SAKARYA GAS FIELD DEVELOPMENT PROJECT - ESIA

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

Chapter 7.3 Offshore Physical and Biological Components Impact Assessment

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7.3.1 Physical

7.3.1.1 Seafloor morphology

Based on the information collected for the definition of the baseline (see 6.3.1.1), the physical component *Seafloor morphology* was assigned a **Medium-high** value of sensitivity for the following reasons:

- Absence of rocky outcrops and gently sloping bathymetry upon the continental slope;
- Presence sedimentary waves in the canyon area; and
- Medium seismicity.

Impacts potentially affecting this component are assessed here below for the construction phase and operation phase.

7.3.1.1.1 Construction phase

Impact factors

The impact factors from the Project activities potentially affecting seafloor morphology during construction phase are listed in the following table.

Table 7-1: Project actions and related impact factors potentially affecting seafloor morphology during construction phase.

Project actions	Brief description	Impact factors
Offshore excavation (trenching) and sediment storage	Excavation of a trench in shallow water in correspondence of the land approach (1.4 km). The sediments removed will be temporarily stored west of Filyos Port, east of the pipeline, and will be moved back to cover the pipeline.	Handling and resuspension of sediments Presence of the cofferdams
Offshore pipeline laying	Offshore laying of the pipelines, umbilical line, and lines within the SPS and their connection.	Introduction of new offshore infrastructures

All the impact factors identified above are described below and assessed in the matrix that follows.

- **<u>Handling and resuspension of sediments</u>**

The offshore excavation of the trench for the first 1.4 km of the pipeline corridor is expected to actively mobilize sediments to be stored at the temporary storage area before the backfill. This will alter the seafloor morphology of the AoI, which, as shown in 6.3.1.1, consists mostly of soft bottoms.

In fact, during the implementation of the excavation and sediment storage, 81,356 m^3 of sediments are expected to be moved. This will cause an alteration of the seascape, since the seafloor, which is currently rather homogeneous, will present a trench in the pipeline corridor and the temporary storage area will be covered by layers of new sediments coming from the trench. In both cases the bathymetry will be altered as well, even if temporarily, since the trench is expected to be dredged for 3 m of depth and, considering the volume of sediments mobilized and the surface covered by the temporary storage area (i.e., 0.26 km^2), a variation of about 0.31 m of thickness may be considered in that zone.

Such operations are expected to take an estimated time of 105 days. This impact factor, however, is expected to be totally temporary since, once laid the pipelines, the trench is expected to be backfilled and the seafloor morphology restored at both sites (i.e., trench and temporary storage area).

- **Presence of the cofferdams**

A cofferdam will be put in place in two rows for the excavation of the first 268 m of the 1.4 km of the trench (two rows per edge of the trench) and the pipeline laying. Two rows of cofferdams will form the sidewalls of the trench. This will alter the seascape and the morphology of the seafloor of the area, even if temporary.

After the pipeline is laid, in fact, the cofferdam ditches (as well as the trench) will be backfilled with the stored sediments excavated during the dredging and the cofferdams themselves will be removed, completely restoring the morphology of the AoI.

The presence of the two rows of cofferdams will be limited to the dredging period in the 268 m of the pipeline corridor and the pipeline laying in the trench (around 105 days). In addition, the alteration to the seafloor morphology by the presence of such cofferdams is expected to be completely reversible, since the seascape will be restored by the backfilling.

- **Introduction of new offshore infrastructures**

The pipeline laying operations will introduce a new type of artificial hard substrate upon the seafloor; the land approach only (the first 1.4 km from the shoreline) will be buried. As illustrated in 6.3.1.1, in fact, the seafloor of the AoI consists mostly of soft bottoms and, besides the canyon systems, the seascape is highly homogeneous. The introduction of the pipelines and cables (i.e., umbilical and cables at the SPS), therefore, is expected to alter the seafloor morphology, by disrupting the natural homogeneity of the sandy-muddy-clayey bottoms of the AoI.

Such alteration is expected to be very limited, considering the linear typology of the infrastructures and their size (16'' maximum for the pipeline diameter). However, even if limited, it should be considered to be permanent because the infrastructures will be introduced (i.e., laid) during the construction phase, but are also planned to remain and to be operative for the whole operation phase. This does not mean an irreversibility of the impact, since, because of the considered impact factor and environmental component's characteristics, the component itself is expected to recover in a rather short period if the infrastructures are removed.

Mitigation measures

The following mitigation measures shall be implemented to mitigate the effects of the impact factors.

- **Handling and resuspension of sediments**
  - Uncontrolled release of the sediments potentially creating abnormal 3D structures at the temporary and during the backfilling to be avoided.
  - The homogeneity of the seafloor to be restored at the baseline conditions during the backfill of the trench.

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **low negative impact** is expected on the seafloor morphology during the construction phase.

Table 7-2: Residual impact assessment matrix for the seafloor morphology during construction phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Handling and resuspension of sediments	Duration:	Medium	Medium-high	Short-term	**Low**	Low	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Project footprint					
	Intensity:	Medium					
Presence of the cofferdams	Duration:	Medium-short	Medium-high	Short-term	**Low**	None	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Project footprint					
	Intensity:	High					
Introduction of new offshore infrastructures	Duration:	Medium	Medium-high	Short-term	**Low**	None	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Project footprint					
	Intensity:	Low					
Overall assessment:		**Low**	Rationale:	Due to the short-term reversibility, even using a precautionary approach, the residual impact values are not expected to cumulate to a higher impact value. Therefore, the average residual impact value may be considered as a reference for the overall impact.			

Monitoring measures

The following monitoring measure shall be implemented to assess the true effects of the project on the seafloor morphology during the construction and verify the effectiveness of the mitigation measures.

- Bathymetric surveys (i.e., by MBES), or alternatively ROV inspections along transects (200 m minimum), conducted in the scope of the project monitoring, whether planned, to be analyzed to assess the effectiveness of the restoration of the seafloor morphology after the backfill of the trench.

7.3.1.1.2 Operation phase

Impact factors

The impact factors from the Project activities potentially affecting the seafloor morphology during operation phase are listed in the following table.

Table 7-3: Project actions and related impact factors potentially affecting seafloor morphology during operation phase.

Project actions	Brief description	Impact factors
Plant/infrastructure operation offshore	Technical and administrative activities, including operation of the plant/infrastructure, surveillance, monitoring, maintenance, performed according to standard operating procedures to maintain the Project offshore parts in operation.	■ Presence of new offshore infrastructures

The impact factor identified above is described below and assessed in the matrix that follows.

- **Presence of new offshore infrastructures**

Such as stated in the project description (see 3.0), the offshore part of the project consists in the presence of cables to connect the SPS parts, one umbilical line and two pipelines from the SPS (around 2,200 m deep) to the onshore facilities.

While such impact factor is considered negligible to even non-existent in the first 1.4 km, the pipelines will be laid on the sea bottom further offshore, resulting in an artificial hard substrate upon the seafloor. Such as previously stated, this is expected to alter the seafloor morphology, by disrupting the natural homogeneity of the sandy-muddy-clayey bottoms of the AoI, even if very limitedly, considering the linear typology of the infrastructures and their size (16'' maximum for the pipeline diameter). This is not expected to cause erosion or accumulation processes respectively downstream and upstream the currents.

However, such infrastructures will be present for the whole lifetime of the project (i.e., 20-45 years, depending on the gas availability). Nevertheless, will not mean an irreversibility of the impact, since, because of the considered impact factor and environmental component's characteristics, the component itself is expected to recover in a rather short period if the infrastructures are removed.

Mitigation measures

The following mitigation measure shall be implemented to mitigate the effects of the impact factor.

- **Presence of new offshore infrastructures**
  - The pipelines to be buried for the land approach (first 1.4 km from the shoreline).

Residual impacts

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **low negative impact** is expected on the seafloor morphology during the operation phase.

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Table 7-4: Residual impact assessment matrix for the seafloor morphology during operation phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Presence of new offshore infrastructures	Duration:	Long	Medium-high	Short-term	**Low**	Low	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Project footprint					
	Intensity:	Low					
Overall assessment:		**Low**	Rationale:	The presence of new offshore infrastructures is the only impact factor identified for such component in the operation phase.			

Monitoring measures

The following monitoring measure shall be implemented to assess the true effects of the project on the seafloor morphology during the operation and verify the effectiveness of the mitigation measures.

- Bathymetric surveys (i.e., by MBES) and/or ROV inspections conducted in the scope of the project monitoring, whether planned, to be analyzed to inform on the presence of unplanned erosion or accumulation processes.

7.3.1.2 Sediments (grain size and chemical characterization)

Based on the information collected for the definition of the baseline (see 6.3.1.2), the physical component *Sediments* was assigned a **Medium-low** value of sensitivity for the following reasons:

- Limited presence of fine sediment in the excavation area (trench); and
- Absence of significant contamination.

Impacts potentially affecting this component are assessed here below for the construction phase and operation phase.

7.3.1.2.1 Construction phase

Impact factors

The impact factors from the Project activities potentially affecting sediments during construction phase are listed in the following table.

Table 7-5: Project actions and related impact factors potentially affecting sediments during construction phase.

Project actions	Brief description	Impact factors
Offshore excavation (trenching) and sediment storage	Excavation of a trench in shallow water in correspondence of the land approach (1.4 km). The sediments removed will be temporarily stored west of Filyos Port, east of the pipeline, and will be moved back to cover the pipeline.	■ Handling and resuspension of sediments
Offshore pipeline laying	Offshore laying of the pipelines, umbilical line, and lines within the SPS and their connection.	■ Handling and resuspension of sediments ■ Introduction of new offshore infrastructures

All the impact factors identified above are described below and assessed in the matrix that follows.

- **<u>Handling and resuspension of sediments</u>**

The offshore excavation of the trench for the first 1.4 km of the pipeline corridor is expected to actively mobilize sediments to be stored at the temporary storage area before the backfill. Mobilizing the sediments in the AoI might reinsert in the marine environment contaminants present in the area. Moreover, an uncareful handling of the sediments during the backfilling of the trench may also change the sediment distribution disrupting the natural patterns and possibly altering also the sedimentation rate. Around 81,356 m^3 of sediments will be dug up and put back in place during a period of 105 days.

It should be noted, however, that contaminants in the AoI, as shown in 6.3.1.2, never exceed both the Probable Effect Levels (PEL) of the National Oceanic and Atmospheric Administration (NOAA) and the Threshold Limit Value of the Turkish regulation. It is therefore unlikely that the mobilization could cause a true impact by reintroducing contaminants in the marine environment, when present, in hazardous concentrations.

Although the chemical analyses did not show any excesses, applying a precautionary approach, toxicity tests with the marine bacteria *Vibrio fischeri* were also conducted on 5 sediment samples: 4 samples did not have an acutely toxic effect (Class=0). However, one sample showed toxic effect on the marine bacteria. It must be noted that a single ecotoxicological assay is normally not significant, in particular if conducted on single biological target, since the toxicity may be experienced only by that biological target. Nevertheless, whether no further essays are performed, using a precautionary approach, the sample must be considered as potentially ecotoxic. Further essays on different biological targets may probably refute this statement.

- **<u>Introduction of new offshore infrastructures</u>**

Besides the burial operations in the land approach, the pipelines will be simply laid upon the seafloor which, as shown in 6.3.1.1 and 6.3.1.2, consists mostly of fine sediments. The laying operations may cause a resuspension of the sediments while the pipelines are laid, which can cause a reintroduction in the marine environment of the contaminants precipitated in the upper layers (when present). However, as described in 6.3.1.2, most of the pipeline is laid in an active canyon system and the abyssal plain. Those environments are characterized by continuous erosion and mobilization of sediments that already keep changing the seafloor morphology creating new tridimensional sediment structures (Diercks *et al.*, 2018). Moreover, the presence of seamounts and canyons can create asymmetric flow patterns that in turn lead to uneven sedimentation dynamics affecting erosion, resuspension, deposition, and sedimentation naturally changing the sedimentation rate and distribution (Peine *et al.*, 2009).

In addition, during the pipelaying operations the pipeline will remain locked to the vessel meaning it will be gently laid on the seabed at a slow speed and not dropped. It is therefore considered the amount of sediments resuspended to be negligible and unlikely to pose an impact.

Mitigation measures

The following mitigation measures shall be implemented to mitigate the effects of the impact factors.

