel to deeper waters, adding a new habitat with a hard substrate in Achziv Canyon at a depth of 100 m, additional sensitive habitats at the deep Palmachim Disturbance, sponge-rich habitat on hard-bottomed kurkar ridges at a depth of 90 to 130 m in front of Dor, Herzliya, Atlit and Rosh Carmel, (Ministry of Energy, 2018; Ministry of Energy, 2020; IOLR, 2021), addition of rocky habitats along the underwater kurkar ridge at 90 to 140 m depth in Hahotrim, Atlit, Hadera and Beit Yanai area and expansion of pelagic habitats of marine mammals in the southern part of the Israeli coastal area (IOLR, 2024).
- Two marine protected areas (MPAs) were added since issuance of CSA (2016), per the Israel Natures and Parks Authority (2025):
    - Yam Rosh Haniqra-Achziv (Rosh Hanikra-Achziv Marine Reserve): In 2019, the expanded marine reserve was declared, which includes the deep Achziv Canyon. The canyon is located just 5 km from the coast and descends to a depth of 800 m.
    - Yam Rosh Carmel: The Rosh Carmel Marine Reserve protects the underwater continuation of the limestone ridge of Mount Carmel and forms a rich foundation for rocky reefs. Extending to a depth of 45 m, the seafloor surface is relatively mild and covered with algae. As the depth decreases, the ridge surface becomes more fragmented and steeper, and the algae are replaced by sponge gardens. The maximum depth in the reserve is 320 m.

1.1.5 Environmental Monitoring Plan Updates for the Tamar Field

The Tamar-12 proposed Project area is currently reflected in the monitoring program for the Tamar Field. If a new or supplemental monitoring effort will be required based on the Tamar-12 activities, the monitoring program will be updated accordingly.

1.1.6 Bathymetric Maps, Sediment Pollutants, and Sonar Targets Suspected of Being Sensitive Habitat

Figures 1-2 and **1-3** display detailed bathymetry and side-scan sonar data of the Tamar-12 Project Area, respectively, along with sonar contacts identified in well clearance letters. All sonar targets within the Tamar-12 Project Area are not of a sensitive nature and therefore video surveys were not conducted. **Figure 1-4** displays the grain size distribution analyzed across the Tamar Field during the 2023 Tamar Field EMS. **Figures 1-5** and **1-6** display the sediment total petroleum hydrocarbons (TPH) and barium concentrations, respectively, measured across the Tamar Field during the 2023 Tamar Field EMS and the former 2014 Tamar Field EBS. These two parameters were the primary sediment pollutants identified with elevated values during 2023 Tamar Field EMS amongst a wide array of analyzed sediment chemistry parameters; further detail can be found in **Section 1.7.5**.

Figure 1-2. Map displaying the bathymetric data in the Tamar-12 Project Area, along with identified sonar contacts.

Figure 1-3. Seabed morphology in the Tamar-12 Project Area from side-scan sonar data provided by Chevron Mediterranean Limited. Sonar contacts are displayed according to identifying characteristics.

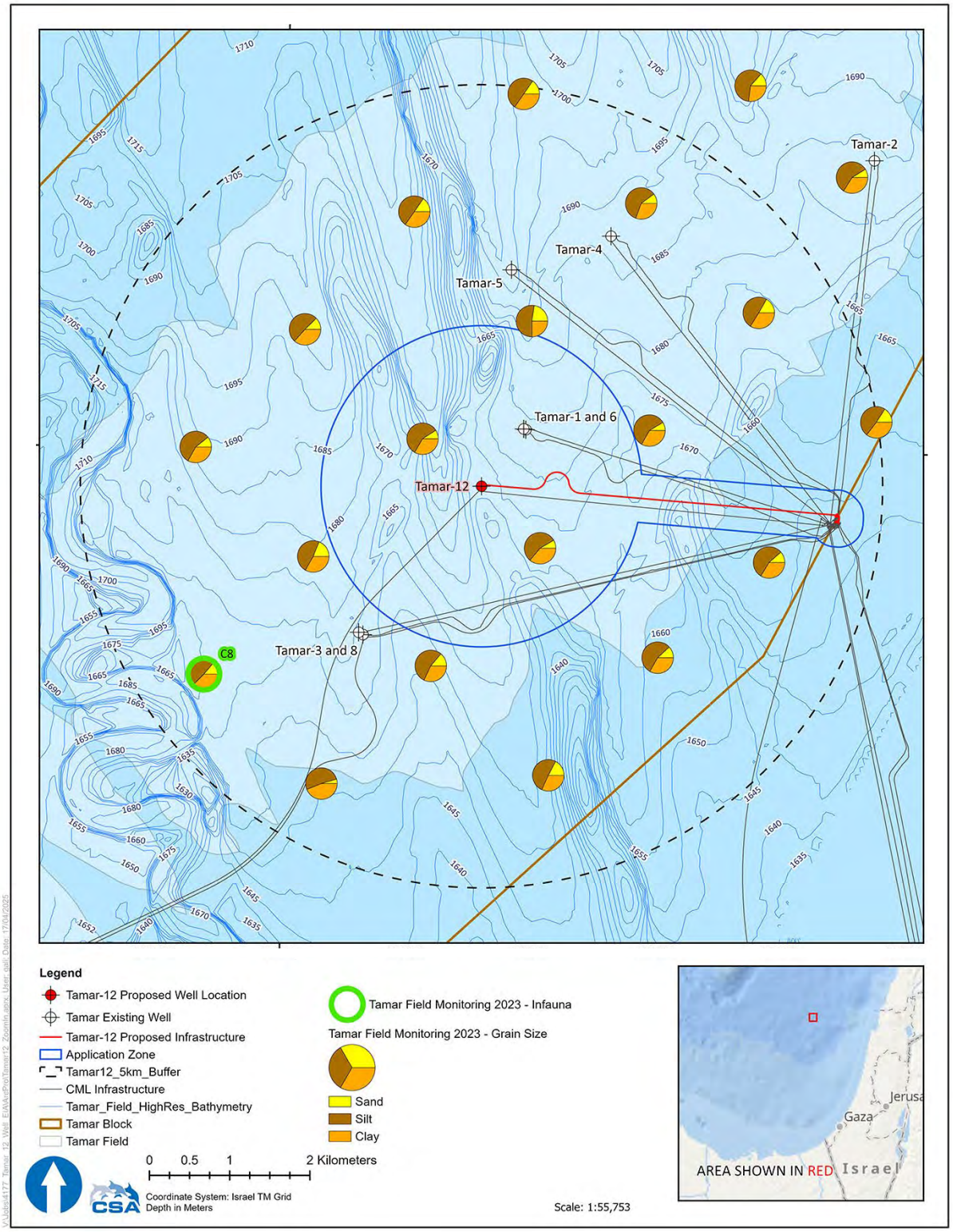


Figure 1-4. Grain size distribution according to classifications by Shepard (1954) for sediment samples collected within the Tamar Field during the 2023 Tamar Field Environmental Monitoring Survey. Station C8, where a singular infauna sample was collected during the 2023 Tamar Field Environmental Monitoring Survey is also shown.

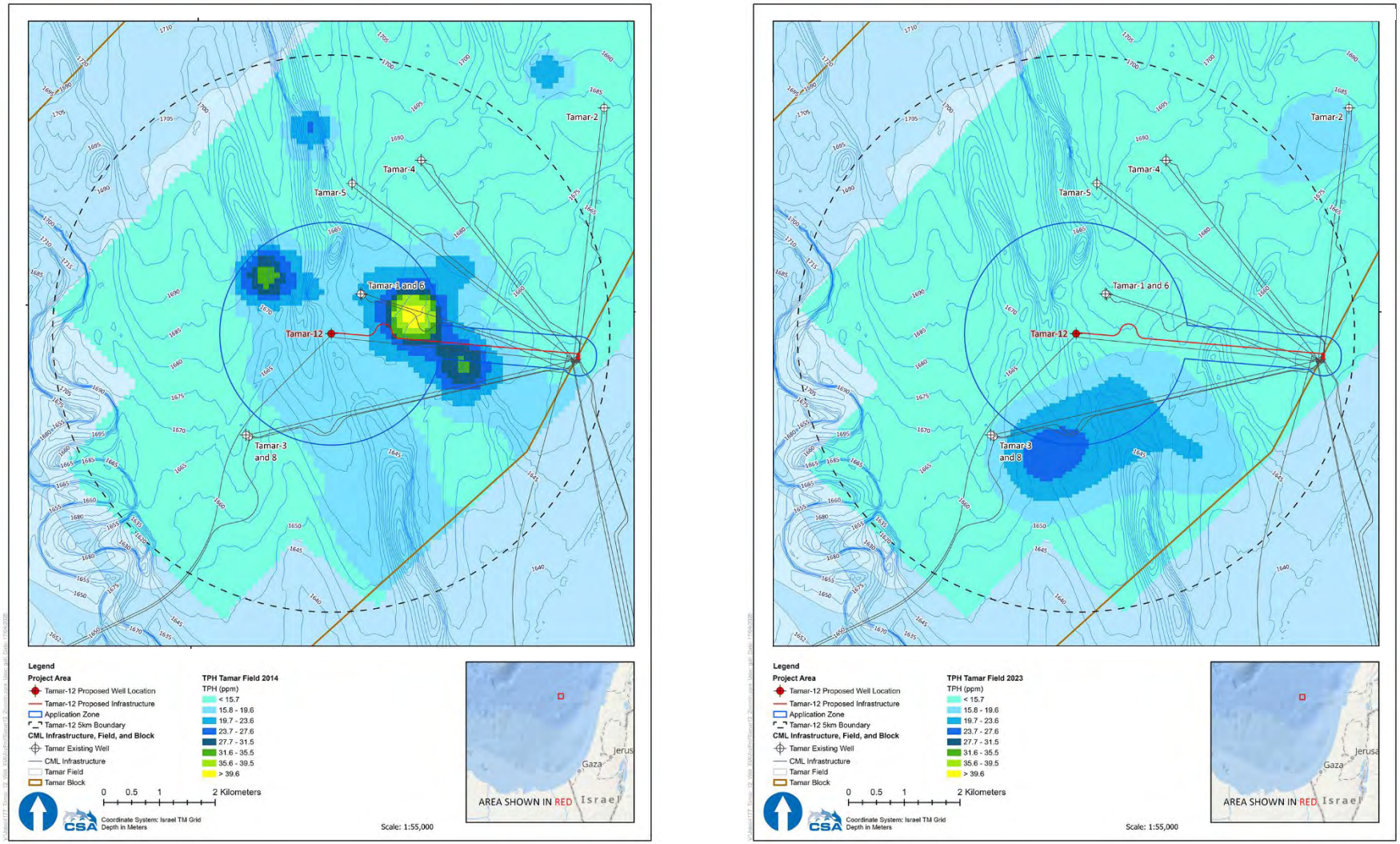


Figure 1-5. Total petroleum hydrocarbon (TPH) concentrations within the Tamar Field sediments in 2014 (left) and 2023 (right), presented in ppm (µg g^{-1}). Seafloor sediments within the Tamar Field that have ambient concentrations of TPH relative to the 2014 Tamar Field mean are presented in various shades of blue, while higher concentrations are displayed in green or yellow.

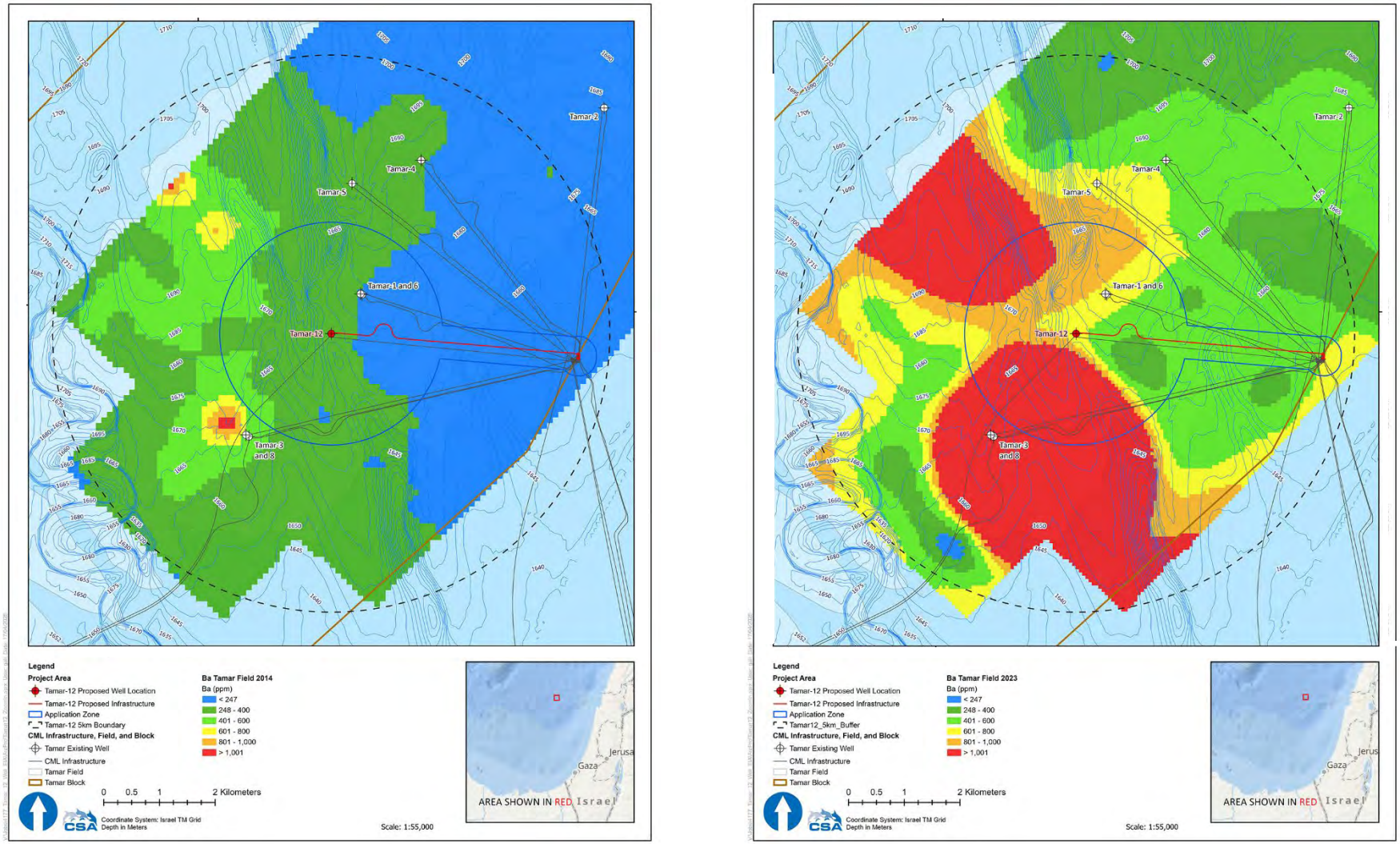


Figure 1-6. Sediment barium (Ba) concentrations within the Tamar Field in 2014 (left) and 2023 (right), presented in ppm (µg g^{-1}). Ba concentrations that were within the 99% confidence limit of the Levantine Basine Baseline are displayed in blue, while higher concentrations are displayed in green, yellow, orange, or red.

1.1.7 Other Marine Uses of the Project Area

Assessment of regional maritime boundaries, submarine cables, shipping lanes and fishing areas reveals that due to the great distance from shore, no fishing activities, marine sports, or other recreational activities are expected to occur within the Tamar-12 Project Area. A single shipping fairway (shipping lane) does extend into the Tamar Field.

1.2 APPLICATION BOUNDARIES AND RANGE OF IMPACT

1.2.1 Detailed Application Zone

CSA (2012, 2016) previously provided a discussion of boundaries from prior drilling activities in the Tamar Field; see Section 3.2 of CSA (2012) and Section 1.1.1 of CSA (2016).

Key Findings:
- The Tamar Field is located in the Tamar lease block which is approximately 90 km west of Haifa in the Levantine Basin;
- The Tamar lease block covers approximately 250 km^2, of which the Tamar Field covers approximately 100 km^2; and
- Water depths in the Tamar Field range from approximately 1,600 to 1,700 m.

Proposed Project:
- CML is proposing to drill and complete one well (Tamar-12) and connect to the existing infrastructure (**Figure 1-1**) within the previously surveyed Tamar field.
- The application zone contains the offshore area within a 2-km radius around the drill sites. The maritime area includes the water column, seafloor and subsea of the seafloor, infrastructure, and offshore installations that are present at the site.

1.2.2 Range of Impact

CSA (2016) previously provided a discussion of the Area of Influence (AoI) from prior drilling activities in the Tamar Field; see Section 1.1.1 of CSA (2016).

Key Findings:
- CSA (2016) examined activities and potential impacts within the AoI as defined based on the worst-case discharge model, including areas within the proposed activities, as well as other areas that may be environmentally affected as a result of the potential transport of discharges or emissions.

Proposed Project:
- Range of impact will include all marine and coastal areas which might be environmentally influenced by routine or non-routine operations:
  - The AoI for ecology, acoustic, air quality, routine storage and use of hazardous materials, and appearance when viewed from the shore from routine operations is limited to at least 2 km radius around the proposed drill site and 0.3 km from the proposed linear infrastructure route, and along transit corridors (e.g., supply or support vessels; helicopters) to shore.
- The AoI from non-routine events based on the worst-case discharge model and the potential loss of hazardous materials:
  - The AoI for an accidental spill extends from the southern coast of Lebanon to the southern coast of Israel but would still be smaller than model simulations indicate; the actual range of a spill would be highly dependent upon volume released and seasonal meteorological and oceanographic conditions.

- The vessels supporting drilling and completion will be based in Haifa, although support operations from Limassol, Cyprus may also occur.
- The vessels supporting subsea infrastructure installation are expected to originate from Limassol, Cyprus.

1.3 MAPS AND ORTHOPHOTOS

1.3.1 Location of Production Well

The Tamar-12 drill site is in the Tamar lease block, located in the Levantine Basin approximately 90 km west (offshore) of Haifa, Israel. The well site is located at 32° 59" 47' ° N, 34° 01" 37' ° E in WGS1984 (109,406.21 Easting, 767,422.09 Northing in Israeli Transverse Mercator geographic coordinator system) at a water depth of 1,671 m total vertical depth subsurface (TVDSS) (**Figure 1-1**, **Figure 1-7**).

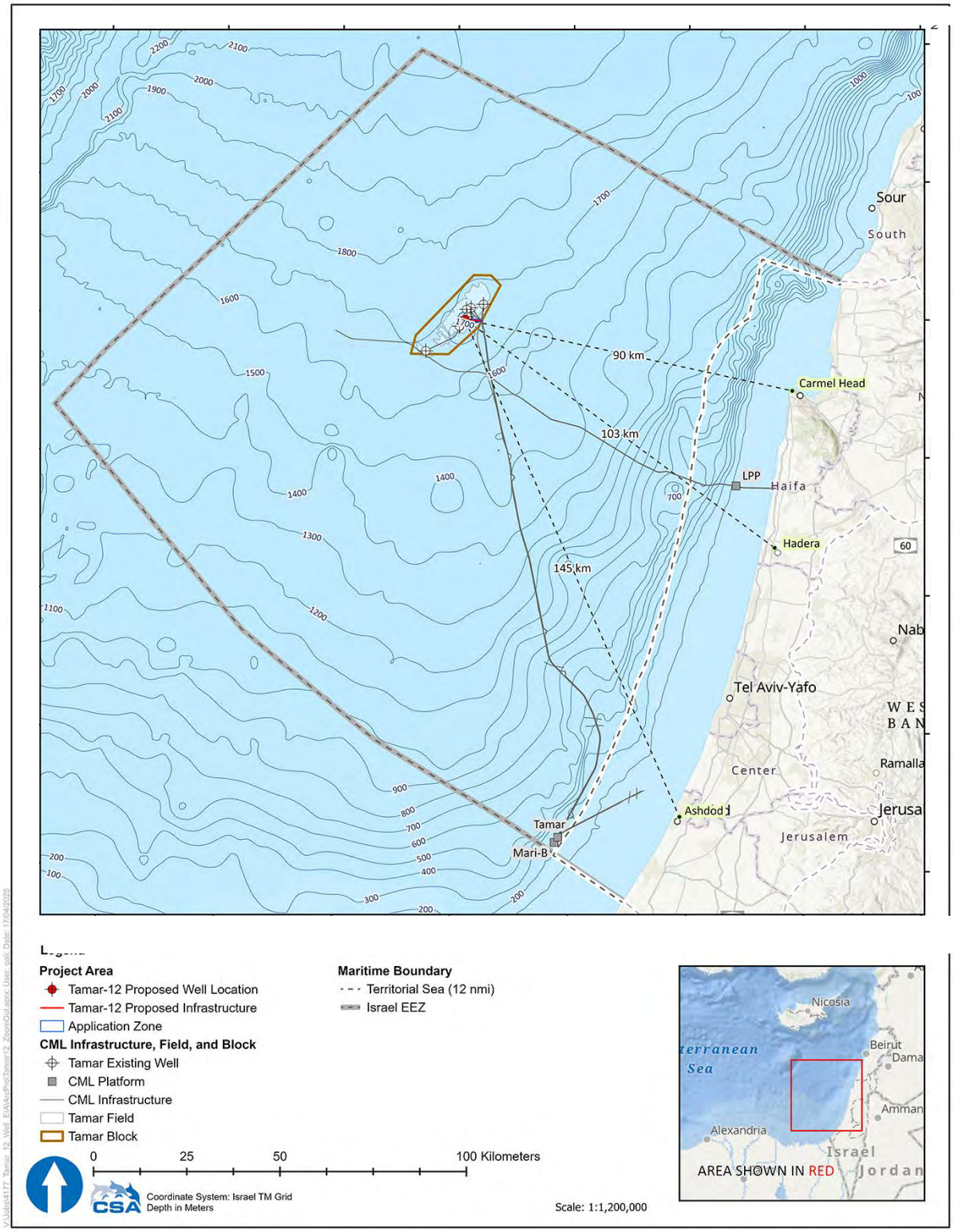


Figure 1-7. Overview of the proposed Tamar-12 drill site location within the Tamar Field, offshore Israel. EEZ = Exclusive Economic Zone.

1.3.2 Distances from Wellsite to Selected Onshore Areas

Figure 1-7 presents the distances to points of note on the Israeli coast from the proposed Tamar-12 drill site. The proposed Tamar-12 drill site is 90 km from Rosh Carmel, which is also the nearest shoreline, 103 km from Hadera, and 145 km from Ashdod.

1.3.3 General Bathymetric Map

Figure 1-8 presents a bathymetric map at a scale of 1:250,000 for the proposed Tamar-12 Project Area showing the locations of all the development components, including the Tamar-12 drill site, existing and proposed subsea systems, boundaries and offshore areas, and other findings such as communication lines and shipping lanes. All existing and proposed marine nature reserves are found at distances greater than 10 km from the Tamar-12 Project Area.

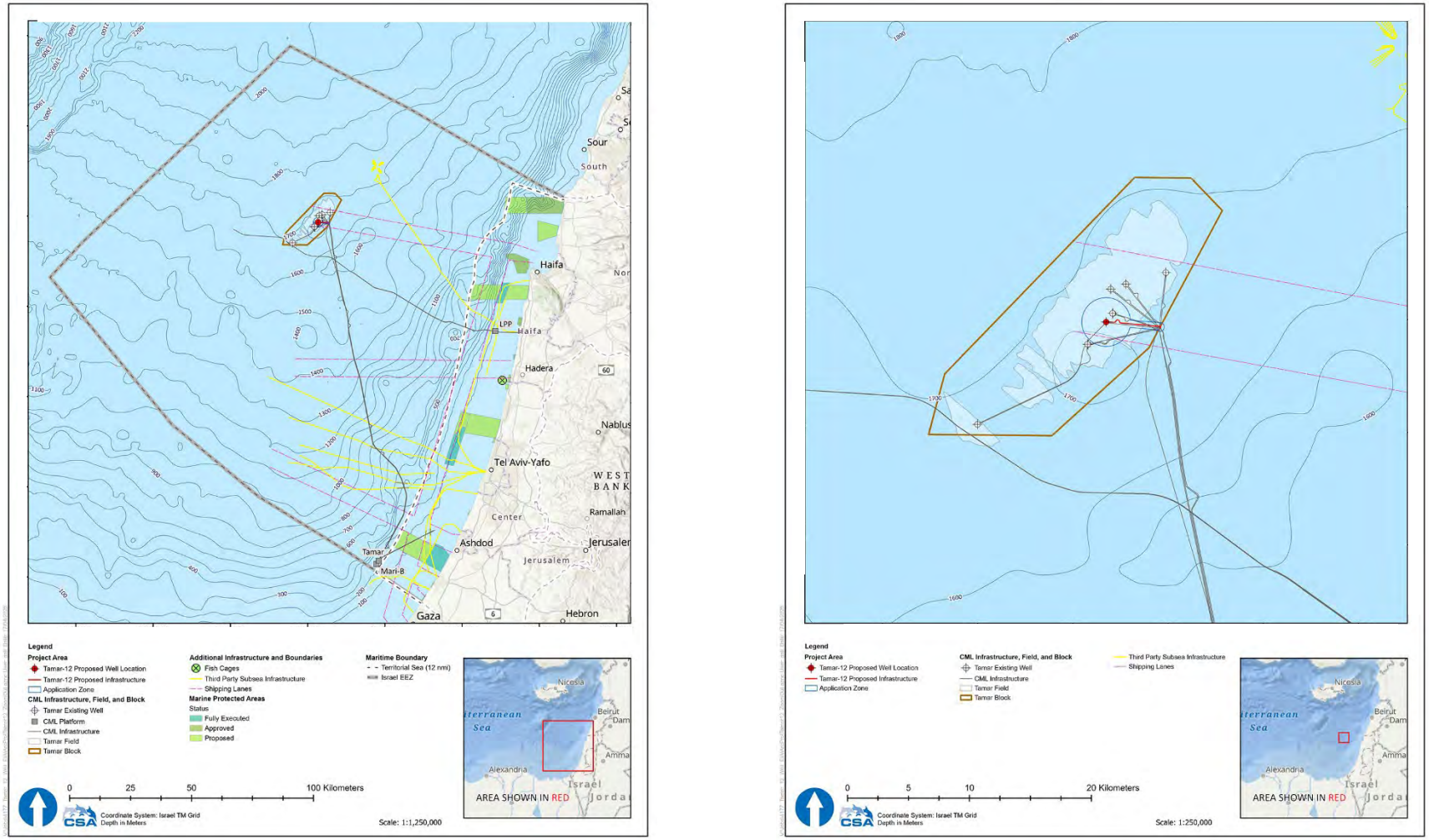


Figure 1-8. Bathymetry of the Tamar Field and Tamar-12 Project Area relative to regional maritime boundaries, submarine cables, mariculture sites, shipping fairways, and marine protected areas off the Israeli coastline at a scale of 1:1,250,000 (left), and 1:250,000 (right).

1.3.4 Regional Bathymetric Maps

Figure 1-2 from the relevant well clearance letters presents a regional bathymetric map within a 2 km distance from the proposed production well and infrastructure at a 1:20,000 scale. **Figure 1-3** presents regional seabed morphology from side-scan sonar and infrastructure within a 2 km distance from the production well at a 1:20,000 scale. **Figure 1-9** provides additional interpretation of the seabed morphology and geohazards present within a 2 km distance from the proposed Tamar-12 drill site location. **Figures 1-4, 1-5**, and **1-6** present findings from the Tamar Field baseline survey and findings from the Tamar Field monitoring program, within a 5 km radius from the proposed Tamar-12 drill site location. The findings in these maps detail sediment grain size composition, and levels of TPH and barium, which were observed to be noteworthy sediment contaminants.

Figure 1-9. Sonar contacts identified in the Tamar-12 Project Area, displayed with interpretation of seabed morphology and identified geohazards.

1.3.5 Marine Aquaculture Activity

No marine aquaculture is present within 30 km of the Tamar-12 Project Area (**Figure 1-8**).

1.3.6 Habitat and Sedimentological Map

Detailed and current data available on the sedimentology and morphology of the seabed around the Tamar-12 Project Area have been presented in earlier chapters and are discussed in detail in **Section 1-4**. A high-resolution map is displayed below illustrating the identified geohazards and various aspects of seabed morphology at a scale of 1:10,000, within distances of 500 m from the proposed Tamar-12 drill site location (**Figure 1-10**).

A series of maps displaying the application zone at a scale of 1:5,000, as required by the MoE guidelines, can be found in **Appendix A**. This map series presents sediment grain size distribution from the 2023 Tamar Field EMS, side-scan sonar data provided by CML, and sonar contact locations.

Figure 1-10. Geohazards identified with 500 m of the proposed Tamar-12 drill site location.

1.3.7 Other Marine Uses Map

All infrastructure found within the application zone is part of the existing Tamar Field well sites and associated subsea infrastructure, the latter of which includes umbilicals, flowlines, utility lines, and pipelines. **Figure 1-11** displays both existing and planned infrastructure in the application zone in a 1:20,000 scale.

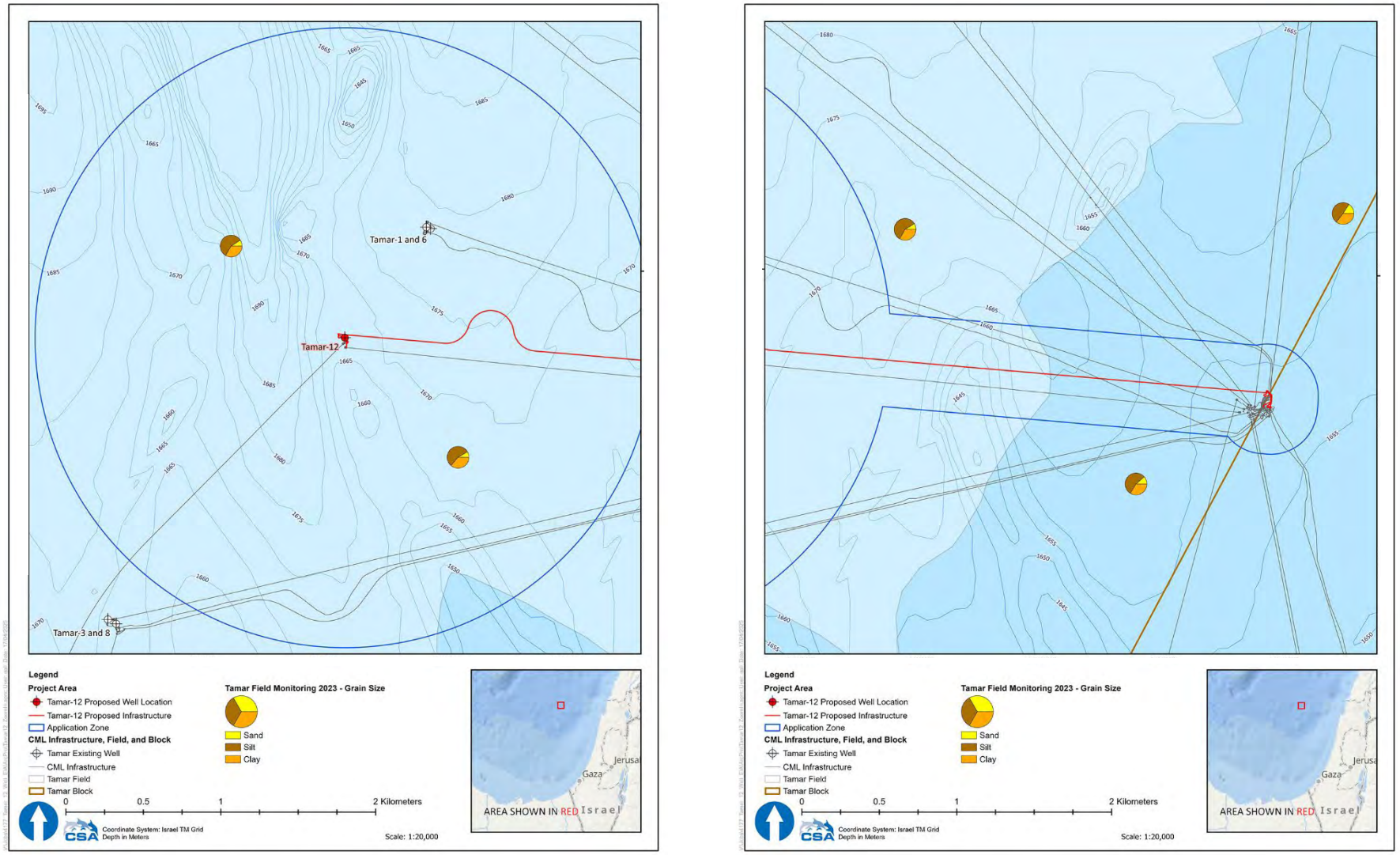


Figure 1-11. Existing and planned infrastructure within a 2-km radius around the east side (left), and west side (right) of the application zone (1:20,000 scale).

1.4 GEOLOGICAL, SEISMIC, AND SEDIMENTOLOGICAL ASPECTS

1.4.1 General Geographic Location of Production Well

1.4.2 General Geological/Geomorphological/Bathymetric Map

Proposed Project:

1.4.3 Regional Geological/Geomorphological/Bathymetric Maps

1.4.4 Dispersion Area of Drilling Muds and Cuttings

1.4.5 Bedrock Infrastructure

considered possible due to various structural characteristics and sediment compositions.

1.4.6 Active Geological Faults

1.5 HYDRODYNAMICS REGIME

1.5.1 Waves

CSA (2012, 2016) previously provided descriptions for waves in the Tamar Field; see Section 3.5.3 of CSA (2012) and Section 1.2.2.2 of CSA (2016), with the key findings summarized below.

Key Findings:

- Wave heights in the region are generally lower than in the large ocean basins because storms are typically weaker in the region.
- Table 12 of CSA (2016) presents the significant wave heights and their frequency of occurrence from July 2005 to February 2008.
- Figure 1-31 of CSA (2016) provides a rose diagram for annual frequency of wave direction per 10° sector across the Levantine Basin. This figure shows that waves predominantly travel towards the east.
- CSA (2016) reviewed wave data from July 2005 to February 2008 from a point near the Cyprus Coastal Ocean Forecasting and Observing System (CYCOFOS) MedGoos-3 buoy location (33°42' N, 32°08' E) in Section 1.2.2.2.
    - Nearly all of the waves were less than 1.5 m in height.
    - Wave direction is nearly always due eastward at this location (mean of 116°, standard deviation of 53°) because of the strong westerly winds.

Proposed Project:

- No new data have been identified at this time. Existing information presented in CSA (2016) is sufficient for impact assessment purposes.

1.5.2 Statistical Distribution of Wave Properties

The distribution of wave properties are summarized in **Section 1.5.1**.

1.5.3 Extreme Storms

CSA (2012, 2016) did not discuss extreme storms as they are extremely rare in the Mediterranean Sea and only one has been reported in Israeli waters, in 2018 (Knobler et al., 2021). MVI (2022) briefly mentioned extreme waves in Section 1.6.3.

Key Findings:

- There are no known records of extreme storms or rogue waves in the Tamar Field.

Proposed Project:

- Rogue waves from extreme storms are not relevant to drilling operations and associated Tamar-12 subsea infrastructure to be installed, given the depths of these components.

1.5.4 Wave Regime

The wave regime for the Tamar Field area has been summarized in **Section 1.5.1**. Additional discussion regarding currents is presented in **Section 1.5.6**.

1.5.5 Winds

CSA (2012, 2016) previously provided descriptions for Winds in the Tamar Field; see Section 3.7.1 of CSA (2012) and Section 1.2.2.1 of CSA (2016), with the key findings summarized below.

Key Findings:

- There is no known wind data set representative of the Tamar Field.
- During most months, the dominant wind direction is from the north-northwest to west-southwest sector due to the general circulation and local thermal circulation patterns.
- ASL Environmental Sciences Inc. (2009), in their analysis of available metocean data for the Tamar and Dalit Fields and potential pipeline corridors to shore, noted 1- and 100-year hourly wind speeds, extremal values, of 16.2 and 22.7 m s^{-1}, respectively.
- CSA (2016) assessed wind speed and direction data at a 10-m height from the National Center for Environmental Predictions (NCEP) Environmental Modeling Center Regional Spectral Model provided by the U.S. National Oceanic and Atmospheric Administration – Cooperative Institute for Research in Environmental Studies (NOAA – CIRES) Climate Diagnostics Center (CDC) for the 10-year period from January 1999 to January 2009 as representative of the Tamar Field environs.
    - Based on the NCEP data set (see Figure 1-30 in CSA, 2016), the wind regime is characterized by predominant westerly winds throughout most of the year (January through October) and varied winds in November and December.
    - Winds are generally moderate in speed, with average monthly speeds of approximately 5 m s^{-1}.
    - Overall, strong seasonal variability is not evident in the wind data.
    - Winter winds (December through February) have higher maximum speeds than the remainder of the year; however, average winds are relatively comparable throughout the year.

Proposed Project:

- No new data have been identified at this time. Existing information presented in CSA (2016) is sufficient for impact assessment purposes.

1.5.6 Currents

CSA (2012, 2016) previously provided descriptions for Currents in the Tamar Field; see Section 3.5.2 of CSA (2012) and Section 1.2.2.4 of CSA (2016), with the key findings summarized below.

Key Findings:

- Lawrence et al. (2011) conducted a metocean study offshore Israel measuring bottom currents at various locations in and near the Tamar Field.
- At the Tamar location at a water depth of 1,688 m, the maximum near-bottom current speed of 8.7 cm s^{-1} was measured in July 2010, although mean current speeds did not exceed 3.5 cm s^{-1} over the period December 2009 through mid-July 2011. Currents at this site and depth are not highly directional, though there is a slight bias to currents from the southwest.
    - Currents in the upper water column at the Tamar location were dominated by episodes of strong flow, particularly in the winter. For example, the maximum recorded current speeds at 25-m depth were 53.6 cm s^{-1} and 52.8 cm s^{-1}, recorded in January 2011 and March 2010, respectively. Lawrence et al. (2011) note that mean current speeds at 25-m depth could be as large as 25 cm s^{-1}.

Proposed Project:

- No new data have been identified at this time. Existing information presented in CSA (2012, 2016) is sufficient for impact assessment purposes.

1.6 NATURE AND ECOLOGY

CSA (2012, 2016) provide resource-specific descriptions of the pertinent, available information on nature and ecology at the time of preparation on both a broad regional (i.e., Eastern Mediterranean Sea, Levantine Basin) and site-specific basis (i.e., Tamar Field and immediate environs); see Section 3.8 of CSA (2012) and Section 1.2.3 of CSA (2016), with the key findings summarized below. MVI (2022) provides a regional description of the natural environment (Section 1.7) from pertinent, available information at the time of preparation, with main points summarized for the proposed project.

1.6.1 Pelagic and Benthic Habitats

1.6.1.1 Plankton

Key Findings:

- Environmental Impact Assessment Tamar Field Development Project Offshore Israel (CSA, 2012; Section 3.8.1).
  - Phytoplankton productivity in the Mediterranean Sea is nutrient-limited (Longhurst, 1998).
  - Mediterranean phytoplankton production is co-limited by phosphorus and nitrogen (Krom et al., 1991; Thingstad et al., 2005).
  - Surface waters in the eastern Levantine Basin are extremely nutrient-poor (ultra oligotrophic) resulting in low phytoplankton biomass and productivity relative to the western Mediterranean (Tanaka et al., 2007).
  - Herut et al. (2000) reported chlorophyll *a* concentrations at two fixed stations across the southeastern Mediterranean continental shelf and slope (i.e., water depths of 120 and 400 m), with results ranging between 0.003 and 0.415 mg m^{-3}.
  - Phytoplankton in the Levantine Basin, including in the vicinity of the study area, are primarily found in the surface ocean (0 to 150 m) where light levels are sufficient for growth (the euphotic zone).
- Tamar Field Development Project Environmental Impact Assessment for Tamar-7, -8, -9 Drilling and Completion; Tamar SW-1 completion (CSA, 2016; Section 1.2.3.1).
  - The dominant phytoplankton in Eastern Mediterranean assemblages is *Synechococcus* spp. (Pitta et al., 2005).
  - Analysis of phytoplankton accessory pigments in the eastern Levantine Basin also indicates the importance of prymnesiophyte nanoplankton (2 to 20 µm) and the presence of coccolithophorids, diatoms, and dinoflagellates (Psarra et al., 2005).
  - Diatom populations studied by Psarra et al. (2005) were found to be dominated by *Thalassionema frauenfeldii*.
  - On average, the vertical distribution of phytoplankton pigment concentrations (chlorophyll *a*) in the eastern Levantine Basin reaches a maximum at 90 to 110 m, just above the nutricline (Yacobi et al., 1995; Krom et al., 2005).
  - Ciliate abundances are maximal in the surface mixed layer (0 to 50 m); autotrophic nanoflagellate abundances are maximal just above the nutricline, at approximately 100 m depth; no consistent pattern is found for heterotrophic nanoflagellates in surface and deep waters of the eastern Levantine Basin, although their abundance and bacterial abundances decrease with depth (Tanaka et al., 2007).
  - Mesozooplankton and macrozooplankton in the eastern Levantine Basin are extremely diverse with copepods and at least 21 other zooplankton taxa present (Mazzocchi et al., 1997).

Proposed Project:

- Existing information presented in CSA (2012, 2016) is deemed sufficient for assessment purposes.

1.6.1.2 Seabed Communities

CSA (2012, 2016) previously provided a discussion for Benthic Communities within the Tamar Field; see Section 3.8.2 of the CSA (2012) document and Section 1.2.3 of the CSA (2016) document), with the key findings summarized below. MVI (2022) previously provided a summary of the benthic communities along the proposed TTGL route; see Section 1.7.1 of the MVI (2022) document). Main findings are reported in the proposed project section below.

Key Findings:

- Benthic fauna in continental slope and deep-sea habitats in the Mediterranean Sea are characterized by the fact that 1) they live across a wide range of water depths (are eurybathic), 2) they comprise very few true deepwater species, and 3) the number of endemisms generally declines with increasing depth (Cartes et al., 2004).
- Continental slope and deep-sea habitats in the Mediterranean Sea are characterized by eurybathic fauna (i.e., occupying a wide depth range), with very few true deepwater species (Cartes et al., 2004).
- Deep-sea fauna now found in the eastern Levantine Basin have historically been considered to be extremely impoverished in terms of species number, in part because the deep eastern basin is separated from the western Mediterranean by the Siculo Tunisian sill (approximately 400 m; Pérès, 1985).
- Danovaro et al. (2010) summarized all available information on benthic biodiversity (i.e., prokaryotes, foraminifera, meiofauna, macrofauna, and megafauna) in different deep-sea ecosystems of the Mediterranean Sea (i.e., from 200 to >4,000 m water depths). Results indicated that the deep-sea biodiversity is similarly high for both the eastern and the western basins of the Mediterranean Sea. In general, the biodiversity components decreased with increasing water depth. Quantitative analyses of macrofauna in deep water of the Eastern Mediterranean are limited (Tyler, 2005).
- Few studies have examined deepwater meiofauna off Israel; however, based on existing evidence, Galil (2004) characterized these communities as diverse but scarce, consisting of "autochthonous, self-sustaining populations of opportunistic, eurybathic species." Survey results from 1993 revealed a strong dependence of meiofaunal abundance on depth, distance from the coast, and food (labile organic carbon) availability (Tselepides and Lampadariou, 2004). The meiofaunal community was dominated by nematodes, harpacticoid copepods, and polychaetes.

Proposed Project:

- According to the Strategic Environmental Survey prepared by IOLR, the deep-sea zone of the exclusive economic waters of Israel has a very low combined ecological sensitivity (IOLR, 2015). More recently, the Israel Ministry of Energy (then Ministry of National Infrastructure, Energy and Water Resources) implemented a Strategic Environmental Assessment (SEA) of the offshore Mediterranean region specifically designed to characterize available environmental data, map offshore habitats, and characterize environmental vulnerability (Geo-prospect Ltd. and IOLR, 2015), supplemented with a series of updated maps (State of Israel, 2021) for both benthic and pelagic habitats and an accompanying map set depicting vulnerability to offshore oil and gas activities (State of Israel, 2021).
- The Tamar-12 Project is located in a low vulnerability, deepwater environment as determined by Geo-prospect Ltd. and IOLR (2015). [1]

[1] It is recognized that even though the Tamar-12 Project is located within an area deemed to be of "low vulnerability", there may be data gaps associated with portions of the entire area so designated. To address this issue for the Tamar development, Ministry-required project-specific baseline and monitoring surveys have been required. Results of these surveys have reinforced the determination that seabed/benthic communities in the Tamar project area have a low vulnerability to oil and gas operations.

- The State of Israel (2021) revisited the 2016 assessment to generate a series of habitat maps for the Israeli offshore region (IOLR, 2021). Updates were derived from data from different and additional survey types including multibeam sonar, chirp, autonomous underwater vehicles equipped with high-resolution side-scan sonar, remotely operated vehicles (ROVs), synthetic aperture sonar, box cores, and varying fishing methods.
- The updates and changes implemented to the SEA habitats during the 2021 assessment focused primarily on the continental shelf and slope, and therefore, the results of the 2021 mapping exercise remain consistent with previous findings and indicate that the Tamar-12 Project is located within an area of low vulnerability.
- An additional update to the SEA habitats was made in 2024 (IOLR, 2024). This update focused on benthic habitats along the continental shelf and slope, and pelagic habitats along the continental shelf and slope. These revisions did not change the status of deepwater environments on the abyssal plane, where the Tamar-12 Project is located, and therefore the Tamar-12 Project Area is still considered to be in a low vulnerability environment.
- The most current SEA habitats are displayed below in **Figures 1-18**, **1-19**, and **1-20**, with the location of the Tamar-12 Project Area displayed where figure adjustments were possible. **Figure 1-18** shows the Tamar-12 drill site relative to the SEA benthic habitats offshore Israel, and their broad classifications (State of Israel, 2021). **Figure 1-19** shows the Tamar-12 drill site relative to the SEA benthic habitat vulnerability to offshore oil and gas activities offshore Israel (State of Israel, 2021). **Figure 1-20** shows the SEA pelagic habitats as of 2024; accordingly, the Tamar Field would be located in areas 51/52/53 which are defined as epi-pelagic/ meso-pelagic /bathy-pelagic and are not determined to be sensitive areas.

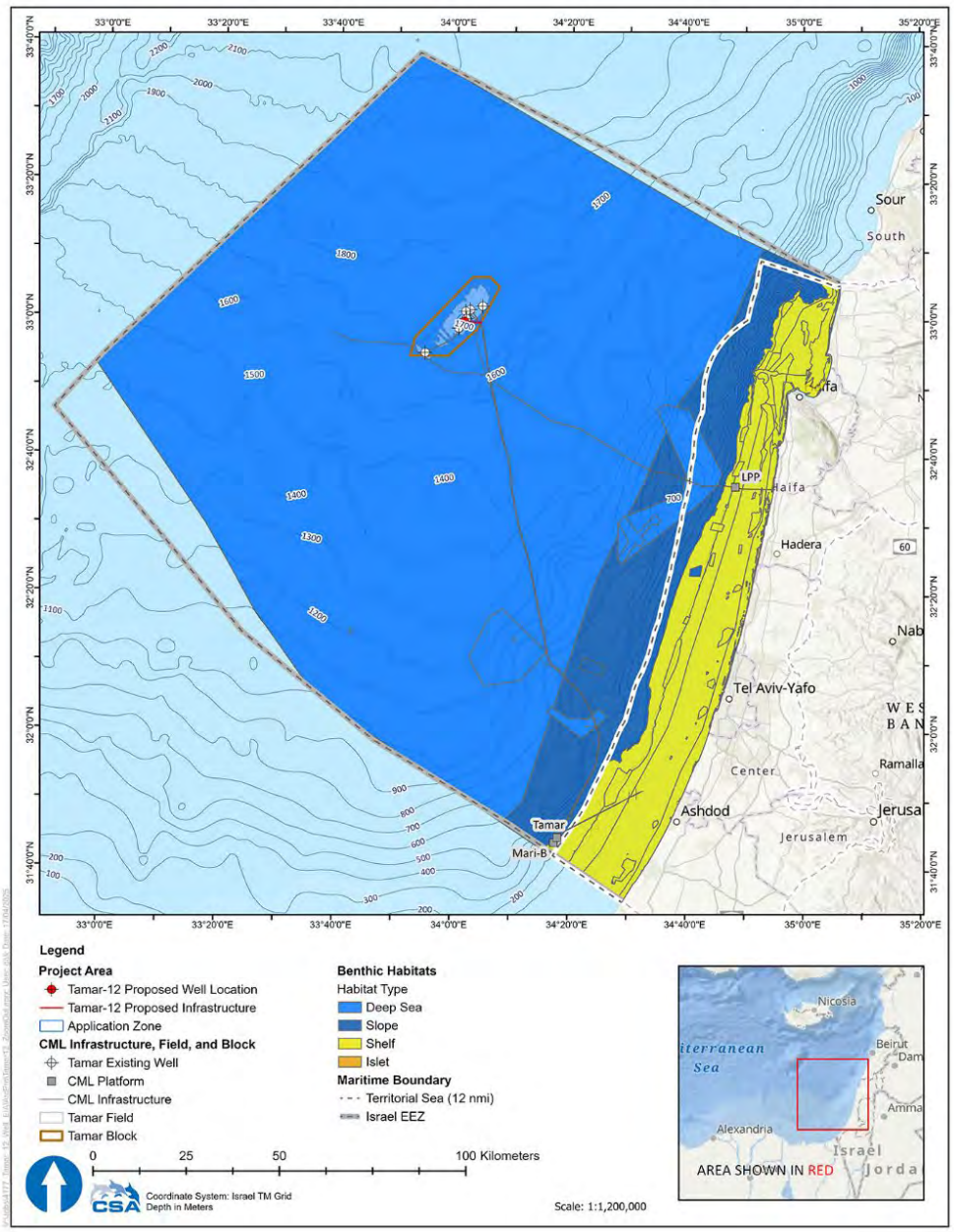


Figure 1-18. Benthic habitat types within the Tamar Field, Tamar-12 Project Area, and the Israeli exclusive economic zone (EEZ) as identified by the Strategic Environmental Assessment (Adapted from: State of Israel, 2021).

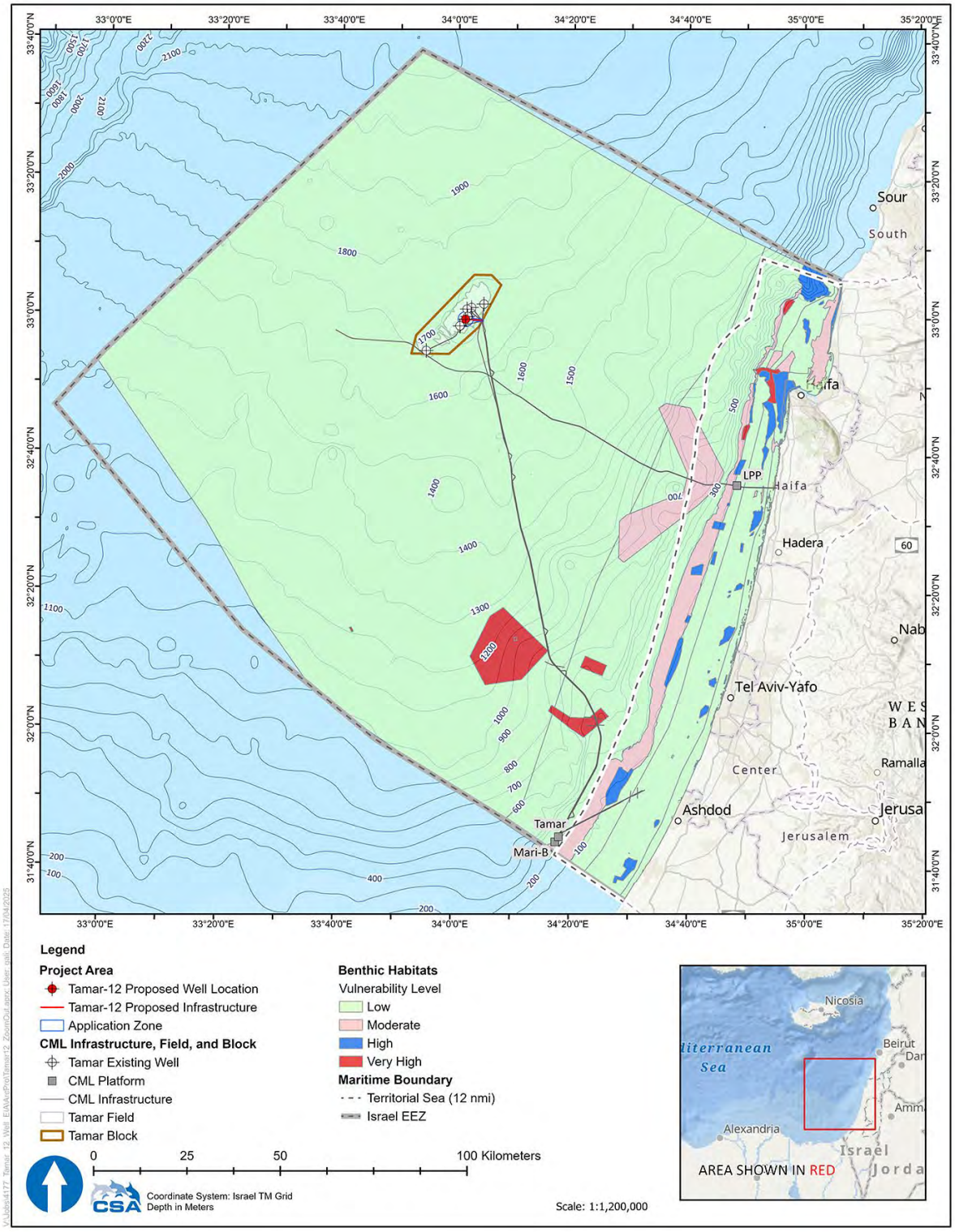


Figure 1-19. Benthic habitats of the Tamar Field, Tamar-12 Project Area, and the Israeli exclusive economic zone (EEZ) displaying vulnerability levels as identified by the Strategic Environmental Assessment (Adapted from: State of Israel, 2021).

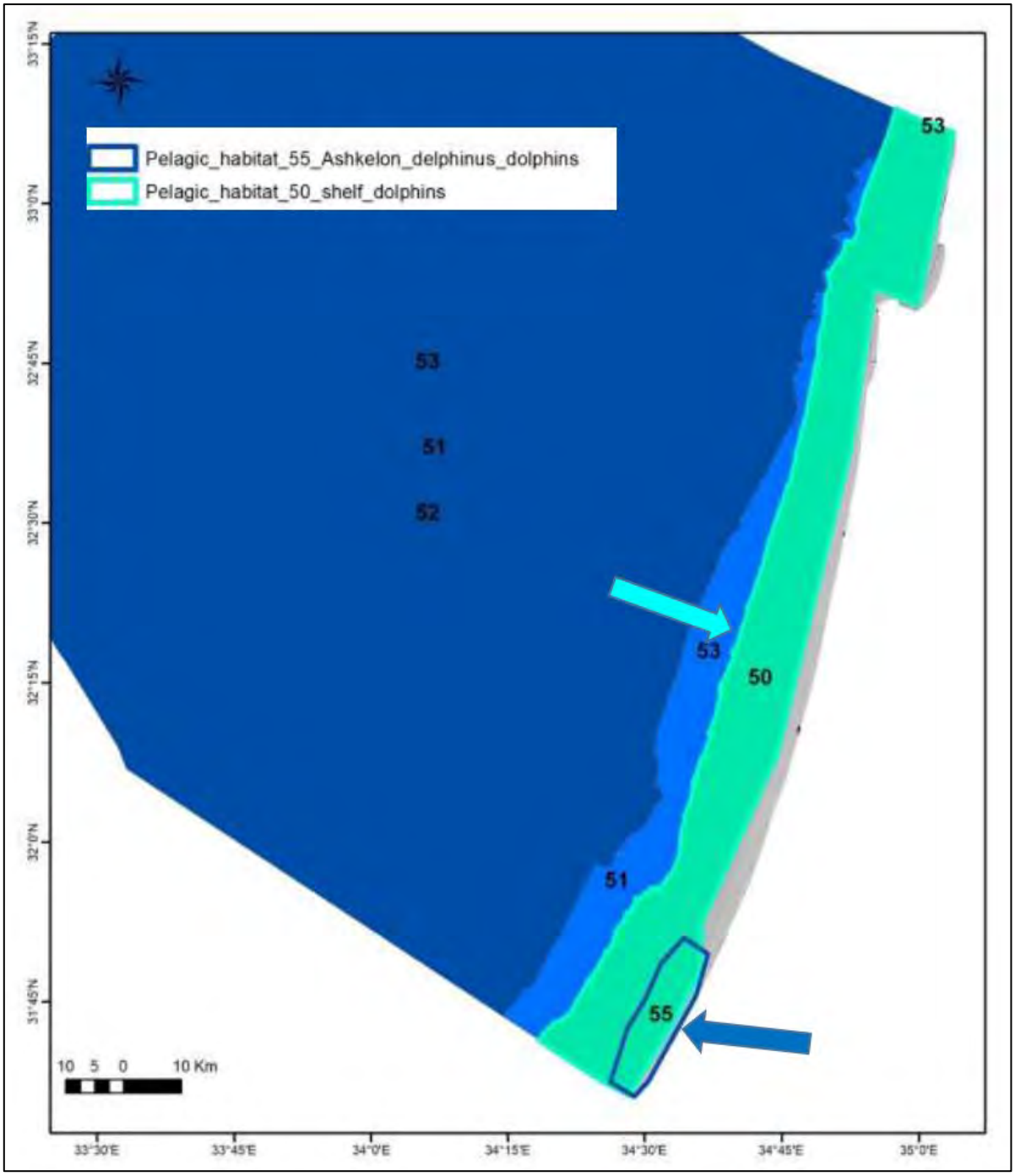


Figure 1-20. Pelagic habitats identified by the Strategic Environmental Assessment (From: IOLR, 2024).

1.6.2 Coastal Biota and Natural Values

The Tamar-12 Project Area lies within the deep-sea zone of the Israeli EEZ. According to the Strategic Environmental Assessment (SEA) prepared for the Israel Ministry of Energy, and updated in 2021 and 2024, the area has a very low combined ecological sensitivity. The seabed in the area consists primarily of soft bottom, mud and silt, and there are no known hard bottom sites or sensitive habitats (Geo-prospect Ltd. and IOLR, 2015; IOLR, 2021, 2024). As the Tamar-12 Project Area and application zone are located 90 km from the nearest coastline, no coastal biota is found in the application zone. Infaunal organisms, sampled during the 2023 Tamar Field EMS, are described in **Section 1.6.5**, and compared to findings from the 2014 Tamar Field EBS. Otherwise, no additional biological organisms or natural values have been identified in the application zone during previous Tamar Field monitoring efforts or other research activities conducted by universities or non-governmental organizations.

1.6.3 Marine Mammals, Sea Turtles, Birds, and Fishes

1.6.3.1 Marine Mammals

CSA (2012, 2016) previously provided a discussion for marine mammals; see Section 3.8.6.1 of CSA (2012) and Section 1.2.3.4 of CSA (2016), with key findings summarized below. MVI (2022) also discussed marine mammals in Section 1.7.3.1. Main findings are reported in the proposed project section below.

Key Findings:

- No site-specific marine mammal data are available for the Tamar-12 Project Area.
- Several small cetacean taxa are considered regular visitors – e.g., Bottlenose Dolphin (*Tursiops truncatus*), Risso's Dolphin (*Grampus griseus*), and False Killer Whale (*Pseudorca crassidens*). (Kerem et al., 2012).
- Several large cetacean taxa are considered regular visitors to the area – e.g., Fin Whale (*Balaenoptera physalus*), Sperm Whale (*Physeter macrocephalus*), and Minke Whale (*Balaenoptera acutorostrata*). The Humpback Whale (*Megaptera novaeangliae*) and Killer Whale (*Orcinus orca*) are considered vagrants in the Levantine Basin (Kerem et al., 2012).
- Mediterranean Monk Seal (*Monachus monachus*) is the only Vulnerable pinniped on the IUCN Red List; this species is extremely rare off Israel, with only two sightings of this species noted within the past 50 years. A single seal was observed offshore Herzliya in 2010.
- Based on strandings and sightings data, the Bottlenose Dolphin appears to be the most abundant marine mammal taxa present in Israeli waters. Bottlenose Dolphins account for 85% of all marine mammal sightings and 60% of the strandings in Israel. Sightings have occurred up to 30 km offshore in up to 1,300 m water depths (Kerem et al., 2012).
- A Mediterranean subpopulation of Rough-toothed Dolphin (*Steno bredanensis*) is present in the Eastern Mediterranean, near Cyprus; this species is IUCN-listed as Least Concern.
- CSA conducted a marine protected species survey as part of a two dimensional (2D) bathymetric survey offshore Israel from 29 September to 24 October 2014. There were five marine mammal sightings during the survey period, and all were Bottlenose Dolphins. No sea turtle or whale species were observed during the survey (CSA Ocean Sciences Inc., 2014).

Proposed Project:

- Small cetacean species that are considered regular species or visitors in the Levantine Basin include the Common Bottlenose Dolphin (*Tursiops truncatus*), Short-beaked Common Dolphin (*Delphinus delphus*), Risso's Dolphin (*Grampus griseus*), Rough-toothed Dolphin (*Steno bredanensis*), Striped Dolphin (*Stenella coeruleoalba*), Cuvier's Beaked Whale (*Ziphius cavirostris*), and False Killer Whale (*Pseudorca crassidens*).
- Large cetaceans that are considered regular residents or visitors in the Levantine Basin include the Fin Whale (*Balaenoptera physalus*), Minke Whale (*Balaenoptera acutorostrata*), and Sperm Whale (*Physeter macrocephalus*).

- The Humpback Whale (*Megaptera novaeangliae*) and Killer Whale (*Orcinus orca*) are considered vagrants in the Levantine Basin, along with the Indo-Pacific Humpback Dolphin (*Sousa chinensis*), a Lessepsian migrant introduced through the Suez Canal.
- Several other marine mammal species are considered vagrants elsewhere in the Mediterranean and their presence is not confirmed in Israeli waters (**Table 1-1**).
- Rough-toothed Dolphin is the only Mediterranean cetacean species for which the Levantine Basin may be the critical habitat for the subpopulation (Notarbartolo di Sciara and Birkun, 2010; Kerem et al., 2012).
- Kerem et al. (2014) assessed the status of small cetacean species offshore Israel, including Bottlenose Dolphin, Short-beaked Common Dolphin, Risso's Dolphin, Rough-toothed Dolphin, and Cuvier's Beaked Whale. Abundance was not estimated for any of these species. Based on strandings and sightings data, Common Bottlenose Dolphin appears to be the most abundant.
- According to Brand et al. (2019), there is a small resident population of common dolphins in the south of Israel, in shallow waters.
- There is also one report of a grey whale (*Eschrichtius robustus*) sighting offshore Israel, but it is considered an extreme example of a vagrant species.
- The Mediterranean Monk Seal (*Monachus monachus*), a Critically Endangered species, is the only pinniped found in the Mediterranean region. The Mediterranean Monk Seal population is estimated at approximately 350 to 450 surviving individuals, making it one of the world's most Critically Endangered mammals. It is very unlikely that monk seals will be present in the project area because they are extremely rare within waters offshore Israel. Although sightings have increased in recent years (Roditi-Elasar et al., 2021), many of the sightings are thought to be from the same individual that has repeatedly crossed the maritime border from Lebanon into Israel.
- More recently, in May 2023, a female monk seal came ashore along the central Israel coast.
- Several marine mammal species which may be present are considered Near Threatened or Vulnerable, per the IUCN Red List (IUCN, 2025).
- Several marine mammal species which have been recorded in Israeli waters and may be present in the Tamar-12 Project Area are considered Near Threatened or Vulnerable, per the IUCN Red List (IUCN, 2025).

