ENVIRONMENTAL IMPACT ASSESSMENT "3D" OFFSHORE SEISMIC RECORD OF CAN_100, CAN_108 AND CAN_114, ARGENTINA

CHAPTER 1: EXECUTIVE SUMMARY

MARCH 2021

INDEX

EXECUTIVE SUMMARY

The data and conclusions herein below presented as part of this report are the result of the Environmental Impact Assessment (EIA) associated with the 3D Seismic Registration Project in CAN_100, CAN_108 and CAN_114 Areas, located offshore the Argentine Republic. They are considered relevant for the completion of said project within the framework of an adequate environmental management, trying to prevent, minimize, control, correct and / or compensate the possible negative effects on the surrounding environment. However, it should be mentioned that this document constitutes only a synthesis of said assessment since much of the information has been left aside. Hence, it must be considered together with the main body of the study for the proper understanding of all aspects.

1. EXECUTIVE SUMMARY

This document presents a synthesis of the information contained in the chapters that make up the EIA "3D Seismic Record in the CAN_100, CAN_108 and CAN_114 Areas, Argentina".

2. PRESENTATION

Equinor, the operator of CAN_100, CAN_108 and CAN_114, is an International Energy company present in more than 30 countries, committed to developing oil, gas, wind and solar energy, in a safe and sustainable way. It is aimed at turning natural resources into energy for people and progress for society. Equinor supports the Paris Climate Agreement and the United Nations Sustainable Development Goals. At the same time, it recognizes that the world's energy systems must be profoundly transformed to drive de-carbonization, while guaranteeing universal access to affordable and clean energy. We know that global demand for oil has to decline, but even within the framework of the Paris Agreement, the world shall depend on oil for many years. That is why the company explores and produces oil and gas with the lowest possible emissions, replacing coal with gas and investing ambitiously in renewable energy.

The Argentine offshore is one of the most extensive spaces with potential for hydrocarbon resources globally, however, it is little explored compared to similar regions. Therefore, it is necessary to go on investing in exploratory activities so as to ensure the future production of oil and gas resources. The purpose of the seismic survey is to facilitate the complete characterization of the possible hydrocarbon reserves identified in the assessment areas.

The main objective of the project is a “3D” Seismic Survey in the areas called CAN_100, CAN_108 and CAN_114 located offshore in the North Argentine Basin (CAN) of the Argentine Continental Shelf. The CAN_108 and CAN_114 blocks will be explored according to the permits granted by Resolutions 691 and 702 of 2019, from the then Secretary of the Government of Energy (now the Secretary of Energy, under the Ministry of Production) to EQUINOR ARGENTINA AS SUCURSAL ARGENTINA, and to EQUINOR ARGENTINA AS SUCURSAL ARGENTINA and YPF SA respectively, within the framework of the Offshore International Public Tender No. 1. Regarding the CAN_100 area, Resolution 55/2020 of the Ministry of Energy authorized the transfer of 50% of the ownership of YPF SA of the exploration permit granted on said area in favor of the company EQUINOR BV ARGENTINA SUCURSAL ARGENTINA[1].

The registration areas are more than 300 km offshore from the nearest coastal town (Mar del Plata, in the Province of Buenos Aires).

[1] EQUINOR ARGENTINA B.V. SUCURSAL ARGENTINA belongs to the same Group as EQUINOR ARGENTINA AS SUCURSAL ARGENTINA.

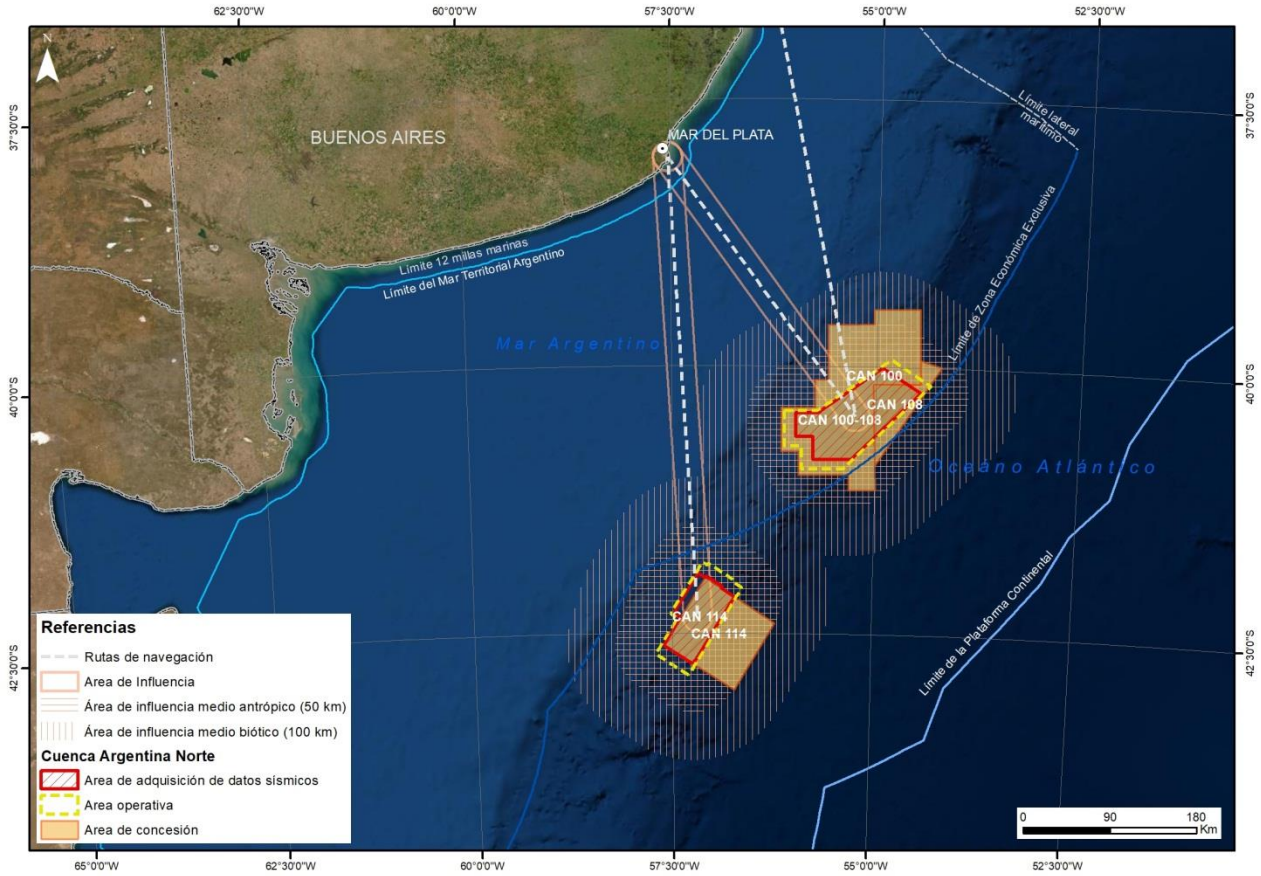


Figure 1. Geographical location of the CAN_100-108 and CAN_114 Areas.

(Map)

Límite 12 millas marinas:	12 Nautical-Mile Limit
Límite del mar territorial argentine:	Argentine Territorial Sea Limit
Límite lateral marítimo:	Maritime Lateral Limit
Límite de Zona Económica Exclusiva:	Economic Exclusive Zone Limit
Límite de la Plataforma continental:	Continental Shelf Limit

References/Navigation Routes/Area of Influence/Area of Influence- Anthropic environment/ Area of Influence – Biotic Environment/North Argentine Basin/ Seismic Data Acquisition Area/Operative Area/License Area.

3. LEGAL AND INSTITUTIONAL FRAMEWORK

The exploration shall be carried out within the Argentine Exclusive Economic Zone (EEZ) in the case of CAN 100 and CAN 108 areas, and outside the EEZ when referring to CAN 114, but within waters superjacent to the Continental Shelf measured and registered before the Commission of the Continental Shelf in accordance with the International Law of the Sea, away from the strip of provincial jurisdiction and without interactions with the coastal provinces. The areas were granted in accordance with the exploration regulations established in Law 17,319 and its amendments. Likewise, the environmental impact assessment regulations applicable to the contemplated activity framed within the Argentine Federal system are analyzed, as well as the hydrocarbon regulatory framework and the international maritime protection treaties to which the Argentine Republic has adhered, especially the Convention of the International Maritime Organization (IMO) on the Law of the Sea.

Law 23,968 refers to the continental shelf over which the Argentine Nation exercises sovereignty, and establishes that it comprises the bed and subsoil of the underwater areas that extend beyond its territorial sea and throughout the natural extension of its territory up to the outer edge of the continental margin, or up to a distance of 200 nautical miles measured from the baselines, in cases where the outer edge does not reach said distance.

In terms of hydrocarbon exploration and exploitation, as of the enactment of Law 26,197, and afterwards with Law 27,007 which amended Hydrocarbon Law N ° 17,319, the dispute regarding the dominance of the deposits located in the territorial sea has been clearly settled. The criterion of exclusive national jurisdiction in the Exclusive Economic Zone and the Continental Shelf has been confirmed, and the provincial authority has been limited to territorial waters up to 12 miles.

Given the characteristics of the offshore operation, the project shall be monitored by the Ministry of Energy, dependent on the Productive Development portfolio and its subordinate agencies, along with the Hydrocarbons Sub-secretariat regarding permits for exploration and associated work, in accordance with the Hydrocarbons Law.

Regarding the application of the Environmental Impact Assessment procedure, the Ministry of Environment and Sustainable Development (MAyDS) shall participate through its agencies, together with the Ministry of Energy, by virtue of Joint Resolution 3/19 which established a circuit of interaction between the energy and environment portfolios for the application of the Environmental Impact Assessment (EIA) procedure of the exploratory operations in waters and continental shelf, with an intervention of the environmental portfolio and subsequent monitoring and follow-up by the sectorial portfolio. The procedure designed for the approval of environmental studies also includes a sectoral intervention by the National Institute for Fisheries Research and Development (INIDEP), under the Ministry of Agriculture, Livestock and Fisheries.

Regarding navigation and the operation of offshore facilities, there is a set of agreements drawn up within the International Maritime Organization (IMO) to which the Argentine Republic is signatory. Many of them are expressly aimed at protecting the environment or maritime safety issues. The main agreements with environmental implications for the project are the following:

- International agreement to prevent pollution of seawater by hydrocarbons -OILPOL- approved by Law 21,353.
- Agreement on the Prevention of Marine Pollution by Dumping of Wastes and Other Substances, approved by Law 21,947.
- Convention on Safety of Human Life at Sea -SOLAS 74- approved by Law 22,079, the 1978 Protocol approved by Law 22,502 and its amendment approved by Law 23,706.
- International Convention on Intervention on the High Seas in Cases of Accidents that Cause Pollution by Hydrocarbons - approved by Law 23,456.
- International Agreement to Prevent Pollution from Ships, MARPOL 1973/78, its Annexed Protocols approved by Law 24,089.
- OPRC Agreement (International Agreement on Cooperation, Preparation and Fight Against Oil Pollution (Law 24,292).
- United Nations Convention on the Law of the Sea –CONVEMAR-, approved by Law 24,543.
- Protocol of 1992 that amends the International Convention on Civil Liability derived from Damage due to Hydrocarbon Pollution -CLC- (London-1969), approved by Law 25,137.
- Protocol of 1992 that amends the International Convention on the Constitution of an International Fund for Compensation for Damage due to Oil Pollution -FUND Convention- (London-1971), approved by Law 25,137.
- Agreement on the Management of Ballast Water and Management of Bilge Sediments, approved by Law 27,011.

With regard to fishing activity in Argentina, Federal Fishing Law 24,922 introduces a new system of regulation of fishing resources that, until the enactment of said rule, were legally supported by fishing permits granted by the then Ministry of Agriculture, Livestock, Fishing and Food (SAGPyA) and its complementary resolutions. Said Law establishes a more active role for the State, placing it at the head of the fishing resource heritage, with fish as public property, prohibiting exploitation by individuals who operate with precarious permits from the Administration.

It is worth mentioning what is established in Joint Provision 1/19 of the Undersecretaries of Hydrocarbons and Fisheries, dependent on the Energy and Agriculture and Fisheries portfolios respectively. The regulation enables the creation of a working group to share and deepen the knowledge of the interactions between both activities, promoting good practices and conservation measures in order to mitigate any conflict situation between fishing and exploratory activity.

Regarding the CAN_100-108 and CAN_114 seismic data acquisition areas, there are no sectors with restrictions and / or closures in force for fishing. However, according to Resolution 973/1997 Ex SAGPyA, the opening to fishing for squid (*Illex argentinus*) north of parallel 44º is established from May 1 to August 31 of each year, unless the early closure of the fishing season is ordered for conservation reasons, with directed fishing of the prohibited species remaining in said sector for the rest of the year.

The United Nations Convention on the Law of the Sea (UNCLOS) constitutes the general framework for the regulation of all the activities carried out in the EEZ, thus serving as support for the security measures adopted for navigation, pollution control and authorization of offshore operations. It is based on this founding international agreement that the Argentine Republic bases its jurisdiction on the Continental Shelf. Based on the forwarding criteria established in CONVEMAR and other international instruments that require integrating the environmental study with the most consolidated and recent good practices regarding offshore seismic activity, the good practices of the Joint Nature Conservation Commission of the United Kingdom (JNCC) of April 2017 have been taken as a reference together with the guidelines for additional support, as well as the “Guide for the Monitoring of Marine Fauna in Marine Seismic Studies” of the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) of the Ministry of the Environment of Brazil (2018).

On the other hand, the Navigation Law (Law 20,094) regulates all legal relationships originated in water navigation, covering ships and naval devices. The enforcement authority of this legal system is the Argentine Coast Guard (PNA), as expressed in Law 18,398 modified by Law 20,326 inasmuch as it establishes that it is in charge of the navigation security police service and the security and judicial police service.

The PNA acts in matters related to the control of ships and naval devices, as well as in the issuance of regulations tending to prohibit the pollution of river, lake and maritime waters by hydrocarbons or other harmful or dangerous substances, and therefore verify their compliance, among others. Likewise, it (Argentine Coast Guard) applies international conventions on the safety of navigation, goods and human life at sea.

The Navigation, Maritime, River and Lake Regime (REGINAVE) constitutes the central regulation of maritime, river and lake activity. The standards grouped in REGINAVE are supplemented with specific regulations issued by the highest authority of the PNA (Argentine Coast Guard) or by other technical agencies.

4. PROJECT DESCRIPTION

4.1 SEISMIC TECHNOLOGY

Compressed air devices are used as the source of power generation for aquatic seismic recording which are towed by boats along the projected survey lines.

The seismic method to be used in the aquatic environment consists of studying the trajectory of compressional waves, called P waves, which when propagating into the interior of the earth and finding changes in physical properties (different geological strata, gas, oil, etc.) are refracted and reflected towards the surface where they are captured by electrical sensors. These waves are measured by the time it takes them to reach the surface, from which depth position and geometry are inferred. The final product is a 3-dimensional "image" of the subsoil after being amplified, filtered, digitized, and registered.

When discharging the devices, high pressure air quickly enters the water producing a bubble. Two or more compressed air power sources with different volumes are used to optimize the frequency and amplitude characteristics of the signal emitted by the source and to minimize other effects that obscure the signal.

The reception of seismic signals is carried out with a drag system called streamers; more precisely through the use of hydrophones, that are located inside the streamers, which are made up of sections of solid cable. The streamers have neutral buoyancy along with devices to regulate their orientation and depth, factors that are monitored with special sensors located between the hydrophone groups, so that their spatial position is known at all times.

The acquisition of seismic information is obtained along lines that make up a 3D registration grid.

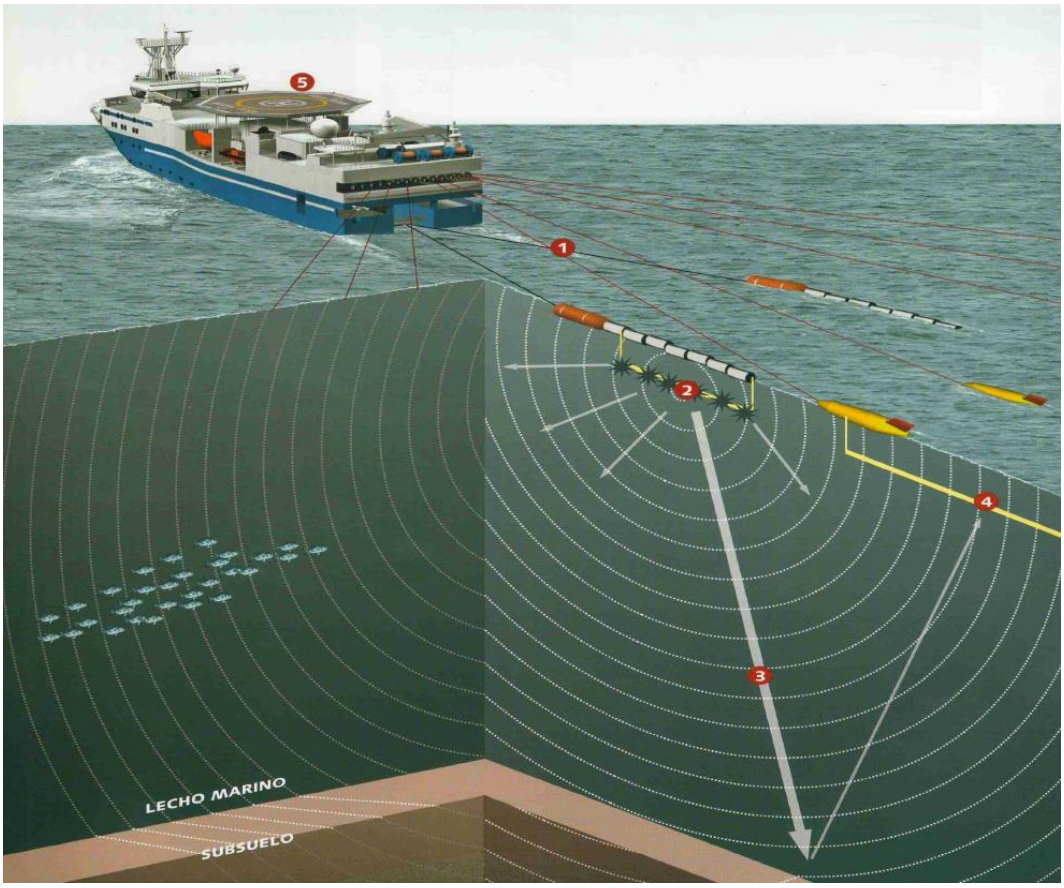


Figure 2. Display of a 3D seismic survey.

References: 1- Deployment of compressed air energy sources and streamers, 2- Generation of pressure wave, 3- Transmission of energy, 4- Recording of reflected waves with hydrophones, 5- Digitalization of ship data.

4.2 REQUIRED EQUIPMENT

The specifications of the sound emission equipment provided for the realization of seismic activities with recording by means of streamers are herein below presented. Bottom detectors that use technologies such as OBN (Ocean Bottom Nodes) or OBC (Ocean Bottom Cables) shall not be used).

A concentrated array called "Triple Source" shall be used to carry out the seismic process as it is made up of 6 sub-arrays, which emit alternately in groups of 2 (system called 2-2-2). Each emission source is composed of 2 sub-arrays separated 10 meters from each other, taking up an area of 10 meters wide by 14 meters long (140m2), and with a total volume of 3,280 cubic inches (cu.in). 53,75 liters.

According to the "Guidelines for minimizing the risk of injury to marine mammals from geophysical surveys" of the United Kingdom Joint Committee for Nature Conservation ("Guidelines for minimizing the risk of injury to marine mammals from geophysical surveys" United Kingdom Joint Nature Conservation Committee) (JNCC, 2017), the geophysical contractor shall apply a gradual increase procedure of compressed air energy sources ("soft start" or " ramp up") at the beginning of each line and after having stopped for any reason for more than 10 minutes. This procedure allows a steady increase in the sound levels generated by the compressed air devices until reaching the operational level before the survey for a 20/40 minute-period, to provide adequate time for the marine fauna to leave the area.

4.3 SEISMIC VESSEL, SUPPORT VESSELS AND LOGISTICS

The use of a seismic vessel is used for the acquisition. This seismic vessel shall be escorted by two support vessels with different tasks. One is the guard or follow-up vessel (escort). It shall guarantee the seismic vessel (and its array) a safe navigation, without interference with other vessels. The other support vessel is a supply one. It shall be used to supply groceries, consumables and carry out crew changes. When this ship does not have to reach the port for groceries and / or crew, it shall also be supporting the seismic vessel, and also towing it upon emergency in its propulsion system.

The seismic vessel is expected to move to the seismic acquisition area from the Port of Buenos Aires, where it shall be boarded by the crew. Mar del Plata shall be the port used for logistics services during the execution of the project, when fuel, fresh food and supplies are required. The waste generated on board shall be disposed of at said Port and shall also be used for crew changes.

The mobilization, execution (seismic) and demobilization activities shall last up to 5 months. The acquisition schedule shall be adjusted to oceanographic conditions to ensure the safety of operations. The acquisition is scheduled to take place during the fourth quarter of 2021 and the first quarter of 2022. They shall uninterruptedly operate 24 hours a day, every day of operation.

5. ENVIRONMENTAL BASELINE

The impact that a project may have on the environment depends both on the set of activities and actions involved in it, and on the set of elements and processes that make up the environmental system in which it shall be inserted. Therefore, it is necessary to analyze it from an environmental point of view, developing a deep characterization of the environment by describing its general aspects (physical, biological, cultural, socioeconomic features). This is known as the Environmental Baseline (LBA).

5.1 AREA OF STUDY AND AREA OF INFLUENCE

The area of influence of a project is defined as the area over which it shall be possible to measure impacts derived from the actions proposed. Depending on the direct or indirect impact, the area may be of direct (DIA) or indirect (IIA) influence. The "Guide for the preparation of environmental impact studies" of the then Secretary of Environment and Sustainable Development (SAyDS, 2019) defines the Area of direct influence (AID) as "the maximum area surrounding the project and its associated facilities, within which the direct environmental impacts on the sensitive receptors identified in the study area and the Area of Indirect Influence (AII) as "the area within which indirect impacts are anticipated linked to direct impacts of the project" can be predicted with reasonable (grounded) confidence and accuracy , and whose effects could overlap or accumulate with environmental effects of other past, present or future projects".

Obviously, it shall not be possible to determine the area of influence of the project until the impacts have been properly assessed. However, considering similar background, it is possible to determine an area of study that, in an estimate, easily encompasses the areas of direct and indirect influence. Consequently, the definition of the Study Area allows defining areas of greatest interest and concentrating efforts towards them.

Given that the appearance of the environmental impacts of an activity, work or project may vary from one component to another and from one activity to another, it is feasible that during the process of identification and delimitation of the area of influence of said project, areas of influence by component, group of components or environment are then added to define the area of influence of the project. In this way, the delimitation of the area of influence can consider one or more polygons.

According to the "Terms of Reference for the preparation of the Environmental Impact Assessment - EIA in marine seismic exploration projects at depths less than 200 m." of the Ministry of Environment and Sustainable Development of Colombia (2016), “the area of influence of a marine seismic exploration project, corresponds to the addition of the following areas: i) polygon of the seismic exploration area, ii) buffer strip or protection, calculated from the generated acoustic wave propagation models, defining as distance the sound level that can potentially affect the structure and function of the ecosystem components (mainly turtles and marine mammals), iii) maneuvering areas to change course; due to the fact that, although seismic activity is not carried out in this area, the teams are deployed, and iv) fraction of the continental zone, when applicable, due to the location of communities that are affected in the normal development of their economic activities (eg fishing or tourist operation) due to the execution of the project.”

For the definition of these areas for the project "Offshore 3D Seismic Registry Areas CAN_100, CAN_108 and CAN_114", the starting point is the operational area (AO), that is, the space in which the key actions of the project shall be carried out. The criterion used to establish the AO was to consider about 12 km beyond the limits of the seismic data acquisition area in the direction of the acquisition lines (prime lines), in order to include the turns that the seismic vessel shall make to perform line changes, which according to the Project Description (Chapter 4) shall not exceed 11 km, and a buffer of 2 km in the rest of the perimeter. In this way, the AO comprises the maximum range of the ship's movements during the survey.

The AO also includes the Port of Mar del Plata, where the logistics vessel shall be supplied with fuel, fresh food and consumables every 2 or 3 weeks on average, and it shall also embrace the routes between said port and CAN_100–108 and CAN_114 acquisition areas. Although the port of Buenos Aires has been set as the port of shipment, it shall only be used during mobilization (entry of the seismic vessel into the country) and demobilization (departure from the country of the seismic vessel), hence, this port and this route shall only be used once at the beginning of the project, and once at the end. The project activities are not expected to have a significant impact on these areas given the limited nature of these operations and their common characteristics in shipping activities.

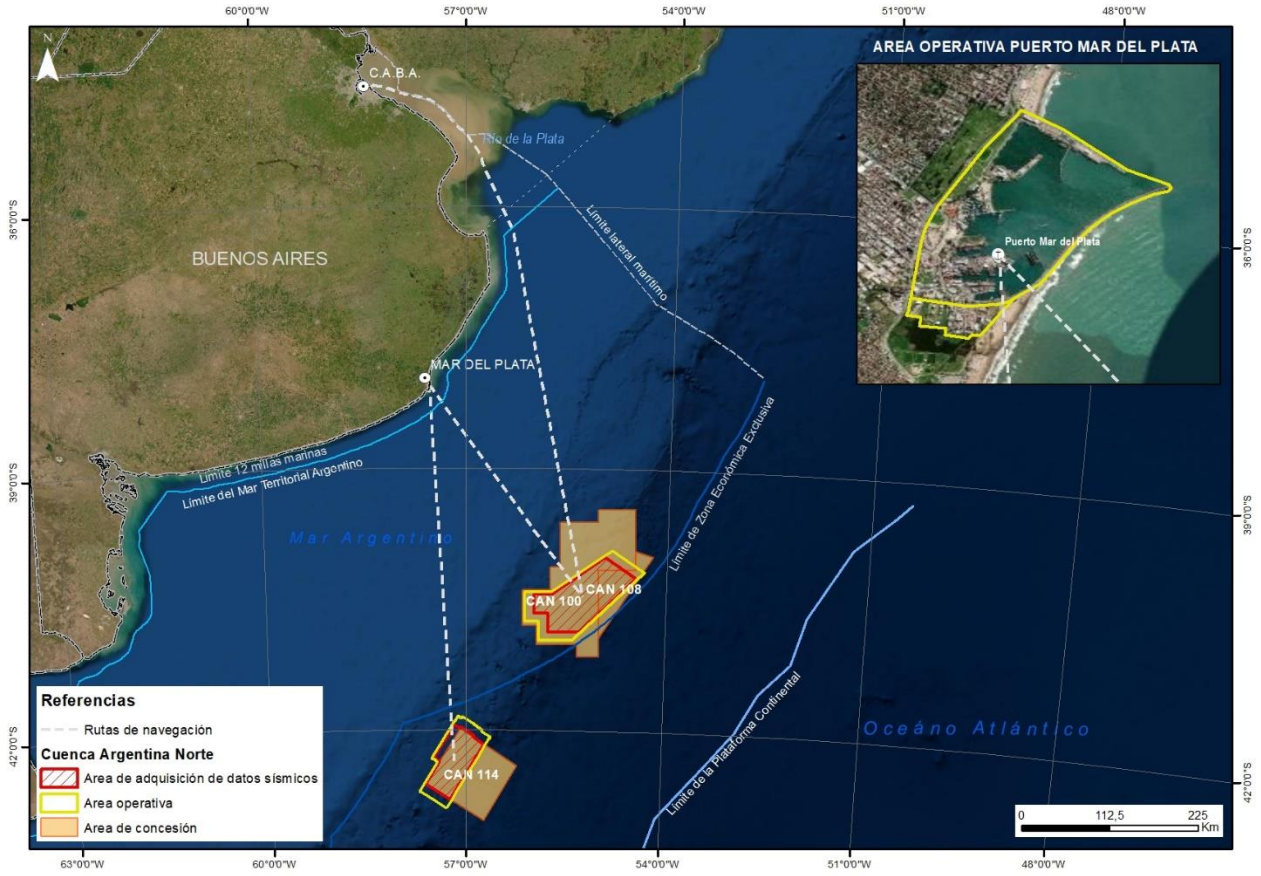


Figure 3. Project Operational Area.

(Map)

Límite 12 millas marinas:	12 Nautical-Mile Limit
Límite del mar territorial argentine:	Argentine Territorial Sea Limit
Área operativa Puerto de Mar del Plata	Operative Area Port of Mar del Plata
Límite lateral marítimo:	Maritime Lateral Limit
Límite de Zona Económica Exclusiva:	Economic Exclusive Zone Limit
Límite de la Plataforma continental:	Continental Shelf Limit

References/ Navigation Routes/ North Argentine Basin/ Seismic Data Acquisition Area /Operative Area/ License Area.

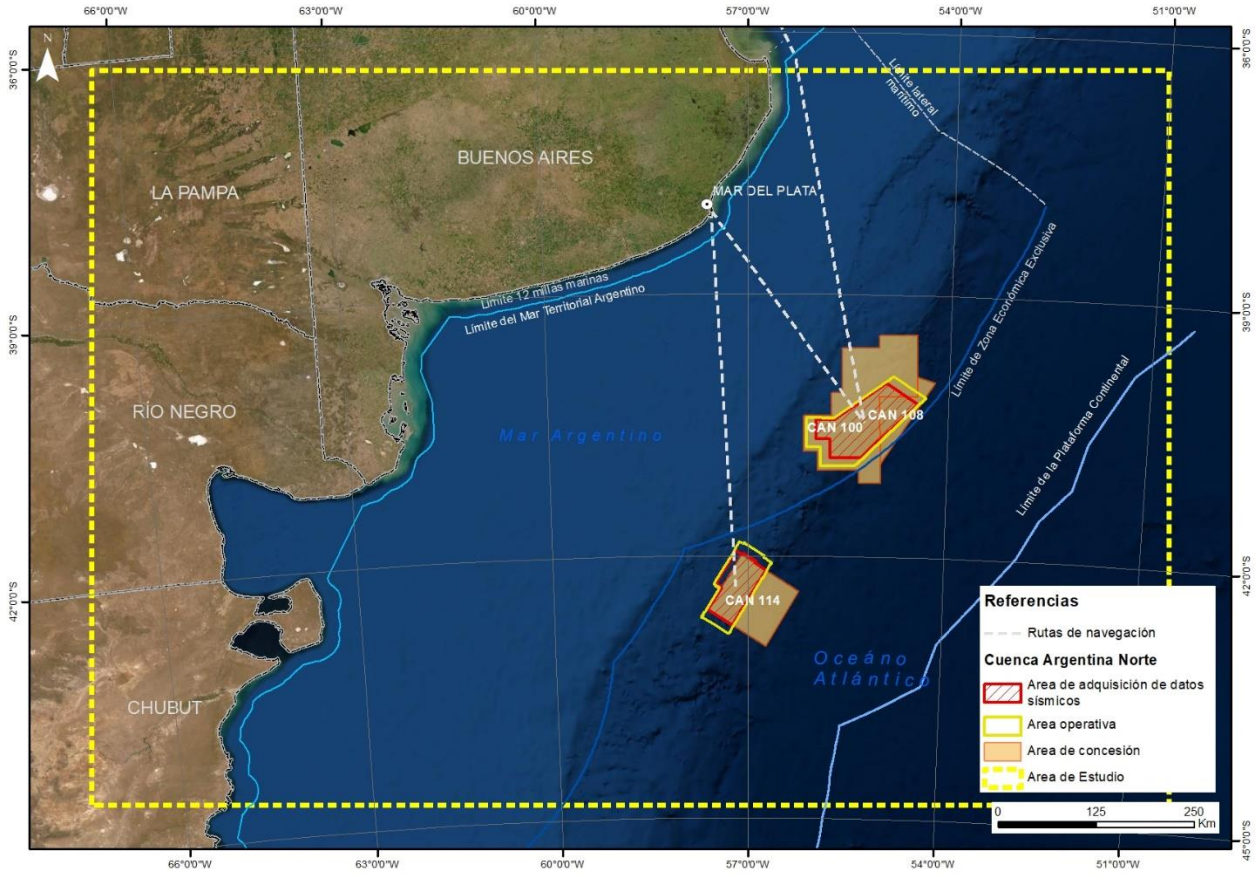


Figure 4. Project Study Area.

(Map)

Límite 12 millas marinas:	12 Nautical-Mile Limit
Límite del mar territorial argentine:	Argentine Territorial Sea Limit
Límite lateral marítimo:	Maritime Lateral Limit
Límite de Zona Económica Exclusiva:	Economic Exclusive Zone Limit
Límite de la Plataforma continental:	Continental Shelf Limit

References /Navigation Routes/ North Argentine Basin/ Seismic Data Acquisition Area /Operative Area/ License Area/Study Area.

Area of Influence of the Biotic Component

Background data on the potential effects (and their scope) on marine biota typically associated with exploratory seismic records, characterized by the emission of sound energy, have been preliminarily considered. Likewise, incidental hydrocarbons spill or other dangerous substances with potential consequences for marine fauna have been taken into account.

When referring to the biotic component, it is considered that the spatial scope of the potential effects on marine mammals also includes the effects upon other environmental factors.

In this way, a Direct Area of Influence (AID) or area of direct impact is established, which is mainly associated with the acoustic propagation of the noise generated by the activity, and its maximum incidence is typically limited to a distance ranging from 500 meters to 3 km from the seismic data acquisition area. In this sense, the AID is defined as a 3 km buffer surrounding the AO of the CAN_100–108 and CAN_114 areas (at a minimum distance of 5 km from the seismic data acquisition area). The surroundings adjacent to the port of Mar del Plata and the shipping routes between said port and the acquisition areas are outside of this polygon, but are also part of the AID.

Surrounding the AID, a 100km buffer area is considered and measured from the seismic data acquisition area that contemplates the scope of the potential effects on mammals that are not related to the damage. This section makes up the area of indirect influence (AII). The AIDs of the port of Mar del Plata and the logistics route are considered areas of indirect influence.

Beyond these areas, the characterization of the biotic component covers a study area on a broader general scale or “regional area of influence” that includes the environments - and their functional relationships - around the project, embracing all areas of influence defined above. On this scale, a general characterization is carried out with emphasis on the analysis of sensitive environments (ANP, AICAs, Proposed Marine Areas, etc.).

In areas where the general spatial scope is not applicable to a given resource, the analysis of a relevant subzone approximately delimited by the polygon called the Detailed Study Area was defined within this “regional area of influence”.

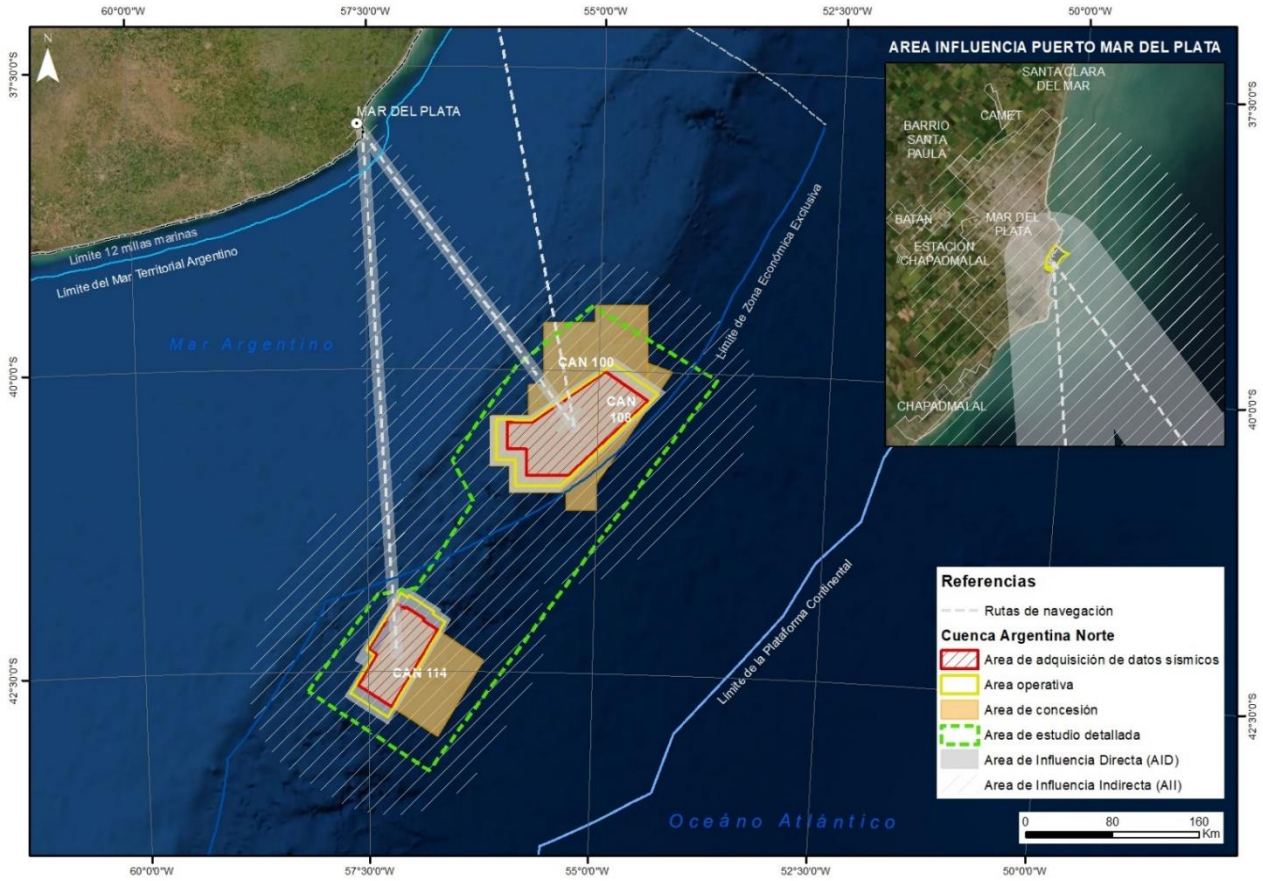


Figure 5. Area of Influence of the Biotic Component.