- **Handling and resuspension of sediments**
  - Sediments to be gently placed at the temporary storage area in order to reduce the resuspension.
  - Dredged sediments to be stored in mapped sections at the temporary storage area so the backfill operation shall bring back the sediments at the proper location not to disrupt the sediment type distribution (e.g., sediments dredged at 800 m from the shoreline and at a depth of 10 m to be brought back in about the same location).
  - Presence of clay to be tolerated but its dominance in the upper layer (i.e., the first 20 cm) to be avoided.
  - In order to make the assessment of the sediment quality more meaningful, it would be appropriate to investigate with another 2 or 3 sediment samples near the TCS-3 station, located about halfway through the trench excavation area and increase the number of biological targets to be subjected to the ecotoxicological test, e.g. adding one assay with heterotrophic bacteria or plant organisms, one essay with proper consumers, one assay with prolonged exposure or an endpoint other than mortality – immobility.

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **low negative impact** is expected on the sediments during the construction phase.

Table 7-6: Residual impact assessment matrix for the sediments during construction phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Handling and resuspension of sediments	Duration:	Medium	Medium-low	Short-mid-term	**Low**	Medium-high	**Negligible**
	Frequency:	Continuous					
	Geo. Extent:	Project footprint					
	Intensity:	Medium					
Introduction of new offshore infrastructures	Duration:	Medium	Medium-low	Short-mid-term	**Low**	None	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Project footprint					

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
	Intensity:	Low					
Overall assessment:		**Low**	Rationale:	Using a strong precautionary approach, the highest residual impact value may be considered as a theoretical overall residual impact value.			

Monitoring measures

The following monitoring measure shall be implemented to assess the true effects of the project on the sediments during the construction and verify the effectiveness of the mitigation measures.

- Sediment samplings (i.e., by grab) and analyses to be performed at both the trench and temporary storage area once completed the construction. Results to be compared with the baseline conditions.

7.3.1.2.2 Operation phase

No impacts generated by the operation phase of the project are expected on the sediments.

7.3.1.3 Seawater (chemical and physical)

Based on the information collected for the definition of the baseline (see 6.3.1.3), the physical component *Seawater* was assigned a **Medium** value of sensitivity for the following reasons:

- CTD measurements and chemical main parameters in line with the regional context; and
- AoI located mainly in open sea area with good water circulation.

Impacts potentially affecting this component are assessed here below for the construction phase and operation phase.

7.3.1.3.1 Construction phase

Impact factors

The impact factors from the Project activities potentially affecting seawater during construction phase are listed in the following table.

Table 7-7: Project actions and related impact factors potentially affecting seawater during construction phase.

Project actions	Brief description	Impact factors
Offshore excavation (trenching) and sediment storage	Excavation of a trench in shallow water in correspondence of the land approach (1.4 km). The sediments removed will be temporarily stored west of Filyos Port, east of the pipeline, and will be moved back to cover the pipeline.	■ Minor leakage of contaminants into water ■ Handling and resuspension of sediments

Project actions	Brief description	Impact factors
Offshore pipeline laying	Offshore laying of the pipelines, umbilical line, and lines within the SPS and their connection.	■ Minor leakage of contaminants into water ■ Handling and resuspension of sediments
Pre-commissioning activities (e.g. pipeline hydrotesting, cleaning and gauging)	Following the completion of the construction stage, several procedures will be followed to verify that the lines operate smoothly in the expected circumstances.	■ Emission of particulates and chemicals in water
Wastewater treatment discharge	Treated wastewater discharge of a contractor (Kolin)	■ Discharge of wastewater

All the impact factors identified above are described below and assessed in the matrix that follows.

- **Minor leakage of contaminants into water**

Vessels will be used for all the activities concerning the offshore section of the project: 7 vessels for the land approach (i.e., first 1.4 km from the shoreline) and 19 for the pipelay operations in deeper waters.

When dealing with a vessel, the leakage of small amounts (i.e., negligible, but still present) of contaminants (mostly oily and greasy) from the engines is considered “physiological” and inevitable. Contaminants of such typology are mostly insoluble in water and tend to remain on the surface, affecting the seawater quality. However, it must be noted that the two groups of vessels mentioned above will be rarely operational in the same timeframe, having sequential functions, and all the vessels must be compliant with MARPOL, to which Turkey is signatory.

- **Handling and resuspension of sediments**

As previously stated, the dredging of the trench for the pipelines’ land approach will mobilize close to 82,000 m^3 of sediments, potentially causing a reintroduction to the water column of contaminants retained in the sediments (if present). In addition, such mobilization is expected to cause a temporary increase of turbidity of the seawater.

It should be noted, however, that, as stated during the impact assessment for sediments (see 7.3.1.2.1), all contaminants identified in the AoI and its vicinity exceeded neither the PEL of NOAA nor the TLV of the Turkish regulation and the AoI is very close to the Filyos river mouth, which produce natural turbidity by sediment supply. For both those reason, it is unlikely that this impact factor could severely affect the seawater of the AoI.

- **Emission of particulates and chemicals in water**

After the completion of the construction phase and before the pipelines are put into operations, all the pipes will be hydrotested to detect possible faults in the junctions and prevent leakage. Such test, as described in 3.0, is typically made by filtered seawater, or filtered seawater with chemical additive including corrosion inhibitor, oxygen scavenger, biocide, and dye to prevent internal corrosion or to identify leaks, MEG or umbilical transportation liquid.

Ideally, the liquids used to hydrotest the pipelines are not supposed to leak and, therefore, affect the seawater, especially in the oxygenated layers (i.e., from 0 to -100/-150 m; see 6.3.1.3). Still, this is an ideal scenario. It is not rare that pipelines just laid present small faults (mainly at the junctions) to be repaired before the operation phase. In such a case, a limited volume of the hydrotest liquid may leak, introducing chemicals that may alter the seawater quality.

The fluids, however, are planned to be discharged deep sea, in correspondence to the SPS site (i.e., at a depth of 2,200 m), altering the seawater quality. Nevertheless, as shown in 6.3.1.3, this quality altered is not expected to affect marine life, since the discharge point is located in the anoxic water layer, where no life exists, which does not mix with the oxygenated layer.

This activity is however planned to be implemented very punctually and limited times, reducing the possibility of impacting the marine environment, thank also to the diluting power of seawater, as described in 6.3.1.3.

- **Discharge of wastewater**

Domestic wastewater produced by the temporary camp site of Kolin set up for the construction phase of Filyos Port and the Project shall be discharged at sea. Such kind of wastewater, even if treated and compliant with the national and international regulations illustrated in Annex B, may still affect the seawater quality, in particular if the discharge point is located at the shoreline where dilution is minimal.

Domestic wastewaters contain loads of nutrients (nitrogen and phosphorus derivates) and other chemicals that may affect the water quality and cause eutrophication, especially if not properly managed (i.e., discharge point located deeper, like about 20 m of depth to ensure dilution).

Mitigation measures

The following mitigation measures shall be implemented to mitigate the effects of the impact factors.

- **Minor leakage of contaminants into water**
  - All vessels used to be compliant with MARPOL.
- **Handling and resuspension of sediments**
  - Sediments to be gently placed at the temporary storage area and during the backfill in order to reduce the resuspension.
- **Emission of particulates and chemicals in water**
  - Hydrotest fluids discharged deep sea to be compliant with the relevant standards for deep sea discharges as reported in Annex B.
  - Minimize, when possible, the volume of hydrotest water offshore by testing equipment at an onshore site prior to loading the equipment onto the offshore facilities.
  - Use the same water for multiple tests, when feasible.
  - Reduce the need for chemicals by minimizing as much as possible the time that test water remains in the equipment or pipeline.
  - Carefully select chemical additives in terms of dose concentration, toxicity, biodegradability, bioavailability, and bioaccumulation potential.

- **Discharge of wastewater**
  - Wastewater effluents to be compliant with the relevant standards as reported in Annex B.
  - Discharge point to be located at a sufficient water depth (below 25 m).
  - Effluent dispersion modelling to be performed to design the discharge point (e.g., location, need for diffusers etc.) especially if the discharge is not temporary (e.g., operation for more than one year).

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **low negative impact** is expected on the seawater during the construction phase.

Table 7-8: Residual impact assessment matrix for the seawater during construction phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Minor leakage of contaminants into water	Duration:	Medium	Medium	Short-mid-term	**Low**	Medium-high	**Negligible**
	Frequency:	Continuous					
	Geo. Extent:	Local					
	Intensity:	Low					
Handling and resuspension of sediments	Duration:	Medium	Medium	Short-term	**Low**	Low	**Negligible**
	Frequency:	Continuous					
	Geo. Extent:	Project footprint					
	Intensity:	Medium					
Emission of particulates and chemicals in water	Duration:	Short	Medium	Short-mid-term	**Low**	Medium	**Negligible**
	Frequency:	Infrequent					
	Geo. Extent:	Local					
	Intensity:	Medium					
Discharge of wastewater	Duration:	Medium	Medium	Short-mid-term	**Medium**	Medium-high	**Negligible**
	Frequency:	Continuous					
	Geo. Extent:	Local					
	Intensity:	Medium					
Overall assessment:		**Negligible**	Rationale:	Due to the compliance with relevant standards of the impact factors, even using a precautionary approach, the residual impact values are not expected to cumulate to a higher impact value. Therefore, the average residual impact value may be considered as a reference for the overall impact.			

Monitoring measures

The following monitoring measure shall be implemented to assess the true effects of the project on the seawater during the construction and verify the effectiveness of the mitigation measures.

- Water samplings (i.e., by Niskin bottle close to the surface and close to the bottom) and analyses to be performed at both the trench and temporary storage area immediately after the dredging and backfill activities; results to be compared with the baseline conditions.
- Water samplings (i.e., by Niskin bottle close to the surface and close to the bottom) and analyses to be performed at the hydrotest discharge point immediately after the hydrotesting activities and by one month after them (i.e., a time interval from a week after to a month after is accepted). Chemicals used for the hydrotest (see 3.0) to be searched and quantified in laboratory.
- In case of leakages during the hydrotest, water samplings (i.e., by Niskin bottle close to the surface and close to the bottom) and analyses to be conducted in correspondence of the leakage point(s) immediately after the leak(s) and by one month after (i.e., a time interval from a week after to a month after is accepted). Chemicals used for the hydrotest (see 3.0) to be searched and quantified in laboratory.

7.3.1.3.2 Operation phase

Impact factors

The impact factors from the Project activities potentially affecting the seawater during operation phase are listed in the following table.

Table 7-9: Project actions and related impact factors potentially affecting seawater during operation phase.

Project actions	Brief description	Impact factors
Plant/infrastructure operation offshore	Technical and administrative activities, including operation of the plant/infrastructure, surveillance, monitoring, maintenance, performed according to standard operating procedures to maintain the Project offshore parts in operation.	▪ Discharge of wastewater ▪ Minor leakage of contaminants into water

The impact factors identified above are described below and assessed in the matrix that follows.

- **Discharge of wastewater**

Such as stated in hydrology and surface water impact assessment and freshwater aquatic biodiversity, wastewaters produced by the OPF are expected to be discharged in the Filyos river, after being properly treated. Such discharges concern the industrial wastewater, civil sewage and rain drainages.

Considering that the Wastewater Treatment Plants will collect hazardous and non-hazardous compounds, as well as the drains from the paved areas, their effluents, even if compliant with the national and international regulations illustrated in Annex B may still affect the river water quality (see hydrology and surface water impact assessment and freshwater aquatic biodiversity) and, by consequence, the seawater quality by containing minimal quantities of organics (e.g., lube oil, diesel, heat transfer oil, MEG, TEG, corrosion inhibitor), and solids, (e.g., sand, corrosion products and salts).

In fact, even if diluted by the flow rate of the river, once reached the sea, the discharged wastewater may alter the seawater quality throughout the years (i.e., 20 to 45 years, depending on the gas availability, as stated in 3.0), especially the surface layer because of the limited mixing of waters in the Black Sea (see 6.3.1.3). Therefore, even if compliant with the regulations this is expected to be a long-lasting impact factor, active for the whole project lifetime, becoming chronical.

- **Minor leakage of contaminants into water**

The SPS and pipelines are essential for the project, therefore conducting maintenance/repair operations is mandatory. Such operations are always conducted using vessels that, such as previously stated, may lose small amounts of contaminants (mostly oily and greasy) from the engines, altering the seawater quality.

However, it must be noted that these maintenance/repair operations are not performed continuously and do not require a large number of vessels. In addition, all vessels must be compliant with MARPOL, to which Turkey is signatory; therefore, it is unlikely that this impact factor could severely affect the seawater.

Mitigation measures

The following mitigation measures shall be implemented to mitigate the effects of the impact factors.

- **Discharge of wastewater**
  - Wastewater effluents to be compliant to national and international standards.
- **Minor leakage of contaminants into water**
  - All vessels used to be compliant with MARPOL.