Table 1-1. Resident, visiting and vagrant marine mammal species potentially occurring in the application zone based on Kerem et al. (2012), ACCOBAMS (2012), Notarbartolo di Sciara and Birkun (2010) and IUCN (2023).

Resident Marine Mammals in the Mediterranean Sea				
Common Name	Scientific Name	Population	IUCN status	Presence Confirmed in Israeli Waters
Mysticete Whales				
Fin Whale	*Balaenoptera physalus*	Mediterranean subpopulation	Endangered	Yes
Odontocete Whales, Dolphins, and Porpoises				
Bottlenose Dolphin	*Tursiops truncatus*	Mediterranean subpopulation	Least Concern	Yes
Common Dolphin	*Delphinus delphis*	Inner Mediterranean subpopulation	Endangered	Yes
Cuvier's Beaked Whale	*Ziphius cavirostris*	Mediterranean subpopulation	Vulnerable	Yes
Risso's Dolphin	*Grampus griseus*	Mediterranean subpopulation	Endangered	Yes
Rough-toothed Dolphin	*Steno bredanensis*	Mediterranean subpopulation	Near Threatened	Yes
Sperm Whale	*Physeter macrocephalus*	Mediterranean subpopulation	Endangered	Yes
Striped Dolphin	*Stenella coeruleoalba*	Mediterranean subpopulation	Least Concern	Yes

Table 1-1. (Continued).

Resident Marine Mammals in the Mediterranean Sea				
Common Name	Scientific Name	Population	IUCN status	Presence Confirmed in Israeli Waters
Killer Whale	*Orcinus orca*	Strait of Gibraltar subpopulation	Critically Endangered	Yes
Long-Finned Pilot Whale	*Globicephala melas*	Inner Mediterranean subpopulation	Endangered	No
Pinnipeds				
Mediterranean Monk Seal	*Monachus monachus*	Eastern Mediterranean subpopulation	Vulnerable	Yes
Visiting and Vagrant Marine Mammals in the Mediterranean Sea				
Common Name	Scientific Name	Mediterranean Presence	Global IUCN status	Presence Confirmed in Israeli Waters
Mysticete Whales				
Common Minke Whale	*Balaenoptera acutorostrata*	Visitor	Least Concern	Yes
Sei Whale	*Balaenoptera borealis*	Vagrant	Endangered	No
Bryde's Whale	*Balaenoptera edeni*	Vagrant	Not Evaluated	No
Grey Whale	*Eschrichtius robustus*	Vagrant	Least Concern	Yes
North Atlantic Right Whale	*Eubalaena glacialis*	Vagrant	Critically Endangered	No
Odontocete Whales, Dolphins, and Porpoises				
Short-Finned Pilot Whale	*Globicephala macrorhynchus*	Vagrant	Least Concern	No
Northern Bottlenose Whale	*Hyperoodon ampullatus*	Vagrant	Near Threatened	No
Dwarf Sperm Whale	*Kogia sima*	Vagrant	Least Concern	No
Humpback Whale	*Megaptera novaeangliae*	Visitor	Least Concern	No
Sowerby's Beaked Whale	*Mesoplodon bidens*	Vagrant	Least Concern	No
Blainville's Beaked Whale	*Mesoplodon densirostris*	Vagrant	Least Concern	No
Gervais' Beaked Whale	*Mesoplodon europaeus*	Vagrant	Least Concern	No
Atlantic Harbour Porpoise	*Phocoena phocoena*	Vagrant	Least Concern	No
False Killer Whale	*Pseudorca crassidens*	Visitor	Near Threatened	Yes
Killer Whale	*Orcinus orca*	Vagrant	Data Deficient	Yes
Indian Ocean Humpback Dolphin	*Sousa plumbea*	Visitor	Endangered	Yes

[1] International Union for Conservation of Nature (IUCN, 2025) status.

1.6.3.2 Sea Turtles

CSA (2012, 2016) previously provided a discussion for sea turtles; see Section 3.8.7 of CSA (2012) and Section 1.2.3.5 of CSA (2016), with key findings summarized below. MVI (2022) also discussed sea turtles in Section 1.7.3.2, and main findings are reported in the proposed project section below.

Key Findings:

- No site-specific data are available regarding sea turtles.
- Tracking studies suggest sea turtles could occur within the Application Area – e.g., green turtle (*Chelonia mydas*), leatherback turtle (*Dermochelys coriacea*), and loggerhead turtle (*Caretta caretta*) (**Table 1-2**).
- Mediterranean loggerhead and green turtle populations appear to be genetically isolated from populations in the Atlantic Ocean (Bowen et al., 1992, 1993; Laurent et al., 1993).
- Loggerhead and green turtles are listed on the IUCN Red List (IUCN, 2025).
- Loggerhead and green turtles are known to nest along the Israel coast.
- Greece, Cyprus, and Turkey provide the primary nesting grounds for turtles in the Mediterranean (Levy, 2011).
- Tracking data (SeaTurtle.org, 2020) indicate that there is a large probability of sea turtles occurring offshore Israel, especially in June-July during the breeding season.

Proposed Project:

- Mediterranean loggerhead and green turtle populations appear to be genetically isolated from populations in the Atlantic Ocean, as fishing-induced mortality cannot be counterbalanced by immigration. This implies that the survival of the Mediterranean populations of these species depends to a great extent on current and future conservation efforts by Mediterranean countries' governments to reduce accidental mortality.
- The United Nations Environment Programme previously developed the Mediterranean Action Plan, Regional Activity Centre for Specially Protected Areas for marine turtles (UNEP MAP RAC/SPA, 2007). For Israel, the action plan calls for the implementation of Israeli policies and procedures to 1) ensure long-term protection of major and potential nesting beaches; 2) promote the process of legal declaration of protected marine and coastal areas; and 3) eliminate both destructive human activities on nesting beaches and the disorientation of hatchlings caused by artificial light.
- Green turtles (*Chelonia mydas*) are now the only sea turtle listed as Endangered, with the loggerhead's Mediterranean subpopulation being put into the Least Concern category (IUCN, 2025).

Table 1-2. Updated listing of sea turtle species potentially occurring in the Application Area (From: IUCN, 2025).

Common Name	Scientific Name	IUCN Status[1]	Nesting in Israel
Loggerhead turtle	*Caretta caretta*	LC (Med subpopulation)	Yes
Green turtle	*Chelonia mydas*	EN	Yes
Leatherback turtle	*Dermochelys coriacea*	VU	No

[1] IUCN status: EN = endangered; VU = vulnerable. LC = least concern.

1.6.3.3 Seabirds and Migratory Birds

CSA (2012, 2016) previously provided a discussion for migratory birds; see Section 3.8.5 of CSA (2012) and Section 1.2.3.6 of CSA (2016), with key findings summarized below. MVI (2022) also discussed marine mammals in Section 1.7.3.3, and main findings are reported in the proposed project section below.

Key Findings:

- No site-specific bird data are available regarding seabirds and migratory birds.
- At least 38 seabird species are native to Israeli waters (**Table 1-3**).

- Israel is known as a major migratory pathway with up to 500 million birds using the airspace (Leshem and Atrash, 1998).
- Fifteen important bird areas (IBAs) have been designated in Israel, two of which are important coastal habitats: the Zvulun Valley includes small wetlands, ponds, and coastal marshes; the Carmel Coast includes large complex fish ponds (BirdLife International, 2025).
- Due to the distance offshore (>100 km), pelagic seabirds are likely to be the most prevalent species present in the Tamar Field area.
- Pelagic seabirds native to Israeli waters include Cory's Shearwater (*Calonectris diomedea*), Leach's Storm-Petrel (*Oceanodroma leucorhoa*), Sooty Shearwater (*Puffinus griseus*), and Yelkouan Shearwater (*Puffinus yelkouan*).
- Two of the seabirds which may occur offshore Israel are listed as Vulnerable (Yelkouan Shearwater and Dalmatian Pelican) on the IUCN Red List, however no observed breeding of these species in Israel has been reported (**Table 1-3**).
- Several of the pelagic seabird species in **Table 1-3** are listed in Annex II of the Protocol Concerning Specially Protected Areas and Biological Diversity of the Mediterranean (United Nations Environment Programme, 2013) as endangered or threatened avifauna of the Mediterranean region. These include Cory's Shearwater, Slender-billed Gull (*Larus genei*), Dalmatian Pelican, Great White Pelican (*Pelecanus onocrotalus*), Pygmy Cormorant (*Phalacrocorax pygmeus*), Levantine Shearwater, Little Tern (*Sterna albifrons*), Lesser Crested Tern (*Sterna bengalensis*), Caspian Tern (*Sterna caspia*), Gull-billed Tern (*Sterna nilotica*), and Sandwich Tern (*Sterna sandvicensis*). Two of these, the Great White Pelican and Little Tern, breed in Israel; their IUCN status is Least Concern.
- The United Nations Environment Programme (2013) includes shorebirds reported from Israel of which the Slender-billed Curlew (*Numenius tenuirostris*) is Critically Endangered, however it is considered a vagrant species and does not breed in Israel (**Table 1-4**).

Proposed Project:

- No site-specific data are available, however based on previous reports and data, pelagic seabirds are prevalent. Several species are listed as Vulnerable (IUCN, 2025).
- Seabird species are not expected to breed within or near the project area, reducing the potential for impact.
- According to BirdLife International (2025), 35 seabird species are present in Israel, while a total of 314 migratory bird species occur in Israel, with many species listed as Endangered, Critically Endangered, or Vulnerable per the IUCN Red List.
- Israel is well known as one of two major bird migratory pathways in the Mediterranean region, with the other being Gibraltar. For migratory birds, up to 500 million individuals representing 314 species utilize Israel airspace on an annual basis, with many seeking refuge along Israel's coastal habitats.
- Status designation of Dalmatian Pelican per the IUCN Red List has changed from Vulnerable to Near Threatened; Leach's Storm-Petrel has been changed from Least Concern to Vulnerable; White-eyed Gull has been changed from Near Threatened to Least Concern.
- There has been a taxonomic change for Pygmy Cormorant from *Phalacrocorax pygmeus* to *Microcarbo pygmaeus*.

Table 1-3. Updated listing of seabird species occurring in Israeli waters (Adapted from: BirdLife International, 2025).

Common Name	Scientific Name	IUCN Status[1]	Listed in Annex II[2]	Breeding in Israel[3]
Cory's Shearwater	*Calonectris diomedea*	LC	Yes	--
Black Tern	*Chlidonias niger*	LC	--	--
Caspian Gull	*Larus cachinnans*	LC	--	--
Mew Gull	*Larus canus*	LC	--	--
Lesser Black-backed Gull	*Larus fuscus*	LC		--
Slender-billed Gull	*Larus genei*	LC	Yes	--
Pallas's Gull	*Larus ichthyaetus*	LC	--	--

Table 1-3. (Continued).

Common Name	Scientific Name	IUCN Status[1]	Listed in Annex II[2]	Breeding in Israel[3]
White-eyed Gull	*Larus leucophthalmus*	LC	--	--
Mediterranean Gull	*Larus melanocephalus*	LC	Yes	--
Yellow-legged Gull	*Larus michahellis*	LC	--	--
Little Gull	*Larus minutus*	LC	--	--
Black-headed Gull	*Larus ridibundus*	LC	--	--
Red-breasted Merganser	*Mergus serrator*	LC	--	--
Northern Gannet	*Morus bassanus*	LC	--	--
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	VU	--	--
Dalmatian Pelican[4]	*Pelecanus crispus*	NT	Yes	--
Great White Pelican	*Pelecanus onocrotalus*	LC	Yes	Yes
Great Cormorant	*Phalacrocorax carbo*	LC	--	--
Pygmy Cormorant[4]	*Microcarbo pygmaeus*	LC	Yes	--
Red Phalarope	*Phalaropus fulicarius*	LC	--	--
Red-necked Phalarope	*Phalaropus lobatus*	LC	--	--
Great crested Grebe	*Podiceps cristatus*	LC	--	--
Black-necked Grebe	*Podiceps nigricollis*	LC	--	--
Sooty Shearwater	*Puffinus griseus*	NT	--	--
Yelkouan Shearwater	*Puffinus yelkouan*	VU	Yes	--
Long-tailed Jaeger	*Stercorarius longicaudus*	LC	--	--
Parasitic Jaeger	*Stercorarius parasiticus*	LC	--	--
Pomarine Jaeger	*Stercorarius pomarinus*	LC	--	--
Little Tern	*Sterna albifrons*	LC	Yes	Yes
Bridled Tern	*Sterna anaethetus*	LC	--	--
Lesser Crested Tern	*Sterna bengalensis*	LC	Yes	--
Great Crested Tern	*Sterna bergii*	LC	--	--
Caspian Tern	*Sterna caspia*	LC	Yes	--
Common Tern	*Sterna hirundo*	LC	--	Yes
Gull-billed Tern	*Sterna nilotica*	LC	Yes	--
White-cheeked Tern	*Sterna repressa*	LC	--	--
Sandwich Tern	*Sterna sandvicensis*	LC	Yes	--
Brown Booby	*Sula leucogaster*	LC	--	--

[1] International Union for Conservation of Nature (IUCN, 2025) status: LC = least concern; NT = near threatened; VU = vulnerable.
[2] Annex II of the Protocol Concerning Specially Protected Areas and Biological Diversity of the Mediterranean (United Nations Environment Programme, 2013).
[3] Breeding in Israel based on BirdLife International (2025) map viewer showing range and breeding locations.
[4] Dalmatian Pelican and Pygmy Cormorant are not listed as native to Israel by BirdLife International (2025) but have been added based on IUCN (2025) and their individual species descriptions on the BirdLife International website.
-- = not listed in Annex II, or not breeding in Israel.

Table 1-4. Updated shorebird species occurring in Israel that are on the Annex II list (From: IUCN, 2025).

Common Name	Scientific Name	IUCN Status[1]	Israel Occurrence[2]	Breeding in Israel[3]
Kentish Plover	*Charadrius alexandrinus*	LC	Native	No
Greater Sand Plover	*Charadrius leschenaultii*	LC	Native	No
Pied Kingfisher	*Ceryle rudis*	LC	Native	Yes
White-throated Kingfisher	*Halcyon smyrnensis*	LC	Native	Yes
Slender-billed Curlew	*Numenius tenuirostris*	CR	Vagrant	No
Osprey	*Pandion haliaetus*	LC	Native	No
Eleonora's Falcon	*Falco eleonorae*	LC	Native	No

[1] International Union for Conservation of Nature (IUCN, 2025) status: CR = critically endangered; LC = least concern.
[2] Occurrence in Israel based on IUCN (2014).
[3] Breeding in Israel based on BirdLife International (2025) map viewer showing range and breeding locations.

1.6.3.4 Pelagic Fish

CSA (2012, 2016) previously provided a discussion for pelagic fish; see Section 3.8.3 of CSA (2012) and Section 1.2.3.3 of CSA (2016), with key findings summarized below. MVI (2022) also discussed pelagic fish in Section 1.7.3.4, and main findings are reported in the proposed project section below.

Key Findings:

- The pelagic offshore environment includes both small and large pelagic species; small pelagics tend to be more concentrated in shallow waters and larger pelagics may be found farther offshore in blue water as well.
- Of the large pelagics, special note is warranted for Atlantic bluefin tuna (*Thunnus thynnus*), considered one of the most valuable fish species, as it is undergoing a commercial collapse.
- Bluefin tuna enter the Mediterranean to spawn in the spring.
- Other large offshore pelagic fishes in the Levant include albacore tuna and other scombrids (e.g., *Euthynnus alletteratus*), dolphinfish, swordfish, sailfish, and pelagic sharks (e.g., hammerhead, blue shark, *Priona glauca*).
- Pelagic fishes are generally migratory species that usually form schools and traverse shelf waters occasionally moving onshore to offshore, but typically parallel the coastline.
- Pelagic species found off the Israeli coast are represented by sharks (Carcharhinidae), anchovies (*Engraulis* sp.), herrings (*Sardinella aurita*), jacks (*Trachurus* spp. and *Seriola dumerili*), mackerels (*Scomber japonicus*), tunas (*Euthynnus* spp., *Auxis* spp.), mullets (Mugilidae), and barracudas (*Sphyraena* spp.).
- Smaller pelagic fishes such as anchovies, herrings, and some jacks (*Trachurus* spp.) are planktivores.
- Larger pelagic species including sharks, tunas, mackerels, jacks, and barracudas feed on smaller pelagic species.

Proposed Project:

- The species and movement patterns described in CSA (2012, 2016) is deemed sufficient for assessment purposes.
- There are no site-specific pelagic fish data from the Tamar-12 Project Area.

1.6.4 Nature Reserves and Sensitive Habitats

CSA (2012, 2016) and MVI (2022) previously provided a discussion for nature reserves and sensitive habitats with key findings summarized below.

1.6.4.1 Nature Reserves

Key Findings:

- Environmental Impact Assessment Tamar Field Development Project Offshore Israel (CSA, 2012; Section 3.8.1).
  - There are 15 designated protected marine or marine-terrestrial habitats along the Mediterranean coast of Israel, including those listed by the IUCN (see Table 34 of CSA, 2012).
  - Abdulla et al. (2008) describes 17.97 km^2 or 0.56% of Israel's coast as managed or protected areas (MPAs).
- TTGL Project (MVI, 2022; Section 1.7.4).
  - Several sections within the TTGL project area fall within the Palmachim Disturbance, and are proposed as protected areas or fisheries restricted areas.
  - An extension of the Yam Evtach Nature Reserve has been proposed, expanding the current nature reserve currently 300 m from shore to a total area extending 7.5 km from shore.

Proposed Project:

- There are no Nature Reserves within 10 km of the Tamar-12 Project Area (**Figure 1-8**).

1.6.4.2 Sensitive Habitats

Key Findings:

- Environmental Impact Assessment Tamar Field Development Project Offshore Israel (CSA, 2012; Section 3.8.2.7).
  - Reports from the Hotspot Ecosystems Research on the Margins of European Seas (HERMES) project map chemosynthetic benthic communities several tens of kilometers to the northwest of the Tamar Field.
  - Surveys conducted by Dimitrov and Woodside (2003) and Bayon et al. (2009) have located chemosynthetic communities in various locations of the Eastern Mediterranean (via remote identification of small depressions or surficial pockmarks).
  - In the southeastern Mediterranean, communities of polychaetes and bivalves were found associated with cold seeps and carbonates near Egypt and the Gaza Strip at depths of 500 to 800 m, but no living fauna were collected (Coleman and Ballard, 2001).
- Tamar Field Development Project Environmental Impact Assessment for Tamar-7, -8, -9 Drilling and Completion; Tamar SW-1 completion (CSA, 2016; Section 1.2.3.2).
  - Coleman and Ballard (2001) documented the presence of chemosynthetic benthic communities within small depressions or surficial pockmarks offshore Israel dominated by polychaetes and bivalves.
- TTGL Project (MVI, 2022; Section 1.7.1).
  - The Palmachim Disturbance is an area noted for the presence of hard substrates and associated biota.
  - Areas 63 and 11 of the Palmachim Disturbance are along the proposed TTGL route and are composed of pockmarks, carbonate crusts, active methane seeps, and some soft bottom areas.

Proposed Project:

- There are no acoustic signatures indicative of sensitive benthic communities at, or within a 2,000 m radius of, the proposed well location.
- Tom and Kanari (2023) present an online mapper of offshore Israel, including previous benthic sampling events in the Tamar Field; data presented in the mapper does not indicate any sensitive habitats in the vicinity of the Tamar Field.
- Benthic habitat maps prepared by the State of Israel (2021) show that the deepwater offshore area in the vicinity of the Tamar Field does not have any sensitive habitats present.

1.6.5 Natural Values and Ecology Details

CSA (2012, 2016) and MVI (2022) previously provided a discussion for benthic communities, with the key findings summarized below.

Key Findings:

- Environmental Impact Assessment Tamar Field Development Project Offshore Israel (CSA, 2012; Section 3.8.1).
  - Benthic fauna in the continental slope and deep-sea habitats in the Mediterranean Sea have low diversity and species richness.
  - Overall, mean benthic biomass, abundance, and diversity decrease drastically with depth in the Eastern Mediterranean, with major faunal transitions occurring at 200, 500, and 1,000 m (Tselepides et al., 2000).
  - Given the bathymetric macrofaunal surveys of the Levant (Kröncke et al., 2003; Jones et al., 2003; Galil, 2004), it is generally accepted that faunal shifts occur at 100 to 120 m (i.e., shelf-slope break) and at 650 to 1,000 m (i.e., slope-rise breaks).
- Tamar Field Development Project Environmental Impact Assessment for Tamar-7, -8, -9 Drilling and Completion; Tamar SW-1 completion (CSA, 2016; Section 1.2.3.2).
  - Within the Tamar Field, 667 individual infaunal organisms were collected during the 2013 and 2014 surveys.
  - Infaunal abundance within the Tamar Field was patchy and low, ranging from 25 to 125 individuals per m^2.
  - Infaunal species richness was low, consisting primarily of the polychaete *Notomastus* sp., as the dominant infaunal taxa within the region.
  - The presence of chemosynthetic benthic communities, dominated by polychaetes and bivalves, has been documented offshore Israel (Coleman and Ballard, 2001) and are indicated by an acoustic signature appearing as small depressions or surficial pockmarks.
- TTGL Project (MVI, 2022; Section 1.7.1).
  - Seafloor habitats consist primarily of soft bottom mud and silt.
  - There are no known hard bottom sites along the proposed TTGL route.

Proposed Project:

- During the 2023 Tamar Field EMS, one station was sampled for infauna analysis. This station was B4, 4.2 km northwest of the proposed Tamar-12 drill site location (**Figure 1-2**). Findings from the infauna analysis at this station showed that infaunal abundance and species richness were low but typical of Levantine Basin deep water infauna communities. The infaunal community was dominated by annelids and nematodes, with some contribution by arthropods and ribbon worms (Nemertea). Measured infauna density was 64 individuals m^{-2}, similar to infaunal densities measured during the 2014 Tamar Field EBS which ranged from 25 to 125 individuals m^{-2} at the 83 sampling locations surveyed as part of the EBS.

1.6.5.1 Organism Details

During the 2023 Tamar Field EMS the most abundant phylum was Annelida, accounting for 60.4% of the total infaunal density. The second most abundant phylum was Nematoda, accounting for 18.7% of the total infaunal density, followed by the third most abundant phylum, Arthropoda (subphylum: Crustacea), accounting for 17.7% of the total infaunal density. As a comparison, Annelida, Arthropoda, Mollusca, and Sipuncula were the most abundant phyla during the 2014 Tamar Field EBS.

1.6.5.2 Species Diversity (Across Taxonomic Groups)

Infaunal organisms were identified to the lowest practical taxonomic level, herein referred to as uniquely identified taxa. The six most abundant uniquely identified taxa from the 2023 Tamar Field EMS are listed in **Table 1-5**. Among these taxa were *Spiophanes* sp. (Family: Spionidae) and *Notomastus* sp., which also comprised part of the most abundant uniquely identified taxa of the

2014 Tamar Field EBS, showing some similarity between the surveys. All other abundant uniquely identified taxa from the two surveys were different.

Table 1-5. Infaunal density and relative abundance (proportion in %) of the five most abundant uniquely identified taxa in the composite infauna sample collected during the 2023 Tamar Field Environmental Monitoring Survey and in the individual infauna samples collected during the 2014 Tamar Field Environmental Baseline Survey.

Phylum	Class	Taxon	2014 Tamar Field EBS[1]		2023 Tamar Field EMS	
			Density (individuals m^{-2})	Relative Abundance (%)	Density (individuals m^{-2})	Relative Abundance (%)
Nematoda	--	Nematoda	--	--	12.0	18.9
Annelida	Polychaeta	Spionidae sp.	7.1	8.7	--	--
Annelida	Polychaeta	*Spiophanes* sp.	--	--	10.7	12.7
Annelida	Polychaeta	*Notomastus* sp.	24.9	30.6	9.3	14.6
Annelida	Polychaeta	*Brania* sp.	--	--	7.3	4.7
Annelida	Polychaeta	*Prionospio* sp.	--	--	7.3	4.7
Annelida	Polychaeta	*Glycera lapidium*	3.2	3.9	--	--
Arthropoda	Malacostraca	*Collettea cylindrata*	--	--	7.3	4.7
Arthropoda	Malacostraca	Tanaidomorpha sp. 3 EcoA	5.6	6.9	--	--
Mollusca	Bivalvia	*Microgloma* sp.	4.8	5.8	--	--
Totals for most abundant uniquely identified taxa			45.6	55.9	53.9	60.3

[1] The 2014 sampling included sample collection at 83 different locations whereas the 2023 sampling included just a single location. Densities are relative abundances are presented as totals for the entire Tamar Field survey area and not means ± standard deviation of the sampled stations.
"--" = not determined or not applicable.

1.6.5.3 Diversity Indices

Diversity metrics, including taxa richness (*S*), abundance, density, Shannon-Wiener (*H'*), Pielou's Evenness (*J'*), and Margalef's (*D*) diversity metrics for the 2023 Tamar Field EMS composite sample are presented in **Table 1-6**. The 2014 Tamar Field EBS diversity metrics are also provided for comparison, but results should be reviewed with caution because of the methodological differences between the two surveys.

Table 1-6. Diversity metrics of the infaunal community of the composite infauna sample from the 2023 Tamar Field Environmental Monitoring Survey and of the individual infauna samples from the 2014 Tamar Field Environmental Baseline Survey.

Survey	Taxa Richness (*S*)	Abundance (number of individuals)	Density (individuals m^{-2})	Shannon-Wiener Diversity (*H'*)	Pielou's Evenness (*J'*)	Margalef Diversity (*D*)
2014[1]	62	667	81.7	2.98	0.96	9.38
2023	22	96	64	2.54	0.82	4.6

[1] The 2014 sampling included sample collection at 83 different locations whereas the 2023 sampling included just a single location. Diversity metrics are presented as totals for the entire Tamar Field survey area and not means ± standard deviation of the sampled stations.

1.6.5.4 Sedentary Species and Mobile Species

As infaunal analysis, by definition, includes only mobile species living within the sediment – all species discussed in this section are mobile species.

1.6.5.5 Additional Parameters for Individual Species

No data are available on this matter.

1.6.5.6 Species Origin

There is no evidence that any of the species identified in infaunal samples from the Tamar Field are of a non-native origin.

1.6.6 Fishing Areas

CSA (2012, 2016) previously provided a discussion for commercial fishing, recreational fishing, and marine farming; see Section 3.10.1 of CSA (2012) and Section 1.2.9 of CSA (2016), with key findings summarized below.

Key Findings:

- Most of the fishing in the Mediterranean is in shallow water, in water depths up to 110 m.
- Commercial fishing is controlled by the government, mostly through reduction of effort by freezing the size of the fishing fleet and not allowing any new participants to join.
- The following four domestic fish sources account for local production:
  - Aquaculture – consisting of fish ponds, which account for the majority of production;
  - Marine fishing in the Mediterranean and Gulf of Eilat (Red Sea);
  - Mariculture in Mediterranean; and
  - Freshwater fishing from Lake Kinneret (Sea of Galilee).
- There are three main fishing ports along the Israeli Mediterranean coastline – Ashdod, Jaffa, and Kishon (Haifa).
- Fishing is concentrated along the narrow continental shelf, which is 50 km wide along the southern portions of the country and narrows to only about 15 km in the north.
- Approximately 40% of fishing activity is concentrated between Ashkelon and Jaffa, while another 40% is concentrated in waters between Hadera and Akko.
- Sport fishing in Israel has risen sharply in recent years (Kerem and Edelist, 2008) through the following manners:
  - Scuba spearfishing,
  - Free dive spearfishing,
  - Rod and line fishing,
  - Kayak fishing, and
  - Yacht and small craft fishing.

Proposed Project:

- No fishing grounds or marine farming operations are present within 30 km of the application zone.
- The only marine farming operation in Israeli Mediterranean waters occurs in coastal waters near the town of Mikhmoret.

1.7 SEAWATER AND SEDIMENT QUALITY

MVI (2022) and CSA (2023a) provide data and discussions on both seawater and sediment quality within the Tamar Field. Their findings are presented below.

1.7.1 Seawater Quality

According to CSA (2023a), the most recent seawater sampling effort, conducted as part of the 2023 Tamar Field EMS, found that most seawater analyte concentrations at all stations and sampled water depths were similar to or below the Mediterranean Environmental Water Quality Standards (MEWQS), European Commission Environmental Quality Standards (EUCEQS), criterion continuous concentrations (CCC), Maximum Contaminant Level (MCL), 2014 Tamar Field EBS levels, or the Levantine Basin Baseline (LBB) 99% confidence limit (CL). The only exception to this was the dissolved metal arsenic determination, higher than baseline concentrations and LBB 99% CL, but

within the calculated statistical error and well below the MEWQS, EUCEQS, and CCC reference values (**Section 5.3**).

1.7.2 Total Suspended Solids

According to MVI (2022), during the 2014 Tamar Field Background Monitoring Survey, total suspended solids (TSS) concentrations (**Table 1-7**) averaged 6.7 ± 1.6 mg L^{-1} in the near-surface, 5.2 ± 0.6 mg L^{-1} at mid-depth, and 5.7 ± 0.8 mg L^{-1} at the near-bottom. Values generally were similar among the four water stations located on the perimeter of the field and the station located in the center of the field. During the 2013 Tamar Field and Pipeline Survey, TSS concentrations at the near-bottom depths averaged 6.1 ± 1.3 mg L^{-1}, which is within one standard deviation of the February 2014 Survey results.

Table 1-7. Station concentrations of total suspended solids (TSS) in seawater samples collected throughout the water column in the Tamar Field during the February 2014 Tamar Background Monitoring Survey (From: CSA, 2014).

Background Monitoring Survey Location	Station	Depth	TSS (mg L^{-1})
Perimeter of Tamar Field	B08	Near-Surface	5.8
		Mid-Depth	5.3
		Near-Bottom	6.0
	C01	Near-Surface	7.1
		Mid-Depth	4.1
		Near-Bottom	6.2
	D17	Near-Surface	5.7
		Mid-Depth	5.3
		Near-Bottom	4.7
	H09	Near-Surface	5.6
		Mid-Depth	5.4
		Near-Bottom	4.9
Center of Tamar Field	E11	Near-Surface	9.3
		Mid-Depth	5.7
		Near-Bottom	6.6

According to CSA (2023a), TSS values averaged 3.6 ± 1.2 mg L^{-1} in near-surface water, 3.3 ± 1.2 mg L^{-1} in mid-depth, and 3.7 ± 1.6 mg L^{-1} in the near-bottom (**Table 1-8**). Mean TSS concentrations observed in the Tamar Field were below the LBB mean and in agreement with results from additional studies conducted in the northeastern Mediterranean. TSS values were well below the proposed MEWQS maximum permissible levels. TSS levels at all depths were lower than those recorded during the 2014 Tamar Field EBS, which is likely due to natural variability.

Table 1-8. Concentrations of total suspended solids in seawater samples collected during the 2023 Tamar Field Environmental Monitoring Survey (EMS). Mean concentrations (± standard deviation) of the 2014 Tamar Field Environmental Baseline Survey (EBS) and 2023 Tamar Field EMS are also shown. All values are in mg L^{-1}.

Depth Stratum	Station	Total Suspended Solids (mg L^{-1})
Near-Surface	B4	4.9
	D1	3.9
	D8	3.5
	E4	<2.1
2023 Tamar Field EMS		3.6 ± 1.2[3]
2014 Tamar Field EBS		6.7 ± 1.6
Levantine Basin Baseline Data[1]		9.79 ± 7.73; 29.7
Mid-Depth	B4	4.0
	D1	2.7
	D8	<1.9
	E4	4.4
2023 Tamar Field EMS		3.3 ± 1.2[3]
2014 Tamar Field EBS		5.2 ± 0.6
Levantine Basin Baseline Data[1]		9.92 ± 7.13; 28.3
Near-Bottom	B4	<2.2
	D1	2.7
	D8	4.0
	E4	5.7
2023 Tamar Field EMS		3.7 ± 1.6[3]
2014 Tamar Field EBS		5.7 ± 0.8
Levantine Basin Baseline Data[1]		9.63 ± 8.21; 30.8
MEWQS[2]		--; seasonal mean +10% or 10 mg L^{-1}

[1] Mean calculated from pre-drill and environmental baseline surveys conducted by CSA prior to December 2013; updated 20 August 2014. Values denote mean ± standard deviation; upper 99% confidence level.
[2] Proposed values denote mean; maximum permissible levels.
[3] Method detection limit values were used to calculate the mean where samples were below detection limits.
EBS = Environmental Baseline Survey; EMS = Environmental Monitoring Survey; MEWQS = Mediterranean Environmental Water Quality Standards; "--" = no value established.

1.7.3 Chlorophyll

According to MVI (2022), during both the 2014 Tamar Field Background Monitoring Survey (CSA, 2014) and in the 2013 Tamar Field and Pipeline Survey (CSA, 2013) fluorescence was measured as an indicator of photosynthetic activity and levels of primary productivity using hydrographic profiles. Fluorescence measured in the Tamar Field was similar between the two surveys, with peak fluorescence occurring in the photic zone at approximately 175 m depth during the 2013 survey (0.35 mg m^{-3}) and at 100 m depth during the 2014 survey (0.32 mg m^{-3}).

According to CSA (2023a), fluorescence within the water column reached maximum values (deep chlorophyll maximum) of 0.2 mg m^{-3} at approximately 19 m water depth, indicating a maximum abundance of phytoplankton communities at this depth. There were no measurable fluorescence values below 135 m water depth. Chlorophyll *a* was also sampled from near-surface seawater at four stations during the 2023 Tamar Field EMS. Chlorophyll *a* concentrations from three of the four seawater stations were consistently below the laboratory detection limit value of 0.69 µg L^{-1}. The seawater sample from Station D8 was compromised due to a lab error, therefore no results are available for this station. Chlorophyll *a* concentrations from Stations B4, D1, and E4 correspond and are consistent with fluorescence measurements obtained via a

conductivity-temperature-depth profiler (CTD). Previous studies in the Levantine Basin have shown fluorescence values to be low in the region, ranging between 0.07 and 0.15 mg m^{-3} (Reich et al., 2022) or less than 0.125 mg m^{-3} (Christaki et al., 2001).

1.7.4 Water Chemical Properties

According to MVI (2022) nutrients in seawater were sampled during the 2014 Tamar Field Background Monitoring Survey. Nutrient concentrations in seawater were found to be low and nearly uniform throughout the water column and survey area.

Total organic carbon (TOC) concentrations in seawater were slightly higher in the near-surface (0.70 ± 0.10 mg L^{-1}) than in the near-bottom (0.51 ± 0.08 mg L^{-1}). Total nitrate concentrations were slightly higher in the mid-depth (0.17 ± 0.01 mg L^{-1}) than in the near-surface (0.12 ± 0.01 mg L^{-1}) or in the near-bottom (0.15 ± 0.01 mg L^{-1}). Concentrations of nitrite, nitrate, total phosphate (TP), and phosphate were negligible throughout the survey region. There was no appreciable difference between stations located at the perimeter of the reservoir and the station located at the center of the field.

During the 2023 Tamar Field EMS (CSA, 2023a), TOC, total nitrogen (TN), total phosphorus (TP) as well as nitrate, nitrite, and ammonium were sampled at four seawater stations (**Table 1-9**). Key findings:

- Mean (± standard deviation) TOC concentrations were 0.72 ± 0.05 mg L^{-1} at near-surface, 0.59 ± 0.09 mg L^{-1} at mid-depth, and 0.54 ± 0.04 mg L^{-1} at near-bottom. Mean TOC concentrations were below the LBB means and similar to 2014 Tamar Field EBS means.
- TP and TN were found to be lowest at the near-surface, and slightly higher but stable at the mid-depth and near-bottom. TP and TN concentrations were similar to concentrations measured during the 2014 Tamar Field EBS and lower than or similar to the established LBB mean.
- Concentrations of nitrogen bound within the nitrogen species (ammonium, nitrate, and nitrite) averaged 33% of TN in near-surface water, 60% of TN in mid-depth water, and 53% in near-bottom water. Overall, nutrient concentrations were consistent with previous studies from the Levantine Basin (Azov, 1986; Herut et al., 1999; Kress et al., 2005) and were below the proposed MEWQS mean and/or maximum permissible levels, where applicable. Results were also comparable with the 2014 Tamar Field EBS, where mean concentrations of nitrogen bound within the nitrogen species was 37% in the near-surface water, 47% in the mid-depth water, and 40% in near-bottom water.

Table 1-9. Concentrations of total organic carbon, total phosphorus, total nitrogen, nitrate, nitrite, and ammonium in seawater samples collected during the 2023 Tamar Field Environmental Monitoring Survey (EMS). Mean concentrations (± standard deviation) of the 2014 Tamar Field Environmental Baseline Survey (EBS) and 2023 Tamar Field EMS are also shown. All values are in mg L^{-1}.

Depth Stratum	Station	Total Organic Carbon	Total Phosphorus	Total Nitrogen	Nitrate[3]	Nitrite	Ammonium
Near-Surface	B4	0.72	0.0059	0.10[a]	0.0291	<0.0009	<0.009
	D1	0.71	0.0048	0.08[a]	0.0153	<0.0009	<0.009
	D8	0.67	0.0056	0.08[a]	0.0269	<0.0009	<0.009
	E4	0.78	0.0051	0.09[a]	0.0044	<0.0009	<0.009
2023 Tamar Field EMS		0.72 ± 0.05	0.005 ± 0.0005	0.09 ± 0.01	0.019 ± 0.011	--	--
2014 Tamar Field EBS		0.71 ± 0.11	0.008 ± 0.002	0.12 ± 0.01	0.045 ± 0.013	--	--
Levantine Basin Baseline Data[1]		1.17 ± 0.14; 1.54	0.008 ± 0.004; 0.018	0.44 ± 0.49; 1.70	--[4]	--[4]	--[4]
Mid-Depth	B4	0.71	0.0154	0.15	0.07082	<0.0009	<0.009
	D1	0.50[a]	0.0143	0.14[a]	0.08473	<0.0009	<0.009
	D8	0.60[a]	0.0123	0.15	0.06567	<0.0009	<0.009
	E4	0.54[a]	0.0126	0.14[a]	0.08447	<0.0009	<0.009
2023 Tamar Field EMS		0.59 ± 0.09	0.014 ± 0.001	0.15 ± 0.01	0.076 ± 0.01	--	--
2014 Tamar Field EBS		0.56 ± 0.11	0.015 ± 0.003	0.17 ± 0.01	0.076 ± 0.005	--	--
Levantine Basin Baseline Data[1]		0.89 ± 0.22; 1.45	0.014 ± 0.002; 0.019	0.48 ± 0.47; 1.69	--[4]	--[4]	--[4]
Near-Bottom	B4	0.52[a]	0.0100	0.12[a]	0.06118	<0.0009	<0.009
	D1	0.51[a]	0.0113	0.15	0.04132	<0.0009	<0.009
	D8	0.60[a]	0.0087	0.14[a]	0.07642	<0.0009	<0.009
	E4	0.52[a]	0.0081	0.15	0.07333	<0.0009	<0.009
2023 Tamar Field EMS		0.54 ± 0.04	0.01 ± 0.001	0.14 ± 0.01	0.063 ± 0.016	--	--
2014 Tamar Field EBS		0.50 ± 0.09	0.012 ± 0.001	0.15 ± 0.01	0.058 ± 0.024	--	--
Levantine Basin Baseline Data[1]		0.84 ± 0.14; 1.21	0.011 ± 0.002; 0.016	0.48 ± 0.48; 1.71	--[4]	--[4]	--[4]
MEWQS[2]		N/A	0.1; --	1.0; --	N/A	N/A	0.5; 2.4

[a] Reported value is an estimated concentration since it is below the method reporting limit.
[1] Mean calculated from pre-drill and environmental baseline surveys conducted by CSA prior to December 2013; updated 20 August 2014. Values denote mean ± standard deviation; upper 99% confidence level.
[2] Proposed values denote mean; maximum permissible levels.
[3] Computed by calculation (nitrate + nitrite) minus nitrite. The method detection limit (0.0009 mg L^{-1}) was used for samples where nitrite was not detected.
[4] Levantine Basin Baseline mean cannot be calculated for these parameters since they were not included in the list of parameters set in the Israeli guidelines for offshore monitoring when the LBB was established.
EBS = Environmental Baseline Survey; EMS = Environmental Monitoring Survey; MEWQS = Mediterranean Environmental Water Quality Standards; N/A = not applicable; "--" = no value established, or not calculable.

During the 2023 Tamar Field EMS (CSA, 2023a), dissolved metals, hydrocarbons and radionuclides in seawater were also sampled. Many of the seawater dissolved metals concentrations were below the laboratory quantification limit and below all available reference and background values.

Key findings:

- Dissolved metals with measurable concentrations, except for arsenic, were all below the 2014 Tamar Field EBS values and the LBB standard deviation and 99% CL. Arsenic was slightly higher than the Tamar Field EBS values and LBB 99% CL but within the calculated statistical error and well below the MEWQS, EUCEQS, and CCC reference values. All dissolved metals at all depth strata (near-surface, mid-depth, and near-bottom) were well below Israel's MEWQS, EUCEQS, and CCC reference values.
- TPH determinations were below the laboratory detection limit in all seawater samples collected during the 2023 Tamar Field EMS.
- Radionuclide concentrations in samples collected during the 2023 Tamar Field EMS were higher than concentrations measured during the 2014 Tamar Field EBS. Mean Radium-226 (Ra-226) concentrations in most near-surface and near-bottom samples were below the respective LBB 99% CLs, except for one near-surface sample and two near-bottom samples. Mean Ra-226 concentrations within near-surface samples were below the LBB 99% CL, and mean Radium-228 concentrations of near-bottom samples were higher than the LBB 99% CL (Table 11). Although measured radionuclide concentrations from the 2023 Tamar Field EMS samples were found to be higher than from the 2014 Tamar Field EBS, the combined Ra-226 and Ra-228 values for seawater were still well below the U.S. Environmental Protection Agency (USEPA) established MCL of 5 pCi L^{-1} for combined Ra-226 and Ra-228 (40 CFR 141.66).

1.7.5 Sediment Chemical Properties

MVI (2022) previously provided a discussion on sediment chemical properties in the Tamar Field and along the Tamar pipeline route from the 2014 Tamar Field EBS and the 2013 Tamar Field and Pipeline Survey results. The main findings are summarized below.

- Sediment TOC concentrations from the 2014 Tamar Field EBS and the 2013 Tamar Field and Pipeline Survey were low (0.05% to 0.80%) throughout the survey area. The low TOC content reflects the deep-sea environment and oligotrophic nature of the Eastern Mediterranean.
- Total sediment metals concentrations across the Tamar Field and along the Tamar pipeline route were generally within the range of concentrations found in mean marine sediments, except for arsenic and copper. Most sediment metals values were generally lower than the effects range low (ERL) and effects range median (ERM) values. Exceptions where a metals concentration was higher than the corresponding ERL value occurred occasionally for chromium and copper. Nickel exceeded both the ERL and ERM values at several stations; however, it must be noted that mean marine sediment and continental crust concentrations also exceed the ERM value.
- Alkanes and TPHs were detected in sediments at low concentrations across the Tamar Field and throughout pipeline route. The results indicated that no significant amounts of these hydrocarbons are present in seafloor sediments. Polycyclic aromatic hydrocarbon (PAH) concentrations detected in sediments were low throughout the survey area and well below ERL concentrations.
- Radionuclide samples were collected only within the Tamar Field during the 2014 Tamar Field EBS and were low in all samples. Mean (± standard deviation) radionuclide concentrations for Ra-226 was 0.35 ± 0.10, for Ra-228 was 0.58 ± 0.22, and for Thorium-228 was 0.65 ± 0.05.

Sediment chemical properties across the Tamar Field were sampled during the 2023 Tamar Field EMS (CSA, 2023a), and the main findings are summarized below.

- Sediment grain size analysis indicated that sediments were primarily composed of silt with high clay fractions, but not significantly different from the 2014 Tamar Field EBS where sediments were composed of clay with high fractions of silt (**Figure 1-21**). Sediment TOC concentrations were low (<0.51%) throughout the Tamar Field, apart from Station D3 near the Tamar-2 wellsite

where TOC concentration measured 8.97%. Low TOC values were expected given the highly oligotrophic nature of the region.

- Sediment total metals concentrations from the Tamar Field-wide sampling component were generally within the 99% CL of the LBB mean, below ERL and ERM values, and similar to or lower than the 2014 Tamar Field EBS concentrations. Exceptional sediment metals included barium that was higher than the LBB mean and LBB 99% CL at some of the grid stations; arsenic, copper, and nickel which exceeded ERL and ERM (nickel only) values but are known to be naturally high in Levantine Basin sediments; and chromium, lead, and zinc which were higher than the 2014 Tamar Field EBS concentrations but did not exceed the ERL, ERM, or LBB 99% CL. Interpolated maps comparing 2023 Tamar Field EMS sediment barium, arsenic, copper, and nickel concentrations to 2014 Tamar Field baseline concentrations are presented in **Figures 1-23**, **1-24**, **1-25**, and **1-26** respectively. Interpolated maps for all metals can be found in the 2023 Tamar Field Monitoring Survey Report (**Appendix K**).
- Sediment TPH concentrations were mostly below the analytical detection limits (<1.4 µg g^{-1}). There was no significant difference in sediment TPH concentrations between the 2023 Tamar Field EMS and the 2014 Tamar Field EBS. TPH concentrations throughout the entire survey area were within the 2014 Tamar Field EBS 99% CL of 27.3 µg g^{-1}, and all except two stations were also within the LBB 99% CL of 21.85 µg g^{-1}. The two stations that were greater than or similar to the LBB 99% CL were D7 (28.0 µg g^{-1}) and E6 (21.0 µg g^{-1}). Sediment polycyclic aromatic hydrocarbons (PAHs) were determined only for Stations D7 and E6 and the mean total PAHs concentration was 113 ± 11 ng g^{-1}, well below the ERL and ERM values. Calculation of Fossil Fuel Pollution Index for these two samples was indicative of PAH assemblages dominated by pyrogenic sources and the results were comparable with those encountered during the 2014 Tamar Field EBS.
- Sediment radium and thorium radionuclide concentrations were mostly below the laboratory reporting limit. All radionuclide concentrations were well below the USEPA protective health-based levels. The 2023 Tamar Field EMS mean concentrations were slightly higher than the 2014 Tamar Field EBS mean concentrations and the LBB mean concentrations, but below the LBB 99% CL.

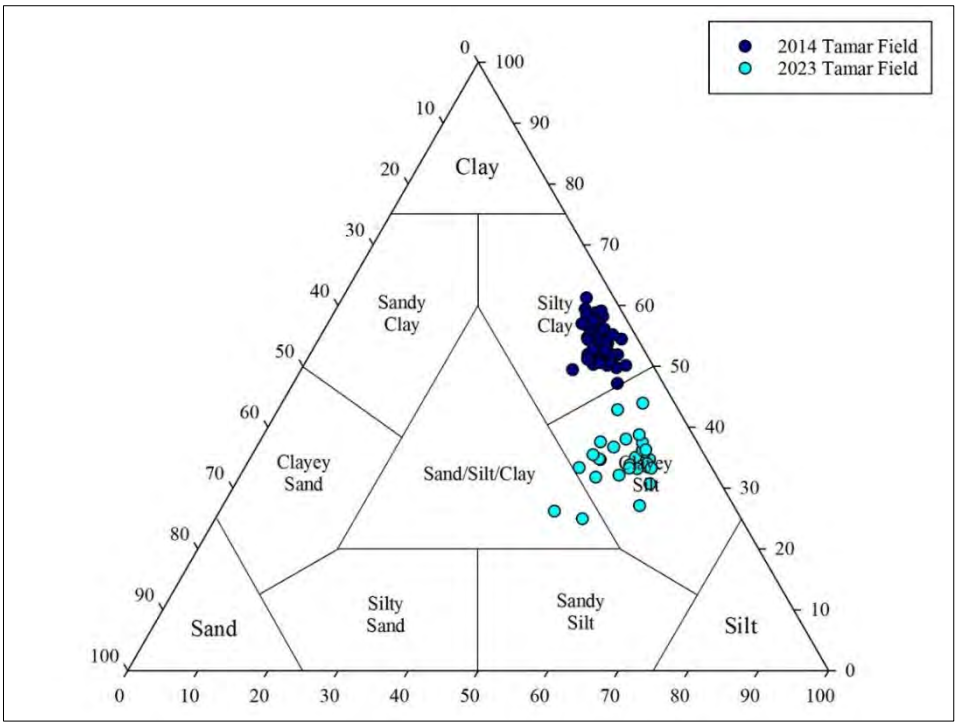


Figure 1-21. Grain size classifications for sediment samples collected within the Tamar Field during the 2014 Tamar Field Environmental Baseline Survey (CSA, 2014) and the 2023 Tamar Field Environmental Monitoring Survey (CSA, 2023a). Sediments collected during the 2023 Tamar Field EMS were mostly classified as clayey silt, whereas sediments collected during the 2014 Tamar Field EBS were all classified as silty clay, per determinations using Shepard (1954).

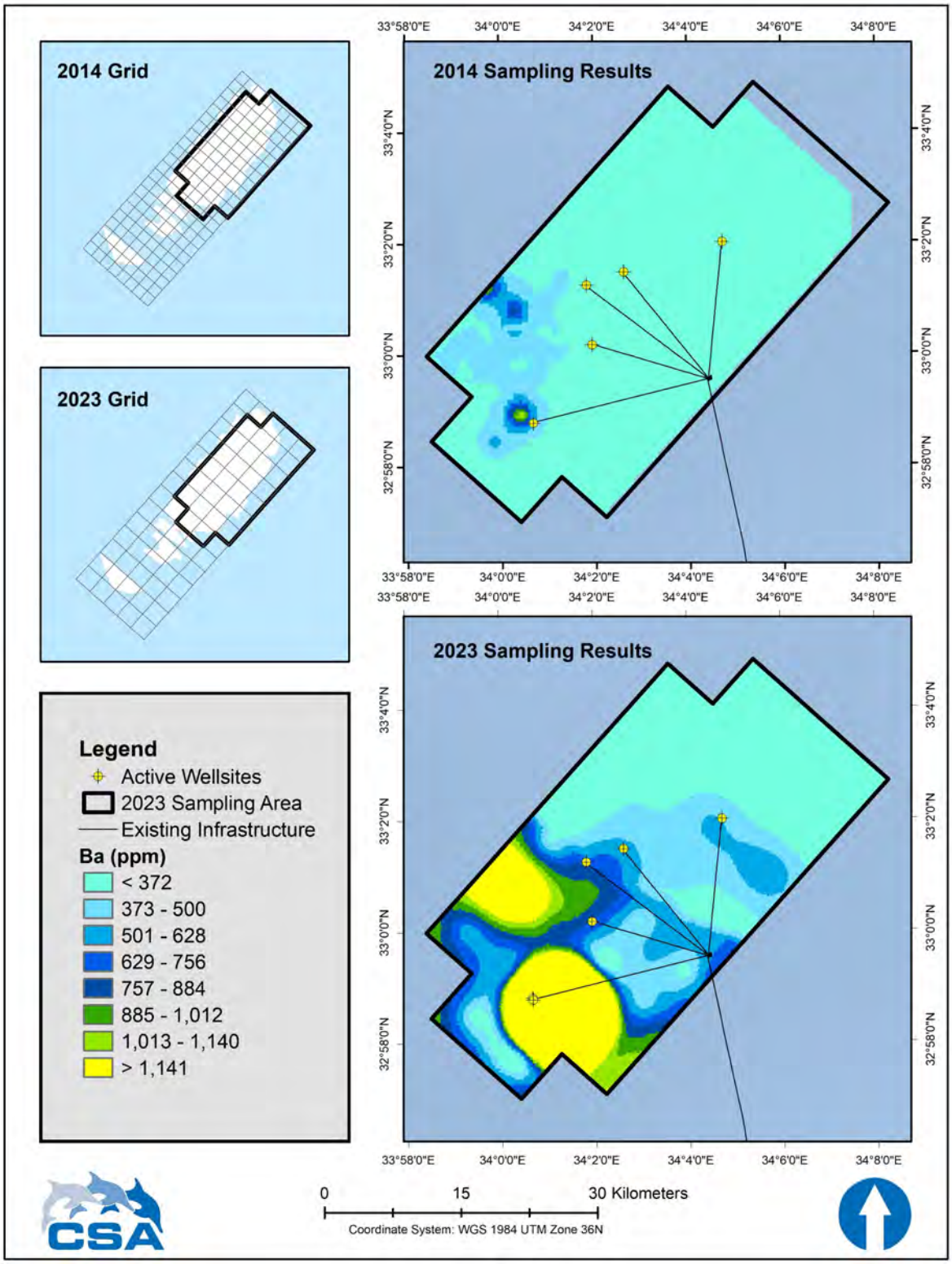


Figure 1-22. 2014 versus 2023 seafloor sediment barium (Ba) concentrations (ppm [mg kg^{-1}]) within the Tamar Field. Seafloor sediments within the Tamar Field that have natural concentrations of barium relative to the 2014 Tamar Field mean are presented in various shades of blue.

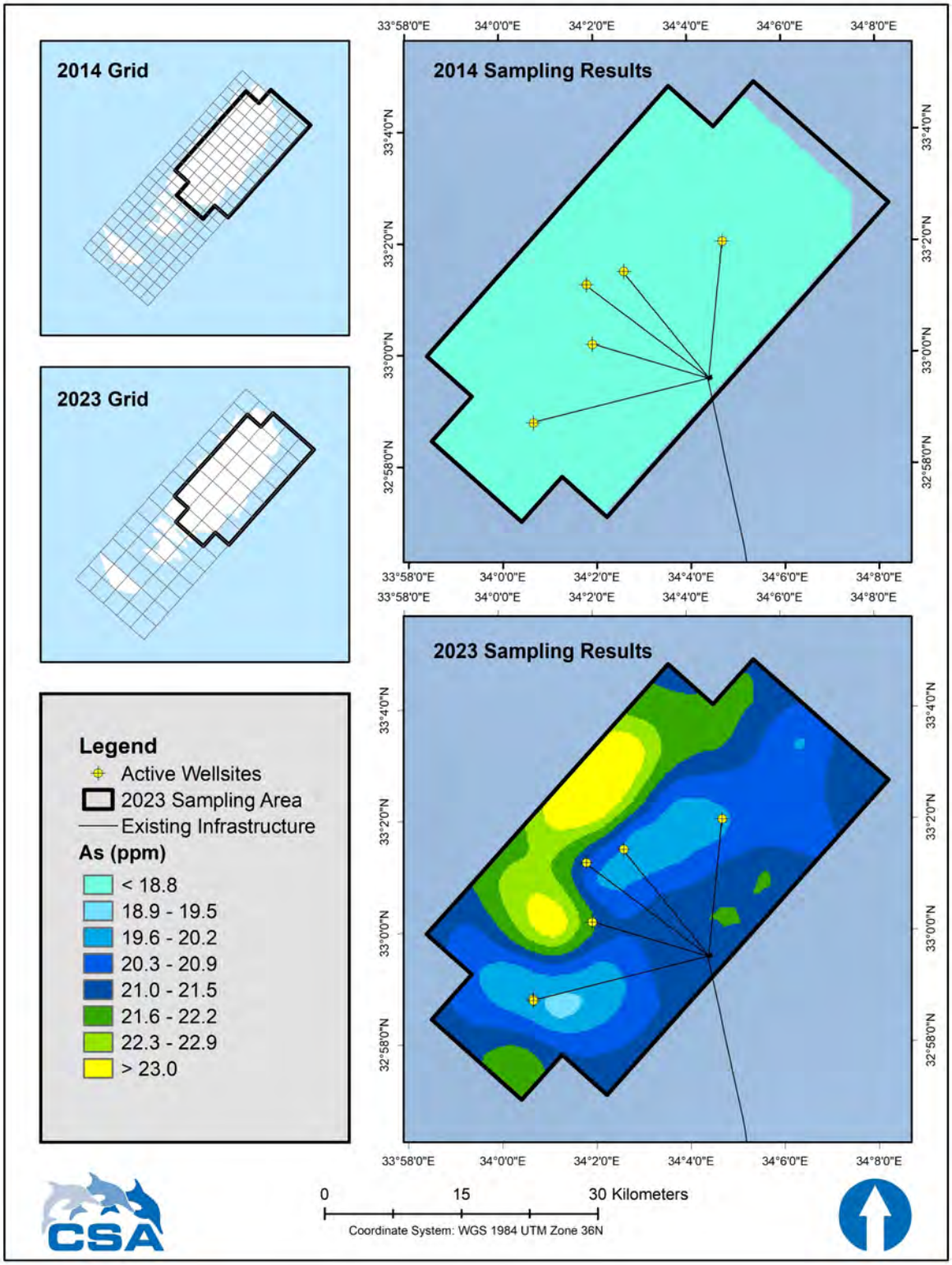


Figure 1-23. 2014 versus 2023 seafloor sediment arsenic (As) concentrations (ppm [mg kg^{-1}]) within the Tamar Field. Seafloor sediments within the Tamar Field that have natural concentrations of arsenic relative to the 2014 Tamar Field mean are presented in various shades of blue.

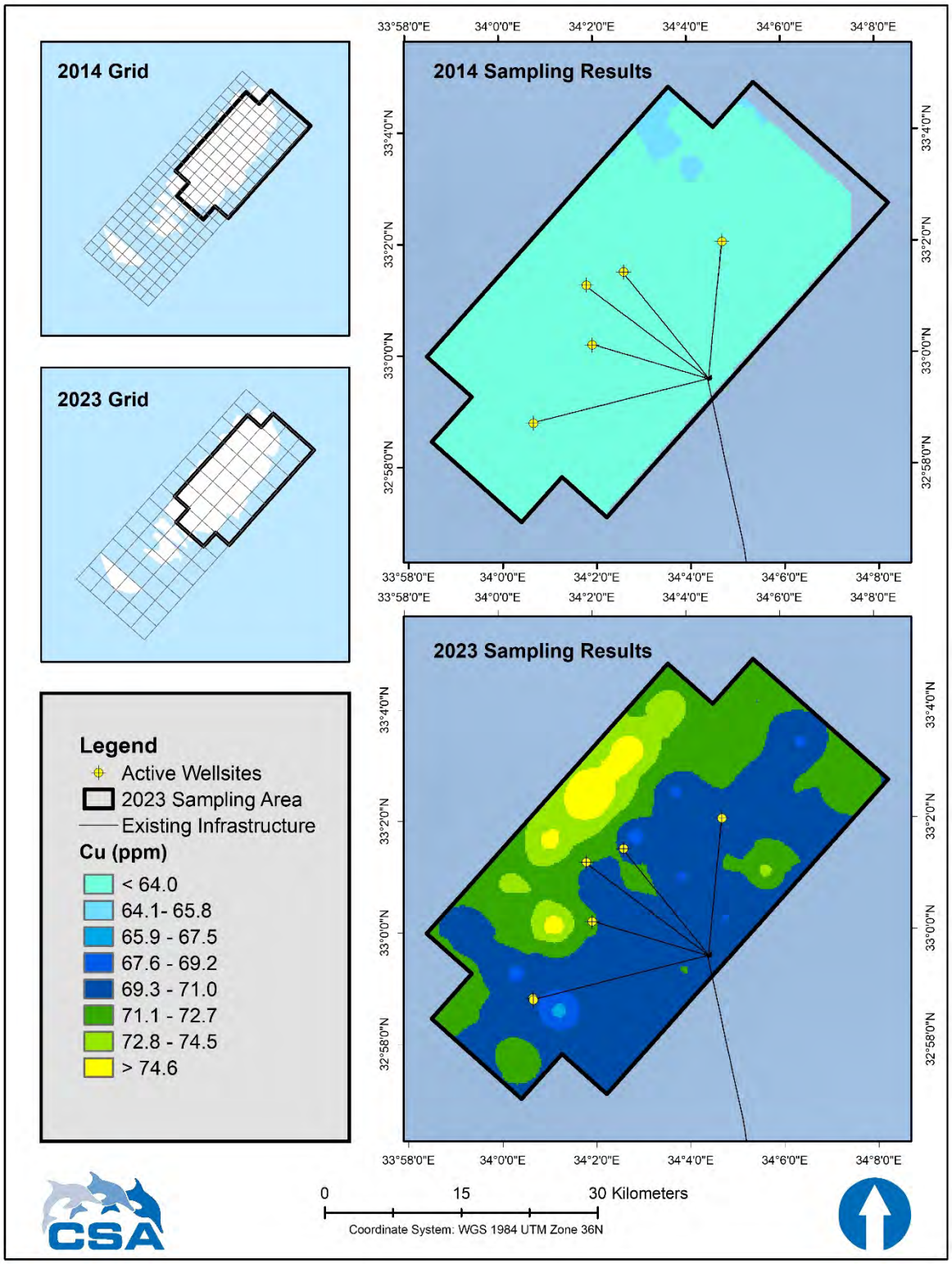


Figure 1-24. 2014 versus 2023 seafloor sediment copper (Cu) concentrations (ppm [mg kg^{-1}]) within the Tamar Field. Seafloor sediments within the Tamar Field that have natural concentrations of copper relative to the 2014 Tamar Field mean are presented in various shades of blue.

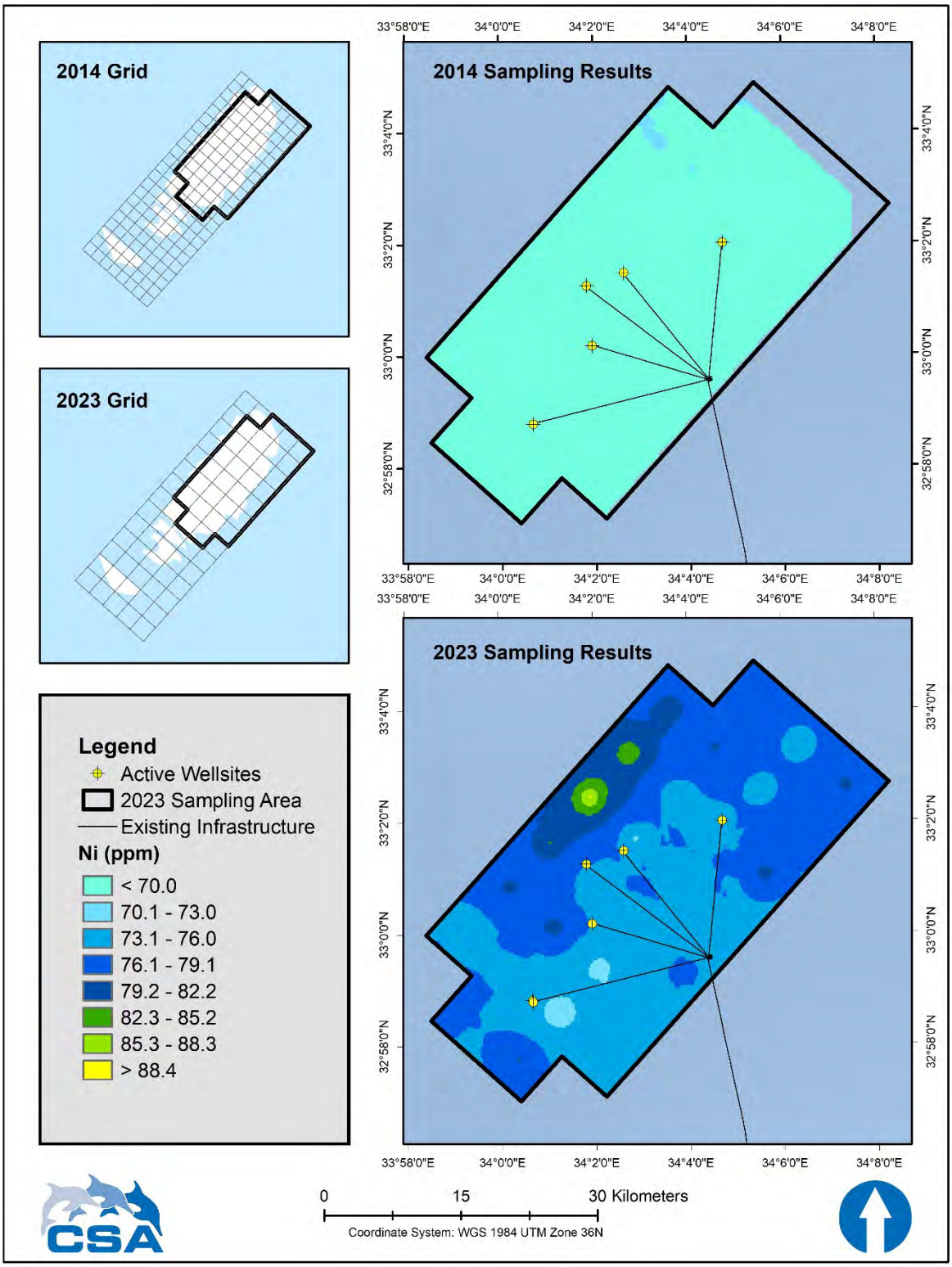


Figure 1-25. 2014 versus 2023 seafloor sediment nickel (Ni) concentrations (ppm [mg kg^{-1}]) within the Tamar Field. Seafloor sediments within the Tamar Field that have natural concentrations of nickel relative to the 2014 Tamar Field mean are presented in various shades of blue.