(Map)

Límite 12 millas marinas:	12 Nautical-Mile Limit
Límite del mar territorial argentine:	Argentine Territorial Sea Limit
Área influencia Puerto de Mar del Plata	Area of Influence Port of Mar del Plata
Límite de Zona Económica Exclusiva:	Economic Exclusive Zone Limit
Límite de la Plataforma continental:	Continental Shelf Limit

References /Navigation Routes/ North Argentine Basin/ Seismic Data Acquisition Area /Operative Area/ License Area/ Detailed Study Area/Direct Area of Influence (DAI)/Indirect Area of Influence (IAI).

Area of Influence of the Biotic Component

Given the nature of the project, the physical variables (geological and oceanographic) shall not be affected by the actions of the project, but, on the contrary, some of them shall be limited and affected by these variables on site.

In this sense, the subcomponents of the physical environment have been described on a general scale in order to help understand the system as a whole, thoroughly characterizing the specific variables within the Detailed Study Area that limit some aspects of the project or its assessment, such as winds, currents, tides and waves, temperature, salinity and speed of sound propagation in water, bathymetry and sediments of the seabed.

Area of Influence of the Anthropic Component

As mentioned above, the seismic data acquisition areas are located offshore more than 300 km from the nearest coastal area in the province of Buenos Aires, beyond 12 miles from the territorial sea; approximately 310 km from the nearest coastal town (Mar del Plata).

Given the nature of the project, no interactions are foreseen between the project and the territorial coastal strip. Modern marine seismic exploration does not produce significant pulses of airborne noise. On the other hand, the project does not require the installation of logistics bases or any infrastructure whatsoever for its development. The project determines the port of Buenos Aires as the port of shipment and the Port of Mar del Plata as the port for supplies or logistics services. The operations of the vessels associated with the project do not differ from those of any other vessel docking in these Ports.

In this sense, potential interferences of the project on the anthropic environment are considered with reference to fishing activities, offshore hydrocarbon exploitation activities, maritime traffic and the infrastructure that may exist in the offshore space. There are some benefits associated to the project in terms of economic activities such as the demand for local services and labor.

It is estimated that, for the rest of the aforementioned factors, the interferences are limited to the area in which said activities and those of the project overlap, with the exception of fishing and economic activities. In this sense, the space that involves the project's AO and the immediately surrounding area that comprises the space that can be potentially impacted by the physical presence of the seismic vessel and / or the support vessels are considered. Regarding economic activities, the demand for logistics services may have some very focused effects in relation to the benefits provided by the port of logistics services (Port of Mar del Plata) and possibly in some other locations as to other supplies / services, but in any case, there would be scattered aspects of little relevance, which shall not affect local economies. The same can be mentioned regarding the demand for labor, since the project generally requires particularly qualified personnel.

Regarding the fisheries activities and the effects upon the species of fishing interest, this impact is of an indirect nature (since the potential effect occurs on the species of commercial interest, and indirectly on the fishing activities). It is estimated that it could be limited to 50 km from the seismic data acquisition area in order to broadly cover the potential effects of the project on this activity. Regarding the interference caused by the movement of fishing vessels, the impact is limited to the nearby environment defined above for the rest of the vessels.

Then, the AID of the anthropic component is defined by a surrounding area of 5 km to the Operative Area of the seismic acquisition areas, which involves the space that can be potentially impacted by the presence of the seismic vessel and the support vessels, while the AII is delimited by a buffer of 50 km from the CAN_100-108 and CAN_114 seismic data acquisition areas. Given that the logistics operations in the port do not differ from those of any other ship that reaches port, the impact of these activities shall not exceed the operational area in the port area of the Port of Mar del Plata. As an area of influence of the Port of Mar del Plata, an AID is established around it, while the City of Mar del Plata is considered as an IIA of the port, which forms the port hinterland.

Beyond these areas, the characterization of the anthropic component comprises an area of study on a broader general and regional scale associated with the identification of the actors or stakeholders in the project.

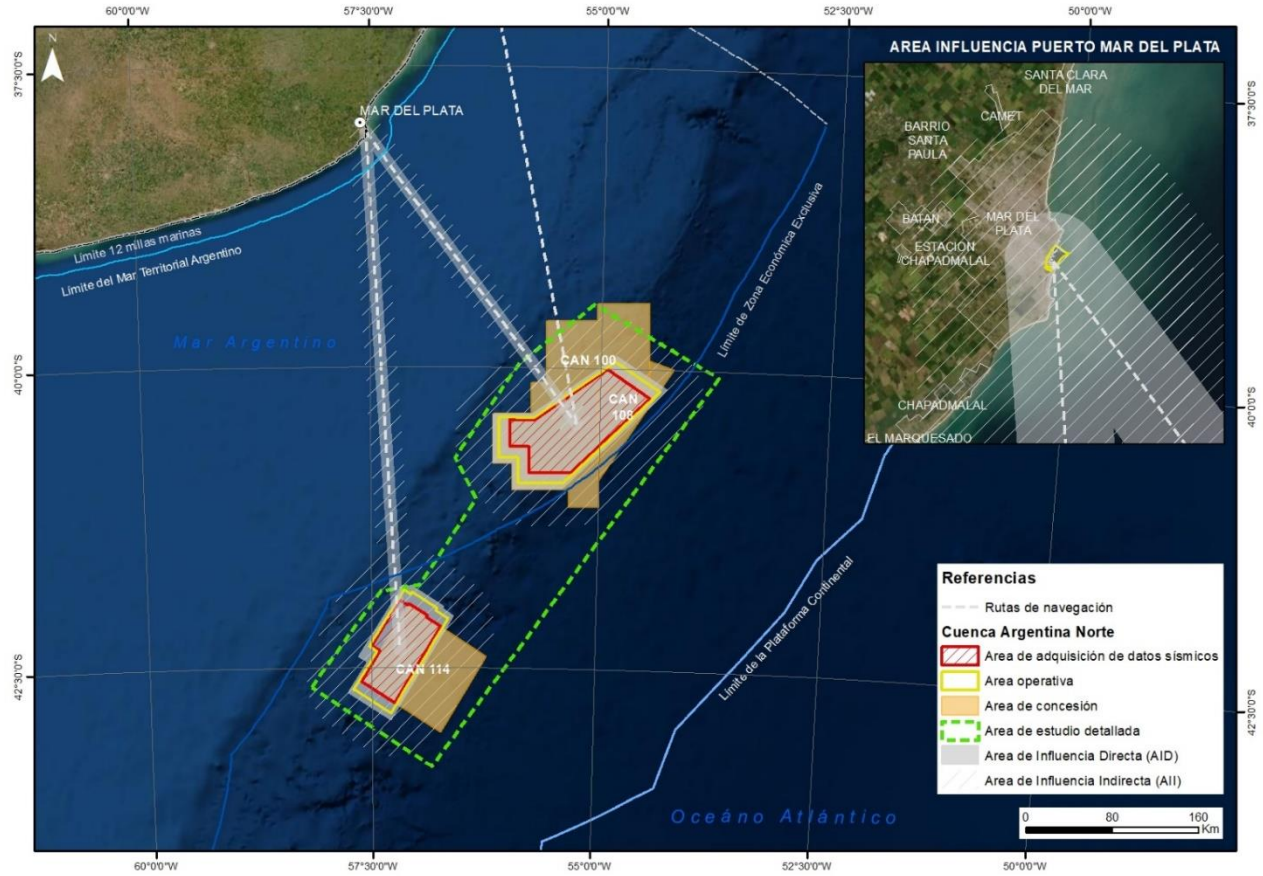


Figure 6. Area of Influence of the Anthropic Component.

(Map)

Límite 12 millas marinas:	12 Nautical-Mile Limit
Límite del mar territorial argentine:	Argentine Territorial Sea Limit
Área influencia Puerto de Mar del Plata	Area of Influence Port of Mar del Plata
Límite de Zona Económica Exclusiva:	Economic Exclusive Zone Limit
Límite de la Plataforma continental:	Continental Shelf Limit

References /Navigation Routes/ North Argentine Basin/ Seismic Data Acquisition Area /Operative Area/ License Area/ Detailed Study Area/Direct Area of Influence (DAI)/Indirect Area of Influence (IAI).

5.2 PHYSICAL ENVIRONMENT

Geology

The Argentine Continental Margin (MCA) is determined by the submerged natural extension of the continent to the abyssal plain or seabed (outer edge of the continental margin) and broadly comprises the shelf, the slope and the continental emersion, in addition to numerous submarine canyon systems.

Regarding the geological and tectonic contexts, the Argentine continental margin is located mainly in the South American plate. It is associated with the cortical extension linked to the opening of the Atlantic Ocean from the Middle Jurassic in a geotectonic context dominated by a passive continental margin, although it is associated with active margin sectors in its southernmost portion.

The Argentine coast in the project area corresponds to a passive margin coastline, with an extensive continental shelf implying a certain tectonic stability.

Argentina's continental shelf extends for about 2,400 km between the “Río de la Plata” and “Cabo de Hornos”, although the coastline is about 5,300 km long considering its major irregularities. Its width varies between 170 and ~ 1,200 km. The inner edge (towards the continent) is marked by a steeply sloping coastline whose base reaches -10/20 m on the Buenos Aires coastline deeply increasing towards the south. The outer edge, which marks the transition towards the slope, follows a NE-SW course between 36 ° S (Río de la Plata) and 44ºS, from where it gradually changes to NS to, at 50ºS, to head east around the Falkland Islands and re-approach the mainland in front of the Strait of Magellan.

The operational area of the CAN_100 - CAN_108 areas is located on the middle and lower sector of the slope that develops from the edge of the Ewing terrace, as well as on the beginning of the continental rise, at depths between 900 m and 4,100 m in the submarine canyon systems area of Mar del Plata and Bahía Blanca.

The operative area named CAN_114 is located on the middle slope, at depths between 1,300 and 3,000 m in the Bahía Blanca submarine canyon system area, immediately north of the Ameghino submarine canyon system.

Unlike the slope, which is a tectonic formation, the continental rise is a sedimentary formation. The continental rise is characterized by a gentle slope and little relief in the study area. It develops around 3,500 to 4,000 m deep and connects with the abyssal plain as of 5,000 m deep, being crossed by underwater canyons and valleys, which have been the main route of sedimentary transport to the abyssal plain.

The variations in sea level associated with the glaciations did not have a direct effect on the continental slope (the greatest retreat of the marine waters reached depths of about 120 meters below the current level). However, climatic changes took place through variations in the circulation of ocean currents. These currents are significant processes that influence the sedimentary dynamics and the modeling of the underwater topography and have left a strong imprint on permanently submerged environments. The Argentine continental margin is dominated, in its deep regions, by currents of Antarctic origin that circulate from south to north at different depths, following the isobaths (contour currents). The consequence of this oceanic dynamics was a sediment transport that formed large sedimentary sequences along the margin, developing so-called “contournitic” deposits, which appear as accumulations on terraced surfaces.

Concurrently, the high slopes of the slope favored the action of gravitational processes shown through dense sediment currents (turbidity currents) that slide over them, digging underwater canyons and producing turbiditic deposits and underwater landslides. These processes are more complex in the Buenos Aires margin, where the currents that circulate from south to north interact with others in the opposite direction, forming the Confluence Zone. In this way, the Buenos Aires slope is formed by alternating sediments, formed by both longitudinal and transverse processes, which prevail in the vicinity of the submarine canyons.

When it comes to the contribution of sediments, the Argentine continental shelf receives terrigenous sediments from two main contribution areas: The Andes region and the Brasilia Massif. Minor contributions from the “Sierras Pampeanas” and other regions of central Argentina should not be ruled out. Despite the presence of the two associations, the predominance of the first is evident in most of the Argentine continental shelf.

The petrographic analysis of rock fragments found in marine deposits on the slope more than 500 m deep near Mar del Plata (38 ° S) submarine canyon revealed the predominance of materials from Buenos Aires (Tandilia) and Patagonian origin.

Given the terrigenous composition of the sediments that make up the platform, the sedimentary dynamics must be considered in an integral way, encompassing both the continental processes that affect the coast as well as the littoral and marine ones. Sediments are introduced into the dynamic coastal system from the adjacent continent in different ways, both by fluvial and wind transport and by coastal erosion, to be subsequently transferred to the platform.

The submarine canyons are other significant features present on the slope, they represent erosive geoforms that shape it and, in many cases, they indicate the easternmost reach of the deposits of terrigenous origin that are carried towards the marine basins. They have been the main route for the sedimentary transfer to the abyssal plain, reaching its greatest development at depths between 2,000 and 4,000 m.

The most recent sedimentary unit of the subsoil of the Argentine continental shelf corresponds to the post-Last Glacial Maximum sedimentary package with an age between ~ 18 ka and the present, defined as a depositional sequence identified by high resolution seismic surveys carried out in the marine areas of East Buenos Aires. The sequence extends from the outer edge of the platform (and even sectors of the slope) to the coastal plains, being limited by the transgressive surface at its base, being the top represented by the current topographic surface. Its thickness averages about 5 m to 10 m, being greater in the Buenos Aires platform where it reaches 10-15 m, and less in Patagonia where it generally does not exceed 5 m, with a discontinuous distribution.

According to the Atlas of Environmental Sensitivity of the Argentine Coast and Sea (2008), the predominant material is mud in the exploration areas, although there is sand in the western zone of CAN_100 - CAN_108. On the other hand, 10- m sedimentary cores extracted in deep sectors near the exploration areas show the presence of clays.

Regarding the sediments that are found below this superficial layer, although the information on the characteristics of these materials is scarce, they would be made up of silty sands, and gravel material could be found in submarine canyons and contour bodies.

The sedimentary thickness in CAN_100 - CAN_108 and CAN_114 operative areas is very important, reaching over 2.5 km.

Climatology and Oceanography

The local atmospheric circulation is controlled by weather changes in the study area through the combination of high-pressure systems of the South Pacific and South Atlantic. The southwesterly circulation, associated with the high pressure system of the South Atlantic, causes advection of warm and humid air from subtropical regions.

Cold anticyclones over southern Argentina periodically (particularly in winter) drive cold maritime air masses from the Southwest Atlantic over the littoral area.

The wind generates a very rough sea year round bringing about waves of varying height and direction within the study area. In this sense, the increase in sea-state is typically generated as a result of storms taking place through the Drake Passage and over South America. The storms coming from the west rapidly generate increases in the sea state, but they do not last more than 2 or 3 days, unless the area is affected by a succession of consecutive storms.

In the detailed Study area, the highest waves are registered predominantly during autumn and winter heading towards the N-NE. It should be noted that the campaign shall take place in the October-March period, thus avoiding the worst conditions of the waves. The wind pattern is characterized by weak intensities and large seasonal variations. The tidal amplitudes are relatively small, and so are their velocities, so their contribution to the total field current is negligible.

The main source of the water bodies of the continental shelf is the sub-Antarctic water, transported from the north of the Drake Passage by the “Cabo de Hornos” current that flows between the Atlantic coast and the Falkland Islands, as well as by the Falklands current that flows along the edge of the shelf. On the other hand, there are small continental discharges that provide fresh water and a source of low salinity water given by the flow that enters through the Strait of Magellan.

Another very important source of water masses for regional oceanographic characterization in the Southwest Atlantic area is the water transported by the Brazilian current. This current flows southward along the continental margin of South America (it constitutes the western limit of the so-called subtropical gyre of the South Atlantic), transporting warm, saline waters of subtropical origin.

The Brazilian and Malvinas currents join near 38º south latitude (moving north or south depending on the season of the year) in the deep-water environment of the slope and form the Brazil / Malvinas (Subtropical Front) confluence zone, becoming the thermohaline front with the highest concentration of energy in all the world's oceans. Subtropical and sub-Antarctic waters coexist and mix there creating important physical-chemical gradients which favor the presence of high concentrations of nutrients with important biological consequences for the entire ecosystem.

After encountering the Malvinas Current, the Brazilian Current splits and one of its branches (the outermost) forms the South Atlantic Current, while the main flow of the Malvinas Current describes a sharp turn and forms the flow return from Malvinas which then heads southeast. This return flow generates the emergence of deep waters that enrich the nutrient content of the surface waters.

These currents determine the oceanographic and biological rhythms of the area.

The Detailed Study area is located in the area of influence of the Malvinas current and its convergence with the Brazilian one.

As a result of the high dynamics of the confluence, meanders and eddies are produced on a large scale. The latter are detached from the two currents and generate intrusions from a body of warm water (the Brazilian current) into a body of cold water (the Malvinas current) and vice versa. All these characteristics mean that the temperature and salinity of the water present a high space-time variability.

In this way, the Detailed Study area, in addition to being characterized by the mixture of these two bodies of water, can be covered both by the cold, low-salinity and nutrient-rich waters of the Malvinas as well as by the warm and salty waters of Brazil. Therefore, the seismic exploration vessel may be moving either in the confluence zone, or in Malvinas or Brazilian waters at any time of the year.

The operational area named CAN_100 - CAN_108 is bathed by both the cold water mass of the Malvinas current and the warm water of Brazil in the area of the confluence of the currents, as well as by the mixing zone between them with their large eddies and meanders.

There is great variability in the field of currents within the area of interest, both in intensity and direction, which is associated with the dynamics of the confluence of the Brazilian and Malvinas currents.

The characteristic water mass is that of Malvinas within the CAN_114 operative Area towards the south, with speeds that do not exceed 0.5 m / s, except in the area closest to the edge of the platform where the current can reach somewhat higher speeds.

5.3 BIOTIC ENVIRONMENT

The analyzed area integrates an oceanic marine ecosystem of high biological diversity and high productivity from a biological point of view, known as the Argentine Sea Ecoregion. There are sensitive areas with important biodiversity in the adjacent coasts. Species of the different trophic levels congregate to benefit from the Patagonian coastal waters which represent areas of high productivity. The intertidal ones host a particular fauna which feed numerous marine and coastal birds gathering there. In addition, the adjacent land areas are sites hosting sea, shorebird and marine mammal settlements.

However, it is important to mention that, within the framework of this project, the coastal areas shall not be affected as they are more than 300 km away from the seismic data acquisition areas. The vicinity of the port of Mar del Plata is the only location where an indirect effect could be registered as a result of the transit of ships from and to the area of operations, as it shall be used as an embarkation and disembarkation Port.

Planktonic Community

These organisms set up the first trophic levels of the ecosystem, being of important value as a food source for the higher trophic levels. Its abundance, biomass and distribution are decisive in the structure of the trophic net that supports the aquatic environment. Therefore, the alterations in the plankton generate cascading effects upon the rest of the trophic net, turning these organisms into indicators of the prevailing environmental conditions.

The Argentine exclusive economic zone (ZEEA) has 6 frontal systems. The indirect area of influence of the project is located in the "Frente del Talud Continental" system, with significant concentrations of phytoplankton.

Phytoplankton production varies depending on the two characteristic currents of the area. The areas influenced by the Brazilian Current show a low concentration of chlorophyll, between 0.02 and 0.20 mg / m3. On the other hand, a high concentration of chlorophyll is observed, which ranges between 0.20 and 2.25 mg / m3, in the waters bathed by the Malvinas Current.

Regarding the distribution of the species, the fronts constitute a dispersal barrier and define biogeographic patterns of marine organisms. Phytoplankton are dominated by flagellates and few diatom species in the warm waters near the fronts. The waters of the Brazil / Malvinas confluence are governed by temperate diatoms (*Leptocylindrus, Pseudonitszchia, Rhizosolenia, Fragilariopsis* and small *Chaetoceros* and *Odontella*). Carreto et al., (2003) determined the presence of three phytoplankton associations in a section that crossed the Río de la Plata from the estuarial zone to the oceanic sector: 1) Estuarial and coastal communities, dominated by the *cryptophyte Cryptomonas* sp., with heterotrophic flagellate *Noctiluca scintillans*. 2) Communities of the continental shelf and the Malvinas Current, ruled by the *coccolithophore Emiliania huxleyi*.3) Community of the Brazilian Current, characterized by the abundance of the picoplanktonic cyanobacterium Synechococcus sp. Olguín et al. (2006) indicate that in the area of the edge of the slope, also the area of indirect influence of the project, the phytoplankton assemblage corresponds to the “Transicional del Norte” group, characterized by the presence of 119 registered diatom species, 20 of which are restricted but invariably rare. 13 species of diatoms are characteristic of this area; among these, *Chaetoceros contortus*, Pseudo-nitzschia multiseries and *C. rostratus* are particularly abundant.

Phytoplankton production in the Argentine Sea describes an annual increase and subsequent decrease bimodal cycle, typical of temperate-cold water ecosystems with seasonal thermoclines. The maximum phytoplankton production occurs in spring, beginning with intense growth during the months of October and November in shallow coastal waters north of the shelf. The production wave gradually expands towards the South and moves away from the coast as it enters the summer period. A secondary maximum of primary production is observed in the first months of autumn. In general, after the peak of primary spring production there is a reduction in the concentration of nutrients, especially silicates, which limits the growth of diatoms, so that there is a change in the phytoplankton flora in favor of *coccolithophores, dinoflagellates* and other small *flagellates* that have the ability to use nutrients from the mineralization of organic compounds.

The maximum values of phytoplankton productivity are recorded during the spring and summer seasons for the Slope Front, in the indirect area of influence of the project.

The zooplankton production cycle adopts typical patterns of temperate-cold seas, with a seasonal variation in its biomass associated with the explosive spring growth of phytoplankton, which experiences a progressive gradient from the coast to the slope and from North to South, according to the abundance of nutrients and the stabilization of the water column. In conclusion, the greatest diversity of species is found in the waters of Malvinas current and in the Confluence or transition zone. The latter, located near the project area, is characterized by the presence of 57% invertebrates.

Regarding the composition of zooplankton, mesozooplankton consists mainly of copepods (89%) and occasionally ostracods, pteropods, juvenile forms of euphausiids and amphipods, and also larvae of other crustaceans and fish eggs. This fraction contributes approximately between 50 and 60% of the total biomass of zooplankton in autumn and spring, respectively. The macrozooplankton mainly includes euphausiids (krill), amphipods and chaetognaths. Krill represents the food source for many species of fish, cetaceans, pinnipeds, penguins, and other seabirds inhabiting the area. The most important krill species is *Munida gregaria*. On the other hand, the amphipod group is practically monospecific and is represented almost exclusively by *Themistho gaudichaudii*. This species constitutes the key food for most of the fish species that are distributed in the area.

A total of 15 species of copepods and 5 species of *cladocero* were identified in the indirect area of influence of the project. Other groups of *appendiculariae*, *ketognaths,* jellyfish, petropods, and various types of mesozooplanktonic larvae were also recorded, such as polychaetes, lamellibranchs, barnacles, and calyptosis and *euphasid furcilia* (Cepeda et al. 2006). With variable abundances throughout the seasons, Cepeda et al. (2018) indicate that the platform and edge of the slope are mainly characterized by C4–5 copepodids of *D. forcipatus*; females and late copepodids of *C. vanus*, *Clausocalanus brevipes* and *C. simillimus*; the cyclopoids *O. aff. helgolandica* and *O. atlantica*; T. gaudichaudii; and euphausiid juveniles. It is observed that the macrozooplankton stands out with the hyperid amphipod T. gaudichauddi and the *Euphasia lucens* in the indirect area of influence of the project. The *O.aff.helgolandica* and *O.atlantica* species are of importance to the north of the survey area.

For the Slope Front, in the indirect area of influence of the project, the highest zooplankton biomass is recorded from the beginning of spring to the end of summer, mainly composed of macrozooplankton, with the *T. gaudichauddi* and *E. lucens* species standing out. *O.aff.helgolandica* and *O.atlantica* are other important species to the north of the survey area.

Regarding the gelatinous zooplankton (GZ), there is presence of fish stomachs with ctenophores in the indirect area of influence of the project, so the diversity of ZG in said area is low. The main groups of ZG are tenophores, salps and jellyfish.

With regard to fish, the Ichthyoplankton collections in these areas are affected by sub-Antarctic waters and Malvinas currents in the surface and subsurface layers, and by Antarctic intermediate waters in a deeper flow. Mytophids are the most abundant small pelagic fish in the area and their larvae and eggs have been recorded in the study area.

The highly productive coastal area associated with large currents provides a powerful selection regime for large individuals of squid (*Illex argentinus*). Squid breeding areas occur in the north of the Argentine Sea, during the winter months, associated with the Brazilian Current. Once the juveniles have developed, they migrate to the south of the Argentine Sea during the summer, and then as adults, return north to spawn.

Benthic Communities

Benthic invertebrates play an essential role in marine ecosystems. Many represent commercially exploited species that support very important fisheries, such as prawn (*Pleoticus muelleri*), scallop (*Zygoclamyspatagónica*) or spider crab (*Lithodes santolla*). Furthermore, they have a close relationship with fish species of commercial interest, either because they are components of their diets as they generate habitats for the deposition of eggs or because they constitute shelter or food for larval or juvenile stages. Likewise, some benthic organisms behave as ecosystem engineers and constitute highly structured environments that allow the development of highly biodiverse communities, as in the case of “animal forests” where sessile and suspensivore organisms such as sponges, corals, bryozoans, brachiopods and certain mollusks are found. Certain groups of benthic invertebrates (sponges, cnidarians, tunicates, brachiopods) are called Taxa Indicators, and they stand out due to their ecological role and their high susceptibility to any natural or anthropic change. When biomasses greater than 10 kg 1,200 m-2 are recorded in these groups, the habitats are framed as Vulnerable Marine Ecosystems (VMEs). The direct area of influence for the CAN_114 zone partly overlaps with the north of the areas considered VMEs.

The indirect area of influence of the project overlaps with area “B” in the internal region of the platform; it presents 112 species of macroinvertebrates, a group sub-dominated by bryozoans and echinoderms, of which only one species is exclusive to this area. While the CAN_114 Area is located in the “C” area, under the influence of the Malvinas current (high productivity and low temperatures) with a total of 152 species, it shows a high percentage of exclusive species (16.30%), the community is dominated by bryozoans and brachiopods and the echinoderms are less abundant than in the “B” area.

Recent studies on the benthic communities from different sectors of the external platform and the continental slope of the Argentine Sea have shown a total of 250 species among poriferous, echinoderms, hydroids, infaunal organisms and epibionics. The scallop plays a very important role as an ecosystem engineer, however, in the indirect area of influence, a low density of biomass is observed, and there are no areas of reproduction, feeding or breeding of Patagonian scallops in the direct area. In deeper areas, cold-water coral reefs were detected in this region, mainly composed of the Bathelia candida species, coral gardens that in turn present a large amount of associated fauna, located at depths between 400 and 1000 meters, and sponge fields, located between 250 and 1300 meters deep. The detailed study area of the project does not overlap with the areas of higher coral density.

Decapods are best known for their commercial interest. This group is made up of crabs, lobsters, shrimp, prawns and spider crabs. Another remarkable characteristic of the group is its role as main prey for many species of fish, mollusks and other animals. Therefore, they are considered important links in the food chains of the worldwide seas. Five species of economic and ecological interest are registered within the area of influence of the project: The *Munida gregaria* lobster, the *Lithodessantolla* crab, the *Thymops birsteini* lobster, the red *Chaceon notialis* crab and the *Ovalipes trimaculatus* swimming crab. Only the *Thymops birsteini* species is classified by IUCN as "least concern" regarding their conservation status (UICN 2020).

Fish, Cephalopods and their Fisheries

The richness of fish totals about 69 species in the study area and its surroundings. A total of 33 species of fish are registered in CAN_100, CAN_108 and CAN_114 areas. Among the most prominent cartilaginous fish, 14 mostly Rajiformes species were identified, and 19 species of bony fish were also registered.

Most of the species present in the project area are demersal. These resources correspond to species that inhabit the waters near the bottom, making vertical migrations usually with a trophic aim. They are generally caught by the same gear as bottom trawls, traps, pots or longline hooks.

Taking the list of ichthyofauna and its IUCN categorization (2020) as a reference for the study area and its surroundings, it is observed that the dominant category is Not evaluated (NE: 62%), followed by the least concern and almost threatened categories. Three vulnerable species (*Bathyraja albomaculata, Zearaja chilensis* and *Squalus acanthias*) and one critically endangered (*Bathyraja griseocauda*) stand out within thechondrictes).

Four species of cephalopods are registered in the detailed study area of the project; *Doryteuthis sanpaulensis, D. gahi, Onykia ingens*, and *Illex argentinus*. Regarding their conservation status, the 4 species are categorized by IUCN as least concern.

Regarding cephalopods, the Argentine squid (*Illex argentinensis*) presents its highest concentration associated with the presence of sub-Antarctic waters and mainly the Malvinas current, so it is distributed on the edge of the slope at depths between 80 and 400 m. Its distribution varies according to the season and is limited to the area of influence of the cold waters of the Malvinas Current. It is a semelparous species with an annual life cycle of four populations and a constant presence of larvae throughout the year (spawning in summer, South-Patagonian, Buenos Aires, North-Patagonian and spawning in spring). Important concentrations are observed in the study area between May and July corresponding to the Buenos Aires-North Patagonian subpopulation (SBNP), which then migrate to deeper waters in the oceanic region where breeding and subsequent death of the spawning individuals take place. This stock spawns at the edge of the continental shelf where their eggs are carried by the Malvinas current to the north where they hatch upon facing the Brazilian current.

Although the project's area of influence is located within the Argentine squid distribution area, the direct area of influence does not overlap with the spawning, breeding, or feeding areas. The areas with the highest concentrations and reproductive groups would be found in the indirect area of influence of the project in spring and summer, but the area of direct influence would be partially synchronized with the pre-reproductive concentrations of the Buenos Aires-North Patagonian subpopulation grouped in high density at the edge of the platform during the autumn and winter.

The area of influence of the project has marginal fishing importance for most of the main species, such as common hake, hoki, toothfish, southern hake, cod, pollock, and squid. Only the toothfish, haddock and squid species are considered relevant for the area of direct influence of CAN_100-108 and CAN_114 areas.

There are two different stocks of the common hake located north and south of 41 ° S respectively. The one located to the north is the most important from the point of view of the catch and its contribution to the fishing of this resource, which is mainly developed on the platform. This species represents the main resource of the Argentine Sea, and its fishery almost does not include the project study area. The greatest interference with the catch of this species, minor in any case, could occur in the months of March to June. The most important fishing area for hoki is outside the project's area of influence. The Patagonian toothfish, on the other hand, is a species of high commercial value, and although it does not present important catch values in the area of direct influence of the project, the catch area of the northern sector extends beyond 1000 m deep coinciding with the depths of the seismic data acquisition area. A minimum fishing effort is exerted on the southern hake species in the project's area of influence. The southern cod is not considered an important species in the direct area of influence of the project. This is exploited as a companion species for hoki and pollock on the Argentine continental shelf. The catch of Pollock is very low in the study area. The haddock, in general, is a species caught as a companion fauna to hake fishing, with very low catches in the study area. The highest catches are recorded only in the second and third quarters.

Finally, squid is a species of high economic importance, and jigger boats operate at night in the area of indirect influence of the project. North of 44 ° S, the Buenos Aires-North Patagonian subpopulation is exploited from March or April to June before the squid migrate to deep waters. The trawlers activity is already registered in April and also extends into winter. Another possible impact may occur on the drift of its larvae, which, depending on oceanographic conditions, may include the project area.

Regarding the seasonality of the adjacent fisheries, the following stand out in the project area: Roosterfish (from September to February), Hake (from May to September), Hoki (from February to December), Pollock (from February to November), Black Hake (from August to December), Polish (from March to June, and from November to December), Cod (from February to May and from October to December), Southern Hake (from March to May and December) and Squid (from May to September).

The fishing fleet in the Argentine Sea is divided into several categories and have different radiuses of action. The fisheries present in the project's area of influence are mainly the deep-sea freshwater and freezer fleet, with trawlers and long-liners. A marginal relationship with the fishing areas can be seen when analyzing the spatial distribution of the different fishing fleets with respect to the area of direct influence of the project. Mar del Plata is the main disembarking port.

When analyzing the Fleet Operations in the North Zone for the 2017 period, a marked seasonality in operations is evidenced, where the greatest activity is concentrated during the months of February to June. The prospecting area is close to the disembarking area during the 2nd quarter of the year. When analyzing the fleet operations in the North basin, there is no evidence of a high volume of disembarkments by the Argentine commercial fleet for the 2013-2017 period.

Reptiles

Sea turtles are the only reptiles present in this region. Among the currently known species, only 3 of them have been reported for the study area: the green turtle (*Chelonia mydas*), the loggerhead turtle (*Carettacaretta*), and the leatherback sea turtle (*Dermochelys coriacea*).

All species of sea turtles are included in the IUCN Red List, in the CMS and CITES appendices. In Uruguay, sea turtles are protected by Decree 144/98 that prohibits any use and commercialization. National Law 22,421, Decree 666/97 and resolutions 1089 (of 1998), 3 (of 2001) and 91 (of 2003) protect sea turtles at the National level in Argentina. Besides, Uruguay and Argentina have entered into various international agreements for the protection and conservation of different species, including sea turtles (CITES, IUCN, among others).

The Río de la Plata estuary is an important feeding area for the Loggerhead Turtle from spring to autumn, with permanently visited areas by tagged individuals. The green turtle would be more frequent during the summer period in the latitude of the project, while the Laud turtle is registered between July and December, with medium to high densities of the tagged specimens.

Given that the estuary of Río de la Plata is an important feeding area for most of the species of marine turtles in the region between the months of spring and autumn, the study area sector would act as a temporary area and, seasonally, as a feeding one. The project's area of influence is not a breeding zone for sea turtles with a probable presence in the area, since there are no breeding areas for them in our country. Ezcurra and Schmidt (2013) point out that the time of greatest sightings of sea turtles in the Río de la Plata is related to the water temperature. Most sightings take place during the warmer months.

Stranding and incidental catches of adults have been recorded in the coastal areas of Argentina near the project site. The Samborombón Bay Ramsar site is the current Argentine protected area with the highest conservation value for sea turtles. However, it is located more than 350 km away from the project's area of direct influence and more than 200 km from the Port of Mar del Plata, so the aforementioned site shall not be affected by the project. Although other coastal areas closer to the port register strandings and incidental catches of adults, they do not present protected areas with conservation value for sea turtles.

Seabirds

The project area accounts for 55 potentially present species, with confirmed occurrences for 53 of them in recent years. These are the following: Sphenisciformes (penguins) with 6 species; Procellariiformes (petrels, albatrosses and shearwaters) with 34 species, Pelecaniformes with one species and Charadriformes (plovers and robbers) with 8 species.

The bird species present in the region are not under any CITES appendix. According to the categorization of birds in Argentina (2017), 8 of the identified species are under some category of threat of extinction (EC, EN and AM) and 9 are almost threatened (VU). According to the most recent publication of the IUCN Red List (2020), 12 species appear in threat categories (CR, EN and VU) and 7 as near threatened (NT).

According to Favero et al (2005), the specific richness of pelagic birds in the Argentine Sea shows peaks of abundance between May and October, reaching coastal waters in some cases. There are many more where the temperature gradient coincides with the slope, as occurs along the northwestern edge of the Malvinas Current. This area exerts a particular attraction on seabirds due to the concentration of planktonic organisms, fish and cephalopods that feed and breed in these waters.

Thus, and according to the bibliography surveyed, the project area is a very important feeding area throughout the year as well as a transit zone for interhemispheric migrants. However, the species present do not breed in the high seas, having their nesting and breeding sites hundreds or thousands of kilometers from their feeding areas.

Marine mammals

As for the study area, 41 species potentially present for AID were counted, with confirmed occurrences for only 13 of them. Four species of Pinnipeds (*Carnivora*) have been recorded: the double-haired sea lion (*Arctocephalus australis*), the Antarctic fur seal (*Arctocephalus gazella*), the one-haired sea lion (*Otaria flavescens*) and the southern elephant seal (*Mirounga leonina)*. Regarding Cetaceans (*Cetartiodactyla*), 4 species of whales have been recorded - the right whale, the blue whale, the sei whale and the fin whale, as well as 4 species of dolphins - the pilot dolphin (*Globicephala melas*), the bottlenose dolphin (*Tursiops truncatus*), dusky dolphin (*Lagenorhynchus obscurus*) and killer whale (*Orcinus orca*) and sperm whale (*Physeter macrocephalus)*.

Four of the confirmed species in the study area are threatened. For example, the sei, blue and fin whales are endangered (EN) in Argentina, but the fin whale is only vulnerable (VU) at a global scale (IUCN). The sperm whale is vulnerable in both categories, while the bottlenose dolphin is vulnerable for Argentina, but it is not threatened globally. Although it has a low probability of presence in the study area, the sei whale (*Balaenoptera borealis*) stands out, as it is considered endangered.

According to the bibliography surveyed, the project area would be mainly a transit area and a seasonal feeding site. It would not be a breeding area for marine mammals likely to be present in the area. In the case of the two-haired sea lion, it is important to mention that a seasonal colony has been registered in Mar del Plata since 1987; although important concentrations have also been recently observed in Necochea.

The period of greatest presence of the Elephant Seal and the Two-Haired Sea Lion in the analyzed area is the spring and summer season. The sperm whale and the pilot dolphin also appear during spring and summer. The Right Whale has not been registered during the summer months, although it can be seen during the autumn, winter and spring seasons.

Protected Areas

As part of this item, environmentally sensitive areas were analyzed, which are generally protected, (or are proposed to be) by means of some legal tool for conservation purposes.

Argentina has 61 coastal marine protected areas (APCM), including national parks, provincial and municipal reserves, biosphere reserves (MaB) and Ramsar sites. The Legal instruments for the creation of these areas are also diverse: municipal ordinances, provisions, resolutions, decrees, Provincial and National Laws and, the Provincial Constitution when it comes to the Province of Buenos Aires. The APCM are registered within the Federal System of Protected Areas (SiFAP).

Given that the project´s operating area is more than 300 km from the coastal zone, the interaction with these protected areas is negligible. In this sense, only the National Protected Areas (NPA) near the support port of Mar del Plata are considered in the analysis, this being the only sector where some interference could eventually be registered. The National Protected Areas identified in the vicinity of said port are: Natural Reserve of Defined Geological and Faunal Objects “Restinga del Faro” and Natural Botanical, Faunistic and Educational Reserve “Puerto Mar del Plata”.