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **low negative impact** is expected on the seawater during the operation phase.

Table 7-10: Residual impact assessment matrix for the seawater during operation phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Discharge of wastewater	Duration:	Long	Medium	Mid term	**Medium**	Medium-high	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Local					
	Intensity:	Medium					
Minor leakage of	Duration:	Long	Medium	Short-mid-term	**Low**	Medium-high	**Negligible**
	Frequency:	Infrequent					

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
contaminants into water	Geo. Extent:	Local					
	Intensity:	Low					
Overall assessment:		**Low**	Rationale:	The impact generated by the discharge of wastewater may be considered as a reference for the overall impact, being the most important in terms of intensity and frequency.			

Monitoring measures

The following monitoring measure shall be implemented to assess the true effects of the project on the seawater during the operation and verify the effectiveness of the mitigation measures.

- Regular continuous monitoring at the discharge points in the Filyos river as illustrated in hydrology and surface water impact assessment will be useful also for the seawater as a consequence.
- In case of exceeding the thresholds defined in Annex B at the discharge points, water samplings (i.e., by Niskin bottle close to the surface and close to the bottom) and analyses to be performed along a transect starting from the Filyos river mouth and directed offshore following the predominant current direction immediately after the detection of the exceeding and by one month after (i.e., a time interval from a week after to a month after is accepted). The exceeded parameter to be searched and quantified in laboratory as minimum.
- Seasonal water samplings (i.e., by Niskin bottle close to the surface and close to the bottom) and analyses to be performed along a transect starting from the Filyos river mouth and directed offshore following the predominant current direction. The same parameters as per the discharge points in the river (as stated in hydrology and surface water impact assessment and reported in Annex B) to be searched and quantified in laboratory. This monitoring coupled with the one reported for hydrology and surface water impact assessment aim at both:
  - Monitoring the input of contaminants from the river to the seawater; and
  - Discriminating whether the source of the possible pollution (whether present) could be the project itself or other sources (e.g., other wastewater discharges in the area).

7.3.1.4 Physical oceanography (currents and waves)

Based on the information collected for the definition of the baseline (see 6.3.1.4), the physical component *Physical oceanography* was assigned a **Medium-low** value of sensitivity for the following reasons:

- Absence of relevant local upwelling phenomena; and
- Low probability of extreme wave events.

Impacts potentially affecting this component are assessed here below for the construction phase and operation phase.

7.3.1.4.1 Construction phase

Impact factors

The impact factors from the Project activities potentially affecting Physical oceanography (currents and waves) during construction phase are listed in the following table.

Table 7-11: Project actions and related impact factors potentially affecting seawater during construction phase.

Project actions	Brief description	Impact factors
Offshore excavation (trenching) and sediment storage	Excavation of a trench in shallow water in correspondence of the land approach (1.4 km). The sediments removed will be temporarily stored west of Filyos Port, east of the pipeline, and will be moved back to cover the pipeline.	▪ Presence of the cofferdams

The impact factor identified above is described below and assessed in the matrix that follows.

- **<u>Presence of the cofferdams</u>**

Such as previously stated, two series of cofferdams will be put in place during the excavation of the trench and subsequent pipeline laying. Those barriers will be erected from the sea bottom to above the sea level to prevent the trench to be refilled by the sediments coming from the Filyor river. During its about 105 days of presence the cofferdams will create a barrier altering the water circulation and movements for the 268 m of their length.

This alteration is however temporary and completely reversible, since the water circulation is expected to be immediately restored once the cofferdams are removed.

Mitigation measures

No mitigation measures are identified for the impact factor potentially affecting the physical oceanography during construction.

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **<u>negligible negative impact</u>** is expected on the physical oceanography during the construction phase.

Table 7-12: Residual impact assessment matrix for the physical oceanography during construction phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
	Duration:	Medium-short	Medium-low	Short-term	**Negligible**	None	**Negligible**

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Presence of the cofferdams	Frequency:	Continuous					
	Geo. Extent:	Project footprint					
	Intensity:	High					
Overall assessment:		**Negligible**	Rationale:	Only one impact factor is expected to influence this component, therefore its residual impact value corresponds to the overall assessment for the component itself.			

Monitoring measures

No monitoring measures are required for the physical oceanography during construction.

7.3.1.4.2 Operation phase

No impacts generated by the operation phase of the project are expected on the physical oceanography.

7.3.1.5 Underwater noise

Based on the information collected for the definition of the baseline (see 6.3.1.5), the physical component *Underwater noise* was assigned a **Medium-high** value of sensitivity for the following reasons:

- Presence of cetaceans; and
- Moderate number of maritime routes.

Impacts potentially affecting this component are assessed here below for the construction phase and operation phase.

7.3.1.5.1 Construction phase

Impact factors

The impact factors from the Project activities potentially affecting Underwater noise during construction phase are listed in the following table.

Table 7-13: Project actions and related impact factors potentially affecting seawater during construction phase.

Project actions	Brief description	Impact factors
Offshore excavation (trenching) and sediment storage	Excavation of a trench in shallow water in correspondence of the land approach (1.4 km). The sediments removed will be temporarily stored west of Filyos Port, east of the pipeline, and will be moved back to cover the pipeline.	▪ Emission of underwater noise

Project actions	Brief description	Impact factors
Offshore pipeline laying	Offshore laying of the pipelines, umbilical line and lines within the SPS and their connection.	▪ Emission of underwater noise

The impact factor identified above is described below and assessed in the matrix that follows.

- **Emission of underwater noise**

As previously stated, a total of 26 vessels will be used for the pipelay activities offshore, namely 7 for the land approach (corresponding to the first 1.4 km to be dredged from the shoreline) and 19 for the pipelaying in the deeper waters. Such vessels are expected to be the main responsible for the emission of underwater noise, if not the only one. The underwater noise of being laid pipelines in fact, is reported to be negligible to unrecordable because covered by the noise emitted by the vessels' propellers and so may be dredging activities, depending on the dredger and the substrate. Fine sediments which characterize the seafloor of the AoI are not considered of overpass the noise emission of the propellers.

In addition, it should be noted that, as illustrated in 6.1.8.2 and 6.3.1.5, the AoI is already frequented by several vessels all year long and that noise emissions, being on a logarithmical scale, are not summed arithmetically. Moreover, as described in 3.0, these two groups of vessels will work subsequently and are planned to overlap in their operations very rarely only.

The increase for the AoI may be considered of few dB re 1 μPa, but the ambient underwater noise (already influenced by the strong presence of vessels) shall be completely restored once the construction phase is over.

All the vessels must be compliant with MARPOL, to which Turkey is signatory, whose regulations also have the objective of minimizing and preventing the noise pollution created by maritime traffic.

Mitigation measures

The following mitigation measures shall be implemented to mitigate the effects of the impact factor.

- **Emission of underwater noise**
  - All vessels used to be compliant with MARPOL.

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **low negative impact** is expected on the underwater noise during the construction phase.

Table 7-14: Residual impact assessment matrix for the underwater noise during construction phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Emission of underwater noise	Duration:	Medium	Medium-high	Short-term	**Low**	Low	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Local					
	Intensity:	Medium					
Overall assessment:		**Low**	Rationale:	Only one impact factor is expected to influence this component, therefore its residual impact value corresponds to the overall assessment for the component itself.			

Monitoring measures

No monitoring measures are required for the underwater noise during construction.

7.3.1.5.2 Operation phase

Impact factors

The impact factors from the Project activities potentially affecting the Underwater noise during operation phase are listed in the following table.

Table 7-15: Project actions and related impact factors potentially affecting seawater during construction phase.

Project actions	Brief description	Impact factors
Plant/infrastructure operation offshore	Technical and administrative activities, including operation of the plant/infrastructure, surveillance, monitoring, maintenance, performed according to standard operating procedures to maintain the Project offshore parts in operation.	▪ Emission of underwater noise

The impact factor identified above is described below and assessed in the matrix that follows.

- **Emissions of underwater noise**

As previously stated, the offshore infrastructures are expected to be periodically monitored and maintained. Such operations are always conducted using vessels whose propellers are expected to emit underwater noise.

Depending on the vessel used, an emission of 150-185 dB re 1 μPa at 1 m in the low frequency band (< 300 Hz) may be expected. However, it must be noted that these maintenance/repair operations are not performed continuously and do not require a large number of vessels and that noise emissions do not sum arithmetically, being on a logarithmical scale. In addition, all vessels must be compliant with MARPOL, to which Turkey is signatory.

All operations may be periodic but always temporary (i.e., never lasting more than 2 weeks) and are performed in an already maritime route “congested” area. For such period, the increase for the AoI may be considered of few dB re 1 μPa, but the ambient underwater noise (already influenced by the strong presence of vessels) shall be completely restored once the construction phase is over.

Mitigation measures

The following mitigation measures shall be implemented to mitigate the effects of the impact factor.

- **<u>Emission of underwater noise</u>**
  - All vessels used to be compliant with MARPOL.

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **<u>low negative impact</u>** is expected on the underwater noise during the operation phase.

Table 7-16: Residual impact assessment matrix for the underwater noise during operation phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Emission of underwater noise	Duration:	Long	Medium-high	Short-term	**Low**	Low	**Low**
	Frequency:	Infrequent					
	Geo. Extent:	Local					
	Intensity:	Medium					
Overall assessment:		**Low**	Rationale:	Only one impact factor is expected to influence this component, therefore its residual impact value corresponds to the overall assessment for the component itself.			

Monitoring measures

No monitoring measures are required for the underwater noise during construction.

7.3.2 Biological

7.3.2.1 Plankton

Based on the information collected for the definition of the baseline (see 6.3.2.1), the biological component *Plankton* was assigned a **High** value of sensitivity for the following reasons:

- Presence of highly productive waters; and
- High density of gelatinous plankton.

Impacts potentially affecting this component are assessed here below for the construction phase and operation phase.

7.3.2.1.1 Construction phase

Impact factors

The impact factors from the Project activities potentially affecting plankton during construction phase are listed in the following table.

Table 7-17: Project actions and related impact factors potentially affecting plankton during construction phase.

Project actions	Brief description	Impact factors
Offshore excavation (trenching) and sediment storage	Excavation of a trench in shallow water in correspondence of the land approach; the sediment removed will be temporarily stored west of Filyos Port, east of the pipeline, and will be moved back to cover the pipeline.	▪ Minor leakage of contaminants into water
Offshore pipelines and lines laying	Offshore laying of the pipelines (gas pipeline and MEG line) and lines (seabed umbilical and flexible pipes), and their connection with the Subsea Production System (SPS).	▪ Emission of light ▪ Minor leakage of contaminants into water
Wastewater treatment discharge	Treated wastewater discharge of a contractor (Kolin)	▪ Discharge of wastewater
Pre-commissioning activities (e.g., pipeline hydrotesting, cleaning and gauging)	During the pre-commissioning phase, the pipelines will by hydrotested by pumping a chemical mixture.	▪ Emission of particulates and chemicals in water

The impact factors identified above are described below and assessed in the matrix that follows.

- **<u>Minor leakage of contaminants into water</u>**

Such as previously discussed for the seawater (see 7.3.2.1.1), vessels will be used for all the activities concerning the offshore section of the project: 7 vessels for the land approach (i.e., first 1.4 km from the shoreline) and 19 for the pipelay operations in deeper waters.

When dealing with a vessel, the leakage of small amounts (i.e., negligible, but still present) of contaminants (mostly oily and greasy) from the engines is considered "physiological" and inevitable. Contaminants of such typology are mostly insoluble in water and tend to remain on the surface, potentially affecting marine organisms of the AoI, such as plankton. Indeed, depending on the amount, hydrocarbons may have severe effects on all marine organisms. A study showed that, while large amounts of oil can reduce photosynthesis and growth, as well as being lethal to phytoplankton, small amounts can on the opposite stimulate growth, which can result in excessive blooms. For zooplankton, sublethal effects may include impacts on feeding, behavior, reproduction, and development (Faggetter, 2011).

It must be noted, however, that all the vessels must be compliant with MARPOL, to which Turkey is signatory, highly reducing the possibility of large leakages. In addition, the construction works should not last more than a year and the two groups of vessels mentioned above will be rarely operational in the same timeframe, having sequential functions.

- **Emission of light**

During the construction phase, pipelay activities are operations that are performed continuously. Therefore, night working, and the use of artificial light, will be required.

Night light pollution is known to affect marine organisms, their presence and space use. Indeed, plankton organisms are known to perform daily vertical migrations (zooplankton in particular, but phytoplankton as well: Gerbersdorf & Schubert, 2011), corresponding to their circadian rhythms where sunlight is the main limiting factor. Zooplankton, in fact, come to the surface during the night-time to feed and go back down during the day to avoid predation (Schiopca, 2018).