1.7.6 Hard Substrate and Fauna Chemical Properties

No hard substrate has been identified in the Tamar Field, and more specifically, no hard substrate has been identified in the Tamar-12 Project Area.

1.8 CULTURE AND HERITAGE SITES

1.9 METEOROLOGY AND AIR QUALITY

1.9.1 Existing Meteorological Conditions

CSA (2012, 2016) and MVI (2022) previously provided a discussion for existing meteorological conditions; see Section 1.2. of CSA (2012), Section 1.2.6 of CSA (2016), and Section 1.10.1 of MVI (2022). Key findings are summarized below.

Key Findings:

- There are no known publicly available site-specific meteorological records for the Tamar-12 Project Area.
- Israel's subtropical location between 29° and 33° N Latitude along the Eastern Mediterranean generally brings long, hot, dry summers and short, cool, rainy winters, as modified locally by altitude and latitude.
- The cold period (December to March) is characterized by the low circulation associated with intense cyclogenetic activity (Kallos et al., 1993; Kassomenos et al., 1995).
- The warm period (June to September) is characterized by high circulation where the North Atlantic lows pass over Europe and only edges of the fronts reach the northeastern part of the Mediterranean.
- During the warm period, the entire Mediterranean region is occupied by anticyclonic activity and large-scale subsidence. This period of the year is highly controlled by the balance between the North Atlantic anticyclone and the monsoon activity over the Indian Ocean and the Middle East.
- During the transitional seasons of spring (April to May) and autumn (October to November), the synoptic circulation varies between cold and warm types.

Proposed Project:

- Existing information presented in CSA (2012, 2016) and MVI (2022) is deemed sufficient for assessment purposes.
- Data from 2024 from the closest onshore location (Haifa) shows that recorded highest daily air temperatures ranges from approximately 18°C in January to 35°C in June, July, and August (Weatherspark, 2025).
- Haifa receives an annual mean rainfall of 539 mm, with the greatest amounts during the cold period (December to March) and virtually no precipitation during the warm period (June to September) (Weatherspark, 2025).

1.9.2 Special Meteorological Conditions

There are no known special meteorological conditions within or adjacent to the Tamar Field that might create dispersion conditions that could result in high concentrations of air pollutants in the vicinity of the Tamar-12 Project Area.

1.9.3 Air Quality

CSA (2012, 2016) and MVI (2022) previously provided discussions for air quality; see Section 3.7.3.5 of CSA (2012), Section 1.2.6 of CSA (2016), and Section 1.10.3 of MVI (2022), with key findings summarized below.

Key Findings:

- Given the relatively remote location of the offshore AoI and prevailing wind patterns (i.e., predominant westerly winds January through October; variable November and December), air quality offshore likely reflects the long-range transport of natural and anthropogenic air pollutants, with contribution from regional sources.
- Three major synoptic weather types are conducive to short-term air quality problems in coastal Israel (Dayan and Levy, 2002):
  - Red Sea Trough: 29% occurrence, mainly during autumn; brings light winds with hot/dry air.
  - Anticyclone: 25% occurrence, mainly in spring; leads to stagnation caused by weak pressure gradient over Israel.
  - Shallow Persian Trough: 20% occurrence, mainly during summer; leads to subsidence and stabilization of the atmosphere.

Proposed Project:

- Existing information presented in CSA (2012, 2016) and MVI (2022) is deemed sufficient for assessment purposes.

1.10 NOISE

CSA (2012, 2016) and MVI (2022) previously provided discussions for noise and the acoustic environment; see Section 3.4 of CSA (2012), Section 1.2.7 of CSA (2016), and Section 1.11 of MVI (2022), with key findings summarized below. CSA (2023a) also prepared a noise and light assessment for Tamar, including a summary of ambient noise for the Eastern Mediterranean.

Key Findings:

- CSA (2012) provides a discussion on the variety of natural and anthropogenic sources of underwater sounds.
  - Natural sounds are either biological (e.g., fishes, marine mammals, some invertebrates) or environmental (e.g., waves, earthquakes, rain).
  - Anthropogenic sources can produce noise as a by-product of their normal operations (e.g., shipping, drilling, tidal turbines) while others are produced for specific remote sensing purposes (e.g., sonars, airguns).
- Ambient noise covers the whole acoustic spectrum from below 1 Hz to well above 100 kHz (Urick, 1983) and is generally made up of three constituent types – wideband continuous noise, tonals, and impulsive noise.
- Shipping noise (frequencies below 300 Hz) from propellers (most dominant), thrusters, machinery, and hydrodynamic noise (hull movement) are likely to be the main contributors of noise for the area (Wenz, 1962; Ross, 1976; Hildebrand, 2009; McKenna et al., 2012; CSA, 2023a).
- Ambient noise measured in the shallow waters offshore Haifa exhibited characteristics of medium to heavy shipping noise (Potter et al., 1997).
- According to Galil (2006), the ambient noise in areas of heavy shipping could range between 85 and 95 dB re 1 µPa m.

Proposed Project:

- There are no site-specific measurements of underwater noise in the application zone.
- Existing information presented in CSA (2012, 2016, 2023a) and MVI (2022) is deemed sufficient for assessment purposes.

1.11 INFRASTRUCTURE AND MARINE TRANSPORTATION SYSTEM

The Tamar-12 Project Area is spatially limited, and the application zone is confined to an area approximately 4 km × 5 km. This area is 90 km from the nearest shoreline and, although one shipping lane (**Figure 1-8**) overlaps the Tamar Field (which connects the area with the Port of Haifa), minimal vessel traffic is expected in the area; appropriate measures will be taken to avoid any conflicts with shipping.

2 Location and Technological Alternatives and the Justifications for the Selected Alternative

2.1 GENERAL

CSA (2012) provided a description of general activities planned for the Tamar Field Development Project which included drilling, completion, and subsea installation operations. CSA (2016) provided a description of additional development activities including subsea installation and drilling and completion of three additional wells. Several different alternatives were considered in CSA (2016), including 1) preferred locations and potential alternatives (Section 2.2); 2) drilling technology alternatives (Section 2.3.1); and 3) infrastructure and pipeline alternatives (Section 2.3.2). New information for the proposed Tamar-12 Project is detailed below under individual entries for the proposed project.

2.2 LOCATION ALTERNATIVES

2.2.1 Well Location Alternatives

CSA (2016) provided an Overview and Application Rationale of the Tamar Field Development Project including a breakdown of proposed well locations and alternatives; the rationale for well locations was presented in Section 2.2 of the 2016 document. New information for Tamar-12 is outlined below. CML has, during the course of engineering for the Tamar-12 Project, reconsidered those options pertaining to future wells and have matured decisions on location of such future wells, the approaches and the technologies used to develop the wells.

Key Findings:

- CML (formerly NEML) proposed to conduct well drilling and completion activities in the Tamar Field. Section 2.2 of CSA (2016) explained the options that were evaluated in selecting the initial well locations and drilling technology.

Proposed Project:

- The proposed CML expansion plan for the Tamar Field includes drilling and completion of a new well, as well as the installation of a subsea production tree and supporting subsea infrastructure. The well location was selected based on factors such as reservoir performance, reservoir connectivity, development phases and production profile. The specific location of the well also considered shallow hazard evaluations and avoidance of potential archaeological contacts.
- The well tophole location was selected to leverage proximity of existing Tamar SW infrastructure by connecting the Tamar T-12 tree to the FLET 7 XT with two jumpers and an Intermediate Jumper Structure. Thus, a need for a brand new flowline was mitigated. To service and control the new Tamar-12 subsea production tree, a new umbilical will be installed connecting it to the Tamar Field production control system at the Tamar Gathering Center. Selected subsea infrastructure will be capable of servicing the base and the contingency (re-spud) Tamar-12 well location.

CSA (2012) provided a description of the Proposed Development program, as presented in Section 2.2 of the 2012 document.

Key Findings:

- To optimize gas production and minimize water influx, the following philosophy was used by CML (formerly NEML):

    - Completions in the “C” Sand were restricted to the structurally highest part of the field, where a significant standoff above water can be maintained. The “C” Sand is relatively thick sand

throughout Tamar Field. In the structurally highest core of the field, it tends to include a gas column with water in the lowest part of the sand.

Proposed Project:

- CML adheres to the same philosophy used previously (e.g., in CSA, 2016) during its selection of the new drill site (i.e., targeting formations containing maximum gas reserves, with limited to no associated water).

2.2.2 Subsea Infrastructure Location Alternatives

No alternatives were considered in establishing the general layout of the Tamar subsea facilities and routing of the umbilical; the same principal drivers as used on legacy Tamar projects were employed: 1) use of the most direct umbilical route; 2) minimize the number of crossings (i.e., cables; existing linear infrastructure); 3) minimize the footprint that the new facilities occupy while allowing for future developments; and 4) use existing subsea (legacy Tamar) infrastructure to the maximum extent practical. The new Tamar-12 well will be tied directly into an existing Tamar flowline, eliminating the need to construct a new flowline.

2.2.3 Completion Philosophy and Details of Well Planning

2.2.4 Well Clearance and Environmental Sensitivity

CSA (2016) provided a description of the Well Clearance and Environmental Sensitivity for the drilling and completion of wells under the 2016 program; see Section 1.2.1 of the 2016 document. New information for the proposed Tamar-12 Project is provided below under the proposed project.

Key Findings:

- The proposed location and borehole trajectory of the initial Tamar development wells were selected, and the well drilling program was designed to include considerations minimizing the risk of encountering the following shallow hazards:
  - Seafloor instability – The selected locations were in a relatively flat area, located away from any seafloor channel or fault scarp;
  - Shallow faulting – The locations avoid areas of shallow faulting at or near the seafloor; and
  - Anomalies within salt – The proposed locations were screened, using seismic interpretation, to avoid areas of significant intra-salt deformation.
- Geohazards surveys of the Tamar Field were conducted in 2009, as reported by DOF Subsea UK Ltd. (2010). A geohazards assessment was performed for the Tamar drill sites and the surrounding area (i.e., within a 2,000 m radius) based on 3D seismic data. Site-specific well clearance letters were prepared and submitted as part of the application for a marine discharge permit (Discharge to Sea Permit) for the Tamar wells (Gardline Surveys, Inc., 2012, 2013a,b, 2014, 2016). Subsurface, the seafloor sediments are believed to be composed of silts and clays with interbedded sands, which were expected to become firmer with increasing depth.
- An enlarged area encompassing the entire Tamar Field was studied to define the original drill site locations, from which the proposed locations were set to avoid potential gas hazards.
- The Tamar drill sites were chosen to avoid active seafloor channels, shallow faulting, and potential shallow gas hazards associated with amplitude anomalies and low-angle slump escarpments or other seafloor topographic elements. The final location for the proposed drill sites was adjusted to avoid deeper faults proximal to the original wellbores. The choice of the drill sites effectively avoids intersection with small faults in the shallow, post-salt section and allowed for the setting of two successive casing points in relatively clean salt that was expected to be clean of clastic interbeds. All of these considerations helped to minimize the safety, environmental, and drilling risks at the proposed drill site locations.

- Additional criteria cited by CML (formerly NEML) in regard to well clearance and environmental sensitivity, in compliance with respective EIA guidelines, included:
  - Structural analysis issues; the size of the field and the location of the target stratum – these issues were considered as part of the geological evaluation as described in Section 1.2.1 of CSA (2016).
  - Landslides and liquefaction – these and other potential geohazards were evaluated on the basis of the geohazards assessment as described in the preceding paragraphs of this section; see Section 1.2.1 of CSA (2016).
  - Marine reserves – none were present in the Application Area (see Section 2.2 of CSA, 2016).
  - "Regions defined as special regions such as ridges, canyons or deep coral reefs, sponges, clams or other sedentary organisms" – none of these regions were present in the Application Area (see benthic communities discussion in Sections 1.2.1 and 1.2.3 in CSA, 2016).
  - "Proximity to towns and residential areas, visibility and appearance from the coastline" – this was deemed not relevant due to the distance from shore (~90 km from Haifa).
  - "Habitats of animals in danger of extinction" – there were no specific "critical" habitats for endangered or threatened species in the Application Area. Endangered or threatened species that might have been present in the region were discussed in Section 1.2.3 and were included in the impact analysis in Chapter 4 of CSA (2016).
  - Shipping lanes – There is one shipping lane in the Tamar Field which connects the area with the Port of Haifa (see Section 1.2.8 of CSA, 2016). Appropriate measures will be taken to avoid any conflicts with shipping (see Section 5.2.10).
  - Existing infrastructure, communications and energy lines (e.g., flowlines) proximal to the drill sites included 1) A Med Nautilus submarine telecommunications cable oriented perpendicular to the Israeli shore is located approximately 2 km north of the Tamar SW-1 wellsite, within the Tamar Field (Figure 1-4 of CSA, 2016). The drill sites have been selected to avoid any physical impacts to the telecommunications cable; all drill sites are more than 1 km away from the nearest cable. No seafloor-disturbing activities will be conducted near the telecommunications cable and no impacts are expected (see Chapter 4 of CSA, 2106).
  - Oceanographic current regime – the local oceanographic current regime for offshore Israel was considered in the design criteria for the drilling unit and support vessels, but there were no significant spatial differences in the oceanographic current regime within the Tamar Field. Therefore, it was not a factor in selecting the individual drill sites.
  - Fish reproduction zones and times; fishing areas and marine farming zones – there were no fish reproduction zones or fishing areas in the Tamar Field, and the nearest marine farming zones are along the coast (see Section 1.2.9 of CSA, 2016).

Proposed Project:

- New well clearance letters for the proposed Tamar-12 drill site and umbilical corridor have been received by CML.

2.3 TECHNOLOGICAL ALTERNATIVES

While the selection of the most appropriate alternatives for the Tamar-12 Project was based on efficient installation and operation of project components to maximize production, the CML approach was driven primarily by their corporate policies regarding environmental protection. CML priorities to help protect the environment included responsible design, development, operations and retirement of assets through the entire life cycle of the project. By considering potential environmental risks during planning, CML intended to enhance environmental performance by identifying and selecting alternatives which allow for the prevention or mitigation of potential environmental impacts. CML's Operational Excellence Management System (OEMS) environment focus area promotes systematic consideration of business risks and environmental performance alongside stakeholder expectations. Tamar-12 project-related impacts and viable mitigation measures are addressed in **Chapter 4**.

CSA (2016) provided a description of Technological Alternatives considered at the time the EIA was prepared (see Section 2.3 of the 2016 document). New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:
- Technological alternatives were evaluated including drillship, drilling technology, the drilling mud program, and cuttings treatment technology.
- Technological subsea development alternatives, including route and equipment site selection, installation methods, and testing and pre-commissioning methods, were evaluated to ensure that the new infrastructure is safe, uses the smallest land-use footprint, and minimizes the days offshore required for installation and testing activities.

Proposed Project:
- Managed Pressure Drilling (MPD) will be evaluated for use during drilling of the Tamar-12 well. This would be one of the first applications by CML in Israel, if utilized. MPD is defined by the American Petroleum Institute (API) as an adaptive drilling process used to precisely control the annular pressure profile throughout the wellbore. This technique helps in mitigating risks and costs associated with drilling wells that have narrow downhole environmental limits by proactively managing the annular hydraulic pressure. MPD can be particularly useful for drilling in depleted reservoirs by maintaining a constant bottom hole pressure and minimizing additional pressure acting on the formation utilizing lower mud weights and compensating with surface back pressure to reduce chance of lost circulation. MPD, if utilized, will not affect discharges to the sea.
- Design of subsea facilities supporting the development of the new well remains largely unchanged in comparison with design of existing Tamar facilities.

2.3.1 Drilling Vessel, Blowout Preventer, Drilling Muds/Fluids

2.3.1.1 Type of Drilling Rig

CSA (2016) provided a description of the drilling program, including identification of the candidate drilling rigs considered (see Section 3.2.2 of the 2016 document). The type of drilling rig summarized in CSA (2016) was not considered in the discussion of Technological Alternatives, aside from summary tabular information (Section 3.2 and Table 2-2 of the 2016 document). New information for the Tamar-12 Project is mentioned under the proposed project.

Key Findings:
- The *Ensco 5006*, a DNV, Maltese Cross A1A Column Stabilized Drilling Unit was initially identified as a potential drilling unit for the proposed project.
- CML (formerly NEML) planned to use a fifth-generation DP drillship or DP semisubmersible for drilling operations. The *Atwood Advantage* and *GSF Development Driller II* were identified as candidate drilling vessels.

Proposed Project:
- The proposed drillship is expected to be with similar capabilities to that used for latest CML drilling and completion campaigns. Based on the technical requirements for the drilling program, CML determined that a dynamic positioning (DP) drillship is preferred with the following general specifications:
  - Maximum drilling depth capability in excess of 10,700 m;
  - Minimum working water depth capability greater than 1,700 m;
  - Outfitted with well control equipment rated at >10,000 psi capacity;
  - Capable of installation of an 18¾-inch 10K blowout preventer (BOP) system with dual annulars and 4 ram-type preventers;
  - Equipped with four mud pumps;
  - Adequate bulk storage capacity for cement and barite;
  - Fluid storage for active and reserve pits and additional storage of brine;

    - Pipe and tubular handling for all drill pipe, casing, and tubing required for the project; and
    - Experience with completion and well-testing operations.
- A drillship for the Tamar-12 Project drilling and completion activities will be used and selected at a later date during the tendering process.

2.3.1.2 Drilling Technology

CSA (2016) provided a description of Drilling Technology Alternatives (see Section 2.3.1 of the 2016 document). New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- Well control equipment was rated at 10,000 psi capacity.
- An 18¾-inch BOP system with dual annulars and 4 ram-type preventers was also proposed.
- The wells were planned to be drilled vertically to the 13⅝ in. casing point. Below that, a directional pilot hole was to be drilled to total depth, the reservoir evaluated, and the wellbore sidetracked back to vertical, offsetting the original wellbore, down to the top of reservoir as required. The wells were planned with a generous target tolerance. Control drilling or sliding to maintain the wellbore vertically was not a requirement; however, care was to be taken to minimize dog legs.
- Rotary steerable systems: Designed to drill vertically or directionally with continuous rotation from the surface, eliminating the need to slide a steerable motor. With a steerable drilling system, penetration rates are improved because there are no stationary components to create friction that reduces efficiency and anchors the bottom hole assembly (BHA) in the hole. The flow of cuttings past the BHA is enhanced because annular bottlenecks are not created in the wellbore. State of the-art rotary steerable systems have minimal interaction with the borehole, thereby preserving borehole quality. The most advanced systems exert consistent side force similar to traditional stabilizers that rotate with the drill string or orient the bit in the desired direction while continuously rotating at the same number of rotations per minute as the drill string. They offer precise steering control that maximizes reservoir contact for increased production. The technology reduces the uncertainty of drilling away from the target, due to deviation prone sections (salt sections). The precision steering system can be combined with polycrystalline diamond compact bits, modular motors, near-bit sensors, measurement while drilling and logging while drilling tools. Based on real time formation evaluation, better reservoir navigation decisions can be made.
- Polycrystalline diamond compact bits: Provide superior directional control, longer run life, improved rate of penetration, enhanced durability, and better drilling efficiency. The synthetic diamond disks shear the rock with a continuous scraping motion. Polycrystalline diamond compact bits are effective at drilling shale formations, especially when used in combination with oil-based muds.
- Modular motors: Positive displacement drilling motors that use hydraulic horsepower of the drilling fluid to drive the drill bit. Mud motors are used extensively in jetting in conductor casing and directional drilling operations.
- Near-bit sensors: Placed below rotary steerable systems can accurately pick a casing point with bit only 2.5 m below. The data are transmitted to the surface along with other logging while drilling data further up in the BHA without any signal detection issues. This helps steer the hole section to the best place in less time.
- Measurement while drilling (MWD): Provides evaluation of physical properties, usually including pressure, temperature, and wellbore trajectory in 3D space, while extending a wellbore. MWD is now standard practice in offshore directional wells. The measurements are made downhole, stored in solid-state memory for some time and later transmitted to the surface. Data transmission methods vary from company to company, but usually involve digitally encoding data and transmitting to the surface as pressure pulses in the mud system. These pressures may be positive, negative, or continuous sine waves. Logging while drilling (LWD) tools use similar data storage and transmission systems, with some having more solid-state memory to provide higher

resolution logs after the tool is tripped out than is possible with the relatively low bandwidth, mud pulse data transmission system.
- Logging while drilling (LWD): Provides measurements of formation properties during the excavation of the hole or shortly thereafter, through the use of tools integrated into the BHA. LWD has the advantage of measuring properties of a formation before drilling fluids invade deeply. Further, many wellbores prove to be difficult to measure with conventional wireline tools. Timely LWD data can be used to guide well placement so that the wellbore remains within the zone of interest or in the most productive portion of a reservoir.

Proposed Project:
- A similar scope of drilling technologies, as outlined above, is expected for the Tamar-12 Project. MPD might be implemented (as discussed in **Section 2.3**) and implementation of a big-bore completion to enhance high-rate capability is also being considered by CML. MPD, if utilized, will not affect discharges to the sea.

2.3.1.3 Blowout Preventer Technology

CSA (2016) provided a description of Blowout Preventer Technology; see Sections 2.3.1.8 and 3.2.4.1 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:
- As noted in CSA (2016), the leaseholder at the time (CML; formerly NEML) and the drillship's owner engaged in a comprehensive inspection and testing of the drillship's subsea BOP system to ensure compliance with the U.S. Bureau of Safety and Environmental Enforcement (BSEE) regulations. The inspection and testing were witnessed and certified by a third-party surveyor.

Proposed Project:
- A similar scope of BOP technologies, as outlined above, is expected for the Tamar-12 Project (see **Section 3.2.4**).

2.3.1.4 Drilling Mud Selection and Cuttings Treatment Technology

CSA (2016) provided a description of Drilling Mud Selection and Cuttings Treatment Technology (see Section 3.2.2.4 of the 2016 document). New information for the Tamar-12 Project is mentioned under the proposed project.

Key Findings:
- Proposed use of both WBM and mineral oil-based mud (MOBM) for the Tamar wells, due to the inefficiency associated with WBM (approximately 15% to 20% longer time to drill wells), including the need to add a large number of specialty chemicals (e.g., glycols, bactericides, potassium, and special shale inhibitors) that have increased the complexity of managing the drilling program in an environmentally responsible manner.
- Use of a MOBM could result in a reduction of as much as 20% of the time required to drill due to increased rates of penetration, reduced hole-stability issues, and fewer electronic failures currently experienced with the use of salt-saturated WBM.
- CML's (formerly NEML) preferred option for the Tamar wells was to use WBM in the upper two well sections, with the use of MOBM in subsequent well sections due to increased operational efficiency, shale inhibition, wellbore stability, and lubricity while reducing drilling time and chemical usage.
- mud system (**Appendix C**), a high-performance invert emulsion fluid system developed by Baroid (a product service line of Halliburton) with ExxonMobil Chemical's as the base fluid, was CML's (formerly NEML) preferred MOBM option for the Tamar wells, pending approval from the Ministry of National Infrastructures, Energy and Water Resources (NMIEWR).

Proposed Project:

- CML intends to use a similar drilling mud program as employed during the last drilling campaign. Specifically, this will include the following main stages:

- WBM cuttings disposal will be to the seafloor, with the amount of cement designed to reach the seafloor with a target to minimize excess.
- Cuttings from the MOBM well sections will not be discharged at the seabed or overboard from the drillship. All MOBM cuttings throughout the entire Tamar-12 drilling campaign are expected to be shipped to shore via skip and ship tanks for disposal. Any MOBM cuttings treatment on board the drillship will be evaluated once the drillship is identified, and a drilling fluids company is contracted.
- Currently, CML anticipates using a base fluid similar to for the mud system (**Appendix C**).

2.3.1.5 Hazardous Materials

Hazardous materials are discussed in **Section 3.5**, including specific materials required for select applications, as well as references to storage, safety levels, risks, emissions, leaks detection abilities and treatment.

2.4 LAYOUT ALTERNATIVES

2.4.1 Infrastructure Components

CML expects to use similar infrastructure components as were previously installed for the Tamar Field Development and no new alternatives were considered. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Proposed Project:

- The Tamar-12 Project will augment Tamar production by installing a new subsea well, with associated production tree, jumpers and an Intermediate Jumper Structure (IJS), infield umbilical, and flying leads. The new well will be connected to the existing Tamar subsea distribution assembly (SDA) through an existing flowline. Additional information on the proposed infrastructure is presented in **Section 3.2.8**.

2.4.2 Umbilical Installation Methodology

The Tamar-12 umbilical will be installed using the same method as was used for the previously installed Tamar umbilicals. This standard installation method will require the use of a multi-purpose construction vessel (MPCV) selected by the subsea installation contractor. The well jumpers, flying leads, crossing mattresses and the IJS will be installed using traditional crane lift and deployment methods by the same MPCV.

2.5 SUMMARY

CSA (2016) provided a summary of the major topics addressed in this section on alternatives (see Section 2.4 of the 2016 document). New information for the Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- In CSA (2016), Table 2-2 provided a summary of major findings pertinent to well location alternatives, drillship, drilling technologies, drilling mud programs, cuttings treatment technology, and BOP selection.

Proposed Project:

- For Tamar-12 drilling and completion, a summary of the well location alternatives, drillship options, drilling technologies, drilling mud program, cuttings treatment technology, BOP selection, and flowline installation and pre-commissioning is provided in **Table 2-1**. A summary of subsea infrastructure installation alternatives, including location, infrastructure components, and installation and pre-commissioning options, is also presented in **Table 2-1**.

Table 2-1. Summary of alternatives for well and subsea infrastructure location, drillship, drilling technologies, drilling program, muds and cuttings treatment, blowout preventer selection, and infrastructure components, installation, and pre-commissioning for the Tamar-12 Project.

Subject	Proposed Action	Alternatives Evaluated and Ratings		Reference
Well location	CML's development plan includes the identification for the new well location which was selected based on factors such as reservoir performance, reservoir connectivity, development phases, production profile, shallow hazards, and appraisal.	**RATING: Acceptable** The location of the well was selected to satisfy early production needs, provide optimal drainage of gas, and provide reservoir surveillance. Initial well location has been selected based on the interpretation of seismic and geophysical survey data as well as results from previous exploratory and appraisal wells in the region. Geohazards and environmental factors were considered.		Section 2.2.1
Subsea infrastructure location	CML intends to use the most direct umbilical route, minimize the number of crossings, minimize the seafloor footprint while allowing for future developments, and use existing infrastructure to the maximum extent practical.	**RATING: Acceptable** No additional alternatives were considered for infrastructure location, given the merits of the proposed action.		Section 2.2.2
Type of drillship	One drillship will be used to conduct the drilling and completion operations. CML has not selected the specific drillship, but plans to use a DP3 drillship (e.g.,	**DP Drillship or DP Semisubmersible** **RATING: Acceptable** A DP drillship or semisubmersible can meet CML's specifications.	**Moored Semisubmersible** **RATING: Less Suitable** A moored semisubmersible would be less practical in these water depths and would create additional environmental impacts due to seafloor disturbance.	Section 2.3.1.1
Drilling technology	The initial drilling plan includes a vertical and sidetrack (directional) well. The new well is planned as a vertical well where possible but directional where required to avoid shallow hazards. Key drilling technologies include rotary steerable systems, polycrystalline diamond compact bits, modular mud motors, near-bit sensors, measurement while drilling, and logging while drilling.	**RATING: Acceptable** The design of the well will be based on CML's evaluation of reservoirs and is intended to satisfy early production needs, result in optimal drainage of gas, and provide reservoir surveillance. Drilling technologies will be selected based on CML's experience as most suitable for the safety and efficiency of the drilling program.		Section 2.3.1.2
Cuttings treatment and disposal	CML proposes to discharge WBM cuttings to the ocean at the drill site (i.e., from the wellbore).	**Offshore Disposal** **RATING: Acceptable**		Section 2.3.1.4
	Cuttings from the MOBM portion of the well will be transferred to a support vessel and into skip and ship tanks to be taken to land for disposal.	**Onshore Disposal** **RATING: Acceptable** MOBM cuttings will be transferred to a support vessel and processed for land-based disposal. The cuttings would need to be disposed of at the Ramat Hovav or other certified waste site in Israel, or exported to a recycling facility in a nearby country (e.g., Cyprus). The cuttings would contribute to filling up the Ramat Hovav or similar facility.		

Table 2-1. (Continued).

Subject	Proposed Action	Alternatives Evaluated and Ratings		Reference
Drilling mud selection	CML plans to use a combination of WBM and MOBM.	**WBM and MOBM Combination:** **RATING: Acceptable** This alternative will allow CML to drill efficiently while maintaining proper well control, rheological control, inhibition capability, and lubricity. The MOBM system was selected based on its technical performance and environmental characteristics.	**WBM Only:** **RATING: Less Suitable** Using WBM exclusively would be less efficient, extend drilling time, and would require the use of numerous specialty chemicals.	Section 2.3.1.4 Appendix E
Blowout preventer (BOP) technology	CML and the drillship's owner will engage in a comprehensive inspection and testing of the drillship's subsea BOP system to ensure compliance with the U.S. Bureau of Safety and Environmental Enforcement (BSEE) guidelines in this regard.	**RATING: Acceptable** The BOP specifications to be selected will be based on best industry practice and reflect CML's commitment to safety throughout the drilling program.		Section 2.3.1.3
Infrastructure components	CML expects to use similar infrastructure components as were previously installed for the Tamar Field Development and no new alternatives were considered.	**RATING: Acceptable** CML will optimize Tamar production capabilities by installing a new subsea well, with a production tree, jumpers, infield umbilical, and flying leads.		Section 2.4.1
Umbilical installation	CML will install the new umbilical using standard installation technology.	**Rating: Acceptable** The installation methodology will be based on best industry practice and reflects CML's commitment to safety throughout the umbilical installation program.		Section 2.4.2

3 Describing the Operations Resulting from Implementing the Application

3.1 DESCRIPTION OF THE APPLICATION

3.1.1 General

This chapter describes CML's plans to conduct well drilling and completion activities for the initial expansion of gas production and development in the Tamar Field, offshore Israel. Under CML's expansion plans, the Tamar-12 Project will include the drilling and completion of one well (Tamar-12), installation of the associated wellhead and subsea production tree, as well as the installation of one new infield production control umbilical, flying leads, and jumpers. The Project will utilize the existing Tamar SW flowline for connecting the new well into the Tamar production system (**Figure 3-1**). Once completed, the new well will be placed into production. Key considerations evaluated in the development of the Tamar-12 Project included:

- The well location was selected based on factors such as reservoir performance, reservoir connectivity, development phases, production profile, shallow hazards, and appraisal; and
- The length of the new umbilical was optimized by tie-in to existing equipment in the Tamar manifold area (i.e., at the SDA).

Figure 3-1. Locations of the proposed Tamar-12 well and proposed new infield umbilical in relation to existing infrastructure in the Tamar Field. The Tamar-12 drill site location and tie-in to the subsea distribution assembly are noted as blue, dashed rectangles.

3.1.1.1 Purpose and Type of Drilling

The purpose of the Tamar-12 Project is to support continued safe, reliable production from the Tamar Field. The Tamar-12 development well, targeting natural gas, will be similar to the original Tamar wells, incorporating lessons learned, best practices, and updated execution procedures. The Tamar-12 well will provide redundancy in the system and maintain production capacity in the coming years. Key Performance Indicators will be the same as in previous wells (including design life), with CML also considering implementation of a big-bore, high-rate capability not applied to earlier wells. MPD may also be used, as discussed previously in **Section 2.3**. MPD, if utilized, will not affect discharges to the sea.

3.1.1.2 Drilling Platform

One drillship will be used to conduct the drilling and completion operations. CML has not selected the specific drillship but plans to use a DP drillship (an example is shown in **Figure 3-2**) that would not require the use of anchors to maintain position and will mobilize to the Tamar Field under its own power. Representative drillship specifications are provided in **Appendix D**. Details on the selected drillship will be provided no later than three months from the drilling date.



Figure 3-2. Example of a dynamic positioning (DP) drillship.

3.1.1.3 Audit Reports

An audit report regarding the selected rig's compliance with the Safety and Environmental Management System (SEMS) according to 30 Code of Federal Regulations (CFR) 250, or an equivalent or more stringent management system, will be provided after selection of the drilling rig.

3.1.1.4 Water and Drilling Depth

Additional details on the drilling process are presented in **Section 3.1.2**.

3.1.1.5 Vessels and Aircraft

A single drillship is proposed for the drilling and completion operations. CML has not selected the specific drillship, but plans to use a DP3 drillship

The drilling program will be supported by three MMC-887 Class platform support vessels or similar (e.g., operating out of the port of Haifa with an average of four one-way trips (i.e., two round-trips) per week. The vessels range in overall length from 51.3 m to 87.9 m, with maximum draft ranging from 2.7 m to 6.8 m. Helicopter support, including 24/7 medical evacuation services, will be provided by a Sikorsky S-76C++ (or similar) medium sized commercial utility helicopter operated out of Haifa Airport with an average of 10.5 round-trip flights per week. Standby cover will be provided by the support vessels when available in the field.

Installation of the new subsea infrastructure, including the infield umbilical, will be conducted using an MPCV (e.g., or alternative), supported by a supply/standby vessel (e.g., a light construction vessel (LCV) equipped with an ROV (e.g., and a crew change vessel (e.g., Support operations for subsea infrastructure installation are expected to operate out of Limassol, Cyprus.

3.1.2 Description of the Drilling Process

3.1.2.1 Drilling Processes and Stages

The general steps for drilling the Tamar-12 well are as follows:

Figure 3-3. Representative schematic diagram for completion of the Tamar-12 well.

3.1.2.2 Drilling Schematic (Depth of Drilling by Time)

Figure 3-4. Time vs. depth plot for drilling the Tamar-12 well (Provided by CML).

3.1.2.3 Gantt Chart of Drilling Operations

Figure 3-5 shows a representative sequence of proposed drilling and completion activities.; this schedule may be modified based on project delivery or CML drilling commitments. The Tamar-12 well will be drilled (approximately 82 days) and temporarily abandoned pending completion. Completion activities will follow sequentially and are expected to require approximately 40 days. The total time for drilling and completing of the well is estimated to be 122 days.

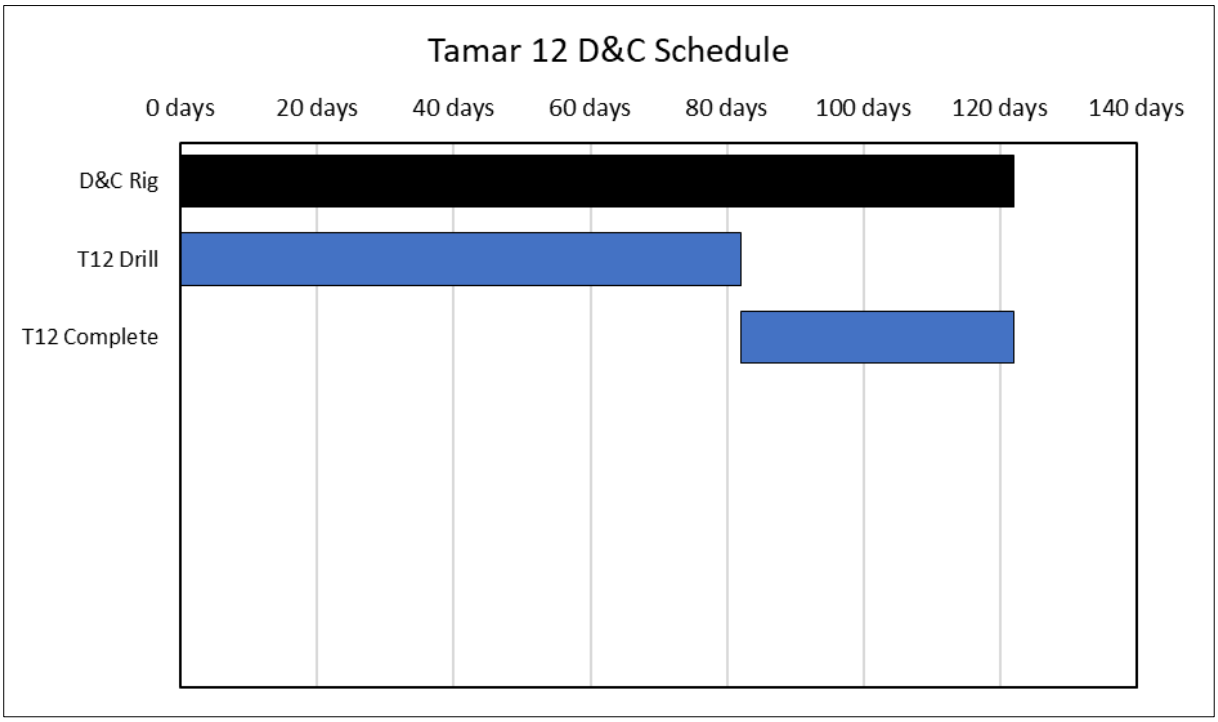


Figure 3-5. Schedule for drilling and completion activities for the Tamar-12 Project. Drilling and completion sequencing, as shown, is tentative, may not be sequential, and may change depending on various factors as outlined in text.

3.1.3 Hydrocarbon Blowout Preventers

3.1.3.1 Blowout Prevention Device

CML will use safe drilling practices during its activities in the Tamar Field. Best industry practice will be used during all drilling phases (e.g., setting of BOP; cementing of concrete between bore and protective pipe). CML has not selected a specific drillship, and detailed BOP specifications vary depending on the drillship. A typical BOP stack is shown in **Figure 3-6**. Final BOP selection will depend on the drillship selected. CML's drillship tender will include the following specifications:

- Minimum well control equipment rated at 10,000 psi capacity; and
- 18¾-inch BOP system with dual annulars and four ram-type preventers (**Figure 3-6**).

CML and the drillship's owner will engage in a comprehensive inspection and testing of the drillship's subsea BOP system to ensure compliance with the U.S. Bureau of Safety and Environmental Enforcement (BSEE) regulations. The inspection and testing will be witnessed and certified by a third-party surveyor.

In deeper offshore operations with the wellhead just above the mudline on the seafloor, there are four primary ways by which a BOP can be controlled:

- Electrical Control Signal – sent from the surface through a control cable;

- Acoustical Control Signal – sent from the surface based on a modulated/encoded pulse of sound transmitted by an underwater transducer;
- ROV Intervention – ROVs can mechanically control valves thereby providing hydraulic pressure to the stack (via “hot stab” panels); and
- Dead Switch/Auto Shear – fail-safe activation of selected BOPs during an emergency or if the control power and hydraulic lines have been severed.

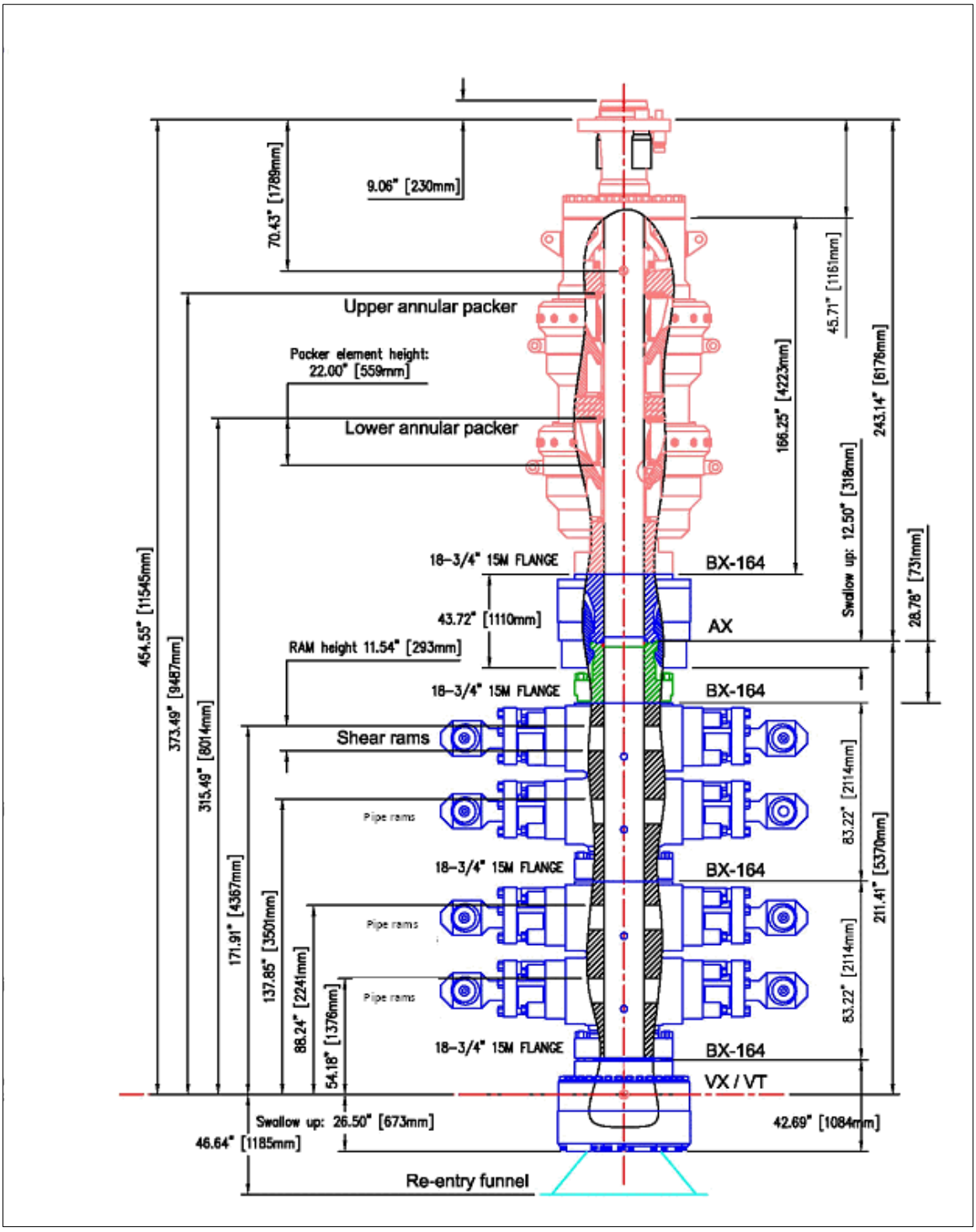


Figure 3-6. Typical blowout preventer (BOP) stack.

Two control pods are provided on the BOP for redundancy. Electrical signal control of the pods is primary; acoustic ROV intervention and dead-man controls are secondary.

An emergency disconnect system (EDS) separates the drillship from the well in case of an emergency. The EDS is intended to automatically trigger the dead-man switch, which closes the BOP as well as kill and choke valves. The EDS may be a subsystem of the BOP stack's control pods or separate.

Pumps on the drillship normally deliver pressure to the BOP stack through hydraulic lines. Hydraulic accumulators on the BOP stack enable closure of BOPs even if the BOP stack is disconnected from the drillship.

CML has committed to operating in Israel per BSEE regulations, unless superseded by Ministry of Energy (MoE) regulations. The BSEE specifications for maximum anticipated surface pressure (MASP) are derived from 30 CFR 250.414 (f) (2) (vi), as follows: *"The design criteria considered for the well and for well control include… anticipated surface pressures (which for purposes of this section are defined as the pressure which can reasonably be expected to be exerted upon a casing string and its related wellhead equipment)."*

It is left to the operator to calculate the MASP and to include in the Application for Permit to Drill the assumptions, formulas, and results. The MASP calculations and results accepted by BSEE are reported as the lesser of the pressures calculated using two methods:

1. Pore Pressure Method ($MASP_{pore)}$: This calculation assumes the well is partially unloaded to gas and equals the maximum expected pore pressure at the bottom of the open hole less the hydrostatic head of the gas column and the mud column from the bottom of the hole to the "surface."
2. Fracture Gradient Method ($MASP_{frac}$): This calculation assumes the well is completely unloaded to gas and equals the fracture pressure at the deepest exposed casing or liner shoe less the hydrostatic head of the gas from that shoe to the "surface."

The corresponding maximum anticipated wellhead pressure (MAWP) is equivalent to MASP plus gas hydrostatic from surface to the wellhead. The maximum required casing and blind shear ram surface test pressure will be equivalent to the MASP plus 500 psi or 70% of the minimum internal yield pressure ($MIYP_{70}$) of the casing being tested less mud weight vs. pore pressure at the previous shoe difference at the wellhead, casing top or shoe, whichever is less. For production casing strings, the casing test pressure will be determined by the completion requirements. The maximum required surface BOP pressure test will be equivalent to the MASP plus 500 psi less mud weight vs. seawater hydrostatic difference at mud line. Test pressures are not to exceed 70% of the annular rating or 100% of the ram rating at seafloor conditions.

3.1.3.2 Three-Way Diverter Device

CML has not selected a specific drillship, and detailed BOP specifications vary depending on the drillship. A BOP stack was shown in **Figure 3-6**. Once selected, CML will inform MoE of the specifications associated with the three-way diverter device and information concerning the three-way diverter device will be provided as part of the drilling plan. As noted previously, CML and the drillship owner will engage in a comprehensive inspection and testing of the subsea BOP system to ensure compliance with BSEE regulations, with inspection and testing to be witnessed and certified by a third-party surveyor.

3.1.3.3 Casings and Cementing

Details of the casing strings are provided in **Section 3.1.3.3.1**. The absence of cement between the 14” and 16” is to mitigate a phenomenon known as APB. This occurs when the temperature of fluid in the annulus increases during production which leads to elevated annular pressures that may adversely affect well integrity. By leaving the top of cement below the 16” shoe, a pressure relief pathway is maintained.

3.1.3.3.1 Casings

Figure 3-7 shows a representative wellbore schematic for Tamar-12. The basis of the well and casing design is as follows:

Figure 3-7. Representative wellbore schematic for the Tamar-12 well.

3.1.3.3.3 Construction, Cementing, and Duration of Drilling

Well cementing is described in **Section 3.1.3.3.2**. Durations of the main stages of drilling are presented in **Table 3-1**.

Table 3-1. Approximate durations of drilling for Tamar-12 sections (intervals).

3.1.3.3.4 *Cementing Materials*

Estimated volumes of well cement products consumed and remaining in the wells are presented in **Table 3-2**.

Table 3-2. Estimated per-well cement products consumed and remaining in the well for Tamar-12 drilling.

3.1.3.3.5 Cementing Quality Assurance

Cement Laboratory Testing

Laboratory testing is a critical element in successful well cementing. Unless specifically indicated, all cement testing procedures shall adhere to the latest version of the cement service provider's Global Laboratory Best Practices.

Formation Integrity Test

The purpose of a Formation Integrity Test is to determine the competence of the primary cement job and the competence of the formation below the casing shoe. A Formation Integrity Test will be performed after running and cementing each casing string, cleaning out the rathole section, and drilling 3 m of new formation below the casing shoes. If a leak-off pressure is obtained that is lower than anticipated and the equivalent mud weight is less than that required to safely drill to the next casing depth, consideration will be given to squeezing the casing shoe. Subsequent re-testing should verify if the primary cement job was ineffective or if the formation fracture gradient was lower than anticipated. Lift pressures will be monitored for indication of cement placement in the production casing and a cement bond log or equivalent will be run if required to confirm cement bond and top of cement.

Casing Test Pressures

Casing tests will be conducted as per 30 CFR 250. Casing pressure tests shall be conducted to the MASP plus 500 psi or $MIYP_{70}$ of the casing being tested less mud weight vs. pore pressure at the previous shoe difference at the wellhead, casing top or shoe, whichever is less. For production casing strings, the casing test pressure will be determined by the completion requirements. If necessary, a cement bond log may be run on the production casing string to confirm the cement bond and the top of the cement.

3.1.4 Testing the Drilling String

Drill string tests are not planned during the Tamar-12 Project.

3.1.5 Subsea Field Development

3.1.5.1 Planned Subsea Infrastructure

Planned subsea infrastructure was previously described in **Section 3.1.1**.

3.1.5.2 Actions to Lay Infrastructure

An MPCV may be used for jumpers and umbilical installation. An example of an MPCV is the Subsea vessel Installation will be supported by the use of ROVs and an associated LCV, which will be equipped for ROV deployment and recovery capabilities. An example of such a vessel is the

3.1.5.3 Cleaning Actions

No new pipeline is proposed as part of the Tamar-12 project. After installation, the new subsea jumpers and the IJS will be pre-commissioned prior to establishing production operations. The jumpers will be leak tested and packed with MEG, the umbilical and flying leads will be tested. The new subsea infrastructure will be subjected to periodic maintenance and asset integrity operations (e.g., inspection) in line with the existing infrastructure and its operation. Jumper and IJS pre-commissioning includes the following main steps:

Jumpers:

- Prior to Installation – The jumpers will likely be filled with MEG to the extent practical.
- During Installation – Any remaining jumper volume not filled with MEG will be allowed to free flood with seawater.
- After Jumper Installation – The subsea connectors will be leak tested.

After leak testing, the jumpers will be flushed with the selected preservation/hydrate inhibition medium to displace any seawater that entered the jumper during installation. This will protect the internal surfaces from seawater corrosion and biogenic growth; jumpers will be flushed with MEG prior to locking them down to displace any water resulting from installation. CML will seek prior approval for any chemicals remaining in the subsea infrastructure or pipelines which are intended to be discharged to the sea at a later date.

3.1.5.4 Method of Establishment and Installation of Additional Infrastructure

Other than the infrastructure described in **Section 3.1.1**, no other infrastructure is proposed to be installed as part of the Tamar-12 Project.

3.1.6 Production Tests

Production tests are not planned as part of the Tamar-12 Project.

3.2 NOISE POLLUTION

3.2.1 Mechanical Equipment and Noise Levels

CSA (2016) provided a discussion of the noise from the drillship; see Sections 3.3 and 4.5 of the 2016 document. CSA (2023b) also prepared a noise assessment for Tamar. Details regarding the approach to be used for Tamar-12 are provided as part of the proposed project entries below.

Key Findings:

- Drilling noise is typically low and continuous, with most energy below 1 kHz (Richardson et al., 1995).
- Greene (1987) found that the sound generated by a semisubmersible drillship did not exceed local ambient levels beyond 1 km, although weak tones were detectable up to 18 km away.
- Sound from drilling activities was based on Miles et al. (1987) using a drillship and was found to have a peak sound pressure level (SPL) of 177 dB re 1 µPa.

Proposed Project:

- Non-impulsive noise from subsea installation is expected to be similar to non-impulsive noise from the drillship and support vessels; no unique impacts are expected from installation activities.
- Roberts and Elliott (2017) note that vibration from activities such as drilling or pile driving have the potential to cause behavioral or physical changes for marine species. Other researchers (e.g., Dannheim et al., 2020; He et al., 2023) have concluded, based on their synthesis of available data, that noise or vibration might affect local populations of fish or benthic invertebrates, although it is acknowledged that overall implications from these anthropogenic vibration sources are not well understood.
- CML will rely on the summary information regarding drilling and drillship noise, as outlined in CSA (2016, 2023b), supplemented with more recent measurements of drilling-related noise.

3.2.1.1 Support Vessels

CSA (2016) provided a discussion of the noise from support vessels; see Sections 3.3 and 4.5 of the 2016 document. CSA (2023b) also prepared a noise assessment for Tamar.

Key Findings:
- Broadband source levels for most small ships (a category that would include support vessels) are in the range of 170 to 180 dB re 1 µPa at 1 m (Richardson et al., 1995).
- Most of the energy is in frequencies below 100 to 200 Hz, but broadband sounds may include acoustic energy at frequencies as high as 100 kHz.
- Propeller cavitation is usually the dominant noise source.
- Support vessels are considered transient sound sources as they move between the shore base and the drillship.

Proposed Project:
- New information has been identified. CML will rely on the summary information regarding support vessel noise, as outlined in CSA (2016, 2023b), however, CSA has supplemented the 2016 and 2023 findings with relevant results from peer-reviewed literature data sources for the representative vessels being considered for the Tamar-12 Project (see **Section 4.5**).

3.2.1.2 Underwater Noise from Helicopters

CSA (2016) provided a discussion of Underwater Noise from Helicopters; see Sections 3.3 and 4.5 of the 2016 document. CSA (2023b) also prepared a noise assessment for Tamar.

Key Findings:
- Received SPLs (in water) from a Bell 212 helicopter flying at altitudes of 152 m (500 ft) were 109 dB re 1 µPa with an estimated source level of 149 dB re 1 µPa (Richardson et al., 1995).
- Penetration of noise into the water column is greatest directly below the aircraft.
- Duration of underwater sound from a helicopter passing at an altitude of 152 m may be detectable for only 38 seconds at 3 m depth and for 11 seconds at 18 m depth (Richardson et al., 1995).

Proposed Project:
- No new information has been identified. CML will rely on the summary information regarding helicopter noise, as outlined in CSA (2016, 2023b).

3.3 LIGHT POLLUTION

CSA (2016) provided a discussion of Light Hazards; see Section 4.4 of the 2016 document. CSA (2023b) also prepared a light assessment for Tamar. Details regarding the approach to be used for Tamar-12 are provided as part of the proposed project entries below.

3.3.1 Drilling Rig and Installation Vessel

Key Findings:
- Lighting on offshore facilities serves a variety of purposes, including navigational and worker safety, but concern over the potential effects of artificial light at night (ALAN) on the marine environment has increased in recent years.
- While not a fixed platform, the drillship and installation vessel will be equipped with operational and navigational lighting.

Proposed Project:
- No new information has been identified. CML will rely on the summary information regarding drilling rig and installation vessel light hazards, as outlined in CSA (2016, 2023b).

3.3.2 Support Vessels

Key Findings:
- Supply and support vessels operating either during drilling and completion activities or during subsea infrastructure installation operations will emit light during nighttime operations.

- Unlike the drillship which will be stationary, or the installation vessel which will be stationary or moving slowly, support vessels will transit between the project area and shore base, with limited time remaining on station in the Tamar Field.

Proposed Project:
- No new information has been identified. CML will rely on the summary information regarding support vessel light hazards, as outlined in CSA (2016, 2023b).

3.4 AIR QUALITY

CSA (2016) provided a discussion of Air quality; see Sections 3.4 and 4.4 of the 2016 document. Details regarding emissions specific to the Tamar-12 Project are provided in detail below.

3.4.1 Sources of Air Pollution

Emission sources during the Tamar-12 Project are anticipated to result from internal combustion engines on the drillship, support vessels, installation vessel, and helicopters. Estimated emission rates are presented in **Section 3.4.3**.

3.4.2 Monitoring, Detection, and Control Measures

In December 2022, the 79th meeting of the Marine Environment Protection Committee (MEPC 79) adopted amendments to designate the Mediterranean Sea, as a whole, as an Emission Control Area (ECA) for sulfur oxides (SO_x) and particulate matter, under MARPOL Annex VI. In such an ECA, the limit for sulfur in fuel oil used on board ships is 0.10% mass by mass (m/m), while outside these areas the limit is 0.50% m/m. The amendment entered into force on 1 May 2024, with the new sulfur limit taking effect from 1 May 2025. A summary of the MEPC 79 decisions is available on the International Maritime Organization (IMO) website. All project vessels entering the Mediterranean will comply with this amendment, as this becomes mandatory under Annex VI.

During drilling operations, methane and hydrogen sulfide will be monitored in the filtration room and the regenerated mud reception tubs. Any detection of methane or hydrogen sulfide during the course of any drilling will be documented and reported; bleed off emissions will be diverted to the poor boy degasser on the drillship and shall be reduced as far as possible.

3.4.3 Air Pollutant Emission Estimates

The drillship, subsea installation vessel, and support vessels will produce emissions from internal combustion engines, including carbon monoxide (CO), nitrogen oxides (NO_x), sulfur oxides (SO_x; inclusive of sulfur dioxide, SO_2), volatile organic compounds (VOCs), and particulate matter (PM), as well as greenhouse gases (GHGs) including carbon dioxide, methane (CH_4), and dinitrogen oxide/nitrous oxide (N_2O). Emissions were estimated using either actual fuel usage data or vessel engine horsepower ratings, and employing a worksheet developed by BOEM (2024) based on USEPA AP-42 emission factors, among others. Actual fuel usage was applicable to the representative drillship maximum horsepower ratings, adjusted to 75% maximum load, were applied to a representative subsea installation vessel (i.e., and various support vessels (i.e., .

Table 3-3 shows the estimated emissions for: 1) drilling of the well (82 days); 2) well completion (40 days) from a representative DP drillship operating 24 hours per day for the duration of well activity, 3) support vessels required during drilling and completion; and 4) subsea infrastructure

installation including both primary subsea equipment installation vessel and support vessels. Emissions are based on the following primary vessel and support vessel usage:

- Drilling and completion will require the use of the drillship (122 days total), with support from vessels for a total of 105 vessel days (35 days each; see **Table 4-23** for a detailed breakdown of vessel-by-vessel emissions) over the 122-day drilling and completion period; and
- Subsea installation will require the use of the *Seven Seas* for installation (44 days), with vessel support from the (44 vessel days each) and crew change provided by (6 vessel days), resulting in a total of 138 vessel days (see **Table 4-24** for a detailed breakdown of vessel-by-vessel emissions).

Table 3-3. Estimated air pollutant emissions from drilling, completion, subsea infrastructure installation, and all support vessels, Tamar-12 well.

Activity	Duration (days)	Total Emissions (metric tonnes)									
		CO	NO_x	SO_x	VOCs	PM2.5	PM10	CO_2	CH_4	N_2O	GHGs
Drilling	82	30.38	193.70	0.12	5.57	4.73	4.88	13,242.38	0.08	0.58	13,243
Well Completion	40	14.82	94.49	0.06	2.72	2.31	2.38	6,459.70	0.04	0.29	6,460
Support Vessels (During Drilling and Completion)	105 Vessel Days	63.92	407.56	0.25	11.72	9.96	10.26	17,164	0.10	0.76	17,165
Subsea Infrastructure Installation Including Installation Vessel and Support Vessels	138 Vessel Days	41.08	261.90	0.16	7.53	6.40	6.60	17,905	0.11	0.79	17,906

Emissions were calculated using the U.S. Bureau of Ocean Energy Management (2024) air emissions worksheet; drillship emissions were based on actual fuel usage data (i.e., 60 m^3 per day) for the operating 24 hours per day; emissions for the installation vessel and support vessels was based on maximum horsepower ratings, adjusted to 75% maximum load. CO_2, CH_4, and N_2O emissions were added to the worksheet using emission factors provided by Wilson et al. (2019). GHG = CO_2 + CH_4 + N_2O.
CO = carbon monoxide; CO_2 = carbon dioxide; CH_4 = methane; GHG = greenhouse gas; NO_x = nitrogen oxides; N_2O = dinitrogen oxide; PM = particulate matter; SO_x = sulfur oxides; VOC = volatile organic compound.

Helicopter support will be provided by a Sikorsky S-76C++ (or similar) operated from Haifa Airport; specifications are provided in **Appendix D**. It has been estimated that the helicopter will make 10.5 round-trips per week between Haifa and the drillship during drilling and completion operations. During subsea infrastructure installation, it is expected that a total of six round-trip helicopter flights between Haifa and the project area will be required (**Table 3-4**).

Table 3-4. Estimated pollutant emissions from helicopters during drilling and completion and subsea infrastructure installation operations (Sikorsky S-76C++) based on emissions calculations by the Swiss Federal Office of Civil Aviation (From: Rindlisbacher and Chabbey, 2015).

Source	Fuel Usage (kg)	Emissions (kg)			
		NO_x	HC	CO	PM
Single LTO Cycle	50.0	0.311	0.624	0.801	0.0097
One Hour of Flight	324.5	2.56	1.28	1.56	0.074
Single Round-Trip (LTO + 0.86 hours)	329.1	2.51	1.72	2.14	0.0733
Total (entire drilling and completion program, 183 round-trips; 10.5 trips per week for approximately 17.5 weeks)	60,225.3	459.3	314.8	391.6	13.41
Total (entire subsea infrastructure installation program; 6 round-trips total)	1,975	15.06	10.32	12.84	0.4398
Grand Total (drilling and completion and subsea infrastructure installation)	**62,200.3**	**474.36**	**325.12**	**404.44**	**13.85**

CO = carbon monoxide; HC = hydrocarbons; LTO = landing-takeoff; NO_x = nitrogen oxides; PM = particulate matter.

Table 3-4 provides an estimate of air pollutant emissions for drilling and completion and subsea infrastructure installation resulting from helicopter flights based on published emissions estimates for a Sikorsky S-76C++ helicopter (Rindlisbacher and Chabbey, 2015). Assuming a cruising speed of 226 km h^{-1} and a 195 km round-trip flight distance (approximate distance from Tamar Field to Haifa round-trip), each round-trip is assumed to require approximately 0.86 hours of flight time plus one landing-takeoff cycle. With 10.5 weekly round-trips, there will be approximately 183 trips during the entire drilling and completion program (122 days, or approximately 17.5 weeks).

3.4.4 Failures

CML does not anticipate any failures, either during drilling and completion or subsea infrastructure installation, that would result in an increase in air pollutant emissions to the environment.

3.4.5 Emergency Shutdowns

Emergency response plans and procedures will be in place. Emergency procedures and equipment will be tested to ensure they are in place and functioning. CML does not anticipate that emergency shutdowns would result in an increase in air pollutant emissions to the environment.

3.5 HAZARDOUS MATERIALS

CSA (2016) provided a discussion of Hazardous Materials; see Sections 3.2.2 and 3.5 of the 2016 document. Details regarding hazardous materials specific to the Tamar-12 Project are provided in detail below.

A table of hazardous chemicals planned to be used is included in **Appendix E**, along with safety data sheets (SDSs) for each chemical. All hazardous chemicals will be handled in compliance with MARPOL requirements and Toxin Permit requirements, as well as drilling vessel and installation vessel procedures.