As hereinbefore mentioned, there is a settlement of sea lions in the Port of Mar del Plata. The species was declared a Natural Monument of Mar del Plata in 1994, through Ordinance 9440. This establishes the prohibition of any action or omission that directly or indirectly implies mistreatment, damage, catch or captivity of the specimens, unless justified otherwise. The most outstanding characteristic of the colony is that only male specimens prevail, which mate on the Uruguayan coasts, and can be seen throughout the year.

A situation similar to that stated for the CMPA occurs in the case of areas of importance for the conservation of birds (AICAS), which correspond to terrestrial or coastal zones, not encompassing the marine environment. Three AICAs have been identified in the project's coastal area of influence (defined by the Port of Mar del Plata): Estancia Medaland, "Mar Chiquita" Biosphere Reserve, "Punta Mogotes" Beach and Port of Mar del Plata. This last AICA is inserted within the area of direct influence of the logistics route of the vessels that are going to operate.

Considering that there are particular situations requiring special treatment, Dellacasa et al., (2018), 55 Marine AICAS were defined in Argentina after having considered the different activities and life stages of seabirds (for example breeding, feeding, maintenance and migration). These are also limited to coastal areas, so they do not present a risk of being affected by the project. In this sense, only the marine AICA “Boca de la Albúfera de Mar Chiquita”, close to the Port of Mar del Plata, is considered. In relation to the Pelagic marine AICAs, the area called “Aguas del Talud Patagonia Norte” stands out, which shall be crossed by the logistics route that connects the Port of Mar del Plata with the CAN_114 Area.

The identification of Priority Aquatic Areas (AAP) was carried out in the Río de la Plata and its Maritime Front within the context of the FREPLATA Project (2004). The Southern Slope Front is the closest highest priority core area, which is nevertheless located 250 km from the seismic survey area, so it shall not be affected. The APP containing it is the Slope Edge located 93 km from the CAN_114 seismic data acquisition area and therefore overlaps only marginally with the area of indirect influence of the prospecting areas. On the other hand, the "Costa Atlántica Argentina" APP is located in the area of influence of the port of logistical support and the logistics route, while the logistics route of the ships crosses the "Banco de Mejillones" APP.

Marine protected areas (MPAs) are one of the most powerful tools to prevent the overexploitation of resources and the degradation of marine habitats. According to the Convention on Biological Diversity and the UN Sustainable Development Goals to which Argentina has adhered, at least 10% of its marine surface must be protected by 2020.

The future marine protected areas proposed in Argentina are relevant sites for the biodiversity of the Argentine Sea, but they do not have creation proposals for now. The closest to the prospecting area is the Slope Front (FT), located 30 km from the prospecting area (and 17 km from the direct area of influence). Therefore, it is situated in the indirect area of influence of the seismic acquisition site. The Middle Platform Front (FPM) is located 114 km from the prospecting areas and outside its area of influence. The "Profundo" and "El Rincón" RCP are at longer distances. Both the Slope Front (FT) and the Middle Platform Front (FPM) shall be crossed by the logistics route that connects the CAN_114 Area with the Port of Mar del Plata.

5.4 ANTHROPIC ENVIRONMENT

Due to the offshore nature of the seismic survey project, the analysis of the anthropic environment was focused on its area of influence and its socio-economic use, including the Port of Mar del Plata, which has been defined the logistical support port for the Project. The CAN_100-CAN_108 Area is located more than 300 km from Mar del Plata and the CAN_114 Area is more than 440 km from Necochea.

The CAN_100-CAN_108 Area is within the Exclusive Economic Zone (EEZ), while Area 114 remains outside, but within the jurisdiction of the National State, as is the case of the Continental Shelf, duly measured and explored, in accordance with the requirements of the CONVEMAR[2].

[2] Convención del Derecho del Mar (Convention on the Law of the Sea).

Administrative and Political Context

As already mentioned, the CAN_108 and CAN_114 study areas correspond to the International Offshore Public Tender N ° 1 (Round N ° 1) for the award of hydrocarbons exploration permits in the Offshore areas of National scope; and, the government authorized YPF to assign 50% of the offshore exploration permit for CAN_100 to EQUINOR through Resolution 55/2020 of the Ministry of Energy.

Nearby coastal towns

The CAN_100-CAN_108 Areas under study are approximately 310 km from the coast of the City of Mar del Plata. This city is located southeast of the province of Buenos Aires, on the coast of the Argentine sea. It is the main city of "General Pueyrredón" district, an important port and seaside resort; and the second most important tourist city at the country level, following the Autonomous City of Buenos Aires, since it can increase its population density by 300% during the summer. Its main industries are fisheries, tourism and textiles.

The "CAN 114" Area is located more than 400 km from the coast of the City of Necochea, located south of the province of Buenos Aires, on the Atlantic coast. It is the main city of the homonymous district, with wide beaches and an important port located at the mouth of the Quequén Grande River and the Argentine Sea. It is also a tourist center during the summer months, but on a considerably smaller scale than the aforementioned City of Mar del Plata.

Port of Mar del Plata

Although the seismic data acquisition areas are located in the maritime zone, the Port of Mar del Plata shall be the land support for very specific activities: crew changes and supplies. It is located on the Argentine Sea, on the coast of Mar del Plata, Province of Buenos Aires. The Mar del Plata Regional Port Consortium, a non-state public entity, is in charge of its administration. On the other hand, the Argentine Coast Guard in its Mar del Plata branch is in charge of providing security.

It has two well-differentiated sectors: a purely military area that encompasses the properties and facilities surrounding the Mar del Plata Naval Base (under the jurisdiction of the Mar del Plata Coast Guard); and the commercial part that covers the rest of the port area where most of the fishing activity takes place, but it is also registered in the oil, cereal and tourist exploitation sectors.

Surface inspection and exploration Licensees

There are other blocks bordering those that involve CAN_100 - 108 and CAN_114 acquisition areas under study, which have also been part of the Offshore International Public Tender No. 1. CAN_100 and CAN_108 blocks adjoin CAN_105, 106, 107, 109 and 110 blocks. The CAN_114 block borders CAN_111, 112 and 113 blocks.

The CAN_107 and CAN_109 blocks were granted to Shell Argentina SA group and Qatar Petroleum International Limited, with the oil company Shell being the operator holding 60% stake in the consortium. Both Shell and Spectrum (now TGS) have submitted project notices for seismic exploration activities in these areas according to information provided by the Ministry of Environment and Sustainable Development (MAyDS). According to communications between Equinor and Shell, the latter aims to begin the seismic acquisition in the aforementioned blocks during the last quarter of 2021.

On the other hand, CAN_111 and 113 blocks were granted to Total Austral SA and BP Exploration Operating Company Limited, each holding a 50% stake each. The seismic data acquisition process of the CAN_114 area includes a marginal sector of the CAN_113 Area. In turn, the CAN_114 operational area involves a sector of the CAN_111 boundary block where vessels shall make turns, maneuvers, etc. without operating seismic sources. Equinor holds the permit by which Total Austral SA authorizes to carry out the aforementioned operations in the CAN_111 and CAN_113 blocks. According to the communications between Equinor and Total, the latter would have planned to carry out the seismic acquisition in blocks CAN_111 and CAN_113 during 2022, so it would not overlap with Equinor's activities planned for the first quarter of 2022.

The tender for CAN_105, 106, 110 and 112 blocks was declared void as no offers were received for those areas.

Navigation

Navigation in the area of the Port of Mar del Plata presents a high intensity, as is to be expected, since it is the place of entry and exit of ships. With respect to the seismic data acquisition area corresponding to the CAN_100, CAN_108 and CAN_114 areas, a generally moderate density is considered as regards maritime traffic.

Regarding the type of vessels that can be seen in the area corresponding to the navigation routes that connect the Port of Mar del Plata and CAN_100-108 and 114 seismic data acquisition areas, fishing boats (fishing vessels) followed by tankers and cargo vessels prevail. To a lesser extent, there are also tugs and special crafts, some unspecified ships and passenger vessels only in the area corresponding to the Port of Mar del Plata.

Fishing activity

The fishing activity is of great importance at the regional level in most of the cities located along the Argentine sea coast. Employment opportunities and activity thereof can be highlighted; as well as its exports derived from the foreign exchange.

In the first instance, there is an extractive stage of catch (primary sector). The commercial fishing activity began very incipiently in the province of Buenos Aires at the end of the 19th century, based on beach and boat fishing. Then it moved south progressively. The activity presents fluctuations, which originate both in the maximum catches defined by the Federal Fisheries Council for the main fisheries, as well as in the abundance of resources for those species without maximum allowable catch and in international demand. Marine catch fisheries account for around 98% of the national fish production. The port in which the highest percentage of landings of maritime catches is concentrated is the Port of Mar del Plata (53%), where an important fresh fleet operates, followed by the Patagonians: Puerto Madryn (16%), Puerto Deseado (10%) and Ushuaia (6%), where the freezer fleet operates almost exclusively.

There is a later stage of processing the extracted resources (secondary sector), which can be carried out in processing plants on land or on board freezer vessels. There were 140 processing plants and cold stores for fishery products authorized to export to the European Union from Argentina during 2019, which were operated by 127 companies. These onshore facilities offer a wide variety of products. The following industrial processes are carried out for fish and shellfish in General Pueyrredón district: fresh or chilled and frozen, salted, canned and elaboration of fish flour and oils. The largest number of plants are located in the province of Buenos Aires, mainly in Mar del Plata (63%) where most of the landings of the fresh and coastal fleet are carried out (72% up to 2014) to be processed at the factories, as well as almost all of the fresh fish products directed to the domestic market.

Finally, the commercialization (tertiary sector) of the fishing resources is carried out. Domestic demand is very limited with production destined predominantly for export. The main destination markets have maintained some stability. The European Union (EU), mainly Spain, has been the main destination for Argentine exports of fishery products followed by China, Brazil, the United States and Japan; shrimp being the main exported product.

The jobs related to sea fishing in 2018 were close to 23,000, where the majority (60%) is concentrated in coastal and deep-sea fishing activities (including in factory vessels), then 40% of them is assigned to the processing industry and 10% to labor contractor services. Most of the workers are men. With regard to salaries, workers in the sector are above the average of what is received by registered employees in Argentina. Historically, the salary in the Primary Sector has been higher than in the Secondary Sector, however, the crew do not generally receive a basic salary, but it is established according to the catches of the vessel.

Hydrocarbon Activity

Argentina has an extensive submarine platform with great potential for hydrocarbon resources; However, the offshore is one of the least explored areas of the territory which, if exploited, would expand the horizon of gas and oil reserves to a global scale.

The International Offshore Public Tender N ° 1 (Round N ° 1) is the largest tender in the last 30 years as reported by the Secretary of the Government of Energy.

There are no hydrocarbon wells, pipelines or concession areas within the study area beyond those previously tendered; however, there is a record of the existence of 2D exploratory activities. According to the information gathered, only the extensive campaign of 2018 (identified with the date 5/5/2018) by the company SPECTRUM ASA SUCURSAL ARGENTINA (now TGS), involved the seismic acquisition areas targeted in this study. Two more recent campaigns of lesser extension are close to these areas. The one identified on 10/11/2019 was located immediately west of the seismic data acquisition area of the CAN_100-108 areas and the 2020 campaign identified on 1/2/2020 was located northeast of the CAN-114 area.

Infrastructure

Numerous communication cables have been laid on the Argentine sea front, linking Argentina, Uruguay and other worldwide countries. Most of them are located under sediment, although in some cases cables rest on the sea floor. Currently, eight active cables in the Argentine EEZ can be seen in the cartography: “ARBR”, “Atlantis-2”, “Bicentenario”, “Malbec”, “SAm-1”, “SAC”, “Tannat” and “Unisur”. In this case, the project's operational area is approximately 400 km south of the underwater cable “Atlantis-2”, which is the southernmost of all the cables present in the area.

Stakeholders

Disclosure of information and an open dialogue with potentially affected communities and other impacted interested parties, are key elements in all impact assessment processes undertaken by Equinor.

The main purpose of the stakeholder participation process, including the public hearing that shall be facilitated by the Convening Authority, is to identify the possible environmental and social contributions of the relevant actors and the probable concerns, related to the seismic survey planned by Equinor in the CAN_100, CAN_108 and CAN_114 licenses and, where appropriate, integrate this feedback into the Environmental Impact Assessment (EIA).

Equinor carried out extensive research and analysis of potential stakeholders related to the planned offshore seismic programs in Argentina, in order to identify stakeholders in a global perspective, and based on detailed analysis of the information collected, also spot key stakeholders with whom Equinor must proactively engage, prior to the approval of the EIA.

A comprehensive registry was developed identifying stakeholders in nine main categories and, in turn, analyzing their supposed level of interest in the project, their supposed level of influence on the project, and their probable attitude towards the project (against, neutral or positive).

The full list of potential stakeholders compiled from the research contains a broad spectrum of over 100 participants, which has been useful as a database for further analysis and an assessment to define 'key stakeholders'.

Equinor shall consult with 'key players' by proactively communicating with people directly affected or with a specific interest in the project area, and shall organize meetings where relevant to do so. It shall also reveal information about the project to all interested parties by establishing a web page with related information, and documenting the activities conducted along with comments from stakeholders.

The consultation with key actors started early to analyze their input and enable identification of potential risks and impacts at an early stage to subsequently cater for improvement of mitigating actions. Replies have been received from eight interested parties. It has proved difficult to reach stakeholders due to a challenging Covid-19 context. Therefore, EQUINOR decided to use email and video conferencing as the main channels.

Outreach and dialogue with stakeholders shall be an ongoing process of two main phases: **First**, the consultation of key stakeholders before obtaining the final approval of the EIA (completed stage), then the communication activities until and after the Public Hearing. **Second**, monitoring and communication with key stakeholders after the approval of the EIS: prior to commissioning, reporting on time and location, defining communication protocols with key stakeholders; **during operations**: periodically updating information on the operation and location of the vessel, notifying and coordinating in case of incidents or emergencies; **and after operations**: reporting on the end of activities.

Equinor shall follow a stepwise and dialogue-based approach throughout all phases of the project. The aim is to continuously evaluate our outreach and activities directed towards interested parties, take learnings and implement them in our plans moving forward. In turn, a complaints and claims management procedure shall be set up in order to receive, investigate, respond to, and resolve complaints from individuals or communities or their representatives, who are related to Equinor operations, its contractors and subcontractors. It shall be designed to resolve grievances in a transparent, systematic and timely manner.

6. ACOUSTIC MODELING

The project to be carried out implies the temporary affectation of some natural characteristics of the study area, particularly the noise derived from seismic recording activities.

For the purposes of the potential acoustic impact, a numerical modeling was carried out enabling the assessment of sound intensity loss by transmission depending on the conditions of sound speed for different profiles of salinity and temperature of the water within the study area, as well as the depth and seabed characteristics.

Next, the main emission characteristics of the seismic arrangement are presented and the main aspects and results of the modeling carried out are summarized.

First, the parameters and metrics used for the analysis are briefly described, whose rigorous definition is provided in Chapter 4.

6.1 UNDERWATER SOUND EMISSION FROM COMPRESSED AIR POWER SOURCES

Glossary of terms and metrics

The source force is the maximum acoustic pressure radiated by a marine seismic source measured in Bar-m, 1 m from the source.

Since human and animal hearing aids perceive a very wide range of pressures, sound is measured on a scale based on the logarithm of the ratios between measured pressures and a reference pressure. The decibel scale (dB) relative to 1 microPascal (1 μPa) is used to indicate the sound pressure level (Sound Pressure Level – SPL).

The peak-to-peak pressure (pp) value of the source expressed in Bar-m can be converted to the sound level of the SPL source in dB re 1 Pa-m as follows:

SPL (dB re 1μPa-m) = 20 log (p-p) + 220

The zero-peak (0-p) acoustic pressure represents the amplitude measured between zero and the positive peak, which is 6 dB lower than the pressure (pp) if the positive and negative peaks are equal in intensity.

Given that the thresholds of affectation to the biota are expressed according to zero to peak acoustic pressure, all the analysis shall be carried out using SPLpeak metric.

The Sound Exposure Level SEL (Sound Exposure Level) is a measure of the energy of an acoustic signal, so it depends on both its amplitude and its duration. Its SEL units are dB re 1μPa2s. It is a useful metric for evaluating cumulative exposure. Although the units of the SEL and the SPL are different, the numerical value of the SEL is typically 20 to 25 dB lower than that of SPLpeak.

Emission characteristics from seismic prospecting arrays

Most of the sound energy produced by a series of shots amounts to 10-300 Hertz (Hz), with the highest levels at frequencies below 100 Hz. The array's Far Field Signature (FFS) is the observed theoretical signal output from a recorded source in an infinite body of water.

The theoretical signatures of the sources are then propagated at an arbitrary distance of 9,000 m below the source matrix and are added up to represent a specific source at that far-field position, where the output signals of individual compressed air power sources constructively interfere. This expands backwards to obtain the theoretical wave form 1 m away from the source, taking into account the sound pressure fall rate according to the distance. This nominal point source level is a theoretical sound pressure level. Due to partial destructive interference between signals from individual compressed air power sources, the actual level at this point actually tends to be 10 times (20 dB) lower than the nominal level.

Air source arrays for seismic exploration are designed so that most of the energy is directed vertically towards the seabed (desired effect), although some energy is horizontally directed (undesired effect). The levels emitted vertically are between 15 and 24 dB higher than those directed horizontally.

Frequencies corresponding to thirds of octaves are used for sound energy propagation analyzes. An octave is the interval of frequencies between a given frequency and twice that, and to calculate thirds, the segment representing an octave on a logarithmic scale is divided by 3.

The marine environment is affected by natural and anthropic sounds from various sources and a wide range of frequencies, some of which coincide with the emission range of seismic arrays, but with relatively lower intensities, which do not contribute significantly to SEL accumulation.

Submarine sound emission from the compressed air sources to be used

The typical concentrated type array of “Triple” compressed air energy sources considered for the preparation of this study presents the following emission characteristics.

Table 1. Features of Triple Compressed Air Power Source Array.

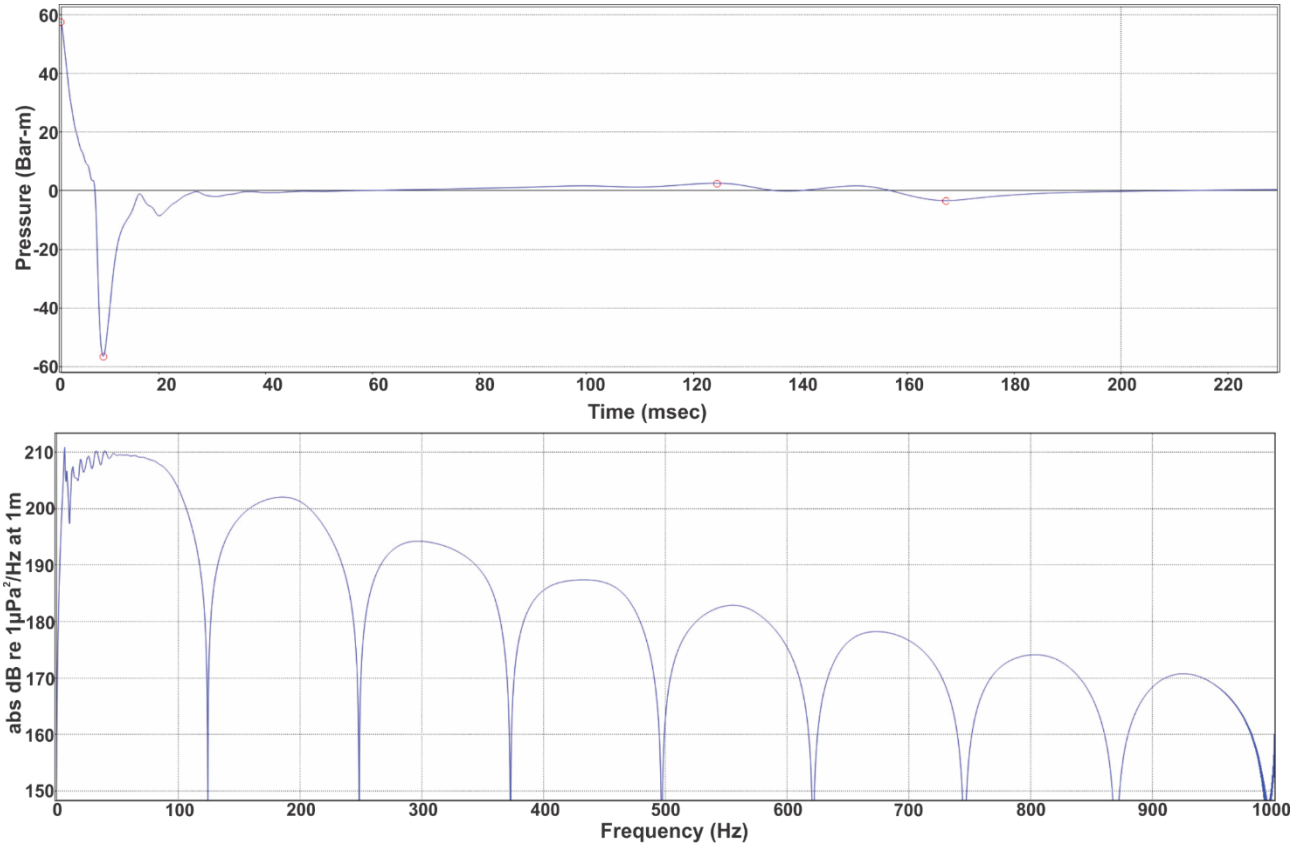
Number of subarrays	3	
Number of Sources per sub-array	20 + 2 spare	
Source working pressure	2,000	Psi
Total Source Volume	3,280 / 53.75	cu.in. (cubic inches) / liters
Distance between emission points	15	meters
Interval between emission points	6.5	seconds
Vessel speed during emission	4.5	knots
Energy Sources: 0 to peak	57.5	Bar.meters
Depth of the Sources	6	Meters

The total sound energy emitted by the Triple source array, measured 1 m from the source, is then equal to:

SPLpeak = 20 log (57.5 0-p Bar.m) + 220 = 255.2 dB re 1µPa-m

According to the recommendation of the European Community, “Monitoring Guidance for Underwater Noise in European Seas” - Part II (Dekeling et. Al, 2014) the Triple array is classified as a High Level source, as SPLpeak is above 253 dB re 1µPa -m.

The acoustic signature of the array in the time domain and the spectrum in the frequency domain up to 1 kHz are illustrated in Figure 7. The maximum emissions approximately occur between 5 Hz and about 100 Hz in frequency, then the maximum values decline.



Far Field Signature Time and Amplitude spectra for the Triple Source. Far Field is computed at a distance of 9000m in the inline direction(Azimuth = 0) and directly below the source array (Dip = 0).
Primary 57.5 Bar-m, Peak-Peak 114 Bar-m.

Figure 7. Vertical acoustic signature of the 3,280 cu.in. Triple array spectrum.

The energy distribution in frequency for 3 different Azimuths is shown by Figure 8 in two-dimensional form, 0º (forward direction), 45º and 90º (direction perpendicular to advance). The values are relative to the maximum corresponding to Azimuth 0º and vertical direction. The angles indicated on the edges of the semicircles belong to the vertical direction (below the array), where the 90º (horizontal) direction has very low energy.

Figure 9 illustrates the angular distribution of energy per octaves between 32 Hz and 1,000 Hz in polar form. The angles indicated on the edge of the circles are the Azimuths relative to the direction of the ship´s progress. The radial distances represent the angles from the vertical (in the center) to the horizontal (in the periphery), where the weakening of the energy with the angle (Dip) can be appreciated. The center of the circle represents a 0º angle, and each successive circle represents 30º, 60º and 90º.

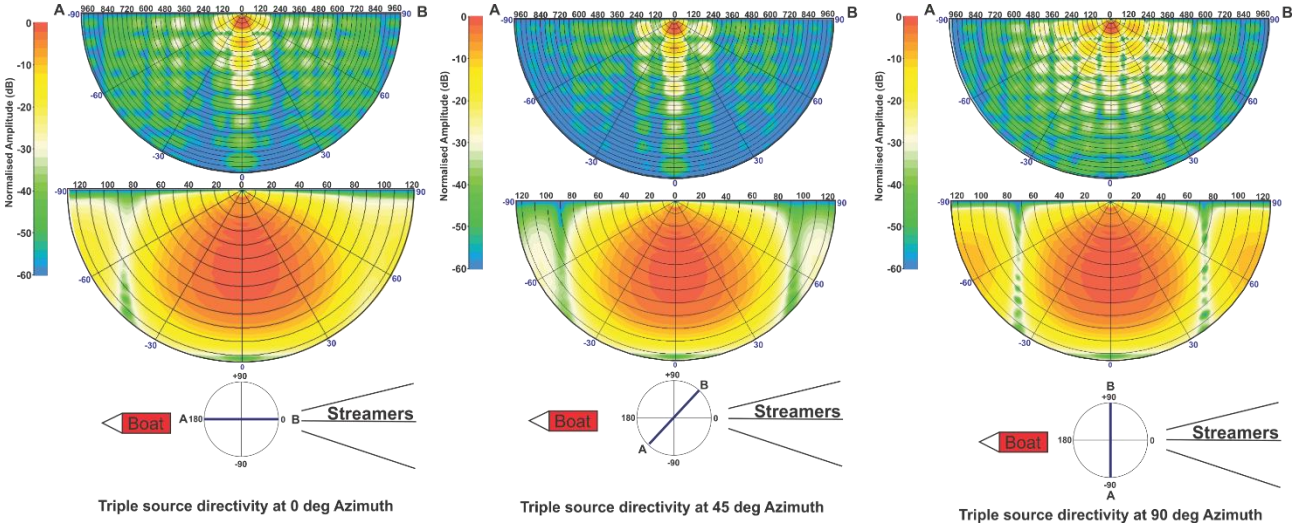


Figure 8. 2D spectra for different Azimuths as regards the direction of advance of the survey for the Triple array of 3,280 cu.in.

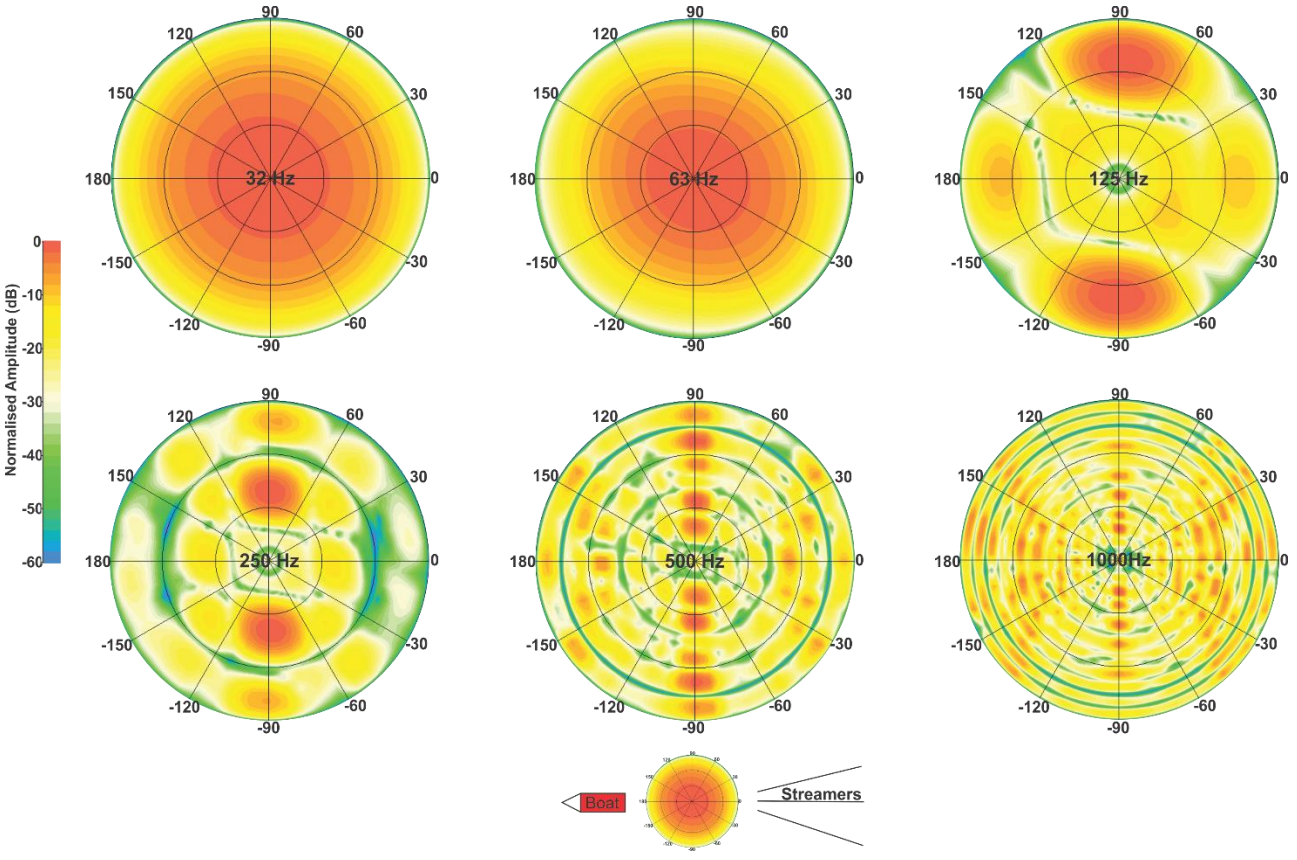


Figure 9. Polar graphics of angular distribution of sound energy for frequencies in octaves.

The following figures illustrate the spectra emitted for (Azimuth) 0º (forward direction) and 90º (perpendicular direction) directions, and for angles with (Dip) 0º vertical, 70º (20º from the horizontal), 80º (10º from the horizontal) and 90º (horizontal). The Units are dB re 1 µPa^2 /Hz a 1 m.

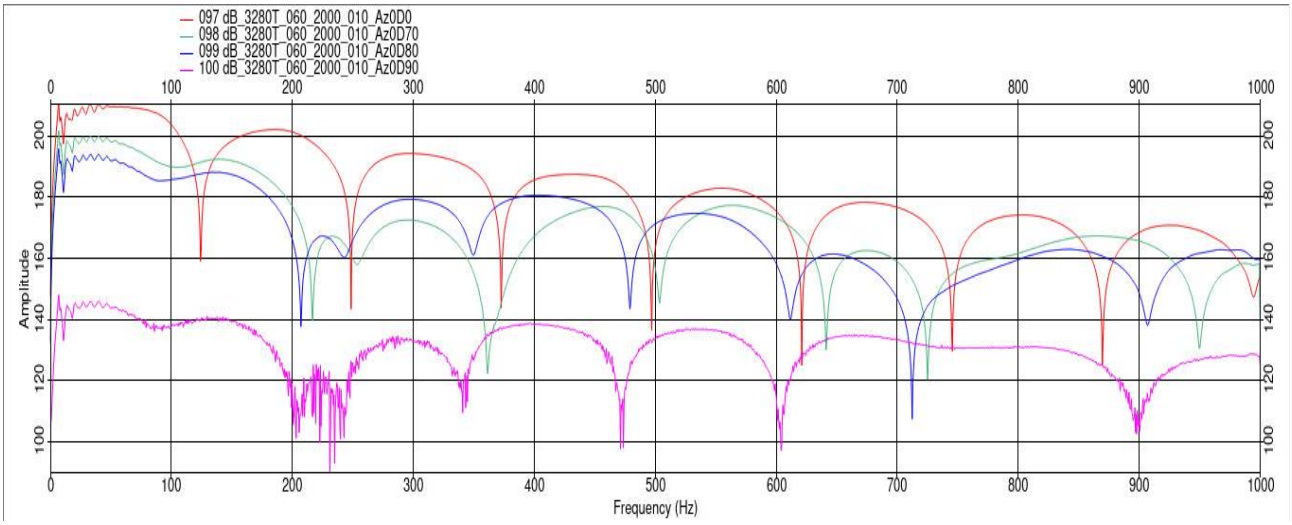


Figure 10. Energy spectrum for different angles with the vertical and with 90º Azimuth regarding the advance direction for the 3,280 cu.in array.

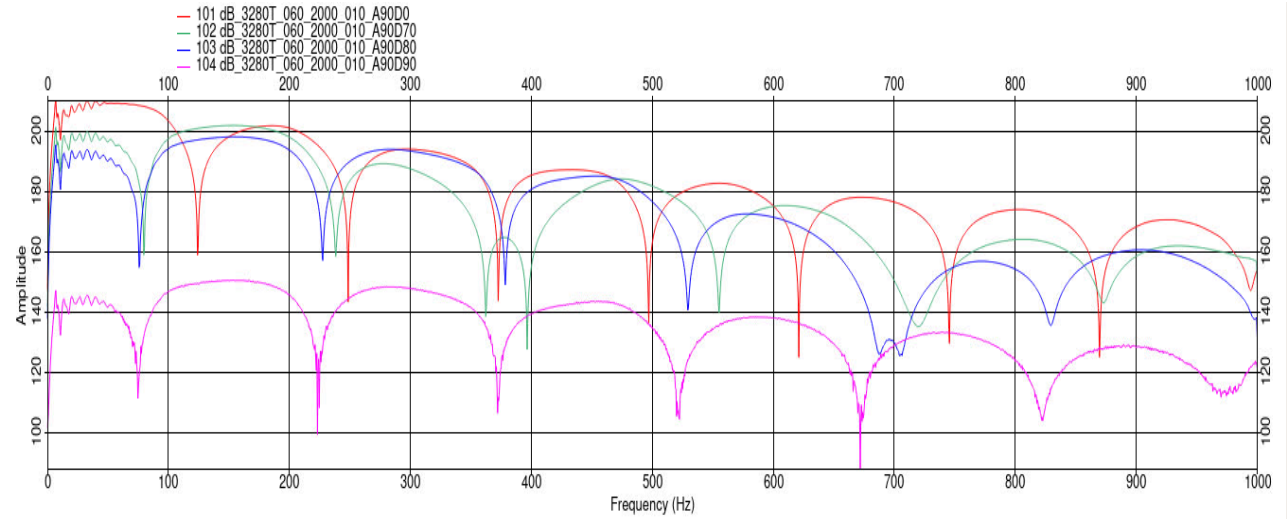


Figure 11. Energy spectrum for different angles with the vertical and with 90º Azimuth regarding the advance direction for the 3,280 cu.in array.

It can be seen that the energy emitted horizontally is practically negligible compared to that emitted vertically (about 40 to 60 dB lower depending on the frequency). On the other hand, the energy emitted with 10º and 20º angles with respect to the horizontal, presents smaller amplitudes but closer to that emitted vertically, which allows to verify the difference between the energy radiated in the vertical direction and that radiated in the horizontal direction, which it is usually considered to be about 20 dB.

Vertically speaking, the energy is 85% concentrated up to 120 Hz and 95% up to 210 Hz.

There is a strong decrease in SEL as the angle increases with respect to the vertical "Dip" (that is, it approaches the horizontal) while the frequency distribution of the energy is broadened to cover higher frequencies as the direction of emission is more horizontal.

In the case of 90º Azimuth, the total energy is greater than that for 0º Azimuth and there is a greater participation, between 200 and 300 Hz in the percentage of energy for higher frequencies.

The maximum values of total SEL are shown in Table 2 according to the angle with respect to the vertical and the Azimuth regarding the advance direction.

Table 2. Total SEL (dB re 1 µPa2s at 1 m) emitted for different angles with respect to the vertical and Azimuth regarding the advance direction.

Angle from vertical (Dip)	0º Azimuth (forward direction)	Difference with vertical for 0º Azimuth (dB)	90º Azimuth (perpendicular)	Difference with vertical for 90º (dB) Azimuth	Difference 0º Azimuth - 90º Azimuth (dB)
0º (vertical)	232.02	-	232.02	-	0
70º (20º horiz.)	220.69	11.33	225.70	6.32	-5.01
80º (10º horiz.)	215.34	16.68	222.61	9.41	-7.26
90º (horizontal)	168.89	63.12	175.79	56.23	-6.90

It should be mentioned that the SEL value equal to 232.0 dB re 1µPa2 s at 1 m represents the energy contained in the entire vertical emission spectrum, while the maximum value of 210 dB re1 µPa2 / Hz at 1 m is shown in the different figures for 0ºAzimuthh which represents the spectral value of SEL with reference to 1 Hz at the maximum frequency, so they correspond to different physical quantities that should not be compared with each other.

The difference between the “nominal” value of the total SEL emitted vertically (232.0 dB re 1µPa2 s at 1 m), calculated by integrating the corresponding energy spectrum, and the total value of SPLpeak previously calculated from the emission in Bar. m of the array (255.2 dB re 1µPa at 1 m), equals 23.2 dB.

Figure 12 presents the spectral signature of the Triple array, corresponding to the energy accumulated in the bands of thirds of octaves for 0 Azimuth (in the direction of advance of the array), on a logarithmic scale. Figure 13 presents the same information for the 90º Azimuth.

Figure 12. Energy per octave for different angles in 0º Azimuth (forward direction).