Considering that the pipelay operations are going to be performed continuously 24/7, the emission of light may cause the zooplankton descent in the water column preventing the organisms from feeding when the light itself is on (Schiopca, 2018). Even if continuously active for the whole pipelay duration (i.e., almost a year), such impact factor is limited to the vessel's circumscribed area and may be considered as affecting only few tens of meters from the vessels. In addition, even if the pipelay vessel is expected to proceed very slowly (almost still; 0.4 kn are assumed, considering the CastorOne technical sheet), the impact may be considered as totally temporary, as the situation is expected to completely recover once the vessel has passed (i.e., every night the pipelay vessel is assumed to be 5 km apart).

- **Discharge of wastewater**

Such as already stated in 7.3.1.3.2, domestic wastewater produced by the temporary camp site set up for the construction phase shall be discharged at sea. Such kind of wastewater, even if treated and compliant with the national and international regulations illustrated in Annex B, may still affect the seawater quality, in particular if the discharge point is located at the shoreline where dilution is minimal.

As previously discussed, domestic wastewaters contain loads of nutrients (nitrogen and phosphorus derivates) and other chemicals that may affect the water quality by causing eutrophication. Such phenomenon can lead to uncontrolled vegetal blooms (phytoplankton), including possibly toxic species that are normally absent because naturally contrasted by their feeders (zooplankton).

Even if temporary, whether not properly managed (i.e., discharge point located deeper, like about 20 m of depth to ensure dilution), this impact factor may cause changes in the plankton community composition that, subsequently, may be reflected on the whole marine biodiversity. In fact, the natural resources that are linked to plankton (fishes, cetaceans and seabirds) may reduce their presence in the area because their food has disappeared.

- **Emission of particulates and chemicals in water**

As previously stated for the seawater (see 7.3.1.3.1), after the completion of the construction phase and before the pipelines are put into operations, all the pipes will be hydrotested by pumping liquids at 550 PPM into them to detect possible faults in the junctions and prevent leakage. Such test, as described in 3.0, is typically made by filtered seawater, or filtered seawater with chemical additive, such as RX-5255, containing a mixture of corrosion inhibitor, oxygen scavenger, biocide, and dye to prevent internal corrosion or to identify leaks, MEG or umbilical transportation liquid.

Ideally, the liquids used to hydrotest the pipelines are not supposed to leak and, therefore, affect the water column and the pelagic organisms of the oxygenated layers (i.e., from 0 to -100/-150 m; see 6.3.1.3). Still, this is an ideal scenario. It is not rare that pipelines just laid present small faults (mainly at the junctions) to be repaired before the operation phase. In such a case, a limited volume of the hydrotest liquid may leak, introducing chemicals that may alter the seawater quality (see 7.3.1.3.1).

Limited information is available about the effects of corrosion inhibitors or leak detection dyes on marine ecosystems. However, commercial corrosion inhibitors are known to show traces of heavy metals which has negative effects on living organisms (Amadi & Ukpaka, 2007). In addition, leak detection dyes include components that are classified as environmental hazard, whereas oxygen scavengers are reported to alter the water chemistry. In fact, they are commonly made of sodium bisulfide or ammonium bisulfide, which are reductive agent lowering the pH of the water. Regarding biocides, research has shown that it has a multitude of negative effects on marine organisms, showing decrease in growth and photosynthetic activity in phytoplankton and acute toxicity and mortality in zooplankton (Guardiola, Cuesta, Meseguer, & Esteban, 2012).

However, it should be mentioned that Staples et al. (2001) demonstrated that ethylene glycol (EG) undergoes rapid biodegradation in aerobic and anaerobic environments with approximately 100% removal of EG within 24 h to 28 days. Moreover, the results of the study showed that EG is practically non-toxic to aquatic organisms and does not bioaccumulate.

The hydrotest fluids are planned to be discharged deep sea, in correspondence to the SPS site (i.e., at a depth of 2,200 m), where they may cause alteration of the seawater quality, as shown in 7.3.1.3.1. Nevertheless, as previously discussed, this alteration is not expected to affect marine life, since the discharge point is located in the anoxic water layer, where no life exists, which does not mix with the oxygenated layer.

This activity is however planned to be implemented very punctually and limited times, reducing the possibility of impacting the marine environment, thank also to the diluting power of seawater, as described in 6.3.1.4.

Mitigation measures

The following mitigation measures shall be implemented to mitigate the effects of the impact factors.

- **Minor leakage of contaminants into water**
  - All vessels used to be compliant with MARPOL.
- **Discharge of wastewater**
  - Wastewater effluents to be compliant with the relevant standards as reported in Annex B.

  - Discharge point to be located at a sufficient water depth (below 25 m).
  - Effluent dispersion modelling to be performed to design the discharge point (e.g., location, need for diffusers etc.) especially if the discharge is not temporary (e.g. operation for more than one year).
- **Emission of particulates and chemicals in water**
  - Hydrotest fluids discharged deep sea to be compliant with the relevant standards for deep sea discharges as reported in Annex B.
  - Minimize, when possible, the volume of hydrotest water offshore by testing equipment at an onshore site prior to loading the equipment onto the offshore facilities.
  - Use the same water for multiple tests, when feasible.
  - Reduce the need for chemicals by minimizing as much as possible the time that test water remains in the equipment or pipeline.
  - Carefully select chemical additives in terms of dose concentration, toxicity, biodegradability, bioavailability, and bioaccumulation potential.

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **low negative impact** is expected on plankton during the construction phase.

Table 7-18: Residual impact assessment matrix for plankton during construction phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Minor leakage of contaminants into water	Duration:	Medium	High	Short-mid-term	**Medium**	Medium-high	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Local					
	Intensity:	Low					
Emission of light	Duration:	Medium	High	Short-term	**Low**	None	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Project footprint					
	Intensity:	Medium					
Discharge of wastewater	Duration:	Medium	High	Mid term	**High**	High	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Local					
	Intensity:	Medium					

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Emission of particulates and chemicals in water	Duration:	Short	High	Short-mid-term	**Medium**	Medium	**Low**
	Frequency:	Infrequent					
	Geo. Extent:	Local					
	Intensity:	Medium					
Overall assessment:		**Low**	Rationale:	Due to the compliance with relevant standards of the impact factors, even using a precautionary approach, the residual impact values are not expected to cumulate to a higher impact value. Therefore, the average residual impact value may be considered as a reference for the overall impact.			

Monitoring measures

The following monitoring measures shall be implemented to assess the true effects of the project on plankton during the construction and verify the effectiveness of the mitigation measures.

- Regular continuous monitoring at the wastewater treatment plant as illustrated in 7.3.1.3.1 will be useful also for plankton as a consequence.
- Water samplings (i.e., by Niskin bottle at the chlorophyll-a peak, quantified by probe) and zooplankton samplings (i.e., WP2 net), with subsequent plankton community identification, to be performed along a transect starting from the discharge point and following the predominant current direction before the first wastewater discharge (in two opposite seasons, if practicable with the project timings) in the same sampling stations as per seawater. Results to be used in case of exceeding the thresholds (see the next bullet point).
- In case of exceeding the thresholds defined in Annex B at the wastewater treatment plant, water samplings (i.e., by Niskin bottle at the chlorophyll-a peak, quantified by probe) and zooplankton samplings (i.e., WP2 net), with subsequent plankton community identification, to be performed along a transect starting from the discharge point and following the predominant current direction immediately after the detection of the exceeding and in the opposite season (e.g., summer and winter) in the same sampling stations as per seawater. Results to be compared with the previous bullet point and among them.
- Seasonal water samplings (i.e., by Niskin bottle at the chlorophyll-a peak, quantified by probe) and zooplankton samplings (i.e., WP2 net), with subsequent plankton community identification, to be performed along a transect starting from the discharge point and following the predominant current direction in the same sampling stations as per seawater. Results to be compared among them.

7.3.2.1.2 Operation phase

Impact factors

The impact factors from the Project activities potentially affecting plankton during operation phase are listed in the following table.

Table 7-19: Project actions and related impact factors potentially affecting plankton during operation phase.

Project actions	Brief description	Impact factors
Plant/infrastructure onshore operation	Technical and administrative activities, including operation of the plant/infrastructure, surveillance, monitoring, maintenance, performed according to standard operating procedures to maintain the Project offshore parts in operation.	■ Discharge of wastewater ■ Minor leakage of contaminants into water

The impact factors identified above are described below and assessed in the matrix that follows.

- **Discharge of wastewater**

Such as already stated in 7.3.1.3.2, wastewaters produced by the OPF are expected to be discharged in the Filyos river, after being properly treated. Such discharges concern the industrial wastewater, civil sewage and rain drainages.

Considering that the Wastewater Treatment Plants will collect hazardous and non-hazardous compounds, as well as the drains from the paved areas, their effluents, even if compliant with the national and international regulations illustrated in Annex B may still affect the river water quality (see hydrology and surface water impact assessment and freshwater aquatic biodiversity) and, by consequence, the characteristics of the seawater by containing minimal quantities of organics (e.g., lube oil, diesel, heat transfer oil, MEG, TEG, corrosion inhibitor), and solids, (e.g., sand, corrosion products and salts).

In fact, even if diluted by the flow rate of the river, once reached the sea, the discharged wastewater may alter the seawater quality throughout the years (i.e., 20 to 45 years, depending on the gas availability, as stated in 3.0), such as assessed in 7.3.1.3.2, especially the surface layer because of the limited mixing of waters in the Black Sea (see 6.3.1.4). Depending on the chemical typologies and quantities, a reduction of the photosynthetic ability of the phytoplankton may be observed, as well as phenomena of acute toxicity and/or in the zooplankton. However, even if compliant with the regulations, this is expected to be a long-lasting impact factor, active for the whole project lifetime, potentially expected to become chronical and resulting in a community composition change.

- **Minor leakage of contaminants into water**

Maintenance/repair operations of the SPS and pipelines are planned for the operation phase of the project. Such operations are always conducted using vessels that, such as previously stated, may lose small amounts of contaminants (mostly oily and greasy) from the engines, potentially altering the seawater quality (see 7.3.1.3.2) and, by consequence, the plankton communities of the AoI.

However, it must be noted that these maintenance/repair operations are not performed continuously and do not require a large number of vessels. In addition, all vessels must be compliant with MARPOL, to which Turkey is signatory; therefore, it is unlikely that this impact factor could severely affect the seawater to cause a community significant alteration or switch.

Mitigation measures

The following mitigation measures shall be implemented to mitigate the effects of the impact factors.

- **Discharge of wastewater**
  - Wastewater effluents to be compliant to national and international standards.
- **Minor leakage of contaminants into water**
  - All vessels used to be compliant with MARPOL.

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **medium negative impact** is expected on plankton during the operation phase.

Table 7-20: Residual impact assessment matrix for plankton during operation phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Discharge of wastewater	Duration:	Long	High	Mid term	**High**	Medium-high	**Medium**
	Frequency:	Continuous					
	Geo. Extent:	Local					
	Intensity:	Medium					
Minor leakage of contaminants into water	Duration:	Long	High	Short-mid-term	**Medium**	Medium-high	**Low**
	Frequency:	Infrequent					
	Geo. Extent:	Local					
	Intensity:	Low					
Overall assessment:		**Medium**	Rationale:	The impact generated by the discharge of wastewater may be considered as a reference for the overall impact, being the most important in terms of intensity and frequency.			

Monitoring measures

The following monitoring measures shall be implemented to assess the true effects of the project on plankton during the operation and verify the effectiveness of the mitigation measures.

- Regular continuous monitoring at the discharge points in the Filyos river as illustrated in hydrology and surface water impact assessment will be useful also for plankton as a consequence.
- Water samplings (i.e., by Niskin bottle at the chlorophyll-a peak, quantified by probe) and zooplankton samplings (i.e., WP2 net), with subsequent plankton community identification, to be performed along a

transect starting from the Filyos river mouth and directed offshore following the predominant current direction before the first wastewater discharge into the river (in two opposite seasons, if practicable with the project timings). Results to be used in case of exceeding the thresholds (see the next bullet point).