Loading and offloading of chemicals will be in compliance with International Maritime Dangerous Goods (IMDG) code, as integrated into the drillship operator's guidelines for handling hazardous materials. Materials to be used in drilling (i.e., WBM, MOBM, and additives) are discussed in **Section 3.6.1**.

On the installation vessel, as well as aboard support vessels transporting hazardous materials, these materials will be handled in accordance with their Safety Data Sheet (SDS); handling requirements will be integrated into each set of vessel operator guidelines. All hazardous materials will be properly identified, stored, and handled, per SDS requirements and in such a manner that ensure no spill or discharge to sea. In addition, hazardous materials will be handled by vessel personnel according to SDS-based exposure limits. Hazardous materials storage areas will be designated on the pipelay and support vessels, located in areas isolated from other operations. Storage areas housing hazardous wastes will be maintained in clean condition (i.e., no residues or spilled materials on the container, floor, or surrounding area).

3.6 SOURCES OF DISCHARGES TO THE SEA

3.6.1 Discharge Sources – General

CSA (2016) discusses discharges in Section 3.6, including discharge sources, quantities, frequency of discharge, and potential contingency materials. Discharges addressed include those resulting from drilling and completion and subsea infrastructure installation and commissioning activities.

3.6.1.1 Sources of Discharge and Processes which Generate the Discharge

Discharges to be released into the sea during drilling operations can be divided into several main groups:

- Drilling discharges, including drilling muds, cuttings, and excess cement;
- Routine discharges from the drillship (and support vessels, as appropriate), including sanitary and grey water, food wastes, cooling water, desalination brine (reverse osmosis concentrate water), bilge water, excess cement, oil-water separator (OWS) discharges, and deck drainage;
- Routine discharges from the installation vessel (and support vessels, as appropriate), including sanitary and grey water, food wastes, cooling water, desalination brine (reverse osmosis concentrate water), bilge water, OWS discharges, and deck drainage; and
- Discharges from pre-commissioning of infield subsea infrastructure.

During the start-up phase, certain process adjustments might be implemented on Tamar platform. As a result, some discharge parameters may temporarily present elevated values than those obtained during normal operating conditions. These changes are expected to be short-term with limited impact on the marine environment and will be carefully managed and monitored. More specific details will be provided in proximity to start-up and will be laid down in the discharge permit application that will be submitted to MOEP. Once the operation reaches steady-state, discharge levels will align with the permit thresholds. In addition, the toxin and air permits for the Tamar platform will be revised if needed.

A diagram showing major discharge sources, discharge types, and discharge pipe diameters for project vessels is shown in **Figure 3-8**. Most discharge points are typically located below sea level; drain outlets are typically located about 2.5 m above sea level.

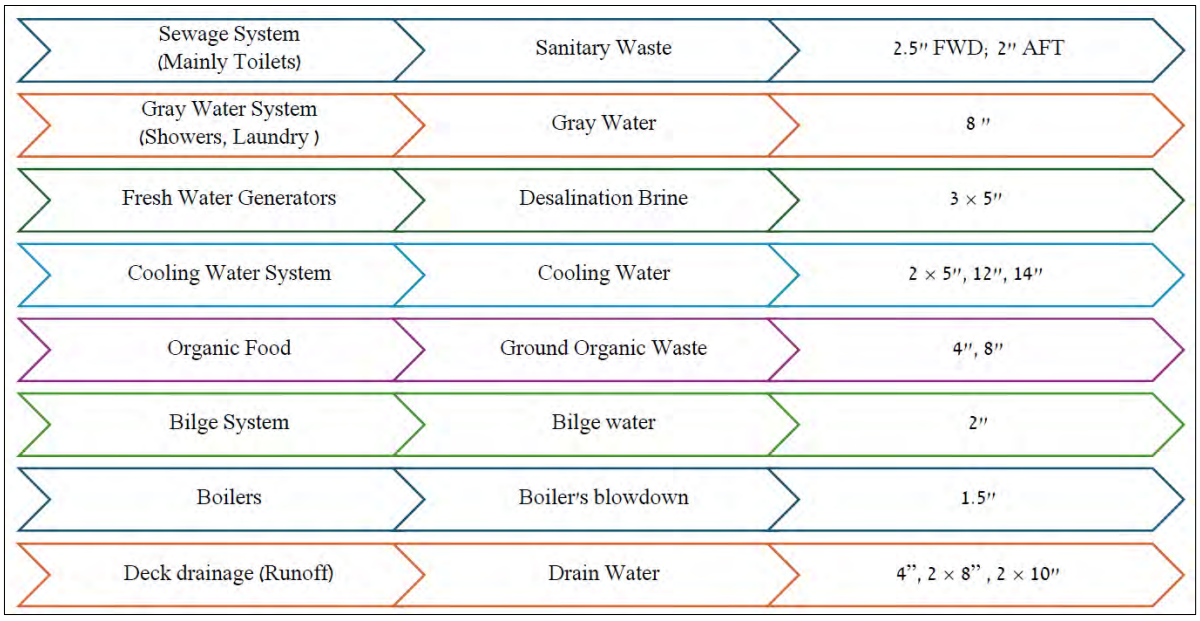


Figure 3-8. Simplified diagram showing major discharge sources, types, and pipe diameters for the Tamar-12 Project.

3.6.1.2 Treatment Processes

CSA (2016) provided a discussion of routine Discharge Treatment; see Section 3.6.1.2 of the 2016 document.

Key Findings:

- The drillship and installation vessels, as well as support vessels, will comply with International Convention for the Prevention of Pollution from Ships (MARPOL), Annex I (oil pollution prevention), Annex IV (sewage pollution prevention), and Annex V (garbage pollution prevention) requirements as demonstrated by International Oil Pollution Prevention and International Sewage Pollution Prevention certificates and a DNV Statement of Fact.
- All sanitary waste will be treated using an IMO-approved sewage treatment unit which will comply with the applicable IMO effluent standards and performance tests for treatment efficiency specified in IMO Resolution MEPC.159(55).
- The Marine Environment Protection Committee (MEPC) standards shall be met for the following effluents: Thermotolerant Coliform Standard, Total Suspended Solids Standard, Biochemical Oxygen Demand and Chemical Oxygen Demand Standards, and pH. The sanitary system will also adhere to thresholds specified in the Discharge to Sea Permit.
- Organic or food wastes are generated from galley and food service operations; food wastes will be ground up in a garbage disposal unit prior to discharge (i.e., comminuted), in accordance with Annex V of MARPOL 73/78 requirements. Cooking oils will be separated from the organic food waste stream.
- Cooling water discharge effluent is expected to result in a temperature increase of no more than 3°C at the edge of the zone where initial mixing and dilution take place, typically considered to be 100 m from the point of discharge.
- Drainage from machinery spaces passes through an OWS prior to discharge and all discharges will meet MARPOL requirements for discharges from machinery spaces from fixed or floating platforms (MARPOL Annex I, Resolution MEPC 117[52]).

Proposed Project:

- No new information has been identified. CML will rely on the summary information regarding routine discharge treatment, as outlined in CSA (2016).

3.6.1.3 Discharge Additives

Tables with ecological information (e.g., toxicology, ecotoxicology, degradability, etc.) for drilling discharges, completion discharges, and pre-commissioning discharges that are expected during the Tamar-12 Project are presented in **Appendix F**. The chemicals in these tables are based on previous drilling campaigns or subsea infrastructure installation operations but are expected to be representative. Final selection of chemicals and concentrations will be completed prior to commencement of the project and will be presented in the Discharge to Sea Permit application.

Appendix E contains safety data sheets for chemicals expected to be used during the Tamar-12 Project; specific chemicals to be used will be presented in the Discharge to Sea Permit application.

3.6.1.4 Discharge Schedule

Total estimated discharges for drilling and completion and subsea installation are summarized in **Table 3-5**. Further details on project-related discharges (e.g., cement, WBM), as well as metals concentrations in the barite (e.g., Hg, Cd) will be presented in the Discharge to Sea Permit.

Table 3-5. Summary of estimated discharge frequencies, average daily rate, and total quantity for drilling and completion and subsea infrastructure installation operations, Tamar-12 (drilling and completion drillship and installation vessel only).

Source	Frequency	Average Daily Rate for Calculations	Total Quantity
Drilling/Completion Vessel: (total duration: 122 days)[a]			
WBM	Continuous	--	WBM: 24,106 metric tons
Cuttings (WBM intervals)	Continuous	--	580 m^3
Cement (at wellbore; overboard line; possible bulk dump at end of drilling)	Periodic	--	271 m^3
End of well (completion brine)	Once	--	3,882 tons
Sanitary wastes	Periodic	74.9 m^3	9,126 m^3
Grey water	Continuous	55.0 m^3	6,710 m^3
Organic (food) waste	Periodic	0.3 m^3	33.6 m^3
Cooling water	Continuous	80,000 m^3	9,760,000 m^3
Desalination brine	Continuous	16.1 m^3	1,965 m^3
Deck drainage (runoff, washdown)	Periodic	845 m^3	103,090 m^3
Blowout preventer fluid	Periodic	--	10 m^3
Subsea Infrastructure Installation Vessel (total duration: 44 days)[b]			
Sanitary wastes	Periodic	40.8 m^3	1,795 m^3
Grey water	Continuous	30 m^3	1,320 m^3
Organic (food) waste	Periodic	0.15 m^3	6.6 m^3
Cooling water (est.)	Continuous	60,000 m^3	2,640,000 m^3
Desalination brine (est.)	Continuous	20 m^3	1,965 m^3
Deck drainage (runoff, washdown)	Periodic	161 m^3	7,084 m^3

[a] Average daily rate is based on a maximum of 220 persons on board (
[b] Average daily rate is based on a maximum of 120 persons on board (
Note: Maximum amount of deck drainage per day is based on the maximum daily amount of rain that has fallen in Ashkelon between 2009 and 2024 (92 mm on 12 December 2013) multiplied by the estimated deck area; 9,141 m^2 for the 1,750 m^2 for the washdown water estimated at 5 m^3 per day.
WBM = water-based mud.

Discharges from support vessels operating during drilling and completion operations and installation activities are not summarized in **Table 3-5**. Support vessels operating in support of drilling and completion will discharge sanitary wastes (2,047 m^3), grey water (1,505 m^3), and food waste (7.5 m^3), with additional discharges from cooling water, deck drainage, and potentially desalination brine. Support vessels operating in support of subsea installation will discharge sanitary wastes (1,798 m^3), grey water (1,322 m^3), and food waste (6.6 m^3), with additional discharges from cooling water, deck drainage, and potentially desalination brine. Additional details for several miscellaneous discharges (e.g., bilgewater; boiler blowdown, etc.) are provided in **Section 3.6.1.6**.

3.6.1.5 Discharge Technique

For the drillship, discharges occur through various pipes. Based on the drillship, pipes are ranging from 1.5-inches to 14-inches in diameter and are either gravity fed or pumped, with pipe orientation in a vertical, downward direction. Non-hazardous discharges, including deck drainage and bilge water, will pass through an oil detector and meet the 15-ppm threshold for total oil and grease (TOG). Cooling water is discharged through four discrete discharge pipes (diameters: two 5-inch, one 12-inch, and one 14-inch) at 5.95 m and 12 m below the sea surface. Brine from the potable water makers is discharged through one of three 5-inch diameter pipes either 5.1 m or 12 m below the sea surface. Treated sewage (black water) is discharged through either a 2.5-inch diameter pipe (forward) or a 2-inch pipe located at 12 m below the sea surface. Bilge water will be collected and treated in an OWS, pass through an oil detector, and comply with the 15-ppm threshold for TOG (**Table 3-6**).

Table 3-6. Types of routine discharges from a representative drillship (exclusive of drilling muds, cuttings, and cement) during Tamar-12 Project drilling and completion activities. Discharge pipe diameters are based on the drillship as a representative example.

Discharge Type	Discharge Frequency and Treatment	Discharge Pipe (using drillship as an example)	
		Pipe Diameter (in.)	Depth of outlet below sea level (m)
Sanitary Waste (Black Water)	Periodic; chlorinated in IMO-approved sewage treatment plan	2.5 FWD; 2 AFT	2 × 12 m
Grey Water	Continuous; no treatment	8	12
Desalination Brine	Continuous; diluted with water prior to discharge	3 × 5 inch	2 × 5.1 m; 12
Cooling Water	Continuous; no treatment	2 × 5 inch; 12; 14	2 × 5.95 m; 2 × 12 m
Organic Food Waste	Periodic; macerated to meet MARPOL requirements	4; 8	12
Bilge Water	Intermittent; passes through the OWS	2	12
Boiler Drainage Water	Intermittent; no treatment	1.5	12
Deck drainage (Runoff)	Continuous; drainage from machinery areas passes through OWS; no treatment for other deck drainage	4; 2 × 8 inch; 2 × 10 inch outlets; 2 × 10 inch U seal by-pass	+2.5

IMO = International Maritime Organization; MARPOL = International Convention for the Prevention of Pollution from Ships; OWS = oil-water separator.

For the subsea infrastructure installation vessel, discharge types are expected to be similar if not identical. Discharge frequency was outlined in **Table 3-5**. Discharge pipe locations and respective diameters for the representative installation vessel are currently unavailable. Depths of each respective discharge are expected to be similar to those outlined in **Table 3-5**.

3.6.1.6 Discharge Volumes

Estimated routine discharges from the drillship exclusive of drilling muds and cuttings and cement, are summarized in **Table 3-7**. Well-specific discharge information will be provided to the MoEP in the Discharge to Sea Permit application. The table is based on actual discharge data from the last CML drilling and completion campaign. Discharges will include sanitary waste, grey water, organic (food) waste, cooling water, desalination brine, bilge water, and deck drainage (runoff).

Table 3-7. Estimated routine discharges from the drillship during Tamar-12 drilling and completion activities, exclusive of drilling muds, cuttings, and cement.

Discharge Type	Maximum Daily Flow[1] ($m^3 h^{-1}$)	Estimated Discharge Data from Drillship			Estimated Total Quantities for Planned Drilling and Completion Activities (m^3)		
		Average Hourly ($m^3 h^{-1}$)	Average Daily ($m^3 d^{-1}$)	Average Monthly (m^3 month^{-1})	Drilling Tamar-12 (82 days)	Completing Tamar-12 (40 days)	Drilling and Completing Tamar-12
Sanitary Waste (Black Water)	75 (0.34 m^3 per day per person)[2]	3.1	74.9	2,247	6,142	2,996	9,126
Grey Water	55 (0.25 m^3 per day per person)[2]	2.3	55.0	1,650	4,510	2,200	6,710
Desalination Brine[3]	16	0.7	16.1	483	1,321	644	1,965

Table 3-7. (Continued).

Discharge Type	Maximum Daily Flow[1] ($m^3 h^{-1}$)	Estimated Discharge Data from Drillship			Estimated Total Quantities for Planned Drilling and Completion Activities (m^3)		
		Average Hourly ($m^3 h^{-1}$)	Average Daily ($m^3 d^{-1}$)	Average Monthly (m^3 month^{-1})	Drilling Tamar-12 (82 days)	Completing Tamar-12 (40 days)	Drilling and Completing Tamar-12
Cooling Water[4]	80,000	3,333	80,000	2,400,000	6,560,000	3,200,000	9,760,000
Organic Food Waste	0.275 ($0.00125 m^3$ per day per person)[2]	0.01	0.3	8	23	11	33.6
Bilgewater	20	0.1	3.3	100	273	133	406
Boiler's Blowdown	0.5	0.01	0.3	8	21	10	31
Deck Drainage (Runoff[5] and Wash Water)	845	1.5	35.2	1,056	2,886	1,408	4,294

[1] Flow rates estimated based on pump/processing plants/daily consumption, etc.
[2] 220 people on board.
[3] Desalination Brine is not discharged directly over the side as the by-product of the water production. It is mixed/diluted with water by a vacuum in water maker. The ejector (vacuum) pump's capacity is $2 \times 88 m^3 h^{-1}$ during normal operations with two water makers running. Realistically, approximately 9 m^3 of brine is diluted with approximately 4,224 m^2 of seawater prior to discharging over the side.
[4] There are no additives, including chlorine, in the cooling water.
[5] Maximum amount per day is based on the maximum daily amount of rain that has fallen in Ashkelon between 2009 and 2024 (92 mm on 12 December 2013) multiplied by the estimated deck area – 9,141 m^2, a total of 840 cubic meters per day.

During the subsea infrastructure testing and pre-commissioning steps, only a small number of chemicals will be utilized and discharged. Estimated volumes of the discharged chemicals are summarized in **Table 3-8**. If possible, these chemicals will be classified as Gold under the Offshore Chemical Notification Scheme (OCNS) classification, which indicates that they present a relatively low hazard to the environment. Final chemical selection will be made during the detailed design phase of the project and submitted to MoEP approval as part of the Discharge to Sea Permit application. For this assessment, the chemicals stated in **Table 3-8** are considered as typical examples of chemicals that may be used in the project.

Table 3-8. Estimated volumes (m^3) of chemicals[1] to be discharged during infrastructure pre-commissioning activities.

Parameter	Volume (m^3)
MEG + Dye (Jumpers)	20
Total Discharges from all sources	20

[1] Exact chemicals and concentrations will be submitted to the MoEP at a later stage as part of the application for the Discharge to Sea Permit.
MEG = monoethylene glycol.

3.6.1.7 Black Water and Grey Water Volumes

Estimated volumes of black water (sanitary wastes) and grey water (sinks, showers, etc.) are presented separately in **Table 3-9** for the drillship, subsea infrastructure installation vessel, and support vessels (i.e., drilling and completion; subsea infrastructure installation).

Table 3-9. Estimated volumes (m^3) of black water and grey water to be discharged during the Tamar-12 Project.

Source	Black Water (m^3)	Grey Water (m^3)
Drillship	9,126	6,710
Support Vessels – Drilling and Completion	2,047	1,505
Installation Vessel	1,795	1,320
Support Vessels – Installation	1,798	1,322

3.6.1.8 Discharge Quality

CSA (2016) provided data regarding the quality of routine discharges; see Section 3.6.4 of the 2016 document.

Key Findings:
- Effluent quality data collected by CML (formerly NEML) during drilling of the Tamar SW-1 well in the Tamar Field are considered as representative for the proposed Tamar-12 activities (see Tables 3-30 to 3-38 in CSA, 2016).

Proposed Project:
- CML expects that effluent quality of routine discharges and drilling and completion discharges during the Tamar-12 Project will be similar to those from the recent CML drilling campaigns. Effluent quality data from the recent CML drilling campaign are presented in **Appendix G**.

3.6.1.9 Onshore Alternatives

CSA (2016) provided a discussion on the evaluation of Alternatives to On-Site Discharge; see Section 3.6.2.8 of the 2016 document.

Key Findings:
- Available alternatives to on-site discharge of WBM and cuttings include injection or discharge into wellbores or subsurface formations and transport to shore for treatment and disposal; each come with their own set of environmental effects.
- CML has implemented a series of mechanisms and procedures to ensure that impacts to the marine environment from on-site discharge of WBM are minimized.
- Alternatives to the on-site discharge of other routine effluents either are not practical, are limited, or increase safety concerns.

Proposed Project:
- MOBM and cuttings with adhering MOBM will be transported to shore for recycling or proper disposal.
- WBM and cuttings while drilling with WBM will be discharged at the seafloor as this section is drilled riserless and there is no conduit back to the drillship.

3.6.2 Drill Cuttings

3.6.2.1 Drill Cuttings Quantities

- WBM-wetted cuttings will be discharged only at the seabed (no discharge of cuttings will occur from the overboard lines). For the WBM sections of Tamar-12 that will result in drill cuttings discharge, an estimated 580 m^3 will be discharged at the seafloor. A breakdown of the cuttings discharge rate and volume by drilling interval where WBM-wetted cuttings will be discharged is presented in **Table 3-10**.

Table 3-10. Estimated cuttings discharges for the Tamar-12 well.

Section (Interval)	Hole Diameter (inches)	Interval Duration (days)	Cuttings Discharge Rate ($m^3 d^{-1}$)	Cuttings Discharge Total Volume (m^3)
				Vol.
			32.5	65
			156	515
Total Discharged Cuttings Volume (m^3)				580

3.6.2.2 Treatment and Disposal

Cuttings generated during the well intervals using WBM will be discharged at the seafloor untreated. MOBM-wetted cuttings will be transported to shore for recycling or proper disposal at an appropriately permitted facility.

3.6.2.3 Cuttings Accumulation on Seafloor

Previous wells drilled in the Tamar Field (e.g., Tamar SW) have shown to have WBM and cuttings dispersion fields within close proximity to the wellbore, but with drilling tracers (e.g., Ba) ranging up to 500 m from the wellsite. The distance from the well where the cuttings deposition thickness is greater than 6.3 mm (i.e., threshold proposed by Smit et al. [2008] as a 'predicted no effect concentration' for benthic species that are sensitive to sediment deposition') is much lower. Modeling data (i.e., for drilling discharges at an adjacent location showed that thicknesses of 6.3 mm would not be expected to occur past 55 m from the wellsite with an affected areal extent of 0.0080 km^2 (CSA, 2016). Given that the modeling included deposition of both WBM and MOBM muds and cuttings, and the drilling programs are generally similar (i.e., Tamar-12 WBM sections are slightly deeper), the modeling results are deemed applicable to the Tamar-12 Project, although the results may not be directly comparable to Tamar-12. It is expected that the deposition of WBM and associated cuttings will be slightly higher than was noted in the modeling data (i.e., slightly higher maximum deposition at and near the wellbore) due to slightly higher volumes for the upper two sections of the Tamar-12 well. However, it is deemed unlikely that muds and cuttings deposition of thicknesses greater than 6.3 mm will extend further than 75 m from the wellsite. Based on the power law function (which can be used to estimate the relative change in one factor based on the relative change of another factor), the deposition thickness under modeling Scenario 1 (see **Appendix I**) would be approximately 5.1 mm and the deposition thickness under Scenario 2 would be approximately 4.9 mm.

As stated in **Section 3.6.2.2**, WBM and WBM-wetted cuttings will be discharged untreated, and therefore no monitoring or control processes are relevant. MOBM cuttings will be transported to shore by vessel and then to a disposal or recycling facility by truck.

3.6.3 Drilling Mud and Cement Surplus

For the Tamar-12 Project:

- WBM cuttings will be discharged only at the seabed (no discharge of cuttings from the overboard lines).
- An effort will be made to purchase barite that contains a low concentration of metals.
- MOBM cuttings will be collected and sent to shore for proper disposal (no discharge of MOBM or cuttings to the marine environment).
- No condensate will be discharged to sea under any circumstances.
- Preferably, additives to cement, brine, and WBM blends will be classified on the PLONOR list (considered by the OSPAR Commission to pose little or no risk to the environment) or Gold-rated by the (OCNS).

3.6.3.1 Drilling Mud Quantities

- **Table 3-11** provides a representative drilling program including mud type and estimated discharge rates, volumes, and locations for each well interval.
- An estimated 1,500 metric tonnes of MOBM and associated cuttings will be collected and removed to an authorized terrestrial site. A more accurate estimate will be conducted during the well's detailed design stage.
- No brine will be discharged as part of drilling activities.

Table 3-11. Proposed drilling program for the Tamar-12 well.

Section (Interval)	Hole Diameter (inches)	Interval Duration (days)	Cuttings Discharge		Drilling Fluid (Mud) Discharge		Mud Type	Release Location
			Vol. (m^3)	Rate ($m^3 d^{-1}$)	Vol. (m^3)	Rate ($m^3 d^{-1}$)		
			65	32.5	25	12.5	WBM	Seafloor, released continuously with cuttings
			515	156	18,000	4,500	WBM Brine	Seafloor, released continuously with cuttings
			TBD	TBD	TBD	TBD	MOBM	N/A
			TBD	TBD	TBD	TBD	MOBM	N/A
			TBD	TBD	TBD	TBD	MOBM	N/A
			TBD	TBD	TBD	TBD	MOBM	N/A
			N/A	N/A	N/A	N/A	N/A	N/A

BOP = blowout preventer; MOBM = mineral oil-based mud; N/A = not applicable; TBD: to be determined; WBM = water-based mud.

3.6.3.2 Drilling Mud Composition

Table 3-12 summarizes the estimated WBM products and seawater to be consumed and discharged during drilling; the final decision on chemicals selection will be presented in the Discharge to Sea Permit application.

Table 3-12. Estimated water-based mud (WBM) and seawater total material consumed (and discharged) during drilling of the Tamar-12 well.

Table 3-12. (Continued).

Table 3-13 provides the estimated cement products to be consumed, discharged, and remaining in the well for the Tamar-12 well. The final decision on chemicals selection will be presented in the Discharge to Sea Permit application.

Table 3-13. Estimated cement products consumed, remaining in the well, and discharged for the Tamar-12 well.

Table 3-14 summarizes the estimated materials to be consumed and discharged during completion; the final decision on chemicals selection will be presented in the Discharge to Sea Permit application.

Table 3-14. Estimated total material consumed (and discharged) during Tamar-12 well completion.

3.6.3.3 Drilling Mud Creation Processes

Seawater is typically used while drilling the top section of the hole (i.e., during jetting). For the second section, a WBM mixture will be created. Most water-based mud systems begin with water, then clays and other chemicals are added to create a homogeneous blend. Some of the 36 separate drilling products or solutions noted in **Table 3-14** will be used to prepare the WBM mixture. Final selection of chemicals (and their respective concentrations) will be completed prior to commencement of the project and will be presented in the Discharge to Sea Permit application.

3.6.3.4 Safety Data Sheets

Safety Data Sheets for all chemicals to be used during the Tamar-12 Project, including drilling muds, are presented in **Appendix E**.

3.6.3.5 Chemicals/Additives

Tables with chemical information including ecological information (e.g., toxicology, ecotoxicology, degradability, etc.) for drilling discharges, completion discharges, and pre-commissioning discharges that are expected during the Tamar-12 Project are presented in **Appendix F**. The chemicals in these tables are based on previous drilling campaigns or subsea infrastructure installation operations but are expected to be representative. Final selection of chemicals and concentrations will be completed prior to commencement of the project and will be presented in the Discharge to Sea Permit application.

3.6.3.6 Drilling Mud Tests

Water-based mud will be utilized during the initial two drilling sections (i.e., 36-inch and 26-inch sections). The testing of the mud, including various parameters, sampling standards, and frequency, will be conducted in accordance with the requirements stipulated in the Discharge to Sea Permit**.**

3.6.3.7 Biotoxicity Test

The water-based mud will undergo a toxicity test, in accordance with the Discharge to Sea Permit. The test will be conducted in a certified laboratory.

3.6.3.8 Treating Drilling Mud

MOBM is circulated through a mud system to transfer mud, cuttings, and solids through the wellbore and surface systems. The cuttings are separated by solids control equipment like shale shakers, centrifuges, and filters. All MOBM-wetted cuttings will be captured and shipped onshore for disposal and all MOBM will be contained within a “closed system”. Once the BOP & riser are installed there is a continuous conduit from the wellbore and the rig and fluid displacements will be performed prior to any planned disconnects. After filtering the MOBM, the fluid is returned into an active rig mud system for further utilization in drilling activities. Specific details of the mud system will be defined following rig selection.

3.6.3.9 Illustrations

Detailed information concerning physical specifications of the manufacturing units/process/treatment and return of drilling mud will be provided later on in the project once the specific drilling rig is selected. The details will be provided in the Discharge to Sea application submitted to the regulators.

3.6.3.10 Drilling Stages and Cementing

A description of casing and cementing by well interval is presented in **Section 3.1.3.3**.

3.6.3.11 Cement Quantities

It is anticipated that the majority of the cement consumption and discharge will occur in the casing interval.

3.6.4 Information About the Quality of Discharges to the Sea

Information referenced in this section is based on data from the drilling of the latest well conducted in 2023. Detailed information on expected discharges for the Tamar-12 well will be submitted with the application for the discharge to sea permit.

3.6.4.1 Chemical Composition Information Requirements

Analytical data from a previous drilling campaign, expected to be similar to Tamar-12, is presented in **Appendix G**.

3.6.4.2 Chemical Composition

Analytical data from a previous drilling campaign, expected to be similar to Tamar-12, is presented in **Appendix G**.

3.6.4.3 Metal Content

Analytical data from a previous drilling campaign, expected to be similar to Tamar-12, is presented in **Appendix G**.

3.6.4.4 Barite Information

Analytical data from a previous drilling campaign, expected to be similar to Tamar-12, is presented in **Appendix G**.

3.6.4.5 Discharges from Leachate Treatment Facility

This guideline is not relevant for the Tamar-12 Project as no treatment of the WBM will occur (or can occur) before discharge (i.e., no surface returns; discharge at the wellbore) and no MOBM will be discharged.

3.6.4.6 Discharges from Sanitary Wastewater Treatment Facility

Analytical data from a previous drilling campaign, expected to be similar to Tamar-12, is presented in **Appendix G**.

3.6.4.7 Means of Separation of Clean and Contaminated Runoff

This specific information will be provided later on in the project once the specific drilling rig is chosen and will be included in the Discharge to Dea application submitted to the regulators.

3.7 WASTE

CSA (2016) provided a discussion of all wastes; see Section 3.7 of the 2016 document.

Key Findings:

- All wastes were handled and disposed of according to MARPOL and permit requirements.
- Wastes that could not be discharged overboard under MARPOL requirements were shipped to authorized waste disposal sites onshore in accordance with the regulations.
- The drillship managed the generation, storage, and disposal of all solid waste.
- Each identified waste stream was classified and handled as scheduled waste or non-scheduled waste and was segregated by type.

- Different waste streams were not mixed together, stored together, or managed in the same container.
- All containers had their lids, rings, covers, bungs, and other means of closure properly installed at all times except when waste was being added or removed.

Proposed Project:
- Based on previous drilling and completion campaigns, CML estimates that approximately 30 m^3 of solid wastes will be generated during the Tamar-12 Project.
    - Wastes are anticipated to consist of cooking oil, incinerator ashes, and domestic, operational, plastic, and e-wastes.
    - Based on previous subsea infrastructure installation campaigns, CML estimates that approximately 10 to 15 m^3 of solid wastes will be generated during the Tamar-12 Project.
    - Similar to drilling and completion, the wastes expected to be generated during subsea infrastructure installation will include cooking oil, incinerator ashes, and domestic, operational, plastic, and e-wastes.

For solid waste, vessel-specific waste management plans (WMPs) will include provisions for 1) segregating solid wastes; 2) ensuring appropriate onboard storage; and 3) recycling or reuse, when practical. Solid waste generated during drilling and completion and subsea installation will comply with the requirements of MARPOL 73/78. Project vessels will comply with their individual WMPs, the latter of which will outline the procedures for collection, storage, processing, and proper disposal of waste.

In compliance with MARPOL 73/78, project solid waste will be managed as MARPOL Annex V waste (i.e., discharge at sea strictly prohibited). Solid waste, once separated and containerized/stored, will be periodically shipped to shore for transport to an appropriate waste facility (i.e., licensed facilities which comply with national regulations).

As part of each WMP, monitoring records will be maintained which will include types and quantities of waste generated; types and quantities of waste leaving the project area for recycling, recovery, or disposal; location of treatment or disposal facilities to which the wastes are transported; and records of any accidental releases of solid waste.

Solid wastes onboard the drilling vessel will be treated in accordance with the IMO MEP 66/21, and in compliance with MARPOL Convention Annex VI (Regulation 16) under MEPC permit, and in compliance with local regulations and conditions set by the MoEP in the Toxin Permit for the drilling activity.

3.8 DECOMMISSIONING/ABANDONING WELLS AND INFRASTRUCTURE

Permanent well decommissioning and abandonment will occur at the end of the operational service life of the Tamar-12 well. CML will follow regulations and best industry practice in its abandonment program, reflecting safety practices in place at the time of decommissioning. Prior to decommissioning and abandonment activities occurring, CML will develop a plan that will include a description of decommissioning project management and engineering, well plugging and abandonment, cleaning and flushing activities, disconnection of subsea and gathering systems, and removal of infrastructure, as required.

Key Findings:
- CSA (2016) discussed, in very general terms, future well abandonment and infrastructure decommissioning within the Tamar Field; see Section 4.15 of the 2016 document.

Proposed Project:

- No new information has been identified. CML will rely on the summary information regarding decommissioning/abandoning wells and infrastructure, as outlined in CSA (2016).
- A designated EIA for permanent decommissioning and abandonment will be conducted prior to those activities occurring.
- For future decommissioning, the scope will include plugging and abandonment (P&A) of all wells, flushing of all subsea infrastructure, and the removal (or abandonment in place) of subsea infrastructure, as discussed below.

3.8.1 Abandonment Chronology

The abandonment chronology for the Tamar-12 well has not yet been established. A designated EIA for permanent decommissioning and abandonment of the Tamar wells will be conducted prior to those activities occurring.

3.8.2 Decommissioning Process

During the preparation/planning phase, the abandonment activities will focus on data gathering to form the basis for well abandonment design, facilities front-end engineering, feasibility studies, risk assessments, environmental impact assessments, inventory planning, inspections, surveys, and budgets.

It is a common practice with global precedents in deep-sea environments to leave underwater well heads protruding from the seabed. The removal of production trees, production lines and peripherals will be evaluated and executed as defined in the detailed abandonment plan for each well. In general, underwater equipment at depths such as the Tamar Field (>1,600 m) have minimal impact on health, safety and the environment. Any material removed would be reused, recycled or disposed of in appropriate facilities.

After Cease of Production (CoP), the subsea infrastructure must be freed of hydrocarbons and hazardous materials to make the equipment and pipework safe for deconstruction and transportation, or to be left in place, depending upon a comparison of various decommissioning options. The cleaning program depends on the specific needs of the facility, equipment, and lines at the time of abandonment. Isolation and freeing of hydrocarbons, depressurization of the system, purging, draining, and flushing of all process, utility, and service systems associated with the decommissioned infrastructure and equipment will be performed to regulatory standards and industry best practices. Requirements will depend on how the facility was operated and maintained. The cleaning standards, however, will follow environmental permits and national, regional, or local regulations. If cleanliness levels are unspecified by regulation, CML will set a minimum cleanliness level, which may be specified in parts per million, flushing until clean returns.

3.8.3 Bathymetry Post-Abandonment

Information regarding the bathymetry level post-abandonment in relation to the pre-drilling bathymetry is not available.

3.8.4 Chemicals

Chemicals to be used in decommissioning have not been determined. A designated EIA for permanent decommissioning and abandonment of the Tamar wells will be conducted prior to those activities occurring which will include a list of chemicals, including SDSs.

3.8.5 Pre-and Post-Abandonment Schematics

An illustration of the anticipated Tamar-12 well schematic is presented in **Figure 3-7**.
A post-abandonment well schematic has not been developed. A designated EIA for permanent decommissioning and abandonment of the Tamar-12 well will be conducted prior to those activities occurring which will include a schematic of the anticipated post-abandonment well.

3.8.6 Principles of Decommissioning Plan

A decommissioning plan for the Tamar-12 well has not yet been developed. Prior to those activities occurring, a Decommissioning Plan will be developed and submitted to the Ministries.

4 Evaluating the Expected Environmental Impact of Implementing the Application, and the Means of Prevention or Mitigation

This chapter evaluates the environmental impacts of CML's proposed drilling and completion activities in the Tamar Field, specifically for Tamar-12, as well as the installation of limited subsea infrastructure. The issue of well control and integrity are addressed elsewhere in this document. Detailed BOP specifications are provided in **Section 3.1.3.1**. The detailed casing design and testing are described in **Section 3.1.3.3**. CML's methods for risk assessment and management are summarized in **Section 5.2**.

The impact assessment includes both routine activities and accidental events. The topics in the impact analysis are those specified in the "Petroleum Commissioner Guidelines: Guidelines for Preparing an Environmental Document (EIA) for the Tamar 12 Production Drilling and its Connection to the Existing Infrastructure" issued 09 January 2025 (MoE and MoEP, 2025; **Appendix H**).

The following definitions are used in this assessment:

- **Aspect** – an element of an organization's activities, products, or services that can interact with the environment (International Organization for Standardization, 2004; ISO 14001);
- **Resource –** a component of the natural or human environment that could be affected by any aspect of an organization's activities; and
- **Impact –** any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's environmental aspects (International Organization for Standardization, 2004).

The following aspects and resources were included in the analysis:

Aspects:

- Seafloor disturbance;
- Drilling discharges;
- Routine discharges;
- Air emissions;
- Safety and protection zones;
- Noise hazards;
- Light disturbances;
- Waste and marine debris;
- Support vessel traffic;
- Helicopter traffic;
- Accidental fuel release; and
- Accidental condensate loss (loss of well containment).

The first step in the impact analysis was a screening assessment to identify the resources potentially affected by each aspect. **Table 4-1** shows a matrix of potential interactions between aspects and resources. Each interaction indicates a potential impact to be analyzed.

The next step was to analyze each potential impact by describing and quantifying each impact to the extent practicable. This step included an assessment of the "consequence" (severity) and likelihood of each impact.

Finally, the overall environmental risk posed by each impact was assessed using a risk matrix that combines aspect likelihood and impact consequence (**Table 4-2**). The likelihood of each aspect (considering all of the identified management and mitigation measures) was given a score between 1 and 5 based on the definitions in the matrix. The consequence of each potential environmental impact was also rated on a scale of 1 to 5. Each cell in the matrix (i.e., each intersection of likelihood and consequence) was calculated as the product of likelihood and consequence. These risk values were grouped into three color-coded risk categories: Low, Moderate, and High.

Table 4-1. Impact matrix showing potential interactions between aspects and resources. A bullet symbol in a cell indicates a potential impact to be analyzed, and numbers indicate the section number(s) where the impact is analyzed. Impact significance determinations are found (in tabular form) in the final subsection of each numerical entry noted below.

Aspect	Resource													
	Air Quality	Water Quality	Sediment Quality	Benthic Communities	Marine Mammals	Sea Turtles	Seabirds and Migratory Birds	Fish and Fishery Resources (including Plankton)	Fishing and Marine Aquaculture	Culture and Heritage Sites	Marine Transportation and Infrastructure	Coastal Habitats and Infrastructure	Nature Reserves/ Protected Areas	Acoustic Environment
Routine Operations														
Seafloor disturbance	--	● 4.6.1.1.2	● 4.6.1.1.1	● 4.6.1.1.1	--	--	--	--	--	● 4.7.1	--	--	--	--
Drilling discharges	--	● 4.6.1.2.3	● 4.6.1.2.4	● 4.6.1.2.4	--	--	--	● 4.6.1.2.3	--	● 4.7.2	--	--	--	--
Routine discharges	--	● 4.6.1.3.1	--	--	● 4.6.1.3.2	● 4.6.1.3.2	--	● 4.6.1.3.1	--	--	--	--	--	--
Air emissions	● 4.8.1.1	--	--	--	--	--	--	--	--	--	--	● 4.8.1.1	● 4.8.1.1	--
Safety and protection zones	--	--	--	--	--	--	--	--	● 4.12.1.1	--	● 4.13.1.1	--	--	--
Noise hazards	--	--	--	● 4.5.3.1	● 4.5.1.1	● 4.5.1.2	--	● 4.5.1.3	--	--	--	--	● 4.5.3	● 4.5
Light hazards	--	--	--	--	--	● 4.4.1.1	● 4.4.1.2	● 4.4.1.3	--	--	--	--	--	--
Waste and marine debris	--	● 4.6.1.6.1	● 4.6.1.6.1	● 4.6.1.6.1	● 4.6.1.6.2	● 4.6.1.6.2	● 4.6.1.6.4	● 4.6.1.6.3	--	--	--	--	--	--
Support vessel traffic	--	--	--	--	● 4.6.1.4.1	● 4.6.1.4.2	--	--	● 4.12.1.2	--	● 4.13.2.1	--	--	● 4.5
Helicopter traffic	--	--	--	--	● 4.6.1.5.1	● 4.6.1.5.1	● 4.6.1.5.2	--	--	--	--	--	--	--
Accidents														
Accidental fuel spill	● 4.3.6.3; 4.8.1.2	● 4.3.6.3	--	--	● 4.3.6.3	● 4.3.6.3	● 4.3.6.3	● 4.3.6.3	● 4.3.6.3	● 4.3.6.3; 4.7.3	● 4.3.6.3	● 4.3.6.3	● 4.3.6.3	--
Accidental condensate loss	● 4.3.6.3; 4.8.1.2	● 4.3.6.3	● 4.3.6.3	● 4.3.6.3	● 4.3.6.3	● 4.3.6.3	● 4.3.6.3	● 4.3.6.3	● 4.3.6.3	● 4.3.6.3; 4.7.3	● 4.3.6.3	● 4.3.6.3	● 4.3.6.3	--

Table 4-2. Risk assessment matrix for impact analysis.

Consequence				Likelihood				
				1	2	3	4	5
				Rare	Unlikely	Possible	Likely	Almost Certain
			Historical Occurrence	Never occurred or prevented with standard practices, procedures and safeguards.	Possible to occur but unlikely if standard practices, procedures and safeguards are used.	Likely to occur even if standard practices, procedures and safeguards are used. Additional safeguards are required.	Has occurred in the industry. Additional safeguards are required.	Has occurred in company history. Additional safeguards are required.
Severity		Environment	After Controls/ Mitigation (Residual)	Controls have historically been highly effective.	Controls have generally been effective previously.	Controls are unproven but are expected to be effective.	Controls have been ineffective previously.	Controls are likely to fail or be ineffective.
5	Very Severe	Adverse permanent impacts on key ecosystem functions and services in larger natural habitats (e.g., restitution time more than 5 years).	Heat Map	5	10	15	20	25
4	Severe	Adverse impact on ecologically valuable natural habitats (e.g., restitution time 2 to 5 years).		4	8	12	16	20
3	Medium	Adverse impacts on a significant part of habitats (e.g., restitution time 1 to 2 years).		3	6	9	12	15
2	Minor	Adverse short-term impact on natural habitats.		2	4	6	8	10
1	Insignificant	No or very limited impact on natural habitats. No impact on population level, only on individual organism level.		1	2	3	4	5

Overall risk is rated as = Low, = Moderate, or = High.

4.1 ESTIMATING POTENTIAL IMPACTS ON THE MARINE ENVIRONMENT

4.1.1 Drilling Platform Maximum Range of Impact

4.1.1.1 Range of Impact

Details regarding production drilling were presented in **Section 3.1.2**. The proposed drillship will not employ anchors, effectively eliminating any potential anchor-related impacts to the seafloor. The drilling of the well will disturb an area at and immediately around the Tamar-12 drill site, including the physical penetration of sediments at the borehole, and the release of WBM at the wellbore. Localized water and sediment quality impacts, as well as impacts to proximal benthic communities, are also expected as a result of WBM and cuttings released from the wellbore (see **Section 4.6.1.1**).

No protected areas or nature reserves are located within the area of impact resulting from drilling and completion or subsea infrastructure installation operations. Results from the well clearance review indicate the presence of a single amphora identified within a 2 km radius (i.e., at ~1,750 m) of the proposed drill site which can be considered of cultural and heritage importance. Due to the distance, no impacts to this site are expected.

4.1.2 Muds and Cuttings Degree of Impact

Impacts from the deposition of drilling muds and cuttings are expected to occur locally, potentially affecting water quality, sediment quality, and benthic communities; there is also potential to affect demersal fishes which may be present near the drill site.

4.1.3 Muds and Cuttings Disposal Alternatives

No muds and cuttings disposal alternatives are available given the nature of the drilling process to be employed on Tamar-12. Specifically, both first and second upper sections of the borehole will require the use of WBM with the difference that the first section will be jetted and the second section will be drilled, in a riserless configuration (i.e., no surface returns; discharged from the wellbore). MOBM will be used in the lower (deeper) sections of the well, with returns to the surface (drillship) for muds and cuttings processing. For sections drilling with an MOBM, cuttings and minor amounts of adhering MOBM will be containerized and shipped to shore for disposal (i.e., there will be no on-site discharge of MOBM cuttings and associated drilling muds).

4.1.4 Muds and Cuttings Mitigation Measures

There are no alternatives or mitigation measures available relevant to the subsea release of WBM at the wellbore, with minor exception. For alternatives, it is preferable that all additives to the WBM/brine be PLONOR or Gold-rated according to OSPAR guidelines. Further, barite in WBM will have a low metals concentration and will comply with the Discharge to Sea Permit thresholds for mercury and cadmium. In terms of mitigation measures, WBM and brine will be tested in accordance with Discharge to Sea Permit requirements.

MOBM cuttings will not be discharged on-site; they will be containerized and shipped to shore for proper disposal. Additional discussion of muds and cuttings discharges and associated mitigation measures is presented in **Section 4.6.1.2**.

4.1.5 Muds and Cuttings Maximum Impact Range

The majority of WBM deposition typically extends 20 to 25 m or more from the drill site, where muds and cuttings deposits may measure several centimeters to a meter or more in thickness. The seafloor

affected within 25 m of the wellsite represents an area of approximately 1,964 m^2. Based on post-drill survey results, a drilling mud tracer (barium) has been identified within a 250 to 500 m radius from a Tamar drill site (CSA, 2016), resulting in a deposition area (for these radii) of between 196,350 m^2 to 785,398 m^2, respectively. The majority of this larger area will potentially receive extremely low, minor amounts of WBM; larger cuttings fragments will tend to be deposited in closer proximity to the well.

For purposes of discussion regarding the extent of drilling impacts to sediments, barium tracers in the Leviathan Field were detected in surficial sediments (i.e., 0 to 0.3 cm) up to 5 km away from previous drilling activity (CSA, 2023c). In this study, barium, analyzed as a trace-marker for the presence of drilling muds, was detectible in elevated concentrations across the entire Leviathan-8 post-drilling survey area up to distances of 5 km from the wellhead. However, at distances greater than 500 m, elevated barium concentrations were only detectable in surficial sediments several mm deep, while at distances between 200 to 500 m from the wellhead elevated barium concentrations were detectable at variable sediment depths, direction dependent; at distances less than 200 m from the wellhead, elevated barium concentrations were detected in sediments as deep as 16 cm into the seabed. To further complicate the analysis, it remains unclear if those concentrations identified for the Leviathan-8 well can be directly attributed to that specific drill site or from other nearby drilling locations in the Leviathan Field (e.g., proximal wells include the Leviathan-4 well, completed in 2013, located 70 m due west of Leviathan-8 wellsite; the Leviathan-7 well, completed in 2018, is located 1,540 m due north-northeast of Leviathan-8).

The 2023 Tamar Field enhanced barium assessment indicated that there was a broad surficial distribution of barite laden sediments (0 to 0.3 cm thick) extending several kilometers to the southeast of the Tamar Field wellsites, including the planned Tamar-12 wellsite (CSA, 2023a).

4.1.6 Muds and Cuttings Dispersion Modeling

Drilling discharge dispersion modeling was conducted using a nearby location as a representative location for the 2016 Tamar Field EIA (CSA, 2016; see Section 4.6.1.1). Those results remain relevant for discharges that will occur during drilling of the Tamar-12 well. The modeling was conducted using the model and the input data included proposed well intervals and discharge quantities, site-specific current data, and particle size data provided by CML; the Tamar-12 drilling program and well depth are sufficiently similar to warrant their use in the current analysis. Discussion of the modeling parameters and results are presented in **Section 4.6.1.2** The complete muds and cuttings discharge modeling report is presented **Appendix I**.

Seasonal effects on muds and cuttings dispersion are discussed in **Section 4.6.1.2**. No other parameters (e.g., discharges at different water depths) were considered.

4.1.7 Impact Estimate of Subsea Production System

As part of the Tamar-12 Project, CML will install subsea infrastructure as described in **Section 3.1.1**. Based on the proposed infrastructure to be installed, a total seafloor footprint of 2,032 m^2 may be disturbed during installation (**Table 4-3**). Impacts from the installation of subsea infrastructure are discussed in **Section 4.6.1**.

Table 4-3. Estimated seafloor footprint of proposed infrastructure for the Tamar-12 Project.

Proposed Subsea Infrastructure	Length (m)	Width (m)	No.	Estimated Seafloor Footprint (m^2)
IUMB-T12 Umbilical	4,500	0.18	1	810
IUMB-T12 UTAs (2x)	7.0	4.5	2	63
IUMB-T12 Crossings (5x)	16.0	8.0	5	640
IUMB-T12 Umbilical, 20% contingency	-	-	20%	303

Table 4-3. (Continued).

Proposed Subsea Infrastructure	Length (m)	Width (m)	No.	Estimated Seafloor Footprint (m^2)
Intermediate Jumper Structure	11.0	7.0	1	77
Intermediate Jumper Structure 20% contingency	-	-	20%	15
Hydraulic and Electrical Flying Leads	150	0.03	15	68
Flexible Flying Leads	125	0.07	4	35
Distribution Contingency (20%)	-	-	20%	21
			Total	**2,032**

IUMB = intermediate umbilical; T12 = Tamar-12; UTA = umbilical termination assembly.
Umbilical land take is based on the full 7-inch diameter of umbilical giving a land take per unit of 0.18 m^2/m.
Hydraulic flying lead and electrical flying lead land take is based on average lengths of 150 m and 0.03 m diameter giving a land take of 0.03 $m^2 m^{-1}$.
Flexible flying lead land take is based on average lengths of 125 m and 0.07 m diameter giving a land take of 0.07 $m^2 m^{-1}$.
Contingencies are applied to address present design maturity level.

4.2 PRODUCTION TESTS

4.2.1 Precautionary Measures

Production tests are not planned as part of the Tamar-12 Project.

4.2.2 Drilling Fluids Maximum Impact Range

The maximum impact range resulting from the release of drilling muds and cuttings is detailed in **Sections 3.6.2** and **3.6.3**; summary information regarding WBM and cuttings deposition is presented in **Section 4.1.5**. Given the expected release of WBM from the jetting and drilling of the first two well sections, and the absence of surface discharge of MOBM cuttings, the maximum radial distance of drilling fluid and cuttings transport and initial deposition from the Tamar-12 wellbore is on the order of 250 to 500 m, with more significant accumulations of WBM and cuttings within approximately 25 m or more from the wellbore.

4.3 ENVIRONMENTAL IMPACT OF AN OIL POLLUTION INCIDENT AT SEA IN AN EXTREME-CASE SCENARIO

Two accidental spill scenarios, each of which considered four different seasonal conditions, were previously evaluated in the CSA (2016) document and remain relevant for the Tamar-12 Project: a diesel fuel spill and a condensate spill from a well loss of containment. The diesel fuel spill scenario assumed an instantaneous release of 16,500 bbl from the drillship. The condensate spill scenario assumed a well loss of containment resulting in the release of [1] (API 35) continuing for a period of 30 days.

The probability of the two spill scenarios has not been calculated. However, both scenarios represent highly unlikely events. Historically, the loss of well containment (i.e., blowouts) are rare, and most do not result in spills. Based on North Sea data, the International Association of Oil & Gas Producers (2010) estimated the probability of a blowout during development drilling (deep gas wells) is 7×10^{-5} per well. Data from the U.S. Gulf of Mexico from 1992 to 2005 indicate that half of blowouts lasted less than half a day, and fewer than 10% of blowouts resulted in spilled oil (Minerals Management Service, 2007). These statistics were published prior to the *Deepwater Horizon* incident in 2010. However, following the *Deepwater Horizon* spill, Eckle et al. (2012) revisited the historic spill data in order to integrate the 2010 spill event into the worldwide database and to re-evaluate accident statistics. The authors concluded that the expected risk has not really been changed by the *Deepwater Horizon* incident. Since then, additional preventive procedures, including many safety and well control protocols have been implemented to ensure that safety and environmental integrity are not compromised by uncontrolled releases of hydrocarbons. Mitigation measures, including spill

prevention and well control measures, are discussed in **Chapter 5**. Detailed BOP specifications are provided in **Section 3.1.3** and the design and testing of the casing to prevent a loss of well control are described in **Section 3.1.3.3**.

A large diesel spill, such as one releasing the entire fuel contents of a drillship, would also be a rare event. Historical data from the U.S. Gulf of Mexico include no such incidents from 1964 to 2010, with the volume of the largest platform or drillship-related diesel spill being approximately 238 m^3 (1,500 bbl) (Anderson et al., 2012). The most likely type of spill to potentially occur during offshore oil and gas activities is a small fuel spill (BOEM, 2012).

Trajectory modeling results for a fuel spill are available from modeling conducted by for the Tamar SW-1 drill site in the Tamar Field. Modeling of a condensate spill was conducted by using the Tamar SW-1 drill site as a release point. The oil spill model used for these simulations was was developed by the Cyprus Oceanographic Center and is currently the model of choice for applications in the eastern Mediterranean. Spill trajectory modeling methods and results are presented in **Appendix J**.

4.3.1 Changes in Current Fields and Movement of the Oil Slick

The current fields employed in the model simulations for condensate release and diesel fuel spill were computed using the Princeton Ocean Model (POM), resulting in a high-resolution downscaling of the Mediterranean Operational Oceanography Network (MOON/MyOcean) reanalysis fields for the Mediterranean Sea. Winds were extracted from the European Centre for Medium-Range Weather Forecasts (ECMWF) ERA-Interim (ECMWF Re-Analysis) 6 hourly reanalysis.

The four simulations of each type of spill were conducted based on meteo-oceanographic conditions for different time periods that represented the worst-case scenarios of an uncontrolled loss of well containment. These periods were determined in coordination with the MoEP.

In all four scenarios for both the condensate and diesel fuel releases, 43% to >45% of the oil evaporates within a few days, stabilizing at ~45.4 to 45.6%. Remaining condensate or diesel fuel is divided between oil remaining on the surface, dispersion in the water column, and coastal deposition, with the separation into these three compartments based on spill trajectories and spreading driven by winds and currents. Due to distance offshore and the effects of seasonally-variable local wind and current conditions, coastal deposition may occur as soon as day 6 post spill up to 25 days post spill.

4.3.2 Current Regime

The currents used to drive the oil spill model were generated using an expanded domain version of the model developed by Brenner (2003) and Brenner et al. (2007) for the southeastern Levantine Basin within the framework of the Mediterranean Forecasting System (MFS) and running operationally as part of the MOON/MyOcean program. The POM is a time-dependent, free surface, three-dimensional primitive equations ocean model with an embedded subgrid scale turbulence closure component (Blumberg and Mellor, 1987). The dependent variables include the three spatial components of the current vector, temperature, salinity, the free surface height, the turbulent kinetic energy, and the turbulence length macroscale.

4.3.3 Oil Spill Modeling – Worst-Case Scenario

For the two spill scenarios modeled – instantaneous diesel spill release and 30-day condensate release – the worst-case scenario was the release of of condensate over a period of 30 days.

4.3.4 Oil Spill Modeling – Four Common Sea States

4.3.4.1 Extreme Winter Wave Storm

The extreme winter wave storm scenario was modeled as Scenario 1. The timeframe for this scenario extended from 9 December 2010 to 8 January 2011, a period that included an extreme winter storm.

4.3.4.2 Winter Wave Storm

The winter wave storm scenario was modeled as Scenario 2. The timeframe for this scenario extended from 26 January to 25 February 2008, a period during which typical winter conditions were predominant.

4.3.4.3 Swell in Summer

The summer swell scenario was modeled as Scenario 3. The timeframe for this scenario extended from 17 July to 16 August 2008, a period during which typical summer conditions with persistent northwesterly winds and swell occurred.

4.3.4.4 Strong Northeasterly Wind

The strong northeasterly wind scenario was modeled as Scenario 4. The timeframe for this scenario extended from 25 September to 25 October 2007. This scenario exhibited typical autumn conditions representative of the transition seasons and including at least one episode of strong easterly to northeasterly winds.

4.3.5 Total Oil Quantity During a 30-day Uncontrolled Discharge

The condensate spill scenario assumed a loss of well containment and subsequent release of condensate (API gravity of 35), resulting in the release of continuing for a period of 30 days. Total spill volume for the loss of well containment was
The technical basis for the condensate spill scenario is provided in **Appendix J**. Spill fate was modeled for 30 days from the beginning of the spill.

Additional details regarding the short-term fate of a condensate release at the seafloor, and how the discharge plume is potentially affected as it passes through the water column to the surface, is presented in CSA (2016), with key considerations noted in the following discussion. In the subsea release spill scenario, where the release occurs at depth, gas released from the seafloor is driven into the water column where it initially forms a momentum jet. The jet region is confined to the immediate vicinity of the release and is relatively short in length (i.e., on the order of meters). The density difference between the discharge plume and the receiving water results in a buoyant force that drives the plume upward. As the plume rises, it entrains ambient seawater due to the velocity difference between the rising plume and the receiving water. This entrainment reduces the plume's velocity and buoyancy and increases its radius, while also initiating several weathering factors to the entrained condensate (e.g., dissolution of water-soluble fractions; dispersion). If the buoyant driving force for the plume is dissipated by 1) entrainment; 2) dissolution of gas bubbles; or 3) formation of gas hydrates before it reaches the surface, the plume will terminate.

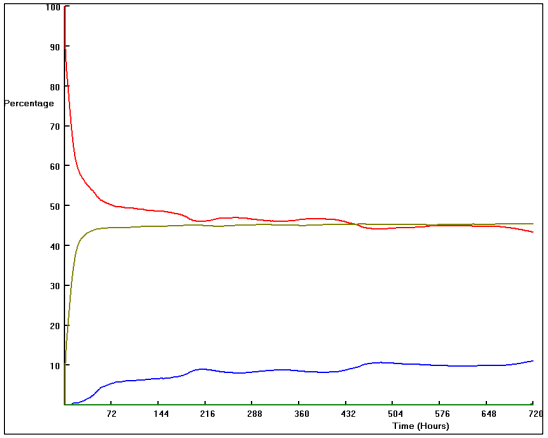
At the upper end of the plume, oil droplets (i.e., condensate) will leave and ascend to the surface solely by their own buoyancy. Rise velocities of oil droplets are much slower than the velocity of a buoyant gas-liquid plume. Compared to situations in which the plume retains its original buoyancy and remains intact all the way to the surface, oil particles released when a plume terminates will take considerably longer to reach the surface and may be transported farther (horizontally) from the release site by ambient currents. The terminal height of the plume (i.e., when a plume terminates midway up the water column or hits the water surface) depends on total discharge rate, gas oil ratio, ambient temperature (hydrate formation), and density field (entrainment).

The model includes a spill weathering component to estimate how much of the spilled volume would remain on the sea surface at various times following a spill. The weathering analysis does not take into account any spill response activities. CML's OSCP provides detailed information about the response capabilities and methods that CML would use to minimize the potential for significant impacts.

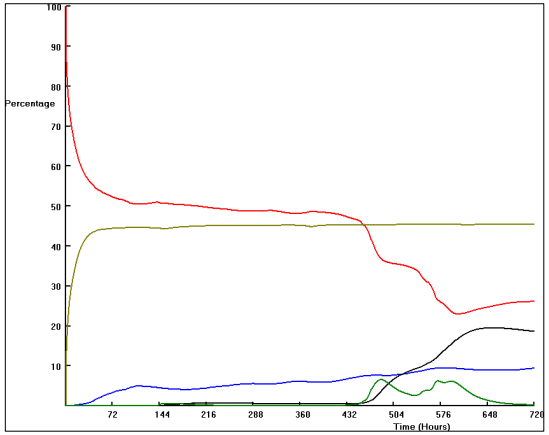
Table 4-4 and **Figure 4-1** summarize the modeling results for a condensate spill under the four scenarios. Shoreline impacts may occur as early as 11 days after the discharge begins. At the end of 30 days, all four scenarios show 45.4% evaporation, from approximately 25% to approximately 43% oil remaining on the sea surface, and up to 12% dispersed. The percent of condensate deposited on the coastline ranges from 0.1% to 18.6% with impacts to the coastline of Israel, Cyprus, and Lebanon. Total length of impacted shoreline ranges from 16.5 to 223 km. Impact hotspots in Israel are Zichron Yaakov and Haifa Bay, depending on the weather conditions. In all but one scenario (Scenario 1), the Israel coastline is impacted from the border of Lebanon to an area just north of Haifa. Two of the scenarios impact areas farther south of Haifa (Scenarios 2 and 4), with one scenario impacting the coastline to the south of Tel Aviv (Scenario 2).

Table 4-4. Trajectory and weathering model results at the end of 30 days for a condensate spill from Tamar SW-1 under four environmental scenarios (From: CSA, 2016).

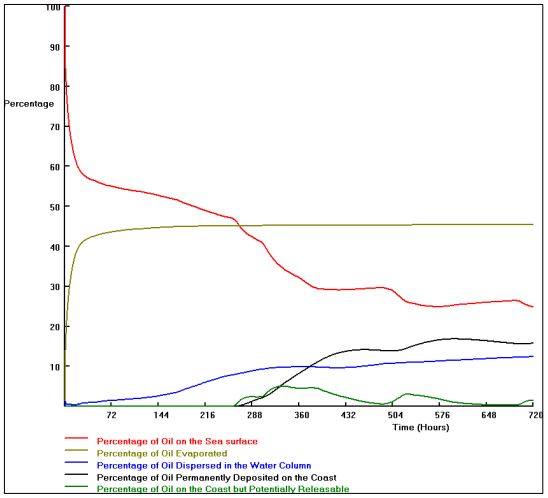
Scenario	Percent Evaporated at 30 Days	Percent on Sea Surface	Percent Dispersed	Percent Deposited on Coast	Days Until Initial Shoreline Impact	Length of Coastline Affected (km)	Coastline Affected	Impact Hotspots (bbl km^{-1})
1	45.4	43.3	11	0.1	25	16.5	Cyprus, Israel	Paphros, Cyprus (86)
2	45.4	26.1	9	18.6	16	223	Israel, Lebanon	Zichron Yaakov, Israel (>500)
3	45.4	24.9	12	17.3	11	95	Israel, Lebanon	Jieh, Lebanon (500 to 1,000)
4	45.4	39.9	10	4.2	14	133	Israel, Lebanon	Haifa Bay, Israel (100 to 195)



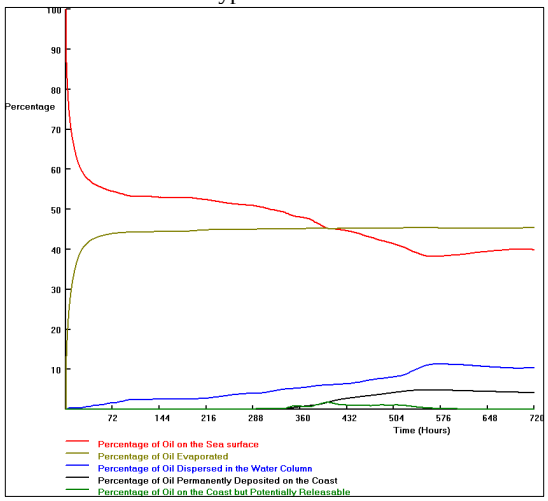
Scenario 1: Extreme winter storm.



Scenario 2: Typical winter conditions.



Scenario 3: Typical summer conditions.