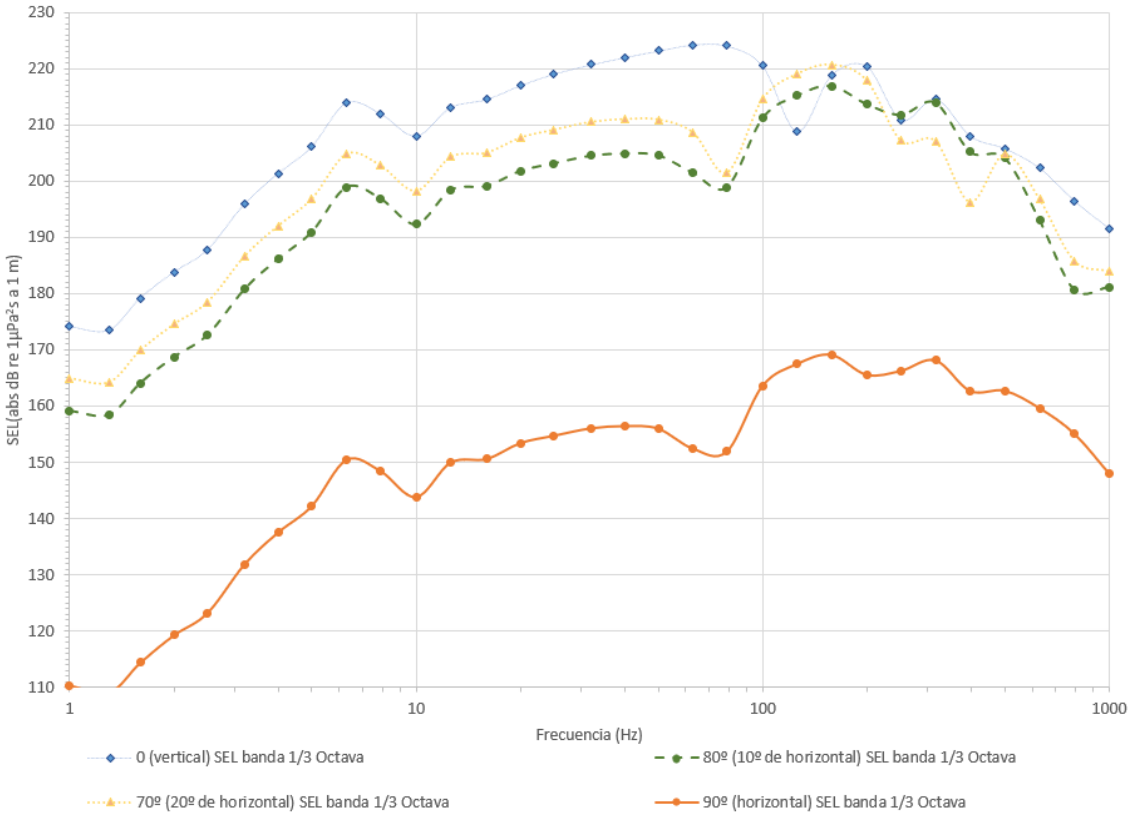


Figure 13. Energy per octave for different angles in 90º Azimuth (perpendicular to the advance).

6.2 METHODOLOGIES FOR ASSESSING SOUND DISPERSION IN WATER

Transmission Loss (TL) expresses the decrease in acoustic energy or the weakening of the signal as it propagates through a medium, from a point located on the acoustic axis of the source, at 1 m from its "center", and a distant point (at R distance).

Transmission Loss includes all the effects inherent to the propagation of sound at sea, each of which is very complex, comprising the following:

a) Spreading or geometric dispersion, which consists of the enlargement of the wave front with the distance;
b) attenuation, which includes chemical absorption, scattering, viscosity and leakage out of the sonic channels, among other phenomena.

When sound can constantly propagate without obstacles or interactions in all directions, TL is calculated by the spherical expansion expression:

$$TL_{esferico}(dB\ re\ 1m) = 20.log(\frac{R}{1m})$$

When the distance R ≥ H (where H is the depth of the water), the sound cannot propagate in all directions as a spherical wave, but rather as a cylindrical wave that is limited by the seabed and the sea surface. In this case, TL can be calculated by replacing the 20 factor in the above formula with 10. In certain cases, the spread can be close to an intermediate pattern, represented by a 15 factor in the formula.

In this study, the three theoretical Transmission Loss patterns are represented in the graphs only as a frame of reference. At distances less than the depth of water, the propagations are usually similar to those of the spherical type, while they are more similar to an intermediate propagation for greater gaps.

When sound is transmitted in water, attenuation occurs because the vibration of the water molecules generates heat, dissipating energy by other processes due to the absorption of the environment, the dispersion or scattering of the waves by the suspended particles. It has been contemplated in this process although it is irrelevant when frequencies are below 10,000 Hz.

The bouncing of sound on the seabed can extend the range of propagation of sound waves, as it returns the sound energy that had been carried there by refraction through the water, allowing longer-range transmissions.

At low frequencies, part of the energy penetrates the sediment layer at the bottom of the sea and from here it is refracted back to the boundary between the water and the sea floor, where it returns to the water. This refraction from the seabed, which is not a reflection, is the predominant energy return mechanism. At medium or high frequencies (greater than 1000 Hz), reflection is the predominant energy return mechanism since the wave is reflected in the sediment layer of the seabed without penetrating it.

From the spectrum of sound energy or Sound Exposure level (SEL) at 1 m from the source for a given SL frequency (Source Level in dB re1µPa2 / Hz re 1 m) and knowing the TL (R) (dB re 1 m) Transmission Loss at a certain R distance from the source, the received RL level can be calculated by the following simple expression:

RL (dB re 1µPa^2 s/Hz re 1 m) = SL – TL (R)

This expression is also valid to evaluate the Sound Pressure Level SPL at the R distance from the source, starting from the value at 1 meter.

In order to model the transmission of sound in water, the Range-Dependent Acoustic Model "RAM" was used, which utilizes the parabolic equation (PE) method, which is very effective in solving oceanic acoustic problems that depend on the range (that is, they are spatially variable).

6.3 ACOUSTIC THRESHOLDS AFFECTING MARINE MAMMALS AND FISH

The different sound thresholds that can cause hearing losses considered for impact assessment are summarized below in order to define the sound distances with higher values.

These thresholds correspond to hearing losses in marine mammals called threshold shifts (TS), which can be permanent (PTS) or temporary (TTS).

- Permanent Threshold Shift (PTS) is a permanent and irreversible increase in the threshold of audibility at a specific frequency or portion of an individual's hearing range above a previously established reference level. This is considered a hearing loss.

- Temporal Threshold Shift (TTS) is a temporary and reversible increase in the audibility threshold at a specific frequency or portion of an individual's hearing range above a previously established reference level.

In the case of fish, the proposed threshold sensitivity values are considered for those with and without a swim bladder, regarding the level of mortality or potential mortality.

As proposed by Southall (2019), a dual “metric” is considered to define the impact thresholds, corresponding to the peak SPL values whose total value is 255.2 dB re 1µPa-m, and to the SEL values accumulated during a certain period of exposure to noise emissions.

The codes used to differentiate the auditory groups of marine mammals are summarized in the following table, and are detailed in the chapters of the impact assessment.

Table 3. Hearing groups and their hearing ranges

Code	Group	General Hearing Range
LF	Low-frequency cetaceans	7 Hz to 35 kHz
HF	High-frequency cetaceans	150 Hz to 160 kHz
VHF	Very High Frequency Cetaceans	275 Hz to 189 kHz
PW	Phocidae Carnivores	50 Hz to 86 kHz
PO	Otariid pinnipeds and other carnivores	60 Hz to 39 kHz

In order to estimate the SEL accumulated in successive emissions, the emitted SEL value is “analyzed” by subtracting the level corresponding to the hearing capacity of each species of marine mammals (audiograms).

Table 4 presents the sound values from which situations of auditory impact can be verified by temporary (TTS) or permanent (PTS) shift of the hearing thresholds. SPL pk (SPLpeak) is the minimum exposure criterion for injured mammals, a level at which it is estimated that a single exposure causes a shift in hearing thresholds, and SELcum refers to the sound energy that accumulates over a period of time for a receiver with multiple exposures.

Both are used for mobile and intermittent emission sources: exceeding any of these levels is a sufficient condition to predict TTS or the onset of PTS. These values are also used to estimate safe distances, that is, distances from the source for which a certain threshold is not exceeded, using the isoline that gives the greatest distance for the set of groups that can be potentially impacted.

Table 4. PTS and TTS levels for different hearing groups. Sources: Southall et al 2019. Non-analyzed values are usually used for SPL (pK). The analyzed values for SEL are based on the generalized 7 Hz to 160 kHz. hearing range for marine mammals. An accumulation of 24 hours, or during the actual exposure is considered in the case of SEL.

Code	Auditory Group	PTS start		TTS start	
		SPL pK [1] (not analyzed)	SELcum[2] (analyzed)	SPL pK [1] (not analyzed)	SELcum[2] (analyzed)
LF	Low-frequency cetaceans	219	183	213	168
HF	High-frequency cetaceans	230	185	224	170
VHF	Very High Frequency Cetaceans	202	155	196	140
PW	Phocidae Carnivores	218	185	212	170
PO	Otariid pinnipeds and other carnivores	232	203	226	188

[1] SPL pK (L*p*,0-pk,flat) Re: 1 µPa (flat: non-analyzed values)

[2] SELcum (LE,*p*, 24h) Re: 1µPa^{2}s (analyzed values in 24 hs or during actual exposure)

Very high frequency (VHF) cetaceans are the most demanding category, although their hearing range is above the frequencies with the highest sound intensity emitted during seismic surveys, which range from 5 to 90 Hz.

Regarding fish, the following thresholds for potential mortality and recovery were adopted (Popper et al. 2014):

Auditory Group	**SPL pK (dB re 1 µPa)**
Fish WITHOUT swim bladder	213
Fish WITH swim bladder [1]	207

[1] It includes fish with a swim bladder not connected to the ear and with a swim bladder connected to the ear

Finally, a conventional limit of affectation equal to 190 dB re 1 µPa is cited in the bibliography, which is also evaluated in the study.

6.4 SOFT START PROCEDURE AND RELATIONSHIP BETWEEN SPL AND SEL VALUES

One of the mitigation measures applied in seismic surveys is the so-called “soft start”, which consists of emitting the sound slowly increasing the number of sources, so that the recipient animal has enough time to move away from the array when this begins to emit at its maximum power. According to industry publications, the following measures are implemented during marine seismic survey operations in the absence of operation-specific monitoring and mitigation regulations or requirements:

- Implement a marine mammal exclusion zone of at least 500 m horizontal radius from the center of the array.
- Visually observe the exclusion zone with trained operators for at least 30 minutes before the seismic source is activated:
  - If there are marine mammals within the defined exclusion zone, postpone the start of the soft start procedure until at least 20 minutes after the last cetacean sighting.
  - If no marine mammals are present, initiate the soft start procedure.
- The first stage of soft start involves the activation of the smallest volume element in the matrix.
- Later stages involve doubling the number of active items at the beginning of each stage.
- All stages should have roughly equal lengths of time.
- The total duration of the soft start must be at least 20 minutes, but not more than 40 (or as specified in applicable regulatory requirements).

In order to simulate the soft start procedure as adequately as possible, the evolution of the SPLpeak and SEL was calculated using the Nucleus Software with successive increments of the number of energized individual sources, taking the values obtained to a theoretical distance of 1 m of the "source" (the array).

The results of the Nucleus software were processed for interpretation, showing the values of SEL and SPLpeak through Figure 14 , and the difference between them in decibels.

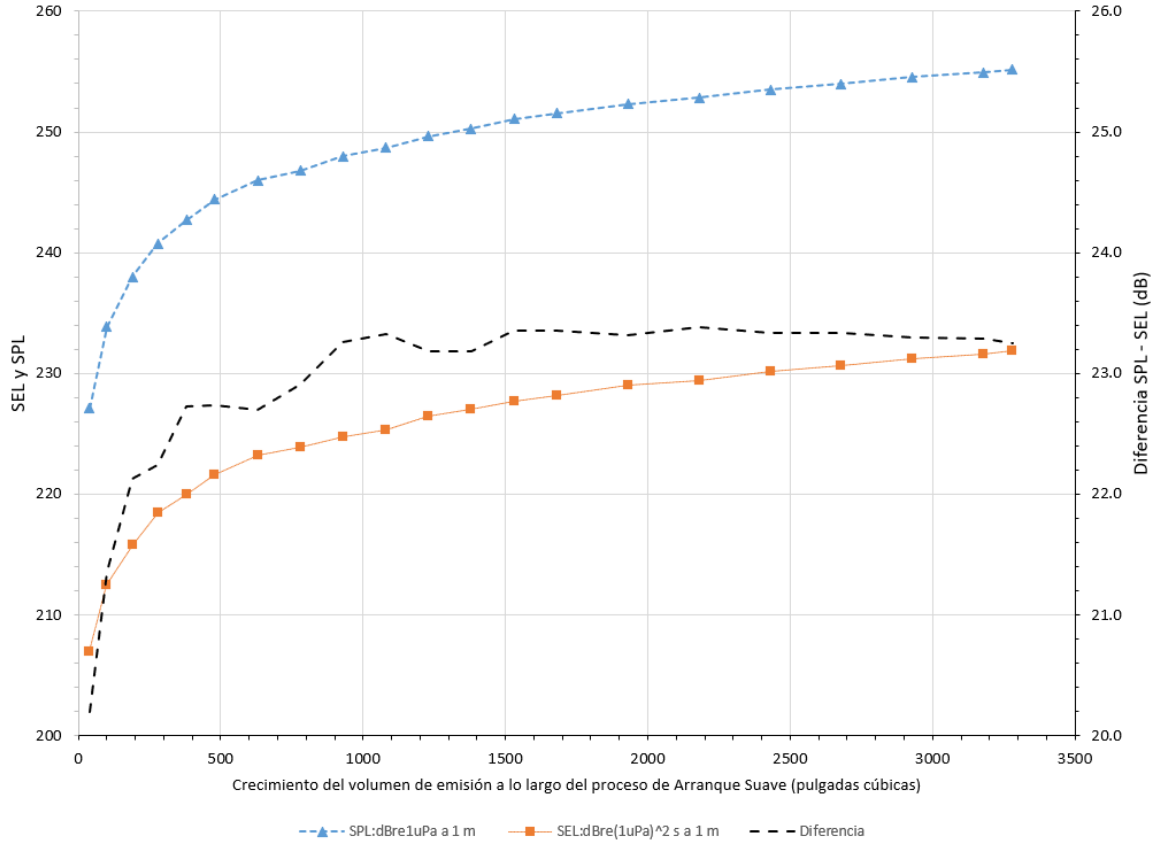


Figure 14. Evolution of the SPL and SELpeak resulting from the increase in the emission volume during the soft start procedure. Note that the units of each variable are different.

The total value of SEL obtained by the Nucleus software at the end of the soft start process is equal to 231.91 dB re 1µPa2 s at 1 m (practically the same as that obtained by integrating the energy spectrum), and the total value of the SPL is 255.16 dB re 1µPa at 1 m (also practically the same as that arising from the calculation with the emission in Bar.m of the array). The difference between both values equals 23.25 dB at the end of the process, reaching a maximum of 23.36 dB in combination 14 when 1,680 cu.in of volume have been activated.

Consequently, the entire sound propagation process shall be carried out considering the SEL, and then the SPLpeak shall be estimated by conservatively increasing the SEL value obtained for each distance by 23 dB.

6.5 MATHEMATICAL MODELING PARAMETERS AND SENSITIVITY ANALYSIS

The parameters of the environment used for the mathematical modeling are presented below.

Five points of analysis with different depths were selected in each of the studied areas (CAN_100-108 and CAN_114), which are described in the Annexes to chapter 6, and the transmission loss was modeled in two transects of variable bathymetry in CAN_100 -108, and a transect in CAN_114, considering both increasing and decreasing depths from different emission points.

The present study was designed so that its results are applicable to the period between October and March, although the sensitivity analyzes show that the results for each month are very similar, so an additional flexibility in the schedule could be considered without modifying the analysis conclusions.

The CAN_100 and CAN_108 areas are located in the Brazil-Malvinas confluence zone, where the cold Malvinas current converges with the warmer and more saline Brazilian current. The temperature and salinity of the water in this area exhibit high spatio-temporal variability. In contrast, CAN_114 Area is located south of the confluence, where oceanographic conditions are more stable.

Annex 1 to Chapter 6 illustrates the temperature and salinity profiles downloaded from the COPERNICUS base, and the profiles of sound speed and water density calculated for different months of the year and 5 points at different depths and geographical location, representing the environment of each area, namely:

CAN_100-108

The following months of the year were considered:

- October and November in the northernmost subzone.
- January, February and March in the southernmost subzone.

The following analysis points were selected:

- SW -1000 Point. 1000 m deep.
- SE-3000Point. 3000 m deep.
- E-4000 Point. 4000 m deep.
- W-1500 Point. 1500 m deep.
- N-2500 Point. 2500 m deep.

CAN_114

The following months of the year were considered:

- October, November, December, January, February.

The following analysis points were selected:

- W-1000 Point. 1000m deep.
- N-1500 Point. 1500 m deep.
- E-3000 Point. 3000 m deep.
- SW-2000 Point. 2000 m deep.
- SE Point. 2500 m deep.

The values of compressional and shear velocities in sediments and sound attenuations vary greatly depending on the type of sediment.

The characteristic parameters of sediments are: p: porosity (%) ρb/ρw: density of sediment over density of water (ρw= 1000 kg / m3), Cp/ Cw: compressional velocity over average sound speed in water (Cw= 1500 m / s), Cp: compressional velocity, Cs= Shear velocity,αp: Attenuation associated with the compressional wave,αs: Attenuation associated with the shear wave. The value of Cs depends on the thickness z of the superficial layer of sediments for silt, sand and gravel.

The seafloor sediment data was obtained from the Atlas of Environmental Sensitivity of the Argentine Coast and Sea (2008), as well as from seabed sediments extracted in the area of interest. The predominant material is mud in the exploration areas, although there are sands in the western zone of CAN_100-108. On the other hand, 10- m sedimentary cores extracted in deep sectors near the exploration areas show the presence of clay.

According to all this information, a z = 15-meter thickness of sludge was initially adopted for the calculation of Cs cutting speed in this area. Sensitivity analyzes show that the results of Transmission Loss are little dependent on the value of this parameter, but it is slightly more conservative to reduce it to 10 meters.

Although the information on the characteristics of these materials is scarce, it has been verified that it is better to consider the sediments that are below this superficial layer since their presence reduces the loss of transmission in the aquatic environment, due to the second "bounce" of sound at the interface between the two materials.

Considering that most of the area would have muds on silty sand and that gravel would be likely to be found in the submerged “canyons” sectors and in contour bodies, two types of underlying materials, that is, sand and gravel were analyzed. Sensitivity analysis to thickness and other parameters of sediments in both layers has also been carried out.

6.6 CALCULATION OF THE MINIMUM TRANSMISSION LOSS

The simulations carried out with the RAM model generate two-dimensional TL matrixes, in depth and distant from the source. Figure 15 illustrates a typical two-dimensional result for SW-1000 point with January oceanographic profile for an 80 Hz frequency. Figure 16 shows the processes of the matrix to obtain the minimum TL in the entire vertical (called TLV (x)) and then the minimum TL according to the horizontal distance (called TLV, H (x)), which is finally presented in Figure 17.

The $TL_{V,H}$ (x) value eliminates the oscillations seen in TLV (x), generating an "upper" envelope that represents the TL lowest (conservative) value that can be found for each distance "x" from the source, and from that distance "x" onwards, up to the assessed 25,000 m.

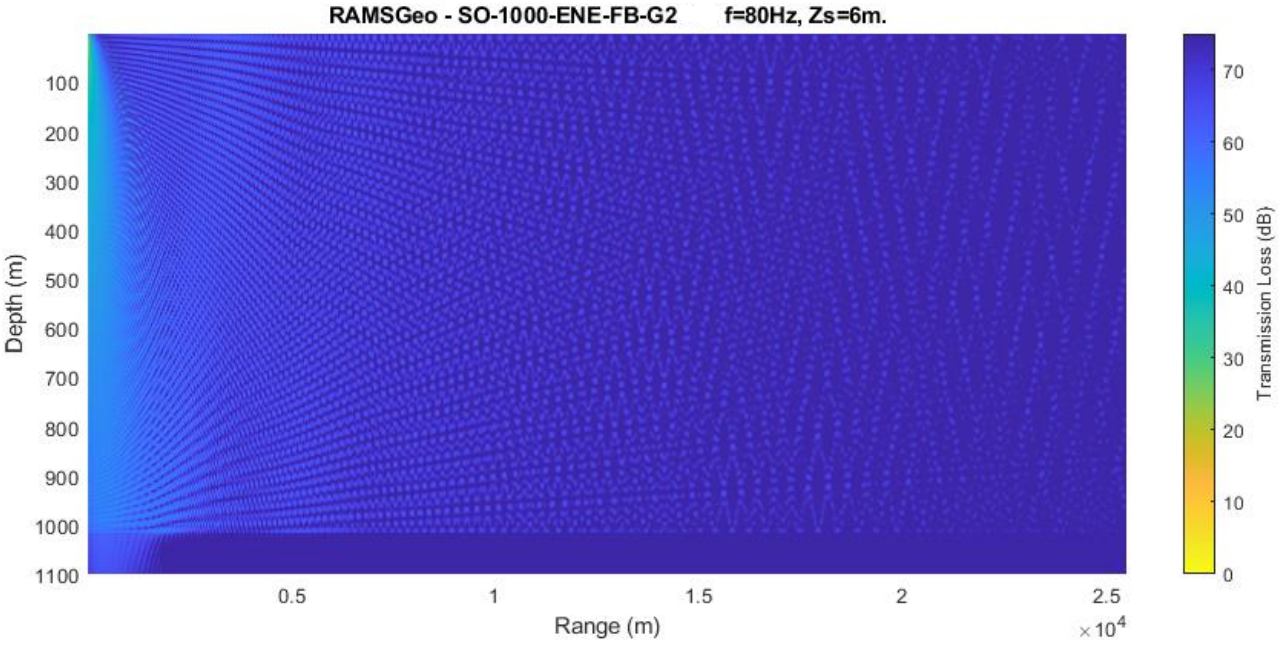


Figure 15. Example of a two-dimensional TL matrix calculated by the RAM model

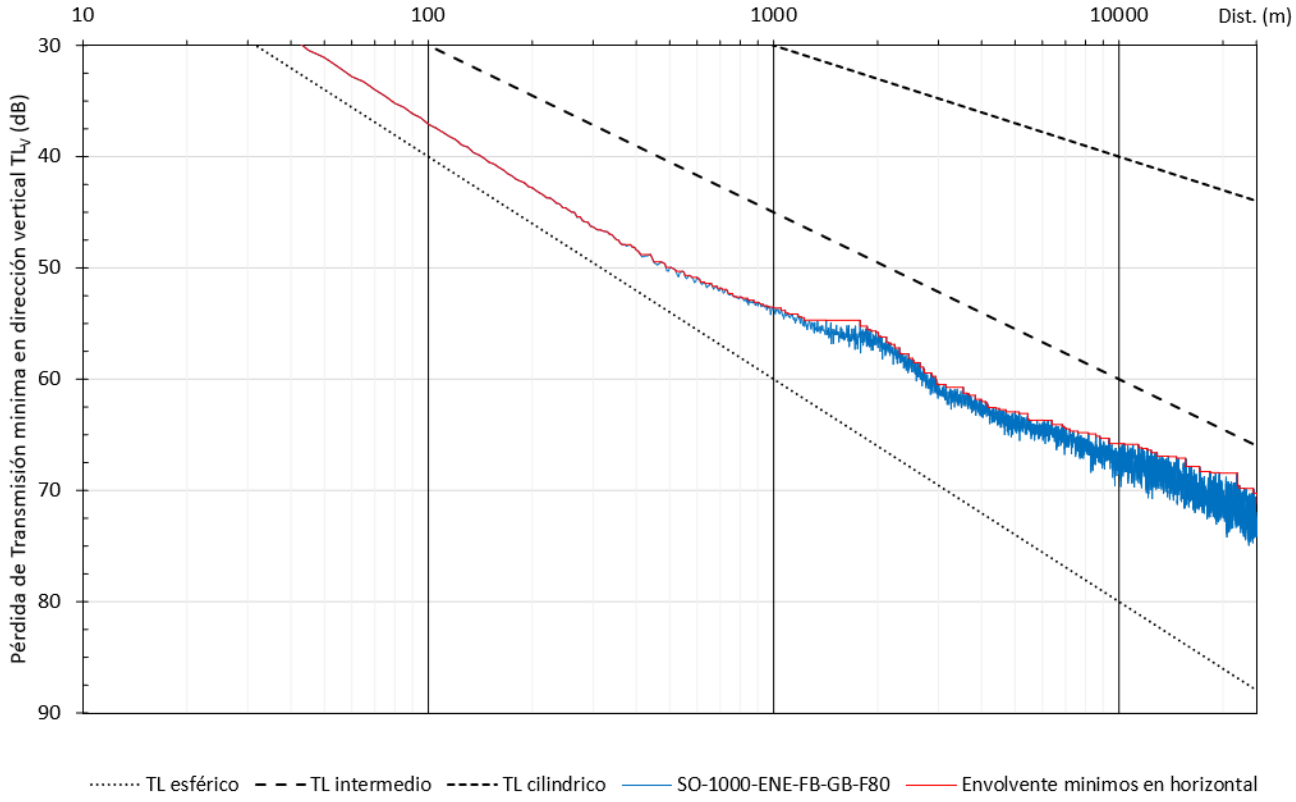


Figure 16. Example of processing of the two-dimensional TL matrix calculated by the RAM model to obtain the minimum Transmission Loss vertically (oscillating blue line) and the minimum envelope horizontally (red line).

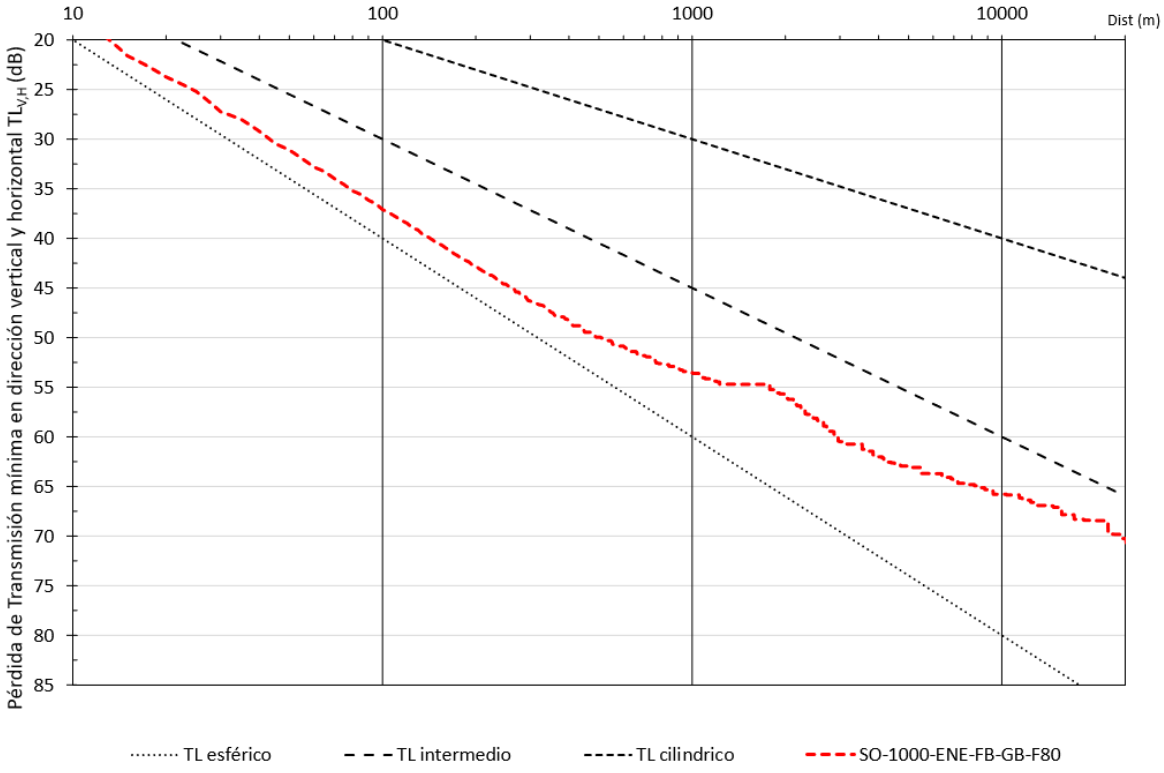


Figure 17. Example of the final result of the processing of the two-dimensional TL matrix calculated by the RAM model to obtain the minimum Transmission Loss vertically and horizontally.

The representation of $TL_{V,H}$ (x) is much clearer for comparison and for defining distances in which certain values of TL are exceeded than the two-dimensional graphs and representations of TLV (x) that present oscillations.

Therefore, all the TL values that are illustrated in one-dimensional graphs according to the distance like the one shown in Figure 17, that are mentioned as "Minimum Transmission Loss" must be interpreted as TLV values, H (x), obtained with the filed procedures. On the other hand, in other one-dimensional graphs the value of TLV (x) is usually called simply “Transmission Loss”.

6.7 RESULTS OF THE SENSITIVITY ANALYSIS

The sensitivity analyses for 5 representative frequencies of the total spectrum (20, 40, 80, 160 and 320 Hz) presented in Annexes 2 and 3 of Chapter 6, allowed to reach the following conclusions:

- The points where the Transmission Losses are more conservative are those of less depth (1,000 meters) in both areas located to the Southwest in CAN_100-108 (SW-1000) and to the West in CAN_114 (W-1000).
- These conditions have been more conservative than those corresponding to transects of variable depth, except in some particular case of the highest frequencies tested, which are not the most energetic in the emission, and are also very distant from the source.
- Although within the period in which the surveys would be carried out (October to March) the most conservative months of the year were selected to develop the subsequent systematic calculations, corresponding to January in CAN_100-108 and October in CAN_114, the differences in the TL values for all the frequencies tested that are obtained in different months are practically irrelevant, so it is estimated that the tasks could be carried out even in different months within the spring and autumn seasons without modifying the conclusions of the study.
- The parameters that must be specified for modeling are ρ or ρb: density of the sediment, Cp: compressional velocity of sound in the sediment, Cs = Shear velocity, αp (or Ap): attenuation associated with the compressional wave, αs (or As): attenuation associated with the shear wave.
- Regarding the soil parameters, given the existing uncertainties not only regarding its exact composition but also the values that must be assumed for a certain type of soil (especially for the Cs cutting speed parameter, which depends on the thickness of the layer), various variants were analyzed, and finally the one called F1 (variant 1 of sludge in the upper layer, with lower thickness and Cs value) and G3 (variant 3 of gravel in the lower layer, with higher Cp compressional velocity and higher density) were selected.

6.8 RESULTS OF THE SYSTEMATIC MATHEMATICAL MODELING OF THE TRANSMISSION LOSS

Once the transmission loss calculation conditions and parameters had been selected based on the sensitivity analyzes carried out, the modeling process was carried out systematically for all frequencies in thirds of octaves between 1 Hz and 1 kHz. The results obtained from TLV, H (x) and TLV (x) are presented below for the selected conditions in each area (Figure 18 and Figure 19 for CAN_100-108; Figure 20 and Figure 21 for CAN_114).

Since it emerged from the sensitivity analysis that for high frequencies and long distances, the combination of Sand on Gravel was more conservative than that of Mud on Gravel, the modeling for the frequencies in thirds of octaves was also carried out for SW-1000 point (CAN_100-108) with the oceanographic profiles for the month of January and the combination Sands over Gravels. The results obtained are similar to those for Mud over Gravels.

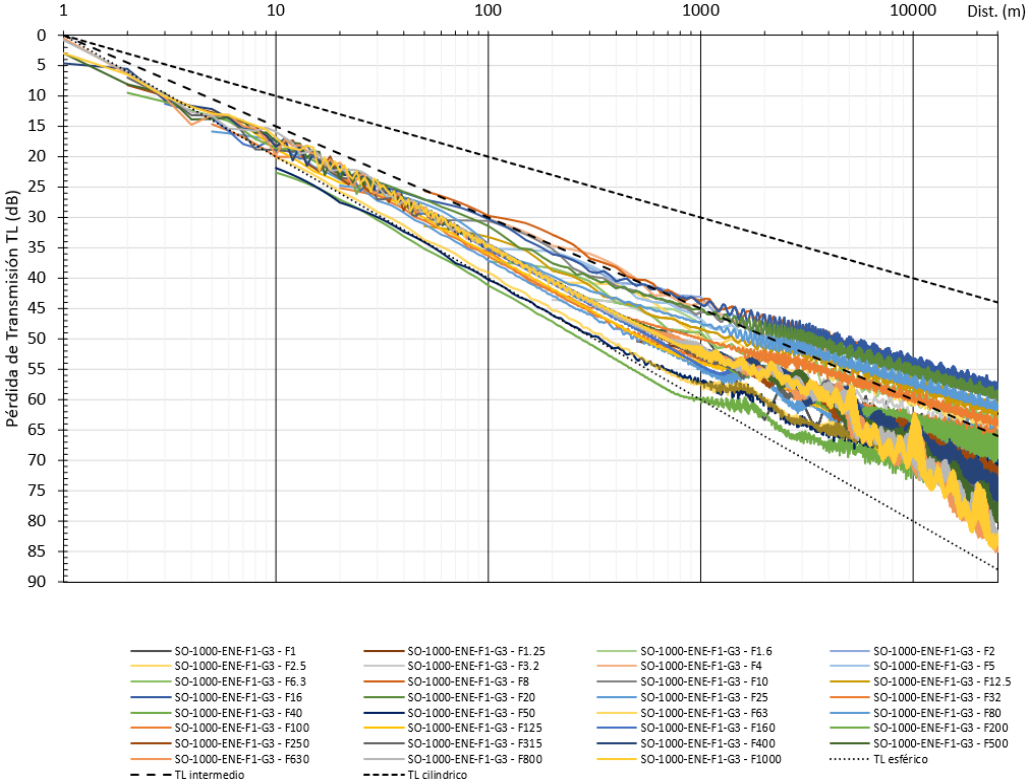


Figure 18. Minimum Transmission Loss in the vertical and in TLV, H distance for the CAN_100-108 area, with the most conservative condition of the sensitivity analysis (Sludge F1 and underlying Gravel G3).

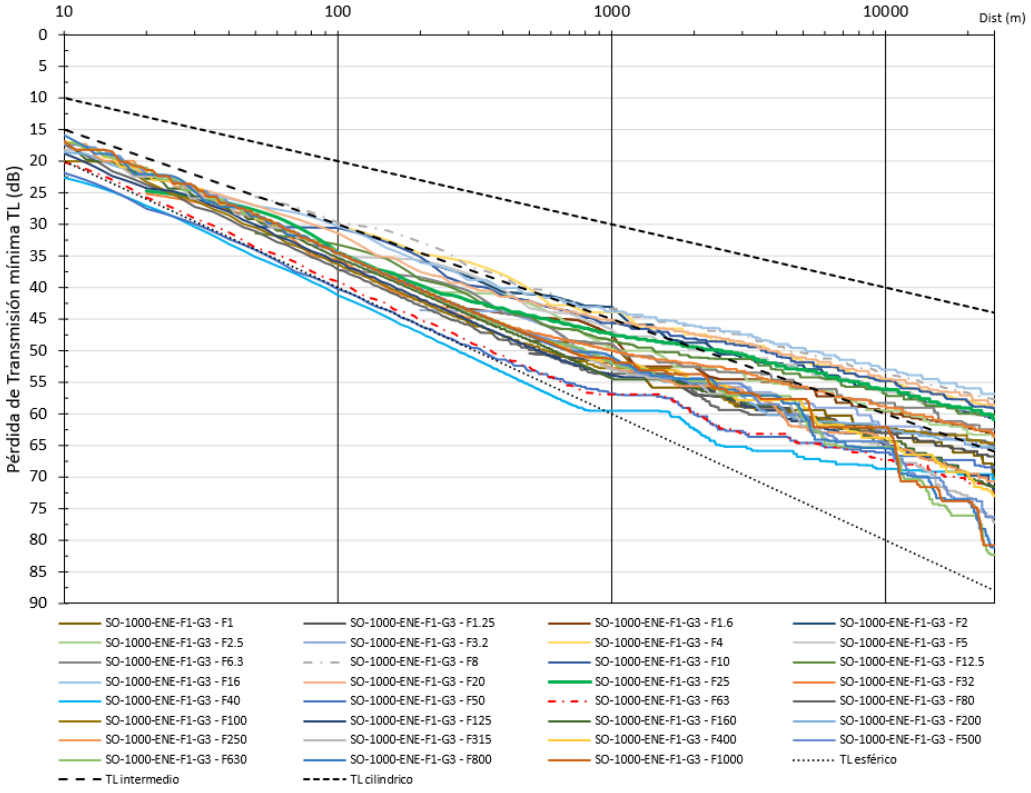


Figure 19. Minimum Transmission Loss in the TLV vertical for the CAN_114 Area, with the most conservative condition of the sensitivity analysis (Sludge F1 and underlying Gravel G3).

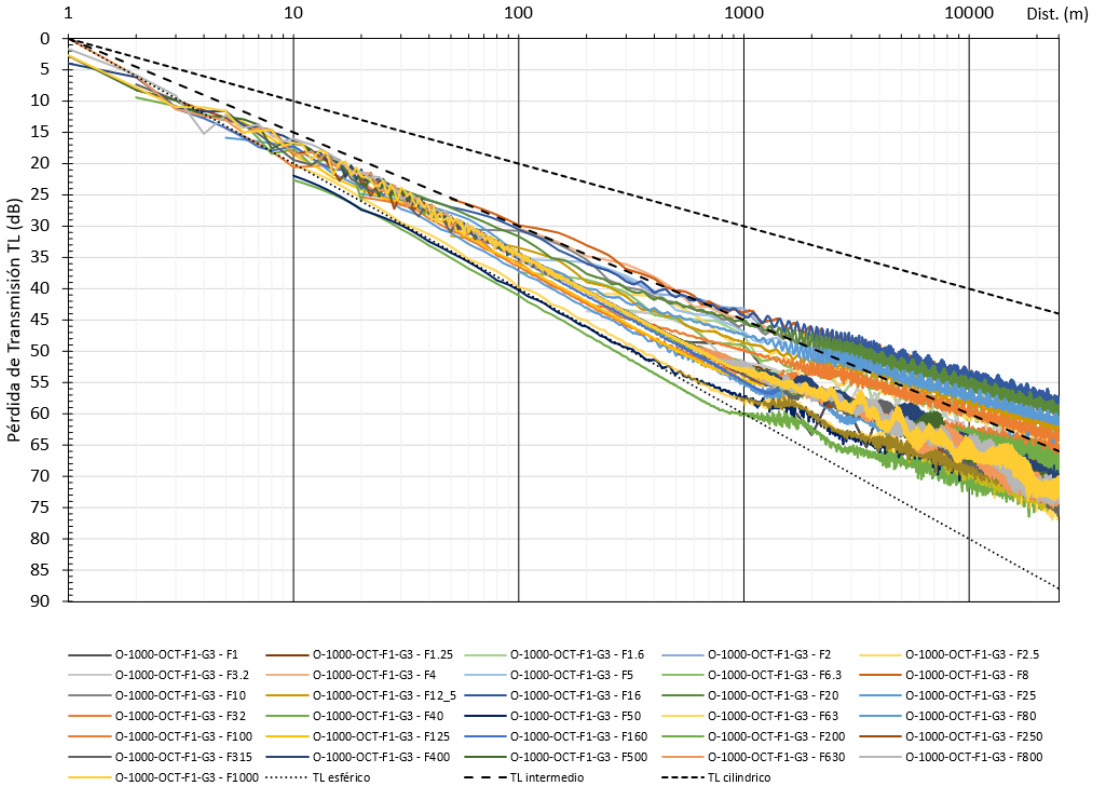


Figure 20. Minimum Transmission Loss in the vertical and in TLV, H distance for the CAN_114 Area, with the most conservative condition of the sensitivity analysis (Sludge F1 and underlying Gravel G3).