- In case of exceeding the thresholds defined in Annex B at the discharge points, water samplings (i.e., by Niskin bottle at the chlorophyll-a peak, quantified by probe) and zooplankton samplings (i.e., WP2 net), with subsequent plankton community identification, to be performed along a transect starting from the Filyos river mouth and directed offshore following the predominant current direction immediately after the detection of the exceeding and in the opposite season (e.g., summer and winter) in the same sampling stations as per seawater. Results to be compared with the previous bullet point and among them.
- Seasonal water samplings (i.e., by Niskin bottle at the chlorophyll-a peak, quantified by probe) and zooplankton samplings (i.e., WP2 net), with subsequent plankton community identification, to be performed along a transect starting from the Filyos river mouth and directed offshore following the predominant current direction in the same sampling stations as per seawater. Results to be compared among them.

7.3.2.2 Benthic Communities (phyto- and zoobenthos)

Based on the information collected for the definition of the baseline (see 6.3.3.2), the biological component *Benthic communities* was assigned a **Medium** value of sensitivity for the following reasons:

- Absence of protected, endemic, or threatened species; and
- Presence of species of economic importance.

Impacts potentially affecting this component are assessed here below for the construction phase and operation phase.

7.3.2.2.1 Construction phase

Impact factors

The impact factors from the Project activities potentially affecting the benthic communities during construction phase are listed in the following table.

Table 7-21: Project actions and related impact factors potentially affecting benthic communities during construction phase.

Project actions	Brief description	Impact factors
Offshore excavation (trenching) and sediment storage	Excavation of a trench in shallow water in correspondence of the land approach; the sediment removed will be temporarily stored west of Filyos Port, east of the pipeline, and will be moved back to cover the pipeline.	■ Handling and resuspension of sediments
Offshore pipelines and lines laying	Offshore laying of the pipelines (gas pipeline and MEG line) and lines (seabed umbilical and flexible pipes), and their connection with the Subsea Production System (SPS).	■ Handling and resuspension of sediments ■ Introduction of new offshore infrastructures

Project actions	Brief description	Impact factors
Wastewater treatment discharge	Treated wastewater discharge of a contractor (Kolin)	■ Discharge of wastewater

All the impact factors identified above are described below and assessed in the matrix that follows.

- **Handling and resuspension of sediments**

Such as already stated in 7.3.1.1.1 and 7.3.1.2.1, the offshore excavation of the trench for the first 1.4 km of the pipeline corridor is expected to actively mobilize sediments to be stored at the temporary storage area before the backfill. These actions are expected to cause direct mortality to benthic organisms located in the trench area by the mechanical action of the dredger, as well as to the benthic organisms at the temporary storage area, since even infaunal species are reported not to survive if buried beyond 20 cm of sediments. Resuspension of sediments is also reported to impact benthic communities by creating a choking effect on bottom (Souza Dias, 2020) and by increasing the turbidity, which may affect the photosynthetic capabilities of the phytobenthic species. However, as reported in 6.3.3.2, the presence of the Filyos river mouth already represents a sediment supply for the AoI, and no seaweed and/or seagrasses were found in the AoI; therefore, these particular effects may be considered as negligible, if not completely absent.

As analyzed in 7.3.1.1.1 and 7.3.1.2.1, around 81,356 m^3 of sediments will be dug up and put back in place during a period of 105 days but, such as stated in 6.3.3.2, the benthic communities observed in the AoI are all characterized by a strong resilience to human pressure.

- **Introduction of new offshore infrastructures**

As previously discussed, besides the burial operations in the land approach, the pipelines will be simply laid upon the seafloor which, as shown in 6.3.1.1 and 6.3.1.2, consists mostly of fine sediments and host benthic communities typical of soft bottoms.

Such laying operations, in fact, consist in the introduction of two pipelines and one umbilical line which may cause direct mortality of the organisms by crushing due to the lay of the pipes. A limited habitat disruption, which is mainly composed by large sandy stretches, more or less covered or mixed with mud, is also expected by the introduction of hard substrates which will fragment the soft bottom habitats themselves. However, both impacts described are expected to be very limited since (i) beyond 80 m of depth the sediments are almost completely anoxic, (ii) the benthos of the oxygenated sections of AoI is mainly composed by highly resilient communities (see 6.3.3.2) and (iii) the presence of hard substrates may act as a low environmental enrichment in the long period (see 7.3.2.2.2).

- **Discharge of wastewater**

As already discussed, domestic wastewater is expected to be produced by the temporary camp site set up for the construction phase and, such wastewater, is planned to be treated and discharged at sea. Domestic wastewaters are known to represent a nutrient load input to aquatic environments, potentially causing eutrophication. As stated in 6.3.1.2, sediments are a conservative matrix that may sequestrate and accumulate contaminants and nutrients from water.

For this reason, it is not rare that eutrophication phenomena may happen at the discharge port(s) located offshore, causing benthic algal blooms in correspondence. Such blooms may alter the benthic community composition potentially showing mucilage events as well.

Such impact is however spatially limited to the discharge point(s) and temporary, since related to the camp site to be decommissioned after construction.

Mitigation measures

The following mitigation measures shall be implemented to mitigate the effects of the impact factors.

- **Handling and resuspension of sediments**
  - Sediments to be gently placed at the temporary storage area in order to reduce the resuspension.
  - Dredged sediments to be stored in mapped sections at the temporary storage area so the backfill operation shall bring back the sediments at the proper location not to disrupt the sediment type distribution (e.g., sediments dredged at 800 m from the shoreline and at a depth of 10 to be brought back in about the same location).
  - Presence of clay to be tolerated but its dominance in the upper layer (i.e., the first 20 cm) to be avoided to favor recolonization.
- **Discharge of wastewater**
  - Wastewater effluents to be compliant with the relevant standards as reported in Annex B.
  - Discharge point to be located at a sufficient water depth (25 m or below 25).
  - Effluent dispersion modelling to be performed to design the discharge point (e.g., location, need for diffusers etc.) especially if the discharge is not temporary (e.g. operation for more than one year).

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **low negative impact** is expected on benthic communities during the construction phase.

Table 7-22: Residual impact assessment matrix for benthic communities during construction phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Handling and resuspension of sediments	Duration:	Medium	Medium	Short-mid-term	**Low**	Medium-high	**Negligible**
	Frequency:	Continuous					
	Geo. Extent:	Project footprint					
	Intensity:	Medium					
	Duration:	Medium	Medium		**Medium**	High	**Negligible**

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Discharge of wastewater	Frequency:	Continuous		Short-mid-term			
	Geo. Extent:	Local					
	Intensity:	Medium					
Introduction of new offshore infrastructures	Duration:	Medium	Medium	Short-mid-term	**Low**	None	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Project footprint					
	Intensity:	Low					
Overall assessment:		**Low**	Rationale:	Using a strong precautionary approach, the highest residual impact value may be considered as a theoretical overall residual impact value.			

Monitoring measures

No monitoring measures are required for benthic communities during construction.

7.3.2.2.2 Operation phase

Impact factors

The impact factors from the Project activities potentially affecting benthic communities during operation phase are listed in the following Table 7-23.

Table 7-23: Project actions and related impact factors potentially affecting benthic communities during operation phase.

Project actions	Brief description	Impact factors
Plant/infrastructure operation offshore	During the operation phase, the pipeline will be present on the seabed.	▪ Presence of new offshore infrastructures

The impact factors identified above is described below and assessed in the matrix that follows.

- **Presence of new offshore infrastructures**

Such as stated in the project description (see Chapter 3), the offshore part of the project consists in the presence of cables to connect the SPS parts, one umbilical line and two pipelines from the SPS (around 2,200 m deep) to the onshore facilities.

While such impact factor is considered negligible to even non-existent for the cables and the umbilical line, due to their diameter, the presence of the pipelines is expected to act as an artificial hard substrate upon the sandy seafloor. As stated for the construction phase (see 7.3.2.2.1), the introduction of the pipelines may disrupt the soft bottom habitats of the AoI. However, the presence of hard 3D structures in marine habitats are reported to have the potentiality to create the so-called "reef effects" (Taormina, et al., 2018), resulting in a potential positive impact. In fact, hard structures located in areas dominated by soft bottoms are usually reported to act as environmental enrichments, potentially forming biodiversity oases, since they may attract different species by providing a shelter for benthic organisms that may settle there.

However, it should be noted that this is particularly reported of structures showing a complex and heterogeneous 3D structure, characterized by a high degree of rugosity. In addition, based on what stated in 6.3.3.2, the sediments of the AoI become anoxic beyond 80 m of depth, substantially preventing life and the first 1.4 km of the pipelines from the shoreline are planned to be buried. Therefore, due to those considerations, the positive impact should be very limited, but still present.

Mitigation measures

Neither mitigation measures nor optimization measures are identified for benthic communities during operation phase.

Residual impacts

Based on the baseline conditions of the assessed component, the project characteristics and actions, a potential **low positive impact** is expected on the benthic communities during the operation phase.

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Table 7-24: Residual positive impact assessment matrix for benthic communities during operation phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Enhancement effectiveness	Residual impact value
Presence of new offshore infrastructures	Duration:	Long	Medium	Short-term	**Low**	Low	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Project footprint					
	Intensity:	Negligible					
Overall assessment:		**Low**	Rationale:	The presence of new offshore infrastructures is the only impact factor identified for such component in the operation phase.			

Monitoring measures

No monitoring measures are required for benthic communities during operation.

7.3.2.3 Fishes

Based on the information collected for the definition of the baseline (see baseline fishes), the biological component *Fishes* was assigned a **High** value of sensitivity for the following reasons:

- Abundance of pelagic fish targeted by fisheries; and
- Presence of species of economic interest.

Impacts potentially affecting this component are assessed here below for the construction phase and operation phase.

7.3.2.3.1 Construction phase

Impact factors

The impact factors from the Project activities potentially affecting fish during construction phase are listed in the following table.

Table 7-25: Project actions and related impact factors potentially affecting fishes during construction phase.

Project actions	Brief description	Impact factors
Offshore excavation (trenching) and sediment storage	Excavation of a trench in shallow water in correspondence of the land approach; the sediment removed will be temporarily stored west of Filyos Port, east of the pipeline, and will be moved back to cover the pipeline.	▪ Minor leakage of contaminants into water ▪ Emission of underwater noise
Offshore pipelines and lines laying	Offshore laying of the pipelines (gas pipeline and MEG line) and lines (seabed umbilical and flexible pipes), and their connection with the Subsea Production System (SPS).	▪ Minor leakage of contaminants into water ▪ Emission of light
Pre-commissioning activities (e.g., pipeline hydrotesting, cleaning and gauging)	During the pre-commissioning phase, the pipelines will by hydrotested by pumping a chemical mixture.	▪ Emission of particulates and chemicals in water

The impact factors identified above are described below and assessed in the matrix that follows.

- **<u>Minor leakage of contaminants into water</u>**

Such as previously discussed for the seawater and plankton (see 7.3.1.3.1 and 7.3.2.1.1), vessels will be used for all the activities concerning the offshore section of the project: 7 vessels for the land approach (i.e., first 1.4 km from the shoreline) and 19 for the pipelay operations in deeper waters.

The leakage of small amounts (i.e., negligible, but still present) of insoluble contaminants (mostly oily and greasy) from the engines is considered as “normal” and cannot be prevented.

Fish usually get in touch with chemicals mostly during their larval stage (i.e., ichthyoplankton) and through the gills during adulthood. Such contaminants may cause toxicity effects (both acute and chronicle) and/or accumulate in their organisms. Oils, in particular, are known to affect developing fish by retarding growth, causing premature hatching, and causing developmental or genetic changes (Faggetter, 2011), whereas hydrocarbons do bioaccumulate in fish, potentially causing secondary effects along the trophic food chain (Porte & Albaigés, 1994).

It must be noted, however, that all the vessels must be compliant with MARPOL, to which Turkey is signatory, highly reducing the possibility of large leakages. In addition, the construction works should not last more than a year and the two groups of vessels mentioned above will be rarely operational in the same timeframe, having sequential functions.

- **Emission of underwater noise**

The operating vessels will emit underwater noise through their propellers while working and navigating in the AoI. It has been shown that fishes can suffer from acoustic stress (ISPRA, 2011). Continuous sounds generated by vessels could contribute to increase the overall sound level in the environment. If this happens for extended periods of time, it may change the acoustic environment to which a fish is adapted, with consequences in fish behaviour (Popper & Hawkins, 2018).

It must be noted, however, that this impact factor is common to any vessels navigating in the AoI and its proximity, which are areas already characterized by an intense maritime traffic. The fish fauna of the area is therefore considered as possibly “habituated” to the noise of the vessel propellers.

- **Emission of light**

During the construction phase, pipelay activities are operations that are performed continuously. Therefore, night working, and the use of artificial light, will be required.