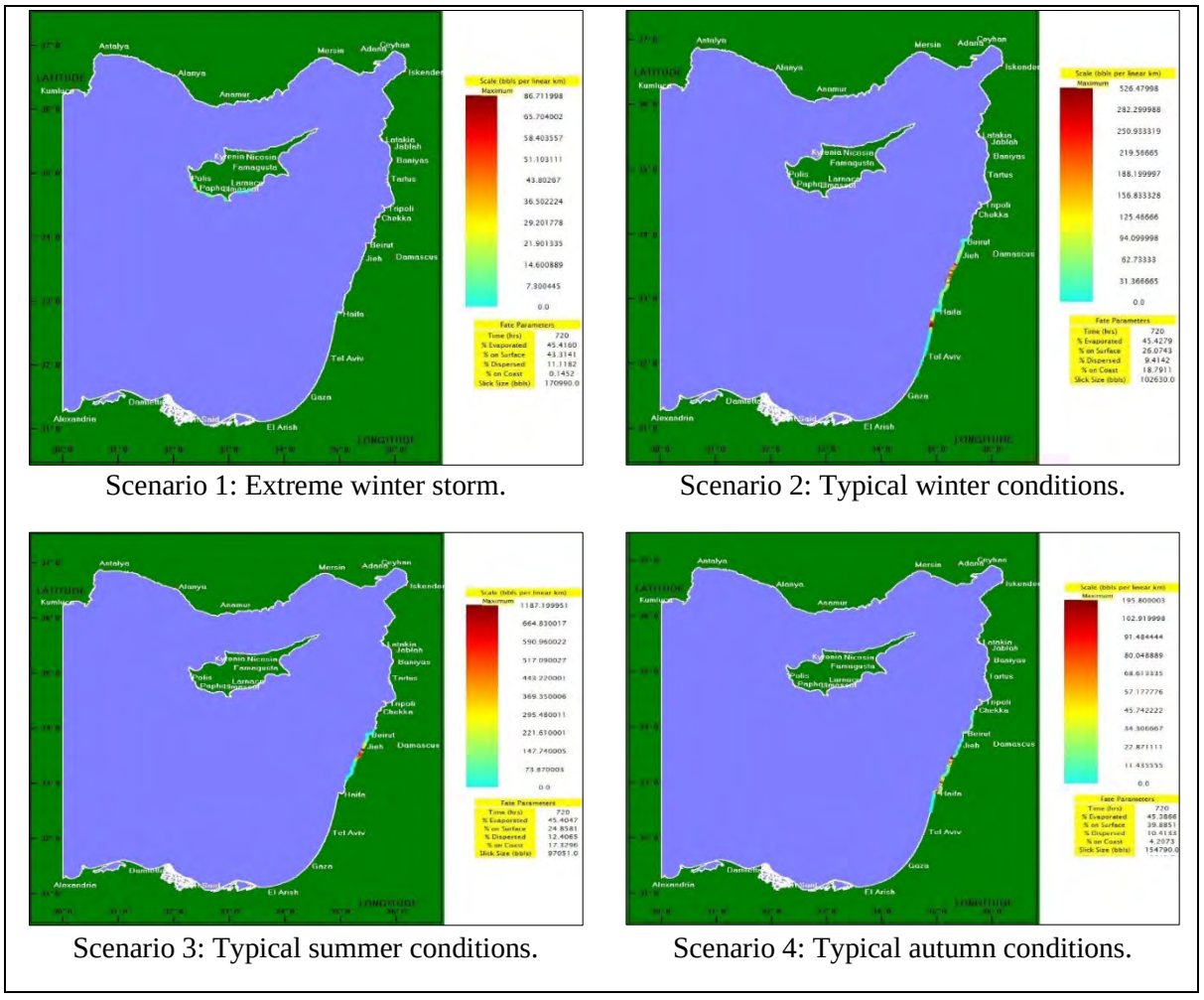
Scenario 4: Typical autumn conditions.



Figure 4-1. Spill fate parameters for a condensate spill from Tamar SW-1 for four different scenarios representing various climatic conditions (From: CSA, 2016).

Figure 4-2 shows the extent and concentration of a condensate spill deposited on the coast for the four scenarios. Each scenario resulted in approximately 44% of the condensate being evaporated by the end of 30 days. In summary:

- Scenario 1 (extreme winter storm) produced the smallest coastal impact, with only 0.1% of the spill predicted to reach the shore and only 16.5 km of shoreline affected, with the majority occurring outside of Israel's waters;
- Scenario 2 (typical winter conditions) resulted in 18.6% of the condensate being deposited on the coastline starting within 16 days, with maximum extent (linear extent) of shoreline oiling among the four simulations (233 km);
- Scenario 3 (typical summer conditions) resulted in 17.3% of condensate being deposited on 95 km of coastline, with the majority occurring outside of Israel; and
- Scenario 4 (typical autumn conditions) resulted in 4.2% of condensate deposited on the 133 km of the coast, with the area most adversely affected being Haifa Bay, where concentrations were projected to reach 195 bbl km^{-1}.



Scenario 1: Extreme winter storm.

Scenario 2: Typical winter conditions.

Scenario 3: Typical summer conditions.

Scenario 4: Typical autumn conditions.

Figure 4-2. Total amounts of condensate deposited on the coast at the end of 30 days after a spill from Tamar SW-1 for four different scenarios representing various climatic conditions (From: CSA, 2016).

Although localized hotspots were identified, deposition on the coast is highly variable and seasonally dependent. The results for the worst-case condensate spill scenario indicate that a condensate spill from the Tamar SW-1 well would affect both offshore and coastal resources to varying extent,

depending on the environmental conditions. Overall, coastal impacts to Israel from a 30 day condensate release from Tamar are expected to occur along 117 km of coastline, extending from just south of Tel Aviv to the Lebanon border (**Table 4-4**).

4.3.6 Oil Spill Dispersion

4.3.6.1 Impacts on the Ecosystem in General

Summary determinations regarding the extent and trajectories of a condensate spill under the four spill scenarios are presented in **Section 4.3.5**. In the event of a condensate release, adverse impacts to the environmental resources of the Eastern Mediterranean may be expected to affect regional water quality, air quality, sediment quality in close proximity to shore, and a variety of biological resources (i.e., plankton, fishes, marine mammals, sea turtles, marine birds, and benthic communities). Impacts to nearshore waters and coastal segments where the spill reaches landfall may also be expected.

Per CSA (2016), the likelihood of a large fuel spill or a worst-case condensate spill from a blowout is rated was unlikely (2), taking into account CML's well control, blowout prevention, and other spill prevention measures. The consequences ranged from minor (2) to medium (3) depending on the resource, with a condensate spill considered to have greater consequences because of the extended time period (30 days) and the general greater volumes of oil reaching the shoreline. The residual risk, following application of mitigation measures, was rated as Low to Moderate. Impact significance for accidental spills was summarized in Table 4-9 of CSA (2016). Additional discussion on resource-specific resources and spill-related impacts is presented in **Section 4.3.6.3**.

4.3.6.2 Impact on Various Uses

As discussed in Section 4.3 of CSA (2016), spill fate modeling indicates that a fuel or condensate spill could be carried into shallow water under certain meteorological and oceanographic conditions depending on the season, where it may contact shallow coastal sediments. There is the potential for culture and heritage sites along the coast to be contaminated or disturbed by spill response and cleanup activities.

Similarly, coastal fishing and marine farming areas may be affected in the event of a spill. Potential impacts could include direct impacts to fish or aquaculture species (e.g., toxicity or contamination) as well as temporary disruption or suspension of fishing or marine farming due to spill response activities. It is noteworthy that the time required for a spill to reach coastal waters is approximately a week or more, during which ~40% of the condensate spill will evaporate, further limiting the potential for direct impacts to coastal fishing and marine farming. Local spill response activities in nearshore coastal waters may present a space use conflict with local fishing operations for the duration of spill response operations.

4.3.6.3 Impacts on Various Environments

Based on the spill assessment and impact analysis summarized in CSA (2016), the following summary impact table was presented (**Table 4-5**) which identifies predicted residual impacts to various physical, chemical, biological and socio-cultural resources present in the project area. Residual risks range from Low to Moderate, with the majority of impacts falling within the Low category. Resources deemed most sensitive and reflecting a Moderate residual impact determination, depending upon whether a condensate or diesel spill, included seabirds and migratory birds, coastal habitats and infrastructure, marine mammals, sea turtles, and fishing and fishing activities.

Table 4-5. Summary of spill-related impacts resulting from a condensate release and diesel fuel spill, offshore Israel (From: CSA, 2016).

Aspect and Description	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Accidental Spills						
Fuel spill from the drilling rig (16,500 bbl)	Air quality	Elevated VOC concentrations due to evaporation of volatile hydrocarbons (mostly in first 24 to 48 hours).	• Spill prevention measures • Drilling rig SOPEP • OSCP	2	2	4 Low
	Water quality	Sheen or slick on water surface; elevated hydrocarbon concentrations in water column.	• Spill prevention measures • Drilling rig SOPEP • OSCP	2	2	4 Low
	Marine mammals	Potential impacts due to inhalation, ingestion, direct contact with skin, or ingestion of fouled prey items.	• Spill prevention measures • Drilling rig SOPEP • OSCP	2	2	4 Low
	Sea turtles	Potential impacts due to inhalation, ingestion, direct contact with skin, or ingestion of fouled prey items.	• Spill prevention measures • Drilling rig SOPEP • OSCP (including protection of nesting beaches)	2	2	4 Low
	Seabirds and migratory birds	Potential impacts due to inhalation, ingestion, direct contact with eyes or feathers, or ingestion of fouled prey items.	• Spill prevention measures • Drilling rig SOPEP • OSCP (including protection of coastal bird habitats)	2	3	6 Mod
	Fishes	Potential impacts due to direct contact with oil or ingestion of fouled prey items.	• Spill prevention measures • Drilling rig SOPEP • OSCP	2	2	4 Low
	Fishing activities and marine farming	Potential disruption of fishing due to response activities; potential contamination of fishing areas or marine farming areas if a spill reached shoreline.	• Spill prevention measures • Drilling rig SOPEP • OSCP (including notification procedures and protection of fishing and marine farming areas)	2	2	4 Low

Table 4-5. (Continued).

Aspect and Description	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Fuel spill from the drilling rig (16,500 bbl)	Culture and heritage sites	Potential contamination of culture and heritage sites (including coastal sites if spill reached shoreline).	• Spill prevention measures • Drilling rig SOPEP • OSCP (including protection of coastal archaeology sites) • 305-m avoidance zone for potential wreck sites; 31-m avoidance zone for other sonar contacts	2	2	4 Low
	Marine transportation and infrastructure	Potential disruption or rerouting of ship traffic due to response activities.	• Spill prevention measures • Drilling rig SOPEP • OSCP	2	2	4 Low
	Coastal habitats and infrastructure	Potential contamination of beaches, shorelines, parks, preserves, marinas, ports, etc.	• Spill prevention measures • Drilling rig SOPEP • OSCP (including protection of coastal habitats and infrastructure)	2	3	6 Mod
Condensate spill from a blowout (for 30 days)	Air quality	Elevated VOC concentrations due to evaporation of volatile hydrocarbons (mostly first 24 to 48 hours).	• Spill prevention measures • OSCP	2	2	4 Low
	Water quality	Sheen or slick on water surface; elevated hydrocarbon concentrations in water column.	• Spill prevention measures • OSCP	2	2	4 Low
	Sediment quality	Physical impact to sediments within 300 m of blowout site; sediment contamination unlikely.	• Spill prevention measures • OSCP	2	2	4 Low
	Benthic communities	Physical impact to benthic organisms within 300 m of blowout site; benthic community impacts due to sediment contamination are unlikely.	• Spill prevention measures • OSCP	2	2	4 Low
	Marine mammals	Potential impacts due to inhalation, ingestion, direct contact with skin, or ingestion of fouled prey items.	• Spill prevention measures • OSCP	2	3	6 Mod
	Sea turtles	Potential impacts due to inhalation, ingestion, direct contact with skin, or ingestion of fouled prey items.	• Spill prevention measures • OSCP (including protection of nesting beaches)	2	3	6 Mod

Table 4-5. (Continued).

Aspect and Description	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Condensate spill from a blowout for 30 days) Continued	Seabirds and migratory birds	Potential impacts due to inhalation, ingestion, direct contact with feathers, or ingestion of fouled prey items.	• Spill prevention measures • OSCP (including protection of coastal bird habitats)	2	3	6 Mod
	Fishes	Potential impacts due to direct contact with oil or ingestion of fouled prey items.	• Spill prevention measures • OSCP	2	3	6 Mod
	Fishing activities and marine farming	Potential disruption of fishing due to response activities; potential contamination of fishing areas or marine farming areas if a spill reached shoreline.	• Spill prevention measures • OSCP (including notification procedures and protection of fishing and marine farming areas)	2	2-3	4-6 Mod
	Culture and heritage sites	Potential contamination of heritage sites (including coastal sites if spill reached shoreline).	• Spill prevention measures • OSCP (including protection of coastal archaeological sites) • 305-m avoidance zone for potential wreck sites; 31-m avoidance zone for other sonar contacts	2	2	4 Low
	Marine transportation and infrastructure	Potential disruption or rerouting of ship traffic due to response activities.	• Spill prevention measures • OSCP	2	2	4 Low
	Coastal habitats and infrastructure	Potential contamination of beaches, shorelines, parks, preserves, marinas, ports, etc.	• Spill prevention measures • OSCP (including protection of coastal habitats and infrastructure)	2	3	6 Mod

OSPC = oil spill contingency plan; SOPEP = Shipboard Oil Pollution Emergency Plan.

4.3.7 Oil Spill Dispersion Model Information

4.3.7.1 General

4.3.7.1.1 Model Name

The model used for the assessment of the two accidental spill scenarios was

4.3.7.1.2 Brief Description of the Model

, and its successor is a software package designed to predict the fate and dispersal of an oil spill. It has been developed over a period of years at the Cyprus Oceanographic Center. The version used in the present analysis was described by Lardner (2011). The surface spill is advected and dispersed by both the near-surface currents and direct wind forcing. Advection of the oil is simulated as a Lagrangian displacement by the currents and winds plus a horizontal turbulent diffusion based on the random walk hypothesis. Details can be found in recent studies such as Coppini et al. (2011) and Zodiatis et al. (2012). The model also accounts for weathering of the oil through physiochemical processes such as evaporation, emulsification, and small-scale turbulent mixing in the water as well as adhesion to the coast as described by Lardner and Zodiatis (1998).

4.3.7.1.3 Compatibility of Model with Simulating Dispersion in the Mediterranean Sea

was initially incorporated as part of the Mediterranean Forecasting System (Pinardi and Masetti, 2000; Pinardi et al., 2003) which provides daily forecasts of the circulation on various scales within the framework of the MOON/MyOcean program. It successor, has undergone a series of revisions (v. 1.01, 1.02, 2.0) to accommodate the capability to 1) simulate multiple independent oil spill sources; 2) be forced by Stokes drift velocities computed directly by a wind-wave model; 3) use local wind fields rather than interpolated to an oil gravity center; 4) potentially use a 4th order Runge-Kutta numerical scheme to solve the advective part of the active tracer equation; and 5) the possibility to switch off the weathering part to simulate passive tracers. Later versions of also allowed application in environments outside the Eastern Mediterranean.

4.3.7.1.4 Examples of Model Use

During the past few years, has been used in various oil spill exercises in the Eastern Mediterranean. One of the earlier and extensively studied applications of was the oil spill from the Jieh power station near Beirut in July 2006 (e.g., Zodiatis et al., 2007; Coppini et al., 2011; Neves et al., 2015). Scientists from the Italy's National Institute of Geophysics and Volcanology have also used in a preliminary study of the *Deepwater Horizon* oil spill in the U.S. Gulf of Mexico.

Updates to occurred in 2013 with the release of the latter of which has been applied to spills in China (Peng et al., 2024), Syria (Atake et al., 2024), and Italy (Liubartseva et al., 2021), among other applications.

4.3.7.2 Meteo-Physical Conditions and Variables

4.3.7.2.1 Boundary Conditions

The hydrodynamic model requires initial conditions as well as time-dependent lateral boundary conditions at the open (western) boundary and surface forcing. The initial and lateral boundary conditions were extracted from the reanalysis fields produced within the framework of the operational MOON/MyOcean forecast system.

4.3.7.2.2 Initial Condition

The high-resolution fields were produced from a continuous 34-day downscaling run of the model. In order to eliminate the initial shock or mismatch between the original reanalysis fields and the interpolated values, each simulation was started three days before the desired date to allow for model spin up and adjustment.

4.3.7.2.3 Horizon and Vertical Resolution

Daily averaged three-dimensional fields of temperature, salinity, currents, and sea level are available beginning from 1999 with a spatial resolution of 1/16° (~6.5 km) horizontally and 72 fixed depth levels in the vertical.

4.3.7.2.4 Initial Model Data

For surface forcing, the 10 m winds were extracted from the ECMWF ERA-Interim reanalysis data (Dee et al., 2011). These data are available with a frequency of 6 hours. Surface heat and freshwater fluxes were approximated by relaxing the model's surface temperature and salinity to the MOON/MyOcean reanalysis fields with a relaxation time scale of 2 days. All data were spatially and temporally interpolated to the hydrodynamic model grid and time steps as necessary. Four specific periods were chosen which represent meteo-oceanographic conditions that could potentially lead to worst-case scenarios.

4.3.7.2.5 Bathymetry

For the scenarios considered here, the model domain covers the entire Levantine Basin east of 30°E. The horizontal resolution is 1' (~1.7 km) and the water column is divided into 30 unevenly spaced sigma layers which cover the entire water column. The bathymetry was extracted from the General Bathymetric Charts of the Ocean (GEBCO) and their global 1' (one minute) data set (GEBCO, 2012). The model is one-way nested in the daily MOON/MyOcean reanalysis fields (1/16°, ~6.5 km horizontal resolution) for the relevant periods following the methodology of Brenner (2003) and Brenner et al (2007). These models and the nesting methodology have been extensively tested and validated for this region within the framework of MFS and MOON. The domain and the bathymetry for the model are shown in **Figure 4-3**.

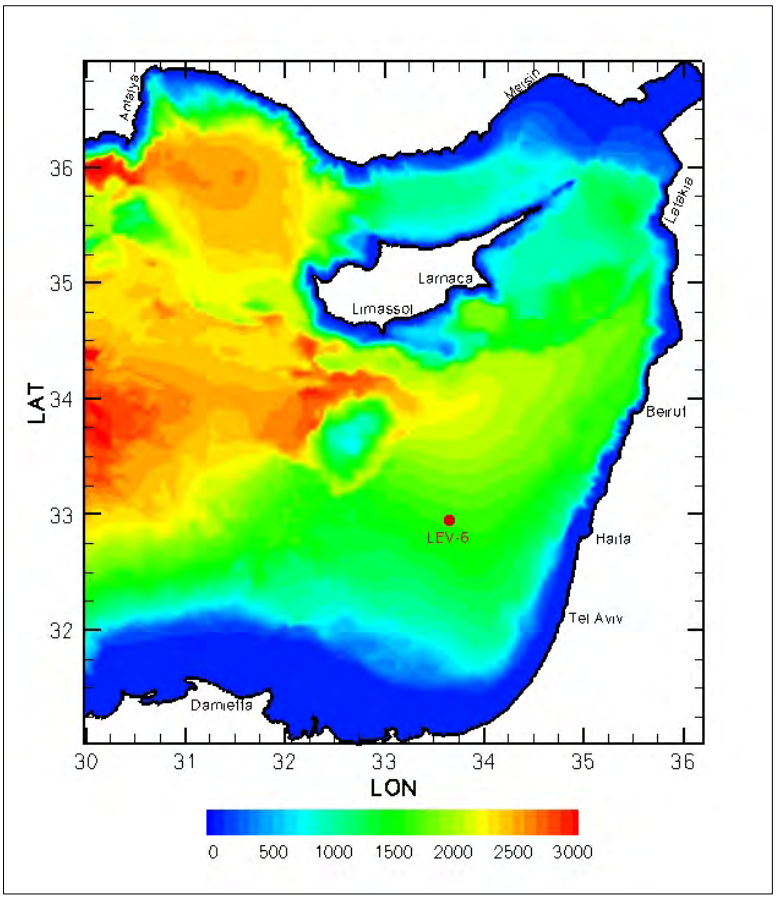


Figure 4-3. Domain and bathymetry (m) for the circulation model. The red dot indicates the location of the Leviathan-6 drilling site (From: CSA, 2016).

4.3.7.3 Chemical Variables

4.3.7.3.1 Type of Petroleum

Limited characteristics were available for the condensate and diesel fuel used as spill modeling components. The condensate was treated as an equivalent oil discharge from the well. The diesel fuel employed in the spill model was relatively light (API 35).

4.3.7.3.2 Amount of Petroleum Emissions Per Time Unit

Two accidental spill scenarios were previously evaluated in the CSA (2016) document and remain relevant for the Tamar-12 Project: a fuel spill and a condensate spill from a loss of well containment. The fuel spill scenario assumed an instantaneous release of 16,500 bbl from the drillship. The condensate spill scenario assumed a well loss of containment resulting in the release of continuing for a period of 30 days.

4.3.7.4 Model Calibration and Verification

4.3.7.4.1 Proposed Calibration Method

model assumptions were summarized by De Dominicis et al. (2013a), while calibration and verification were summarized by De Dominicis et al. (2013b); the latter analysis detailed the results of three groups of experiments conducted to understand the sensitivity of oil slick simulations to different model assumptions. Modeling results were validated and calibrated via the use of both in situ and satellite data. Model calibration focused on 1) the simulation of single drifter trajectories as a function of the space and timescales of the Eulerian current field; and 2) the impact of local wind and

the wave-induced velocity correction terms. De Dominicis et al. (2013b) also evaluated 1) model sensitivity to the oil spill trajectories derived from satellite observations; 2) effects of uncertain oil input properties (e.g., oil type, slick thickness, age); and 3) sensitivity tests to the number of Lagrangian particles and tracer grid resolution.

All experimental results were compared to observed data; the degree of predictability of the trajectories were evaluated in terms root-mean-square error between observed and simulated particle trajectories as a function of model parameters and skill score, thereby establishing the limit of predictability of oil spill evolution as a function of the Eulerian input fields and their respective horizontal resolution (De Dominicis et al., 2013b).

4.3.7.4.2 Calibration Variables

Per Di Dominis et al. (2013b), three different state variables were defined in the model: 1) the concentrations structural state variables; 2) the oil slick and particle state variables that are used to simulate weathering and transport-diffusion processes, respectively; and 3) reconstruction of the concentrations.

4.3.7.4.3 Calibration Findings

Key findings resulting from the assessment conducted by De Dominicis et al. (2013b) included:

- Accuracy of the forecasting of Lagrangian trajectories largely depends on the accuracy of the input ocean currents: an hourly time frequency and an open-ocean horizontal resolution of only a few km are necessary for recovering drifter trajectories;
- Subsequently, the current model is accurate in reproducing drifter trajectories for 1 to 2.5 days, depending on the current conditions;
- In general, there is no need to add a wind correction to reconstruct a correct Ekman current; however, corrections allowed by may still be necessary, particularly for simulations under strong wind conditions;
- Further investigations are needed to obtain the correct representation of the physical processes in the upper surface layer (i.e., the first millimeter of the water column) because the thin, interfacial viscous layer may be important in surface oil spill dynamics;
- The specific role of waves in slick movement is acknowledged, especially in nearshore areas; wave transport (i.e., Stokes drift) has been integrated into
- Swell and other wave processes should be considered in modeling simulations; should be coupled with a fully-resolved surface wind waves model;
- Variations in oil type and slick thickness have noticeable effects on spill simulation results; realistic oil concentration distributions can be obtained by an optimal oil grid tracer resolution of the order of 100 m and number of particles of the order of a hundred thousand; and
- The predictability time for oil spill forecasting is on the order of a few days, maintaining the spatial errors for trajectories within three times the numerical grid resolution; this determination suggest that frequent re-initialization of the simulation approximately every day along the drifter trajectory positions is warranted.

4.3.7.4.4 Proposed Verification Method

model assumptions and verification were summarized by De Dominicis et al. (2013a,b), respectively. Per De Dominicis et al. (2013b), the sensitivity of the oil spill simulations to several model parameterizations was analyzed and the results were validated using surface drifters, synthetic aperture radar, and optical satellite images in different regions of the Mediterranean Sea.

4.3.7.4.5 Verification Findings

De Dominicis et al. (2013b) summarized the verification process for Key determinations included: 1) the forecast accuracy of Lagrangian trajectories largely depends on the accuracy of the Eulerian ocean currents; 2) operational models provide useful estimates of currents,

but high-frequency (i.e., hourly) and high-spatial resolution is required; 3) the Stokes drift velocity has to be added, especially in coastal areas.

Further, the verification process determined that a realistic oil concentration reconstruction can be obtained using an oil tracer grid resolution of about 100 m, with at least 100,000 Lagrangian particles. Sensitivity experiments to uncertain model parameters indicated that specifications regarding oil type and slick thickness are key model parameters affecting spill simulation results.

De Dominicis et al. (2013b) determined that a maximum spatial error of the order of three times the horizontal resolution of the Eulerian ocean currents is acceptable. The accuracy of the model predictions for particle trajectories ranged from 1 to 2.5 days, depending on the specific current regime, suggesting that re-initialization of the simulations is required every day.

4.3.7.5 Scenarios to be Tested

No scenarios pertinent to the Tamar-12 spill simulation (based on a condensate spill from Leviathan-6 and diesel fuel spill from ML-1X) were tested; modeling results presented for Tamar-12 have been based on scenarios outlined in **Section 4.3.4**.

4.4 LIGHT DISTURBANCES

Light sources on the offshore drillship, installation vessel, and support vessels include navigational lighting; helicopter flight deck lights, and safety and performance lighting (for work areas) (Golder Associates et al., 2007).

All vessels maintain exterior lighting for navigational and aviation safety. The total time for drilling and completing the Tamar-12 wells in the Tamar Field is estimated to be 122 days (see **Section 3.1.2**). Installation operations are expected to require a total of 44 days. Vessels associated with the Tamar-12 drilling, completion, and subsea infrastructure installation program are summarized in **Section 3.1.1.5**.

Resources potentially affected by artificial lighting include marine mammals, sea turtles, seabirds and migratory birds, and pelagic fishes. The effects of artificial lighting on marine mammals is unknown, although it is unlikely that marine mammals are directly affected as they are not known to use lighting cues (in air) in their foraging, reproduction, or other activities (Stanton and Cowart, 2024).

4.4.1 Potential Impacts

4.4.1.1 Impacts on Sea Turtles

Adult sea turtles spend most of their time submerged (Renaud and Carpenter, 1994; Polovina et al., 2003) and are therefore unlikely to be exposed to artificial lighting from the drillship, installation vessel, and support vessels. Some sea turtles may be attracted to offshore structures (Rosman et al., 1987; Lohoefener et al., 1990), but it is unknown whether artificial lighting plays any role in this attraction.

Sea turtle hatchlings use lighting cues for navigation, and artificial lighting can disrupt their nocturnal orientation (Witherington, 1997; Tuxbury and Salmon, 2005). It has been suggested that sea turtle hatchlings could be attracted to brightly lighted offshore structures, including drillship and platforms, where they may be subject to increased predation by birds and fishes (U.S. National Marine Fisheries Service [NMFS], 2007). However, when offshore, hatchlings may rely less on light cues than when they are emerging on the beach (Salmon and Wyneken, 1990). Once hatchlings swim away from the nesting beach, they inhabit mats of flotsam (Carr and Meylan, 1980; Bolten and Witherington, 2003) and their ability to swim toward a drillship or other offshore structures would be very limited. Due to the distance of the Tamar Field from nesting beaches (approximately 90 km from the nearest

shoreline), it is possible, but unlikely, that a few hatchling turtles would be affected. In the Gulf of Mexico, where thousands of offshore structures are present, drillship and platform lighting has been evaluated as unlikely to appreciably reduce the reproduction, numbers, or distribution of sea turtles (NMFS, 2007). Any exposure of sea turtles to light emitted from the drillship, installation vessel, or support vessels would be brief and typical of normal maritime activities in the Mediterranean.

4.4.1.2 Impacts on Sea Birds and Migratory Birds

Seabirds can be attracted to offshore structures because of both the lights and the structure itself (Wolfson et al., 1979; Tasker et al., 1986; Baird, 1990; Wiese et al., 2001), as well as to the increased concentrations of fishes around the structure (Baird, 1990; Montevecchi et al., 1999). Seabirds use mostly optical cues for migrating between breeding and wintering areas; navigation aids include internal maps, sunlight and sunrise/sunset cues, starlight and celestial navigation, topography, and an internal magnetic compass (Greer et al., 2010). Birds migrating through an environment that is otherwise flat and very dark at night find offshore platforms or floating, stationary vessels an attractive visual cue. It should be noted that visibility is important in itself, to prevent collisions.

The presence of offshore structures can have both positive and negative impacts on birds (Baird, 1990; Montevecchi et al., 1999; Fraser et al., 2006). Some birds may be attracted to offshore structures because of the lights, as well as the fish populations that aggregate around these structures. Particularly sensitive species would be petrels and other procellariforms that forage on vertically migrating bioluminescent prey. Birds may use offshore structures for resting, feeding, or as temporary shelter from inclement weather (Russell, 2005). However, birds migrating over water at night have been known to strike offshore structures, resulting in death or injury (Wiese et al., 2001; Russell, 2005; OSPAR Commission, 2012).

A study in the North Sea indicated that offshore platform lighting can cause circling behavior in some birds, especially on cloudy nights; apparently the birds' geomagnetic compasses are upset by the red part of the spectrum from the lights currently in use (Van de Laar, 2007; Poot et al., 2008). The numbers varied greatly, from none at all to tens of thousands of birds per night per platform, with an apparent effect radius of up to 5 km. A study in the Gulf of Mexico also noted the phenomenon (Russell, 2005). The overall consequences of circling behavior are unknown, but the impact is unlikely to be significant based on the limited scope and duration of drilling and completion activities.

While the bulk of the bird migration over Israel occurs inland, the edge of the migration routes passes over the nearshore portions of the Eastern Mediterranean Sea. The radius of the bird monitoring radar located in Latrun, Israel, reaches to approximately 30 km off the shoreline and regularly detects activity up to its margin (Dinevich and Leshem, 2010). The bird migration period extends from March to the end of May and from August to the end of November. Because of the distance between the Tamar Field and the nearest shoreline (approximately 90 km), it is expected that the drillship, installation vessel, and other Tamar-12 Project vessels will not be visible to migrating birds that routinely migrate along or near the coast. Consequently, lighting is unlikely to have significant impact on seabird or migratory bird populations.

4.4.1.3 Impacts on Fishes

Offshore structures typically attract epipelagic fishes such as tunas, dolphins, billfishes, and jacks (e.g., Holland et al., 1990; Higashi, 1994). Offshore vessels, as floating structures in the deepwater environment, essentially act as fish aggregating devices (FADs). Day/night variations in fish populations around platforms suggest that lighting may be part of the attraction (Wilson et al., 2006). Offshore structures also provide shelter and food in the form of attached fouling biota (Gallaway and Lewbel, 1982).

Positive fish associations with offshore drillships and platforms are well documented (Gallaway and Lewbel, 1982; Wilson et al., 2003, 2006; Peabody and Wilson, 2006). The FAD effect could possibly enhance the feeding of epipelagic predators by attracting and concentrating smaller fishes. Because the drillship and installation vessel are temporary structures, any impacts on fish populations are likely to be insignificant.

4.4.2 Mitigation Measures

Navigational lighting onboard both the drillship and installation vessels, as well as support vessels, will meet International Convention for Safety of Life at Sea (SOLAS) requirements as per IMO Resolution MSC.253(83) or equivalent requirements. No mitigation is proposed for this type of lighting, as the requirements are essential for navigational safety.

Helicopter flight decks use perimeter lighting in accordance with international standards such as International Civil Aviation Organization Annex 14, Volume II (Heliports) or API Recommended Procedure 2L (Recommended Practice for Planning, Designing, and Constructing Heliports for Fixed Offshore Platforms). No mitigation is proposed for this type of lighting, as the requirements are essential for aviation safety.

To the extent practicable without compromising safety or work performance, safety and performance lighting in open deck areas will be shielded (i.e., oriented downward) to minimize excess light emissions into the environment.

4.4.3 Impact Significance

Impact significance for light hazards is summarized in **Table 4-6**. The consequence of potential impacts to sea turtles, seabirds and migratory birds, and pelagic fishes is rated as insignificant (1). The likelihood of impacts on sea turtles and birds are rated as possible (3). Although the attraction of pelagic fishes is almost certain, the likelihood of any adverse impacts on them is also rated possible (3). The residual risk is assessed as Low in all cases.

Table 4-6. Summary of potential impacts from light hazards.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Artificial lighting on drillship, installation vessel, and support vessels	Sea turtles	Possible attraction of hatchlings resulting in exposure to discharges and predation	To the extent practicable without compromising safety or work performance, lighting in open deck areas will be shielded (i.e., oriented downward) to minimize excess light emissions into the environment.	3	1	3 Low
	Seabirds and migratory birds	Possible attraction and/or disorientation including circling behavior and collisions with drillship structure	Same as above	3	1	3 Low
	Fishes (pelagic)	Attraction to lights resulting in exposure to discharges and noise	Same as above	3	1	3 Low

4.5 NOISE

Sources of underwater noise during the drilling, completion, and installation program at Tamar-12 include the drillship, installation vessel, supply vessels, and helicopters. The source characteristics are summarized in **Section 3.2**. Resources potentially affected by underwater noise include marine mammals, sea turtles, and fishes.

To evaluate potential impacts of underwater noise, it is necessary to distinguish between different types of sound sources because they pose different risks of effect and thus different criteria have been developed for them (NMFS, 2024; Popper et al., 2014). Sound sources are generally characterized as impulsive or non-impulsive, and intermittent or continuous. Impulsive sounds (such as those made by seismic airguns and impact pile driving) are typically abrupt, of brief duration, and may contain a wide range of frequencies. Impulsive sounds are characterized by a rapid rise in sound pressure, quickly reaching a maximum value, followed by a period of decay. Non-impulsive sounds (such as those produced by vessels and drilling activities) can be continuous or intermittent, broadband or tonal, and do not have the rapid rise in sound pressure typical of impulsive sounds. Continuous sounds produce a sound pressure that remains above ambient sound levels throughout the entire observation period, whereas intermittent sources produce bursts of sound separated by periods of low or no sound.

All of the sound sources considered in this analysis are considered non-impulsive, continuous, broadband sources for the purpose of impact analysis. As noted by Richardson et al. (1995), the distinction between continuous and intermittent sources is not absolute; although noise from the drillship, installation vessel, support vessels, and helicopters is continuous, it could be considered transient as far as a stationary receiver is concerned. Sound source levels for project-related vessels and aircraft are summarized below.

Drillship. Drilling rigs and semisubmersible drillships produce primarily non-impulsive, continuous, broadband sound, with strong tonal components at low frequencies (Richardson et al., 1995). Sound from Tamar Field drilling activities was referenced by CSA (2016) using measurements from several drilling units, as adapted from Richardson et al. (1995). Semisubmersible broadband sound source levels are expected to be approximately 177 dB re 1 µPa m. Recent measurements summarized by Huang et al. (2023) for vibrating and drilling noises showed fundamental frequencies of 41 and 45 Hz, and source levels of 158.9 dB re 1 µPa m and 155.9 dB re 1 µPa m, respectively. The drillship will be a noise source in the Tamar Field during the entire period of drilling and completion activities. The total time for drilling and completing all of the Tamar-12 well is estimated to be 122 days, although only 24 days will be required for actual drilling operations (see **Section 3.1.2**).

Support Vessels and Installation Vessel. The drilling program will be supported by three MMC 87 Class platform support vessels or similar. The installation program is expected to be conducted by one MPCV (for jumpers and umbilicals installation) and a single LCV, along with a supply/standby vessel and a crew change vessel. All drilling support vessels are expected to operate out of the port of Haifa (see **Section 3.2.3**); the MPCV, LCV, and other support or crew change vessels, will likely operate out of Cyprus. Broadband source levels are expected to be in the range of 170 to 180 dB re 1 µPa m (Richardson et al., 1995). Most of the energy is in frequencies below 100 to 200 Hz, with propeller cavitation usually being the dominant noise source. Although underwater noise produced by the support vessels and installation vessel is generally characterized as a continuous sound source (NMFS, 2024; Popper et al., 2014), an individual animal's exposure to the sound would likely be occasional and transient as the vessels move between the shore base and the project area.

Helicopter. A Sikorsky S-76C++ helicopter will make an average of 10.5 round-trips per week between Haifa and the project area during drilling and completion activities and subsea infrastructure installation operations; a total of approximately 183 helicopter round-trips is expected during the Tamar-12 Project. Penetration of aircraft noise into the water is greatest directly below the aircraft; at angles greater than 13° from the vertical, much of the sound is reflected and does not penetrate into the water. The duration of underwater sound from passing aircraft is much briefer in water than air;

for example, a helicopter passing at an altitude of 152 m (500 ft) that is audible in air for 4 minutes may be detectable underwater for only 38 seconds at 3 m (10 ft) depth and for 11 seconds at 18 m (59 ft) depth (Richardson et al., 1995). Realistically, an individual animal's exposure to the sound from the helicopter would likely be occasional and transient as the helicopter moves between the shore base and the drillship.

Ambient Noise Levels and Project-Specific Noise Impacts. Shipping noise is a dominant component of ambient noise in the sea at lower frequencies, typically between 20 and 200 Hz. Large vessels are sources of low-frequency acoustic waves, with cavitation being the primary noise-generation mechanism together with machinery and plate vibrations (National Research Council, 2003; Southall, 2005; Skarsoulis et al., 2023).

Galil (2006) broadly characterized the acoustic environment of the Mediterranean and noted that the Eastern Mediterranean region represents one of the busiest sea routes in the world with a number of high-volume port facilities and crowded shipping lanes. The opening of the Suez Canal significantly increased the volume of shipping traffic, particularly in the Eastern Mediterranean region. While shipping noise affects large segments of the world's oceans, noise levels are greatest near well-travelled shipping lanes, straits, canals, and busy ports. According to Galil (2006), the ambient noise in areas of heavy shipping could reach levels ranging between 85 and 95 dB re 1 µPa m SPL.

According to Jalkanen et al. (2022), the Eastern Mediterranean continues to exhibit significant vessel traffic (i.e., Red Sea to Europe through the Suez Canal). The contribution of container ships, bulk cargo ships, and tankers to underwater noise emissions approaches 70% when the results are aggregated by vessel category. Based on the contributions from individual vessels, the 50 largest noise source energy emitters are all containerships. Containerships are the most prevalent vessels visiting both Haifa and Ashdod, representing a significant source of vessel noise in the region. Additional information regarding noise hot spots in the Mediterranean, including off the coast of Israel, has been summarized by ACCOBAMS (2022).

There are no specific ambient sound data specifically from the area of the Tamar Field. Ambient sources of sound in the region include shipping noise, along with natural noise sources (e.g., wind, precipitation). In addition, the areas affected by different sound contributions likely will vary throughout the year, as acoustic propagation loss varies throughout the seasons (CSA, 2023b).

The dominant sources of project-specific noise will originate from several sources: topside equipment (e.g., drilling and completion activities), support vessels, and support aircraft. Project-related noise will contribute to ambient noise levels both at the Tamar-12 drill site and along support vessel and helicopter transit routes to shore. Due to the nature of project-related noise sources, the offshore location of the Tamar Field, and relatively short duration of Tamar-12 Project activities, the project-specific contribution to ambient noise levels is expected to be minimal, limited in both temporal and spatial extent.

4.5.1 Impact of Noise on Animals

4.5.1.1 Impacts on Marine Mammals

The impacts of underwater noise on marine mammals have been studied and reviewed extensively (Geraci and St. Aubin, 1987; Richardson et al., 1995; National Research Council, 2003, 2005; Southall et al., 2007, 2016, 2021; Ellison et al., 2012; Harding and Cousins, 2022). However, there are some key limitations: 1) most impacts are not readily predictable, except for the potential for injury or auditory trauma from high-energy sources; and 2) the biological significance of lesser impacts such as behavioral responses is difficult to assess.

Richardson et al. (1995) defined four zones of potential noise effects on marine mammals. In order of increasing severity, these include 1) audibility; 2) responsiveness (behavioral effects); 3) masking; and 4) hearing loss, discomfort, or injury (physical effects). The levels of sound produced during drilling and completion activities, the latter of which are expected to be the highest among the Tamar-12 Project vessels, are sufficient to be audible to marine mammals, to produce behavioral responses, and possibly to contribute to masking effects; however, the source levels are much lower than those known to cause hearing loss or injury as discussed in the following subsections.

4.5.1.1.1 Potential Impacts: Injury Including Auditory Trauma

Source levels for a drillship were estimated as a maximum SPL of 177 dB re 1 µPa m, and source levels for installation/support vessels are expected to be in the range of 170 to 180 dB re 1 µPa m (see **Section 3.3.1**). For comparison, the NMFS (2024) has published criteria for permanent threshold shift (PTS) and temporary threshold shift (TTS), both forms of auditory injury resulting in permanent or temporary hearing loss in individuals. Dual criteria were proposed based on the peak sound pressure level (Lpk) and cumulative sound exposure level over 24 hours (SEL_{24h}) metrics. The sound sources analyzed for the Tamar-12 Project only include non-impulsive sources (**Section 3.3.1**) for which threshold criteria only consider the SEL_{24h} metric (**Table 4-7**). The Lpk metric is used to characterize the rapid rise in sound pressure which can contribute to auditory injuries, but is only applicable for impulsive sources because non-impulsive sources do not have this rapid increase in sound pressure such that auditory injury would be expected to occur (NMFS, 2024). Rather, the risk of auditory injury in marine life from non-impulsive sources is a result of continued exposure to above-threshold noise represented by the SEL_{24h} metric.

Table 4-7. Criteria for permanent threshold shift (PTS) and temporary threshold shift (TTS) onset for cetaceans in response to non-impulse sounds (From: National Marine Fisheries Service, 2024).

Hearing Group (and Functional Hearing Range)	Examples in the Levantine Basin (see **Section 1.6.3.1**)	PTS Onset Threshold for Non-Impulse Sources[a]	TTS Onset Threshold for Non-Impulse Sources[a]
Low-frequency cetaceans (7 Hz–36 kHz)	Fin Whale Minke Whale Humpback Whale	197	177
High-frequency cetaceans (150 Hz–160 kHz)	Sperm Whale Short-Beaked Common Dolphin Risso's Dolphin Striped Dolphin Rough-Toothed Dolphin Common Bottlenose Dolphin Cuvier's Beaked Whale False Killer Whale Killer Whale Indo-Pacific Humpback Dolphin	201	181
Very High-frequency cetaceans (275 Hz–165 kHz)	Dwarf Sperm Whale[b] Harbour Porpoise[b]	181	161
Phocid Pinnipeds in water (40 Hz–90 kHz)	Mediterranean Monk Seal[b]	195	175

[a] Values are cumulative sound exposure levels over 24 hours in units of dB re 1 μPa^2s.

[b] Indicates vagrant species whose presence is in the Levantine Basin is not confirmed (see **Section 1.6.3.1**).

Using the estimated source levels and frequency range for drillships presented above in the companion User Spreadsheet Tool to NMFS (2024) available at NMFS (2025), the PTS thresholds would not be exceeded beyond 20 m for any species, even if an individual were to be present within the ensonified area for the entire operational period. TTS thresholds could be exceeded over a longer distance compared to PTS, but this would require an individual to be present within the ensonified area for the entire operational period, which is not likely with animal movement. Additionally, TTS is a temporary effect that an animal would be able to recover from following cessation of project drilling activities.

Noise produced by the installation and support vessels is not expected to result in PTS or TTS for any marine mammals based on calculations from the companion User Spreadsheet Tool to NMFS (2024), the characteristics of the source, and the transient nature of the activity. Accumulation of sound energy due to vessel activity is unlikely to occur as both the source (i.e., the vessels) and the receivers (i.e., the animals) are moving and marine mammals would only be present in the ensonified area for limited periods, reducing the likelihood of auditory effects.

4.5.1.1.2 Potential Impacts: Behavioral Responses

Low-frequency noise from vessels can be detected by marine mammals (Richardson et al., 1995; Tyack, 2008). Low-frequency cetaceans (baleen whales such as the fin and minke whale) are more likely to detect low-frequency sounds than most odontocetes (toothed whales and dolphins belonging to the high-frequency and very high-frequency cetacean hearing groups), which have their best hearing in high frequencies.

The NMFS SPL criterion of 120 dB re 1 µPa is applied for marine mammal behavioral responses to non-impulsive, continuous noise. This is based on the lowest received levels at which responses have been observed in marine mammals. Based on the estimated source levels, marine mammals within approximately 1,000 m of the drillship or support vessels/installation vessel may be exposed to sound levels sufficient to elicit behavioral responses (**Table 4-8**). Although the NMFS behavioral disturbance criterion does not distinguish between mysticetes and odontocetes, sound produced by these sources poses the highest risk for mysticetes such as the fin whale and minke whale, which are low-frequency cetaceans whose hearing range most closely overlap with that of the drillship or support vessels/installation vessel. Because most odontocetes have their best hearing in mid- or high frequencies, there is less overlap between their hearing range and the frequency range of the source, decreasing the risk of effects occurring for these species.

Table 4-8. Sound sources associated with the Tamar-12 Project and calculated distances to the current U.S. National Marine Fisheries Service criterion for behavioral response to non-impulsive, continuous sources.

Sound Source	Source Levels (dB re 1 µPa 1 m)	Criterion for Behavioral Response (dB re 1 µPa)	Calculated Distance to Threshold (m)[a]
Drillship	177	120	708
Support vessels/ Installation vessel	170–180	120	316–1,000

[a] Distance calculated assuming spherical spreading (i.e., transmission loss = 20logR).

The NMFS 120-dB threshold is very simplistic. There has been considerable research about the levels of received sound that can cause behavioral responses in marine mammals, as well as the biological significance of those responses (Richardson et al., 1995; National Research Council, 2005; Southall et al., 2007; Ellison et al., 2012). There is evidence that many factors other than received sound level, including the activity state of animals exposed to different sounds, the nature and novelty of a sound, and spatial relations between sound source and receiving animals (i.e., the exposure context) strongly affect the probability of a behavioral response (Ellison et al., 2012). Southall et al. (2021) established a behavioral response severity scale to help account for some of these factors and quantify the biological significance of the effects on marine mammals. This study found in response to drilling and

vessel noise, behavioral effects ranged from no detectable response to the onset of avoidance behaviors and detectable changes in foraging behaviors depending on the individual assessed. However, no prolonged changes in behaviors or injuries were documented in response to drilling and/or vessel noise (Southall et al., 2021).

In conclusion, underwater noise from the drillship and support vessels/installation vessel may elicit behavioral responses in marine mammals in the immediate vicinity of these sound sources. The most likely impacts would be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area.

4.5.1.1.3 Potential Impacts: Masking

Masking refers to obscuring sounds of interest by interfering sounds, particularly for those sounds which have overlapping frequencies with the sounds of interest (Richardson et al., 1995). Payne and Webb (1971) first raised the possibility that noise from anthropogenic sources might affect marine mammal communication. Acoustic masking from shipping noise and other anthropogenic sources is increasingly being considered as a threat to marine mammals, particularly those most able to detect low-frequency sounds such as mysticetes (Clark et al., 2009; Castellote et al., 2010).

Underwater noise from ships is ubiquitous in the world's oceans and is the dominant source of underwater noise at frequencies below 300 Hz in many areas (Wenz, 1962; Ross, 1976; Hildebrand, 2009; McKenna et al., 2012; Duarte et al., 2021). On the scale of ocean basins, shipping noise is increasing as the level of ship traffic increases (McDonald et al., 2006; Hildebrand, 2009).

Although vessel noise can be considered a point source, distant shipping noise (where no single ship dominates the spectrum) is the broader concern (Clark et al., 2009). Distant shipping primarily consists of frequencies below 100 Hz, since sound attenuation increases exponentially with increasing frequency (Southall and Scholik-Schlomer, 2008).

As individual sound sources, the drillship, and support vessels/installation vessel are not likely to result in significant auditory masking effects. The underwater noise produced by project activities would represent an incremental contribution to the overall noise from shipping and industrial activities in the region.

4.5.1.2 Impacts on Sea Turtles

Three sea turtle species are known to occur in the Levantine Basin: the green turtle, leatherback turtle, and loggerhead turtle (see **Section 1.6.3.2**). Turtles are low-frequency hearing specialists with their best hearing at frequencies less than 1 kHz (Ridgway et al., 1969; Lavender et al., 2012; Martin et al., 2012).

Finneran et al. (2017) provide quantitative thresholds for PTS, TTS, and behavioral disturbances in sea turtles for both impulsive and non-impulsive sound sources (**Table 4-9**). Blackstock et al. (2018) recommended using the SPL threshold of 175 dB re 1 µPa provided in Finneran et al. (2017) based on data from caged sea turtle studies conducted by McCauley et al. (2000). Blackstock et al. (2018) noted that due to the potential caging influence, the SPL threshold of 175 dB re 1 µPa was likely a more appropriate threshold to use for the onset of behavioral disturbance in sea turtles in open water compared to observed responses of caged sea turtles.

Table 4-9. Acoustic criteria for non-impulsive sources for sea turtles (From: Finneran et al., 2017).

Permanent Threshold Shift[a]	Temporary Threshold Shift[a]	Behavioral Disturbances[b]
220	200	175

[a] Values are cumulative sound exposure levels over 24 hours in units of dB re 1 μPa^2 s.
[b] Values are in root-mean-square sound pressure level in units of dB re 1 µPa.

Based on the estimated source levels for the drillship, installation vessel, and support vessels (**Section 3.3.1**) neither the PTS, TTS, nor behavioral disturbance thresholds are likely to be exceeded beyond 50 m from the source. Outside this distance, the most likely impact on sea turtles would be auditory masking. The importance of auditory masking is difficult to assess for sea turtles, as they are not known to use sound to the same extent as marine mammals. However, sea turtles may use sound for navigation, locating prey, avoiding predators, and environmental awareness (Dow Piniak et al., 2012).

In conclusion, sea turtles near the drillship, installation vessel, and support vessels may be exposed to sound levels sufficient to elicit behavioral responses and potentially to create auditory interference by masking. The most likely impacts would be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area.

4.5.1.3 Impacts on Fishes

Sound plays a major role in the lives of all fishes (Zelick et al., 1999; Fay and Popper, 2000). In addition to listening to the overall environment and being able to detect sounds of biological relevance many species of bony fishes communicate with sounds and use sounds in a wide range of behaviors including, but not limited to, mating and territorial interactions (Zelick et al., 1999). Most fishes cannot hear sounds above approximately 3 to 4 kHz, and the majority of species are only able to detect frequencies of 1 kHz or below. Broad discussions of interactions of anthropogenic sounds and fishes can be found in Popper and Hastings (2009a,b) and Popper and Hawkins (2012).

Popper et al. (2014) proposed preliminary sound exposure guidelines for fishes exposed to shipping and non-impulsive, continuous noise sources. There is no direct evidence of mortality or potential mortal injury to fishes from ship noise, but there is some evidence for reversible auditory tissue effects and TTS caused by non-impulsive, continuous sound. For non-impulsive sources, quantitative thresholds were proposed for recoverable injury and TTS for fishes that have a swim bladder used in hearing. Also, the risk of impacts was qualitatively characterized as low, moderate, or high based on proximity to the source, as summarized in **Table 4-10**.

Table 4-10. Relative risk of auditory impacts on fishes exposed to shipping noise and other continuous sound sources (From: Popper et al., 2014).

Type of Impact	Proximity to Source			Threshold
	Near (tens of meters)	Intermediate (hundreds of meters)	Far (thousands of meters)	
Mortality and potential mortal injury	Low	Low	Low	None specified (no evidence of this impact)
Recoverable injury	Low	Low	Low	SPL 170 dB re 1 µPa for 48 hours (fishes with a swim bladder involved in hearing)
Temporary threshold shift (TTS)	Moderate	Low	Low	SPL 158 dB re 1 µPa for 12 hours (fishes with a swim bladder involved in hearing)
Masking	High	High	Moderate-High	None specified
Behavioral response	Moderate-High	Moderate	Low	None specified

Based on the exposure guidelines, fishes that remain for extended periods (e.g., 12 to 48 hours or more) in the immediate vicinity of the drillship may be at risk for recoverable tissue injury, TTS, auditory masking effects, and behavioral responses. At distances beyond a few hundred meters, fishes are probably at low risk for any impacts other than auditory masking. Impacts are unlikely to occur near support vessels because the exposure of individual fishes would be so brief.

In conclusion, fishes that remain for extended periods near the drillship and/or support and installation vessels may be exposed to sound levels sufficient to elicit behavioral responses, to create auditory interference by masking, and to cause recoverable auditory impacts (TTS). Due to the limited spatial extent and recoverable nature of impacts, these are unlikely to be significant on a population level.

4.5.1.4 Mitigation Measures

There are no planned mitigation measures to reduce underwater noise. Drillship and support vessels/installation vessel engines will be operated and maintained in accordance with manufacturers' specifications to avoid excessive noise and emissions.

No critical habitats for marine mammals, sea turtles, or fishes have been identified within the Tamar Field. No seasonal periods of peak abundance or activity have been identified in the Application Area that would warrant scheduling constraints. The sea turtle nesting season starts at the end of May for loggerhead turtles and in mid-June for green turtles, continuing until about the end of July and mid-August, respectively. However, scheduling activities to avoid this time period is 1) not warranted due to the distance from shore (greater than 90 km); and 2) not practical given the duration of planned activities (the total time for drilling and completing of the Tamar-12 well is estimated to be 122 days).

4.5.2 Impact Significance

Impact significance for underwater noise is summarized in **Table 4-11**. The consequence of potential impacts to marine mammals, sea turtles, and fishes are rated as insignificant (1) and the likelihood of impacts is rated as possible (3). The residual risk is assessed as Low.

Table 4-11. Summary of potential impacts from underwater noise.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Underwater noise from drillship, installation vessel, support vessels, and helicopters	Marine mammals	Behavioral responses such as avoidance; potential for auditory masking	None	3	1	3 Low
	Sea turtles	Behavioral responses such as avoidance; potential for auditory masking	None	3	1	3 Low
	Fishes	Behavioral responses such as avoidance; potential for auditory masking	None	3	1	3 Low

4.5.3 Noise Levels in Sensitive Habitats

As summarized in **Section 1.6.4**, there are no known sensitive habitats within 10 km downstream of the Tamar-12 Project Area or the proposed drill site. Tom and Kanari (2024) present an online mapper of offshore Israel, including previous benthic sampling events in the Tamar Field. Data presented in the mapper does not indicate any sensitive habitats in the vicinity of the Tamar Field. Furthermore,

benthic habitat maps prepared by the State of Israel (2021a) show that the deepwater offshore area in the vicinity of the Tamar Field does not have any sensitive habitats present.

As noted in **Section 4.1.1.1**, no protected areas, nature reserves, or culture and heritage sites are located within the area of impact resulting from drilling and completion or subsea infrastructure installation operations. Given the distance of these sensitive habitats from the proposed Tamar-12 Project location, acoustic impacts are extremely unlikely.

Support vessels transiting between the Tamar-12 drill site and the shore base will generate noise during transit. Noise from support vessel transit is a combination of tonal and broadband sound (Richardson et al., 1995), with dominant frequencies typically between 5 Hz and 1 kHz and source levels typically in the range of 150 to 170 dB re 1 µPa m. Support vessels in transit generate continuous noise primarily from propeller cavitation, with other sources including onboard machinery and hydrodynamics of water flow. The noise produced by transiting vessels depends on several various factors, including the type of machinery on the vessel, vessel speed, and vessel condition (e.g., hull condition, shielding, etc.) (Center for Marine Acoustics, 2023). Transiting support vessels would have to pass in close proximity to sensitive habitats to produce noise-based impacts; the periodic nature of support vessel activity and the short-term duration of vessel trips near sensitive habitats, as well as relative proximity, suggests that the potential for noise-related impacts to sensitive habitats is very limited.

4.5.3.1 Noise at Bottom and Accumulated Noise Level

During production drilling operations, noise will be generated by a variety of sources including support vessels transiting between the drilling location and the shore base; thrusters used in the dynamic positioning of the drillship; on-site support vessels using dynamic positioning; machinery, pumps, and generators located on the drillship or support vessels; and drilling operations. The dominant noise sources aboard a drillship are generally the vibrations and rotations of pumps, generators, engines, hydraulic winches, pipe-handling equipment, cranes, and other machinery on or below deck; these sounds are transmitted through the physical structure of the vessel (e.g., through the hull of drillships; through the pontoons and support legs of semisubmersibles) and into the water column; sound and vibration may also emanate from the drill string (Austin et al., 2018).

Limited research or measurements have been done to assess underwater noise levels from exploratory or production drilling (McCauley, 1998; Blackwell et al., 2004; Kyhn et al., 2014; Kent et al., 2016; Center for Marine Acoustics, 2023). Most of these noise sources originate at the ocean surface; measurements at the seafloor (e.g., at the wellbore) are very limited (i.e., Kent et al., 2016; Austin et al., 2018; Erbe and McPherson, 2017).

According to Kent et al. (2016), the major sources of noise during an offshore exploratory or production drilling operation are associated with three primary sources, including 1) ground vibrations created at the sediment-water interface; 2) mechanical vibration of the drill string in the water (i.e., along the entire length of the drill string); and 3) noise transmitted from the drilling rig. Ground vibrations created during drilling produce compressional and shear waves that are transmitted through the seafloor which are transformed into sound in the water column at the sediment-water interface. Mechanical vibrations from the drill string radiate sound directly into the water column. Measurements of drilling-related sound at depth are scarce. Shallow water drilling operations conducted for an offshore wind farm installation off northern Wales produced an SPL of 135 dB re 1 µPa measured at 160 m from the drilling platform (Nedwell et al., 2003). Similar or lower sound source levels may be expected from production drilling operations in deepwater at the Tamar-12 drill site.

Austin et al. (2018) reported on drilling vessel noise for various operations in the Chukchi and Beaufort seas. The highest broadband (10 Hz to 32 kHz) source level during drilling was measured from the drillship *Discoverer* operating in the Chukchi Sea (174.9 dB re 1 µPa m). The

semisubmersible drilling unit *Polar Pioneer* drilling in the Chukchi Sea exhibited a lower source level (170.1 dB re 1 µPa m), while the ice-strengthened drilling barge *Kulluk* operating in the Beaufort Sea exhibited the lowest broadband source level of the rigs measured (168.6 dB re 1 µPa m).

Erbe and McPherson (2017) recorded the underwater noise from the jack-up rig Sideson II during geotechnical drilling and standard penetration testing, both of which generate noise levels which are considered to be less than those produced during exploratory or production drilling. Measured noise levels for each activity were 145 and 142 dB re 1 µPa m, respectively, with frequencies ranging between 30 Hz and 2 kHz.

For the current analysis of drilling-related noise, the majority of the noise originates from onboard equipment noise with some minimal sound transmitted via vibrations of the drill string as well as interactions with the seafloor resulting in some substate vibrations. **Table 4-12** summarizes the source levels of several drilling units and the calculated attenuation of sound reaching the seafloor, at a depth of 1,670 m and assuming spherical spreading (i.e., 20logR).

Table 4-12. Calculations of received sound levels at the seafloor from drilling-related noise.

Vessel	Source Level (dB re 1 µPa, SPL)	Received Level at the Seafloor (dB re 1 µPa, SPL)	Source Level Source
Various	177	112	Richardson et al., 1995
Polar Pioneer	170	106	Austin et al., 2018
Unnamed	155.9	91	Huang et al., 2023

Drilling-related noise undergoes significant attenuation with increasing depth. Source levels at the surface, ranging from 155.9 to 177 dB re 1 µPa m, expressed as SPL, diminish to between 91 and 112 dB re 1 µPa m, SPL at the seafloor 1,670 m below the source. **Figure 4-4** depicts sound level decay with increasing distance (range) from the source for three different drilling vessels.

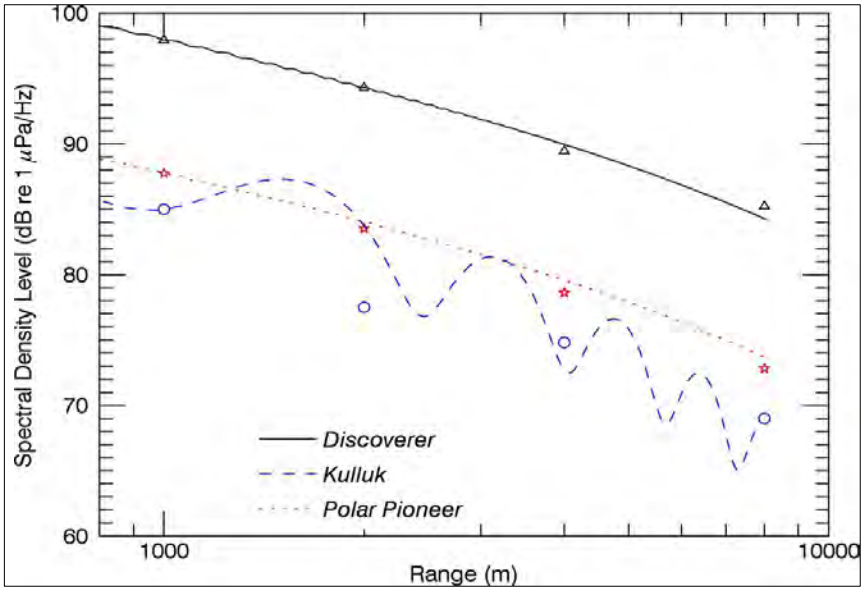


Figure 4-4. Measured spectral density levels at 20 Hz for various drilling rigs (*Discoverer*, Δ, solid line; *Kulluk*, ☼, dotted line; *Polar Pioneer*, ○) during drilling showing modeled sound level decay with range (From: Austin et al., 2018).

Accumulated sound exposure levels at the seafloor from drilling operations are summarized in **Table 4-13**, assuming actual drilling operations requiring 24 days (i.e., remaining time for drilling operations consisting of cementing or running casing operations).

Table 4-13. Calculated accumulated sound levels at the seafloor from drilling operations.

Vessel	Source Level (dB re 1 µPa m, SPL)	Accumulated Sound Exposure Level (dB re 1 µPa s^2) over 24 days	Source Level Source
Polar Pioneer	170	233	Austin et al., 2018
Unnamed	155.9	219	Huang et al., 2023

Accumulated sound levels are expected to range from 219 to 233 dB re 1 µPa s^2 at the seafloor for the 24 days during which actual drilling will occur.

Installation of the subsea infrastructure will produce sound from installation and support vessels only. No significant sounds are expected from installation activities at the seafloor.

4.5.4 Noise Assessment Instructions

The summary information provided in **Sections 4.5.1** through **4.5.3** complies with the requirements and guidelines outlined in ISO 18405:2017.

4.6 NATURAL VALUES AND ECOLOGY

4.6.1 Impact on Habitats

4.6.1.1 Impacts of Seafloor Disturbance

4.6.1.1.1 Impacts on Sediment Quality and Benthic Communities

Because a DP vessel will be used for drilling and completion, there will be no anchoring. DP-based drilling operations disturb only a very small area of the seafloor around the drill site where the bottom template and wellbore are located; in general, the area normally disturbed by drilling activity has been estimated to be 2,500 m^2 or less (BOEM, 2012). Drilling discharges at the wellbore will also affect local sediment quality and soft bottom benthic communities present in close proximity to the drill site.

For Tamar-12, the area around the drill site will be affected by the deposition of WBM and associated cuttings. Significant deposition of WBM and cuttings will occur at and close to the wellbore (i.e., within 20 to 25 m of the wellsite), where muds and cuttings deposition will range from several centimeters to a meter or more; the seafloor affected within 25 m of the wellsite represents an area of approximately 1,964 m^2. WBM deposition patterns may also be expected at radial distances of 250 to 500 m from the drill site, based on Ba tracers observed during post-drill monitoring surveys, resulting in a deposition area of between 196,350 m^2 at 250 m to 785,398 m^2 at 500 m. The majority of this area will potentially receive very minor amounts of WBM muds and cuttings. Further discussion regarding barium tracers is presented in **Section 4.1.5**.

As described in **Section 4.1.7**, approximately 2,032 m^2 of seafloor will also be disturbed during installation of subsea infrastructure. This disturbance is attributed to emplacement of jumpers, IJS and umbilical, etc.