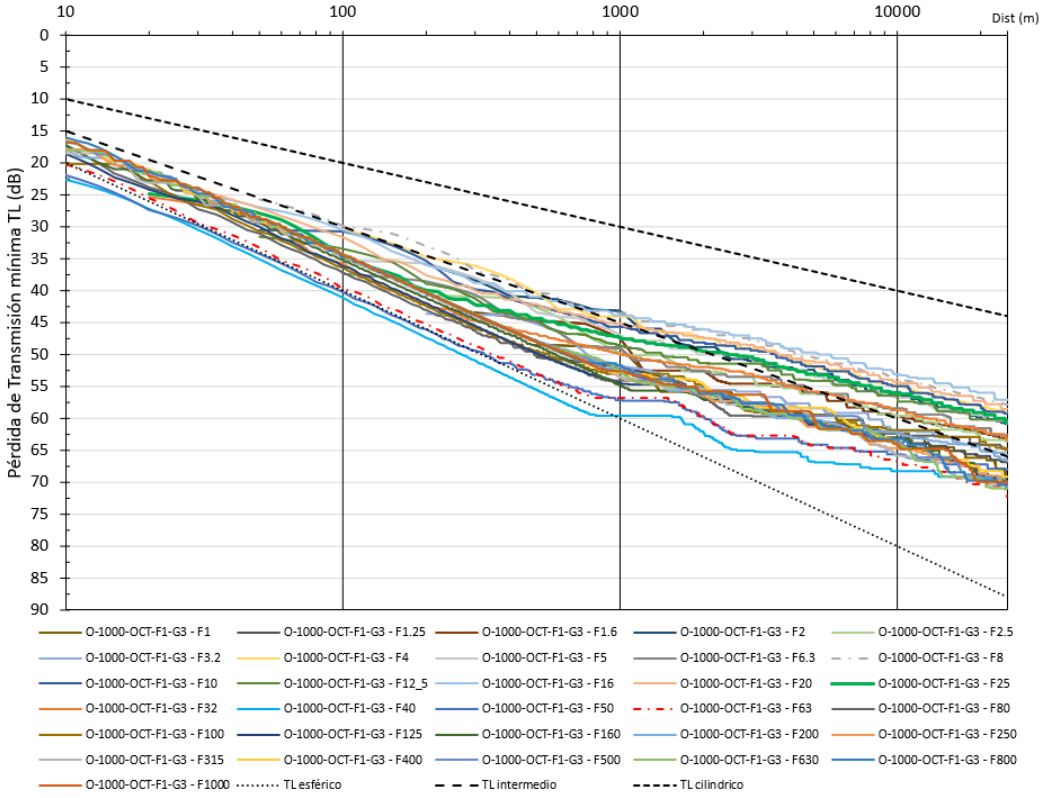


Figure 21. Minimum Transmission Loss in the vertical and in TLV, H distance for the CAN_114 Area, with the most conservative condition of the sensitivity analysis (Sludge F1 and underlying Gravel G3).

6.9 RESULTS OF SEL PROPAGATION

As previously indicated, the sound levels emitted vertically are at least between 15 and 24 dB higher than those directed horizontally. The propagation of sound over long distances requires the modeling of the horizontal emission, which as a whole, presents less energy than the vertical one. Taking into account the great depths of this area, it was appropriate to adopt a vertical angle Dip = 70º (20º with respect to the horizontal) for this particular case, which presents a 6 dB difference in the total energy emission with respect to the vertical, much lower than the one mentioned above.

SEL propagation was analyzed for the entire thirds octaves spectrum by comparing the following three conditions:

- Vertical emission (0º Dip) for reference.
- 0º Azimuth and 70º Dip
- 90º Azimuth and 70º Dip

Likewise, the filtering effect was evaluated with the audiogram of each auditory group, and such information shall be necessary for the subsequent calculation of the accumulated SEL. The procedure was performed for each of the 30 bands considered between 1.3 Hz to 1 kHz.

The values obtained from SEL received RLB(R, j) for each band, without filter, and for each auditory filter are presented as an example for the case of 0º Azimuth and 70º Dip, from Figure 22 to Figure 27.

The graphs allow you to see that the lower frequencies, down to 3.2 Hz, provide low SEL values that are still unfiltered, and show how the audio filters modify the SEL received for each band in a different way, reducing strongly or practically canceling the SEL of frequencies less than about 5 Hz. A characteristic frequency of the highest emission of the spectrum (80 Hz) was highlighted in dotted lines only for the purpose of allowing a visualization and comparison of its degree of reduction when applying the different filters.

The contributions to SEL by each band are added in the linear domain and re-represented in the logarithmic domain in decibels, by means of the following equation:

$$RL(SEL_{TOTAL}) = log_{10}\left[\sum_{j=1}^{N} 10^{\frac{RL_B(j)}{10}}\right]$$

Where:

N = number of 1/3 octave bands (30 in this case, between 1.3 Hz and 1 kHz)

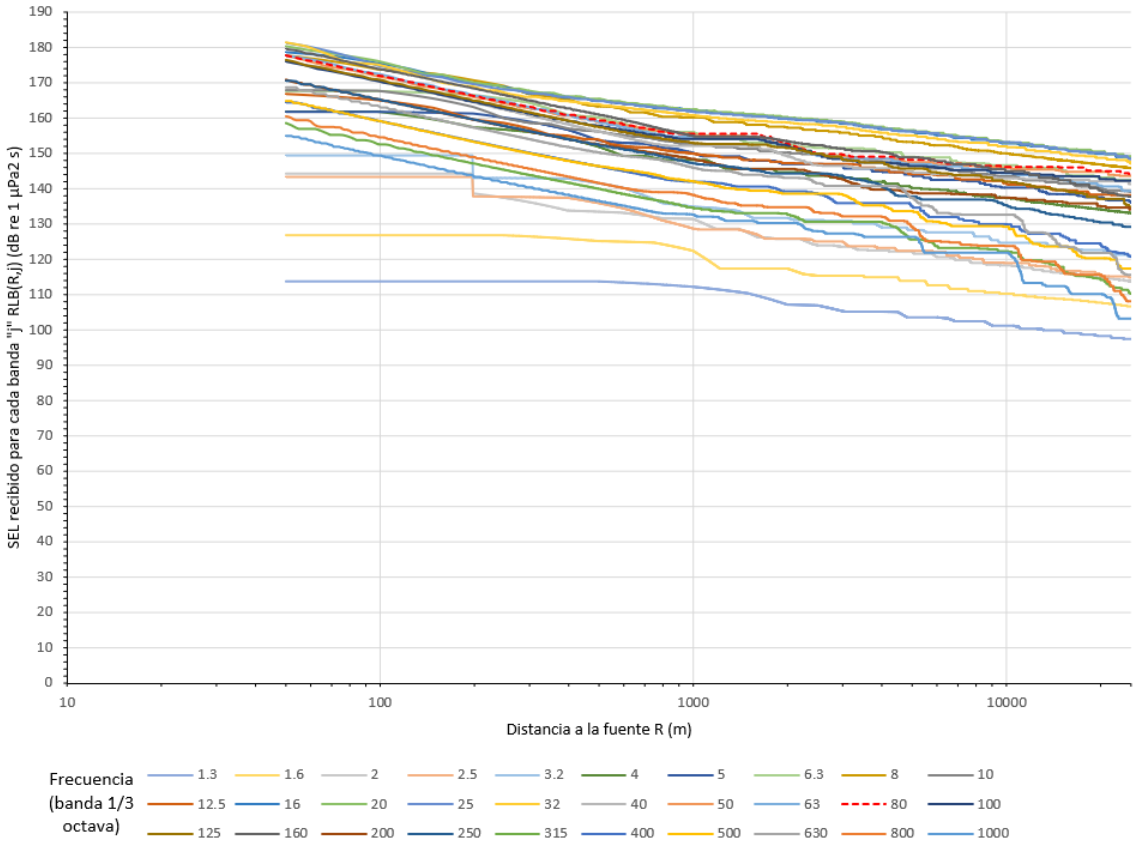


Figure 22. Received SEL (RL) for each band. CAN_100-108. 0º Azimuth 70º Dip. No filter.

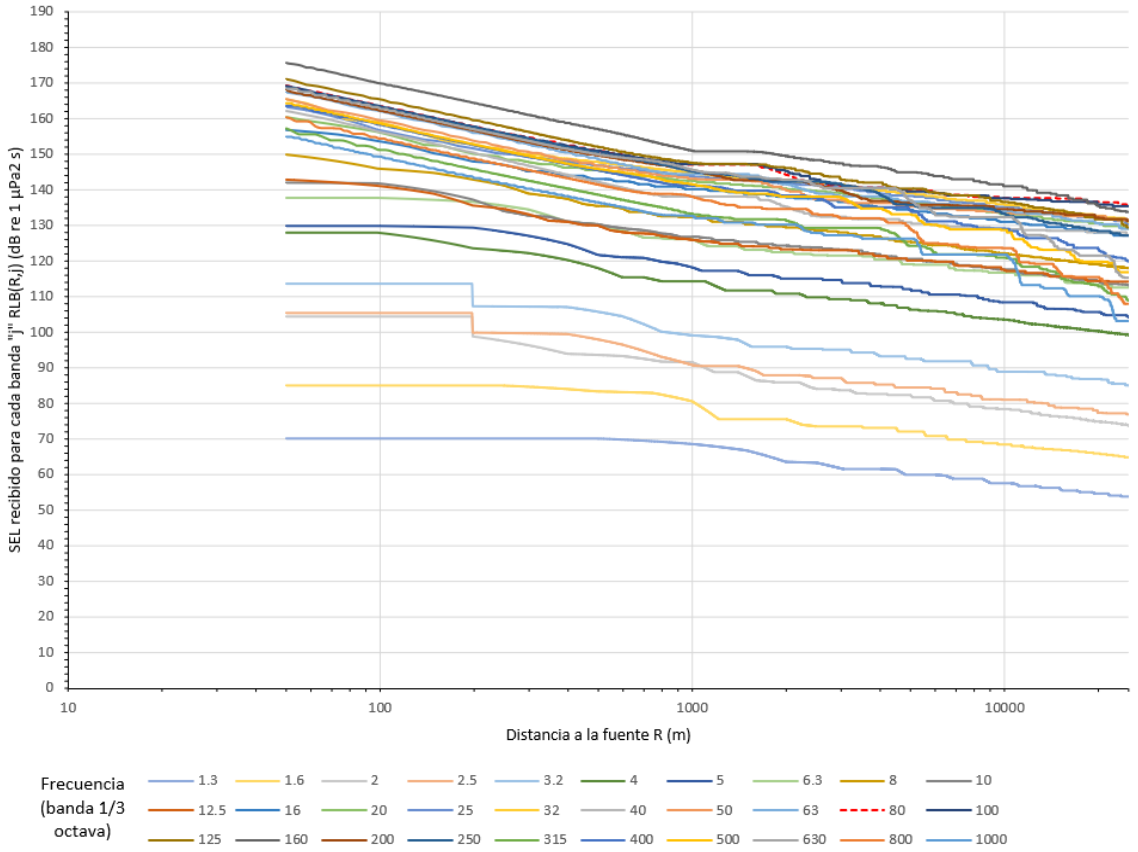


Figure 23. Received SEL (RL) for each band. CAN_100-108. 0º Azimuth 70º Dip. LF Filter.

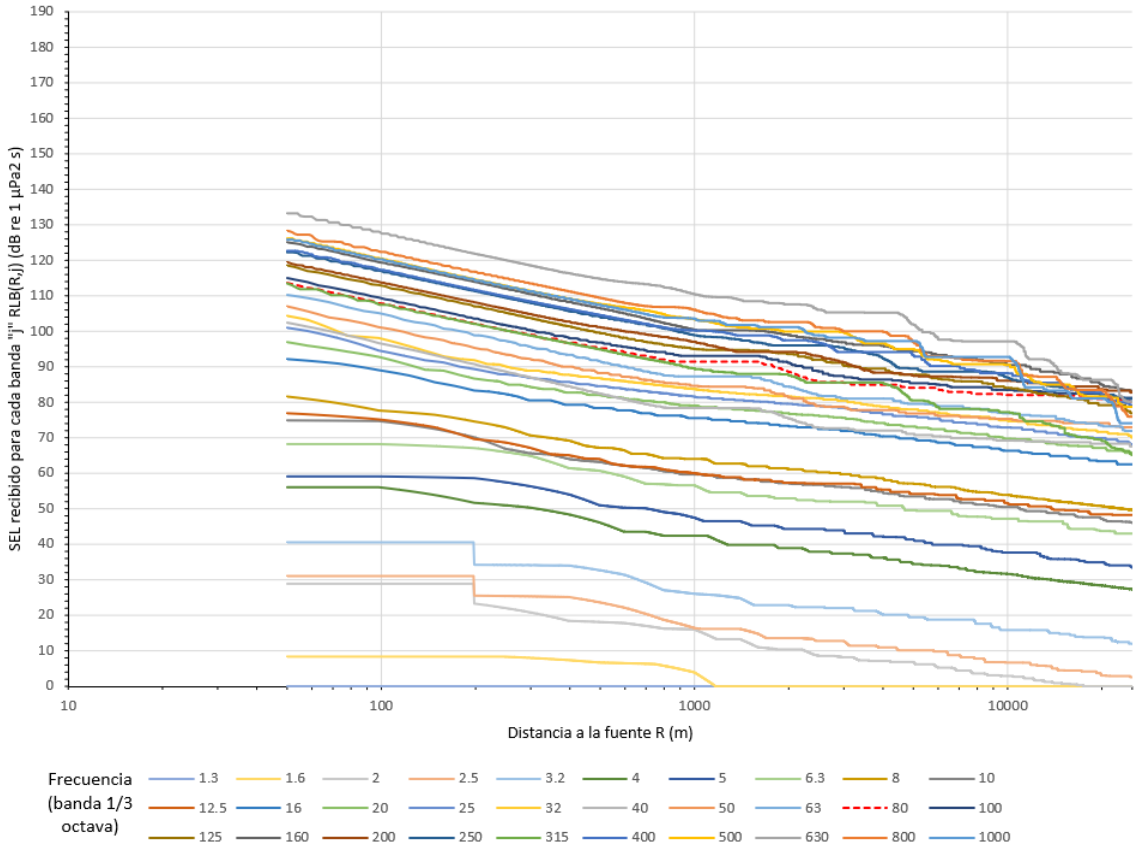


Figure 24. Received SEL (RL) for each band. CAN_100-108. 0º Azimuth 70º Dip. HF Filter.

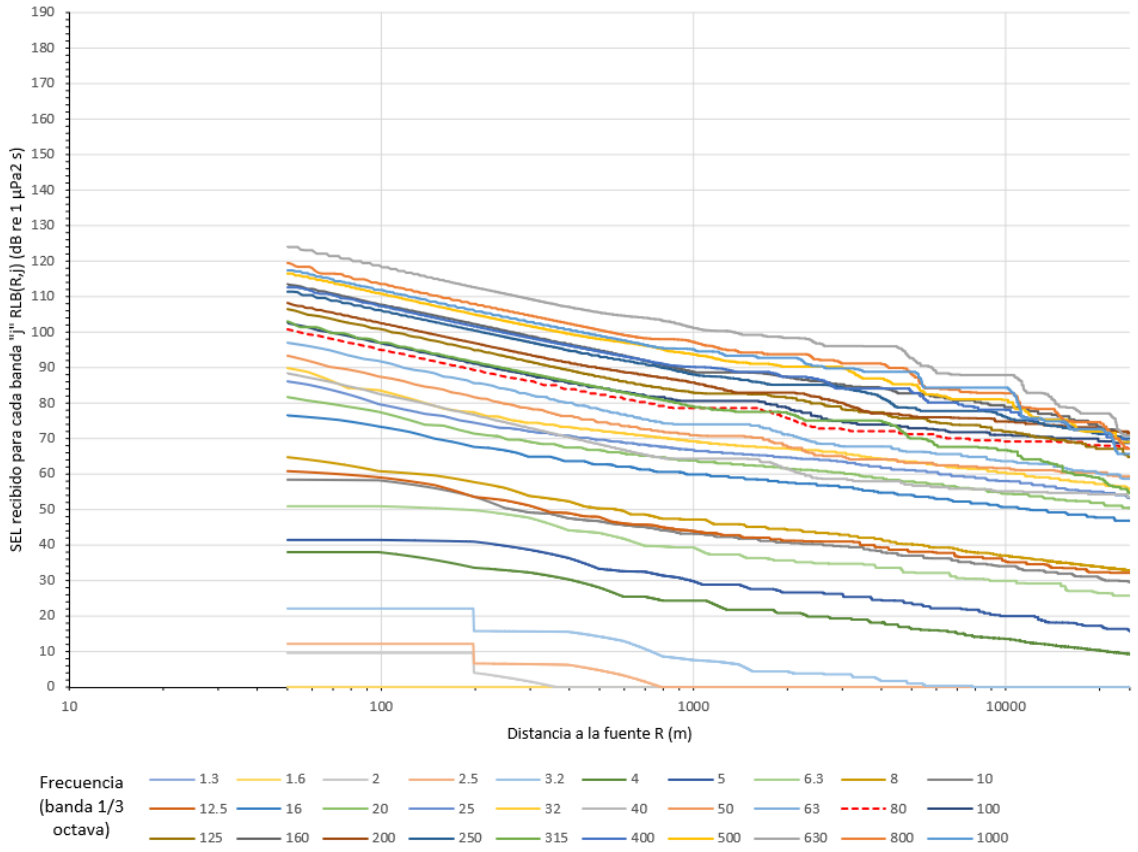


Figure 25. Received SEL (RL) for each band. CAN_100-108. 0º Azimuth 70º Dip. VHF Filter.

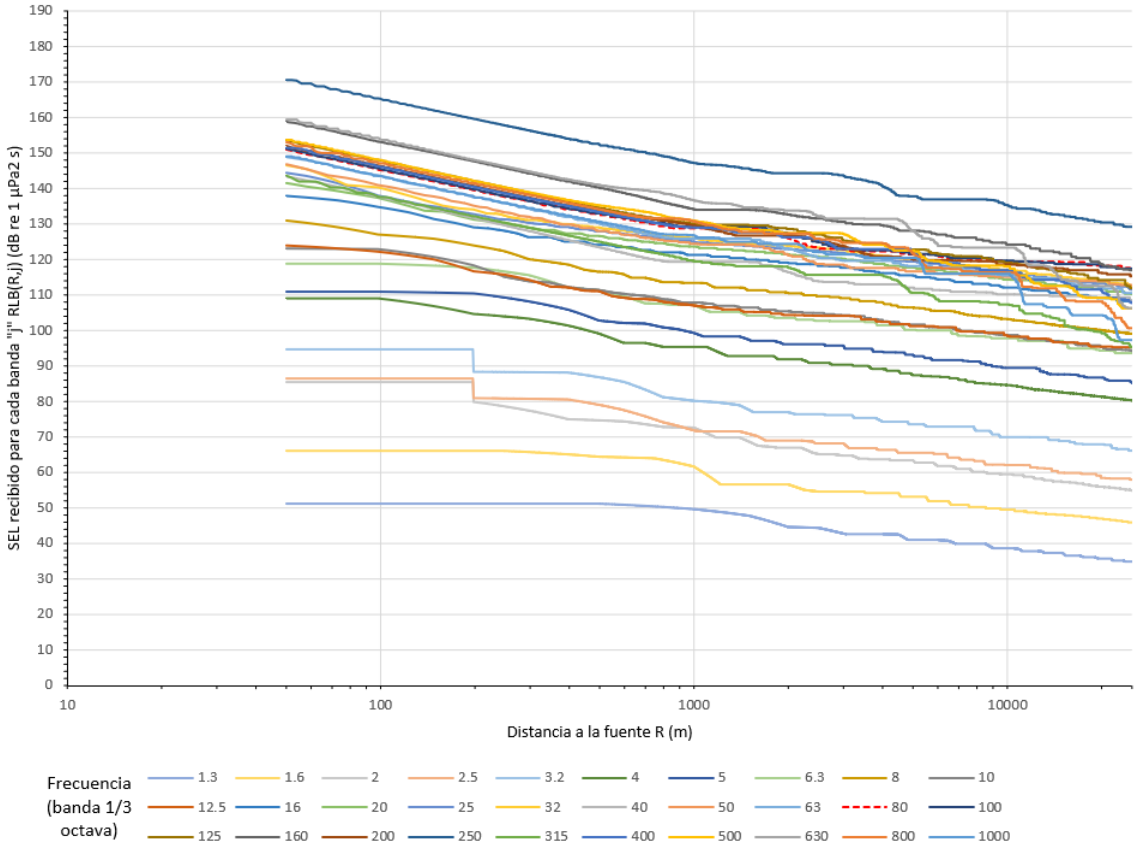


Figure 26. Received SEL (RL) for each band. CAN_100-108. 0º Azimuth 70º Dip. PW Filter.

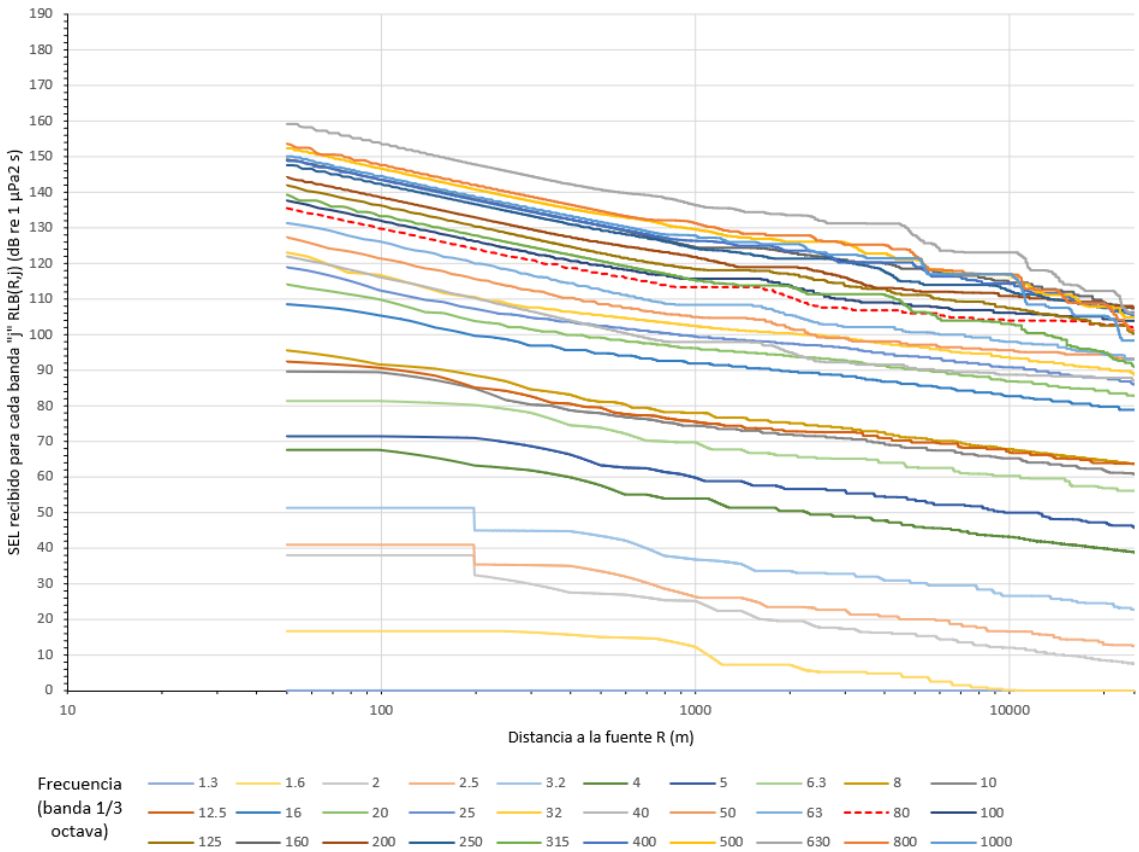


Figure 27. Received SEL (RL) for each band. CAN_100-108. 0º Azimuth 70º Dip. PO Filter.

Some of the RL (SELTOTAL) results are presented as an example in the following figures, which include the total SEL received for 0º Dip (which is independent of Azimuth) and with 70º Dip for 0º Azimuth or 90º for Azimuth, together with the difference with the value corresponding to 0ºDip.

This difference is what actually influences the accumulation of the SEL for each distance when an emission angle different from the vertical is adopted. When it comes to CAN_100-108 Area, it is somewhat greater for 0º Azimuth when the SEL is filtered with the audiograms (going from about 10 dB without filter to 13 dB for LF and PW), while for 90 Azimuth, it is practically reduced to half the value without filter, going from 7.6 dB to about 3.5 dB.

The results for CAN_114 Area are similar.

Figure 28 and Figure 29 present examples of the results for CAN_100-108 without filter and with LF filter (low frequency). The title of each figure indicates the corresponding point, the month and the type of soil (F1 Mud on G3 Gravel) that were selected as the globally most conservative condition.

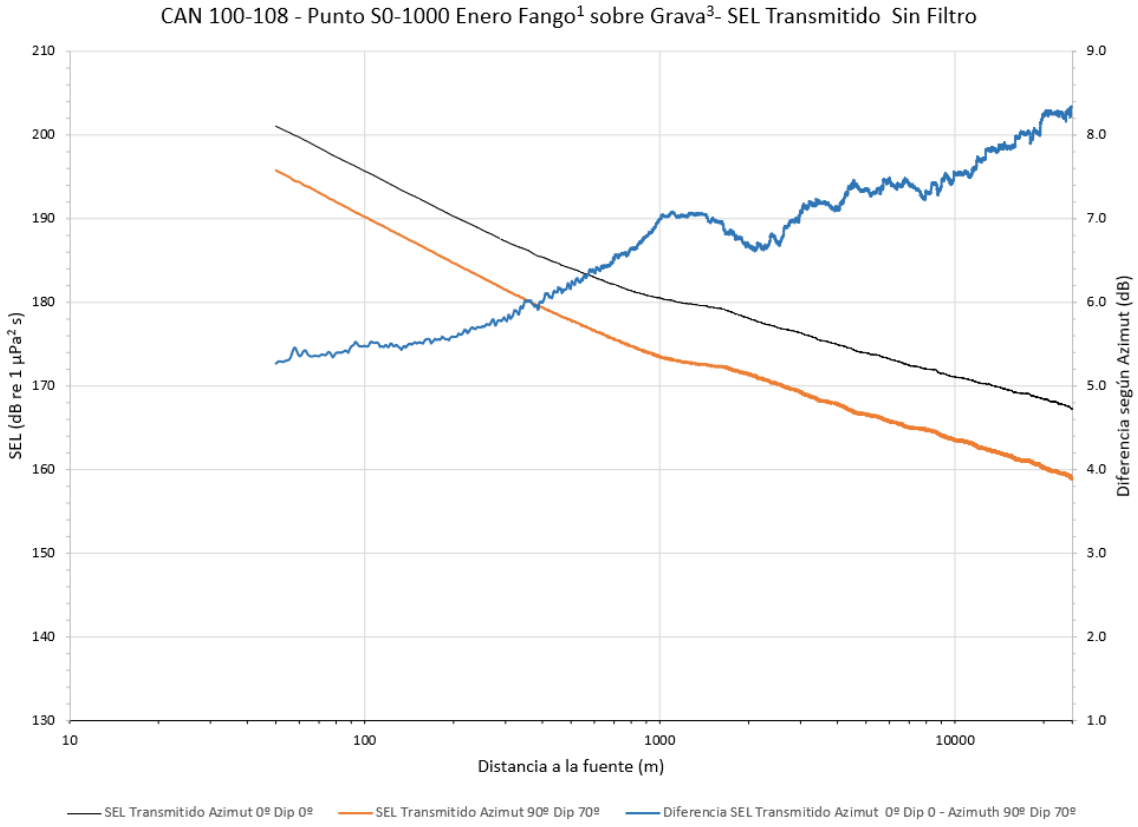


Figure 28. Received SEL (RL). CAN_100-108. 0º Azimuth vs 90º no filter.

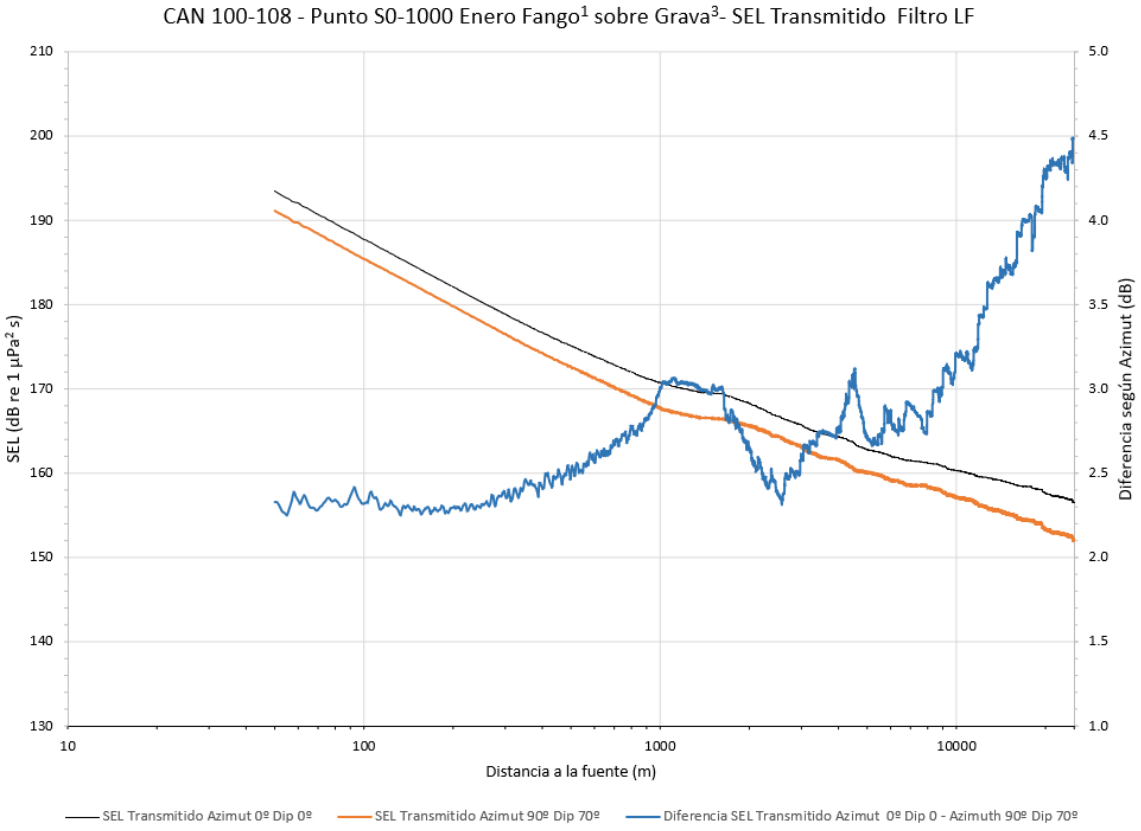


Figure 29. Received SEL (RL). CAN_100-108. 0º Azimuth vs 90º LF Filter (low frequency).

6.10 ASSESSMENT OF DISTANCES TO REACH THE SPL THRESHOLDS

As shown by the results of the previously presented SEL propagation (values of received SEL RL without filter), the values received from the SPLpeak were estimated according to the distance to the emission source, considering a minimum distance of 50 meters from the “virtual center”of the emitting array. The distance calculations were carried out for CAN_100-108 considering two different types of soil and to illustrate the difference between the forward directions of the array (0º Azimuth) and its perpendicular (90º Azimuth). Both cases were considered, always with 70º Dip emission with respect to the vertical.

The results obtained show that, for the usual ranges to obtain the thresholds of affectation for mammals and fish, which are up to 1 km (lower than the depths of the analyzed region), the different theories that can be adopted upon soils have no practical influence upon the resulting distances for each hearing group and species. Differences only arise in the "conventional limit of affectation", which covers distances greater than 1 km.

For instance, the SPLpeak values received for CAN_100-108 are presented in Table 5, also considering the combination of AB-GB soils, where the evolution along the distance to the source can be compared with the corresponding PTS and TTS thresholds (Southall, 2019), as well as with fish mortality. The only difference between this combination and the one adopted (F1-G3) is found in the conventional limit of affectation, since the other distances of up to 1 km from the source are identical.

In conclusion, considering the SPL metric, it is considered appropriate to adopt the distance for PTS - VHF resulting from the condition of 90º Azimuth (perpendicular to the direction of advance of the array), which is slightly less than 400 m, since the distance obtained is only half when aligned with the forward direction.

Table 5. Distances to the source (meters) to reach the various thresholds and hearing groups assessed. CAN_100-108 Area, based in SW-1000 Point.

Auditory Group	SPL pK (0-p)	F1 variant Mud Soil on G3 Gravel variant		AB "base" Sand Soild on GB "base" Gravel	
		0º Azimuth 70º Dip	90º Azimuth 70º Dip	0º Azimuth 70º Dip	90º Azimuth 70º Dip
	(dB re 1 μPa)	(meters)	(meters)	(meters)	(meters)
PTS – LF	219	<50	50	<50	50
PTS – HF	230	<50	<50	<50	<50
PTS – VHF	202	205	391	205	391
PTS – PW	218	<50	52	<50	52
PTS – PO	232	<50	<50	<50	<50
Fish WITHOUT swim bladder	213	50	97	50	97
Fish WITH swim bladder	207	106	206	106	206
TTS – LF	213	50	97	50	97
TTS – HF	224	<50	<50	<50	<50
TTS – VHF	196	514	1006	524	1006
TTS – PW	212	55	110	55	110
TTS – PO	226	<50	<50	<50	<50
Conventional limit of affectation	190	2144	4240	2200	3737

Table 6. Distances to the source (meters) to reach the various thresholds and hearing groups assessed. CAN_114 Area, based on W-1000 Punto.

Auditory Group	SPL pK (0-p)	F1 variant Mud Soil on G3 Gravel variant	
		0º Azimuth 70º Dip	90º Azimuth 70º Dip
	(dB re 1 μPa)	(meters)	(meters)
PTS – LF	219	<50	50
PTS – HF	230	<50	<50
PTS – VHF	202	200	377
PTS – PW	218	<50	52
PTS – PO	232	<50	<50
Fish WITHOUT swim bladder	213	50	96
Fish WITH swim bladder	207	104	200
TTS – LF	213	50	96
TTS – HF	224	<50	<50
TTS – VHF	196	505	945
TTS – PW	212	54	109
TTS – PO	226	<50	<50
Conventional limit of affectation	190	2149	4314

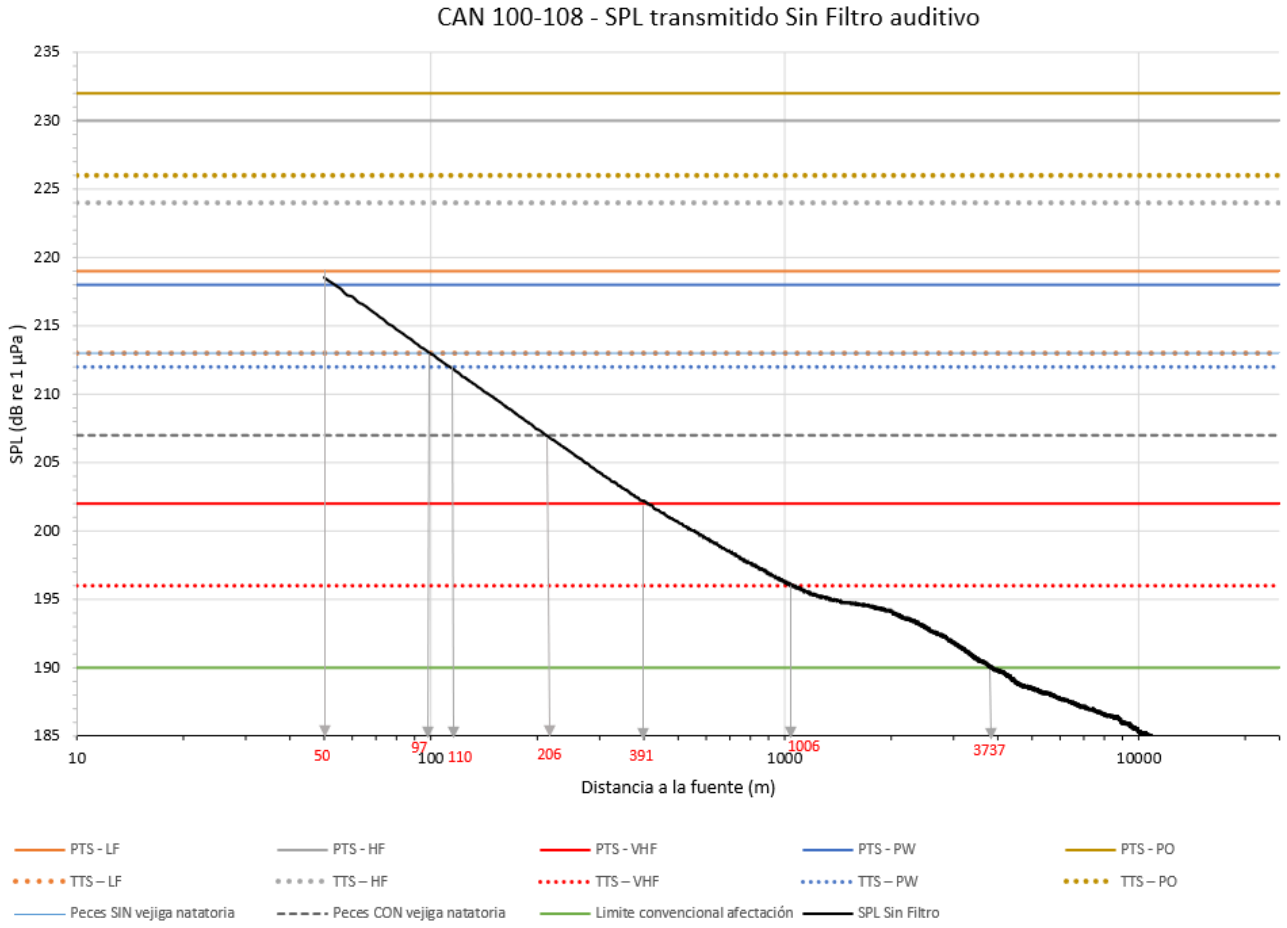


Figure 30. Example of comparison between the SPLTOTAL values and the different thresholds to determine the corresponding distances (CAN_100-108. 90º Azimuth - 70º Dip, AB-GB Soils).