Night light pollution is known to affect marine organisms, their presence and space use, mostly by attracting them. Fish are indeed by the emission of underwater lights. Behavioural changes such as this are known to cost the animal in terms of energy expenditure (i.e., fish are mostly active at night, looking for food, and their attraction to light may prevent them from feeding) and exposure to predators (both predators and preys are attracted by light) (Davies, Duffy, Bennie, & Gaston, 2014).

Considering that the pipelay operations are going to be performed continuously 24/7, the emission of light may cause complete the food prevention for the species feeding on zooplankton since, as stated in the relevant section (see 7.3.2.1.1), zooplankton (which is normally at the surface at night) is known to descent in the water column when light is present.

However, even if continuously active for the whole pipelay duration (i.e., almost a year), such impact factor is limited to the vessel’s circumscribed area and may be considered as affecting only few tens of meters from the vessels. In addition, even if the pipelay vessel is expected to proceed very slowly (almost still; 0.4 kn are assumed, considering the CastorOne technical sheet), the impact may be considered as totally temporary, as the situation is expected to completely recover once the vessel has passed (i.e., every night the pipelay vessel is assumed to be 5 km apart).

- **Emission of particulates and chemicals in water**

As previously stated (see 7.3.1.3.1 and 7.3.2.1.1), after the completion of the construction phase and before the pipelines are put into operations, all the pipes need to be hydrotested to detect possible faults in the junctions.

Hydrotest is usually made with filtered seawater with chemical additives (i.e., mixture of corrosion inhibitor, oxygen scavenger, biocide, and dye to prevent internal corrosion or to identify leaks, MEG or umbilical transportation liquid).

Ideally, the liquids used to hydrotest the pipelines are not supposed to leak and, therefore, affect the water column and the pelagic organisms of the oxygenated layers (i.e., from 0 to -100/-150 m; see 6.3.1.3). Still, this is an ideal scenario. It is not rare that pipelines just laid present small faults (mainly at the junctions) to be repaired before the operation phase. In such a case, a limited volume of the hydrotest liquid may leak, introducing chemicals that may alter the seawater quality (see 7.3.1.3.1).

Even if limited information is available about the effects of corrosion inhibitors or leak detection dyes on marine ecosystems, such substances contain chemicals that may have negative effects on living organisms, such as heavy metals, oxygen scavengers and bisulfides (Amadi & Ukpaka, 2007). Regarding biocides, research has shown that it has a multitude of negative effects on marine organisms: in particular, it has acute toxicity effects to mortality in adult fish and juveniles, moreover, it shows bioaccumulation in fish (Guardiola, Cuesta, Meseguer, & Esteban, 2012).

However, as already discussed, it should be mentioned that Staples et al. (2001) demonstrated that ethylene glycol (EG) undergoes rapid biodegradation in aerobic and anaerobic environments with approximately 100% removal of EG within 24 h to 28 days. Moreover, the results of the study showed that EG is practically non-toxic to aquatic organisms and does not bioaccumulate.

In addition, the hydrotest fluids are planned to be discharged deep sea, in correspondence to the SPS site (i.e., at a depth of 2,200 m), where they may cause alteration of the seawater quality, as shown in 7.3.1.3.1. Nevertheless, as previously discussed, this alteration is not expected to affect marine life, since the discharge point is located in the anoxic water layer, where no life exists, which does not mix with the oxygenated layer.

This activity is however planned to be implemented very punctually and limited times, reducing the possibility of impacting the marine environment, thank also to the diluting power of seawater, as described in 6.3.1.4.

Mitigation measures

The following mitigation measures shall be implemented to mitigate the effects of the impact factors.

- **Minor leakage of contaminants into water**
  - All vessels used to be compliant with MARPOL.
- **Emission of underwater noise**
  - All vessels used to be compliant with MARPOL.
- **Emission of particulates and chemicals in water**
  - Hydrotest fluids discharged deep sea to be compliant with the relevant standards for deep sea discharges as reported in Annex B.
  - Minimize, when possible, the volume of hydrotest water offshore by testing equipment at an onshore site prior to loading the equipment onto the offshore facilities.
  - Use the same water for multiple tests, when feasible.
  - Reduce the need for chemicals by minimizing as much as possible the time that test water remains in the equipment or pipeline.
  - Carefully select chemical additives in terms of dose concentration, toxicity, biodegradability, bioavailability, and bioaccumulation potential.

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **low negative impact** is expected on fishes during the construction phase.

Table 7-26: Residual impact assessment matrix for fishes during construction phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Minor leakage of contaminants into water	Duration:	Medium	High	Short-mid-term	**Medium**	Medium-high	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Local					
	Intensity:	Low					
Emission of underwater noise	Duration:	Medium	High	Short-term	**Low**	Medium	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Local					
	Intensity:	Medium					
Emission of light	Duration:	Medium	High	Short-term	**Low**	None	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Project footprint					
	Intensity:	Medium					
Emission of particulates and chemicals in water	Duration:	Short	High	Short-mid-term	**Medium**	Medium	**Low**
	Frequency:	Infrequent					
	Geo. Extent:	Local					
	Intensity:	Medium					
Overall assessment:		**Low**	Rationale:	Due to the compliance with relevant standards of the impact factors, even using a precautionary approach, the residual impact values are not expected to cumulate to a higher impact value. Therefore, the average residual impact value may be considered as a reference for the overall impact.			

Monitoring measures

No monitoring measures are required for fishes during construction.

7.3.2.3.2 Operation phase

Impact factors

The impact factors from the Project activities potentially affecting fish during construction phase are listed in the following table.

Table 7-27: Project actions and related impact factors potentially affecting fishes during operation phase.

Project actions	Brief description	Impact factors
Plant/infrastructure onshore operation	Technical and administrative activities, including operation of the plant/infrastructure, surveillance, monitoring, maintenance, performed according to standard operating procedures to maintain the Project offshore parts in operation.	▪ Discharge of wastewater
Plant/infrastructure operation offshore	During the operation phase, the pipeline will be present on the seabed.	▪ Presence of new offshore infrastructures

The impact factors identified above are described below and assessed in the matrix that follows.

- **Discharge of wastewater**

Such as already stated in 7.3.1.3.2, wastewaters produced by the OPF are expected to be discharged in the Filyos river, after being treated. Such discharges include the industrial wastewater, civil sewage and rain drainages.

Considering that the Wastewater Treatment Plants will collect hazardous and non-hazardous compounds, as well as the drains from the paved areas, their effluents, even if compliant with the national and international regulations illustrated in Annex B may still affect the river water quality (see hydrology and surface water impact assessment and freshwater aquatic biodiversity) and, by consequence, the characteristics of the seawater by containing minimal quantities of organics (e.g., lube oil, diesel, heat transfer oil, MEG, TEG, corrosion inhibitor), and solids, (e.g., sand, corrosion products and salts) that may affect the fishes' health by acute and/or chronical toxicity. In fact, even if compliant with the regulations, this is expected to be a long-lasting impact factor, active for the whole project lifetime, potentially expected to become chronical and resulting in a community composition change.

- **Presence of new offshore infrastructures**

Such as previously discussed, the offshore part of the project consists in the presence of cables to connect the SPS parts, one umbilical line and two pipelines from the SPS (around 2,200 m deep) to the onshore facilities.

While such impact factor is considered negligible to even non-existent for the cables and the umbilical line, due to their diameter, the presence of the pipelines is expected to act as an artificial hard substrate upon the sandy seafloor. As assessed for benthic communities (see 7.3.2.2.2), the presence of hard 3D structures in marine habitats are reported to have the potentiality to create the so-called "reef effects" (Taormina, et al., 2018), resulting in a potential positive impact. In fact, hard structures located in areas dominated by soft bottoms are usually reported to act as environmental enrichments, potentially forming biodiversity oases, since they may attract different species by providing a shelter for benthic organisms that may settle there, acting as food for fish and, whether arborescent, nursery for juveniles.

However, it should be noted that this phenomenon is particularly reported of structures showing a complex and heterogeneous 3D structure, characterized by a high degree of rugosity, which a pipeline is not. In addition, based on what stated in 6.3.3.2, the sediments of the AoI become anoxic beyond 80 m of depth, substantially preventing life and the first 1.4 km of the pipelines from the shoreline are planned to be buried. Therefore, due to those considerations, the positive impact should be very limited, but still present.

Mitigation measures

- **Discharge of wastewater**
  - Wastewater effluents to be compliant to national and international standards.

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **medium negative impact** and **low positive impact** is expected on fishes during the operation phase.

Table 7-28: Residual impact assessment matrix for fishes during operation phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Discharge of wastewater	Duration:	Long	High	Mid term	**High**	Medium-high	**Medium**
	Frequency:	Continuous					
	Geo. Extent:	Local					
	Intensity:	Medium					
Overall assessment:		**Medium**	Rationale:	The discharge of wastewater is the only impact factor identified for such component in the operation phase.			

Table 7-29: Residual positive impact assessment matrix for fishes during operation phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Enhancement effectiveness	Residual impact value
Presence of new offshore infrastructures	Duration:	Long	High	Short-term	**Low**	Low	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Project footprint					
	Intensity:	Negligible					
Overall assessment:		**Low**	Rationale:	The presence of new offshore infrastructures is the only impact factor identified for such component in the operation phase.			

Monitoring measures

No monitoring measures are required for fish during operation.

7.3.2.4 Marine mammals

Based on the information collected for the definition of the baseline (see 6.3.3.4), the biological component *Marine mammals* was assigned a **High** value of sensitivity for the following reasons:

- Presence of protected and/or threatened species; and
- Presence of feeding grounds.

Impacts potentially affecting this component are assessed here below for the construction phase and operation phase.

7.3.2.4.1 Construction phase

Impact factors

The impact factors from the Project activities potentially affecting marine mammals during construction phase are listed in the following table.

Table 7-30: Project actions and related impact factors potentially affecting marine mammals during construction phase.

Project actions	Brief description	Impact factors
Offshore excavation (trenching) and sediment storage	Excavation of a trench in shallow water in correspondence of the land approach; the sediment removed will be temporarily stored west of Filyos Port, east of the pipeline, and will be moved back to cover the pipeline.	▪ Presence of working and moving vessels ▪ Emission of underwater noise
Offshore pipelines and lines laying	Offshore laying of the pipelines (gas pipeline and MEG line) and lines (seabed umbilical and flexible pipes), and their connection with the Subsea Production System (SPS).	▪ Presence of working and moving vessels ▪ Emission of underwater noise

All the impact factors identified above are described below and assessed in the matrix that follows.

- **<u>Presence of working and moving vessels</u>**

Such as already stated in the project description (see 3.0) and in the impact assessment for the offshore physical components (see 7.3.1), a total of 26 vessels will be used for the pipelay activities offshore, namely 7 for the land approach (corresponding to the first 1.4 km to be dredged from the shoreline) and 19 for the pipelaying in the deeper waters.

The physical presence of moving vessels may possibly affect marine mammal species in the AoI. It should be reported, in fact, that collisions between vessels and large sized species are frequently observed (Panigada et al., 2006), mostly exceeding 14 kn of speed (Laist et al., 2001). However, it is worth mentioning that no large cetacean species occurs in the Black Sea, whose population is composed by three small subspecies only (see 6.3.3.4) and that the pipelay vessel is expected to proceed very slowly (almost still; 0.4 kn are assumed, considering the CastorOne technical sheet). Given those considerations, as well as the fact that small-sized delphinids are known to bow-ride[1] vessels of all sizes and that porpoises are able to apply area avoidance behavior in case of high vessels activity and high vessels speed, getting back as the vessel has passed, (Akkaya et al., 2017), this impact factor is not expected to pose a threat to the marine mammals of the AoI.

[1] Dolphin habit of riding bow waves of boats, probably as an adaptation from surfing on large waves and nearshore breakers. While easy travel has been postulated, it is more likely that bow-riding is more often simply for the fun of it, or play.

- **Emission of underwater noise**

The presence of working vessels will consequently cause an emission of underwater noise because of their propeller. Overall, vessels generate sound at low frequencies (<1 kHz) because of their relatively high power, deep draft, and slow turning (<250 rpm) engines and propellers (Richardson et al., 1995), whose noise can propagate up to 1.5 Nm (roughly 3 km) from the ship (Pricop et al., 2018). The underwater noise of being laid pipelines, in fact, is reported to be negligible to unrecordable because covered by the noise emitted by the vessels' propellers and so may be dredging activities, whose emissions are in the low frequency band as well, depending on the dredger and the substrate. Fine sediments which characterize the seafloor of the AoI are not considered of overpass the noise emission of the propellers.

The highest noise may be caused by the vessel propellers' cavitation, which has peak power near 0.05-0.15 kHz (at blade rates and their harmonics) (Ross, 1976; Gray & Greeley, 1980; Arveson & Vendittis, 2000).