The maximum total seafloor area affected by subsea infrastructure emplacement and initial WBM and cuttings deposition is expected to range from 196,350 to 785,398 m^2, with further qualification regarding biologically significant deposition thresholds outlined below.

The area affected by subsea infrastructure (2,032 m^2) will be encompassed within the area affected by WBM and cuttings deposition. Benthic organisms in the footprint and immediate vicinity of the drill site and installed subsea infrastructure will be crushed or buried. Drilling muds and cuttings with a thickness greater than 6.3 mm, the predicted no effect concentration (PNEC) threshold for benthic

species that are sensitive to sediment deposition, have been primarily identified in the Tamar Field at distances up to 55 m from the wellhead, though it is possible that such drilling muds and cuttings could extend up to distances of 75 m (see **Section 3.6.2.3**). Drilling muds and cuttings with a thickness of 6.3 mm or greater could smother the surficial sediment layer, impacting benthic communities and affecting localized oxygen diffusion. At a radial distance of 75 m from the Tamar-12 drill site, the area affected by WBM and cuttings deposition with concomitant effects to local benthic communities, is 17,671 m^2.

As discussed in **Section 1.6.1**, only soft bottom benthic communities are present at and near the drill site and along the route of the subsea infrastructure, and the types of communities are broadly similar throughout the Tamar Field (and presumably ubiquitous in similar water depths in the region). There are no known unique or sensitive benthic communities in the area of impact. Impacts on sediment quality and benthic communities from seafloor infrastructure installation activities are evaluated as negligible.

4.6.1.1.2 Impacts on Water Quality

During drilling and completion operations, the seafloor at the Tamar-12 drilling location will be disturbed. Physical disturbance will result from drilling and wellhead emplacement, and installation of the umbilical and other seafloor infrastructure. Local water quality will be affected by these installation operations via mobilization of surficial sediments and subsequent increases in local turbidity and potential mobilization of sediment-bound contaminants.

The seafloor will also be disturbed via deposition of WBM near the wellbore. The total area affected via drilling and completion activities per well, including drilling muds and cuttings deposition, is summarized in **Appendix I**. Additional discussion of muds and cuttings deposition is presented in **Section 4.1**. Impacts to water quality will occur in the immediate vicinity of drilling and completion operations, installation of infrastructure, and within the deposition field for the discharge of WBM muds and cuttings from the Tamar-12 well.

4.6.1.1.3 Mitigation Measures

No mitigation measures are recommended for seafloor disturbance due to the unavoidable nature of the impact. CML will conduct a post-drilling survey at the drill site to ensure that the seafloor is clear of equipment and debris from drilling and completion activities. No rehabilitation or restoration of benthic habitats is recommended due to the low level of residual impact. The affected area will eventually recover through larval settlement and migration of benthic organisms from adjacent areas.

4.6.1.1.4 Impact Significance

Impact significance for seafloor disturbance is summarized in **Table 4-14**. The consequence of potential impacts to sediment quality, benthic communities, and water quality is insignificant (1) due to the small area affected around the drill site/installation location and the temporary period of water quality degradation. In evaluating likelihood for impacts, a 100-m mixing zone was assumed around the drillship (i.e., it is referring to the likelihood of impacts occurring beyond the mixing zone). The impacts are rated as possible (3) and the residual risk is assessed as Low.

Table 4-14. Summary of potential impacts from seafloor disturbance.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Seafloor disturbance	Sediment quality	Physical disruption and resuspension of sediments	None	3	1	3 Low
	Benthic communities	Localized burial and crushing of individual organisms; areal extent within 75 m or less of the drill site from WBM and cuttings deposition and from seafloor infrastructure installation	None	3	1	3 Low
	Water quality	Mobilization of local sediments, potential mobilization of sediment-bound contaminants, deposition of muds and cuttings	None	3	1	3 Low

In evaluating likelihood for sediment quality and benthic impacts, a 100-m mixing zone was assumed around the drillship (i.e., it refers to the likelihood of impacts occurring beyond this radius).

4.6.1.2 Impacts of Drilling Discharges

4.6.1.2.1 Discharge Characteristics

Drilling discharge quantities and components have been summarized in **Section 3.6**. CML plans to drill the new Tamar-12 well using a combination of WBM and MOBM. The first two initial well intervals (before the marine riser is set) are expected to be drilled using WBM and the cuttings, as well as excess cement, would be released at the seafloor. Once the marine riser is set allowing mud and cuttings to be returned to the drillship, the remaining well intervals would be drilled with MOBM. Cuttings from MOBM well intervals will be shipped to shore and not discharged to the sea.

Pre-commissioning discharges will also be released from subsea infrastructure, as detailed in **Section 3.6.1.6**.

4.6.1.2.2 Modeling of Drilling Discharges Fate

Drilling discharges were modeled by Applied Science Associates (ASA; now part of TetraTech) using a representative drill site location (**Appendix I**) for the 2016 Tamar EIA (CSA, 2016). Those results remain relevant for discharges that will occur during drilling of the Tamar-12 Project well. The modeling was conducted using the model and the input data included the comparable well intervals and discharge quantities, site-specific current data, and particle size data from CML for MOBM well cuttings treated in a thermomechanical cuttings cleaner (TCC) unit.

It should be noted that since the initial modeling was conducted, CML no longer plans to discharge treated MOBM-drilled well cuttings; all MOBM-drilled well cuttings, including minor amounts of adhering MOBM, will be shipped to shore. Therefore, the actual muds and cuttings discharge areal extent and thickness will be substantially less than modeled, with muds and cutting discharges occurring exclusively at the seafloor and centered around the wellbore. Two seasonal scenarios were modeled: winter (December to February), and summer (July to September). Drilling discharges from seafloor release of WBM in the initial well intervals will largely be limited to within tens of meters of the Tamar-12 drill site in thicknesses >6.3 mm. Detailed methods and results for the muds and cuttings dispersion modeling are presented in **Appendix I**.

Modeling results are summarized in **Figures 4-5** and **4-6**. The areal extent of thickness contours is summarized in **Tables 4-15** and **4-16**.

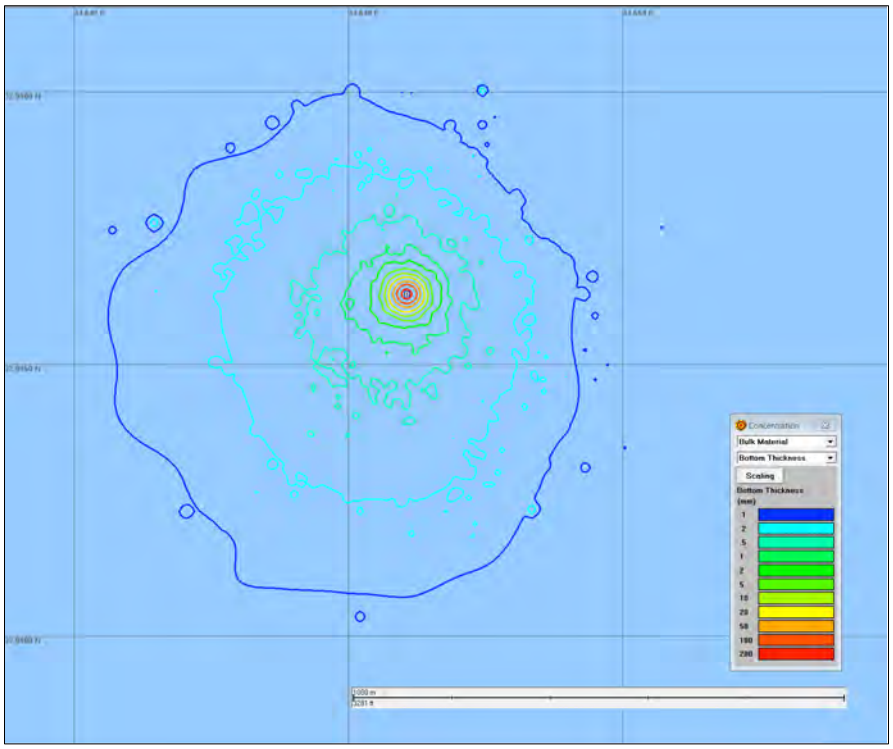


Figure 4-5. Cumulative deposition thickness for drilling discharges from a representative drill site for the winter (December to February) scenario.

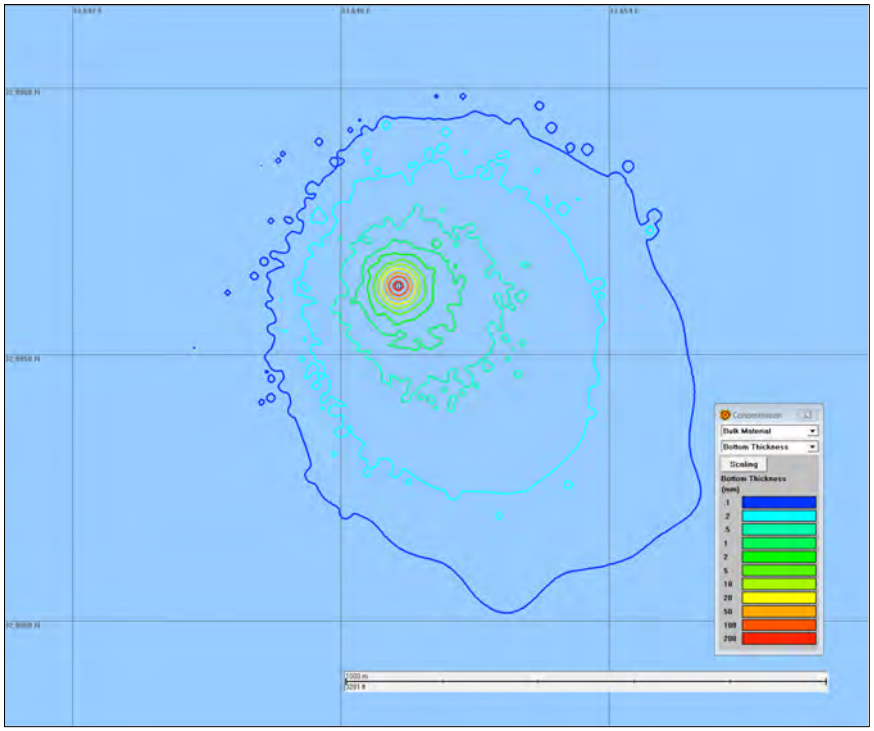


Figure 4-6. Cumulative deposition thickness for drilling discharges from a representative drill site for the summer (July to September) scenario.

Table 4-15. Areal extent of seafloor deposition of drilling discharges for two seasonal scenarios at a representative drill site. Burial thresholds (6.3 mm is the burial thickness affecting 5% of benthic species; 54 mm is the median burial thickness affecting 50% of benthic species) from Smit et al. (2008) are in bold.

Table 4-16. Maximum extent of thickness contours resulting from drilling discharges for two seasonal scenarios at a representative drill site. Burial thresholds (6.3 mm is the burial thickness affecting 5% of benthic species; 54 mm is the median burial thickness affecting 50% of benthic species) from Smit et al. (2008) are in bold.

The key findings of the modeling can be summarized as follows:

4.6.1.2.3 Potential Impacts on Water Quality and Fishes

During the two initial well intervals, releases of WBM and cuttings at the seafloor will produce turbidity in near-bottom waters. The turbidity plume will be carried away from the well by near-bottom currents and may be detectable within tens to hundreds of meters of the wellbore. As resuspended sediments settle to the seafloor, the water clarity will return to background conditions within minutes to a few hours after discharges cease. The duration of these two well intervals is brief (approximately 6.5 days total per well).

Discharges of WBM and cuttings are expected to cover an area of approximately 17,671 m^2 at a thickness of 6.3 mm or greater, with a larger area realizing deposition thicknesses between 6.3 mm and 0.01 mm (i.e., approximately 0.20 to 0.79 km^2 at 250 to 500 m radial distances, respectively), as outlined in **Section 4.6.1.1.1**. During muds and cuttings deposition, benthic fishes will be displaced by turbidity. Minor losses of benthic (epifaunal and infaunal) food items would also occur due to burial by muds and cuttings.

No MOBM is planned to be discharged to the sea. The cuttings from the production hole section using MOBM will be shipped to shore. Therefore, there will be no impact to water quality or fishes from MOBM drilling operations and potential discharges.

4.6.1.2.4 Potential Impacts on Sediment Quality and Benthic Communities

During the two initial well intervals, releases of WBM and cuttings at the seafloor will create a mound with a diameter of several meters to tens of meters around the wellbore. Also, during setting of the casing, cement slurry will be pumped into the well to bond the casing to the walls of the hole. Excess cement slurry will emerge from the hole and accumulate on the seafloor, typically within 10 to 15 m around the wellbore (Shinn et al., 1993). Cement slurry components include cement mix and some of the same chemicals used in WBM (Boehm et al., 2001). These releases will alter the sediment quality near the well location. Sediments will eventually return to baseline conditions due to normal sediment movement, remixing of sediments by benthic organisms, and sediment deposition from the water column.

The main benthic impacts during the initial two well intervals will be the burial and smothering of benthic organisms within several meters to tens of meters around the wellbore. WBM can also cause oxygen depletion in near-surface sediments (Trannum et al., 2006; Schaanning et al., 2008a,b). Soft bottom sediments disturbed by cuttings, drilling mud, and cement slurry will eventually be recolonized through larval settlement and migration from adjacent areas. The deposition of muds and cuttings particles can prompt tube building and burrowing activity of indigenous fauna in response to this short-term disturbance of the sediment surface (Trannum et al., 2010).

MOBM-wetted drill cuttings will be collected on the drillship and sent to either an onshore recycling facility or to a landfill capable of handling hazardous wastes. No MOBM or MOBM-wetted cuttings will be discharged to the sea.

The cuttings discharge modeling predicts that deposition of discharged cuttings (WBM-wetted only) will occur in all directions around the drill site, but primarily toward the southeast (**Figures 4-5** and **4-6**). Deposition of WBM and cuttings will extend several hundred meters from the Tamar-12 drill site, however, significant deposition of 6.3 mm or greater (e.g., for impacts to benthic communities, discussed below) is only expected to occur with 75 m of the drill site (**Table 4-16**). Although the initial muds and cuttings dispersion modeling considered both WBM and MOBM discharges, only WBM releases are considered in this analysis (i.e., no MOBM cuttings discharges will occur).

Benthic community effects of drilling discharges have been reviewed extensively (National Research Council, 1983; Neff, 1987, 2005, 2010; Bakke et al., 2013). Due to the low toxicity of most drilling fluids, the main mechanism of impact to benthic communities is increased sedimentation, resulting in burial or smothering. Most benthic fauna live in the upper few centimeters of offshore, fine-grained sediments, with benthic communities composed of varying feeding guilds – filter feeders, surface deposit feeders, subsurface deposit feeders, and carnivores. Deposit feeders, in particular, are recognized for their ability to process/ingest or move sediment during tube building and feeding (i.e., bioturbation). The maximum depth of bioturbation is in the range of 4 to 5 cm for most infauna, although larger infaunal burrowers are known to extend 20 cm or more into the sediment. Infaunal feeding guilds are important in determining impacts from sediment deposition (i.e., filter feeding species are highly susceptible to increased sedimentation compared to deposit feeders).

The potential impacts of cuttings deposition can be summarized based on a monitoring study conducted in the deepwater Gulf of Mexico (Continental Shelf Associates, Inc., 2006). Areas of cuttings deposition within approximately 500 m of drill sites were associated with elevated organic carbon concentrations and anoxic conditions. Affected areas had patchy zones of disturbed benthic communities, including microbial mats, areas lacking visible benthic macroinfauna, zones dominated by pioneering stage assemblages, and areas where surface-dwelling species were selectively lost. Infaunal and meiofaunal densities generally were higher near drilling, although some faunal groups were less abundant near drill sites. Some stations near drilling had lower diversity, lower evenness, and lower richness indices compared with stations farther away from drilling. Some stations affected by drilling were dominated by high abundances of one or a few deposit-feeding species, including known pollution indicators.

A thickness of 6.3 mm has been proposed by Smit et al. (2008) as a PNEC threshold for benthic species that are sensitive to sediment deposition. The model predicts that deposition having a thickness of 6.3 mm or more would affect approximately 0.008 km^2 around the Tamar-12 drill site under either scenario and would extend approximately 54 to 55 m from the discharge point, occupying an area of 9,503 m^2. The total area receiving this deposition thickness from the Tamar-12 well would be 0.0095 km^2, or approximately 0.0095% of the seafloor area in the Tamar Field (100 km^2). In a conservative approach, a radial distance of 75 m may be expected for the 6.3 mm threshold; under this assumption, the total area receiving a thickness of 6.3 mm or greater would be 17,671 m^2 (0.017 km^2), approximately 0.017% of the seafloor in the Tamar Field.

A thickness of 54 mm has also been proposed as a “median” impact threshold for burial of soft-bottom benthic organisms (Smit et al., 2008). The model predicts that deposition having a thickness of 54 mm or more would affect approximately 0.002 km^2 around the drill site under either scenario and would extend approximately 27 m from the release point. The total area receiving this thickness of deposition from the new well to be drilled under the Tamar-12 Project would be 0.006 km^2, or approximately 0.006% of the seafloor area in the Tamar Field blocks (100 km^2).

The new proposed well is more than 100 m from other Tamar wells and therefore there should be no potential for a significant cumulative deposition of muds and cuttings.

The benthic communities around the Tamar-12 drill site are expected to consist of soft bottom organisms. Soft bottom areas buried by cuttings will eventually be recolonized through larval settlement and migration from adjacent areas. Recovery may require several years (Neff et al., 2000; Continental Shelf Associates, Inc., 2004, 2006) and is dependent on the nature of the indigenous fauna, their tolerance to burial, life history characteristics (e.g., spawning and settlement characteristics), and their relative abundance in the deposition area.

4.6.1.2.5 Mitigation Measures

The following mitigation measures are included in CML's plan:

- Cuttings from MOBM well intervals will be collected on the drillship and not discharged to the sea.
- A background monitoring survey has been conducted and confirms that there are no deepwater coral communities or other hard bottom communities near the proposed drill site (**Appendix K**).
- Simulation modeling has been conducted (at a comparable site, with a similar drilling program) to evaluate the potential deposition of drill muds and cuttings on the seafloor around the Tamar-12 drill site (**Appendix I**). The modeling confirms that a relatively small area of seafloor the drill site will receive deposits sufficiently thick to cause burial or smothering of benthic organisms.

4.6.1.2.6 Impact Significance

The significance of impacts from drilling discharges is summarized in **Table 4-17**. The consequence of potential impacts is insignificant (1) for water quality and fishes, and minor (2) for sediment quality and benthic communities. In evaluating likelihood for impacts, a 100-m mixing zone was assumed around the drillship (i.e., it refers to the likelihood of impacts occurring beyond this radius). Likelihood is rated almost certain (5) for water quality and fishes, and likely (4) for sediment quality and benthic communities. The residual risk is rated as Moderate in all cases.

Table 4-17. Summary of potential impacts of drilling discharges on nature and ecology.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Drilling discharges	Water quality; fishes	Turbidity within a few tens of meters to a few kilometers discharge location (i.e., at the wellbore) Limited displacement of benthic/demersal fishes around the wellbore from turbidity and WBM and cuttings deposition	• Selection of low-toxicity MOBM • No discharge of MOBM or MOBM-wetted cuttings • Preferably, all additives to the WBM/Brine will be PLONOR or Gold-rated according to OSPAR guidelines; barite will have a low metals concentration and will comply with the Discharge to Sea Permit thresholds for mercury and cadmium; WBM and brine will be tested in accordance with Discharge to Sea Permit requirements • Drilling mud samples will be taken for every drilling section in compliance with Discharge to Sea Permit requirements, including the periodic toxicity testing of drilling muds during drilling • Surface waters in the vicinity of the drillship shall be visually monitored for oil sheen on a daily basis	5	1	5 Mod
	Sediment quality	Deposition of WBM and cuttings particles on the seafloor, causing changes in grain size and mineralogy	• No discharge of MOBM or MOBM-wetted cuttings	4	2	8 Mod
	Benthic communities	Localized burial and smothering of benthic organisms; burial impacts are most likely within 75 m of the drill site; anoxia and other benthic impacts may occur due to changes in sediment grain size.	• Background monitoring survey conducted to verify there are no deepwater sensitive habitats	4	2	8 Mod

In evaluating likelihood for impacts, a 100-m mixing zone was assumed around the drillship (i.e., it refers to the likelihood of impacts occurring beyond this radius).
MOBM = mineral oil-based mud.

4.6.1.3 Impacts of Routine Discharges

Routine discharges from the drillship (exclusive of drilling muds and cuttings), installation vessel, and various support vessels will include sanitary waste, grey water, organic (food) waste, cooling water, desalination brine, and deck drainage (see **Section 3.6.1**). All discharges will comply with the appropriate requirements of MARPOL Annex I (oil pollution prevention), Annex IV (sewage pollution prevention), and Annex V (garbage pollution prevention) as well as the applicable Discharge to Sea Permit. Specific treatment processes are detailed in **Section 3.6.1.2** for individual waste streams.

Pre-commissioning discharges were outlined in **Section 3.6.1.6**. During the subsea infrastructure testing and pre-commissioning, MEG and tracer dye will be used to prepare the subsea equipment for commissioning (see **Table 3-8**). If possible, these chemicals will be classified as Gold under the Offshore Chemical Notification Scheme (OCNS) classification, which indicates that they present a relatively low hazard to the environment. Final chemical selection will be made during the detailed design phase of the project and submitted to MoEP approval as part of the Discharge to Sea Permit application. Total pre-commissioning volumes of MEG to be discharged are estimated to be 20 m^3.

4.6.1.3.1 Impacts on Water Quality and Fishes

Sanitary and grey water as well as organic food waste from the drillship, installation vessel, and support vessels may affect concentrations of suspended solids, nutrients, and chlorine as well as generating biochemical oxygen demand. Sanitary waste will pass through an IMO-approved sewage treatment plant prior to discharge. Grey water will be discharged without treatment while food waste will be macerated to pass through a 25-mm mesh in accordance with MARPOL requirements. Cleaning agents used on the drillship that end up in discharged grey water will be compatible with usage in the marine environment. These discharges are expected to be diluted rapidly in the open sea (BOEM, 2012). Impacts to water quality would likely be undetectable beyond 100 m from the source and impacts on fishes or other water column organisms are unlikely due to the intermittent and transient nature of the water quality impacts.

Cooling water and desalination brine are discharges that do not contain added chemicals or contaminants other than the potential for anti-corrosives or anti-scaling agents. The discharges may have localized impacts on water temperature and salinity near the discharge point. It is expected that these discharges would be rapidly diluted and impacts to water quality would likely be undetectable beyond 100 m from the source. Impacts on fishes or other water column organisms are unlikely due to the intermittent and transient nature of water quality impacts.

Deck drainage consists mainly of runoff (rainwater) that falls on the decks of the drillship, installation vessel, and support vessels. Drainage from machinery areas will pass through an OWS prior to discharge or be retained on board to be disposed of onshore. It is expected that deck drainage, once treated and discharged, would be diluted rapidly in the open ocean and will produce no sheen on the water surface. No impacts on fishes or other water column organisms are expected.

Ballast water discharges can result in the introduction of alien invasive species (AIS) (IMO, 2004; IPIECA and International Association of Oil & Gas Producers [OGP], 2024). The introductions can occur when vessels are moved from another geographic location. AIS introduced in ballast water can have a variety of environmental and economic impacts, such as competing with or preying upon native species, decreasing biodiversity, fouling fishing nets, and clogging water systems (Lovell and Stone, 2005; IPIECA and OGP, 2024). CML will operate in accordance with the guidelines developed by IPIECA and OGP (2024), which recommend specific measures to increase awareness of AIS risks and to prepare and plan for, avoid, and monitor for such impacts throughout the project life cycle. The drillship and installation vessel will have a Ballast Water Management Plan and will be equipped with an IMO-approved ballast water management system to minimize the potential for introducing AIS. The water depth, soft bottom substrate, and distance from shore of the Tamar Field are factors that make it unlikely for AIS from ballast water to become established in the region. Some AIS require

hard bottom substrate and will not become established in a soft bottom environment. Due to the distance from shore, any species associated with the drillship are unlikely to reach Israeli coastal waters.

Routine discharges from the drillship, installation vessel, and support vessels will produce minimal effects to plankton and fishes which may pass through the discharge plume; marine mammals and sea turtles are expected to avoid routine discharges. These discharges have no toxic components and will rapidly dilute within meters or tens of meters from the discharge location.

Pre-commissioning discharges may result in localized changes in water quality and potential exposure to fishes and plankton in the vicinity of the discharge. With discharges occurring at depth (e.g., from the jumper or manifold), only demersal/benthic fish species may be affected. Rapid dilution of the MEG and dye discharge is expected with only localized impacts expected.

4.6.1.3.2 Impacts on Marine Mammals and Sea Turtles

Routine discharges from the drillship, installation vessel, or support vessels associated with activities in the Tamar Field and along transit corridors to shore include sanitary and domestic wastes, food waste, deck drainage, cooling water, etc. During the drilling of the Tamar-12 well, drilling muds and cuttings will be discharged only at the seafloor, and only for the initial sections of each well; no on-site discharge of MOBM will occur. Within the open ocean environment of the Tamar Field, discharged fluids will rapidly disperse and dilute in local currents. Therefore, it is not likely that marine mammals or sea turtles will encounter discharged materials in concentrations that would cause significant impacts.

Pre-commissioning discharges of MEG and dye will occur at depth (e.g., from the jumper or manifold). Rapid dilution of the MEG and dye discharge is expected, therefore, the potential for exposure to marine mammals and sea turtles is extremely low.

4.6.1.3.3 Mitigation Measures

The drillship, installation vessel, and support vessels will comply with MARPOL Annex I (oil pollution prevention), Annex IV (sewage pollution prevention), and Annex V (garbage pollution prevention). Individual waste streams are detailed in **Section 3.6.1** and summarized briefly here:

- Sanitary waste will pass through an IMO-approved sewage treatment plant prior to discharge.
- Grey water will be discharged without treatment.
- Food waste will be macerated to pass through a 25-mm mesh in accordance with MARPOL Annex V requirements, commingled with the grey water and discharged overboard more than 12 nmi from shore.
- Cooling water, desalination brine, and deck drainage from non-hazardous areas will be discharged without treatment. Drainage from hazardous areas will be collected and sent to shore for proper disposal.
- Bilge water and deck drainage from machinery areas will pass through an OWS prior to discharge (in accordance with MARPOL Annex I requirements) or be retained on board to be disposed of onshore.
- All discharges are expected to comply with CML's Discharge to Sea Permit requirements.
- CML will operate in accordance with the MoE guidelines for operating vessels in Israel in respect to AIS, which conform with the IPIECA guidelines and IMO Resolution MEPC.207(62). All operating project vessels will provide the following documentation for AIS clearance to minimize the risk of introducing AIS: Declaration letter with working areas in the past 5 years, Ballast Water Management Plan and international Ballast Water Management Certificate, International Anti-fouling System certificate and haul cleaning reports.

4.6.1.3.4 Impact Significance

Potential impacts of other discharges are summarized in **Table 4-18**. The consequence of potential impacts is insignificant (1), except for potential impacts from pre-commissioning MEG and tracer dye discharges, which are rated minor (2). In evaluating likelihood for impacts, a 100-m mixing zone was assumed around the drillship, installation vessel, and support vessels (i.e., it refers to the likelihood of impacts occurring beyond this radius). The likelihood is rated as possible (3) and the residual risk for water quality, fishes, and benthic communities is assessed as Low. For MEG and tracer dye discharges, the likelihood is rated as likely (4), resulting in a residual risk for water quality, fishes, marine mammals, and sea turtles of moderate (8).

Table 4-18. Summary of potential impacts of other discharges on nature and ecology.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Other discharges (sanitary and grey water, food waste, cooling water, desalination brine, deck drainage)	Water quality; fishes and plankton; marine mammals; sea turtles	Localized, transient impacts on water quality within a few meters to a few hundred meters of drillship or other vessels Limited, localized impacts to plankton and fishes encountering the discharge plume; avoidance expected by marine mammals and sea turtles	• Sanitary waste will pass through an IMO-approved sewage treatment plant prior to discharge • Food waste will be macerated to pass through a 25 mm mesh in accordance with MARPOL Annex V requirements, commingled with the grey water and discharged overboard more than 12 nmi from shore • Drainage from hazardous areas will be collected and sent to shore for proper disposal • Bilge water and deck drainage from machinery areas will pass through an oil-water separator prior to discharge (in accordance with MARPOL Annex I requirements) or be retained on board to be disposed of onshore	3	1	3 Low

Table 4-18. (Continued).

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Other discharges (sanitary and grey water, food waste, cooling water, desalination brine, deck drainage) (cont'd)	Continued from above	Continued from above	• All operating project vessels will provide the following documentation for AIS clearance to minimize the risk of introducing AIS: Declaration letter with working areas in the past 5 years, Ballast Water Management Plan and international Ballast Water Management Certificate, International Anti-fouling System certificate and haul cleaning reports	3	1	3 Low
Pre-commissioning fluid discharges (including MEG and dye)	Water quality; fishes; marine mammals; sea turtles	Localized, transient impacts on water quality; limited potential for exposure for demersal/ benthic fishes and benthic communities; no potential for exposure for marine mammals and sea turtles	• Preferably, all pre-commissioning and preservation fluids will be PLONOR or Gold-rated under the Offshore Chemical Notification Scheme	4	1	4 Mod
Other discharges (ballast water)	Fishes; benthic communities	Potential introduction of AIS in ballast water	• CML will operate in accordance with guidelines developed by IPIECA 436 and IMO Resolution MEPC.207(62) to increase awareness of AIS risks and to prepare and plan for, avoid, and monitor for such impacts throughout the project life cycle. Vessels will have a Ballast Water Management Plan and be equipped with an IMO-approved ballast water management system	3	1	3 Low

AIS = alien invasive species; IMO = International Maritime Organization; MARPOL = International Convention for the Prevention of Pollution from Ships. In evaluating likelihood for impacts, a 100-m mixing zone was assumed around the drillship (i.e., it refers to the likelihood of impacts occurring beyond this radius).

4.6.1.4 Impacts of Vessel Traffic

Vessel traffic during the drilling program will include routine support vessel trips between the shore base in Haifa and the project area. The drilling program will be supported by three MMC 87 Class platform support vessels or similar as explained in **Section 3.2.2.1**. Each support vessel is expected to make four one-way trips (i.e., two round-trips) per week during drilling and completion. Support vessels may disturb marine mammals or turtles, and there is a small possibility of a vessel striking a marine mammal or sea turtle. Additional vessel trips will occur during the subsea installation operations, including those from the subsea infrastructure installation vessel and support vessels. It is likely that the subsea installation vessel will operate out of Cyprus.

The movements of the drillship and installation and support vessels, including initial mobilization, movements to and from the Tamar-12 drill site (as appropriate), and demobilization at the end of the program, could also disturb marine mammals or sea turtles. However, these vessels are expected to pose little risk of vessel strikes because of their slow speed. A DP drillship would mobilize to the Tamar Field under its own power. Any noise-related disturbance would be similar to existing vessel traffic in the region.

4.6.1.4.1 Impacts on Marine Mammals

Many marine mammal species are vulnerable to collisions with moving vessels (ship strikes) (Laist et al., 2001; Douglas et al., 2008; Pace, 2011). Most reports of collisions involve large whales; most dolphins are agile swimmers, but vessel strikes have been reported for them as well (van Waerebeek et al., 2007). Of the 11 marine mammal species known to have been hit by vessels in the Eastern Mediterranean Sea, fin whales are struck most frequently, and sperm whales are commonly hit (Laist et al., 2001). Although all sizes and types of vessels can collide with whales, most lethal or severe injuries are caused by ships 80 m or longer and traveling 14 knots or faster (Laist et al., 2001).

Vessel strikes are among the threats affecting the population status of both humpback and sperm whales (NMFS, 1991, 2010). Sperm whales are vulnerable to ship strikes because they typically spend up to 10 minutes “rafting” at the surface between deep dives (Jacquet et al., 1998). There have been many reports of sperm whales of different age classes being struck by vessels, including passenger ships and tugboats. There were also instances in which sperm whales approached vessels too closely and were injured by propellers (NMFS, 2010).

4.6.1.4.2 Impacts on Sea Turtles

Vessel strikes are among the threats affecting the endangered population status of several sea turtle species (National Research Council, 1990). The risk of striking a sea turtle during the drilling program is similar to that associated with existing vessel traffic in the region. Studies indicate that sea turtles are at the sea surface approximately 10% of the time and readily sound (dive) to avoid approaching vessels (Byles, 1989; Lohoefener et al., 1990; Keinath and Musick, 1993; Keinath et al., 1996).

The likelihood of a support vessel striking a sea turtle is low. The most likely impacts would be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area.

4.6.1.4.3 Mitigation Measures

No mitigation measures are recommended for vessel traffic. Support vessel operators are expected to follow all applicable maritime navigation rules and would normally follow the most direct route (weather conditions permitting) between the drill sites and the shore base. Support vessels are expected to use existing routes into port including well-traveled shipping lanes. Vessel operators normally maintain a watch for obstructions during transit and will not deliberately approach a whale or turtle.

4.6.1.4.4 Impact Significance

Potential impacts of support vessel traffic on marine mammals and sea turtles are summarized in **Table 4-19**. The likelihood of the aspect is rated possible (3); although the vessel trips are certain to occur, proximity sufficient to cause impacts is less likely. The consequence of potential impacts in most cases will be insignificant (1) on a population level. The residual risk is rated as Low.

Table 4-19. Summary of potential impacts of support vessel traffic.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Support vessel traffic	Marine mammals; sea turtles	Short-term behavioral disturbance; potential for a vessel to strike a marine mammal or sea turtle	• Voluntary use of trained vessel crew or observers to monitor for the presence of marine mammals or sea turtles during vessel transit	3	1	3 Low

4.6.1.5 Impacts of Helicopter Traffic

Helicopter support will be provided by a Sikorsky S-76C++ operated from Haifa Airport as explained in **Section 3.4.1**. The helicopter will make an estimated 10.5 trips per week between Haifa and the project area during drilling and completion activities.

Corporate policies for helicopter companies typically require a minimum altitude of 210 m during transit to and from a drillship and a minimum altitude of approximately 150 m while traveling between drillships or platforms (BOEM, 2012). In addition, helicopters are expected to follow Federal Aviation Administration (2004) Advisory Circular 91-36D or similar guidelines, which recommend a minimum altitude of 610 m when flying over noise-sensitive areas such as parks, preserves, and wildlife areas.

4.6.1.5.1 Impacts on Marine Mammals and Sea Turtles

Helicopter traffic has the potential to disturb marine mammals (Richardson et al., 1995, 1997; Patenaude et al., 2002). Reported behavioral responses of marine mammals are highly variable, ranging from no observable reaction to diving or rapid changes in swimming speed or direction (Efroymson et al., 2000; Smultea et al., 2008). Similarly, sea turtles may experience behavioral disturbance from helicopter noise. The duration of underwater sound from passing aircraft is much briefer in water than air; for example, a helicopter passing at an altitude of 152 m that is audible in air for 4 minutes may be detectable underwater for only 38 seconds at 3 m depth and for 11 seconds at 18 m depth (Richardson et al., 1995). Realistically, an individual animal's exposure to the sound from the helicopter would likely be occasional and transient as the helicopter moves between the shore base and the project area.

The most likely impacts on marine mammals and sea turtles from helicopter flights would be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area.

4.6.1.5.2 Impacts on Seabirds and Migratory Birds

Seabirds and migratory birds can be disturbed by helicopters, and there is a small possibility of a helicopter striking a bird. The most likely impacts would be short-term behavioral changes such as course changes or disruption of activities. Potential impacts on dense bird populations would be reduced by maintaining recommended minimum altitudes when flying over coastal habitats such as parks, wildlife refuges, and wilderness areas.

4.6.1.5.3 Mitigation Measures

Helicopters are expected to maintain company-recommended minimum altitudes when flying over the open ocean and sensitive habitats such as parks and preserves. This will minimize the potential for disturbing bird colonies along the coast. No additional mitigation measures are recommended.

4.6.1.5.4 Impact Significance

Potential impacts of helicopter traffic on marine mammals, sea turtles, and seabirds and migratory birds are summarized in **Table 4-20**. The likelihood of the aspect is rated possible (3); although helicopter trips are certain to occur, proximity sufficient to cause impacts is less likely. The consequence of potential impacts in most cases will be insignificant (1) at a population level. The residual risk is rated as Low.

Table 4-20. Summary of potential impacts of helicopter traffic.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Helicopter traffic	Marine mammals; sea turtles; seabirds and migratory birds	Short-term behavioral disturbance of marine mammals, sea turtles, or birds; potential for a helicopter to strike a bird	• Maintain recommended minimum altitudes when flying over sensitive coastal habitats such as parks and preserves	3	1	3 Low

4.6.1.6 Impacts of Marine Debris

CML's waste management procedures are discussed in **Section 3.7**. All wastes will be handled and disposed according to MARPOL requirements and permit requirements. However, there is the potential for solid waste to be accidentally lost overboard, resulting in marine debris in the water or on the seafloor (BOEM, 2012; BOEM, BSEE, and USEPA, 2023). The risk of solid waste being lost overboard will be minimized through the drillship operator's and the subsea installation contractor's Garbage Management Plan as required by MARPOL Annex V and the additional waste management requirements set by CML. Potential impacts of marine debris are discussed in the following subsections, and additional impact considerations for wastes are analyzed in **Section 4.9**.

4.6.1.6.1 Impacts on Water Quality, Sediment Quality, and Benthic Communities

Debris accidentally lost overboard could have impacts on water and sediment quality and benthic communities (National Research Council, 2008; BOEM, 2012; BOEM, BSEE, and USEPA, 2023). Heavy items such as welding rods, buckets, pieces of pipe, etc. may have a minor, localized impact on sediment quality beneath the drillship location by creating small areas of hard substrate on the soft bottom seafloor (Shinn et al., 1993; Gallaway et al., 2008). Lighter pieces of debris may float on the sea surface and adversely affect water quality and marine biota (National Research Council, 2008; NOAA, 2024). The potential impacts on water quality from marine debris are expected to be similar to those from the existing shipping and fishing industries.

4.6.1.6.2 Impacts on Marine Mammals and Sea Turtles

Materials accidentally lost overboard during offshore oil and gas operations could entangle marine fauna or cause injury through the ingestion of the debris (Laist, 1996). Marine debris is among the threats affecting the population status of both humpback and sperm whales (NMFS, 1991, 2010). Ingestion of or entanglement with accidentally discarded trash and debris can kill or injure sea turtles (Laist, 1996; Lutcavage et al., 1997). Marine debris is among the threats affecting the endangered population status of several sea turtle species (National Research Council, 1990). Leatherback turtles

are especially attracted to floating debris, particularly plastic bags because they resemble their preferred food: jellyfish. Ingestion of plastic and Styrofoam can result in drowning, lacerations, digestive disorders or blockage, and reduced mobility. The types of impacts on marine mammals and sea turtles from drilling-related marine trash and debris would be similar to those from existing shipping and fishing industries.

4.6.1.6.3 Impacts on Fishes

During Tamar-12 Project activities, debris such as welding rods, buckets, pipe segments, and other materials may accidentally fall overboard. Dense, solid waste objects will fall to the seafloor where they will be colonized by epibiota and possibly small fishes. Seafloor debris could leach chemicals into the surrounding water potentially affecting local benthic organisms, including demersal fish species.

4.6.1.6.4 Impacts on Seabirds and Migratory Birds

Marine trash and debris could injure or kill birds that ingest or become entangled in it. The ingestion of plastic by seabirds and migratory birds can cause obstruction of the gastrointestinal tract, which can result in mortality (Laist, 1996). The types of impacts on marine birds from drilling-related marine trash and debris would be similar to those from the existing shipping and fishing industries.

4.6.1.6.5 Mitigation Measures

The risk of solid waste being lost overboard will be minimized through the drillship operator's Garbage Management Plan as required by MARPOL Annex V and the additional waste management requirements set by CML. CML will conduct a post-drilling ROV survey/inspection at the Tamar-12 drill site to ensure that the seafloor is clear of equipment and debris from drilling and completion activities.

4.6.1.6.6 Impact Significance

Potential impacts of marine debris on marine mammals, sea turtles, and seabirds and migratory birds are summarized in **Table 4-21**. Existing waste management practices are expected to be effective and the release of marine debris into the environment is rated as unlikely (2) to possible (3). The consequence of potential impacts in most cases will be insignificant (1). The residual risk is rated as Low.

Table 4-21. Summary of potential impacts of marine debris.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Marine debris	Water quality; sediment quality; benthic communities	Potential accumulation of metal debris on the seafloor, with growth of fouling biota	• Drillship operator's and subsea installation contractor's Garbage Management Plan and the additional requirements set by CML will minimize the potential for accidental loss of items overboard • Post-drilling ROV survey to ensure the seafloor is clear of equipment and debris	2–3	1	2-3 Low
	Marine mammals; sea turtles; seabirds; migratory birds; fishes	Potential entanglement, ingestion; leaching of residual chemicals due to accidental loss of debris	• Drillship operator's Garbage Management Plan and the additional requirements set by CML will minimize the potential for accidental loss of items overboard	2–3	1	2-3 Low

4.6.2 Description of Rehabilitation

As noted in Section in **4.6.1.6**, CML will conduct a post-drilling ROV survey/inspection at the Tamar-12 drill site to ensure that the seafloor is clear of equipment and debris from drilling and completion activities.

4.7 CULTURE AND HERITAGE SITES

An archaeological assessment was conducted at the Tamar-12 drill site and along the subsea infrastructure corridor to be used during the Tamar-12 Project. The evaluation of the Tamar-12 drill site and environs (i.e., 2,000 m radius from the drill site) was based on review and evaluation of high-resolution geophysical data (i.e., multibeam bathymetry, side-scan sonar, sub-bottom profiler) acquired via autonomous underwater vehicle (AUV). The evaluation for the subsea infrastructure route covered a 300 m-wide corridor (i.e., 150 m either side of the proposed route) centered on the proposed 4,710 m-long Tamar manifold to Tamar-12 umbilical route, traversing the Tamar infield area from the existing Tamar manifold to the proposed Tamar-12 drill site location. Additional discussion and characterization of culture and heritage attributes in the project area is presented in **Section 1.8**. Key findings of these archaeological assessments included the following:

For the Tamar-12 drill site:

For the Tamar-12 subsea infrastructure:

4.7.1 Impacts of Seafloor Disturbance

All potential impacts of seafloor-disturbing activities are expected to be avoided.

4.7.2 Impacts of Drilling Discharges

No significant impacts are expected from drilling discharges. Identified targets from the analyses are modern in nature and do not reflect artifacts of cultural or heritage significance. Muds and cuttings dispersion modeling of drilling discharges is presented in **Appendix I**, and the results are summarized in **Section 4.6.1.2**.

4.7.3 Impacts of Accidental Spills

Two accidental spill scenarios were evaluated: a fuel spill and a condensate spill from a well loss of containment (see **Section 4.3**). Neither is likely to affect archaeological resources on the seafloor such as shipwrecks. A spill reaching the coastline could contaminate culture and heritage sites or cause disturbance during spill response and cleanup activities.

A fuel spill would not affect archaeological sites on the seafloor because the scenario assumes a spill from the drillship at the sea surface. Spilled fuel will float and disperse at the sea surface and will not contact wreck sites on the seafloor.

A condensate spill from a well loss of containment could result in physical disturbance around the drill site. BOEM (2012) estimated that a seafloor blowout could physically disturb a radius of approximately 300 m around a drill site. A condensate spill is expected to rise through the water column and would not be likely to contact archaeological sites on the seafloor. No impacts are expected on archaeological sites in the Tamar Field.

As discussed in **Section 4.3**, spill fate modeling indicates that a fuel or condensate spill could be carried into shallow water under certain meteorological and oceanographic conditions depending on the season, where it may contact shallow coastal sediments. There is the potential for culture and heritage sites along the coast to be contaminated or disturbed by spill response and cleanup activities.

A detailed analysis of sensitive areas and focal points along the Israeli shoreline, including archaeological sites, was completed by Pareto Engineering Ltd. (2006) for MoEP. In addition, CML's ESI Atlas identifies archaeological sites along the Israel coast. Most of the sites are within the range of potential shoreline contacts for a fuel or condensate spill during the typical winter, summer, or autumn scenarios. The areas would be a high priority for protection in the event of a spill. Therefore, it is expected that significant impacts would be avoided.

4.7.4 Mitigation Measures

The following mitigation measures are proposed to prevent and reduce harm to culture and heritage sites:

- CML will implement a 305-m avoidance zone for sonar contacts identified as potential wreck sites, and a 31-m avoidance zone for other contacts that may represent associated debris. No seafloor-disturbing activities will be conducted within these avoidance zones.
- During routine operations, should any object be determined to likely represent an antiquity, Israel's Antiquities Authority will be notified.

- Archaeological sites would be a high priority for protection in the event of a spill reaching the coast. A detailed analysis of sensitive areas and focal points along the Israeli shoreline, including archaeological sites, was completed by Pareto Engineering Ltd. (2006) for the MoEP. In addition, CML's ESI Atlas identifies coastal archaeological sites. The response to a specific spill would take into account the potential impacts on these areas in developing and implementing a response strategy.

4.7.5 Impact Significance

Impact significance for culture and heritage sites is summarized in **Table 4-22**. The likelihood is rated as unlikely (2) because all impacts are expected to be avoided through standard practices, procedures and safeguards. The consequence of impacts is rated as minor (2) for seafloor disturbance, drilling discharges, and accidental spills. Residual risk is assessed as Low.

Table 4-22. Summary of potential impacts on culture and heritage sites.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Seafloor disturbance	Culture and heritage sites	Possible physical damage to wreck sites from drilling and/or subsea infrastructure installation	• 305-m avoidance zone for potential wreck sites and 31-m avoidance zone for other sonar contacts	2	2	4 Low
Drilling discharges	Culture and heritage sites	Possible burial or contamination of wreck sites	• 305-m avoidance zone for potential wreck sites and 31-m avoidance zone for other sonar contacts	2	2	4 Low
Accidental spills	Culture and heritage sites	Possible contamination; indirect effects of physical damage during cleanup activities (if a spill reached the coastal zone)	• 305-m avoidance zone for potential wreck sites; 31-m avoidance zone for other sonar contacts • Oil spill response would prioritize protection of archaeological sites if a spill reached the shoreline	2	2	4 Low

4.8 AIR QUALITY

4.8.1 Project Emissions

Sources of air pollutant emissions during the project include engines onboard the drillship, installation vessel, support vessels, and helicopters. Engines on these vessels will produce emissions including CO, NO_x, SO_x, VOCs, and PM, as well as GHGs such as CO_2, CH_4, and N_2O. Aircraft emissions will include NO_x, hydrocarbons, CO, and PM.

4.8.1.1 Impacts from Routine Emissions

In **Section 3.4**, emissions were estimated using a worksheet developed by BOEM (2024), using vessel specifications as provided by CML. Helicopter calculations were based on published emissions estimates for a Sikorsky S-76C++ helicopter (Rindlisbacher and Chabbey, 2015). **Table 4-23**

summarizes the estimated total emissions for drillship and support vessels during drilling and completion of the Tamar-12 well.

Table 4-23. Total estimated air pollutant emissions from one drillship and three support vessels during drilling and completion of the Tamar-12 well.

Activity	Total Duration (days)	Total Estimated Emissions (metric tonnes)									
		CO	NO_x	SO_x	VOCs	PM2.5	PM10	CO_2	CH_4	N_2O	GHGs
Drilling	82	30.38	193.70	0.12	5.57	4.73	4.88	13,242.38	0.08	0.58	13,243
	35	39.38	251.06	0.15	7.22	6.13	6.32	6,736.5	0.04	0.30	6,737
	35	15.46	98.54	0.06	2.83	2.41	2.48	6,465.1	0.04	0.29	6,465
	35	9.09	57.96	0.04	1.67	1.42	1.46	3,962.7	0.02	0.18	3,963
Completion	40	14.82	94.49	0.06	2.72	2.31	2.38	6,459.70	0.04	0.29	6,460
	Total	109.13	695.75	0.43	20.01	17	17.52	36,866.38	0.22	1.64	36,868

Drilling (will require 82 days for the Tamar-12 well (24 hours per day); completion (will require a total of 40 days (24 hours per day). Each support vessel was assumed to operate for 16 hours per day for 35 days (2 round-trips per week; 17 weeks for the single well). Emissions were calculated using the U.S. Bureau of Ocean Energy Management (2024) air emissions worksheet. Emissions for the were based on actual fuel consumption; emissions for support vessels were based on maximum, vessel-specific horsepower ratings, adjusted to 75% maximum load. CO_2, CH_4, and N_2O emissions were added to the worksheet using emission factors provided by Wilson et al. (2019). GHG = CO_2 + CH_4 + N_2O.
CO = carbon monoxide; CO_2 = carbon dioxide; CH_4 = methane; GHG = greenhouse gas; NO_x = nitrogen oxides; N_2O = dinitrogen oxide; PM = particulate matter; SO_x = sulfur oxides; VOC = volatile organic compound.

Table 4-24 summarizes the estimated total emissions from project vessels during subsea infrastructure installation activities that are part of the Tamar-12 Project. Helicopter emissions for both drilling and installation activities are less than 3 metric tonnes for each of the pollutants estimated (see **Section 3.4.3**) and are omitted from the tables.

Table 4-24. Total estimated air pollutant emissions from project vessels during subsea infrastructure installation activities during the Tamar-12 Project.

Vessel Type	Vessel Days	Total Estimated Emissions (metric tonnes)									
		CO	NO_x	SO_x	VOCs	PM2.5	PM10	CO_2	CH_4	N_2O	GHGs
Subsea Install (	44	24.83	158.30	0.10	4.55	3.87	3.99	10,822.4	0.06	0.48	10,823
	44	9.32	59.44	0.04	1.71	1.45	1.50	4,063.8	0.02	0.18	4,064
	44	6.35	40.48	0.02	1.16	0.99	1.02	2,767.6	0.02	0.12	2,768
	6	0.58	3.68	0.00	0.11	0.09	0.09	251.6	0.00	0.01	252
Total	138	41.08	261.90	0.16	7.53	6.40	6.60	17,905.3	0.11	0.79	17,907

Emissions were calculated using the U.S. Bureau of Ocean Energy Management (2024) air emissions worksheet and using maximum horsepower ratings, adjusted to 75% maximum load, for each vessel. Operating days were based on projected number of vessel days (see **Section 3.4.3**). CO_2, CH_4, and N_2O emissions were added to the worksheet using emission factors provided by Wilson et al. (2019). GHG = CO_2 + CH_4 + N_2O.
CO = carbon monoxide; CO_2 = carbon dioxide; CH_4 = methane; GHG = greenhouse gas; NO_x = nitrogen oxides; N_2O = dinitrogen oxide; PM = particulate matter; SO_x = sulfur oxides; VOC = volatile organic compound.

Air pollutant emissions from engines on the drillship, installation vessel, and support vessels will produce localized, transient impacts on air quality. The total time for drilling and completing the Tamar-12 well is estimated to be 122 days. The time required for the subsea installation campaign varies, depending upon the specific vessel being used: subsea installation vessel, 44 days; supply/standby vessel, 44 days; LCV with ROV, 44 days; and crew change vessel, 6 days (see **Section 3.4.3**). Emissions will be occurring over a relatively short period; the project-specific emission rates represent a small percentage of the emissions from shipping in the Mediterranean. Due to the distance of the project area from shore (greater than 90 km), no impacts on coastal air quality are expected (i.e., no impacts expected to coastal habitats or nature reserves/protected areas).

4.8.1.2 Impacts of Accidental Spills

Spill scenarios are described in **Section 4.3**. Two accidental spill scenarios were evaluated: a diesel fuel spill and a condensate spill from a well loss of containment. The diesel fuel spill scenario assumed an instantaneous release of 16,500 bbl from the drillship. The condensate spill scenario

assumed a well loss of containment resulting in the release of continuing for a period of 30 days.

A fuel spill or condensate spill would affect air quality near the spill site by introducing VOCs through evaporation. Impacts would occur mainly during the first two days after the spill enters the environment. Approximately 45% of the fuel spill volume and 44% of the condensate spill volume are predicted to evaporate, mostly within the first 24 to 48 hours. Because the fuel spill is a single, instantaneous event, the impacts would be limited to that period. For the condensate spill, impacts at the spill site would continue throughout the 30-day period as new condensate is released each day. It is estimated that a spill may travel approximately 20 km from the spill site during the first two days, the period of time in which a significant portion of the fuel or condensate will evaporate. Therefore, air quality impacts are likely to be limited to an arc within a 20-km radius of the spill site (with the arc depending on the direction of spill movement).

Little or no impact on coastal air quality would be expected due to the distance from shore and the early evaporation of the most volatile components. The earliest landfall is expected to be 12 days for a fuel spill and 7.5 days for a condensate spill.

4.8.2 Mitigation Measures

4.8.2.1 Design and Operational Controls

Measures and actions to be implemented typically fall within the category of design and operational controls. For internal combustion engines, the project design and operational procedures already incorporate measures to avoid or minimize an impact. These measures are inherent to the design and operational controls of the project vessels and align with good international industry practice, one of which has also been identified as a mitigation measure. Specifically, CML and its vessel subcontractors will comply with applicable national and international regulations (MARPOL 73/78 Annex VI) and guidelines regarding emissions of nitrogen oxides (NO_x) and sulfur oxides (SO_x) from project vessels.

Other design and operational controls will be implemented to reduce emissions as prompted by fiscal considerations. For example, monitoring vessel fuel consumption, while fiscally responsible, also serves as a proxy for measuring engine performance and emissions.

4.8.2.2 Mitigation Measures

CML proposes the following measures to reduce impacts from air pollutant emissions associated with the Tamar-12 Project:

- All drillship, installation vessel, and support vessel engines, generators, and other emission sources will be operated and maintained in accordance with manufacturers' recommendations to avoid excessive emissions.
- The drillship, installation vessel, and support vessels will comply with applicable MARPOL Annex VI regulations including the use of low sulfur fuels and meeting the applicable NO_x emission limits under Regulation 13 of Annex VI (Note: Israel has not ratified Annex VI). The fuel oil supplied to the drillship and installation vessel will meet the requirements of Regulations 14 and 18 of Annex VI of MARPOL 73/78.
- Use of low sulfur fuel oil to reduce SO_x emissions.
- Fugitive emissions will be minimized to the extent practicable by using leak resistant equipment and reducing the number of tanks and other potential emissions sources.
- To date, no H_2S has been recorded within the immediate vicinity and the low thermal gradient in the area is not suggestive of H_2S.

4.8.2.3 Impact Significance

Impact significance for air quality is summarized in **Table 4-25**. For routine air emissions from the drillship, installation vessel, support vessels, and helicopters, the consequence of impacts is rated as insignificant (1). The likelihood of impacts from these routine emissions is rated possible (3) and the residual risk is rated as Low. For accidental spills, the likelihood is rated unlikely (2) and the consequence is minor (2) for air quality, with a residual risk of Low.

Table 4-25. Summary of potential impacts on air quality.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Air emissions (drillship)	Air quality	Localized, transient elevations in air pollutant concentrations near drillship; greenhouse gas emissions	• Routine maintenance and inspection of engines and generators • Compliance with MARPOL Annex VI regulations including the use of low sulfur fuel and meeting the NO_x emission limits under Regulation 13 of Annex VI	3	1	3 Low
Air emissions (installation vessel, support vessels and helicopters)	Air quality	Localized, transient elevations in air pollutant concentrations along installation and transportation routes; greenhouse gas emissions	• Routine maintenance and inspection of engines and generators • Compliance with MARPOL Annex VI regulations including the use of low sulfur fuel and meeting the NO_x emission limits under Regulation 13 of Annex VI	3	1	3 Low
Accidental spills: Fuel spill from the drillship (16,500 bbl)	Air quality	Elevated volatile organic compound (VOC) concentrations due to evaporation of volatile hydrocarbons (mostly first 24 to 48 hours)	• Spill prevention measures • Drillship Shipboard Oil Pollution Emergency Plan • Oil Spill Contingency Plan	2	2	4 Low
Accidental spills: Condensate spill from a well loss of containment (for 30 days)	Air quality	Elevated VOC concentrations due to evaporation of volatile hydrocarbons (mostly first 24 to 48 hours)	• Blowout preventer and well control methods • Oil Spill Contingency Plan	2	2	4 Low

In evaluating likelihood for air quality impacts, a 100-m mixing zone was assumed around the drillship (i.e., it is referring to the likelihood of impacts occurring beyond this radius).

4.8.3 Emissions from Expected Malfunctions

The Tamar-12 Project will be located far from any population centers, and any malfunctions from project equipment, should they occur, are not expected to result in impacts to any environmental or social receptors. A single shipping fairway extends into the Tamar Field; project-related emissions are not expected to adversely affect transiting vessels.

4.8.4 Air Pollutant Emissions

4.8.4.1 Emission Rates

Emission rates for project vessels are summarized in **Table 4-26**, encompassing drilling and completion and subsea infrastructure installation activities, and support vessel operations in support of each. Emission rates are expressed in kilograms per day.

Table 4-26. Summary of daily emission rates, in kilograms, for project vessels proposed for the Tamar-12 Project.

Vessel Type	Total Daily Emissions (kg)									
	CO	NO_x	SO_x	VOCs	PM2.5	PM10	CO_2	CH_4	N_2O	GHG
Drilling and Completion										
Drilling (	1,337.58	8527.91	5.18	245.19	208.30	214.74	583,024	3.43	52.79	583,080
Well Completion (	441.57	2,815.30	1.71	80.95	68.77	70.89	192,472	1.13	8.50	192,482
	423.78	2,701.86	1.64	77.68	66.00	68.04	184,717	1.09	8.16	184,726
	259.75	1,656.06	1.01	47.62	40.45	41.70	113,219	0.67	5.00	113,225
	1,337.58	8,527.91	5.18	245.19	208.30	214.74	583,024	3.43	52.79	583,080
Total, D&C	3,800.26	24,229.02	14.72	696.63	591.81	610.12	1,656,456	9.75	127.24	1,656,593
Subsea Infrastructure Installation										
Installation Vessel (	564.29	3,597.70	2.19	103.44	87.88	90.59	245,963	1.45	10.86	245,975
	144.30	920.03	0.56	26.45	22.47	23.17	62,900	0.37	2.78	62,903
	211.89	1,350.93	0.82	38.84	33.00	22.68	92,358	0.54	4.08	92,363
	96.20	613.35	0.37	17.64	14.98	23.17	41,933	0.25	1.85	41,935
Total, Subsea Install	1,016.69	6,482.02	3.94	186.37	158.33	159.61	443,154	2.61	19.57	443,176

CO = carbon monoxide; CO_2 = carbon dioxide; CH_4 = methane; D&C = drilling and completion; GHG = greenhouse gas; kg = kilograms; NO_x = nitrogen oxides; N_2O = dinitrogen oxide; PM = particulate matter; SO_x = sulfur oxides; VOC = volatile organic compound.

4.8.4.2 Total Greenhouse Gases, Methane, and Carbon Dioxide Emission Estimates

Total GHG emissions, including CO_2, CH_4, and N_2O for all phases of the Tamar-12 Project (i.e., drilling and completion; subsea infrastructure installation; support vessel operations), were outlined previously in **Tables 4-23** and **4-24**. Total CO_2 emissions are estimated to be 106,198 tonnes. Total methane emissions are expected to be 0.63 tonnes. Total N_2O emissions are estimated to be 4.69 tonnes. Total GHG emissions for the Tamar-12 Project are expected to be approximately 106,204 tonnes.

4.9 WASTE

Waste management for the well drilling and completion and subsea infrastructure installation and commissioning program is described in **Section 3.7**. Impacts from waste and marine debris are addressed in **Section 4.6.1.6**. All wastes will be handled and disposed according to MARPOL requirements and permit requirements (e.g., Discharge to Sea Permit). Under MARPOL Annex V (Resolution MEPC.201[62]), all fixed or floating platforms are required to carry a Garbage Management Plan and maintain a Garbage Record Book.

Wastes that cannot be discharged overboard under MARPOL requirements will be shipped to authorized waste recycle or disposal sites onshore in accordance with the regulations. Waste storage areas will be designated on the drillship, installation vessel, and support vessels in areas isolated from other operations. Waste containers will be stored in these areas prior to processing or shipment to the contract waste management vendor. All waste materials will be stored properly in containers that are non-leaking and compatible with the waste being stored. All containers will have their lids, rings, covers, bungs, and other means of closure properly installed at all times except when waste is being added or removed.

No significant environmental impacts are expected from waste disposal. The waste will be transported to shore in support vessels during their routine trips and will not generate additional air emissions, discharges, or other impacts. Solid waste disposal requirements for the drilling and completion and subsea infrastructure installation and commissioning program are expected to be negligible relative to the available services and recycle or landfill capacity in Israel.

4.10 HAZARDOUS MATERIALS

4.10.1 Measures for Mitigating Risk

Drilling and completion activities will include the use of hazardous materials including MOBM and drilling mud additives. The subsea infrastructure installation and commissioning activities will also utilize hazardous materials, primarily in association with pre-commissioning activities. The chemicals and quantities to be used (i.e., for drilling and completion; for subsea infrastructure and commissioning operations) are summarized in **Section 3.5**. All hazardous materials will be handled in accordance with their SDS-specified guidelines (**Appendix E**), as integrated into the hazardous materials handling guidelines established for the drillship, installation vessel, and support vessels.

Each specific chemical or product for which an SDS has been provided identifies information pertinent to chemical composition, brand name, CAS number (chemical abstract system number) and/or UN number, and storage requirements. Handling of hazardous materials will also comply with the project-specific Toxin Permit requirements. All personnel must receive hazard communication information and training before handling, using, or otherwise being exposed to hazardous chemicals. Hazardous chemicals may only be handled or used after reviewing the SDS and label information and only if the container is properly labeled with chemical hazard information.

Hazardous waste streams will be segregated by type and will not be mixed together or managed in the same container with non-hazardous wastes. Hazardous waste storage areas will be designated on the drillship, installation vessel, and support vessels in areas isolated from other operations. Waste containers will be stored in these areas prior to processing or shipment to the contract waste management vendor. Separate storage locations or sufficient space/barriers will be provided to enable the segregation of incompatible chemicals. All waste materials will be stored properly in properly labeled containers that are non-leaking and compatible with the waste being stored. All containers will have their lids, rings, covers, bungs, and other means of closure properly installed at all times except when waste is being added or removed. Hazardous chemical containers and storage areas will be maintained in clean condition with no residues or spilled materials on the container, floor, or surrounding area.

No significant environmental impacts are expected from the management of hazardous materials. Hazardous waste will be segregated from non-hazardous waste and transported to shore in support vessels during their routine trips and will not generate additional air emissions, discharges, or other impacts. Disposal requirements for hazardous materials are expected to be negligible relative to the available services and waste management capacity in Israel.

4.10.2 Measures in Case of Hazardous Material Discovery

Based on prior drilling experience in the Tamar Field, there is a limited potential for encountering hazardous materials during drilling (e.g., H_2S). In the event that H_2S is encountered, the main objective is to shut in and secure the well to prevent any escape to the atmosphere. Operations will only be resumed when necessary safety equipment has been installed on the drillship. H_2S scavenger will be available on the drillship and the mud treated to prevent any H_2S gas from reaching the surface. The mud logging personnel will install and maintain H_2S detection equipment at strategic locations on the drillship. The Control Room Operator and supervisory personnel will be alerted

should the presence of H_2S be detected. The drillship contractor has procedures for responding to an H_2S alarm on the drillship, including instructions to crew members in the event of an alarm.