6.11 CALCULATION OF THE ACCUMULATED SOUND EXPOSURE LEVEL (SEL)

Conceptually, the procedure for calculating the SEL accumulation, which is often referred to as SELcum in the literature, consists of adding the contributions of each seismic emission perceived by the sound-receiving animal, considering the distance to the array, the depth in which it can be found, its trajectory, and its perception ability (audiogram).

The most unfavorable level that can occur at any depth between the surface and the bed is considered, so this conservative criterion includes any evolution that the receiver makes in the vertical direction.

The individual values of total SEL that integrate all the energy bands (RL (SELTOTAL)) for each emission of compressed air, are accumulated for all the emissions that take place during the survey period.

The RL received SEL value considered is analyzed by the audiogram corresponding to the auditory group whose PTS or TTS threshold is being assessed. For fish, the unfiltered value is used instead.

The prospecting of a seismic line is considered for the SEL accumulation, since accumulation for 24 hours is not justified, due to the time it takes to survey it and make the turn to go to the next line, at a 10 km-distance at 10.75 km between successive lines, and to the mobility of potentially exposed animals.

As the seismic source moves further away from the receivers, there comes a point where SEL no longer accumulates significantly. Therefore, accumulation occurs for the duration necessary for the SELcum value to reach a maximum value and stabilize, which usually happens after about an hour or an hour and a half.

The following recommendations of the 2018 IBAMA Guide applicable to the array under analysis have been considered:

- From the beginning of soft start to full operating power: 20 minute-minimum, 40 minute-maximum.
- Seismic survey operations should be planned to avoid unnecessary emissions to operating power before beginning a survey line and to schedule operations to begin data collection as soon as possible once full operating power is reached.
- If line changes are expected to take more than 20 minutes (in this case they reach almost 4 hours), regardless of the broadcast volume:
  - Emissions must be terminated at the end of the survey line;
  - A search shall be performed prior to the beginning of the soft start during the scheduled line change;
  - The soft start shall be delayed if marine mammals and turtles are seen within the exclusion zone during the pre-release search; and
  - A full soft start must be performed before the start of the next line.

As the receiver moves with a VR speed modifying its spatial position according to the angle of its trajectory with respect to the advance of the ship, an emission of sound energy is produced every 6.5 seconds approximately, so the array shall have advanced 15 meters in the positive X direction at a VE speed of 4.5 knots (2.3 m / s). In this way, the “R” distance between the two and the Azimuth of the receiver with respect to the instantaneous position of the emitter is continuously modified.

The geometric calculation scheme implemented to accumulate the SEL during the receiver escape period is as follows:

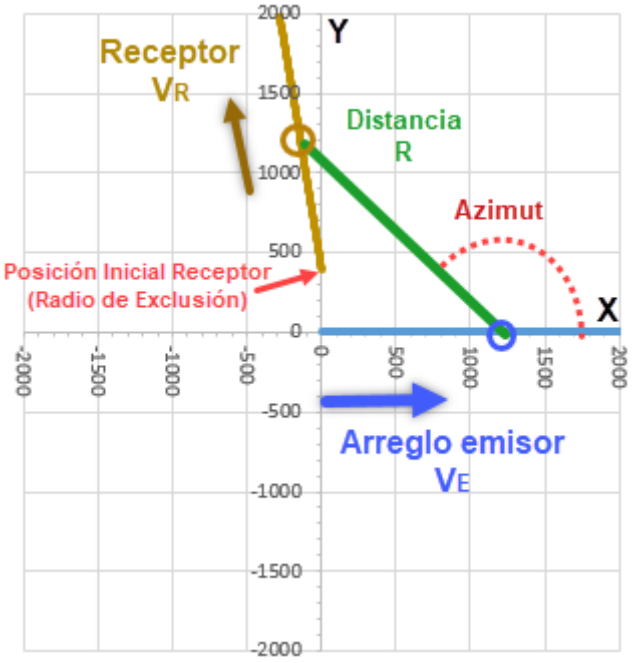


Figure 31. Geometric diagram used to calculate SELcum.

The information available on the possible reactions of marine mammals to seismic emissions shows that they carry out avoidance trajectories, with a 4 m / s speed for approximately half an hour, then maintaining around 2 m / s. speed. A constant velocity of 2 m / s was considered for the receiver´s escape in this study. In order to accumulate the SEL, plausible hypotheses must be made about the interrelation of the receiver and emitter trajectories.

Considering the available background, it was seen that the receiver shall follow paths with directions opposite or perpendicular to the direction of advance of the array, moving it away from the emission point.

In order to adopt a reasonably conservative position based on the polar emission diagrams, a combined analysis was carried out, considering not only the distance between emitter and receiver to accumulate the SEL of each individual emission, but the relative angle (Azimuth), adopting the result for 90º Azimuth if the angle is between 60º and 120º (or the same negative values), and 0º Azimuth for the rest of the angles (0º to 60º and 120º to 180º). Since the results finally obtained for CAN_100-108 are similar to those for CAN_114, the sensitivity analyzes are presented only for the first area.

Regarding the scenarios, it should be remembered that according to Southall (2019) there are two conditions to define the exclusion zone, one based on the unfiltered SPLpeak, and the other on the accumulated SEL (dual metric). Therefore, and having defined through SPLpeak a minimum exclusion distance of 400 meters at the beginning of the soft start, it does not make practical sense to propose smaller distances for the SELcum evaluation, so only verification scenarios of the exceedance of the SELcum thresholds with this initial distance shall be considered.

Various interrelation scenarios between the emitter and receiver array were proposed and analyzed (in the first place for CAN_100 -108) to evaluate whether the exclusion distance of 400 m arising from the SPL metric is enough so as not to exceed the PTS for the SELcum metric.

The most unfavorable proposed scenarios are the following:

- E1: the receiver is right on the array advance line at the beginning of the soft start (XR = 400 m, YR = 0 m), and escapes to the array advance direction (90º) at 2 m / s.
- E2: the receiver is perpendicular to the line of advance of the array at the beginning of the soft start (XR = 0 m, YR = 400 m), and escapes perpendicularly to the direction of advance of the array (90º) at 2 m / s.

According to these hypotheses, the SELcum obtained does not exceed the PTS values for any of the auditory groups, as shown below. Any escape angle in the opposite direction to the advance of the array (> 90º) generates a SELcum lower than that obtained with the previous hypotheses. Although there is a range of escape angles in the direction of the array advance (<90º) for which the PTS LF (which is the most restrictive condition) is not exceeded, it is not considered realistic for the receiver to maintain these trajectories for a long time, given the evasive behavior of marine mammals.

The following figures illustrate the SEL accumulation for the different conditions tested.

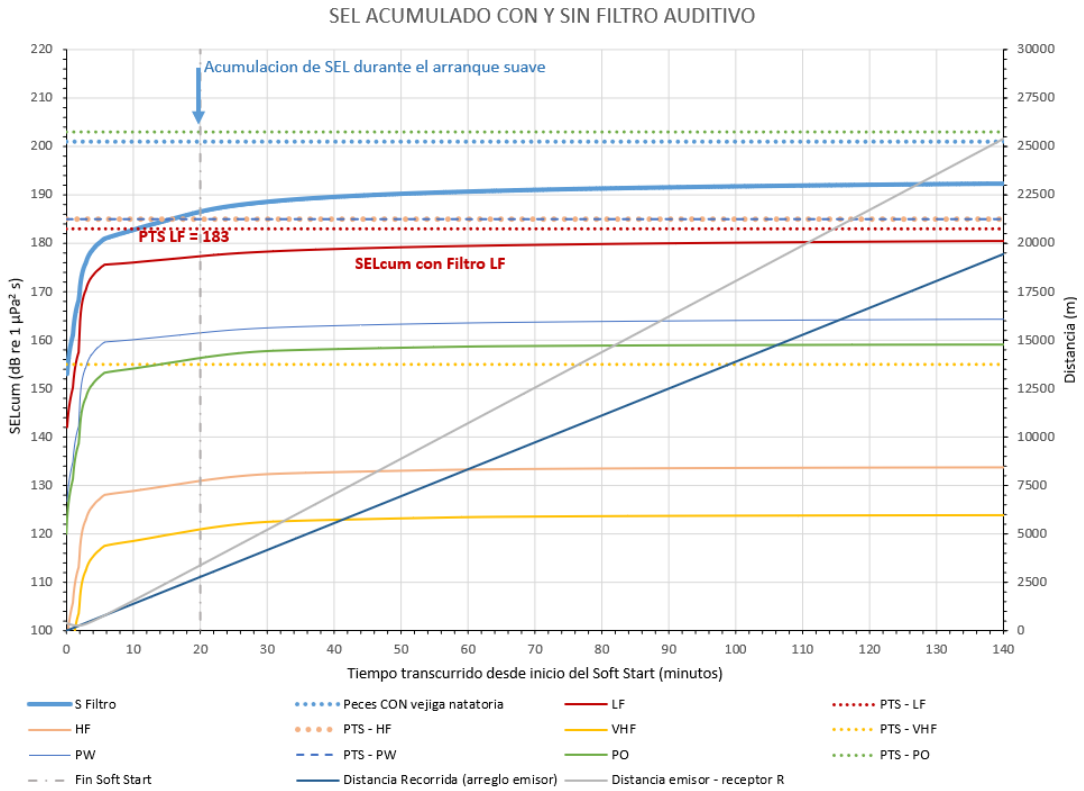


Figure 32. CAN_100-108. Accumulated SEL. 20-minute Soft Start. Initial position of the receiver 400 m from the transmitter on the line of advance. 90º at 2 m / s Azimuth movement of the receiver.

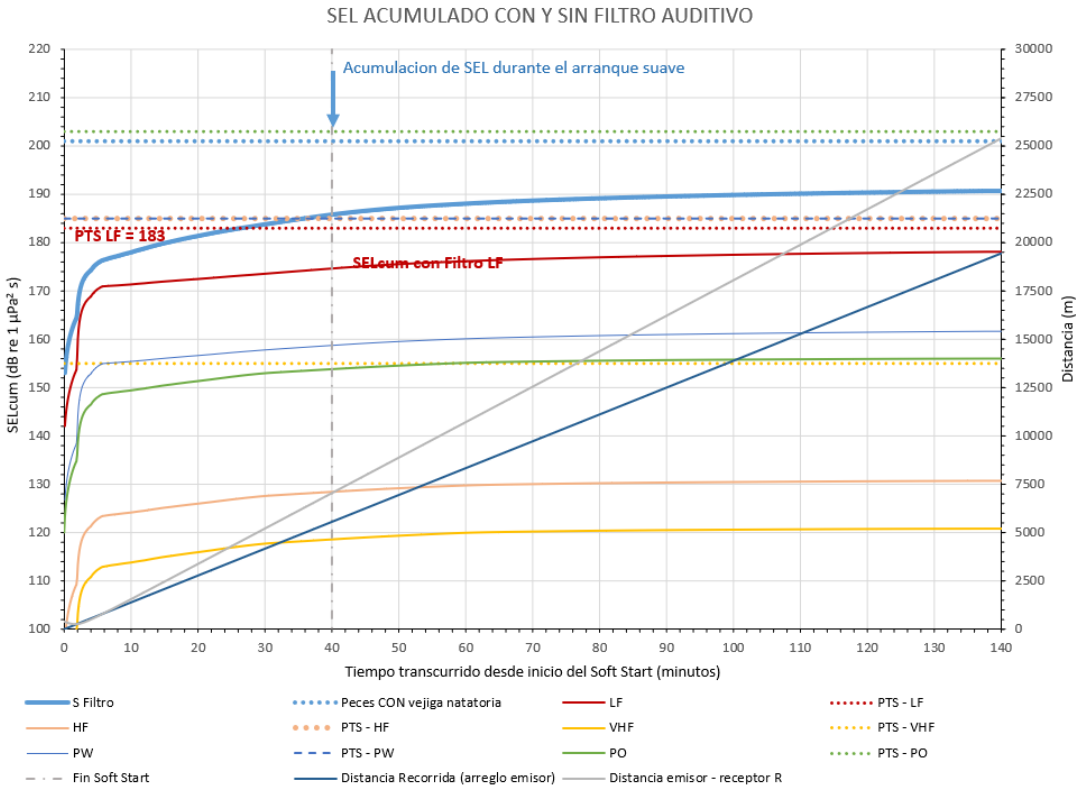


Figure 33. CAN_100-108. Accumulated SEL. 40-minute Soft Start. Initial position of the receiver 400 m from the transmitter on the line of advance. 90º at 2 m / s Azimuth movement of the receiver.

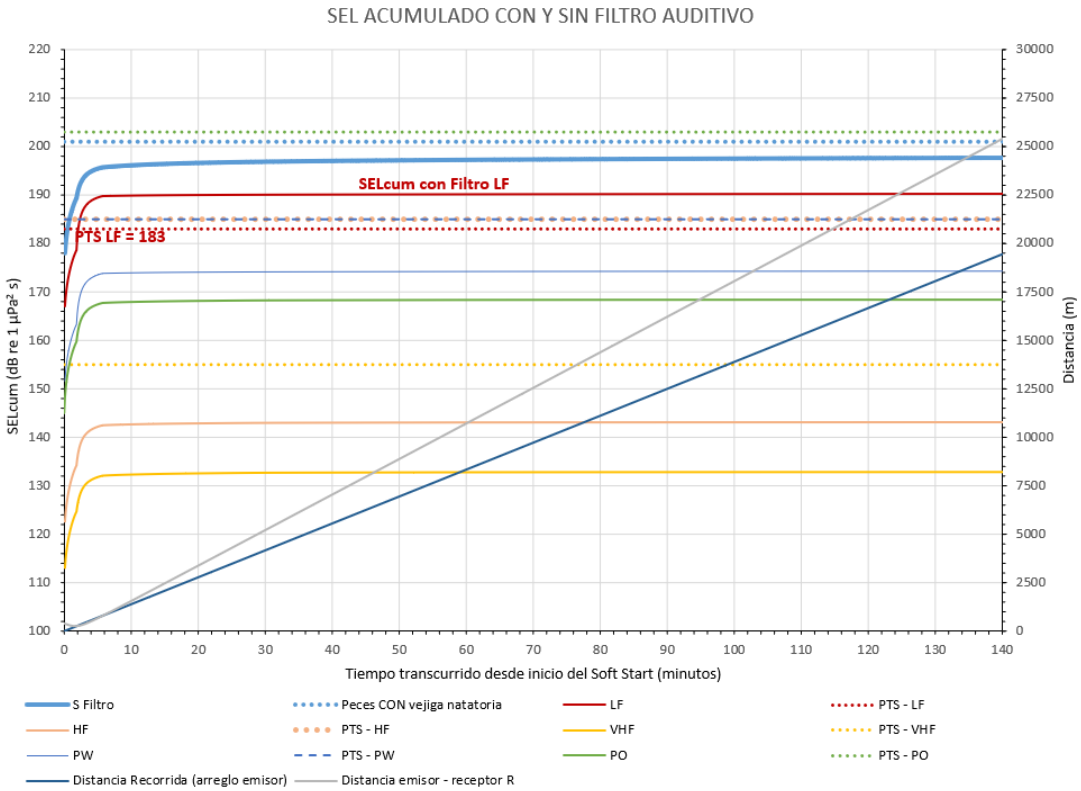


Figure 34. CAN_100-108. Accumulated SEL. No Soft Start Hypothesis. Initial position of the receiver 400 m from the transmitter on the line of advance. 90º at 2 m / s Azimuth movement of the receiver.

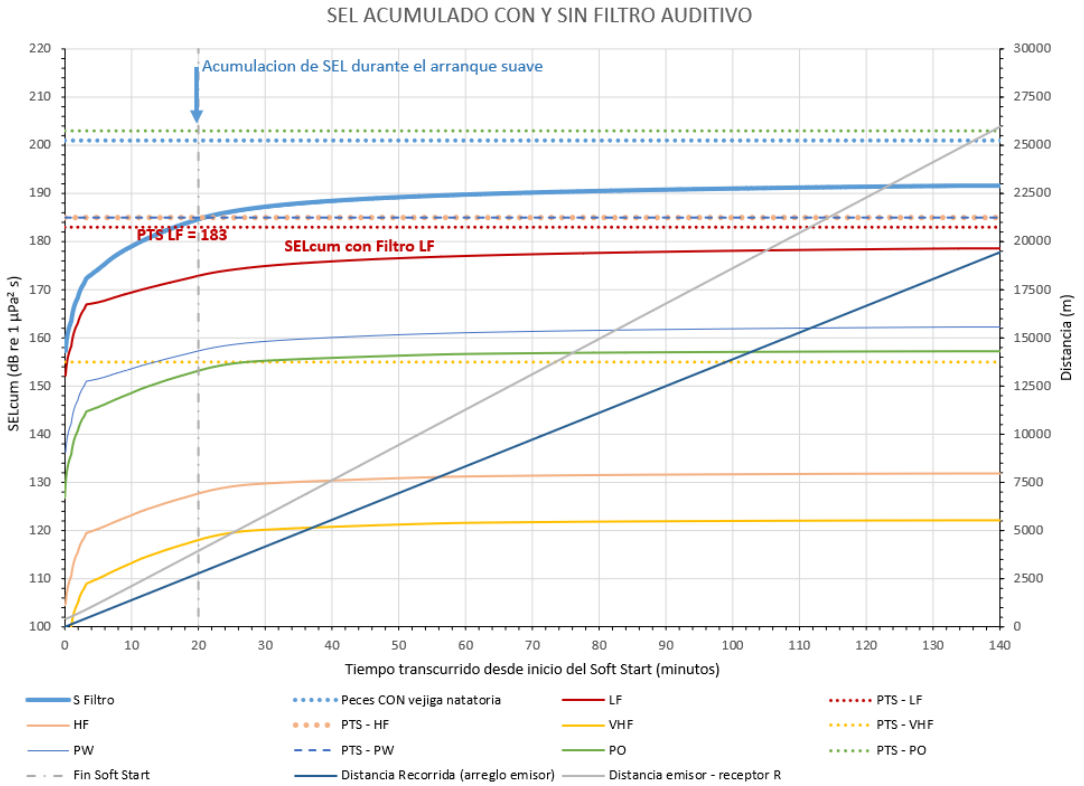


Figure 35. CAN_100-108. Accumulated SEL. 20-minute Soft Start. Initial position of the receiver 400 m away from the transmitter, perpendicular to the advance line at the Soft Start starting point. 90º at 2 m / s Azimuth movement of the receiver.

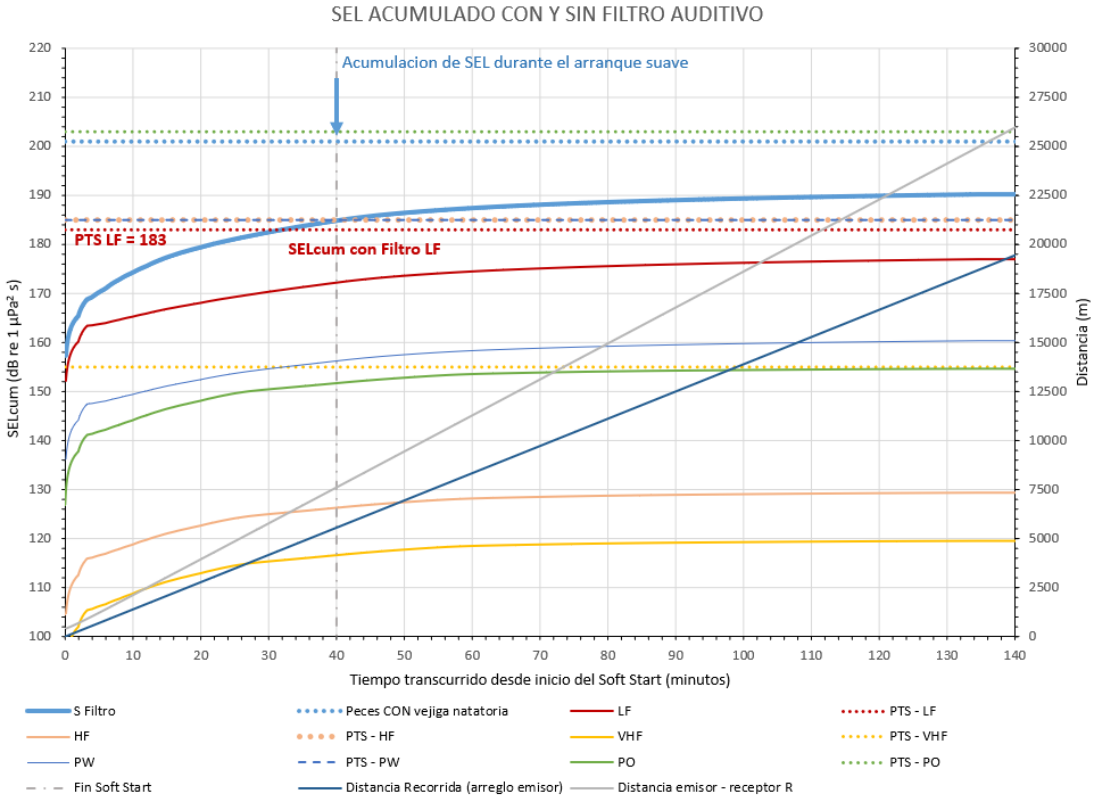


Figure 36. CAN_100-108. Accumulated SEL. 40-minute Soft Start 40. Initial position of the receiver 400 m away from the transmitter, perpendicular to the advance line at the Soft Start starting point. 90º at 2 m / s Azimuth movement of the receiver.

Table 7 presents the SELcum values obtained under different hypotheses of initial point, receiver trajectory and duration of the soft start.

It can be seen that reducing the duration of the soft start from the maximum of 40 minutes to the minimum of 20 minutes usually implies an increase in the SELcum with the LF filter (the most restrictive), although the value of PTS LF is not exceeded (183 dB re 1 μPa^2 s). Based on this, it is considered appropriate that the duration of the soft start is, as far as possible, greater than the established minimum, as a safety measure.

On the other hand, the hypothetical situation of not performing a soft start would lead to the PTS LF being exceeded by more than 7 dB, which illustrates the importance of this measure, in order to be able to move marine mammals away before starting the emission at full power.

Table 7. CAN_100-108. SELcum values (dB re 1µPa2 s) compared to PTS thresholds for mammals and limits for fish.

Filter	No filter	LF	HF	VHF	PW	PO
Comparison thresholds	Fish WITHOUT VN	PTS - LF	PTS - HF	PTS - VHF	PTS - PW	PTS - PO
	219	**183**	**185**	**155**	**185**	**203**
	Fish WITH VN	TTS – LF	TTS – HF	TTS – VHF	TTS – PW	TTS – PO
	201	168	170	140	170	188
20-minute Soft Start. Initial position of the receiver 400 m from the emitter on the line of advance.						
SELcum	**192.3**	**180.5**	**133.7**	**123.9**	**164.3**	**159.1**
PTS Difference	-8.7	-2.5	-51.3	-31.1	-20.7	-43.9
40-minute Soft Start. Initial position of the receiver 400 m from the emitter on the line of advance.						
SELcum	**190.7**	**178.1**	**130.7**	**120.8**	**161.7**	**156.0**
PTS Difference	-10.3	-4.9	-54.3	-34.2	-23.3	-47.0
Without Soft Start. Initial position of the receiver 400 m from the emitter on the line of advance.						
SELcum	**197.7**	**190.2**	**143.1**	**132.8**	**174.3**	**168.4**
PTS Difference	-3.3	7.2	-41.9	-22.2	-10.7	-34.6
20-minute Soft Start. Initial position of the receiver 400 m away from the emitter. perpendicular to the advance line at the Soft Start starting point.						
SELcum	**191.6**	**178.6**	**131.9**	**122.1**	**162.3**	**157.2**
PTS Difference	-9.4	-4.4	-53.1	-32.9	-22.7	-45.8
40-minute Soft Start. Initial position of the receiver 400 m away from the emitter. perpendicular to the advance line at the Soft Start starting point.						
SELcum	**190.2**	**177.0**	**129.4**	**119.5**	**160.4**	**154.6**
PTS Difference	-10.8	-6.0	-55.6	-35.5	-24.6	-48.4

In relation to the fish, it is verified that if they were 50 meters from the array at the moment of the soft start, even if they did not move from that place, the movement of the emitter would generate a SELcum 9 dB lower than the corresponding threshold to fish with swim bladder (WITH VN in the table).

If the fish were found in the vicinity of the survey line while it was developing at full power, the potential mortality threshold of 201 dB re 1µPa2 s would be reached (without auditory filter), if they were 170 meters from the line and remain static while the array approaches and moves away to the point of minimum distance (unlikely situation since the background information indicates that evasive behavior occurs). This situation is illustrated by Figure 37 where the accumulation of SEL has been simulated for static fish located km 10 from the survey line (it can be seen how the R distance decreases and increases with time as the array moves).

The threshold value for fish without a swim bladder equal to 219 dB re 1 µPa2 s (without auditory filter) would not be reached even when the fish were at the minimum evaluated distance of 50 meters from the survey line.

It should also be remembered that the energy emitted in the vicinity of the array is less than that arising from the far-field calculations, which is herein being assessed. These results suggest that an affectation of the fish that potentially implies their mortality would occur in a highly localized environment around the array.

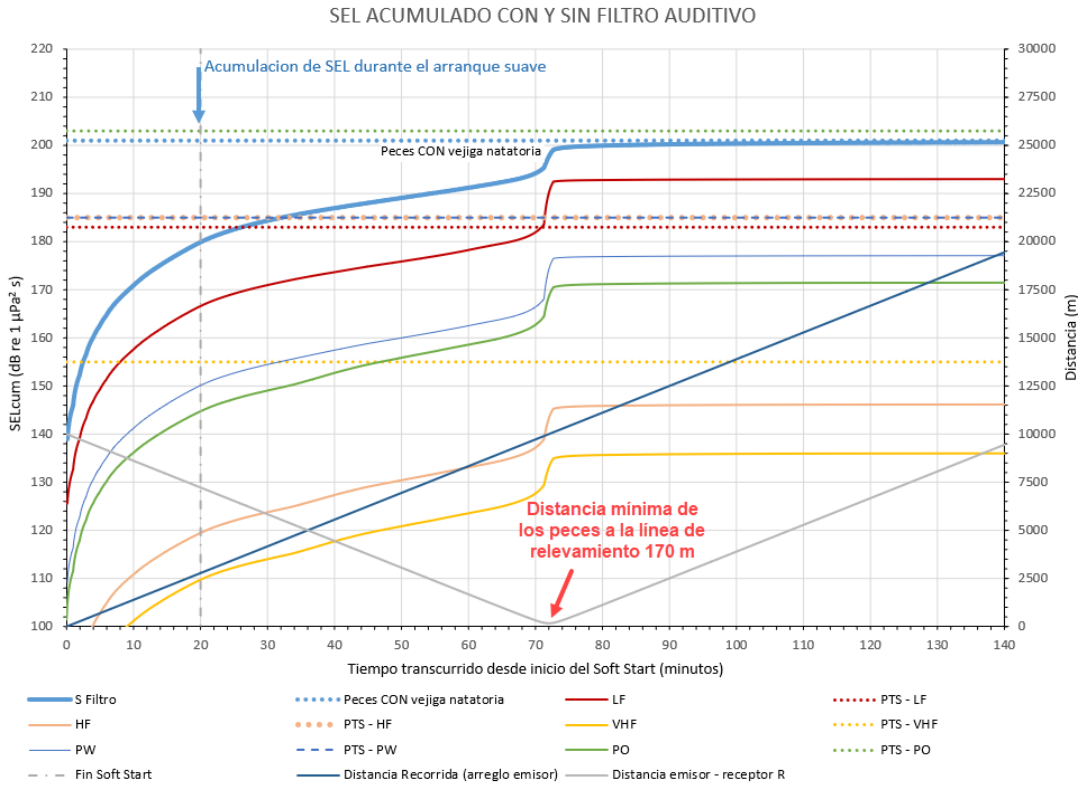


Figure 37. CAN_100-108. Cumulative SEL equal to the potential mortality threshold for fish with swim bladder, considering that they are located 170 m from the survey line.

The same analyzes of marine mammal escape scenarios were repeated considering the SEL results for the combination of sand-over-gravel soils, rather than the mud-over-gravel variant used for the preceding assessments.

Ultimately, the results are similar to the preceding ones, which was to be expected given that, in the first kilometers of relative distance between transmitter and receiver, the Transmission Losses are very similar for both types of soil, which have an influence at greater distances where the accumulation of SEL is less relevant.

The same SEL accumulation calculation procedure was performed for CAN_114 based on the results obtained for CAN_100-108, considering that the soft start is carried out with a minimum duration of 20 minutes, and that the trajectories are the same as those evaluated for the previous area.

The results are presented in Figure 38 and Figure 39. Table 8 displays the differences between the SELcum values reached and the PTS thresholds, which are only slightly lower than those for CAN_100-108.

Table 8. CAN_114 SELcum values (dB re 1µPa2 s) compared to PTS thresholds for mammals and limits for fish.

Filter	No Filter	LF	HF	VHF	PW	PO
Comparison thresholds	Fish WITHOUT swim bladder	PTS - LF	PTS - HF	PTS - VHF	PTS - PW	PTS - PO
	219	**183**	**185**	**155**	**185**	**203**
	Fish WITH swim bladder	TTS – LF	TTS – HF	TTS – VHF	TTS – PW	TTS – PO
	201	168	170	140	170	188
20-minute Soft Start. Initial position of the receiver 400 m away from the emitter on the line of advance.						
SELcum	**192.4**	**180.7**	**134.1**	**124.3**	**164.6**	**159.5**
PTS Difference	-8.6	-2.3	-50.9	-30.7	-20.4	-43.5
20-minute Soft Start. Initial position of the receiver 400 m away from the emitter. perpendicular to the advance line at the Soft Start starting point.						
SELcum	**191.7**	**178.9**	**132.6**	**122.9**	**162.8**	**158.0**
PTS Difference	-9.3	-4.1	-52.4	-32.1	-22.2	-45.0

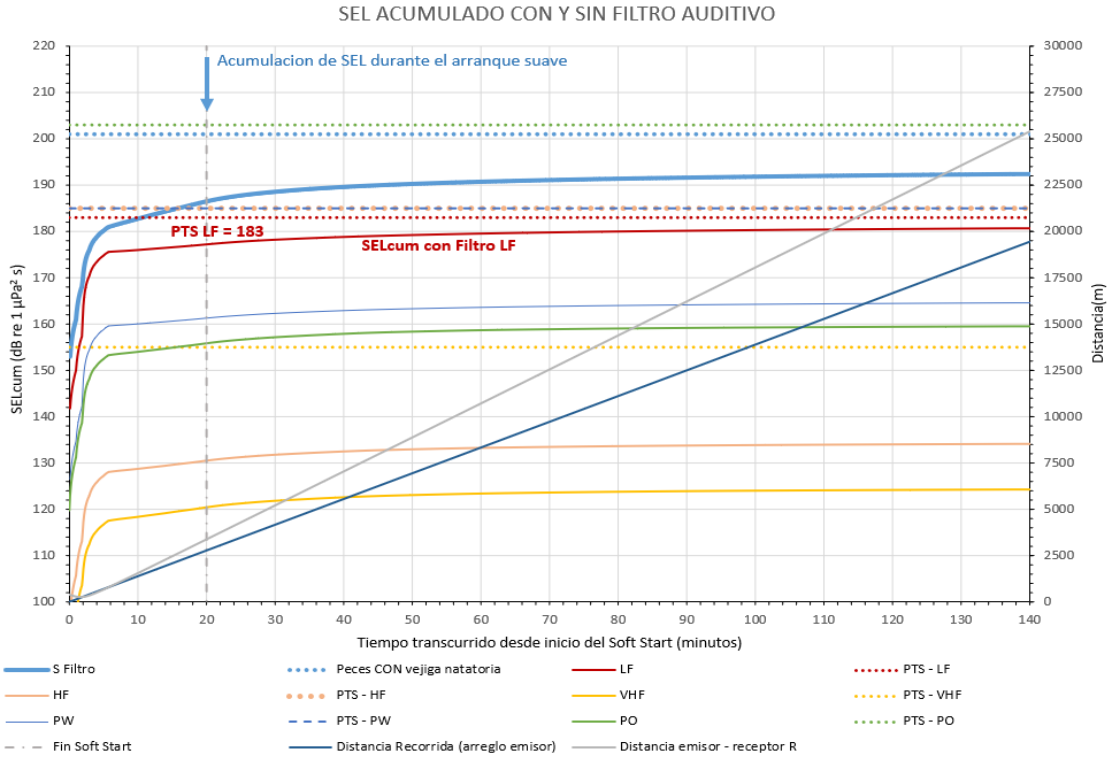


Figure 38. CAN_114. Accumulated SEL. 20-minute Soft Start. Initial position of the receiver 400 m away from the emitter, perpendicular to the advance line at the Soft Start starting point. 90º at 2 m / s Azimuth movement of the receiver.

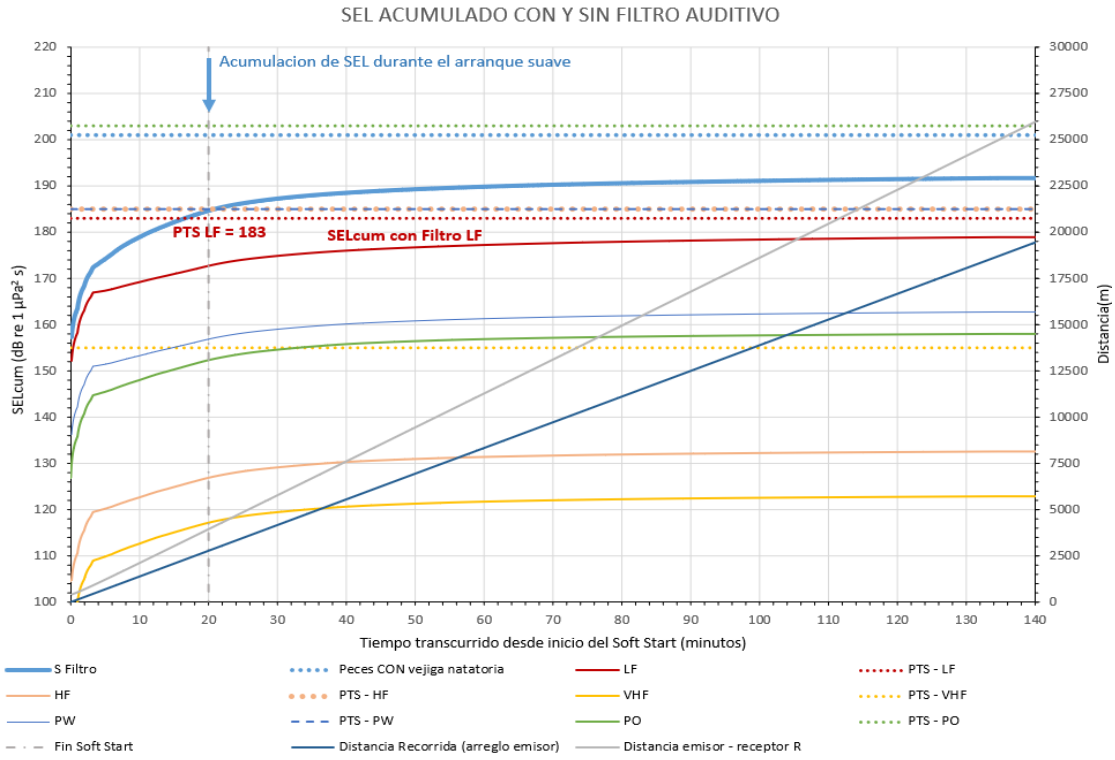


Figure 39. CAN_114. Accumulated SEL. 20-minute Soft Start. Initial position of the receiver 400 m away from the emitter, perpendicular to the advance line at the Soft Start starting point. 90º at 2 m / s Azimuth movement of the receiver.

6.12 CONCLUSIONS

The exclusion distances obtained by using the dual metric criterion proposed by Southall (2019) are 400 meters for both CAN_100-108 and CAN_114 areas.

This distance arises from the unfiltered SPLpeak criterion, with a limited PTS - VHF value (group of cetaceans with very high auditory frequencies).

It should be noted that the value obtained has been assessed by selecting the most conservative depth conditions and characteristics of the environment in terms of Sound Transmission Losses, but its magnitude is practically independent of the adopted seabed conditions. Nor are the Transmission Losses significantly modified according to the characteristics of the oceanographic profiles used (monthly sound speed and water density). Therefore, flexibility can be considered in terms of the months the surveys take up, provided they are not carried out in winter, when conditions change substantially.

The SELcum criterion was applied to verify whether the previously obtained exclusion distance should be extended by exceeding the PTS thresholds for any of the hearing groups.

A minimum duration of the soft start procedure of 20 minutes was considered, verifying that if it increases, the SELcum accumulation shall be lower.

The most restrictive situation of SELcum is generated for cetaceans with low auditory frequencies (PTS - LF). However, if scenarios of reasonable escape trajectories according to the bibliographic antecedents are proposed, SELcum values are lower than the PTS threshold, so the exclusion distance of the SPLpeak criterion is valid.

Nonetheless, it is convenient to extend this distance to 500 meters, which is a common standard used in the industry.

With respect to fish and considering the SPL metric, the distances in which the potential mortality threshold is exceeded are about 200 m for fish with a swim bladder and 100 m for fish without a swim bladder.