Considering that cetaceans (which are the only marine mammals occurring in the area) highly rely on the acoustics, underwater noises have the potentiality to interfere with primary functions of such species, masking acoustic signals (e.g., echolocation of prey, vocalizations, social interactions, mating) (Tyack, 2008). However, this may happen only if the underwater noise is emitted in a frequency range that overlaps with the hearing and vocal abilities of the species (Southall et al., 2007; Clark et al., 2009; Hatch et al., 2012; Southall et al., 2019).

In particular, such low frequency activities may potentially affect Low Frequency (LF) cetaceans (i.e., baleen whales) (Southall et al., 2019), which are however completely absent in the Black Sea. Instead, considering the marine mammals present or potentially present within the AoI, it must be noted that, according to Southall et al. (2019), *Tursiops truncatus ponticus* and *Delphinus delphis ponticus* are classified as High Frequency (HF) cetaceans (hearing range: 0.1 to 165 kHz and 0.3 to 44 kHz for social vocalizations, respectively; 23 to 102 kHz and 25 to 35 kHz for echolocation sounds, respectively), whereas *Phocoena phocoena relicta* is classified as Very High Frequency (VHF) cetacean (hearing range: 125 to 200 kHz for echolocation sounds[2]).

Taking into account these considerations, it can be safely stated that the noise produced during construction phase does not overlap with the hearing ability of the marine mammals and it can be considered not to act as an issue to this biological component. In addition, noise emission should be limited, especially if dated propellers are avoided, allowing a quick restoration of the basic environmental conditions. Therefore, this impact factor is unlikely to seriously affect cetaceans of the AoI.

Mitigation measures

Being part of the ACCOBAMS area, mitigation measures need to be implemented to safeguard cetaceans and minimize any possible impact.

No specific procedures are specified for offshore pipeline laying activities, therefore a set of **mitigation measures** aiming at minimizing the risk of affecting cetaceans is proposed also taking into account the "General guidelines", Guidelines for coastal and offshore construction works" and "Guidelines for shipping" issued by ACCOBAMS guidelines (res. 7.13, 2019), which report *"Designers, shipbuilders, and ship operators are encouraged to also consider technologies and operational measures not included in these Guidelines, which may be more appropriate for specific applications"*. This set of actions shall be implemented within the AoI to mitigate the impact factors of the Project and shall include the following mitigation measures.

[2] Social sounds emitted by the harbour porpoise are poorly studied, but considered as insignificant. Authors like Hansen, Wahlberg, & Madsen (2008) even stated that there is no evidence that the species produces communication whistes.

Therefore, the following mitigation measures shall be implemented to mitigate the effects of the impact factors.

- **Presence of working and moving vessels**
  - Defined routes to be used for all the vessels.
  - A dedicated and trained member of the crew should be in charge to scan the sea surface aboard each vessel during all activities involving the vessels navigating over 10 kn of speed in order to early detect the presence of cetaceans and avoid possible collisions.
  - Reduced speed limits of vessel/ship to decrease and/or avoid any risk of injury and mortality to aquatic fauna arising from vessel collisions.
  - Feeding or attracting any wild animal shall be strictly prohibited.
- **Emission of underwater noise**
  - All vessels used to be compliant with MARPOL.
  - Anthropogenic noise unnecessary to the work activities only to be avoided to reduce disturbance to marine mammals.
  - Work activities to be planned so that noisiest activities are, as much as possible, scheduled not to be performed at dusk and dawn, when marine mammals are more active.

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **low negative impact** is expected on marine mammals during the construction phase.

Table 7-31: Residual impact assessment matrix for marine mammals during construction phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Presence of working and moving vessels	Duration:	Medium	High	Short-term	**Low**	High	**Negligible**
	Frequency:	Continuous					
	Geo. Extent:	Project footprint					
	Intensity:	Medium					
Emission of underwater noise	Duration:	Medium	High	Short-term	**Low**	Medium	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Local					
	Intensity:	Medium					
Overall assessment:		**Low**	Rationale:	Only one impact factor is expected to influence this component, therefore its residual impact value			

Impact Factor	Impact Factor Features	Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
			corresponds to the overall assessment for the component itself.			

Monitoring measures

The following monitoring measures shall be implemented to assess the true effects of the project on marine mammals during the construction and verify the effectiveness of the mitigation measures.

- A Marine Fauna Monitoring report indicating all the visual and acoustic detections of cetacean species during the construction activities to be prepared.
- A logbook with the occurred vessel collisions with the marine mammals, as well as the near-miss, to be compiled indicating the species involved (or taking diagnostic photographs where identification is not feasible), date and time, coordinates, weather conditions and name of the vessel involved in the event.

7.3.2.4.2 Operation phase

Impact factors

The impact factors from the Project activities potentially affecting marine mammals during operation phase are listed in the following table.

Table 7-32: Project actions and related impact factors potentially affecting marine mammals during operation phase.

Project actions	Brief description	Impact factors
Plant/infrastructure operation offshore	Technical and administrative activities, including operation of the plant/infrastructure, surveillance, monitoring, maintenance, performed according to standard operating procedures to maintain the Project offshore parts in operation.	▪ Presence of working and moving vessels ▪ Emission of underwater noise ▪ Emission of electromagnetic fields (EMF)

All the impact factors identified above are described below and assessed in the matrix that follows.

- <u>**Presence of working and moving vessels**</u>

As previously stated, the offshore infrastructures are expected to be periodically monitored and maintained. Such operations are always conducted using vessels whose presence may expose marine mammals to the risk of collision.

However, as assessed for the construction phase (see 7.3.2.4.1), this risk may be considered as significantly low due to the habits of the marine mammal species inhabiting the area. In addition, it must be noted that these maintenance/repair operations are not performed continuously and do not require a large number of vessels. All operations may be periodic but always temporary (i.e., never lasting more than 2 weeks) and are performed in an already maritime route "congested" area. Therefore, no big issues are expected for this impact factor.

- **Emission of underwater noise**

The vessels used for the maintenance/repair operations are expected to emit underwater noise from their propellers.

However, such as stated for the construction phase (see 7.3.2.4.1), noises generated by the propellers are characterised by a low frequency, whereas the cetaceans frequenting the AoI are HF (High Frequency) and VHF (Very High Frequency) cetaceans. No overlap in the sound frequency range is expected and, therefore, no significant impacts are anticipated, also considering the fact that the area is already frequented by a large amount of vessels.

- **Emission of electromagnetic fields (EMFs)**

The presence of the umbilical line from the SPS to the OPF will cause the emission of EMFs which may affect the marine mammals of the AoI in terms of behavioural response, space use etc.

Cetaceans' relationship with EMFs is still poorly studied. They appear to use the Earth's magnetic field for migration parallel to the contours of the local field topography and as a timer based on the regular fluctuations in the field allowing animals to monitor their progress on this map. However, cetaceans do not appear to use the Earth's magnetic field for directional information (Klinowska 1990).

As already discussed for fish (see 7.3.2.3.2), depending on the orientation of a cable to the geomagnetic field, the cable itself could cause a local decrease in the magnetic field. However, when dealing with a single EMF-emitting cable, it appears that the likelihood of such a change affecting a large enough area to elicit a significant course alteration or even stranding on cetacean would be low (Normandeau et al., 2011).

Potential responses could include a temporary change in swim direction or a deviation from a migratory route (Gill et al. 2005).

It's however rather clear that the influence a cable can have on a marine mammal species depends on the benthic-feeding habits of the species. The bottlenose dolphin (*Tursiops truncatus*, whose subspecies *T. truncatus ponticus* is present in the area) is reported shoeing a sensitivity threshold of < 0.05 µT, perceived at a range defined as 50 m plus above the cable, and 48 to 68 m along the sea floor. The bottlenose dolphin, indeed, is normally a benthic feeder as well. However, those data are not specific to the Black Sea, where dolphin are unlikely to present benthic-feeding habits because of the anoxia of the sediments from roughly 80 m of depth and the rich pelagic environment.

For this reason, using a strong precautionary approach, the emission of EMFs is considered as potentially affecting marine mammals of the AoI, even if limitedly. In addition, the original situation is considered to recover rather rapidly once the umbilical line stops working.

Mitigation measures

The following mitigation measures shall be implemented to mitigate the effects of the impact factors.

- **Presence of working and moving vessels**
    - Defined routes to be used for the vessels.
    - A dedicated and trained member of the crew should be in charged to scan the sea surface aboard each vessel during all activities involving the vessels navigating over 10 kn of speed in order to early detect the presence of cetaceans and avoid possible collisions.

- Reduced speed limits of vessel/ship to decrease and/or avoid any risk of injury and mortality to aquatic fauna arising from vessel collisions.
- Feeding or attracting any wild animal shall be strictly prohibited.

- **Emission of underwater noise**
  - All vessels used to be compliant with MARPOL.
  - Anthropogenic noise unnecessary to the work activities only to be avoided to reduce disturbance to marine mammals.
  - Work activities to be planned so that noisiest activities are, as much as possible, scheduled not to be performed at dusk and dawn, when marine mammals are more active.

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **low negative impact** is expected on marine mammals during the operation phase.

Table 7-33: Residual impact assessment matrix for marine mammals during operation phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Presence of working and moving vessels	Duration:	Long	High	Short-term	**Low**	High	**Negligible**
	Frequency:	Frequent					
	Geo. Extent:	Project footprint					
	Intensity:	Medium					
Emission of underwater noise	Duration:	Long	High	Short-term	**Low**	Medium	**Low**
	Frequency:	Frequent					
	Geo. Extent:	Local					
	Intensity:	Medium					
Emission of electromagnetic fields (EMF)	Duration:	Long	High	Short-term	**Low**	None	**Low**
	Frequency:	Continuous					
	Geo. Extent:	Local					
	Intensity:	Medium					
Overall assessment:		**Low**	Rationale:	Only one impact factor is expected to influence this component, therefore its residual impact value corresponds to the overall assessment for the component itself.			

Monitoring measures

The following monitoring measures shall be implemented to assess the true effects of the project on marine mammals during the construction and verify the effectiveness of the mitigation measures.

- A Marine Fauna Monitoring report indicating all the visual and acoustic detections of cetacean species during the construction activities to be prepared.
- A logbook with the occurred vessel collisions with the marine mammals, as well as the near-miss, to be compiled indicating the species involved (or taking diagnostic photographs where identification is not feasible), date and time, coordinates, weather conditions and name of the vessel involved in the event.
- Cetacean stranding networks to be periodically consulted to verify the absence of suspicious cetacean deaths.

7.3.2.5 Marine habitats

Based on the information collected for the definition of the baseline (see 6.3.3.5), the biological component *Marine habitats* was assigned a **Medium-low** value of sensitivity for its subcomponent *Benthic habitats* and a **High** value of sensitivity for its subcomponent *Pelagic habitats*. The reasons are listed here below:

- **Benthic habitats (Medium-low):**
  - Presence of nursery areas (*sensu lato*);
  - Simple communities dominated by few species; and
  - Absence of bioconstructions and seagrasses.
- **Pelagic habitats (High):**
  - Productive pelagic habitats highly rich in species;
  - Probable feeding area; and
  - Presence of protected species.

Impacts potentially affecting this component are assessed here below for the construction phase and operation phase.

However, considering that habitats are both natural and artificial environments having physical and biological features where given species may live, shelter, feed and/or reproduce, potential impacts on marine habitats may be considered as an integration of all the physical and biological components assessed previously. For such reason, no impact assessment matrices are given here, since they may result as redundant, except for the impact factor *"Possible introduction of alien species"* in the construction phase.

7.3.2.5.1 Construction phase

Impact factors

In general, it can be stated that all the project actions for both construction and operation phases can potentially impact habitats. For this reason, all the impact factors already analyzed for the previous physical and biological components may be considered as potentially impacting habitats.

It can be excluded that the project will lead to physical habitat destruction as a true balance. In fact, while some actions are expected to generate **benthic habitat**[3] destruction during construction (i.e., dredging; see 7.3.1.1.1, 7.3.1.2.1 and 7.3.2.2.1), those actions are planned to be completed with a total restoration (i.e., backfill). A low residual impact is expected by the *"Introduction of new offshore infrastructures"*, which may limitedly disrupt the habitat homogeneity because of the introduction of the being-laid pipelines. This impact factor is however expected to act as a positive impact during operation phase (see 7.3.2.2.2, 7.3.2.3.2 and 7.3.2.5.2).