4.10.3 Emergency Procedures

CML's Emergency Response Plan will deal specifically with the actions to be taken in the event of emergencies including those involving hazardous materials. CML will also require the drillship contractor to have an Emergency Response Plan to deal specifically with the actions to be taken in the event of emergencies. The facilities and procedures will provide for emergency response and, where appropriate, evacuation, escape, and rescue requirements. Emergency response capabilities of equipment and personnel will be tested through regular drills and exercises. In the event of an accident or emergency, the designated person in charge, the drillship contractor's offshore installation manager, is in overall command. The drillship contractor's Emergency Response Plan and procedures must be applied to manage drill site emergency situations to ensure safe evacuation, escape, and rescue of drilling and support personnel. The maintenance and safe operation of evacuation and escape equipment is the responsibility of the drillship contractor. CML and the drillship contractor will coordinate their incident management processes in the event of an emergency that requires onshore emergency response coordination via remove incident management teams.

Hazardous materials will be handled in accordance with the terms and conditions of the Toxin permit received from the Ministry of Environmental Protection and in accordance with the policy of the drillship contractor. Emergency response management to incidents such as hazardous materials is detailed in a Bridging Document between CML and the drillship contractor. The purpose of the Bridging Document is to document agreements and clarify expectations regarding the division and implementation of CML's Operational Excellence Management System (OEMS) requirements with the drillship contractor's Safety Management System (SMS). The Drillship is responsible for the response to all emergency incidents on the vessel, including those involving hazardous materials. Any spill or release overboard shall be managed by CML Emergency Response Plan.

4.11 EARTHQUAKE PREPAREDNESS

CML has considered seismic risk (including potential earthquakes) in developing the proposed Tamar-12 Project. The design and engineering of the Tamar-12 well consider any identified seismic risk as well as seafloor and shallow geohazards.

Regional seismicity is discussed in **Section 1.4**. Earthquakes in the vicinity of the Tamar Field are relatively rare. There have been no strong (magnitude 5.4 or greater) regional earthquakes recorded since 1983 within 200 km of the Tamar Field. There has been one recorded earthquake within 25 km of the proposed Tamar-12 well location since 1979, with a magnitude 4.0 on the Richter scale.

4.11.1 Responding to Early Earthquake and Tsunami Warnings

CML's Emergency Response Plan will deal specifically with the actions to be taken in the event of emergencies including earthquakes. CML will also require the drillship contractor to have an Emergency Response Plan in place to deal specifically with the actions to be taken in the event of earthquake or tsunami warnings.

4.11.2 Means to Prevent Damage

The Geologic Survey of Israel (2023) did not identify any geohazards in the vicinity of the Tamar Field that would be a geological risk to drilling or infrastructure installation and dynamic changes to seafloor stability are not expected. The design and engineering of the Tamar-12 well has considered all identified seismic risks and has been designed to prevent damage in case a seismic event occurs.

4.11.3 Emergency Procedures for Earthquake Incidents

The facilities and procedures will provide for emergency response and, where appropriate, evacuation, escape, and rescue requirements. Emergency response capabilities of equipment and personnel will be tested through regular drills and exercises. In the event of an accident or emergency, the designated person in charge, the drillship contractor's offshore installation manager, is in overall command. The drillship contractor's Emergency Response Plan and procedures must be applied to manage drill site emergency situations to ensure safe evacuation, escape, and rescue of drilling and support personnel. The maintenance and safe operation of evacuation and escape equipment is the responsibility of the drillship contractor. CML and the drillship contractor will coordinate their incident management processes in the event of an emergency that requires onshore emergency response coordination via remove incident management teams.

No environmental impacts from earthquakes are expected during the Tamar-12 drilling and completion program. The response to any spills resulting from an earthquake or other emergency would be in accordance with CML's OSCP. The potential impacts of accidental events including a fuel spill and condensate spill from a well loss of containment are evaluated in **Section 4.3**.

4.12 FISHING AND MARINE AQUACULTURE

No fishing areas are known within the Application Area due to water depth and distance from shore (see **Section 1.6.6**). No mariculture or fish farming operations are known to exist near the Tamar Field. Due to the water depth and the distance from coastal fishing and marine farming areas, no impacts are expected from routine drilling and completion and subsea installation activities.

Three aspects of CML's proposed activities were identified that could potentially affect fishing activities and marine farming: physical presence and exclusion zone, support vessel traffic, and accidental spills.

4.12.1 Impacts on Fishing Activity

4.12.1.1 Impacts of Physical Presence and Exclusion Zone

All vessels (including fishing boats) will be excluded from a 500-m radius exclusion zone around the drillship and installation vessel for safety reasons. Support vessels will monitor this exclusion zone and help minimize the potential for other vessels to enter this area. Because the drill site and subsea infrastructure corridor are not located in a known fishing area, it is extremely unlikely (i.e., rare) that any fishing vessels would be affected by this exclusion.

4.12.1.2 Impacts of Support Vessel Traffic

The drilling program will be supported by three MMC 87 Class platform support vessels or similar operating out of the port of Haifa; specifications of example vessels are provided in **Appendix D**. Each support vessel is expected to make four one-way trips (i.e., two round-trips) per week. The vessels will normally follow the most direct route between the shore base and the drillship, weather permitting. Shipping lanes extend generally westward from Haifa in the direction of the Tamar Field, and it is expected that most of the support vessel route would be in or near these existing shipping lanes where there is already vessel traffic. Therefore, no interactions with fishing vessels or gear are expected during these trips.

The subsea installation program will require multiple trips between the Tamar Field and the subsea installation constructor's shore base which will likely be located in Limassol, Cyprus. The estimated vessel activity levels, duration, frequency, and total trips are presented in **Table 4-27**, by installation activity.

Table 4-27. Estimated installation vessel days and support vessel trips to and from Cyprus for the subsea installation phase of the Tamar-12 Project.

Vessel Type	Activity Duration (days)	Activity	Frequency	Total Trips
Multi-Purpose Construction Vessel	44	1,2,3,4,5	1 trip for umbilical campaign 2 trips for subsea campaign 2 trips for pre-comm campaign	5
Light Construction Vessel with ROV	44	1,2,3,4,5	1 trip for pre-lay, pre-commissioning	1
			Total	6

Activity 1: Jumper Installation.
Activity 2: Umbilical Installation.
Activity 3: Flying Leads Installation.
Activity 4: Umbilical and Flying Leads Testing and Pre-Commissioning.
Activity 5: Pre-Lay Activities.

4.12.1.3 Impacts of Accidental Spills

Two accidental spill scenarios were evaluated: a fuel spill and a condensate spill from a well loss of containment (see **Section 4.3**). Both have the potential to affect fishing activities if a spill reached coastal areas. The impacts could result from 1) exposure of fishery species to fuel oil or condensate; and/or 2) response activities including vessel traffic and areas temporarily closed to fishing during cleanup.

A fuel spill or condensate spill in the Tamar Field would be unlikely to affect fishing or marine farming activities because of the distance from shore. There are no known fishing or marine farming areas in or near the Tamar Field.

Fishing and marine farming areas along the Israeli coast could be affected in the event that a spill reached coastal waters or shorelines. Potential impacts could include direct impacts to fish or aquaculture species (e.g., toxicity or contamination) as well as temporary disruption or suspension of fishing or marine farming due to spill response activities.

Israeli shorelines potentially contacted by a spill range from Israel's northern border south to Gaza, with the most extensive impacts during typical winter conditions for either a fuel spill or condensate spill. Most fish farming takes place in secure bays to avoid damage to the cages. Fish farms in secure bays are not expected to be contacted by a spill.

4.12.1.4 Mitigation Measures

Prior to commencing the Tamar-12 Project drilling and completion and subsea infrastructure installation program, CML will issue a Notice to Mariners to inform fishing vessels and other vessel operators of planned vessel movements and the buffer zone around the drillship and installation vessel.

Fishing and marine farming areas would be a high priority for protection in the event of a spill. A detailed analysis of sensitive areas and focal points along the Israeli shoreline, including archaeological sites, was completed by Pareto Engineering Ltd. (2006) for the MoEP. CML's ESI Atlas also identifies sensitive marine areas including fishing and marine farming areas. The OSCP includes notification procedures. The response to a specific spill would take into account the potential impacts on these areas in developing and implementing a response strategy.

4.12.1.5 Impact Significance

Impact significance for fishing and marine aquaculture is summarized in **Table 4-28**. Impacts on fishing activities due to the physical presence of the drillship and the exclusion zone are considered rare (1) and the consequence is rated insignificant (1), with a residual risk of Low.

Similarly, impacts on fishing activities due to the physical presence of the installation vessel and its exclusion zone are considered rare (1) and the consequence is rated insignificant (1), with a residual risk of Low.

Support vessel traffic is certain to occur, but the likelihood of proximity sufficient to cause impacts is lower and is rated as possible (3). The consequence of impacts on fishing activities is insignificant (1) and the residual risk rated as Low.

The fuel spill and condensate spill are unlikely events (2) with potential consequences rated as minor (2) for a fuel spill and minor to medium (2 to 3) for a condensate spill. The residual risk ranges from Low to Moderate.

Table 4-28. Summary of potential impacts on fishing and marine aquaculture.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Physical presence and exclusion zone (drilling and completion)	Fishing activities	Exclusion of fishing vessels from 500-m buffer zone around drillship	• Provide Notice to Mariners in advance of proposed activities	1	1	1 Low
Physical presence and exclusion zone (subsea installation)	Fishing activities	Exclusion of fishing vessels from 500-m buffer zone around installation vessel	• Provide Notice to Mariners in advance of proposed activities	1	1	1 Low
Support vessel traffic	Fishing activities	Potential interactions with fishing vessels or gear during routine vessel traffic between shore base (Haifa) and the project area	• Provide Notice to Mariners in advance of proposed activities	3	1	3 Low
Accidental spill (fuel)	Fishing activities; marine farming	Possible contamination of fish and shellfish resources; interruption of fishing activities due to response and cleanup activities	• Oil Spill Contingency Plan includes notification procedures; spill response would prioritize sensitive areas including fishing and marine farming areas	2	2	4 Low
Accidental spill (condensate from a well loss of containment)	Fishing activities; marine farming	Possible contamination of fish and shellfish resources; interruption of fishing activities due to response and cleanup activities	• Oil Spill Contingency Plan includes notification procedures; spill response would prioritize sensitive areas including fishing and marine farming areas	2	2–3	4–6 Mod

4.12.1.6 Means to Prevent Overfishing around Fish Aggregating Marine Structures

No fishing areas are known within the Application Area due to water depth and distance from shore and any fish aggregating effect that project vessels may have on commercial fish species would not result in overfishing. No deepwater trawling is known to occur in the vicinity of the Tamar Field.

4.13 SAFETY AND PROTECTION

4.13.1 Exclusion Zone

Consistent with international industry practice, CML will establish a 500-m radius exclusion zone around the drillship, which will be kept clear of all unauthorized vessels. A continuous bridge watch on the drilling unit will be maintained to ensure compliance with the exclusion zone. A standby vessel (e.g., a support vessel) supporting the drilling and completion activities will keep watch also and will be used to enforce the exclusion zone, intervening if any vessel makes a close approach. Similarly, during subsea infrastructure installation, a 500-m radius exclusion zone around the installation vessel will be kept clear of all unauthorized vessels.

The resources potentially affected by the exclusion zone are marine transportation system and infrastructure.

The Tamar Field contains the terminus of a shipping lane into Haifa (i.e., a single shipping lane extends westward from Haifa into the Tamar Field, as shown in **Figure 1-8**). Therefore, it is possible that shipping traffic may pass through the area enroute to or from various Mediterranean ports, but impacts are expected to be negligible.

4.13.1.1 Impact Significance

Impact significance for safety and protection is summarized in **Table 4-29**. Impacts on marine transportation and infrastructure due to the physical presence of the drillship and installation vessel and exclusion zone are considered unlikely (2) and the consequence is rated insignificant (1), with a residual risk of Low.

Table 4-29. Summary of potential impacts of safety and protection zones.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Safety and protection zones	Marine transportation system and infrastructure	Exclusion of vessels from 500-m buffer zone around drillship and installation vessel	• Provide Notice to Mariners in advance of proposed activities • Use standard navigation markings	2	1	2 Low

4.13.1.2 Mitigation Measures

CML proposes the following measures regarding safety and protection zones, consistent with international industry practice:

- CML will establish a 500-m radius exclusion zone around the drillship and installation vessel, which will be kept clear of all unauthorized vessels. A continuous bridge watch will be maintained to ensure compliance with the exclusion zone.
- Navigational markings onboard both the drillship, installation vessel, and support vessels will meet SOLAS requirements as per IMO Resolution MSC.253(83) or equivalent requirements.
- Prior to commencing the Tamar-12 Project drilling and completion program, CML will consult with Haifa port authorities and provide Notice to Mariners to inform the public of planned vessel movements and the exclusion zone around the drillship and installation vessel.

- CML will require support vessel operators to follow all applicable maritime navigation rules and will advise the operators to follow the most direct route (weather conditions permitting) between the drill sites and the shore base.

4.13.2 Impacts of Project-Specific Vessel Traffic

Support vessel operations for the Tamar-12 Project drilling and completions campaign will be conducted primarily from the shore base in Haifa; the subsea installation campaign will likely operate from a shore base in Limassol, Cyprus. Based on recent statistics, Haifa Port handled 11,702,000 tons of cargo and 736,138 twenty-foot equivalent units (TEUs) in 2023 (Haifa Port, 2024). By comparison, the port of Limassol handled almost 1 million tonnes of cargo, approximately 200,000 cruise passengers, 67,529 TEUs, and 22,244 vehicles in 2022 (DP World, 2023). Tamar-12 Project vessels will contribute a small incremental increase to vessel traffic at Haifa Port or the port of Limassol.

4.13.2.1 Impact Significance

It is not expected that the increase in vessel traffic from the Tamar-12 Project will significantly interfere with routine operations at either port. Impacts on marine transportation and infrastructure due to support vessel traffic are considered unlikely (2) and the consequence is rated insignificant (1), with a residual risk of Low (**Table 4-30**).

Table 4-30. Summary of potential impacts of support vessel traffic on marine transportation systems and infrastructure.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Support vessel traffic	Marine transportation system and infrastructure	Project vessel movement and interaction with other marine traffic, including port traffic	• Provide Notice to Mariners in advance of proposed activities	2	1	2 Low

4.13.2.2 Mitigation Measures

CML proposes the following measures regarding vessel traffic and measures to minimize interference with marine transportation systems and infrastructure:

- Navigational markings onboard both the drillship, installation vessel, and support vessels will meet SOLAS requirements as per IMO Resolution MSC.253(83) or equivalent requirements.
- Prior to commencing the Tamar-12 Project drilling and completion program and subsea installation program, CML will consult with Haifa port authorities and port of Limassol authorities, respectively, and provide Notice to Mariners to inform the public of planned vessel movements.
- CML will require support vessel operators to follow all applicable maritime navigation rules and will advise the operators to follow the most direct route (weather conditions permitting) between the drill site and the shore base.

4.14 MONITORING AND CONTROL PROGRAM

Monitoring procedures are an integral element of CML's operations and help to ensure that the mitigation measures identified for the project are implemented. Some monitoring is prescribed in the various regulations and plans; other monitoring is directed by CML's Environment, Health, and Safety (EHS) procedures.

4.14.1 Monitoring and Control Measures

4.14.1.1 Environmental Monitoring

Prior to previous drilling in the Tamar Field, CML conducted a Background Monitoring Survey of the marine environment as required by the Ministry Guidelines. The survey report is provided in **Appendix K**.

CML will conduct a post-drilling environmental monitoring survey around the proposed Tamar-12 well. The post-drilling survey will include sampling of seawater, sediments, and infauna. Reporting of results will include comparison of baseline and post-drilling survey results.

The following additional environmental monitoring is planned:

- CML will visually monitor waters in the vicinity of the drillship for oil sheen on a daily basis. If an oil sheen is observed, the source will be identified and steps taken to reduce, minimize, or eliminate (if possible) the discharge if the source is a drillship or support vessel.
- CML will conduct a post-drilling survey to ensure that the seafloor around the drill site is clear of equipment and debris.
- Tamar Field monitoring will occur on an every five year basis that will assess the environmental condition around the production wells.

4.14.1.2 Discharge Monitoring

Discharge monitoring includes the following elements:

- Monitoring of drilling discharges will be conducted as part of daily monitoring activities on the drillship. This includes the testing of drilling muds and associated chemicals, and periodic toxicity testing of drilling muds during drilling in accordance with Discharge to Sea Permit requirements.
- WBM will be sampled during the first two drilling sections. The WBM will also be subject to a toxicity test that will be conducted by a certified lab.
- Barite will be tested for metals including mercury and cadmium before and during project activities.
- The drillship's routine discharges will be sampled on a daily or monthly basis, depending on the system.
- CML will conduct a performance assessment at least once during the drilling of each well to confirm compliance with the discharge monitoring and reporting requirements on the drillship. These include barite certificates, SDSs for all chemicals listed in the Chemical Use Plan, and the chemicals inventory, among others.
- Documentation of all discharges and related monitoring activities will be conducted as part of daily monitoring activities on the drillship(s) and installation vessel, and per the Offshore Discharge Program that will be prepared.

4.14.1.3 Other Performance Monitoring

Performance assessments will be conducted to address requirements identified under the Environmental Approval and Exploration Authorization and to review the implementation of the EHS management plans required per the Environmental Approval. Other performance monitoring activities include the following:

- Gas monitors for methane and H_2S will be installed on the rig and alarm systems will be connected to the monitors. The exact locations, number of monitors, and detailed response plans will be dependent on the rig selected.
- a performance assessment immediately prior to initiating the drilling and completion program to determine the status of the EHS processes and resources in place.
- CML will conduct performance assessments to the drillship to confirm that spill response resources are in place, trained personnel are available on-site, and third-party contractors are

familiar with spill prevention and response procedures, including notification requirements. The assessment will be reviewed and updated annually.
- CML will conduct a performance assessment to confirm that a Notice to Mariners was issued and support vessels were instructed to monitor and enforce the exclusion zone.
- Waste management will be evaluated during a performance assessment on the drillship at least once during the drilling program. Waste tracking documentation and related monitoring activities will be conducted per the Waste Management Program that will be prepared.
- Fuel use will be monitored and estimated air pollutant emissions will be calculated upon the termination of drilling activities.
- Marine Environment Background Monitoring Plan (previously completed).

4.14.2 Technique for Obtaining Representative Samples

4.14.2.1 Environmental Monitoring

CSA conducted an EMS in the Tamar Field in 2023 (CSA, 2023a), following an earlier EBS in the field in 2014 (CSA, 2014). The recommended sampling approach for the 2023 Tamar Field EMS was to continue utilizing a uniform sampling grid design with fixed station placement from the 2014 Tamar Field EBS, with a larger cell size (4 km^2). This approach, while providing a slightly coarser representation of environmental parameters, continued to lend itself to analysis and comparison with the geostatistical methods utilized during the 2014 effort. The justification to increase the cell size of the 2023 Tamar Field EMS sampling grid was based upon the minimal exploratory and developmental activities that have occurred within the field since 2014, the robust post-drilling analysis of Tamar-8 that was conducted in 2017.

The specific objectives of the 2023 Tamar Field EMS were to:

- Assess the potential effects from field development and production on selected environmental components;
- Determine temporal and spatial variation of selected chemical environmental standards within the study area;
- Compare the concentrations of selected environmental components with environmental standards; and
- Ensure that the sampling methodology results and findings are directly comparable to both the 2014 Tamar Field EBS and all future Tamar Field-wide monitoring surveys.

Sampling focused on several components, including seawater, sediment, and infauna sampling; an enhanced post-drilling sediment barium assessment; and a manifold sediment metals assessment.

A quality assurance (QA) program was implemented during the 2023 Tamar Field EMS to verify that collected samples and data met required specifications and expectations. Quality control (QC) measures were implemented in the field as fundamental components of the project QA program. These QC measures included the collected representative samples and the implementation of sample management procedures to minimize sample loss, and ensure collection of requisite samples and data, such as the preparation of checklists and data checks, and the use of qualified/certified equipment, personnel, and laboratories; chain-of-custody (CoC) process; and detailed documentation of sample and data analysis steps and results. QC measures were discussed in detail in CSA (2023a).

4.14.2.2 Discharge and Performance Monitoring

Sampling of the various discharge streams will be conducted in accordance with the Discharge to Sea Permit. Sampling will be conducted by an authorized sampler representing the accredited laboratory performing each respective test.

For drilling operations, CML will conduct a performance assessment at least once during the drilling of the Tamar-12 well to confirm compliance with the discharge monitoring and reporting requirements on the drillship. These include barite certificates, SDSs for all chemicals listed in the Chemical Use Plan, and the chemicals inventory, among others.

4.14.3 Calibration and Maintenance Activities

4.14.3.1 Environmental Monitoring

Gas monitors for methane and H_2S will be installed on the rig and alarm systems will be connected to the monitors. The exact locations, number of monitors, and detailed response plans will be dependent on the rig selected and is something that will be finalized during the detailed planning stage.

The QC measures noted in **Section 4.14.2.1** identified a series of sampling protocols, equipment, and reporting associated with environmental monitoring. A summary of these QC procedures is provided in **Table 4-31**.

4.14.3.2 Discharge and Performance Monitoring

Daily sampling will be conducted using measuring devices that will be available onboard the drilling rig and calibrated in accordance with the measurement device manufacturer's guidelines. In addition, sampling will be conducted by an authorized sampler representing the accredited laboratory performing the tests in accordance with the Discharge to Sea Permit. Several additional specific examples of discharge and performance monitoring are outlined below.

- Oil on Water Observations: CML will visually monitor waters in the vicinity of the drillship or other project vessels for oil sheen on a daily basis. If an oil sheen is observed, the source will be identified and steps taken to reduce, minimize, or eliminate (if possible) the discharge if t0he source is the drillship, installation vessel, or support vessel.
- Marine Sanitation Devices: Marine sanitation devices aboard each project vessel will be certified by the appropriate entity (e.g., U.S. Coast Guard annual inspections). After a satisfactory inspection, the entity will endorse the current certificate of inspection.
- Oil-Water Separator: OWS inspection requirements will include regular visual checks for leaks, spills, and unauthorized substances, as well as ensuring proper functionality and maintenance, including cleaning and documentation of activities. CML or its subcontractors will maintain a logbook or other documentation to record the date and type of all inspections, service, and maintenance performed on the OWS.

Table 4-31. Summary of calibration, maintenance, and quality control procedures, Tamar Environmental Monitoring Survey field operations, data handling, and reporting (From: CSA, 2023a).

Quality Control Measures	
Cleaning Procedures	Sample collection and processing equipment were thoroughly cleaned prior to use in the field. Sampling equipment was cleaned with Liquinox detergent and raw seawater before the start of the sampling effort, then thoroughly scrubbed and hosed out between sampling stations according to accepted procedures. Pre-cleaned sample containers processed by the distributor following appropriate USEPA protocols as specified in the Office of Solid Waste and Emergency Response (OSWER) Directive 9240.0-05A "Specifications and Guidance for Contaminant-Free Sample Containers" (USEPA, 1992) were used for all sample collections.
Quality Control Samples – Equipment and Field Blanks	Equipment and field blanks were prepared for seawater total petroleum hydrocarbons (TPH) and dissolved metals and processed as any other sample. After the sampling equipment was cleaned, an equipment blank was prepared by pouring deionized water through the equipment and collecting the rinsate in a pre-cleaned and labeled sample container bottle to detect the potential for contamination. A field blank was prepared by pouring analyte-free deionized water into clean sample containers while in the field as a means of detecting contamination from the handling environment.
Laboratory Quality Control – Sample Duplicates	Sample duplicates of seawater TPH and dissolved metals were collected at Stations D1 and B4, respectively, for inter-laboratory comparison and QC. Sample duplicates were used to estimate sampling and laboratory analysis precision.
Data and Sample Collection Checklists	Prior to the survey, data and sample checklists were prepared by the Chief Scientist and completed in the field as appropriate for QC. Prior to departing each sampling station, the Chief Scientist or their designee reviewed the checklist and physically examined and confirmed data files, logbooks, and sample containers to ensure that the data and required samples were properly collected and labeled.
Sea-Bird Profiler Data Check	After completion of a water column profile cast, Sea-Bird hydrographic data were downloaded by a CSA technician. The data were plotted while still in the field to ensure that the collected data were within expected ranges for the conditions at the survey area, the equipment was functioning properly, and the configuration and data files were accurate.
Sample Preservation, Storage, and Holding Times	Samples were preserved and stored according to specifications from applicable regulations or standard industry practice. Samples were shipped to the laboratories for analysis within prescribed sample holding times and under appropriate preservation and handling conditions.
Sampling Handling and Transport	
To ensure proper management of survey activities and sample and data collection and handling, all stages of field sampling, and sample and data storage and handling were documented in a field logbook. All pertinent information concerning field activities and sampling were recorded in the logbook by a CSA field scientist, including problems encountered and necessary deviations from the proposed statement of work. Collected samples were packaged within shipping containers in a manner to avoid contamination or loss (leakage or breakage). The sample shipping containers themselves were secured to be leak proof and were clearly marked with shipping information and labels indicating content and fragility. Sample analysis instructions were prepared to accompany all samples shipped to the laboratories or were sent separately. All samples were transported or shipped under a chain-of-custody (CoC) process. Proper CoC was maintained for all samples, and a CoC record accompanied all samples and provided an efficient means for the analytical laboratories to inventory received samples within each shipping container. Each person involved with the custody of the sample(s) signed the appropriate forms and ensured that the samples were properly handled, stored, and transported to the analytical laboratories. The Chief Scientist or their designee confirmed by telephone or e-mail that all samples were delivered and logged in at each designated laboratory.	

Table 4-31. (Continued).

Document and Data Security

Data and Document Review
Standardized sample description nomenclature was utilized throughout the project and with laboratories for consistent reporting and seamless incorporation of reported results into the database management system. Data review and QC procedures were implemented to ensure that sample and data collections from the field and analytical results from laboratories were accurate and accompanied by required metadata. A CSA scientist with requisite experience and background reviewed all datasets prior to data analysis and inclusion into the report. The draft report was subject to in-house technical and editorial review and copy proofing.

4.14.4 Environmental Baseline Report

Summary information regarding the EBS and EMS efforts completed in the Tamar Field in 2014 and 2023, respectively, were summarized in **Section 4.14.2**. Both the 2014 Tamar Field EBS and the 2023 Tamar Field EMS surveys were conducted in accordance with MoE and MoEP guidelines and recommendations, including the 2019 updated offshore natural gas fields monitoring guidelines (MoE, 2019) and guidance specific to the 2023 Tamar Field monitoring. The 2023 Tamar Field EMS is provided as **Appendix K**.

4.15 DECOMMISSIONING OPERATIONS

At the end of the production life of the Tamar-12 Project well, and possibly the full complement of Tamar Field wells, CML will initiate decommissioning of wells and subsea infrastructure in alignment with MoE guidelines. Prior to decommissioning, CML will conduct an environmental impact assessment and will obtain approval from appropriate Ministry authorities.

Sources of potential impact resulting from future decommissioning are similar to those identified for drilling and subsea infrastructure emplacement, including vessel or infrastructure discharges, physical presence, exclusion zones, vessel movement, air emissions, vessel sound emissions, light emissions, solid waste, helicopter traffic/sound emissions, and seafloor disturbance. These sources of impact potentially affect a suite of environmental resources, including physical/chemical, biological, and environmental/social attributes. Decommissioning operations are expected to be temporary and short term in nature, producing limited, localized impacts. The decommissioning assessment, to be conducted prior to decommissioning, will fully outline decommissioning options and expected impacts from each.

Several key sources of impact associated with decommissioning are outlined below.

4.15.1 Discharges

During the plugging and abandonment of the Tamar-12 well, there is the potential for small discharges of cement, MEG, and brine to escape from the wellhead and be distributed onto the seafloor. These discharges, heavier than seawater, may affect sediment quality and benthic communities in relatively close proximity to the wellhead. Deposition of these materials may result in localized changes in the texture and physical/chemical properties of the sediments, or may affect local soft bottom infauna. The effects to sediment quality and benthic communities due to these possible discharges are not readily quantifiable due to the uncertainty concerning discharge material composition, volumes, and depositional patterns.

4.15.2 Seafloor Disturbance

The Tamar-12 well will be permanently abandoned as part of decommissioning activities.
A determination of whether the wellhead is removed or left in place (with a protective guard) will be discussed with the appropriate ministry. If wellhead removal is required, seafloor disturbance will result. If the wellhead is abandoned in place and fitted with a protective guard, a reduced level of seafloor disturbance may be expected.

At a minimum, the physical dimensions of seafloor disturbance caused by removal of the wellhead system is approximately 0.7 m^2. The extent of seafloor disturbance caused by placement of a guard over the wellhead will be dependent upon guard dimensions.

Similarly, decommissioning of subsea infrastructure will be discussed with the appropriate ministry. It is expected that cleaning and flushing of all subsea infrastructure will be required. Decommissioning options include removal or abandonment in place. Removal will disturb sediments immediately beneath and adjacent to umbilicals, intermediate jumpers, etc. This disturbance will result in increased turbidity near the wellhead and subsea infrastructure removal operation, with potential for mobilization of sediment-bound chemicals in the water column near the seafloor.

4.15.3 Waste Management

The intentional release of solid waste into the marine environment is prohibited under MARPOL and national regulation. Solid waste will not intentionally be discarded in the Tamar Field or along transit corridors to shore. However, accidental loss of debris from project vessels may occasionally occur.

It is possible that debris may accidentally fall overboard during decommissioning activities in the Tamar Field. Buoyant debris and solid waste will be transported by surface currents, while heavier, non-buoyant solid waste will sink to the seafloor. Buoyant debris may or may not undergo degradation (e.g., wood, cardboard, and paper will degrade over time; plastics will degrade more slowly according to their composition). Degradation by-products may affect local water quality, including potentially leaching chemicals that may cause localized changes in water quality.

5 Proposal for Application Provisions

5.1 PROPOSALS FOR DETERMINING THE APPLICATION'S PROVISIONS

CSA (2016) provides a general description of application provisions in Section 5.1 of the 2016 document. Key findings are outlined below, followed by summary sections pertaining to CML environmental health and safety management and CML environmental policy. This section concludes by presenting a summary of potential impacts and applicable mitigation measures, including determination of residual impacts.

Key Findings:

- This section outlines applicable Environmental Health and Safety Management practices and environmental policy; summary information regarding CML's approach to these topics is provided in the following subsections.

5.1.1 Chevron Mediterranean Ltd. Environmental Health & Safety Management

CSA (2016) provides a description of Health and Safety Management in Section 5.1.1 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- Environmental, Health and Safety (EHS) management of CML activities is implemented through a hierarchy of policies, plans, and procedures that cascade from the corporate level to the business units and their individual operations.

Proposed Project:

- CML will comply with existing EHS policies, plans, and procedures, and will implement its Operational Excellence Management System (OEMS) which includes Operational Excellence (OE) standards, processes, and procedures.
- Chevron's OEMS is a comprehensive approach to systematically manage workforce safety and health, process safety, reliability and integrity, environment, efficiency, security, and stakeholder risks in order to meet its OE objectives.
- The OEMS is implemented across offshore operations and is applied to third-party contractors involved in drilling and other support activities. This ensures that all levels of operations are performed in a consistent manner such that safety and environmental protection are consistently achieved. The integration of Chevron's OEMS into contractor operations is implemented through Bridging Documents that identify common processes and approaches to address any differences in procedures between CML and the contractor as well as any site-specific- hazards of the Tamar-12 Project activities. CML will conduct an extensive comparison and review of vessel plans, processes, and procedures relative to Chevron's OEMS to ensure that the contractor's plans are acceptable for use as the primary system during the Tamar Field drilling and completion and subsea infrastructure activities.

5.1.2 Environmental Policy

CSA (2016) describes Environmental Policy in Section 5.1.2 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- As part of OEMS, CML implements several key OE processes under the environment focus area that outlines development of energy resources in a responsible manner and works diligently to reduce risks to the environment and human health. CML is committed to ensuring compliance with applicable EHS legislation, implementing best practice standards where laws do not exist, and mitigating risk while protecting the environment and the communities where the company operates.

Proposed Project:

- The Tamar-12 Project activities will be conducted in alignment with approved Facility Emergency Plan, Discharge to Sea Permit and Toxin Permit requirements.
- CML will comply with its existing OEMS, including compliance with existing EHS policies, plans, and procedures, and pending implementation of its Operations Management System (OMS).

5.1.3 Summary of Potential Impacts and Mitigation Measures

Table 5-1 outlines the impacts identified in association with the routine activities to be conducted under the proposed Tamar-12 Project and the viable mitigation measures noted for each to reduce or eliminate impact, culminating in a determination of residual risk.

Table 5-1. Summary of potential impacts, mitigation measures, likelihood, consequence, and residual risk from routine activities associated with the Tamar-12 Project.

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Artificial lighting on drillship, installation vessel, and support vessels	Sea turtles	Possible attraction of hatchlings resulting in exposure to discharges and predation	To the extent practicable without compromising safety or work performance, lighting in open deck areas will be shielded (i.e., oriented downward) to minimize excess light emissions into the environment.	3	1	3 Low
	Seabirds and migratory birds	Possible attraction and/or disorientation including circling behavior and collisions with drillship structure	Same as above	3	1	3 Low
	Fishes (pelagic)	Attraction to lights resulting in exposure to discharges and noise	Same as above	3	1	3 Low
Noise from drillship, installation vessel, support vessels, and helicopters	Marine mammals	Behavioral responses such as avoidance; potential for auditory masking	None	3	1	3 Low
	Sea turtles	Behavioral responses such as avoidance; potential for auditory masking	None	3	1	3 Low
	Fishes	Behavioral responses such as avoidance; potential for auditory masking	None	3	1	3 Low
Seafloor disturbance	Sediment quality	Physical disruption and suspension of sediments	None	3	1	3 Low
	Benthic communities	Localized burial and crushing of individual organisms; areal extent within 75 m or less of the drill site from WBM and cuttings deposition and from seafloor infrastructure installation	None	3	1	3 Low
	Water quality	Mobilization of local sediments, potential mobilization of sediment-bound contaminants, deposition of muds and cuttings	None	3	1	3 Low

Table 5-1. (Continued).

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Drilling discharges	Water quality; fishes	Turbidity within a few tens of meters to a few kilometers from discharge location (i.e., at the wellbore) Limited displacement of benthic/demersal fishes around the wellbore from turbidity and WBM and cuttings deposition	• Selection of low-toxicity MOBM • No discharge of MOBM or MOBM-wetted cuttings • Preferably, all additives to the WBM/Brine will be PLONOR or Gold-rated according to OSPAR guidelines; barite will have a low metals concentration and will comply with the Discharge to Sea Permit thresholds for mercury and cadmium; WBM and brine will be tested in accordance with Discharge to Sea Permit requirements • WBM will be sampled and tested for toxicity per the requirements of the Discharge to Sea Permit • Surface waters in the vicinity of the drillship shall be visually monitored for oil sheen on a daily basis	5	1	5 Mod
	Sediment quality	Deposition of WBM and cuttings particles on the seafloor, causing changes in grain size and mineralogy	No discharge of MOBM or MOBM-wetted cuttings	4	2	8 Mod
	Benthic communities	Localized burial and smothering of benthic organisms; burial impacts are most likely within 75 m of the drill site; anoxia and other benthic impacts may occur due to changes in sediment grain size	Background monitoring survey conducted to verify there are no deepwater corals or other hard bottom communities present	4	2	8 Mod

Table 5-1. (Continued).

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Drillship, installation vessel, support vessel routine discharges (sanitary and grey water, food waste, cooling water, desalination brine, deck drainage)	Water quality; fishes and plankton; marine mammals; sea turtles	Localized, transient impacts on water quality within a few meters to a few hundred meters of the drillship, installation vessel, or other vessels Limited, localized impacts to plankton and fishes encountering the discharge plume; avoidance expected by marine mammals and sea turtles	• Sanitary waste will pass through an IMO-approved sewage treatment plant prior to discharge • Food waste will be macerated to pass through a 25 mm mesh in accordance with MARPOL Annex V requirements, commingled with the grey water and discharged overboard more than 12 mi from shore • Drainage from hazardous areas will be collected and sent to shore for proper disposal • Bilge water and deck drainage from machinery areas will pass through an oil-water separator prior to discharge (in accordance with MARPOL Annex I requirements) or be retained on board to be disposed of onshore	3	1	3 Low
Pre-commissioning fluid discharges (including MEG and dye)	Water quality; fishes; marine mammals; sea turtles; benthic communities	Localized, transient impacts on water quality; limited potential for exposure for demersal/benthic fishes and benthic communities; no potential for exposure for marine mammals and sea turtles	Preferably, all pre-commissioning and preservation fluids will be PLONOR or Gold-rated under the Offshore Chemical Notification Scheme	4	1	4 Mod
Other discharges (ballast water)	Fishes; benthic communities	Potential introduction of AIS in ballast water	All operating project vessels will provide the following documentation for AIS clearance to minimize the risk of introducing AIS: Declaration letter with working areas in the past 5 years, Ballast Water Management Plan and international Ballast Water Management Certificate, International Anti-fouling System certificate and haul cleaning reports	3	1	3 Low

Table 5-1. (Continued).

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Support vessel traffic	Marine mammals; sea turtles	Short-term behavioral disturbance; potential for a vessel to strike a marine mammal or sea turtle	Voluntary use of trained vessel crew or observers to monitor for the presence of marine mammals or sea turtles during vessel transit	3	1	3 Low
Helicopter traffic	Marine mammals; sea turtles; seabirds and migratory birds	Short-term behavioral disturbance of marine mammals, sea turtles, or birds; potential for a helicopter to strike a bird	Maintain recommended minimum altitudes when flying over sensitive coastal habitats such as parks and preserves	3	1	3 Low
Marine debris	Water quality; sediment quality; benthic communities	Potential accumulation of metal debris on the seafloor, with growth of fouling biota	• Drillship and vessel operator's Garbage Management Plan and the additional requirements set by CML will minimize the potential for accidental loss of items overboard • Post-drilling ROV survey to ensure the seafloor is clear of equipment and debris	2-3	1	2-3 Low
	Marine mammals; sea turtles; seabirds and migratory birds; fishes	Potential entanglement, ingestion; leaching of residual chemicals due to accidental loss of debris	Drillship and vessel operator's Garbage Management Plan and the additional requirements set by CML will minimize the potential for accidental loss of items overboard	2-3	1	2-3 Low
Seafloor disturbance	Culture and heritage sites	Possible physical damage to wreck sites	305-m avoidance zone for potential wreck sites and 31-m avoidance zone for other sonar contacts	2	2	4 Low
Drilling discharges	Culture and heritage sites	Possible burial or contamination of wreck sites	305-m avoidance zone for potential wreck sites and 31-m avoidance zone for other sonar contacts	2	2	4 Low
Air emissions (drillship)	Air quality	Localized, transient elevations in air pollutant concentrations near drillship; greenhouse gas emissions	• Routine maintenance and inspection of engines and generators • Compliance with MARPOL Annex VI regulations including the use of low sulfur fuel and meeting the NOx emission limits under Regulation 13 of Annex VI	3	1	3 Low

Table 5-1. (Continued).

Aspect	Resources Affected	Potential Impact	Mitigation	Likelihood	Consequence	Residual Risk
Air emissions (installation vessel, support vessels and helicopters)	Air quality	Localized, transient elevations in air pollutant concentrations along installation and transportation routes; greenhouse gas emissions	• Routine maintenance and inspection of engines and generators • Compliance with MARPOL Annex VI regulations including the use of low sulfur fuel and meeting the NOx emission limits under Regulation 13 of Annex VI	3	1	3 Low
Physical presence and exclusion zone (drilling and completion)	Fishing activities	Exclusion of fishing vessels from 500-m buffer zone around drillship	• Provide Notice to Mariners in advance of proposed activities	1	1	1 Low
Physical presence and exclusion zone (subsea installation)	Fishing activities	Exclusion of fishing vessels from 500-m buffer zone around installation vessel	• Provide Notice to Mariners in advance of proposed activities	1	1	1 Low
Support vessel traffic	Fishing activities	Potential interactions with fishing vessels or gear during routine vessel traffic between shore base (Haifa) and the project area	• Provide Notice to Mariners in advance of proposed activities	3	1	3 Low
Safety and protection zones	Marine transportation system and infrastructure	Exclusion of vessels from 500-m buffer zone around drillship and installation vessel	• Provide Notice to Mariners in advance of proposed activities • Use standard navigation markings	2	1	2 Low
Support vessel traffic	Marine transportation system and infrastructure	Project vessel movement and interaction with other marine traffic, including port traffic	• Provide Notice to Mariners in advance of proposed activities	2	1	2 Low

5.2 PROVISIONS FOR ADDRESSING OPERATIONS

A series of key plans or provisions have been developed, or are in the process of being developed, for the Tamar-12 Project. Key plans associated with operations include the following:

- Tamar Field Development Plan: will outline the scope of drilling and completion and subsea infrastructure installation, as well as operation, of the new Tamar-12 well and associated infrastructure. This development plan, encompassing all wells within the Tamar Field and updated to accommodate Tamar-12, was submitted to the regulators.
- Ballast Water Management Plan: outlines the procedures to be following to manage ballast water, including provisions to eliminate the potential for the introduction of AIS. CML will operate in accordance with guidelines developed by IPIECA 436 and IMO Resolution MEPC.207(62) to increase awareness of AIS risks and to prepare and plan for, avoid, and monitor for such impacts throughout the project life cycle. Applicable project vessels will have a Ballast Water Management Plan and be equipped with an IMO-approved ballast water management system.
- Marine Environment Background Monitoring Plan: CML will continue to conduct monitoring in the Tamar Field, including the area encompassed by the Tamar-12 Project, per the requirements of the 2023 Tamar Field EMS plan (CSA, 2023a).
- Chemical Use Plan: This plan will summarize procedures and requirements for offshore chemical use and storage, all of which will be according to MARPOL Convention Annex II requirements.
- Oil Spill Contingency Plan (OSCP): The project-specific OSCP will include response procedures for all credible spill scenarios, as outlined previously. CML's OSCP shall outline Tier II and III equipment and resource requirements. CML will maintain appropriate oil spill response and cleanup equipment and supplies to quickly and efficiently address spill incidents. The OSCP will contain schedules for the regular maintenance and inspection of equipment, and will include those high risk spill points (e.g., bunkering hoses, storage tank valves, etc.). Offshore chemical use and storage will be according to MARPOL Convention Annex II requirements. Absorbent material will be available onboard all vessels to cleanup any deck spills or leaks, with suitable storage and disposal procedures for waste oil. Procedures will be put in place for bunker transfer and other bulk storage transfers to minimize the risk of a spillage.
- Emergency Response Plan (ERP): The ERP deal specifically with the actions to be taken in the event of emergencies; for both drilling and completion and installation of subsea infrastructure, CML will coordinate with the drillship and installation vessel contractors, aligning their incident management processes to ensure a coherent response in the event of an emergency. Emergency response capabilities for both personnel and equipment shall be tested regularly via drills and exercises to familiarize personnel with the emergency response procedures.
- Garbage Management Plan/Garbage Record Book: Per requirements outlined in MARPOL Annex V (Resolution MEPC.201[62]), all fixed or floating platforms are required to carry a Garbage Management Plan and maintain a Garbage Record Book. CML will ensure that both the drillship and installation vessel contractors have current management plans and record books which meet these requirements.
- Drillship Shipboard Oil Pollution Emergency Plan (SOPEP): CML will ensure that the drillship vessel contractor has a current SOPEP, prepared in compliance with Resolution MEPC.54(32), as amended by resolution MEPC.86(44), as well as Resolution MEPC.85(44), as amended by resolution MEPC.137(53).
- Installation Vessel Shipboard Oil Pollution Emergency Plan: Similar to the bullet above, CML will ensure that the installation vessel contractor has a current SOPEP, prepared in compliance with Resolution MEPC.54(32), as amended by resolution MEPC.86(44), as well as Resolution MEPC.85(44), as amended by resolution MEPC.137(53).

5.3 OTHER PROVISIONS

5.3.1 Drilling Execution Stages, Installation of Infrastructure, and Production Testing

5.3.1.1 Drilling and Production Test Performance

CSA (2016) describes Drilling and Production Test Performance in Section 5.2.1 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- CML will take a risk assessment approach that analyzes safety and environmental hazards and establish procedures, work practices, training programs, and equipment requirements, including monitoring and maintenance rules. Risk assessment and mitigation measures will be extended to requirements for its contractors and subcontractors who provide services and material for the drilling program.
- Drilling operations will be conducted in compliance with a series of operational procedures and instructions, including prescribed drilling procedures, well control procedures, and work instructions.
- Drilling operations will be conducted using industry best practice. The installation, maintenance and testing of the BOP will follow prescribed safety protocols.
- Drilling operations will comply with the drillship well control standards, including adherence to safe drilling practices. All drill string sections will be properly cemented to assure well integrity. At the completion of drilling, the well will be properly completed per current industry best practice and with adherence to the drillship well control standards.
- Training employees and contractors to be cognizant of company and industry practices to prevent major incidents.

Proposed Project:

- CML acknowledges compliance with the Key Findings noted above.
- CML will comply with its existing drilling performance requirements and will seek alignment with its selected drillship contractor.
- Emergency response management to incidents such as hazardous materials will be detailed in a Bridging Document between CML and the drillship contractor. The purpose of the Bridging Document is to document agreements and clarify expectations regarding the division and implementation of CML's Operational Excellence Management System (OEMS) requirements with the drillship contractor's Safety Management System (SMS). The Drillship is responsible for the response to all emergency incidents on the vessel, including those involving hazardous materials. Any spill or release overboard shall be managed by CML Emergency Response Plan.

5.3.1.2 Installation of Subsea Infrastructure

CSA (2016) describes Installation of Subsea Infrastructure in Section 3.1.2.3 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- Gas production from the Tamar Reservoir occurs through the high flow rate subsea wells into a subsea gathering system, which consists of a 10 in. infield flowline from each well to a subsea manifold. From the subsea manifold within the Tamar Field, dual 16 in. subsea pipelines transport Tamar production approximately 150 km to the Tamar Platform, where the gas is processed.
- The Tamar Field is controlled from the Tamar Platform via electrohydraulic umbilicals. The umbilicals terminate at an SDA located close to the subsea manifold. Electric power, communication, and chemicals are distributed from the SDA to the wells via individual infield umbilicals.

- Corrosion inhibitor is mixed with MEG, a hydrate inhibitor, and delivered from the Tamar Platform to the SDA via dual 4-inch supply pipelines then distributed to the wells through infield umbilicals. The processed gas is delivered to the existing Ashdod Onshore Terminal (AOT) via the existing 30 in. pipeline for gas sales into the Israel Natural Gas Line system. Tamar condensate is injected into a dedicated condensate pipeline running between the Tamar Platform and AOT receiving facility. The condensate line is one of three utility pipelines for production services installed from the Tamar Platform to AOT.

Proposed Project:
- 2016 EIA information is deemed sufficient; CML acknowledges compliance with the Key Findings noted above.
- During subsea infrastructure installation, a 500-m radius exclusion zone around the installation vessel will be kept clear of all unauthorized vessels; see **Section 5.3.14** for a discussion of safety and protection zones.

5.3.1.3 Production Testing

No production testing is planned for the Tamar-12 well.

5.3.2 Treating Hazardous Materials

CSA (2016) describes Handling of Hazardous Materials in Section 5.2.2 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:
- Hazardous materials storage areas will be designated on the drillship in areas isolated from other operations. Those storage areas will be maintained in clean condition with no residues or spilled materials on the container, floor, or surrounding area.
- Hazardous waste streams will be segregated by type according to their SDS and will not be mixed or managed in the same container with non-hazardous wastes.
- Separate storage locations or sufficient space/barriers will be provided to enable the segregation of incompatible chemicals.
- All hazardous and non-hazardous waste materials will be stored properly in containers that are non-leaking and compatible with the waste being stored. All containers will have their lids, rings, covers, bungs, and other means of closure properly installed at all times except when waste is being added or removed.
- Hazardous wastes will be handled in compliance with requirements of the Toxin Permit, as well as Israel specific hazardous waste handling guidelines (e.g., for transport and onshore disposal of MOBM), and guidelines as detailed in the drillship environmental management procedures.
- Firefighting Equipment will be available on board.

Proposed Project:
- 2016 EIA information is deemed sufficient; CML acknowledges compliance with the Key Findings noted above.
- MOBM, additives, chemicals, and their quantities will be selected prior to commencement of the project and presented in the applicable permit applications.
- MOBM cuttings throughout the drilling will be transferred to a support vessel and into skip and ship tanks to be taken to land for disposal.

- Hazardous materials will be handled in accordance with the terms and conditions of the Toxin permit received from the Ministry of Environmental Protection and in accordance with the policy of the drillship contractor. Emergency response management to incidents such as hazardous materials is detailed in a Bridging Document between CML and the drillship contractor. The purpose of the Bridging Document is to document agreements and clarify expectations regarding the division and implementation of CML's Operational Excellence Management System (OEMS) requirements with the drillship contractor's Safety Management System (SMS). The Drillship is responsible for the response to all emergency incidents on the vessel, including those involving hazardous materials. Any spill or release overboard shall be managed by CML Emergency Response Plan, as further described in **Section 4.10.1**.

5.3.3 Mitigating Harm to Soil, Seawater, and Shores

CSA (2016) describes Prevention of Harm to the Seafloor, Seawater, and Coastline (including marine ecology, culture and heritage sites, fishing, and marine farming) in Section 5.2.3 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:
- All discharges to the sea will be according to the Discharge to Sea Permit requirements.
- The operator will maintain his solids control equipment (e.g. shakers, centrifuges, screens, etc.) in acceptable operating condition, and will ensure that routine maintenance and testing is conducted.
- Drilling will be done using a combination of WBM and MOBM. The first initial well intervals (before the marine riser is set) would be drilled using seawater and a water-based mud. Once the marine riser is set, allowing mud and cuttings to be returned to the drillship, the remaining well intervals would be drilled with MOBM.
- CML will implement a 305 m radius avoidance zone for any contacts with potential wreck sites and will operate according to conditions set by the Israel Antiquity Authority (IAA); the IAA letter is provided in **Appendix L**.
- CML will operate in accordance with guidelines developed by OGP/IPIECA (IPIECA and International Association of Oil & Gas Producers, 2024) and IMO Resolution MEPC.207(62) to increase awareness of Alien Invasive Species (AIS) risks and to prepare and plan for, avoid, and monitor for such impacts throughout the project life cycle.
- The risk of solid waste being lost overboard (where it could pose a potential harm to the seafloor or to the coastline) will be minimized through CML waste management procedures and the drillship operator’s Garbage Management Plan as required by MARPOL Annex V and Israeli regulation.
- Due to the distance from shore, CML does not expect any significant impacts on fishing or marine farming.
- Prior to commencing the Tamar drilling and completion program, CML will issue a Notice to Mariners to inform fishing vessels and other vessel operators of planned vessel movements and the buffer zone around the drillship.
- Due to the distance from shore, CML does not expect any impacts on coastal habitats, infrastructure, or resources.
- In the event of a spill the response would consider the fishing and marine farming areas, as well as give high priority for protection, response and cleanup strategies regarding predominant habitat types in case the spill reaches the coast.

Proposed Project:
- 2016 EIA information is deemed sufficient; CML acknowledges compliance with the Key Findings noted above.
- CML will conduct a post-drilling survey following completion of the newly drilled well.

5.3.4 Protecting Flora and Fauna

CSA (2016) describes Preservation of Fauna and Flora, Including Pelagic Species, in Section 5.2.4 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- The risk of solid waste being lost overboard (where it could pose a risk of entanglement or ingestion by marine fauna), will be minimized through CML waste management procedures and the drillship operator's Garbage Management Plan as required by MARPOL Annex V and Israel regulation.
- To the extent practicable without compromising safety or work performance, lighting in open deck areas shall be oriented downward to maximize work areas and minimize excess light emissions into the environment and potential harm to birds and pelagic species, when feasible and when vessel navigational safety is not compromised.
- Support vessel operators are expected to follow all applicable maritime navigation rules and would normally follow the most direct route (weather conditions permitting) between the drill sites and the shore base. This will reduce the chance of a vessel striking a marine mammal or sea turtle.

Proposed Project:

- 2016 EIA information is deemed sufficient; CML acknowledges compliance with the Key Findings noted above.
- Low-toxicity drilling fluids shall be used for the MOBM system. CML will be shipping MOBM cuttings to shore for disposal (i.e., no on-site discharge of MOBM-drilled cuttings).

5.3.5 Collecting Data

CSA (2016) describes monitoring associated with data collection in Section 5.2.5 of the 2016 document within the context of Discharge Monitoring Procedures. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- Monitoring program shall be prepared and conducted following completion of drilling and completion operations at all drill sites. This post-drilling monitoring survey shall include sampling of seawater, sediments, and infauna. Reporting of results will include comparison of pre-drilling and/or marine background survey and post-drilling survey results.
- Surface waters in the vicinity of the drillship shall be visually monitored for oil sheen on a daily basis.
- Discharges shall be monitored according to Discharge to Sea Permit requirements.
- WBM will be sampled and tested for toxicity per the requirements of the Discharge to Sea Permit.

Proposed Project:

- Gas monitors for methane and H_2S will be installed on the rig and alarm systems will be connected to the monitors. The exact locations, number of monitors, and detailed response plans will be dependent on the rig selected.
- 2014, CSA conducted an EBS in the Tamar Field; in 2023, an EMS was conducted by CSA in the Tamar Field in accordance with Israeli MoE and MoEP guidelines and recommendations, including the 2019 updated offshore natural gas fields monitoring guidelines (MoE, 2019) and guidance specific to 2023 Tamar Field monitoring. Monitoring of the Tamar Field will occur every five years over the field's production life using the 2023 Tamar Field Monitoring Survey (**Appendix K**) design. Use of this previously approved design will result in findings that are directly comparable to both the 2023 Tamar Field EMS and future 5-year field-wide monitoring efforts.

- Post-drill monitoring of individual wellsites typically includes sediment sampling for metals and particle size in strata located various distances from the wellsites, as well as videographic transects to visually document the state of the seafloor surrounding each wellsite. These sampling parameters will be applied to the Tamar-12 wellsite.

5.3.6 Actions if Data Indicate Potential Environmental Harm

See **Section 5.3.5**. Based on field history of gas sampling and production data, the likelihood of H_2S abnormalities is low. Well design includes metallurgy selection (13-Chrome) to address low levels of H_2S. Additionally, the wells have the capability to inject scavenger chemicals (if necessary). Therefore, further development of H_2S contingency plans isn't deemed necessary at this time and will be addressed on a case-by-case basis.

5.3.7 Establishing Various Monitoring Systems

There is no appropriate cross reference specific to monitoring systems in CSA (2016). Within this context, new information for the proposed Tamar-12 Project is mentioned under the proposed project.

Proposed Project:
- Gas monitors for methane and H_2S will be installed on the rig and alarm systems will be connected to the monitors. The exact locations, number of monitors, and detailed response plans will be dependent on the rig selected.
- Well Control Monitoring: CML employs multiple safeguards to ensure well control. This includes, but is not limited to:
    - The International Association of Drilling Contractors (IADC) recognized Well Control Certification for members of the drilling operation team. Assures people are knowledgeable and capable to detect and react to a well control event.
    - Chevron's WellSafe assurance program, whose objective is to provide maximum reasonable assurance that well control is always maintained on all operations under the direct control of the Chevron Wells organization. Assures the rig equipment to detect and control an influx is in place and functioning and the well design is sufficiently robust to accommodate a range of subsurface uncertainties.
    - Chevron's Decision Support Center which provides continual monitoring during drilling operations from a central command center based in Houston.
    - Source control response procedures to be able to mobilize a response in the event of a loss of containment.
- Following an adaptive management approach, CML will continue to mitigate or will modify mitigation measures to further enhance resource protection. Mitigation measures are outlined in **Section 5.1.3**. Monitoring associated with data collection is summarized above in **Section 5.2.5**.

5.3.8 Measures Preventing/Mitigating Light Pollution

CSA (2016) describes Preventing/Reducing Light Hazards in Section 5.2.6 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:
- To the extent practicable without compromising safety or work performance, lighting in open deck areas shall be oriented downward to maximize work areas and minimize excess lighting of the sea surface, when feasible and when vessel navigational safety is not compromised.
- Navigational lighting onboard both the drillship, installation vessel, and support vessels will meet SOLAS requirements as per IMO Resolution MSC.253(83) or equivalent requirements.
- Helicopter flight decks shall use perimeter lighting in accordance with international standards (e.g., Basic Aviation Risk Standard, Offshore Helicopter Operations, Safety Performance Requirements issued by the Flight Safety Foundation [2016]).

Proposed Project:

- 2016 EIA information is deemed sufficient; CML acknowledges compliance with the Key Findings noted above.

5.3.9 Measures Mitigating Air Pollutant Emissions

CSA (2016) describes Reducing Air Emissions in Section 5.2.7 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- All drilling unit and support vessel engines, generators, and other emission sources will be operated and maintained in accordance with manufacturers' recommendations to avoid excessive emissions.
- The drilling unit and support vessels will comply with applicable MARPOL Annex VI regulations.
- During drilling of the well, every attempt will be made to ensure that no H_2S gas is released into the atmosphere. This will be done by keeping the wellbore full of drilling mud that is of sufficient density to exert a hydrostatic pressure greater than formation pressure, which will ensure that no influx into the wellbore will occur.
- Mud logging personnel will install and maintain H_2S detection equipment at strategic locations on the rig. The Control Room Operator and supervisory personnel will be alerted should H_2S be detected.

Proposed Project:

- 2016 EIA information is deemed sufficient; CML acknowledges compliance with the Key Findings noted above, with minor modifications noted below (i.e., addition of installation vessel for subsea infrastructure installation).
- All drillship, installation vessel, and support vessel engines, generators, and other emission sources will be operated and maintained in accordance with manufacturers' recommendations to avoid excessive emissions.
- The drillship, installation vessel, and support vessels will comply with applicable MARPOL Annex VI regulations.

5.3.10 Measures Preventing or Reducing Noise

CSA (2016) describes Measures for Preventing or Reducing Noise in Section 5.2.8 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- Drilling unit and support vessel engines will be operated and maintained in accordance with manufacturers' specifications to avoid excessive noise.

Proposed Project:

- 2016 EIA information is deemed sufficient; CML acknowledges compliance with the Key Findings noted above, with minor modifications noted below (i.e., addition of installation vessel for subsea infrastructure installation).
- Drillship, installation vessel, and support vessel engines will be operated and maintained in accordance with manufacturers' specifications to avoid excessive noise.

5.3.11 Measures for Mud and Cuttings Disposal

CSA (2016) describes Drilling Mud and Cuttings and Other Discharges; see Section 5.2.9 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- Drilling will be done using a combination of WBM and MOBM. The first two initial well intervals (before the marine riser is set) would be drilled using a water-based mud. Once the marine riser is set, allowing mud and cuttings to be returned to the drillship, the remaining well intervals would be drilled with MOBM.
- Low-toxicity drilling fluids shall be used. The base fluid for the MOBM system is a highly refined product with low toxicity and low aromatic content. According to the SDS (**Appendix E**), the base fluid is readily biodegradable and not expected to be harmful or exhibit chronic toxicity to marine organisms.

Proposed Project:

- Currently, CML anticipates the selection of a base MOBM fluid (similar to for the mud system (**Appendix C**).
- No on-site discharge of MOBM will occur; cuttings drilled using MOBM will be containerized and shipped to shore for proper disposal.
- Drilling operations will be subject to the Discharge to Sea Permit limits, the latter of which will define conditions, discharge monitoring, sampling analysis methods, frequencies, limits and reporting.
- The equipment on board the drillship, including slops oil in water separators, will comply with the requirements of the International Convention for the Prevention of Pollution from Ships 1973, as amended by the Protocol of 1978 (MARPOL 73/78).

5.3.12 Measures for Treating Discharges

CSA (2016) describes Other Discharges in Section 5.2.10 of the 2016 document, including discussion of the treatment of project-related discharges. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- All drilling unit discharges to sea will comply with the appropriate requirements of MARPOL Annex I (oil pollution prevention), Annex IV (sewage pollution prevention), Annex V (garbage pollution prevention), and the discharge permit requirements.
- Sanitary waste will pass through an IMO-approved sewage treatment plant prior to discharge to sea.
- Grey water will be discharged to sea without treatment.
- Food waste will be macerated to pass through a 25-mm mesh in accordance with MARPOL Annex V requirements.
- Cooling water, desalination brine, and deck drainage from non-machinery areas will be discharged without treatment as these effluents do not contain any added chemicals or contaminants.
- Bilge water and deck drainage from machinery areas will pass through an OWS prior to discharge to sea (in accordance with MARPOL Annex I requirements) or be retained on board to be disposed of onshore.
- The drilling unit will have a Ballast Water Management Plan and be equipped with an IMO-approved ballast water management system to minimize the risk of introducing AIS.

Proposed Project:

- 2016 EIA information is deemed sufficient; CML acknowledges compliance with the Key Findings noted above.
- Waste management will comply with conditions set in the Toxin Permit and in the Discharge to Sea Permit provided by the Ministry of Environmental Protection.
- See **Section 5.3.13** for additional information regarding waste treatment and removal.

5.3.13 Methods of Waste Treatment and Removal

CSA (2016) describes Waste Treatment and Removal in Section 5.2.12 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:
- All wastes shall be handled and disposed according to MARPOL regulations and permit requirements.
- All waste materials shall be stored properly in containers that are non-leaking and compatible with the waste being stored. All containers will have their lids, rings, covers, bungs, and other means of closure properly installed at all times except when waste is being added or removed.
- Waste containers will be stored in these areas prior to processing or shipment to the contract waste handling vendor.

Proposed Project:
- Waste management will comply with conditions set in the Toxin Permit and in the Discharge to Sea Permit provided by the MoEP.

5.3.14 Establishing Safety and Protection Zones

CSA (2016) describes Safety and Protection Zones, or exclusion zones; see Section 5.2.11 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:
- CML will establish a 500 m radius safety zone around the drilling rig, which will be kept clear of all unauthorized vessels. A continuous bridge watch on the drilling unit will be maintained to ensure compliance with the safety zone.
- Navigational markings on board the drilling unit and support vessels will meet SOLAS requirements as per IMO Resolution MSC.253(83) or equivalent requirements.
- Prior to commencing the Tamar Field drilling and completion program, CML will consult with Ministry of Transportation and provide Notice to Mariners to inform the public of planned vessel movements and the safety zone around the drilling unit.

Proposed Project:
- 2016 EIA information is deemed sufficient; CML acknowledges compliance with the Key Findings noted above, with minor modifications noted below (i.e., addition of installation vessel for subsea infrastructure installation).
- CML will establish a 500 m radius exclusion zone around the drillship and installation vessel, which will be kept clear of all unauthorized vessels. A continuous bridge watch will be maintained to ensure compliance with the safety zone.
- Prior to commencing the Tamar Field drilling and completion program and the subsea infrastructure installation operations, CML will consult with Ministry of Transportation and provide Notice to Mariners to inform the public of planned vessel movements and the exclusion zone around the drillship and installation vessel.
- Navigational markings onboard the drillship, installation vessel, and support vessels will meet SOLAS requirements as per IMO Resolution MSC.253(83) or equivalent requirements.