Distances as from 50 m from the array were analyzed through modeling, since, very close to the array, the SEL and SPL values are lower than those estimated from the far field, and the calculation of the propagation of some frequencies is ambiguous.

Regarding the SELcum metric, fish with swim bladders may be within 50 m of the array at the beginning of the soft start procedure, and if they were to remain static as the vessel moves away, the potential mortality threshold would not be exceeded. If they were just near a survey line and did not move when the array passes by emitting at full power (which is unlikely to occur as avoidance behaviors have been documented), the potential mortality threshold would be exceeded if the array distance were less than 170 m.

In contrast, fish without a swim bladder can be found within 50 m of the array without exceeding the potential mortality threshold for SELcum.

Although the implementation of mitigation measures with respect to fish is not required or feasible, it can be seen that only those around the array would be affected, and they would probably move not only during the soft start process, but also during the prospecting of each line if the array got closer to their location.

7. ENVIRONMENTAL IMPACTS ASSESSMENT

7.1 ENVIRONMENTAL SENSITIVITY ANALYSIS

The concept of environmental sensitivity is not easy to define. The "Guide for the Preparation of Environmental Impact Studies" published by the MAyDS (2019) defines it as "potential for damage (transformation or change) that environmental components may suffer or generate as a result of the alteration of physical, biotic, and social processes due to human intervention or the development of natural destabilization processes".

On the other hand, according to the "Prevention of Coastal Pollution and Management of Marine Biological Diversity" Project, there are three types of conditions that would allow an area to be considered as environmentally sensitive (Atlas of Environmental Sensitivity of the Argentine Coast and Sea, 2008). In the first place, those areas that present unstable and / or particularly unfavorable environmental conditions for biological production and recolonization. Second, those where the presence of threatened species is registered. Finally, the areas that have some particular ecological value and are vulnerable to natural and anthropic disturbances, areas with key species or that harbor fundamental sites or processes from an ecological point of view.

These conditions are basically of a natural type, and it is necessary to incorporate criteria into the identification of sensitive areas that allow sensitivity to be considered also from the anthropic point of view. Throughout Chapter 5 (Environmental Baseline), a detailed description of the various components of the environment in which the project is expected to be developed was presented through the gathering and analysis of background information.

Beyond any natural or anthropogenic characteristic of a certain area, the level of environmental sensitivity is closely related to the degree of susceptibility of the environment to a given project. In this particular case, said susceptibility is related to seismic acquisition activities. From the interrelation of these two aspects and within the framework of this project, the sensitivity analysis developed for the area of influence is presented below.

The analysis was developed considering the situation of each factor in different seasons. This division was made based on the typical behavior of meteorological variables, that is, considering possible differences for: spring, summer, autumn and winter.

The different factors belonging to the natural and socio-economic environment to be considered in the Environmental Sensitivity Assessment (ESA) were selected. Given the nature of the project and in relation to the physical environment, no particular factors have been identified that should be incorporated in this analysis. Regarding the anthropic component, the analysis involved those relevant activities that could be directly and / or indirectly affected in their normal development or potential as a result of the project´s development process.

The main adverse effect on the biotic environment is related to noise generation, although the presence of seismic vessels can lead to collisions or snagging with the seismic gear. The types of effects can be ordered from highest to lowest such as mortality, permanent or temporary hearing damage, confusion in the perception of sounds (discrimination of intensity, frequency, direction or distance), behavioral changes (escape, modification of trajectories), covering up of socialization or echolocation signals.

Following the methodological framework proposed, an analysis of the main bibliographic reviews on hearing, anthropogenic noise impacts and ecological characteristics commonly used to evaluate sensitivity was carried out, in order to: a) determine taxonomic groups with differential behaviors / responses, b) verify the occurrence of criteria that indicate particular characteristics of sensitivity and c) determine the times of the year when the main species of the group are present in the area of influence of the project (described in the Environmental Baseline).

The analysis is correlated with the areas of influence defined in Chapter 5 (Environmental Baseline). The characterization carried out in the Baseline allows the detailed analysis of species considering biological, ecological, conservation criteria, etc., particularly in the surroundings of the subzone defined as a Detailed Study Area (which widely exceeds the delimited AID depending on the area of maximum incidence of the propagation of the noise generated by the seismic array) and outside said subzone, already within the IIA, depending on the behavior of the birds and marine mammals considered, and according to the definition of the areas of influence referred to hereinabove. At a broader general scale or “regional area of influence”, the analysis considers the identification of sensitive environments (ANP, AICAs, Proposed Marine Areas, etc.).

The analysis of the sensitivity of the species present in this area is extremely valuable, so this information has been taken as input for the impacts assessment. It also highlights the existence of areas located in the project's area of influence that are associated with high sensitivity and which were included in a sensitive or critical areas map, since many of them are used by the species present in the analyzed area.

Among these, the coastal protected areas stand out, which, however, are more than 300 km from the operational area and are directly influenced by CAN_100-108 and CAN_114. It is worth mentioning that the "Restinga del Faro" Natural Reserve of Defined Geological and Faunal Objects and the Botanical, Faunal and Educational Natural Reserve named "Puerto Mar del Plata" are inserted within the area of direct influence of the logistics route that connects the areas of acquisition of seismic data with the Port of Mar del Plata.

Given the nature of the project, marine protected areas (MPAs) should be especially considered. At present Argentina has 3 entirely marine protected areas (MPAs): Yaganes and Namuncurá/ Burdwood Bank I and II, which are all located in the South Atlantic more than 1000 kilometers from the study area. The interaction with these protected areas is negligible.

In view of this situation, the future marine areas to be protected are of particular importance. These sites relevant to the biodiversity of the Argentine Sea have no creation proposals for now. The closest to the prospecting area is the Front of the Slope (FT), located 30 km from CAN_100-108 and CAN_114 operating areas (and 17 km from the area of direct influence) and therefore, situated in the indirect area of influence of the seismic acquisition zones. The Middle Platform Front (FPM) is located 114 km from the prospecting areas and outside its area of influence. Both areas shall be crossed by the logistics route that connects the CAN_114 Area with the Port of Mar del Plata. The FT is one of the most extensive and persistent ocean fronts of the Patagonian Sea, with a key ecological and functional role for the Patagonian marine ecosystem.

In addition to these legally protected areas, there are certain sectors of the Argentine territory that have been identified as ecologically relevant due to some particular aspect. The core area closest to the CAN_100, CAN_108 and CAN_114 seismic prospecting area is the so-called Edge of the South Slope, which is located 250 km away. On the other hand, the "Costa Atlántica Argentina" APP is located in the area of influence of the port of logistical support and the logistics route, while the logistics route of the ships crosses the "Banco de Mejillones" APP.

Likewise, and although the AICAs correspond to terrestrial or coastal areas, far from CAN_100-108 and CAN_114 seismic data acquisition areas, it is worth mentioning that the "Playa de Punta Mogotes and Puerto de Mar del Plata" AICA is inserted within the area of direct influence of the logistics route. Considering that there are particular situations that require special treatment, Dellacasa et al., (2018) delimited 55 "candidate sites" of Marine AICAS in Argentina to date which are awaiting confirmation by Bird Life International. Many of these AICAS are close to the coast, so they do not present a risk of being affected by the project. As part of the work, however, several marine AICAS have been defined such as the so-called “North Patagonia Slope Waters” for its proximity to the study area. This is an area on the continental slope in front of “El Rincón”, characterized by the presence and use of space by two large albatrosses, the wandering one and the northern royal, very long-lived species whose feeding journeys are long and can fly 7,000 km in two weeks. It shall be crossed by the logistics route that connects the Port of Mar del Plata with the CAN_114 Area.

The analysis has shown that the study area presents a moderate sensitivity throughout the year in relation to benthic invertebrates. The zooplankton shows intermediate sensitivity but only during spring and summer. The rest of the year is low. Autumn is also of moderate sensitivity, considering the presence of myctophid larvae.

Regarding cephalopods, the areas with the highest concentrations and reproductive groups would be found in the indirect area of influence of the project in spring and summer, but the area of direct influence would be partially synchronized with the pre-reproductive concentrations of the Buenos Aires-North Patagonian subpopulation grouped in high density at the edge of the platform during the autumn and winter. An additional impact would occur during the laying of eggs and larvae from winter until spring from the southern zone due to the action of the Malvinas current. For this reason, the sensitivity rate is high during the autumn /winter months and low during the rest of the year. The area of influence of the project does not overlap with the areas with the highest landings of cephalopods in the 2003-2017 period. The fleet closest to the area of indirect influence is that of freezer vessels of southern species.

In the case of fish, the sensitivity has been defined as low or medium depending on the species analyzed. The results indicate that most of the taxonomic orders fall into the category of medium sensitivity. It should be noted that there is no information on the breeding area for many of the species; this is why they were assigned the highest overvalued sensitivity rating. Taking into account this situation, the effects of the study at the population level shall be low, and in general, the species identified in the project's area of influence have a wide distribution (some are even frequent on the slope and the platform).

It is also considered that the seismic activity shall have a low interference on the most relevant fisheries. The greatest fishing efforts are observed mainly outside the area of direct influence. Only the pollock, toothfish and squid fisheries could be affected depending on when the fishery survey is conducted. The activity becomes very important in the front area of the slope, especially during the autumn and winter periods. However, it is outside the area of direct influence of CAN_100-108 and CAN_114 areas. Squid larvae are recorded for the area of indirect influence of CAN_100-108 and CAN_114, but it is also possible to find them in the prospecting area. However, these larvae come from spawning areas located in other zones of the Argentine Sea. The area of direct influence is not identified as a breeding area of commercial species. As said, species of fishing interest do not have their spawning site in said area of influence. In any case, summer is the most convenient season for seismic work from the point of view of fisheries, and autumn and winter should be ruled out to avoid potential interferences.

The area of influence of the project is not a breeding area for sea turtles, since there are no breeding areas in our country. CAN_100-108 and CAN_114 seismic data acquisition areas are located in the migratory corridor of the sea turtle species considered to be present in the project's area of influence. The area is not specially visited by sea turtles, but telemetry studies have confirmed the occasional occurrence of juveniles and sub-adult individuals. The warm months are those that register the greatest number of sightings. Therefore, the period of major sensitivity would be spring and summer for the turtles. The sensitivity has been considered moderate for sea turtles, and high for the loggerhead turtle which has been regularly seen in the study area lately. This group would present a low sensitivity for the rest of the year.

The project area is a very important feeding site for birds throughout the year and also a temporary area for interhemispheric migrators. The analyzed sector is located on the continental slope, which exerts a particular attraction on seabirds due to the concentration of planktonic organisms, fish and cephalopods that feed and reproduce in these waters. However, the species do not breed in the high seas, having their nesting and breeding sites hundreds or thousands of kilometers from their feeding areas. Some that breed in the Malvinas Islands (e.g. black-browed albatross) or in the South Georgia Islands (e.g. wandering albatrosses) use the platform and its slope from 60 ° S to 35 ° S as a feeding area, in front of the Río de la Plata near the Brazil-Malvinas confluence. They all carry out large migrations between their breeding and feeding areas.

The Procellariiformes and the Charadriformes stand out for their extraordinary flying abilities and their extensive travels of several thousand kilometers. They carry out daily or seasonal migrations, moving between breeding and feeding areas using migratory routes or corridors that pass over the slope. All species are top predators and good divers, feeding on squid, pelagic fish (anchovies and mytophids), salps, crustaceans (krill), and also floating garbage, such as fisheries waste. In this sense, it is concluded that this group presents, in general, a medium sensitivity for the area of operation and of direct influence of the project, becoming more important at the front of the slope (which is located 30 km from the prospecting area). After analyzing data from incidental catches of birds, Favero et al (2005) mentions that the abundances are greater where the temperature gradient coincides with the slope, as occurs along the northwest edge of the Malvinas Current, with abundance peaks generally observed between May and October. However, data from juvenile and adult non-reproductive tagged individuals show that they may also be present at other times. In the case of penguins, the identified species may be present in the area of influence of CAN_100-108 and CAN_114 during their autumn migrations north of the confluence area, and also when returning to their breeding colonies in late winter. It is important to highlight the Whitebeard Petrel´s situation. This species is not only common but also abundant in the area. In addition, it faces a high degree of threat, being considered Threatened at the local level but Vulnerable at the regional level. For this reason, their sensitivity to the project is considered high during the warmer months.

The area of influence would work as a passage and feeding area for mammals, but would not be a breeding area for the more abundant marine mammals. However, this possibility cannot be ruled out for some species with probable presence due to lack of information. The sensitivity could be considered moderate throughout the year. In the case of the 4 species of whales classified as highly sensitive, a clear period of greater sensitivity is not identified, but spring could be considered more critical.

From the anthropic point of view, the area of influence of the project presents a medium - low sensitivity in terms of navigation. As for CAN_100-108 and CAN_114 operative areas, a marginal relationship with the fishing areas is observed where the fishing effort is mainly concentrated at the front of the slope, located 30 km from the prospecting area and 17 km from the aforementioned operational areas. The density of marine traffic could be considered moderate according to what was surveyed in the Environmental Baseline within CAN_100-108 and CAN_114 operational areas.

7.2 IDENTIFICATION OF ENVIRONMENTAL IMPACTS

The potential impacts of the 3D Offshore Seismic Record of CAN_100, CAN_108 and CAN_114 Areas have been identified through a systematic process by which the activities (both planned and unplanned) associated with the project have been considered as to their potential interaction with environmental factors.

A Matrix of Potential Interactions has been used as a tool to carry out this identification (Table 9). In said matrix, the rows correspond to the various actions of the project that could act as a source of impact. Also, the relevant environmental factors have been listed in the columns.

Table 9. Matrix of Potential Interactions.

COMPONENTES AMBIENTALES / ACCIONES			MEDIO FÍSICO				MEDIO BIÓTICO						MEDIO ANTRÓPICO							
			Agua superficial	Aire	Geología	Oceanografía	Mamíferos marinos	Peces y cefalópodos	Tortugas marinas	Bentos y plancton	Aves	Áreas protegidas y sensibles	Actividad pesquera	Actividad hidrocarburífera	Tránsito Marítimo	Infraestructura subacuática	Actividades económicas	Población	Patrimonio arqueológico	Infraestructuras, recursos y usos terrestres
Registro Sísmico Offshore 3D Áreas CAN 100-108 y CAN 114	**Actividades planificadas**																			
	Operación de las fuentes sísmicas (emisiones de aire comprimido)						X	X	X	X	X	X	X							
	Navegación de los buques sísmicos y de apoyo y presencia física del equipo sísmico						X		X		X	X	X		X					
	Emisiones, efluentes y residuos asociados a la operación normal y el mantenimiento de los buques sísmicos y de apoyo (y otras operaciones)	Emisiones lumínicas de los buques									X	X								
		Emisiones gaseosas		X																
		Emisiones sonoras de los buques (y helicóptero)					X	X	X		X	X								
		Generación de efluentes líquidos en los buques																		
		Generación de residuos en los buques																		
	Demanda de mano de obra y de bienes y servicios																X			X
	Eventos no planificados (contingencias)																			
	Derrames de hidrocarburos		X				X	X	X	X	X	X	X							X
	Descarga accidental de sustancias químicas y/o de residuos sólidos, no peligrosos/peligrosos		X				X	X	X	X	X	X								

	Sin interacción o Interacción sin impacto
X	Interacción potencial identificada

Diagram translation

"3D" Offshore Seismic Record of CAN 100, CAN 108 and CAN 114 Areas.

(From left to right) Environmental Components/Actions/Physical Environment/Biotic Environment/Anthropic Environment.

Surface water/Air/Marine Mammals/Fish and Cephalopods/Sea turtles/Benthos and Plankton/Seabirds/Protected and Sensitive Areas/Fishing Activity/Hydrocarbon activity/Maritime Traffic/Underwater structure/Economical Activities/Population/Archaeological Heritage/Infrastructure, resources and terrestrial use.

Planned Activities/Seismic Sources Operations (compressed air emissions)/Seismic and Support Vessels Navigation and Physical Presence of Seismic Team/ vessel light emissions/ gaseous/ vessel (and helicopter) Sound emission emissions/liquid effluents of vessels/waste of vessels/

Unplanned Events (contingencies)

Oil spills

Accidental Discharge of chemical substances and/or solid waste, hazardous and non-hazardous

No interaction/Interaction without impact

Identified Potential Interaction

Each resulting cell in the Potential Interaction Matrix therefore represents a potential interaction between a Project activity and a factor in the environment. Each of the possible impacts has been classified into one of two categories:

- No interaction (blank cell) or probable interaction without impact: where the Project is unlikely to interact with the environmental factor (for example, projects that are fully developed in marine environments may not have interaction with the terrestrial environment); or where an interaction is likely to exist, but the resulting impact does not change baseline conditions; and

- Identified potential interaction (X): where an interaction is likely to exist and the resulting impact could potentially cause an effect on the receptor factor.

It should be noted that the list of actions is not intended to be exhaustive, but rather an identification of the key aspects of seismic prospecting operations that can potentially interact with the environment / cause environmental impacts. Based on the Project Description (Chapter 4), the following actions are considered within the ordinary activities or planned events:

- **Operation of seismic sources (compressed air emissions):** underwater sound emission generated by compressed air power sources during the acquisition of seismic data.

- **Navigation of the seismic and support vessels and physical presence of the seismic equipment:** navigation of the vessels in the operational areas, during the acquisition of seismic data and from / to the support port in the Port of Mar del Plata, and the presence of the deployed seismic equipment (streamers) during seismic data acquisition.

- **Emissions, effluents and waste associated with the normal operation and maintenance of seismic and support vessels (and other operations):** Sound emissions that shall be produced on the surface and in the water due to the operation of the vessels involved in the project, mainly associated with the propulsion propellers and the helicopter that is used in a possible emergency; light emissions used on ships; gaseous emissions associated with the combustion of engines for propulsion and power generation in ships, other associated operations that generate gaseous emissions (for example, waste incineration).

- **Demand for labor, goods and services:** the development of the project requires mainly qualified labor, although it also includes basic services in terms of navigation operations. The project does not require the construction / development of logistics facilities on land, but uses those in existing ports with enough capacity to receive operations of this type. The project establishes the port of Buenos Aires as a port of call (mobilization / demobilization) and the Port of Mar del Plata as a port for supplies or logistics services. The operations of the vessels associated with the project do not differ from those of any other vessel docking in these ports.

Unplanned/accidental events, or contingencies are considered separate from routine activities, as they only occur as a result of technical failure, human error, or other emergencies. Equinor and the seismic contractors shall maintain high operational performance and adherence to good industry practices at all times. However, as in most projects, there is a low probability of an accidental event to occur:

- **Hydrocarbon spills:** considering the spillage of fuel or lubricating oils used by the Project ships.

- **Accidental discharge of chemical substances and / or non-hazardous / hazardous solid waste:** considering the chemical substances used in the project vessels for cleaning and maintenance, as well as the management of waste generated on board.

The list of environmental factors is a list of key aspects of the environment that are considered vulnerable or important within the context of marine seismic survey activities in CAN_100 - 108 and 114 areas.

Based on the actions identified in the previous section and the possibility that these interact with the environment, the following factors were identified that are not expected to be affected by the project.

- **Geology:** Although the geological environment is relevant for the development of the project, the geological processes shall not be altered.

- **Oceanography:** The activities carried out from the survey vessel shall necessarily take into account local and regional oceanographic conditions. However, they shall not be affected by the exploratory operations under study.

- **Hydrocarbon activity:** There are no hydrocarbon wells, pipelines or concession zones in the study area, beyond those that were particularly tendered. However, there is a record of the existence of 2D exploratory activities. In this sense, no interferences with these activities are foreseen; however, the PGA considers measures in relation to interferences with potential adjoining exploratory activities in the tendered areas.

- **Offshore infrastructure:** The operational area is located approximately 400 km south of the underwater cable "Atlantis-2", which is the southernmost of all the cables present in the area, therefore, it shall not be affected by the project.

- **Population:** There are no receptors near the Project site. The seismic data acquisition area is approximately 300 km from the closest coastal area in the Province of Buenos Aires, beyond 12 miles from the territorial sea. Given the nature of the project, no interactions are foreseen between the project and the territorial coastal strip. Modern marine seismic exploration does not produce significant pulses of airborne noise.

- **Archaeological heritage:** The seismic data acquisition area is located offshore in open waters. No archaeological sites of interest have been detected in the study area and project activities are carried out far from the seabed.

The list of environmental factors is a list of key aspects of the environment that are considered vulnerable or important within the context of marine seismic survey activities in CAN_100 - 108 and 114 areas. A total of 12 factors were then considered, including: Surface water, Air, Marine mammals, Fish and cephalopods, Sea turtles, Benthos and plankton, Birds, Protected and sensitive areas, Fishing activity, Maritime Transit, Economic activities and Infrastructures, resources and terrestrial use.

7.3 SYNTHESIS OF POTENTIAL IMPACTS

Next, the main conclusions of the analysis carried out on the potential impacts of the activity in relation to the natural and anthropic environment are summarized and shall be found in Chapter 7 - Environmental Impact Assessment.

An analysis of the project was conducted from an environmental perspective for the identification of the environmental impacts, and from an analysis of the environment in relation to the specific project. Based on the analysis of the project and the environmental diagnosis of the area, the identification and the environmental impacts assessment generated by the “3D” offshore seismic record of CAN 100, CAN 108 and CAN 114 areas were carried out.

Like most human activities, seismic exploration tasks can cause some unwanted effect upon the environment in terms of the high noise levels required for investigations. It should be noted, however, that the effects shall be specifically located and of limited duration so that mitigation measures may be applied.

Other potential impacts are those usually derived from the operation of ships, since a vessel shall be necessary to carry out the seismic survey. These impacts do not differ from those that are already produced by ship traffic in the work area. In fact, the risk is very low as no oil or derivatives are transported apart from the fuel and lubricants necessary for the navigation itself.

Consequently, this assessment emphasizes the particular aspects of seismic recording related to noise disturbance, considering the possible affectation of fauna and also taking into account the background of specific investigations developed since the beginning of the use of these systems in recent years.

Sound waves move through a certain environment transferring kinetic energy from one molecule to the other. The sea is full of sounds. Marine organisms use sound for many vital functions to inform themselves about their environment, to detect prey or predators, and for orientation and social communication purposes (Hawkins y Popper 2014).

Certain natural events are associated with near-threat situations for certain marine organisms, which present evolutionarily developed adaptive strategies to minimize their exposure to such predictable sources of threat. For instance, marine eruptions with escaping gases and lava can be announced by sound and seismic waves. They are perceived above the background noise activating physiological alarms that translate into escape behaviors. Other extremely loud sounds are considered annoying or unpleasant noises which generate displacement or avoidance behaviors. Most marine vertebrates have auditory mechanisms, but it is important to note that animals also detect sound waves by non-auditory mechanisms.

Potential effects of seismic survey on marine mammals include behavioral disturbance (feeding, breeding, resting, migration), localized displacement, change in vocalizations, masking of sounds necessary for communication and navigation, physiological stress, and physical injury, including temporary or permanent hearing loss. The scope of the effects varies depending on the mammal species, sound level / proximity to the seismic source and pre-exposure activity.

Animals that are exposed to high anthropogenic noises, or for long periods of time, may experience passive resonance that generates direct damage ranging from bruising or organ damage, to extreme cases of death from barotrauma (e.g. by explosions). These damages can cause a temporary (TTS) or permanent (PTS) shift of hearing thresholds affecting communication and detecting threats capabilities. Mitigation measures have been developed to avoid this situation which alert organisms of the presence of an intense noise source (eg Soft start protocols) and also guidelines to calculate these thresholds and define safe distances to suspend seismic operations if an organism of a species of interest penetrates within that radius.

Some marine mammals can avoid the potential damage that noise can cause from compressed air energy emissions by moving away from the source. They must, therefore, determine where this source is, either by phase differences (arrival time) to their two ears, or by intensity differences.

It is important that the noise level increases progressively, so that the animals are not surprised by a high intensity shot when they are a short distance from the source.

This is the principle that is applied to the Soft Start, a mitigation procedure that is required in many parts of the world (in particular, in the “Guidelines to minimize the risk of damage to marine mammals compared to geophysical studies” of the United Kingdom Joint Nature Conservation Committee (JNCC, 2017).

Although this system does not guarantee that all marine mammals shall be able to get away from the source in all circumstances, and that there may also be a negative factor which implies an increase in the amount of “not useful” noise, it is considered an appropriate measure to minimize risks to both individuals and animal populations.

According to the Acoustic Modeling presented in Chapter 6, the most demanding SPL pk (0 - p) condition corresponds to the threshold of temporary hearing loss (TTS) of marine mammals of the very high auditory frequency (VHF) type cetaceans). This threshold is reached in a radius of about 1006 meters with center on the source in the CAN_100-108 area, and in a 945 meter-radius for the CAN_114 Area. The most restrictive permanent hearing loss threshold (PTS) is also for the VHF group, which is reached at about 391 meters for CAN_100-108 areas, and at 377 meters for the CAN_114 Area. These last distances, those corresponding to the PTS criterion, are used to establish the mitigation zones that in this case could be established at 400 meters for both CAN_100-108 and CAN_114 areas.

According to the Environmental Sensitivity Analysis, the area where the seismic prospecting is planned would work as transit and feeding areas. It is not a breeding area for the most abundant marine mammals, however, for some with a probable presence, this possibility cannot be ruled out due to lack of information. The sensitivity could be considered moderate throughout the year. In the case of the 4 species of whales classified as highly sensitive (Southern Right Whale, Sei Whale, Blue Whale and Fin Whale) a clear period of greater sensitivity is not identified, but spring could be considered the most critical.

Based on the proposed analysis methodology, and considering the sensitivity of the study area and all the attributes assessed in terms of the effects (intensity, extension, moment, persistence, reversibility, synergy, accumulation, effect, periodicity and recoverability), and considering the most unfavorable condition that would arise when the surveys are carried out in spring 2021, the importance of the impact of the seismic acquisition on marine mammals is moderate.

The scientific background collected indicates that, although seismic procedures affect the behavior of **fish** near the source, the magnitude of this effect would not generate long-term changes in the size of fish populations.

According to the Environmental Sensitivity Analysis, the fish groups known to be present in the project area include those with low and moderate sensitivity, depending on the biological (including hearing sensitivity, seasonal activity, distribution and trophic niche) ecological, and conservation criteria, as well as the fishing interest exposed.

The results of the acoustic modeling establish that the most demanding threshold (fish with a swimming bladder) which indicates that possible fatal or life-threatening injuries may occur in the fish, is found within a source centered 206 meter-radius for CAN_100 and CAN_108 areas, and within a 200-meter radius for CAN_114 Area for the present project.

In this regard, the existing mitigation measures associated with the project include the use of a soft start protocol at the beginning of each data acquisition line, in which the sound gradually increases over a period of time. Sound levels shall also slowly rise and fall as ships move. This would allow fish in the vicinity of the sound source to move away before the sound levels become harmful. Therefore, the risk of injury to individual fish is low and fish populations are unlikely to be affected, particularly considering that most of the species identified in the project area are widely distributed, and some are even frequent on the slope and the platform.

The project area overlaps with the breeding area of the Rajiformes, and the fact that it coincides with the breeding area of some other species cannot be dismissed due to the lack of information. The reproductive period of the Rajiformes, which is long, presents low sensitivity. It should be noted that none of the bony fish species of commercial interest are bred in CAN_100-108 and CAN_114 area of direct influence.

Whereas the early stages of life (eggs and larvae) cannot avoid the sound pressure wave, the bibliography indicates that the damage is limited to areas close to the source (less than 5 meters), therefore, that mortality is so low that it can be considered to have a negligible impact at the population level.

The impact was classified as moderate bearing in mind that, although the injuries at the individual level of the fish may be registered in a limited space near the source, and therefore may present a low risk at the population level (which could be solved considering the soft start measure), the behavioral responses could imply the temporary distancing from the feeding and spawning areas of those species that overlap with the project area.

The impact is considered low for **cephalopods** considering that the sensitivity for the squid (Illex argentinus) would be low during the seismic process (spring - summer). The impact upon eggs and larvae of this species, as indicated above, is subject to the drift that the Malvinas current may produce, since the project area does not overlap with the spawning area; and on the other hand, it is limited to the surroundings near the sources (5 m), so the effect is negligible at the population level, and in turn, it is very precisely localized. The rest of the evaluation criteria are identical to those mentioned for fish, therefore, the impact on cephalopods would also be of moderate importance.

The project's area of influence is not a breeding area for **sea turtles**, since there are none in our country, nor is it characterized by the especially frequent presence of sea turtles; Therefore, it would predominantly work as a passage area and as a seasonal feeding site. According to the sensitivity analysis developed, the most sensitive seasons would be spring and summer since the greatest number of sightings are recorded during said period, so it is considered high to moderate (depending on the species). This group would present a low sensitivity for the rest of the year.

It should be noted that the lack of research makes understanding the impacts on individuals difficult and the implications on populations almost impossible to figure out. Furthermore, the frequency and duration of exposure to seismic surveys is not discussed in the literature, an issue that is clearly important when determining the level of risk to turtles. Based on the studies that have been conducted to date, it is considered unlikely that sea turtles are more sensitive to seismic operations than cetaceans or some fish. Therefore, mitigation measures designed to reduce the risk or severity of exposure of cetaceans to seismic sounds can be informative about measures to reduce the risk or severity of exposure of sea turtles to seismic sounds. However, sea turtles are more difficult to detect visually than many species of cetaceans, so sighting-based mitigation strategies are expected to be less effective for turtles than for cetaceans.

Collisions with ships and physical entrapments are other types of possible impacts linked to seismic surveys. In fact, sea turtles that get very close to boats and streamers could be trapped by or collide, particularly with terminal buoys which are usually located several kilometers from the stern of the boat. Therefore, these interactions are not easily monitored.

For all the above, the impact on this faunal group is considered moderately important.

No protected species have been identified in the consulted bibliography for both **benthos** and **plankton** components within the project area.

The area does not overlap either with zones of maximum phytoplankton productivity, nor of maximum zooplankton biomass. However, it is considered that in relation to zooplankton, crustacean larvae and Krill have a higher (intermediate) sensitivity during the spring and summer seasons since it is the maximum productivity period. The sensitivity of this component is low for the rest of the year.

Although the emerging bibliography indicates that seismic activity can cause a mortality increase in zooplankton communities, this impact is significantly revealed locally and within the area limited to the operation of the seismic source. Additionally, its effect can be considered temporary, since a substantial recovery has been verified after 72 hours.

The area of influence of the project presents an intermediate sensitivity for benthic communities throughout the year. The indirect area of influence of the project does not overlap with the areas with the highest coral density. However, the CAN_114 seismic data acquisition area partly overlaps with the north of the areas considered Vulnerable Marine Ecosystems. The Patagonian scallop is observed with low biomass density in the indirect area of influence of the project, however, in the area of direct influence of CAN_100-108 and CAN_114 areas, no reproduction, feeding or breeding sites of this species are found. The decapod crustacean species registered in the indirect area of influence of the project are not economically important, presenting bycatch / incidental fisheries, although they have great ecological relevance. In the CAN_100-108 area of direct influence of the project, only one breeding and molting site is recorded, but with a very low density of king crabs. The CAN_114 area of direct influence of the project does not overlap with king crabs´ breeding or feeding sites.

It must be taken into account that when referring to benthic organisms, the seismic vessel shall always operate between 1200 and 3900-meter deep waters. Considering that the revised bibliography indicates that these organisms can be affected in the field close to the sound sources (5 meters away) and that these sources shall be located 6 meters deep, said organisms shall not be affected.

According to the above, the impact due to prospecting activities is related only to the affectation of zooplankton (excluding the affectation of fish eggs and larvae that was previously evaluated), which shall be of medium intensity given the sensitivity associated with crustaceans and krill. Thus, the importance of the impact of seismic prospecting on plankton is low.

Based on the low impact of this component, a negative effect on fish, birds and marine mammals that feed on these benthic and plankton communities is definitely ruled out.

Regarding **seabirds**, the project area is very important as a feeding area throughout the year and also as a passage area for interhemispheric migrators. However, the species present do not breed in the high seas, having their nesting and breeding sites hundreds or thousands of kilometers from their feeding areas, for which the project area is considered to have medium sensitivity throughout the year. In this regard, it is also worth noting the situation of the white-bearded petrel, which, in addition to being abundant, faces a high degree of threat. For this reason, their sensitivity to the project is considered high during the warmer months. This species is considered as Threatened at the local level but Vulnerable at the regional level.

According to bibliographic information, it is inferred that seabirds can suffer changes in behavior during the sounding stage, which shall be reverted once operations have ceased. The latest research suggests that behavioral displacement or avoidance responses occur, but it may depend on the response of its prey. Given that the effects of the project on the components of plankton and fish on which the birds feed shall, in any case, be temporary, this behavioral response may, at most, also be temporary. In the case of the group of depth divers, represented by the penguins in the study area, the available bibliography indicates that the avoidance behavior of their feeding areas could be due to the fact that the sound impulses from seismic sources interfere with their group communications.

The presence and movement of vessels can impact the behavior of seabirds. As mentioned above, the effect of lights and flashes from vessels as potential attracting situations for seabirds flying at night is well documented. Artificial lights can cause collisions and mortality, particularly in conditions of poor nighttime visibility from the moon or stars (mist, haze), in which birds can become disoriented and crash into the boat or on deck, or become trapped between the seismic equipment deployed in the water. This attraction to lights can also cause birds to circle around ships, using additional energy, delaying their migration or feeding, which can result in starvation. These risks are particularly important for those species that feed on bioluminescent prey, and are naturally attracted by lights, such as the black-headed shearwater, one of the most abundant species in the area of influence of the project. This migratory species feeds in the area during the breeding season. They dive at shallow depths to catch their food among shoals. It is a kind of species that follows ships and can present a risk of collision or snagging.

According to the methodology adopted for the environmental assessment, the impact due to prospecting activities shall be of medium intensity considering that the bibliography consulted indicates that seismic sounding fundamentally produces behavioral effects on seabirds, which were classified with intermediate sensitivity given that the area of influence of the prospecting zone is far from the nesting and breeding sites of this group. The impacts on this component are mitigated as there are actions to be taken both with regard to the emission of prospecting activities (soft start) and the night operation of ships (light dimming). Pursuant to the abovementioned, the impact of the project on birdlife is moderate.

Regarding the potential impacts on sensitive or protected areas and because these represent areas of special sensitivity as they correspond to areas of breeding, spawning, feeding or breeding of species of ecological interest, any activity that is carried out in the vicinity of these areas must be specially controlled in such a way that it does not affect the normal development of said species.

In this regard, the project's area of operation and direct influence does not directly affect any declared or proposed protected area. However, the future marine protected area "Frente del Talud" (FT) and the AICA candidate "Aguas del Talud Patagonia Norte" stand out for their proximity, located about 30 and 28 km respectively, from the prospecting area, in the indirect area of influence.

Future marine areas to be protected are of particular importance. The closest to the prospecting area is the "Frente del Talud" (FT), located 30 km from CAN_100-108 and CAN_114 operating areas (and 17 km from the area of direct influence) and hence, situated in the indirect area of influence of the seismic acquisition zones. The Middle Platform Front (FPM) is located 114 km from the prospecting areas and outside its area of influence. Both areas shall be crossed by the logistics route that connects the CAN_114 Area with the Port of Mar del Plata. The FT is one of the most extensive and persistent ocean fronts of the Patagonian Sea, with a key ecological and functional role for the Patagonian marine ecosystem. It should be noted that, although the proposed marine protected areas are relevant sites for the biodiversity of the Argentine Sea, they do not have creation proposals for now.

Considering the maximum valuation of the inserted components in the sensitive areas close to the seismic prospecting areas, the impact on this factor is classified as moderate.

The potential environmental impacts on **fisheries** due to the action of prospecting tasks can occur both due to the impact of seismic impulses on the species of fishing interest, as well as the interference that the activity can produce in relation to the circulation of the fishing fleet that travels through the sector in search of catch areas.

The impact on the performance of the fishing activity in the seismic acquisition area could occur as an indirect result of the affectation of the project on the fauna of fish and invertebrates, since these communities may be affected by seismic prospecting activities. However, the incidence of seismic acquisition activities still lacks firm conclusions regarding their impact upon catches. Possibly, any potential effect on fish does not necessarily turn into population-scale effects or disruptions to fishing. While different studies have shown that exposure to emission from seismic sources has an impact on fish catch, possibly as a result of behavioral responses and their distribution during and after exposure to sound, some authors suggest that the effects on fishing can be temporary, occurring mainly during exposure to the sound itself. In this regard, a non-binding relationship with the fishing areas is observed for the operational areas of the project. The fishing effort is mainly centered on the slope front, which, as mentioned above, is located 30 km from the prospecting area, and 17 km from CAN_100-108 and CAN_114 operational areas. The CAN_100-108 and CAN_114 direct area of influence supports a very low fishing effort that registers an annual variation.

The main species of fishing interest in the area of influence of the project are the following: hake, hoki, haddock, southern cod, black hake, southern hake, Pollock and squid. However, not all these species have the same fishing relevance in the areas of direct influence of CAN_100-108 and CAN_114. Only the pollock, toothfish and squid fisheries could be affected depending on when the fishery survey is conducted. However, pollock has low catches in the study area and its highest catches are recorded in the second and third quarters. Given that the project shall be conducted during the first and fourth quarters, specifically between October 2021 and the end of March, it shall not overlap with the time of highest catches of this species. Patagonian toothfish is caught almost all year round, with greater activity between September and December and much less in the summer season, so the project would coincide with the time of greatest catch, however, it is minimal in the area of direct influence of the project. North of 44 ° S, the Buenos Aires-North Patagonian subpopulation is exploited from March or April to June before the squid migrate to deep waters[3]. In this way, the development of the project does not temporarily overlap with squid fishing.

[3] Resolution 973/1997 Ex SAGPyA states that the opening of the squid (*Illex argentinus*) fishery shall take ´place north of parallel 44º as from May 1st until August 31st each year.