No destruction is expected for the **pelagic habitats**[4] as well rather than a degradation. In fact, as discussed in the previously sections, pelagic habitats of the AoI may be affected by:

- *Emission of light* by the pipelay vessel;
- *Emission of underwater noise* by the by the working vessels' propellers;
- *Presence of working and moving vessels*;
- *Minor leakage of contaminants into water*, mainly caused by the working vessels' engines;
- *Discharge of wastewater* from the temporary camp site; and
- *Emission of particulates and chemicals in water* from the hydrotesting activities.

While the first three are extremely temporary and linked to the presence of the vessels (resulting in a total recovery after the completion of the activities), the last three have been assessed as having a low residual impact value that may cause habitat degradation throughout the years. However, the proper implementation of the mitigation and monitoring measures indicated in the previous sections will address the necessity of implementing new measures to safeguard the pelagic habitats.

The only impact factor considered specific to marine habitats in the scope of this study is presented here below.

- **Possible introduction of alien species**

Alien marine species, including plankton, benthos and fish species, could be potentially introduced into the AoI and surrounding areas due to the discharge of untreated ballast water from the vessels entering the AoI itself for the first time as involved in the offshore construction phase (i.e., pipelay vessels coming from other places).

Ballast water is routinely pumped aboard to maintain safe operating conditions throughout the voyage performed to reach the operational area (i.e., the AoI in this case) by reducing stress on the vessel steel-hull, providing transverse stability, improving propulsion and manoeuvrability, compensating for weight changes in various cargo load levels and reducing fuel and water consumption. However, ballast water is known to contain thousands of marine organisms, such as bacteria, microbes, small invertebrates, eggs, cysts and larvae of several aquatic plants and animal species, which may then be introduced into new ecosystems (Gonçalves, 2013).

Once released through the release of the ballast water, the transferred species, in fact, may survive the new environmental conditions and establish a reproductive population in the host environment, becoming invasive,

[3] Benthic habitats are here reminded to be limited to the bathymetric range of 0-80 m of depth, beyond which anoxic conditions of the sediments are observed.

[4] Pelagic habitats are here reminded to be limited to the bathymetric range of 0-100 m of depth (max. 150 m of depth), beyond which anoxic conditions of the seawater are observed.

out-competing native species and multiplying into pest proportions. Bio-invasions could cause enormous damage to biodiversity and valuable natural riches of the area, posing a serious threat to the ecological and the economic well-being of the area; the damage to the functionality and species composition of the marine ecosystem is often irreversible (Gonçalves, 2013).

Considering that the ballast water is essential for safe and efficient modern shipping operations, the International Maritime Organization (IMO) adopted in 2004 the Ballast Water and Sediments Management Convention (BWM Convention) to prevent the spread of harmful aquatic organisms from one region to another, by establishing global regulations, standards and procedures for the control and management of ships' ballast water and sediments. With the treaty entered into force in 2017, the BWM Convention requires all ships to implement a Ballast Water and Sediments Management Plan: all ships have to carry a Ballast Water Record Book and are required to carry out ballast water management procedures to a given standard. Parties to the Convention, such as Turkey is, are given the option to take additional measures which are subject to criteria set out in the BWM Convention and to IMO guidelines.

However, although the introduction of alien species may have serious effects on marine ecosystems, it is to be noted that the vast majority of aquatic species carried in ballast water do not survive the voyage, as the ballasting and de-ballasting cycle and environmental conditions inside ballast tanks can be quite hostile to organism survival (Gonçalves, 2013). Furthermore, the provenance of the of the vessels is essential. For instance, at the time when this study was prepared, the pipelay vessel *CastorOne* is located in Cyprus. A western Mediterranean provenance is not considered to cause a threat in such a scope.

In addition, considering the BWM Convention standards to be applied, this impact factor is expected to be very limited and is not consider affecting habitats.

Mitigation measures

The following mitigation measures shall be implemented to mitigate the effects of the impact factor described.

- **Possible introduction of alien species**
  - All vessels used to be compliant with BWM Convention.
  - Water ballast of vessels coming from out of the Black Sea to fully treat ballast water before discharge.

Residual impacts

The table below summarizes the impacts caused by the identified impact factors on the component assessed. The whole matrix used for the assessment, including all scores, is available in Appendix K.

Based on the baseline conditions of the assessed component, the project characteristics and actions, as well as the proper implementation of the mitigation measures proposed above, a potential **low negative impact** is expected on both benthic and pelagic habitats during the construction phase.

Table 7-34: Residual impact assessment matrix for benthic habitats during construction phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Possible introduction	Duration:	Short	Medium-low	Long term	**Low**	High	**Negligible**
	Frequency:	Concentrated					

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
of alien species	Geo. Extent:	Local					
	Intensity:	Medium					
Overall assessment:		**Low**	Rationale:	The possible introduction of alien species is the only impact factor considered specific to marine habitats for this study. However, by applying a precautionary approach and considering the residual impact values for the previous components composing benthic habitats, a low overall assessment is considered as appropriate.			

Table 7-35: Residual impact assessment matrix for pelagic habitats during construction phase.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Reversibility	Impact Value	Mitigation effectiveness	Residual impact value
Possible introduction of alien species	Duration:	Short	High	Long term	**High**	High	**Negligible**
	Frequency:	Concentrated					
	Geo. Extent:	Local					
	Intensity:	Medium					
Overall assessment:		**Low**	Rationale:	The possible introduction of alien species is the only impact factor considered specific to marine habitats for this study. However, by applying a precautionary approach and considering the residual impact values for the previous components composing pelagic habitats, a low overall assessment is considered as appropriate.			

Monitoring measures

The monitoring measures to be implemented for the physical and biological components previously assessed during construction will be useful also for marine habitats.

7.3.2.5.2 Operation phase

Such as discussed for the construction phase, <u>all the impact factors already analyzed for the previous physical and biological components may be considered as potentially impacting habitats</u>.

No habitat destruction (*sensu stricto*) may happen on **pelagic habitats** by definition. However, a habitat degradation may be experienced if all the residual impacts on seawater, plankton, fishes and marine mammals are combined together. In particular, as discussed in the previously sections, pelagic habitats of the AoI, during operation, may be affected by:

- *Emission of underwater noise* by the by the working vessels' propellers used for the maintenance;
- *Presence of working and moving vessels*;

- *Minor leakage of contaminants into water*, mainly caused by the working vessels' engines; and
- *Discharge of wastewater* from the OPF into the river flowing into the marine AoI.

The first three may be considered as totally negligible because of the limited number of vessels involved in such activities and the low frequency of the operations to be implemented. The first two, in particular, are furthermore extremely temporary and linked to the presence of the vessels (resulting in a total recovery after the completion of the activities).

On the other way, however, the discharge of wastewater, even if made into the river and even if compliant with the relevant standards (see Annex B), may cause habitat degradation because of its long-lasting characteristics. A low residual impact value was assessed for this impact factor. However, the proper implementation of the mitigation and monitoring measures indicated in the previous sections will address the necessity of implementing new measures to safeguard the pelagic habitats.

As far as what concerns **benthic habitats**, they may experience limited degrees of degradation due to the *"Discharge of wastewater"* impact factor. Sediments, which are the only substrate for the benthic habitats of the AoI, are, in fact, a conservative matrix and can accumulate contaminants present in the wastewater even if in concentration compliant with the relevant standards (see Annex B). Nevertheless, it should be noted that this is expected at the river mouth in particular, where the benthic communities are already subjected to some kind of environmental stress (e.g., continuous burial by the river sediment input).

In addition, however, it should be reminded that the *"Presence of new offshore infrastructures"* may cause a low positive impact because of the presence of a hard substrate that may act as a limited environmental enrichment, by attracting species and proving shelter (see 7.3.2.2.2 and 7.3.2.3.2). It should be noted that, according to some authors, the *"Presence of new offshore infrastructures"*, potentially can be able to promote the colonization of alien species. In any case, this potential issue is much smaller than that of ballast water and the advantages offered by the new substrates for increasing biodiversity with local species are generally considered greater than the risk of colonization of alien species.

Therefore, combining the impact assessment performed for the previous physical and biological components, a **low negative impact** (for both benthic and pelagic habitats) and a **low positive impact** (for benthic habitats only) may be considered for the AoI.

The proper implementation of the mitigation and monitoring measures indicated in the previous sections will address the necessity of implementing new measures to safeguard the marine habitats.

7.3.2.6 Critical habitats

Such as assessed in the baseline (see 6.3.3.7), Critical Habitat (CH) is triggered by:

- *Phocoena phocoena relicta* (under Criteria C1a and C3);
- *Tursiops truncatus ponticus* (under Criteria C1a and C3); and
- *Delphinus delphis ponticus* (potential Critical Habitat under Criteria C1b and C3).

Considering that all the three species are marine mammals, reference to the relevant impact assessment can be made (see 7.3.2.4). Based on that assessment, a **low residual impact** is considered for both construction and operation phase.

Based on IFC PS6 and GN6, No Net Loss and Net Gain shall be reached for Critical Habitats.

Even if a low residual impact is expected for the species triggering CH during both construction and operation, this does not necessarily mean a Net Loss. In fact, all the three species inhabit the pelagic habitats of the AoI and, as previously stated for the assessment on marine habitats (see 7.3.2.5), no habitat destruction can be expected on pelagic habitats by definition. It is very rare a pelagic habitat to be lost; it can be rather subjected to degradation.

Based on the impact assessment carried out, in fact, for both construction and operation, the following impact factors are expected to affect the species triggering CH:

- Presence of working and moving vessels;
- Emission of underwater noise.

In addition, the following impact factor is expected to affect species triggering CH for operation phase only:

- Emission of electromagnetic fields (EMFs).

Impacts generated by the mentioned impact factors are assessed in the *Marine mammals* section. All have a low residual impact value mainly because of the project's long-lasting nature. However, none of them physically occupy the habitats used by the three species triggering Critical Habitat. In fact, as stated in 7.3.2.4, the following considerations can be made.

- The *Presence of working and moving vessels* may result in collisions with the animals, but this is mostly linked with large cetaceans, such the three species triggering Critical Habitat are not. Indeed, these species are known to bow-ride vessels for fun and travelling. In addition, this impact assessment is considered to be completely temporary and linked to the presence of the vessels. Once passed, the situation is expected to fully recover.
- The *Emission of underwater noise* as well is strictly linked to the presence of the vessels and their propellers in operation. Such noise is in the low frequency band, which does not overlap with the hearing and vocalization abilities of the three species, being *P. phocoena relicta* a VHF (Very High Frequency) cetacean and *T. truncatus ponticus* and *D. delphis ponticus* HF (High Frequency) cetacean. In addition, those cetaceans are reported to actively move away from noise sources and return once the emission stops. This impact assessment is considered to be completely temporary and linked to the presence of the vessels as well. Once the emission stops, the situation is expected to fully recover.
- The Emission of electromagnetic fields (EMFs) is caused by the presence and the operation of the umbilical line. It is an impact factor expected to be active for the whole lifetime of the project. However, this is an impact factor linked to the benthic habitats which the three species are unlikely to frequent because of the anoxia of the sediments from roughly 80 m of depth and the rich pelagic environment. EMFs are reported not to affect dolphin behaviour and habits over 50 m of distance from the source. In addition, as assessed in 7.3.2.4.2, dolphins are not reported to be sensitive to EMFs. This impact factor, despite being continuously active during operation, will stop its effects immediately after its interruption at the end of the life of the project. Once stopped, the situation is expected to fully recover.

Given all these assumptions, a true habitat loss is not expected. Rather, a habitat degradation may be experienced but likely in a negligible manner, considering that the area is highly exploited and the three species triggering CH are known to easy to get habituated. For this reason, **No Net Loss is assessed for the Critical Habitats triggered by *P. phocoena relicta*, *T. truncatus ponticus* and *D. delphis ponticus***. The table below highlights the extent of CH potentially subject to the temporary degradation assessed.

Table 7-36: Critical Habitat degraded for the three species triggering it (EAAA definition is reported in 6.3.3.7 and AoI in 6.3.3.4).

Species	Common name	EAAA [km^2]	AoI [km^2]	CH degraded [%]
P. phocoena relicta	Black Sea harbour porpoise	153,846.86	3,440.18	2
T. truncatus ponticus	Black Sea bottlenose dolphin	225,983.04	3,440.18	1
D. delphis ponticus	Black Sea common dolphin	316,504.07	3,440.18	1

In addition, **to reach the Net Gain condition**, the following measure shall be implemented:

- Promotion of raising awareness programs among the population e.g., at schools and/or to fishermen targeted at the conservation of the cetaceans frequenting the Black Sea Turkish coasts and their role in regulating the ecosystems by acting as ultimate predators for the basin.

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