5.3.15 Preparing Emergency Procedures

CSA (2016) describes Emergency Procedures; see Section 5.2.13 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:

- CML will update the Oil Spill Contingency Plan (OSCP) to reflect the addition of Tamar-12 drilling and completion and associated subsea infrastructure installation activities. The plan will be submitted to MoEP.
- Accidental spills shall be reported to the relevant authorities.
- CML's OSCP outlines Tier II and III equipment and resource requirements. CML will maintain appropriate oil spill response and cleanup equipment and supplies to efficiently address spill incidents.
- CML requires the drillship and installation vessel contractor(s) to have Emergency Response Plans to deal specifically with the actions to be taken in the event of emergencies.
- CML and the vessel contractors (i.e., drillship, installation vessel) will coordinate their incident management processes in the event of an emergency that requires emergency response coordination via incident management teams.
- Emergency response capabilities of equipment and personnel shall be tested through regular drills and exercises and drills to familiarize personnel with the emergency response procedures.
- Equipment stockpiles onshore and aboard support vessels shall be checked routinely.
- CML conducts oil spill dispersion modeling to determine likely trajectories and resources at risk.

Proposed Project:

- Gas monitors for methane and H_2S will be installed on the rig and alarm systems will be connected to the monitors. The exact locations, number of monitors, and detailed response plans will be dependent on the rig selected and is something that will be finalized during the detailed planning stage.
- Information in the CSA (2016) document is sufficient for assessment purposes. CML acknowledges compliance with the Key Findings noted above.

5.3.16 Operations to be Performed at Well Decommissioning

No plan currently exists for the decommissioning and abandonment of wells or subsea infrastructure associated with the Tamar Field, including the Tamar-12 Project. As the Tamar Field nears the end of its productive life, and prior to decommissioning, CML will conduct an environmental impact assessment to determine the most environmentally friendly method of decommissioning and will obtain approval from appropriate Ministry authorities. A comparative assessment and net environmental benefit analysis may also be performed to further characterize and quantify various decommissioning options (e.g., full removal, partial removal, abandonment in place). Existing regulatory requirements at the time of decommissioning will provide the primary framework for decommissioning options to be considered and will be formulated into an abandonment plan.

The abandonment plan, once developed, will include a description of decommissioning project management and engineering, well plugging and abandonment, cleaning and flushing activities, disconnection of subsea and gathering systems, and the fate of removed wellheads and subsea infrastructure (e.g., shore disposal). The abandonment plan will outline a proposed execution schedule and any post-decommissioning requirements (e.g., a post-abandonment survey may be required).

5.3.17 Reporting

CSA (2016) addresses Coordination Team and Reporting in Section 5.2.18 of the 2016 document. This subsection addresses periodic reporting and incident notification. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:
- CML shall nominate its representative to the Coordination Team, by request of the MEWR.

Proposed Project:
- Periodical reporting shall be done according to the specific requirements laid out in the Discharge to Sea Permit and Toxin Permit conditions.
- Reporting will be conducted in accordance with MoE and MoEP guidelines, including for irregular events (MoEP, 2021).
- Incident notification shall be done according to CML's incident notification procedure.

5.3.18 Changes to the Development Plan

CSA (2016) addresses Changes in Development Plan in Section 5.2.16 of the 2016 document. New information for the proposed Tamar-12 Project is mentioned under the proposed project.

Key Findings:
- CML will periodically report any changes in the drilling and completion plan, including the impact of such changes on the environment.

Proposed Project:
- CML will periodically report any changes in the Field Development Plan (FDP), including drilling and completion and installation operations, and including the impact of such changes on the environment. For the Tamar-12 Project, the current 2022 version of the FDP notes the Tamar-12 well. Because Tamar-12 is the next well to be drilled in the Tamar Field, CML has initiated an update. A revised FDP for the Tamar Field was submitted to MoE.

6 List of Preparers and Qualifications

Preparers and their qualifications are provided in **Appendix M**.

7 Literature Cited

40 CFR 141.66. Maximum contaminant levels for radionuclides. Accessed 25 March 2025 at: https://www.ecfr.gov/current/title-40/section-141.66.

ACCOBAMS. 2012. Species occurring in the ACCOBAMS area. Updated February 2023. Accessed 1 February 2024 at: https://accobams.org/category/species_cat/cetacean-species/

ACCOBAMS. 2022. Second Hotspots Report: Updated Overview of the Noise Hotspots in the ACCOBAMS Agreement Area. Eighth Meeting of the Parties to ACCOBAMS. Malta, 29 November - 2 December 2022. ACCOBAMS-MOP8/2022/Inf43. 42 pp.

Anderson, C.M., M. Mayes, and R.P. LaBelle. 2012. Update of Comparative Occurrence Rates for Offshore Oil Spills. U.S. Department of the Interior, Bureau of Ocean Energy Management, Herndon, VA. OCS Report BOEM 2012-069.

ASL Environmental Sciences, Inc. 2009. Tamar Metocean Desktop Study, Draft Version. Prepared for Noble Energy, Houston, TX. July 2009. ASL File: PR-658. 46 pp.

Atake, I., G. Accarino, M. Carlo, D. Elia, G. Coppini, and G. Aloisio. 2024. Optimizing Parametrization through a Bayesian search algorithm applied at the Baniyas oil spill incident (Syria, 2021), EGU General Assembly 2024, Vienna, Austria, 14-19 Apr 2024, EGU24-7256. doi: 10.5194/egusphere-egu24-7256.

Austin, M.E., D.E. Hannay, and K.C. Broker. 2018. Acoustic characterization of exploration drilling in the Chukchi and Beaufort seas. Journal of the Acoustical Society America 144(1): 115-123.

Azov, Y. 1986. Seasonal patterns of phytoplankton productivity and abundance in nearshore oligotrophic waters of the Levant Basin (Mediterranean). Journal of Plankton Research 30(1): 41-53.

Baird, P.H. 1990. Concentrations of seabirds at oil-drillships. Condor 92: 768-771.

Bakke, T., J. Klungsøyr, and S. Sanni. 2013. Environmental impacts of produced water and drilling waste discharges from the Norwegian offshore petroleum industry. Marine Environmental Research 92: 154-169.

Bayon, G., L. Loncke, S. Dupré, J.-C. Caprais, E. Ducassou, S. Duperron, J. Etoubleau, J.-P. Foucher, Y. Fouquet, S. Gontharet, G.M. Henderson, C. Huguen, I. Klaucke, J. Mascle, S. Migeon, K. Olu-Le Roy, H. Ondréas, C. Pierre, M. Sibuet, A. Stadnitskaia, and J. Woodside. 2009. Multi-disciplinary investigation of fluid seepage on an unstable margin: The case of the Central Nile deep-sea fan. Marine Geology 261: 92-104.

BirdLife International. 2025. Israel: Accessed 12 March 2025 at: https://datazone.birdlife.org/country/factsheet/israel

Blackstock, S.A., J.O. Fayton, P.H. Hulton, T.E. Moll, K. Jenkins, S. Kotecki, E. Henderson, V. Bowman, S. Rider, and C. Martin. 2018. Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing. Newport, RI: Naval Undersea Warfare Center Division. NUWC-NPT Technical Report. 51 pp.

Blackwell, S., C. Greene, and W. Richardson. 2004. Drilling and operational sounds from an oil production island in the ice-covered Beaufort Sea. Journal of the Acoustical Society of America 116(5): 3,199-3,211.

Blumberg, A.F. and G.L. Mellor. 1987. A three dimensional coastal ocean circulation model, pp. 1-16. In: Heaps, N. (ed.), Three Dimensional Coastal Ocean Models. American Geophysical Union, Washington, DC. doi: 10.1029/CO004p0001.

Boehm, P.D., D. Turton, A. Ravel, D. Caudle, D. French, N. Rabalais, R. Spies, and J. Johnson. 2001. Deepwater Program: Literature Review, Environmental Risks of Chemical Products Used in Gulf of Mexico Deepwater Oil and Gas Operations. Vol. 1. Technical Report. OCS Study MMS 2001-011. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Bolten, A.B. and B.E. Witherington (eds.). 2003. Loggerhead Sea Turtles. Smithsonian Books, Washington DC. 319 pp.

Bowen, B.W., A.B. Meylan, J.P. Ross, C.J. Limpus, G.H. Balazs, and J.C. Avise. 1992. Global population structure and natural history of the green turtle (*Chelonia mydas*) in terms of matriarchal phylogeny. Evolution 46: 865-881.

Bowen, B.W., J.C. Avise, J.I. Richardson, A.B. Meylan, D. Margaritoulis, and S. Hopkins-Murphy. 1993. Population structure of the loggerhead turtle (*Caretta caretta*) in the northwest Atlantic Ocean and Mediterranean Sea. Conservation Biology 7: 834-844.

Brand D., D. Edelist, O. Goffman, N. Hadar, A. Scheinin, and D. Kerem. 2019. Common dolphins, common in neritic waters off southern Israel, demonstrate uncommon dietary habits. Aquatic Conservation: Marine and Freshwater Ecosystems 31: 15-21. doi: 10.1002/aqc.3165.

Brenner, S. 2003. High-resolution nested model simulations of the climatological circulation in the southeastern corner of the Mediterranean Sea. Annales Geophysicae 21: 267-280.

Brenner, S., I. Gertman, and A. Murashkovsky. 2007. Pre-Operational Ocean forecasting in the southeastern Mediterranean: Model implementation, evaluation, and the selection of atmospheric forcing. Journal of Marine Systems 65: 268-287. doi: 10.1016/j.jmarsys.2005.11.018.

Bureau of Ocean Energy Management, Bureau of Safety and Environmental Enforcement, and U.S. Environmental Protection Agency (BOEM, BSEE, and USEPA). 2023. Best Management Practices for Fulfilling ESA and EFH Obligations When Conducting Offshore Wind Site Characterization and Site Assessment Activities in the Gulf of Mexico. Prepared by the Bureau of Ocean Energy Management, with the Bureau of Safety and Environmental Enforcement and the U.S. Environmental Protection Agency. April 18, 2023. 35 pp.

Bureau of Ocean Energy Management. 2012. Gulf of Mexico OCS Oil and Gas Lease Sales: 2012-2017. Western Planning Area Lease Sales 229, 233, 238, 246, and 248; Central Planning Area Lease Sales 227, 231, 235, 241, and 247. Final Environmental Impact Statement. OCS EIS/EA BOEM 2012-019. July 2012.

Bureau of Ocean Energy Management. 2020. Gulf of Mexico Air Emissions for EP's. Form 0138. Accessed 15 January 2025 at: https://www.boem.gov/BOEM-0138/.

Byles, R.A. 1989. Satellite telemetry of Kemp's ridley sea turtle, *Lepidochelys kempi*, in the Gulf of Mexico, pp. 25-26. In: S.A. Eckert, K.L. Eckert, and T.H. Richardson (comps.), Proceedings of the Ninth Annual Workshop on Sea Turtle Conservation and Biology. 7-11 February 1989, Jekyll Island, GA. NOAA Technical Memorandum NMFS-SEFC-232. Miami, FL. 306 pp.

Carr, A. and A.B. Meylan. 1980. Evidence of passive migration of green turtle hatchlings in *Sargassum*. Copeia 2:366-368.

Cartes, J.E., F. Maynou, F. Sardà, J.B. Company, D. Lloris, and S. Tudela. 2004. Mediterranean deep-sea ecosystems: an overview of their diversity, structure, functioning and anthropogenic impacts, pp. 9-38. In: WWF/IUCN (ed.), Mediterranean deep-sea ecosystems: an overview of their diversity, structure, functioning and anthropogenic impacts with a proposal for conservation. Malaga and Rome.

Castellote, M., C.W. Clark, and M.O. Lammers. 2010. Potential negative effects in the reproduction and survival on fin whales (*Balaenoptera physalus*) by shipping and airgun noise. International Whaling Commission Report SC/62/E3. Accessed 15 January 2025 at: http://www.researchgate.net/publication/242570491_Potential_negative_effects_in_the_reproduction_and_survival_on_fin_whales_%28_Balaenoptera_physalus_%29_by_shipping_and_airgun_noise.

Center for Marine Acoustics. 2023. Sound source list: a description of sounds commonly produced during ocean exploration and industrial activity. Report No. BOEM OCS 2023-016. U.S. Department of the Interior, Bureau of Ocean Energy Management, Sterling, VA. 69 pp.

Christaki, U., A. Giannakourou, F. Van Wambeke, and G. Grégori. 2001. Nanoflagellate predation on auto-and heterotrophic picoplankton in the oligotrophic Mediterranean Sea. Journal of Plankton Research 23(11): 1297-1310.

Clark, C.W., W.T. Ellison, B.L. Southall, L. Hatch, S.M. Van Parijs, A. Frankel, and D. Ponirakis. 2009. Acoustic masking in marine ecosystems: Intuitions, analysis, and implication. Marine Ecology Progress Series 395: 201-222.

Coleman, D. and R.D. Ballard. 2001. A highly concentrated region of cold hydrocarbon seeps in the southeastern Mediterranean Sea. Geo-Marine Letters 21: 162-167.

Continental Shelf Associates, Inc. 2004. Final Report: Gulf of Mexico Comprehensive Synthetic Based Muds Monitoring Program. Report prepared for SBM Research Group, Houston, TX. October 2004. 3 vols.

Continental Shelf Associates, Inc. 2006. Effects of Oil and Gas Exploration and Development at Selected Continental Slope Sites in the Gulf of Mexico. Volume I: Executive Summary; Volume II: Technical Report; Volume III: Appendices. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-044 (51 pp.), 2006-045 (636 pp.), and 2006-046 (938 pp.).

Coppini, G., M. De Dominicis, G. Zodiatis, R. Lardner, N. Pinardi, R. Santoleri, S. Colella, F. Bidnami, D.R. Hayes, D. Soloviev, G. Georgiou, and G. Kallos. 2011. Hindcast of oil-spill pollution during the Lebanon crisis in the Eastern Mediterranean, July-August 2006. Marine Pollution Bulletin 62: 140-153.

CSA Ocean Sciences Inc. (CSA). 2012. Environmental Impact Assessment Tamar Field Development Project, Offshore Israel. Prepared for Noble Energy Mediterranean Ltd.

CSA Ocean Sciences Inc. (CSA). 2013. Tamar Environmental Monitoring Program. Tamar Field and Pipeline Survey. Prepared for Noble Energy Mediterranean, Ltd. 81 pp.

CSA Ocean Sciences Inc. (CSA). 2014. Tamar Field Background Monitoring Survey Report. Prepared for Noble Energy Mediterranean Ltd. July 2014. CSA-Noble-FL-14-2650-06-REP-VER02. 132 pp. + apps.

CSA Ocean Sciences Inc. (CSA). 2015. Leviathan Field Development Background Monitoring Survey Report: Drilling Component. Prepared for Noble Energy Mediterranean Ltd. 110 pg.

CSA Ocean Sciences Inc. (CSA). 2016. Tamar Field Development Project, Environmental Impact Assessment, Tamar-7, 8, 9 Drilling and completion; Tamar SW-1 completion, Offshore Israel. March 2016. Prepared for Noble Energy Mediterranean, Ltd., Houston, TX. 320 pp.

CSA Ocean Sciences Israel Ltd. (CSA). 2023a. Environmental Monitoring Program, Tamar Field, Offshore Israel, January 2023 Marine Environmental Monitoring Survey Report. Prepared for Chevron Mediterranean Limited. 90 pp. + app.

CSA Ocean Sciences Inc. (CSA). 2023b. Tamar Noise and Light Assessment. Prepared for Chevron Mediterranean Limited. 104 pp. + app.

CSA Ocean Sciences Inc. (CSA). 2023c. Leviathan-8 Environmental Post-Drilling Survey, Offshore Israel. Final. November 2023. Prepared for Chevron Mediterranean Limited. 56 pp. + app.

Danovaro, R., J.B. Company, C. Corinaldesi, G. D'Onghia, B. Galil, C. Gambi, A.J. Gooday, N. Lampadariou, G.M. Luna, C. Morigi, K. Olu, P. Polymenakou, E. Ramirez-Llodra, A. Sabbatini, F. Sardà, M. Sibuet, and A. Tselepides. 2010. Deep-sea biodiversity in the Mediterranean Sea: the known, the unknown, and the unknowable. PLoS ONE 5(8): e11832.

Dayan, U. and I. Levy. 2002. Relationship between synoptic-scale atmospheric circulation and ozone concentrations over Israel. Journal of Geophysical. Research 107(D24):31/1-31/8.

De Dominicis, M., N. Pinardi, G. Zodiatis, and R. Archetti. 2013b. a Lagrangian marine surface oil spill model for short-term forecasting – Part 2: Numerical simulations and validations. Geoscientific Model Development 6: 1871-1888. doi: 10.5194/gmd-6-1871-2013.

De Dominicis, M., N. Pinardi, G. Zodiatis, and R. Lardner. 2013a. M , a Lagrangian marine surface oil spill model for short-term forecasting – Part 1: Theory, Geoscientific Model Development 6: 1851-1869. doi: 10.5194/gmd-6-1851-2013.

Dee, D.P., S.M. Uppala, A.J. Simmons, P. Berrisford, P. Poli, S. Kobayashi, U. Andrae, M.A. Balmaseda, G. Balsamo, P. Bauer, P. Bechtold, A.C.M. Beljaars, L. van de Berg, J. Bidlot, N. Bormann, C. Delsol, R. Dragani, M. Fuentes, A.J. Geer, L. Haimberger, S.B. Healy, H. Hersbach, E. V. Hólm, L. Isaksen, P. Kållberg, M. Köhler, M. Matricardi, A.P. McNally, B.M. Monge-Sanz, J.-J. Morcrette, B.-K. Park, C. Peubey, P. de Rosnay, C. Tavolato, J.-N. Thépaut, and F. Vitart. 2011. The ERA-Interim reanalysis: configuration and performance of the data assimilation system. Quarterly Journal of the Royal Meteorological Society 137: 553-597. doi: 10.1002/qj.828.

Dilek, Y. and E. Sandvol. 2009. Seismic structure, crustal architecture and tectonic evolution of the Anatolian-African Plate Boundary and the Cenozoic Orogenic Belts in the Eastern Mediterranean Region. Geological Society, London, Special Publications 327: 127-160.

Dimitrov, L. and J. Woodside. 2003. Deep sea pockmark environments in the eastern Mediterranean. Marine Geology 195: 263-276.

Dinevich, L. and Y. Leshem. 2010. Radar monitoring of seasonal bird migration over central Israel. The Ring 32: 1-2.

DOF Subsea UK Ltd. 2010. Route and site evaluation surveys at Tamar and Dalit Field development, offshore geophysical and geotechnical: Final report. Volume 1: Survey results and discussion. DOF Subsea Document No. DSL-3000056-5010-RP. Tamar Document Number TAM-SS-SPR-SUR-0005-001. 440 pp.

Douglas, A.B., J. Calambokidis, S. Raverty, S.J. Jeffries, D.M. Lambourn, and S.A. Norman. 2008. Incidence of ship strikes of large whales in Washington State. Journal of the Marine Biological Association UK 88(06): 1,121-1,132.

Dow Piniak, W.E., D.A. Mann, S.A. Eckert, and C.A. Harms. 2012. Amphibious hearing in sea turtles, pp. 83-87. In: Popper, A.N. and A. Hawkins (eds.), The Effects of Noise on Aquatic Life. Advances in Experimental Medicine and Biology, Vol. 730. Springer.

DP World. 2023. DP World Limassol Performance 2022 (infographic). Accessed 25 March 2025 at: https://www.dpworld.com/cyprus/media/news-events/dp-world-limassol-infographic-performance-2022.

Duarte, C.M., L. Chapuis, S.P. Collin, D.P. Costa, R.P. Devassy, V.M. Eguiluz, C. Erbe, T.A.C. Gordon, B.S. Halpern, H.R. Harding, M.N. Havlik, M. Meekan, N.d. Merchant, J.L. Miksis-Olds, M. Parsons, M. Predragovic, A.N. Radford, C.A. Radford, S.D. Simpson, H. Slabbekoorn, E. Staaterman, I.C. Van Opzeeland, J. Winderen, X. Zhang and F. Juanes. 2021. The soundscape of the Anthropocene ocean. Science 371(6529): eaba4658.

Eckle, P., P. Burgherr, and E. Michaux. 2012. Risk of large oil spills: A statistical analysis in the aftermath of *Deepwater Horizon*. Environmental Science & Technology 46(23): 13,002-13,008.

Efroymson, R.A., W.H. Rose, S. Nemeth, and G.W. Suter II. 2000. Ecological Risk Assessment Framework for Low-Altitude Overflights by Fixed-Wing and Rotary-Wing Military Aircraft. ORNL/TM-2000/289. Oak Ridge, TN: Oak Ridge National Laboratory. 115 pp.

Ellison, W.T., B.L. Southall, C.W. Clark, and A. Frankel. 2012. A new context-based paradigm to assess behavioral responses of marine mammals to sound. Conservation Biology 26: 21-28.

Erbe, C. and C. McPherson. 2017. Underwater noise from geotechnical drilling and standard penetration testing. The Journal of the Acoustical Society of America 142: EL281-EL285. doi: 10.1121/1.5003328.

Fay, R.R. and A.N. Popper. 2000. Evolution of hearing in vertebrates: The inner ears and processing. Hearing Research 149: 1-10.

Federal Aviation Administration. 2004. Advisory Circular 91-36D. Visual flight rules flight near noise-sensitive areas. September 17, 2004. 2 pp. Accessed 15 January 2025 at: https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentid/23156.

Finneran, J.J., E.E. Henderson, D.S. Houser, K. Jenkins, S. Kotecki, and J. Mulsow. 2017. Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III). Technical report by Space and Naval Warfare Systems Center Pacific (SSC Pacific). 183 pp.

Flight Safety Foundation. 2016. Basic Aviation Risk Standard, Offshore Helicopter Operations, Safety Performance Requirements. Version 3, December 2016. Flight Safety Foundation, Alexandria, Virginia, US. 221 pp.

Fraser, G.S., J. Russell, and W.M. Von Zharen. 2006. Produced water from offshore oil and gas installations on the Grand Banks, Newfoundland and Labrador: Are the potential effects to seabirds sufficiently known? Marine Ornithology 34: 147-156.

Galil, B.S. 2004. The limit of the sea: the bathyal fauna of the Levantine Sea. Scientia Marina 68: 63-72.

Galil, B.S. 2006. The marine caravan - the Suez Canal and the Erythrean invasion, pp. 207-300. In: S. Gollasch, B.S. Galil, and A. Cohen (eds.), Bridging Divides. Kluwer Academic Publishers, Dordrecht, the Netherlands.

Galil, B.S. and M. Goren. 1994. The deep sea Levantine fauna. New records and rare occurrences. Senckenbergiana Maritima 25(1/3): 41-52.

Gallaway, B.J. and G.S. Lewbel. 1982. The Ecology of Petroleum Platforms in the Northwestern Gulf of Mexico: A Community Profile. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-82/27. 92 pp.

Gallaway, B.J., J.G. Cole, and L.R. Martin. 2008. Platform Debris Fields Associated with the Blue Dolphin (Buccaneer) Gas and Oil Field Artificial Reef Sites Offshore Freeport, Texas: Extent, Composition, and Biological Utilization. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study 2008-048.

Gardline Surveys Inc. 2012. Noble Energy Inc., 3D Geohazard Assessment, Offshore Israel, Tamar SW Prospect, Proposed Tamar SW Well Location. Well Clearance Letter and Anchoring Assessment. June 2012. Gardline Project Ref. 9205. Prepared for Noble Energy Inc., Houston, TX. Issued September 19, 2012. 39 pp.

Gardline Surveys Inc. 2013a. 3D Geohazard Assessment Offshore Israel. Tamar Prospect Proposed Tamar-7 Well Location Well Clearance Letter. Final report prepared for Noble Energy Inc.

Gardline Surveys Inc. 2013b. 3D Geohazard Assessment Offshore Israel. Tamar Prospect Proposed Tamar-8 Well Location Well Clearance Letter. Final report prepared for Noble Energy Inc.

Gardline Surveys Inc. 2014. 3D Geohazard Assessment Offshore Israel. Tamar Prospect Proposed Tamar-9 Well Location Well Clearance Letter. Final report prepared for Noble Energy Inc.

Gardline Surveys Inc. 2016. Well Clearance Letter – Tamar Area, Offshore Israel – Proposed Tamar-8 Well Location. Gardline Report 10722 prepared for Noble Energy, Inc.

Geological Survey of Israel (GSI). 2023. Marine Geohazards Offshore Israel: Geological Information for Infrastructure Design. Final Report submitted for the Ministry of Energy. Report GSI/10/2023. 109 pp.

Geological Survey of Israel (GSI). 2025. Recent earthquakes. Accessed 25 March 2025 at: https://eq.gsi.gov.il/en/indexEn.php.

Geo-prospect Ltd. and Israel Oceanographic and Limnological Research (IOLR). 2016. Offshore Oil and Gas Exploration and Production Strategic Environmental Assessment (SEA). Prepared for the Israel Ministry of National Infrastructure, Energy and Water Resources.

Geraci, J.R. and D.J. St. Aubin. 1987. Effects of offshore oil and gas development on marine mammals and turtles, pp. 587-617. In: D.F. Boesch and N.N. Rabalais (eds.), Long Term Environmental Effects of Offshore Oil and Gas Development. Elsevier Applied Science Publishers Ltd., London and New York.

Golder Associates, ABR, Inc. Environmental Research & Services, and Rolf Bergman Consulting. 2007. Literature Review, Synthesis, and Design of Monitoring of Ambient Artificial Light Intensity on the OCS Regarding Potential Effects on Resident Marine Fauna. Report for the U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region, Anchorage, AK. OCS Study MMS 2007-055.

Greene, C.R. 1987. Underwater sounds from the submersible drill rig SEDCO 708 drilling in the Aleutian Islands. American Petroleum Institute. 120 pp.

Greer, R.D., R.H. Day, and R.S. Bergman. 2010. Effects of Ambient Artificial Light on Arctic Marine Fauna. Interaction of Oil and Gas Activities with Sensitive Coastal Habitats, Northern Oil and Gas Research Forum, December 1, 2010.

Haifa Port. 2024. Haifa Port – Our Story. Accessed 15 January 2025 at https://www.haifaport.co.il/en/our-story/.

Harding, S. and N. Cousins. 2022. Review of the Impacts of Anthropogenic Underwater Noise on Marine Biodiversity and Approaches to Manage and Mitigate them. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series No. 99. 145 pp.

He, R., A. Tsouvalas, X. Xu, and L. Dong. 2023. Editorial: Noise and vibrations in offshore wind farms and their impact on aquatic species. Front. Mar. Sci. 10:1293733. doi: 10.3389/fmars.2023.1293733.

Herut, B., A. Almogi-Labin, N. Jannink, and I. Gertman. 2000. The seasonal dynamics of nutrient and chlorophyll *a* concentrations on the SE Mediterranean shelf-slope. Oceanologica Acta 23:771-782.

Herut, B., M.D. Krom, G. Pan, and R. Mortimer. 1999. Atmospheric input of nitrogen and phosphorus to the Southeast Mediterranean: Sources, fluxes, and possible impact. Limnology and Oceanography 44: 1,683-1,692.

Higashi, G.R. 1994. Ten years of fish aggregating device (FAD) design and development in Hawaii. Bulletin of Marine Science 55(2-3): 651-666.

Hildebrand, J.A. 2009. Anthropogenic and natural sources of ambient noise in the ocean. Marine Ecology Progress Series 395: 5-20.

Holland, K.R., R.W. Brill, and R.K. Chang. 1990. Horizontal and vertical movements of yellowfin and bigeye tuna associated with fish aggregating devices. Fishery Bulletin 88: 493-507.

Huang, L-F., X-M. Xu, L-L. Yang, S-Q. Huang, X-H. Zhang, and Y-L. Zhou. 2023. Underwater noise characteristics of offshore exploratory drilling and its impact on marine mammals. Frontiers in Marine Science 10: 1097701. doi: 10.3389/fmars.2023.1097701.

International Association of Oil & Gas Producers. 2010. Risk assessment data directory: Blowout frequencies. IAGP Report No. 434-2. March 2010.

International Maritime Organization. 2004. International Convention for the Control and Management of Ship's Ballast Water and Sediments (BWM).

International Organization for Standardization. 2004. ISO 14001. Environmental Management Systems – Requirements with Guidance for Use. Reference No. ISO 14001.2004(E).

International Union for Conservation of Nature (IUCN) 2023. The conservation status of cetaceans in the Mediterranean Sea: trends and changes after a decade of conservation efforts. Gland, Switzerland: IUCN.

International Union for Conservation of Nature (IUCN). 2025. The IUCN Red List of Threatened Species. Version 2024-2. Accessed 15 January 2025 at: http://www.iucnredlist.org.

IPIECA and International Association of Oil & Gas Producers. 2024. Invasive alien species and the energy industry: Guidance for prevention and management. Accessed 15 January 2025 at https://www.ipieca.org/resources/invasive-alien-species-and-the-energy-industry.

Israel Natures and Parks Authority. 2025. Rosh Carmel Marine Reserve. Accessed 25 March 2025 at: https://www.parks.org.il/reserve-park/%D7%A9%D7%9E%D7%95%D7%A8%D7%AA-%D7%99%D7%9D-%D7%A8%D7%90%D7%A9-%D7%9B%D7%A8%D7%9E%D7%9C/

Israel Oceanographic and Limnological Research (IOLR). 2015. Strategic Environmental Survey for Exploration and Production of Oil and Natural Gas at Sea. Part C. Report H20/2015.

Israel Oceanographic and Limnological Research (IOLR). 2021. Habitats update- December 2021. IOLR Report H47/2021. Accessed 25 March 2025 at: https://www.gov.il/BlobFolder/guide/enviromental_info/he/Sea_2021_habitat_update.pdf

Israel Oceanographic and Limnological Research (IOLR). 2024. Habitats update- January 2024. IOLR Report H01/2024. Accessed 7 March 2025 at: https://www.gov.il/BlobFolder/guide/enviromental_info/he/Habitat-map-update-04022024-final.pdf

Jacquet, N., S. Dawson, and E. Slooten. 1998. Diving behaviour of male sperm whales: foraging implications. International Whaling Commission, Scientific Committee Doc. SC/50/CAWS 38. 20 pp.

Jalkanen, J.-P., L. Johansson, M.H. Andersson, E. Majamäki, and P. Sigray. 2022. Underwater noise emissions from ships during 2014–2020. Environmental Pollution 311: 119766. doi: 10.1016/j.envpol.2022.119766.

Jones, E.G., A. Tselepides, P.M. Bagley, M.A. Collins, and I.G. Priede. 2003. Bathymetric distribution of some benthic and benthopelagic species attracted to baited cameras and traps in the deep eastern Mediterranean. Marine Ecology Progress Series 251: 75-86.

Kallos, G., P. Kassomenos, and R.A. Pielke. 1993. Synoptic and mesoscale weather conditions during air pollution episodes in Athens, Greece. Boundary-Layer Meteorology 62: 163-184.

Kassomenos, P., V. Kotroni, and G. Kallos. 1995. Analysis of climatological and air quality observations from Greater Athens Area. Atmospheric Environment 29: 3,671-3,688.

Keinath, J.A. and J.A. Musick. 1993. Movements and diving behavior of a leatherback turtle, *Dermochelys coriacea*. Copeia 1993(4): 1,010-1,017.

Keinath, J.A., J.A. Musick, and D.E. Barnard. 1996. Abundance and Distribution of Sea Turtles off North Carolina. Prepared for the U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 95-0024. 156 pp.

Kent, C.S., R.D. McCauley, A. Duncan, C. Erbe, A. Gavrilov, K. Lucke, and I. Parnum. 2016. Underwater Sound and Vibration from Offshore Petroleum Activities and their Potential Effects on Marine Fauna: An Australian Perspective. Report 2015-13. Centre for Marine Science and Technology, Curtin University, Perth, Western Australia. 184 pp.

Kerem, D. and D. Edelist. 2008. National overview on the current status of cetacean-fisheries conflicts in Israel, 1993-2008. Submitted for the International Workshop on Bycatch within the ACCOBAMS Area. September 2008.

Kerem, D., N. Hadar, O. Goffman, A. Scheinin, R. Kent, O. Boisseau, and U. Schattner. 2012. Update on the cetacean fauna of the Mediterranean Levantine Basin. Open Marine Biology Journal 6: 6-27.

Kerem, D., O. Goffman, A. Scheinin, M. Elasar, N. Hadar, D. Edelist, and O. Sonin. 2014. Report on the status of small cetaceans in Israeli Mediterranean waters. Submitted to the Sub-Committee on Small Cetaceans, the Scientific Committee, the International Whaling Commission, May 2014. IMMRAC, Recanati Institute for Maritime Studies, School of Marine Sciences, University of Haifa, Haifa, Israel.

Knobler, S., D. Bar, R. Cohen, and D. Liberzon. 2021. Wave height distributions and rogue waves in the Eastern Mediterranean. Journal of Marine Science and Engineering 9(6): 660.

Kress, N., A. Golik, B. Galil, and M.D. Krom. 1993. Monitoring the disposal of coal fly ash at a deep water site in the eastern Mediterranean Sea. Marine Pollution Bulletin 26(8): 447-456.

Krom, M.D., E.M.S. Woodward, B. Herut, N. Kress, P. Carbo, R.F.C. Mantoura, G. Spyres, T.F. Thingstad, P. Wassman, C. Wexels-Riser, V. Kitidis, C.S. Law, and G. Zodiatis. 2005. Nutrient cycling in the south east Levantine basin of the eastern Mediterranean: Results from a phosphorus starved system. Deep Sea Research II 52:2,879–2,896.

Krom, M.D., N. Kress, S. Brenner, and L.I. Gordon. 1991. Phosphorus limitation of primary productivity in the eastern Mediterranean Sea. Limnology and Oceanography 36: 424-432.

Kröncke, I., M. Türkay, and D. Fiege. 2003. Macrofauna communities in the eastern Mediterranean deep sea. Marine Ecology 24(3): 193-216.

Kyhn, L.A., S. Sveegaard, and J. Tougaard. 2014. Underwater noise emissions from a drillship in the Arctic. Marine Pollution Bulletin 86(1): 424-433.

Laist, D.W. 1996. Impacts of marine debris: Entanglement of marine life in marine debris including a comprehensive list of species with entanglement and ingestions records, pp. 99-139. In: J.M. Coe and D.R. Rogers (eds.), Marine Debris: Sources, Impacts, and Solutions. Springer-Verlag, New York.

Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science 17: 35-75.

Lardner, R. 2011. Medslik v. 5.6 User Manual. Oceanography Centre, University of Cyprus.

Lardner, R. and G. Zodiatis. 1998. An operational oil spill model for the Levantine Basin (Eastern Mediterranean Sea), pp. 5-9. In: International Symposium on Marine Pollution, Vol. 10.

Laurent, L., J. Lescure, L. Excoffier, B. Bowen, M. Domingo, M. Hadjichristophorou, L. Kornaraki, and G. Trabuchet. 1993. Etude génétique des relations entre les populations méditerranéenne et atlantique d'une tortue marine (*Caretta caretta*) à l'aide d'un marqueur mitochondrial. Comptes Rendus de l'Academie des Sciences de la Vie/Life Sciences 316: 1,233-1,239.

Lavender, A.L., S.M. Bartol, and I.K. Bartol. 2012. Hearing capabilities of loggerhead sea turtles (*Caretta caretta*) throughout ontogeny, pp. 89-92. In: A.N. Popper and A.D. Hawkins (eds.), The Effects of Noise on Aquatic Life. Springer Science + Business Media, LLC, New York.

Lawrence, J., T.D. Mudge, D.B. Fissel, K. Borg, and J. Reitsma. 2011. 2009-2011 Ocean Currents at Tamar and the Pipeline Route: Metocean Design Criteria Values. Prepared for Noble Energy Inc., Houston, TX by ASL Environmental Sciences, Inc., Victoria, B.C. ASL Report No. PR-658. September 2011.

Leshem, Y. and I. Atrash. 1998. Palestine-Israel: A crossroad for bird migration. Palestine-Israel Journal 5(1).

Levy, Y. 2011. Summary of recovery actions for sea turtle populations in the Mediterranean Sea. Israel Nature and Parks Authority.

Liubartseva, S., I. Federico, G. Coppini, and R. Lecci. 2021. Stochastic oil spill modeling for environmental protection at the Port of Taranto (southern Italy). Marine Pollution Bulletin 171: 112744. doi: 10.1016/j.marpolbul.2021.112744.

Lohoefener, R., W. Hoggard, K. Mullin, C. Roden, and C. Rogers. 1990. Association of Sea Turtles with Petroleum Platforms in the North-central Gulf of Mexico. OCS Study/MMS 90-0025. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, LA.

Longhurst, A. 1998. Ecological Geography of the Sea. Academic Press, San Diego. 398 pp.

Lutcavage, M.E., P. Plotkin, B. Witherington, and P.L. Lutz. 1997. Human impacts on sea turtle survival, pp. 387-410. In: P.L. Lutz and J.A. Musick (eds.), The Biology of Sea Turtles. CRC Press, Boca Raton, FL. 432 pp.

Marine Ventures International, Inc. (MVI). 2020. Environmental Monitoring Program Leviathan Field, Offshore Israel; December 2020 Marine Environmental Monitoring Report. Report submitted to Noble Energy Mediterranean Ltd. 1,189 pp.

Marine Ventures International, Inc. (MVI). 2022. Tamar Third Gathering Line (TTGL) Project. Tamar Environmental Impact Assessment Update. July 2022. DOCUMENT NO. MVI-CML-IL-22-81973-3807-01-REP-01-VER03. 210 pp. + apps.

Martin, K.J., S.C. Alessi, J.C. Gaspard, A.D. Tucker, G.B. Bauer, and D.A. Mann. 2012. Underwater hearing in the loggerhead turtle (*Caretta caretta*): a comparison of behavioural and auditory evoked potential audiograms. Journal of Experimental Biology 215: 3,001-3,009.

Mazzocchi, M.G., E.D. Christou, N. Fragopoulu, and I. Siokou-Frangou. 1997. Mesozooplankton distribution from Sicily to Cyprus (Eastern Mediterranean): I. General aspects. Oceanologica Acta 20: 521-535.

McCauley, R.D. 1998. Radiated underwater noise measured from the drilling rig *Ocean General*, rig tenders *Pacific Ariki* and *Pacific Frontier*, fishing vessel *Reef Venture* and natural sources in the Timor Sea, Northern Australia. CMST Report No. 98-20, CMST, Curtin University, Perth, Australia.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000. Marine Seismic Surveys - A Study of Environmental Implications. APPEA Journal 40(1): 692-708.

McDonald, M.A., J.A. Hildebrand, and S.M. Wiggins. 2006. Increases in deep ocean ambient noise in the Northeast Pacific west of San Nicolas Island, California. Journal of the Acoustical Society of America 120(2): 711-718.

McKenna, M.F., D. Ross, S.M. Wiggins, and J.A. Hildebrand. 2012. Underwater radiated noise from modern commercial ships. Journal of the Acoustical Society of America 131(1): 92-103.

Miles, P.R., C.I. Malme, and W.J. Richardson. 1987. Prediction of drilling site-specific interaction of industrial acoustic stimuli and endangered whales in the Alaskan Beaufort Sea. Contract No. 14 12-0001-30295. Report No. 6509. OCS Study MMS 87-0084.

Minerals Management Service. 2007. Gulf of Mexico OCS Oil and Gas Lease Sales: 2007-2012. Western Planning Area Sales 204, 207, 210, 215, and 218; Central Planning Area Sales 205, 206, 208, 213, 216, and 222. Final Environmental Impact Statement. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. OCS EIS/EA MMS 2007-018. April 2007.

Ministry of Energy (MoE) and Ministry of Environmental Protection (MoEP). 2025. Petroleum Commissioner Guidelines: Guidelines for preparing an Environmental Document (EIA) for the Tamar 12 production drilling and its connection to the existing infrastructure. 19 pp.

Ministry of Energy (MoE). 2018. Update of the Strategic Environmental Survey for Offshore Oil and Natural Gas Exploration and Production, Biennial Report (December 2018). Environment Division, Natural Resources Administration, Ministry of Energy, State of Israel.

Ministry of Energy (MoE). 2019. Guidelines for Monitoring the Marine Environment and Development of Field Following Completion. 13 pp.

Ministry of Energy (MoE). 2020. Update of the Strategic Environmental Survey for Offshore Oil and Natural Gas Exploration and Production, Biennial Report (December 2020). Environment Division, Natural Resources Administration, Ministry of Energy, State of Israel.

Ministry of Environmental Protection (MoEP). 2021. Guidelines for Reporting Incidents and Emergencies in Marine Gas Facilities. Version 2.0, 10 May 2021. Originally issued 16 April 2020.

Montevecchi, W.A., F.K. Wiese, G. Davoren, A.W. Diamond, F. Huettmann, and J. Linke. 1999. Seabird Attraction to Offshore Platforms and Seabird Monitoring from Offshore Support Vessels and Other Ships: Literature Review and Monitoring Designs [unpublished report]. Report No. 138. Environmental Studies Research Funds, Calgary, Canada. 56 pp.

National Marine Fisheries Service (NMFS). 1991. Final Recovery Plan for the Humpback Whale (*Megaptera novaeangliae*). Prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, MD. 105 pp.

National Marine Fisheries Service (NMFS). 2007. Endangered Species Act, Section 7 Consultation – Biological Opinion. Gulf of Mexico Oil and Gas Activities: Five-Year Leasing Plan for Western and Central Planning Areas 2007-2012.

National Marine Fisheries Service (NMFS). 2010. Final Recovery Plan for the Sperm Whale (*Physeter macrocephalus*). Silver Spring, MD. 165 pp. Accessed 15 January 2025 at: https://repository.library.noaa.gov/view/noaa/15976.

National Marine Fisheries Service (NMFS). 2024. 2024 Update to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 3.0); Underwater and In-Air Criteria for Onset of Auditory Injury and Temporary Threshold Shifts. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources. NOAA Technical Memorandum NMFS-OPR-71 October 2024. 193 pp.

National Marine Fisheries Service (NMFS). 2025. Marine Mammal Acoustic Technical Guidance & Other Acoustic Tools. Accessed 22 April 2025 at https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance-other-acoustic-tools.

National Oceanic and Atmospheric Administration (NOAA). 2024. Why is Marine Debris a Problem? NOAA, Office of Response and Restoration, Marine Debris Program. Accessed 15 January 2025 at https://marinedebris.noaa.gov/discover-marine-debris/why-marine-debris-problem.

National Research Council. 1983. Drilling Discharges in the Marine Environment. National Academy Press, Washington, DC. 180 pp.

National Research Council. 1990. Decline of the Sea Turtles: Causes and Prevention. National Academy Press, Washington, DC. 259 pp.

National Research Council. 2003. Ocean Noise and Marine Mammals. Washington, DC: National Academies Press. 151 pp. + app. Accessed 15 January 2025 at http://www.nap.edu/openbook.php?isbn=0309085365.

National Research Council. 2005. Marine mammal populations and ocean noise: Determining when noise causes biologically significant effects. Washington, DC: The National Academies Press. 99 pp. + apps. Accessed 15 January 2025 at: http://www.nap.edu/openbook.php?record_id=11147&page=1.

National Research Council. 2008. Tackling Marine Debris in the 21st Century. National Academies Press, Washington, DC. 218 pp.

Nedwell, J., J. Langworthy, and D. Howell. 2003. Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its impact on marine wildlife; initial measurements of underwater noise during construction of offshore windfarms, and comparison with background noise. Report No. 544 R 0424. Subacoustech Ltd, Southampton, UK.

Neff, J.M. 1987. Biological effects of drilling fluids, drill cuttings and produced waters, pp. 469-538. In: D.F. Boesch and N.N. Rabalais (eds.), Long-Term Effects of Offshore Oil and Gas Development. Elsevier Applied Science Publishers, London.

Neff, J.M. 2005. Composition, Environmental Fates, and Biological Effects of Water Based Drilling Muds and Cuttings Discharged to the Marine Environment: A Synthesis and Annotated Bibliography. Prepared for Petroleum Environmental Research Forum and American Petroleum Institute. Battelle, Duxbury, MA. 83 pp.

Neff, J.M. 2010. Fate and Effects of Water-based Drilling Muds and Cuttings in Cold-water Environments. Prepared by Neff & Associates LLC, Duxbury, MA for Shell Exploration and Production Company, Houston, TX. May 25, 2010. 309 pp.

Neff, J.M., S. McKelvie, and R.C. Ayers, Jr. 2000. Environmental Impacts of Synthetic Based Drilling Fluids. Prepared by Robert Ayers & Associates, Inc. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-064. 118 pp.

Neves, A.A.S., N. Pinardi, F. Martins, J. Janeiro, A. Samaras, G. Zodiatis, and M. De Dominicis. 2015. Towards a common oil spill risk assessment framework - Adapting ISO 31000 and addressing uncertainties. Journal of Environmental Management 159: 158-168. doi: 10.1016/j.jenvman.2015.04.044.

Notarbartolo di Sciara, G. and A. Birkun, Jr. 2010. Conserving Whales, Dolphins and Porpoises in the Mediterranean and Black Seas: an ACCOBAMS status report, 2010. ACCOBAMS, Monaco. 212 pp.

OSPAR Commission. 2012. Report of the OSPAR Workshop on Research into Possible Effects of Regular Platform Lighting on Specific Bird Populations. Agenda Item 5. WKBIRD 12/5/1-E. 13 pp. Accessed 15 January 2025 at: https://www.ospar.org/meetings/archive/workshop-on-research-into-the-possible-effects-of-regular-platform-lighting-on-specific-bird-populations.

Pace, R.M. 2011. Frequency of Whale and Vessel Collisions on the U.S. Eastern Seaboard: Ten Years Prior and Two Years Post Ship Strike Rule. U.S. Dept. of Commerce, Northeast Fisheries Science Center, Ref Doc. 11-15. 12 pp.

Pareto Engineering Ltd. 2006. Sensitivity Analysis of Israel's Coastlines to Oil Pollution. Report for the Ministry of Environmental Protection. December 2006.

Patenaude, N.J., W.J. Richardson, M.A. Smultea, W.R. Koski, G.W. Miller, B. Würsig, and C.R. Greene, Jr. 2002. Aircraft sound and disturbance to bowhead and beluga whales during spring migration in the Alaskan Beaufort Sea. Marine Mammal Science 18: 309-335.

Payne, R. and D. Webb. 1971. Orientation by means of long range acoustic signaling in baleen whales. Annals of the New York Academy of Sciences 188: 110-142.

Peabody, M.B. and C.A. Wilson. 2006. Fidelity of Red Snapper (*Lutjanus campechanus*) to Petroleum Platforms and Artificial Reefs in the Northern Gulf of Mexico. Final Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-005. 66 pp.

Peng, J., S. Wang, L. Mu, and S. Wang. 2024. Risk assessment of oil spills along the coastline of Jiaozhou Bay using GIS techniques and the model. Water 16: 996. doi: 10.3390/w16070996.

Pérès, J.M. 1985. History of the Mediterranean biota and the colonization of the depths, pp. 198-232. In: Margalef, R. (ed.), Key Environments: Western Mediterranean. Pergamon Press, Oxford.

Pinardi, N. and E. Masetti. 2000. Variability of the large scale general circulation of the Mediterranean Sea from observations and modelling: a review. Palaeogeography, Palaeoclimatology, Palaeoecology 158: 53-173.

Pinardi, N., I. Allen, E. Demirov, P. De Mey, G. Korres, A. Lascaratos, P.-Y. Le Traon, C. Maillard, G. Manzella, and C. Tziavos. 2003. The Mediterranean ocean forecasting system: first phase of implementation (1998-2001). Annales Geophysicae 21: 3-20. doi:10.5194/angeo-21-3-2003.

Pitta, P., N. Stambler, T. Tanaka, T. Zohary, A. Tselepides, and F. Rassoulzadegan. 2005. Biological response to P addition in the Eastern Mediterranean Sea. The microbial race against time. Deep Sea Research II 52: 2,961-2,974.

Polovina, J.J., E. Howell, D.M. Parker, and G.H. Balazs. 2003. Dive-depth distribution of loggerhead (*Caretta caretta*) and olive ridley (*Lepidochelys olivacea*) sea turtles in the central North Pacific: Might deep longline sets catch fewer turtles? Fishery Bulletin 101:189-193.

Poot, H., B.J. Ens, H. de Vries, M.A.H. Donners, M.R. Wernand, and J.M. Marquenie. 2008. Green light for nocturnally migrating birds. Ecology and Society 13(2): 47.

Popper, A.N. and A. Hawkins (eds.). 2012. The Effects of Noise on Aquatic Life. Springer Science + Business Media, LLC, New York. 695 pp.

Popper, A.N. and M.C. Hastings. 2009a. The effects on fish of human-generated (anthropogenic) sound. Integrative Zoology 4:43-52.

Popper, A.N. and M.C. Hastings. 2009b. Effects of anthropogenic sources of sound on fishes. Journal of Fish Biology 75: 455-498.

Popper, A.N., A.D. Hawkins, R.R. Fay, D.A. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R.L. Gentry, M.B. Halvorsen, S. Løkkeborg, P.H. Rogers, B.L. Southall, D.G. Zeddies, and W.N. Tavolga. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. ASA S3/SC1.4 TR-2014. ASA Press and Springer, New York. 76 pp.

Potter, J.R., T.W. Lim, and M. Chitre. 1997. Ambient noise environments in shallow tropical seas and the implications for acoustic sensing, pp. 191-199. In: Oceanology International 97 Pacific Rim, Singapore.

Psarra, S., T. Zohary, M.D. Krom, R. Fauzi, R.F.C. Mantoura, T. Polychronaki, N. Stambler, T. Tanaka, A. Tselepides, and T.F. Thingstad. 2005. Phytoplankton response to a Lagrangian phosphate addition in the Levantine Sea (Eastern Mediterranean). Deep Sea Research II 52: 2,944-2,960.

Reich, T., T. Ben-Ezra, N. Belkin, A. Tsemel, D. Aharonovich, D. Roth-Rosenberg, S. Givati, M. Bialik, B. Herut, I. Berman-Frank. M. Frada, M.D. Krom, Y. Lehahn, E. Rahav and D. Sher. 2022. A year in the life of the Eastern Mediterranean: Monthly dynamics of phytoplankton and bacterioplankton in an ultra-oligotrophic sea. Deep Sea Research Part I: Oceanographic Research Papers 182: 103720.

Renaud, M.L. and J.A. Carpenter. 1994. Movements and submergence patterns of loggerhead turtles (*Caretta caretta*) in the Gulf of Mexico determined through satellite telemetry. Bulletin of Marine Science 55: 1-15.

Richardson, W.J. and B. Würsig. 1997 Influences of man-made noise and other human actions on cetacean behaviour. Marine and Freshwater Behaviour and Physiology 29: 183-209.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. Academic Press, San Diego, CA. 576 pp.

Ridgway, S.H., E.G. Wever, J.G. McCormick, J. Palin, and J.H. Anderson. 1969. Hearing in the giant sea turtle, *Chelonia mydas*. Proceedings of the National Academy of Sciences 64: 884-890.

Rindlisbacher, T. and L. Chabbey. 2015. Guidance on the Determination of Helicopter Emissions. Swiss Confederation Federal Office of Civil Aviation (FOCA), Reference: COO.2207.111.2.2015750, Bern, Switzerland.

Roberts, L. and M. Elliott. 2017. Good or bad vibrations? Impacts of anthropogenic vibration on the marine epibenthos. Science of the Total Environment 595: 255-268.

Roditi-Elasar, M., L. Bundone, O. Goffman, A.P. Scheinin, and D.H. Kerem. 2021. Mediterranean monk seal (*Monachus monachus*) sightings in Israel 2009-2020: Extralimital records or signs of population expansion? Marine Mammal Science 37(1): 344-251.

Rosman, I., G.S. Boland, L.R. Martin, and C.R. Chandler. 1987. Underwater sightings of sea turtles in the northern Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, OCS Study 87-0107. 37 pp.

Ross, D. 1976. Mechanics of Underwater Noise. Pergamon, New York. 375 pp.

Russell, R.W. 2005. Interactions between Migrating Birds and Offshore Oil and Gas Platforms in the Northern Gulf of Mexico: Final Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-009. 348 pp.

Salmon, M. and J. Wyneken. 1990. Do swimming loggerhead sea turtles (*Caretta caretta*) use light cues for offshore orientation? Marine and Freshwater Behaviour and Physiology 17(4): 233-246.

Schaanning, M.T., H.C. Trannum, S. Øxnevad, J. Carroll, and T. Bakke. 2008b. Effects of drill cuttings on biogeochemical fluxes and macrobenthos of marine sediments. Journal of Experimental Marine Biology and Ecology 361: 49-57

Schaanning, M.T., H.C. Trannum, T.F. Holth, and S. Øxnevad. 2008a. Trace Metal Mobility and Faunal Effects of Weight Materials in Water-Based Drilling Muds. Report No. OR-5680. Norwegian Institute for Water Research.

SeaTurtle.org. 2020. Satellite Tracking. RAC/SPA-SZN Tracking of Mediterranean Marine Turtles. Accessed 25 March 2025 at: http://www.seaturtle.org/tracking/?project_id=358.

Shepard, F.P. 1954. Nomenclature based on sediment: H-clay ratios. Journal of Sedimentary Petrology 24: 151-158.

Shinn, E.A., B.H. Lidz, and C.D. Reich. 1993. Habitat Impacts of Offshore Drilling: Eastern Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 93-0021. 73 pp.

Skarsoulis, E.K., G. Piperakis, A. Prospathopoulos, and D. Makropoulos. 2023. Prediction of shipping noise in range-dependent environments. Journal of Marine Science and Engineering 11(2): 290. doi: 10.3390/jmse11020290.

Smit, M.G.D., K.I.E. Holthaus, H.C. Trannum, J.M. Neff, G. Kjeilen-Eilertsen, R.G. Jak, I. Singsaas, M.A.J. Huijbregts, and A.J. Hendriks. 2008. Species sensitivity distributions for suspended clays, sediment burial, and grain size change in the marine environment. Environmental Toxicology and Chemistry 27(4): 1,006-1,012.

Smultea, M.A., J.A. Mobley, Jr., D. Fertl, and G.L. Fulling. 2008. An unusual reaction and other observations of sperm whales near fixed-wing aircraft. Gulf and Caribbean Research 20: 75-80.

Southall B.L., D.P. Nowacek, A.E. Bowles, V. Senigaglia, L. Bejder, and L. Tyack Peter. 2021. Marine mammal noise exposure criteria: assessing the severity of marine mammal behavioral responses to human noise. Aquatic Mammals 47(5): 421-464.

Southall, B. 2005. Shipping Noise and Marine Mammals: A Forum for Science, Management, and Technology. Final Report of the National Oceanographic and Atmospheric Administration (NOAA) International Symposium. 18-19 May 2004. Arlington, VA. 40 pp.

Southall, B.L. and A. Scholik-Schlomer. 2008. Final report of the NOAA International Conference: Potential Application of Vessel-Quieting Technology on Large Commercial Vessels, 1-2 May 2007, Silver Spring, MD.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33(4): 411-521.

Southall, B.L., D.P. Nowacek, P.J. Miller, and P.L. Tyack. 2016. Experimental field studies to measure behavioral responses of cetaceans to sonar. Endangered Species Research 31: 293-315.

Stanton, D.L. and J.R. Cowart. 2024. The effects of artificial light at night (ALAN) on the circadian biology of marine animals. Frontiers in Marine Science 11: 1372889. doi: 10.3389/fmars.2024.1372889.

State of Israel. 2021. Benthic habitats. Three set map series for benthic habitats and their level of vulnerability (plus one map for pelagic habitats). December 2021. Accessed 7 March 2025 at: https://www.gov.il/en/departments/guides/enviromental_info?chapterIndex=3.

Tanaka, T., T. Zohary, M.D. Krom, C.S. Law, P. Pitta, S. Psarra, F. Rassoulzadegan, T.F. Thingstad, A. Tselepides, E.M.S. Woodward, G.A.F. Flaten, H.R. Skjoldal, and G. Zodiatis. 2007. Microbial community structure and function in the Levantine Basin of the eastern Mediterranean. Deep Sea Research Part I 54:1,721-1,743.

Tasker, M.L., P. Hope-Jones, B.F. Blake, T.J. Dixon, and A.W. Wallis. 1986. Seabirds associated with oil production platforms in the North Sea. Ringing and Migration 7: 7-14

Thingstad, T.F., M.D. Krom, R.F.C. Mantoura, G.A.F. Flaten, S. Groom, B. Herut, N. Kress, C.S. Law, A.F. Pasternak, R. Pitta, S. Psarra, F. Rassoulzadegan, T. Tanaka, A. Tselepides, P. Wassman, E.M.S. Woodward, C. Wexels-Riser, G. Zodiatis, and T. Zohary. 2005. Nature of phosphorus limitation in the ultraoligotrophic eastern Mediterranean. Science 309:1,068-1,071.

Tom, M. and M. Kanari. 2023. Integrative data system for monitoring biota and natural habitats in the Israeli Eastern Mediterranean marine environment. Environmental Monitoring and Assessment 195: 1068. Accessed 15 January 2025 at https://experience.arcgis.com/experience/40e86605ff4d4e5096ed2c901fec2a2f.

Trannum, H.C., A. Pettersen, and F. Brakstad. 2006. Field Trial at Sleipner Vest Alfa Nord: Effects of Drilling Activities on Benthic Communities. Report No. 411.3041.2. Akvaplan-niva.

Trannum, H.C., H.C. Nilsson, M.T. Schaanning, and S. Øxnevad. 2010. Effects of sedimentation from water-based drill cuttings and natural sediment on benthic macrofaunal community structure and ecosystem processes. Journal of Experimental Marine Biology and Ecology 383: 111-121.

Tselepides, A. and N. Lampadariou. 2004. Deep-sea meiofaunal community structure in the Eastern Mediterranean: are trenches benthic hotspots? Deep Sea Research Part I: Oceanographic Research Papers 51(6): 833-847

Tselepides, A., N. Papadopoulou, D. Podaras, W. Plaiti, and D. Koutsoubas. 2000. Macrobenthic community structure over the continental margin of Crete (South Aegean Sea, NE Mediterranean). Progress in Oceanography 46: 401-428.

Tuxbury, S.M. and M. Salmon. 2005. Competitive interactions between artificial lighting and natural cues during seafinding by hatchling marine turtles. Biological Conservation 121: 311-316.

Tyack, P.L. 2008. Implications for marine mammals of large-scale changes in the marine acoustic environment. Journal of Mammalogy 89(3): 549-558.

Tyler, P.A. 2005. Forward. Special issue: Mediterranean deep-sea biology. Scientia Marina 68(Suppl. 3): 3.

U.S. Environmental Protection Agency (USEPA). 1992. Specifications and Guidance for Contaminant-Free Sample Containers. Publication 9240.0-05A. EPA540/R-93/051. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. 28 pp.

United Nations Environment Programme, Mediterranean Action Plan, Regional Activity Centre for Specially Protected Areas (UNEP MAP RAC/SPA). 2007. Action Plan for the conservation of Mediterranean marine turtles. Ed. RAC/SPA, Tunis. 40 pp.

United Nations Environment Programme. 2013. Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean. Annex II: List of Endangered or Threatened Species.

Urick, R.J. 1983. Principles of Underwater Sound. McGraw-Hill, New York.

van de Laar, F. 2007. Green Light to Birds: Investigation into the Effect of Bird-friendly Lighting. NAM Locatie L15-FA-1. December 2007. 23 pp. Accessed 15 January 2025 at: https://tethys.pnnl.gov/sites/default/files/publications/van-de-Laar-2007.pdf.

van Waerebeek, K., A.N. Baker, F. Félix, J. Gedamke, M. Iñiguez, G.P. Sanino, E. Secchi, D. Sutaria, A. van Helden, and Y. Wang 2007. Vessel collisions with small cetaceans worldwide and with large whales in the Southern Hemisphere, an initial assessment. Latin American Journal of Aquatic Mammals 6(1): 43-69

Weatherspark. 2025. Average weather for Haifa, Israel. Accessed 15 January 2025 at: http://weatherspark.com/averages/32339/Haifa-Israel.

Wenz, G.M. 1962. Acoustic ambient noise in the ocean: Spectra and sources. Journal of the Acoustical Society of America 34: 1,936-1,956.

Wiese, F.K., W.A. Montevecchi, G.K. Davoren, F. Huettmann, A.W. Diamond, and J. Linke. 2001. Seabirds at risk around offshore oil platforms in the north-west Atlantic. Marine Pollution Bulletin 42(12): 1,285-1,290.

Wilson, C.A., A. Pierce, and M.W. Miller. 2003. Rigs and Reefs: A Comparison of the Fish Communities at Two Artificial Reefs, a Production Platform, and a Natural Reef in the Northern Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2003-009. 95 pp.

Wilson, C.A., M.W. Miller, Y.C. Allen, K.M. Boswell, and D.L. Nieland. 2006. Effects of Depth, Location, and Habitat Type on Relative Abundance and Species Composition of Fishes associated with Petroleum Platforms and Sonnier Bank in the Northern Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-037. 85 pp.

Wilson, D., R. Billings, R. Chang, B. Do, S. Enoch, H. Perez, and J. Sellers. 2019. Year 2017 Emissions Inventory Study. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2019-072. Prepared under BOEM Contract M16PC00012 by Eastern Research Group, Inc., Morrisville, NC. 231 pp.

Witherington, B.E. 1997. The problem of photo pollution for sea turtles and other nocturnal animals, pp. 303-328. In: J.R. Clemmons and R. Buchholz (eds.), Behavioral Approaches to Conservation in the Wild. Cambridge University Press, Cambridge, England.

Wolfson, A., G.R. VanBlaricom, N. Davis, and G.S. Lewbel. 1979. The marine life of an offshore oil platform. Marine Ecology Progress Series 1: 81-89.

Yacobi, Y.Z., T. Zohary, N. Kress, A. Hecht, R.D. Robarts, M. Waiser, A.M. Wood, and W.K.W. Li. 1995. Chlorophyll distribution throughout the southeastern Mediterranean in relation to the physical structure of the water mass. Journal of Marine Systems 6: 179-190.

Zelick, R., D. Mann, and A.N. Popper. 1999. Acoustic communication in fishes and frogs, pp. 363-411. In: R.R. Fay and A.N. Popper (eds.), Comparative Hearing: Fish and Amphibians. Springer-Verlag, New York.

Zodiatis, G., R. Lardner, D. Hayes, D. Soloviev, G. Georgiou. 2007. The successful application of the Mediterranean oil spill model in assisting the decision makers during the oil pollution crisis of Lebanon in summer 2006. Rapports de la Commission International de la Mer Mediterranee 214: 38.

Zodiatis G., R. Lardner, D. Solovyov, X. Panayidou, and M. De Dominicis. 2012. Predictions for oil slicks detected from satellite images using MyOcean forecasting data. Ocean Science 8: 1105-1115. doi: 10.5194/os-8-1105-2012.

Appendices

Appendix A: Application Zone Maps, 1:5,000 scale

Appendix B: Listing of Side-scan Sonar Contacts, Tamar-12 Drill Site and Umbilical Route

Appendix C: Mud System

Appendix D: Specifications of Representative Project Vessels and Aircraft

Appendix E: Safety Data Sheets

Appendix F: Ecological Information for Drilling, Completion, and Pre-Commissioning Discharges

Appendix G: Drilling Effluent Testing Results

Appendix H: Guidelines for Preparing the Environmental Impact Assessment in the Israeli Exclusive Economic Zone (EEZ) – Tamar-12 Project

Appendix I: Modeling of Drilling Mud and Cuttings Discharges

Appendix J: Worst-Case Discharge Scenario

Appendix K: Tamar Field 2023 Monitoring Survey Report

Appendix L: Israeli Antiquity Authority Approval Letter

Appendix M: List of Preparers and Qualifications