According to the proposed environmental impact assessment methodology, considering the low sensitivity of the fisheries in the project area, and given that the greatest fishing efforts are mainly observed outside the area of direct influence, the impact on the fisheries is low. The area of direct influence is not identified as a breeding area of commercial species. Although squid larvae are recorded for the indirect area of influence of CAN_100-108 and CAN_114 and it is also possible to find them in the prospecting area, these larvae come from spawning areas located in other areas of the Argentine Sea due to the action of the Malvinas current between winter and spring. And in any case, the impact would be limited to the proximity of the array (5 m), as previously evaluated. Nor is it recognized that the bony fish species of fishing interest have their spawning or breeding area in said area of influence. The areas with the highest concentrations and breeding groups of squid would be found outside the area of direct influence of CAN_100-108 and CAN_114 during the seismic acquisition period (spring - summer). In any case, and taking into account that the reviewed antecedents indicate that adult fish react to seismic operations at distances that in some cases would reach 30-33 km (although most of the impacts appear to occur at distances generally less than 10 km), and that the fishing effort is concentrated in the slope front, being very important during the autumn and winter, the seismic operations in the western sector of the seismic data acquisition area closest to said front could have some incidence on fisheries that coincide temporarily. However, the execution of the seismic activity under study is proposed for the spring 2021 - summer 2022 period, that is, outside the period of greatest sensitivity for fishing. The extension is considered partial as the project area represents only a marginal portion of the wide area in which the fisheries are distributed in the region, and only the western sector of the acquisition areas has some proximity to the slope front. The moment is immediate since the development of the prospecting action and the beginning of the effect would be contiguous. Persistence shall be temporary, since it would mainly occur during exposure to sound itself, and therefore reversible in the short run. It would be a periodic effect since all the activity is programmed. All the above mentioned means that the importance of the impact of the seismic survey on the fisheries is classified as low.

The main impacts affecting **maritime traffic** could be associated with an eventual interference in the normal traffic of vessels that are on the route that connects the seismic data acquisition area with the coastal support base and those navigating in the project area.

Fishing activity of deep-sea freshwater fleet and freezer trawlers is recorded in the vicinity of the project's area of influence. Due to the distances from the exploration area to the coast, the activity of the bay or estuary fishing vessels and nearby coastal fishing vessels shall not be interfered with by the prospecting operations. In particular, the operational areas of CAN_100-108 and CAN_114 hold a non-binding relationship with the fishing sites, mainly concentrated in front of the slope, which is located 30 km from the prospecting area and 17 km from the aforementioned areas. The area of direct influence supports a very low fishing effort with an annual variation.

Regarding the type of vessels that can be seen in the navigation routes connecting the Port of Mar del Plata and CAN_100-108 and 114 seismic data acquisition areas, fishing vessels prevail, followed by tankers and cargo vessels. To a lesser extent, there are also tugs and special and pleasure crafts, some unspecified ships and passenger vessels only in the location corresponding to the Port of Mar del Plata.

According to the Environmental baseline, the density of marine traffic could be generally considered moderate in CAN_100-108 and CAN_114 operational areas, therefore taking into account both the fishing activity and the current use of the area by other vessels. This factor has been considered with medium - low sensitivity in relation to the project.

However, if possible interferences are generated, they can be minimized through planning and effective communication with the port authorities and the Argentine Coast Guard. Thus, the impact on maritime traffic is considered low.

Regarding **economic activities**, the demand for logistics services may have some very focused effects in relation to the benefits provided by the port of logistics services (Port of Mar del Plata) and possibly in some other locations as to other supplies / services, but, in any case, there would be scattered aspects of little relevance, which shall not affect local economies. The impact on economic activities shall be of little relevance, but positive, in terms of the demand for labor, due to the number and qualification of the personnel required for the project and its development period.

However, at the macroeconomic level, the project involves the first stage of hydrocarbon exploration that shall lay the basis for planning and continuing with the subsequent drilling and exploitation. Beyond the important demand for labor and services, the benefits hydrocarbon exploration generates for the country from the energy point of view allows confirming new hydrocarbon reserves to be exploited commercially. In this way, the country strengthens its energy matrix to ensure its self-sufficiency, improving the trade balance and future exports with a potential development of offshore hydrocarbon basins in Argentina. As an indirect benefit, these future exports shall allow an important foreign exchange to improve national reserves.

Regarding **infrastructure, resources and land**, the use of the existing ports shall not imply conflicts as to their current services. Since the vessels associated with the project are between 40 and 100 meters in length, they shall require a modest docking space, and in any case, the largest seismic vessel shall dock in the port during the mobilization and demobilization stages, and during the survey period only if staying on the high seas turned dangerous.

Given the size of the metropolitan areas surrounding the aforementioned ports and the short term of the seismic record, the scale of the land resources and services demanded (fuel, food supplies, water, waste disposal, etc.) is not expected to be substantial to cause a significant indirect impact on other users.

Regarding **surface water**, the effects of a small fuel spill that are considered more likely to be associated with fuel transfers would depend on the sea conditions at the time of the spill. Overall, the impact is rated moderately important.

The impact related to the **gaseous emissions** of the project is of low intensity, localized around the ship (it is expected to rapidly dilute and dissipate as the ships move), of temporary persistence (duration of the project) and reversible in the short term, so its importance is classified as low.

Another potential environmental impact derived from the project is related to the inherent risk of **accidental hydrocarbon spills**. These risks are common to all ship operations, and must be managed through proper planning and applicable measures in case of contingencies. The potential impact of a fuel spill is highly dependent on its location, the weather conditions at the time of release, and the proper response and cleanup operations.

Likewise, the probability of a large fuel spill is remote (BOEM, 2014; NOAA, 2016). The spill of all fuel from the seismic vessel is considered particularly improbable, as the fuel is stored in a series of smaller double-bottomed tanks and their contents are unlikely to be lost simultaneously. In addition, the valves connecting the fuel tanks are kept closed, minimizing the loss of fuel if one of the tanks breaks, while the leaks in the storage tanks are directed to the oily bilge water tanks. Such measures would reduce the risk of accident by avoiding any damage to the aquatic ecosystem.

The effects of an oil spill on marine mammals, fish, turtles, benthic communities, plankton and birds have been analyzed and finally classified as moderate.

Taking into account the fact that CAN_100-108 and CAN_114 operational areas, where most of the vessel operations shall take place, do not overlap with protected or sensitive areas, it is considered that if a spill occurs within their surroundings, these impacts would range from minor to moderate, depending on time and location.

Also, significant levels of hydrocarbons on the surface can damage equipment used to catch commercial fish, and transfer contaminants to the catch. This can occur for example when demersal trawls and traps are retrieved through surface stains. An oil spill can cause the area to be temporarily closed to fishing. Regarding the species that may be affected by a hydrocarbon spill, the intensity of this impact is considered high. However, it is classified as moderate given its limited time and extent.

In the event of a hydrocarbon spill associated with the project in the port area, the operation of the port facilities could be temporarily affected depending on the deployment of response actions. The spill would be addressed through the use of ships and local spill response capabilities. Nevertheless, this impact is considered of low importance based on the limited volumes that would be involved in the event of an accidental event of this type, which would most likely be linked to failures in fuel transfer operations.

Finally, the accidental **discharge of chemical substances and / or solid, non-hazardous or hazardous waste** has been evaluated as another contingency. Chemicals used on board during seismic operations are limited to small amounts of cleaning products, solvents, and paints. These chemicals could accidentally spill during storage and / or handling and enter the aquatic environment through the deck drainage system. They are typically stored in small 5 to 25 liter containers and are stockpiled / used in internal areas where any leaks would be retained on board and cleaned in accordance with associated spill cleanup procedures.

However, some spills could occur when small containers of chemicals are used in open areas, where there is a risk of reaching the sea if spilled. Given the size of the chemical containers, the volume of liquid that could be released is limited to the volumes of the individual containers stored on deck. The realistic volume is 25 liters in the worst spill situation. Besides, ships operate with safety data sheets (SDS) available for chemicals on board that detail clean-up procedures for any spills. In turn, the crew is properly trained on these spill clean-up procedures.

Although chemicals released into the sea can cause a reduction in water quality with direct or indirect effects on marine organisms, the impacts would be limited to the immediate area surrounding the discharge point, prior to dilution with the surrounding sea water. In the open sea environment of the study area, a release is expected to dilute and spread rapidly and therefore any contamination would be temporary and localized. With the on board controls (for example, inspection, placement of barriers, spill clean-up procedures) such incidents are considered unlikely, so the impact is considered insignificant.

On the other hand, small amounts of non-biodegradable and hazardous solid waste may be produced during the development of the project. These wastes shall be generated, handled and stored on ships in accordance with the Waste Management Program of each ship, which the waste minimization hierarchy shall adopt to avoid its discharge into the sea. Non-biodegradable / hazardous solid waste shall be handled in accordance with the ship's Waste Management Program, which is governed by the policy of "not throwing non-biodegradable / hazardous solid waste overboard."

7.4 ENVIRONMENTAL IMPACT SUMMARY MATRIX

The Summary Matrix of Environmental Impact is presented below with the connections between actions and factors of the potential environmental impacts identified, and the final assessment obtained.

An additional "Less Significant" category of impact has been included to classify the interactions that have been assessed but their effects are not relevant enough to cause an impact.

Table 10. ENVIRONMENTAL IMPACT SUMMARY MATRIX.

	COMPONENTES AMBIENTALES / ACCIONES		MEDIO FÍSICO		MEDIO BIÓTICO						MEDIO ANTRÓPICO			
			Agua superficial	Aire	Mamíferos marinos	Peces y cefalópodos	Tortugas marinas	Bentos y plancton	Aves	Áreas sensibles y protegidas	Actividad pesquera	Tránsito Marítimo	Actividades económicas	Infraestructuras, recursos y usos terrestres
Registro Sísmico Offshore 3D Áreas CAN 100, CAN 108 y CAN 114	**Actividades planificadas**													
	Operación de las fuentes sísmicas (emisiones de aire comprimido)				-38	-32	-38	-24	-29	-35	-21			
	Navegación de los buques sísmicos y de apoyo y presencia física del equipo sísmico				-24		-24		-24	-24	-24	-24		
	Emisiones, efluentes y residuos asociados a la operación normal y el mantenimiento de los buques sísmicos y de apoyo (y otras operaciones)	Emisiones gaseosas		-24										
		Emisiones lumínicas de los buques							-24	-24				
		Emisiones sonoras de los buques (y helicóptero)			Poco significativo	Poco significativo	Poco significativo		Poco significativo	Poco significativo				
	Demanda de mano de obra y de bienes y servicios												16	Poco significativo
	Eventos no planificados (contingencias)													
	Derrames de hidrocarburos		-36		-40	-38	-40	-27	-40	-40	-35			-24
	Descarga accidental de sustancias químicas y/o de residuos sólidos, no peligrosos/peligrosos		Poco significativo		Poco significativo	Poco significativo	Poco significativo	Poco significativo	Poco significativo	Poco significativo				

REFERENCES

Positive Impact		Negative Impact	
Significance	**Rating**	**Significance**	**Rating**
< 25	Low	> -25	Low
25 a 49	Moderate	-25 a -49	Moderate
50 a 75	High	-50 a -75	Severe
> 75	Relevant	< -75	Critical

Diagram translation

"3D" Offshore Seismic Record of CAN 100, CAN 108 and CAN 114 Areas.

(From left to right) Environmental Components/Actions/Physical Environment/Biotic Environment/Anthropic Environment.

Surface water/Air/Marine Mammals/Fish and Cephalopods/Sea turtles/Benthos and Plankton/Seabirds/Protected and Sensitive Areas/Fishing Activity/Maritime Traffic/Economical Activities/Infrastructure, Resources and Terrestrial Use/

Planned Activities/Seismic Sources Operations (compressed air emissions)/Seismic and Support Vessels Navigation and Physical Presence of Seismic Team/

Emissions, effluents and waste associated to the normal operation and maintenance of seismic and support vessels (and other operations)/gaseous emissions/vessel light emissions/vessel (and helicopter) Sound emission

(Poco significativo) Less significant

Demand for Labor and goods and services

Unplanned Events (contingencies)

Oil spills

Accidental Discharge of chemical substances and/or solid waste, hazardous and non-hazardous

7.5 ENVIRONMENTAL IMPACT MATRIX WITH IMPLEMENTATION OF MITIGATION MEASURES

According to the “Guide for the preparation of environmental impact studies” (SAyDS, 2019a), the approach to mitigation measures considers the conceptual model of early planning of the mitigation of impacts, known as the principle of mitigation hierarchy; which establishes a sequence of steps to be implemented in a united and hierarchical way, which are intended to avoid, minimize, restore and ultimately compensate for the residual significant negative impacts in order to achieve, at least, zero loss and preferably gain additional environmental values, at the project scale.

The summary matrix of environmental impacts considering the implementation of the mitigation measures prepared to address the significant impacts of the project is herein below presented and detailed in Chapter 8. The residual impact level has been assigned qualitatively. The residual impacts have been classified between low and negligible as a result of the implementation of the measures.

Table 11. Summary matrix of environmental impact implementing mitigation measures

Action	Environment	Environmental factor	IMPORTANCE (I)	Mitigation measure / Environmental Management Program	RESIDUAL IMPACT
Operation of seismic sources (compressed air emissions)	BIOTIC	Marine mammals	Moderate	► ONBOARD SEA WILDLIFE OBSERVERS PROGRAM - General - Soft start procedure and visual (and acoustic) monitoring of marine mammals and turtles - Monitoring of seabirds, marine mammals and sea turtles - Mitigation of random impacts upon occasionally discovered species ► PROGRAM FOR PREVENTION OF IMPACTS DUE TO POTENTIAL INTERFERENCES AND COORDINATION WITH ADJOINING ACTIVITIES - Coordination with adjoining explorations (distancing from other seismic surveys)	Low
		Fish and cephalopod	Moderate	► ONBOARD SEA WILDLIFE OBSERVERS PROGRAM - General - Soft start procedure and visual (and acoustic) monitoring of marine mammals and turtles ► PROGRAM FOR PREVENTION OF IMPACTS DUE TO POTENTIAL INTERFERENCES AND COORDINATION WITH ADJOINING ACTIVITIES - Coordination with adjoining explorations (distancing from other seismic surveys)	Low
		Sea turtles	Moderate	► ONBOARD SEA WILDLIFE OBSERVERS PROGRAM - General - Soft start procedure and visual (and acoustic) monitoring of marine mammals and turtles - Monitoring of seabirds, marine mammals and sea turtles - Mitigation of random impacts upon occasionally discovered species ► PROGRAM FOR PREVENTION OF IMPACTS DUE TO POTENTIAL INTERFERENCES AND COORDINATION WITH ADJOINING ACTIVITIES - Coordination with adjoining explorations (distancing from other seismic surveys)	Low
		Birds	Moderate	► ONBOARD SEA WILDLIFE OBSERVERS PROGRAM - General - Soft start procedure and visual (and acoustic) monitoring of marine mammals and turtles - Monitoring of seabirds, marine mammals and sea turtles - Mitigation of random impacts upon occasionally discovered species ► PROGRAM FOR PREVENTION OF IMPACTS DUE TO POTENTIAL INTERFERENCES AND COORDINATION WITH ADJOINING ACTIVITIES - Coordination with adjoining explorations (distancing from other seismic surveys)	Low
		Benthos and plankton	Low	► ONBOARD SEA WILDLIFE OBSERVERS PROGRAM - General	Low

Action	Environment	Environmental factor	IMPORTANCE (I)	Mitigation measure / Environmental Management Program	RESIDUAL IMPACT
				► PROGRAM FOR PREVENTION OF IMPACTS DUE TO POTENTIAL INTERFERENCES AND COORDINATION WITH ADJOINING ACTIVITIES - Coordination with adjoining explorations (distancing from other seismic surveys)	
		Protected and sensitive areas	Moderate	► ONBOARD SEA WILDLIFE OBSERVERS PROGRAM - General - Soft start procedure and visual (and acoustic) monitoring of marine mammals and turtles - Monitoring of seabirds, marine mammals and sea turtles - Mitigation of random impacts upon occasionally discovered species ► PROGRAM FOR PREVENTION OF IMPACTS DUE TO POTENTIAL INTERFERENCES AND COORDINATION WITH ADJOINING ACTIVITIES - Coordination with adjoining explorations (distancing from other seismic surveys)	Low
	Anthropic	Fishing activity	Low	► ONBOARD SEA WILDLIFE OBSERVERS PROGRAM - General - Soft start procedure and visual (and acoustic) monitoring of marine mammals and turtles ► PROGRAM FOR PREVENTION OF IMPACTS DUE TO POTENTIAL INTERFERENCES AND COORDINATION WITH ADJOINING ACTIVITIES - Coordination with adjoining explorations (distancing from other seismic surveys)	Low
Navigation of seismic and support vessels and physical presence of the seismic equipment	Biotic	Marine mammals	Low	► IMPACT PREVENTION PROGRAM ON MARINE FAUNA - Measures to reduce the speed of ships - Monitoring of seabirds, marine mammals and sea turtles	Low
		Sea turtles	Low	► IMPACT PREVENTION PROGRAM ON MARINE FAUNA - Terminal buoys equipped with sea turtle guards - Monitoring of seabirds, marine mammals and sea turtles	Low
		Birds	Low	► IMPACT PREVENTION PROGRAM ON MARINE FAUNA - Prevention for birdlife - Monitoring of seabirds, marine mammals and sea turtles	Low
		Protected and sensitive areas	Low	► IMPACT PREVENTION PROGRAM ON MARINE FAUNA - Measures to reduce the speed of ships - Terminal buoys equipped with sea turtle guards - Prevention for birdlife - Monitoring of seabirds, marine mammals and sea turtles	Low
	Anthropic	Fishing Activity	Low	► PROGRAM FOR PREVENTION OF IMPACTS DUE TO POTENTIAL INTERFERENCES AND COORDINATION WITH ADJOINING ACTIVITIES Mitigation measures for potential interference with fisheries and activities related to the fishing sector	Negligible

Action		Environment	Environmental factor	IMPORTANCE (I)	Mitigation measure / Environmental Management Program	RESIDUAL IMPACT
			Maritime Traffic	Low	► PROGRAM FOR PREVENTION OF IMPACTS DUE TO POTENTIAL INTERFERENCES AND COORDINATION WITH ADJOINING ACTIVITIES - Mitigation measures of potential interference with navigation	Negligible
Emissions, effluents and waste associated with the normal operation and maintenance of seismic and support vessels (and other operations)	Gaseous emissions	Physical	Air	Low	► ENVIRONMENTAL MONITORING AND FOLLOW-UP PROGRAM - General (Maintenance of engines that ensure appropriate emission and noise levels) ► ENVIRONMENTAL EDUCATION AND STAFF CONDUCT PROGRAM	Low
	Light emissions from ships	Biotic	Birds	Low	► IMPACT PREVENTION PROGRAM ON MARINE FAUNA - Prevention for birdlife ► ONBOARD SEA WILDLIFE OBSERVERS PROGRAM - Monitoring of seabirds, marine mammals and sea turtles	Low
			Protected and sensitive areas	Low	► IMPACT PREVENTION PROGRAM ON MARINE FAUNA - Prevention for birdlife ► ONBOARD SEA WILDLIFE OBSERVERS PROGRAM - Monitoring of seabirds, marine mammals and sea turtles	Low
	Sound emissions from ships (and helicopters)	Biotic	Marine Mammals	Less significant	► ENVIRONMENTAL MONITORING AND FOLLOW-UP PROGRAM - General (Maintenance of engines that ensure appropriate emission and noise levels) ► ENVIRONMENTAL EDUCATION AND STAFF CONDUCT PROGRAM	Negligible
			Fish and cephalopod	Less significant	► ENVIRONMENTAL MONITORING AND FOLLOW-UP PROGRAM - General (Maintenance of engines that ensure appropriate emission and noise levels) ► ENVIRONMENTAL EDUCATION AND STAFF CONDUCT PROGRAM	Negligible
			Sea turtles	Less significant	► ENVIRONMENTAL MONITORING AND FOLLOW-UP PROGRAM - General (Maintenance of engines that ensure appropriate emission and noise levels) ► ENVIRONMENTAL EDUCATION AND STAFF CONDUCT PROGRAM	Negligible
			Birds	Less significant	► ENVIRONMENTAL MONITORING AND FOLLOW-UP PROGRAM - General (Maintenance of engines that ensure appropriate emission and noise levels) ► ENVIRONMENTAL EDUCATION AND STAFF CONDUCT PROGRAM	Negligible
			Protected and sensitive areas	Less significant	► ENVIRONMENTAL MONITORING AND FOLLOW-UP PROGRAM - General (Maintenance of engines that ensure appropriate emission and noise levels) ► ENVIRONMENTAL EDUCATION AND STAFF CONDUCT PROGRAM	Negligible
		Anthropic	Business Activities	Low	► LOCAL STAFF HIRING AND LOCAL PURCHASING PROGRAM	Low

Action	Environment	Environmental factor	IMPORTANCE (I)	Mitigation measure / Environmental Management Program	RESIDUAL IMPACT
Demand for labor, goods and services		Infrastructures, resources and land uses	Less significant	► LOCAL STAFF HIRING AND LOCAL PURCHASING PROGRAM	Negligible
Oil Spills	Physical	Surface water	Moderate	► HYDROCARBON MANAGEMENT PROGRAM - Fuel and oil management - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	Low
	Biotic	Marine mammals	Moderate	► HYDROCARBON MANAGEMENT PROGRAM - Fuel and oil management - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	Low
		Fish and cephalopod	Moderate	► HYDROCARBON MANAGEMENT PROGRAM - Fuel and oil management - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	Low
		Sea turtles	Moderate	► HYDROCARBON MANAGEMENT PROGRAM - Fuel and oil management - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	Low
		Seabirds	Moderate	► HYDROCARBON MANAGEMENT PROGRAM - Fuel and oil management - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	Low
		Benthos and plankton	Moderate	► HYDROCARBON MANAGEMENT PROGRAM	Low

Action	Environment	Environmental factor	IMPORTANCE (I)	Mitigation measure / Environmental Management Program	RESIDUAL IMPACT
				- Fuel and oil management - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	
		Protected and sensitive areas	Moderate	► HYDROCARBON MANAGEMENT PROGRAM - Fuel and oil management - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	Low
	Anthropic	Fishing activity	Moderate	► PROGRAM FOR PREVENTION OF IMPACTS DUE TO POTENTIAL INTERFERENCES AND COORDINATION WITH ADJOINING ACTIVITIES - Mitigation measures for potential interference with navigation ► Hydrocarbon management program - Fuel and oil management - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	Low
		Infrastructures, resources and land uses	Low	► ONSHORE LOGISTICS BASE OPERATIONS PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM - Fuel and oil management - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	Negligible
Accidental discharge of chemical substances and / or non-hazardous / hazardous solid waste	Physical	Surface water	Less significant	► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	Negligible
	Biotic	Marine mammals	Less significant	► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM	Negligible

Action	Environment	Environmental factor	IMPORTANCE (I)	Mitigation measure / Environmental Management Program	RESIDUAL IMPACT
				► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	
		Fish and cephalopod	Less significant	► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	Negligible
		Sea turtles	Less significant	► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	Negligible
		Seabirds	Less significant	► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	Negligible
		Benthos and plankton	Less significant	► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	Negligible
		Protected and sensitive areas	Less significant	► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM - Waste management ► ENVIRONMENTAL EDUCATION AND PERSONNEL CONDUCT PROGRAM ► ON-BOARD WASTE AND EFFLUENT MANAGEMENT PROGRAM ► HYDROCARBON MANAGEMENT PROGRAM ► EMERGENCY RESPONSE PROGRAM	Negligible

7.6 CUMULATIVE IMPACTS

While an impact may be relatively small when considering the project or activity alone, it can be magnified in combination with the impacts of other projects and activities; these combined effects are known as "cumulative" impacts.

Cumulative impacts could be caused by the following:

- Interactions between separate residual impacts related to the project (intra-project effects); and
- Interactions between the residual impacts related to the project in combination with the impacts of other projects and their associated activities (effects between projects).

The former (cumulative intra-project effects) have been evaluated as part of the previous point, since, on the one hand, the methodology used (Conesa, 1997) particularly considers this aspect of the impacts; and on the other hand, the project considers a single focus of action, given by the seismic vessel and its array, and the support vessels, which shall cover the entire area to be surveyed.

In this sense, this point of the study focuses on the latter, those related to the potential interaction of the project with other activities or projects within the area of influence.

Therefore, a description of the activities and projects identified around CAN 100, CAN 108 and CAN 114 areas with potential cumulative impacts are herein below described.

- Activities in the adjoining blocks to the acquisition areas under study that were part of the International Offshore Public Bid N ° 1. CAN_100 and CAN_108 blocks are adjacent to CAN_105, 106, 107, 109 and 110 blocks; while the CAN_114 block adjoins CAN_111, 112 and 113 blocks. According to Resolution 276/2019 of the former Secretary of the Government of Energy, the bidding for CAN 105, 106, 110 and 112 blocks was declared void since no offers were received for those areas. CAN_107 and 109 blocks were awarded to Shell Argentina SA group and Qatar Petroleum International Limited, and CAN_111 and 113 blocks to Total Austral SA group and BP Exploration Operating Company Limited. The foregoing would make it possible to rule out the possibility of prospecting tasks with temporal overlap in CAN 105, 106, 110 and 112 adjacent areas (until they are granted). As for the other blocks, Equinor has entered into dialogue with TOTAL and SHELL to find out their plans regarding any seismic operations. Based on the plans reported by EQUINOR to prospect CAN_100-108 and CAN_114 areas during the spring of 2021 and the summer of 2022, Total has confirmed that its operations in CAN_111 and CAN_113 areas would not overlap, as they are planning them for later, in the year 2022. On the other hand, Shell would be planning 3D operations in CAN_107 and CAN_109 areas in the fourth quarter of 2021, which would temporarily overlap with the campaign under study. Equinor in a precautionary way proposes to plan the operations in a coordinated way with SHELL at all times, to be as far away as possible from each other. Equinor proposes, in a preliminary way, to plan the operations later in the fourth quarter, in October 2021, to begin in the easternmost part of CAN_100-108 area, which is about 65 km from CAN_107 block at its closest point. However, as mentioned, this shall be jointly defined in detail by both companies closer to the start date in order to ensure the greatest distance between operations.

- Interaction of the project with coastal This point is basically limited to the use of the port infrastructure of the support port (Puerto de Mar del Plata) by the support vessel from the seismic data acquisition area and, to a lesser extent, from the port of Buenos Aires, in mobilization and demobilization operations. As these operations are routine and shall not differ from those normally carried out by a fishing vessel or freighter ship, the cumulative effect is definitely ruled out.

- Fishing activities. Regarding the activity or fishing pressure, a non-binding relationship with the fishing areas is observed for CAN_100-108 and CAN_114 operative areas. This activity becomes very important during the autumn and winter periods in front of the slope which is 17 km from the project's operational area, and 30 km from the seismic acquisition area (where the seismic array shall effectively operate), and therefore, it does not overlap spatially with the project. Given that the project under study shall be carried out during the spring of 2021 and the summer of 2022, there shall also be no temporal overlap with the peak of the fishing activity in front of the slope. Based on the foregoing, the cumulative impact on the group of fish is not expected to be more significant than that evaluated for the project itself. The possible mitigation consists of the application of the soft start protocol associated with the project, while the project schedule is adequate from the fisheries point of view since it avoids the period of greatest sensitivity of the activity (autumn-winter).

- Interaction of fishing activity with birds, turtles and marine mammals. As has been herein explained, seismic activities have the potential of increasing the vulnerability of individuals to anthropogenic threats, among other effects. Although, as previously indicated, fishing activities are carried out at a certain distance from the prospecting area, the possibility of a cumulative impact occurring when the activities coincide temporarily cannot be discarded, however this is minimized to a certain extent given that the project shall be carried out outside the peak period of the fishing activity in front of the slope (autumn - winter). However, given that these effects may occur at the individual level, and therefore the risk to populations is considered low, the cumulative impact on these groups is not expected to be more significant than that evaluated for the project itself. As mentioned in the previous point, the impact of seismic activity is considered mitigated to the extent possible with the implementation of the soft start protocol.

- Light impact on birds by interaction with fishing activities. The interaction with the jigger fishing fleet which strongly illuminates the surface of the sea to catch squid during the night becomes a major concern. North of 44 ° S, the Buenos Aires-North Patagonian subpopulation is exploited from March or April to June before the squid migrate to deep waters. In this sense, this activity does not temporarily overlap with the development of the project since it shall take place during spring 2021 and summer 2022. Likewise, it is worth noting that the exclusion areas foreseen around the seismic vessel as a whole and its array, and the clearance of its trajectory, also guarantee a certain distancing of prospecting activities from other vessels and the cumulative impact on birds is not expected to be more significant than that assessed for the project itself. The possible mitigation consists of reducing light intensity.

- Recent seismic prospecting activities in the area. According to the information gathered, only the extensive campaign of 2018 (5/5/2018) by the company SPECTRUM ASA SUCURSAL ARGENTINA (now TGS), involved the seismic acquisition areas targeted in this study. Two more recent campaigns of lesser extension are close to these areas. The one identified on 10/11/2019 was located immediately west of the seismic data acquisition area of CAN_100-108 areas and the 2020 campaign identified on 1/2/2020 was located northeast of the CAN-114 area. Although the details of these campaigns are not known in terms of the number and type of vessels involved, the survey pattern, characteristics of the seismic array used, etc., it could be confirmed that mitigation measures were adopted which included the use of procedures for soft start to minimize possible underwater sound impacts in the marine environment, since these procedures have been implemented in the seismic industry for several years and have been required in explorations in our country. Temporal (and also geographic) differences between past and anticipated seismic studies, and the use of the soft start procedure mean that there is a limited range of cumulative impacts to marine organisms due to underwater sound. The impacts of injuries to mammals and fish are avoided through soft start and the behavioral impacts are minor and temporary as previously assessed. Considering that this project shall start in October 2021, the nearby antecedent campaigns are more than 18 months apart (and in more than 3 years with the TGS campaign, which is the only one that overlaps spatially), so the same seasons shall not be affected. Based on the foregoing, the cumulative impact on marine organisms and fisheries is not expected to be more significant than that assessed for the project itself.

- Activities causing the stranding of mammals. Although there is a theory that seismic activities can cause stranding, there is no conclusive evidence to date. In any case, these phenomena are aspects to consider in shallow areas near the coast, which is not the case of the present project that is developed in areas between 1,200 and 3,900 meters deep.

8. MITIGATION MEASURES AND ENVIRONMENTAL MANAGEMENT PLAN

8.1 MITIGATION MEASURES

The most relevant measures are the following:

Soft start procedure and visual (and acoustic) monitoring of marine mammals and sea turtles

The soft start procedure enables a progressive increase in the sound levels generated by the compressed air sources until reaching full operating power for a minimum period of 20 minutes and a maximum period of 40 minutes until the start of the line, in order to provide adequate time for marine organisms to leave the area.

There shall be marine fauna observers (OFM) and personnel in charge of the Passive Acoustic Monitoring (MAP) operation located at high points of the ship, with a clear view of the horizon, the exclusion zone and ahead of the ship. They shall perform a careful visual and listening check to detect the presence of marine fauna in the defined exclusion zone around the emission source.

Measures to reduce the speed of ships

As a preventive measure to avoid a possible incident and / or impact of the vessels operated during the tasks under study and the marine fauna present in the area, requirements about the proximity distance are presented when the seismic, support, and tracking vessels are moving at a speed of 10 knots or greater.

Prevention for birdlife

Regarding birdlife, one of the most significant effects that the project can generate is that of the birds colliding with the ships as a result of the attraction to the lights used during night work. Measures to minimize impacts on birds include reducing external lighting of ships to the minimum that guarantees the safety of navigation, avoiding when possible unnecessary lighting in the event of night inspections.

Terminal buoys equipped with sea turtle protectors

The installation of sea turtle protectors ("turtle guards") in the terminal buoys of the streamers is a correct measure to prevent that the turtles are not trapped in the tail buoys.

Mitigation of random impacts upon occasionally discovered species

In the event that during the prospecting works, the occasional discovery of an unreported species in the study area occurs, and immediately after visualization in the field and the record, the individual / s shall be characterized, checking whether it belongs / to a vulnerable, endangered or threatened species. This particular species shall be added to the list of species already identified on the site, and the evaluations carried out and the measures considered for this species shall be analyzed. If applicable, the necessary measures to mitigate the potential impacts on said species shall be incorporated into the project.

Mitigation measures for potential interference with navigation

A communication process shall be established with key stakeholders involved in maritime affairs (e.g. Argentine Coast Guard) to coordinate the planning of the use of maritime areas, in order to avoid interference affecting both maritime activities in the area of influence of the project as well as the seismic record itself. In order to minimize the effects on the mobility and traffic of ships and boats, task schedules, dates and areas of execution and influence of the project shall be communicated to the corresponding Authorities (Argentine Coast Guard) (PNA).

Mitigation measures for potential interference with fisheries and activities related to the fishing sector

At the time of planning and coordinating activities, a communication process shall be established with key stakeholders involved in fisheries matters (e.g. Secretary of Fisheries, Argentine Coast Guard, INIDEP, representatives of companies or fishing associations) to coordinate the planning of use of the maritime areas, in order to avoid interferences that affect both the fishing activities and / or research campaigns (prospecting) of INIDEP as well as the seismic record itself. Dates and areas of execution and influence of the project shall be communicated to the corresponding Authorities and key interested parties to minimize the effects on fishing activities and related research activities, mobility, ship and boat traffic, task schedules, etc.

The above measures are backed up by a series of general preventive measures, and the management of waste, fuels and oils in relation to Health and Safety aimed at controlling ship operations and seismic activities.

8.2 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan aims to provide the guidelines required for the implementation of the proposed mitigation measures, and the general procedures necessary to ensure that the project is carried out in compliance with current environmental regulations and good environmental practices. In this sense, the plans and programs that emerged from this assessment are:

- **ONBOARD SEA WILDLIFE OBSERVERS PROGRAM**

It ensures the application of the corresponding mitigation measures in order to avoid the possible impacts of seismic activity on marine fauna through observation and registration. The process shall be carried out by trained observers to recognize the species present in the study area so as to assess the possible changes in behavior or affectations derived from the project.

- **Impact prevention program on marine fauna**

It embraces actions and coordination with the authorities in the event of a collision or any situation that may involve damage to specimens of marine fauna.

- **Program for prevention of impacts due to potential interferences and coordination with adjoining activities**

The application of the corresponding mitigation measures shall be ensured in order to avoid possible impacts caused by potential interference with vessels operating in the area or significant interaction with other exploratory activities in neighboring areas.

- **Environmental monitoring and follow-up program**

This measure is aimed at establishing the specific procedures that must be followed to guarantee compliance with the established prevention and mitigation measures; and control of existing environmental conditions in the project's area of influence.

- **On-board waste and effluent management program**

This program is aimed at carrying out a correct management of the substances and solid, liquid and semi-solid waste generated in the vessels involved in the project. The Contracting Company shall be liable for executing this program and shall be controlled by EQUINOR.

- **Hydrocarbon management program**

It is aimed at correctly managing the hydrocarbons used in the vessels involved in the project, through the classification, order and storage of substances with hydrocarbons; seeking the prevention of environmental contamination, avoiding affecting the socioeconomic, cultural, aesthetic, biological and physical environments.

- **Onshore Logistics Base Operation Program**

- Subprogram for fuel loading: one of the operations required by shipping lines is the loading of fuel in port, which is risky both due to its flammability and the environmental damage that a spill might cause. Therefore, it is necessary to have clear procedures on how the operation should be carried out.

- Subprogram for the management of waste from ships: ships are compelled to separate waste on board through Annex V of the MARPOL 73/78 agreement. According to the regulations, the dumping of plastics in the sea and the rest of the garbage is totally prohibited with certain limitations. In accordance with these requirements, ships deliver already segregated waste to the port where the port operator must then take over.
- Management of bilge water and slops: when the capacity of the slop and flow tanks is full, it is necessary to discharge them in the port areas.

- **Emergency Response Program**

The Contingency Plan aims to optimize the actions to control emergencies, in order to protect the lives of people, the affected natural resources and their own property and those of third parties, to avoid or minimize the adverse effects derived from the emergencies arising from the execution of the maritime operations, establish an orderly procedure of the main actions to be followed in case of emergencies, and encourage personnel to develop skills and capacities to quickly face these situations, constitute an ideal team efficiently and permanently trained to achieve the correct use of human and material resources available for this purpose and to comply with current provisions.

During the operation of ships, some emergency situations may arise, and it shall be necessary to have an adequate, timely and efficient contingency program. Possible contingencies identified include:

a) Emergency Plan in Case of Spill of Fuels and other Dangerous Substances from Ships.
b) Fire / Explosion Fighting Plan.
c) Accident on board - Procedure for the evacuation of the injured.
d) Man overboard.

The contracting company shall be responsible for carrying out the Contingency Plan and EQUINOR must control its implementation.

- **Environmental training program and staff conduct**

All the tasks of the seismic prospecting project necessarily require having technically trained personnel in order to carry out the Environmental Management Plan with the necessary and adequate responsibility for the environment. Although this program must be carried out by the contracting company, its compliance must be controlled by EQUINOR.

- **Environmental and social communication program**

The main focus shall be early engagement and consultation with key stakeholders, prior to the approval of the EIA. It shall be oriented towards the participation of key actors, the dissemination of information and an open dialogue with the communities and potentially affected parties.

- **Consultation and Claims Program**

Its objective is to clear as quickly and accurately as possible all doubts and / or claims that the community in general and / or the different key actors identified in particular may have in relation to the Project. Accessible and user-friendly communication channels shall be offered to guarantee the right of the population to be informed.

- **Local Staff Hiring and local Purchasing program**

The personnel that this project requires high qualification, great expertise in the activity and experience; For this reason, the majority shall be foreign personnel. Although this stage includes the exploration of the hydrocarbon resources of the seabed, it is expected to find reserves that can be exploited commercially which might boost the demand for labor and associated goods and services.

- **Identification and verification of Legal Compliance program**

It is a system that allows to organize and control compliance in a dynamic way of all the steps, required permits, formal / contractual aspects and legal requirements associated with the project.

- **Health, safety, environment and quality management in Equinor's operations**

It sets up the principles of Health, Safety, Environment and Quality that govern EQUINOR's operations in offshore activities in Argentina and the requirements towards the Geophysical Contractor.

Health, safety and environmental aspects are a priority at the highest levels of the Company, reflected in its actions, seeking to guarantee that no damage to personnel or the environment occurs as a result of operations.