Environmental, Social, and Health Impact Assessment (ESHIA) for Vista Onshore Operations

Environmental and Social Baseline

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5. ENVIRONMENTAL AND SOCIAL BASELINE

The construction sites are part of the oil and gas area of the concession Bajada del Palo y Entre Lomas. The site itself and the surrounding land are poorly vegetated. The following sections provide detailed data about the abiotic and biotic components (flora and fauna) at the project site.

For the climatic and meteorological study of the project area, we have obtained historical information from La Higuera station.

5.1 Abiotic Component

The objective of the abiotic baseline is to determine the current physical and chemical characteristics of the area in which the Project conducts activities. This includes the concession Bajada del Palo and Entre Lomas.

Knowledge of the area's current abiotic conditions will help to identify how the project could alter the surrounding environment, and thus enable development of environmental management plans to avoid, minimize or mitigate these changes and impacts.

5.1.1 Climatologic Aspects

The study area has a semi-arid climate, a represents a transition zone between the northern more humid climate and the Patagonian arid climate to the south. It is characterized by a marked continental regime with water deficit conditions and the significant daily and annual thermal amplitude. Annual precipitation is less than 200 mm / year, with a water deficit that increases from west to east.

For the climatic and meteorological study of the project area, historical data (2003 – 2007) from La Higuera station was obtained. The following table details the geographic and political location of the station.

Table 5-1 Meterological Station Information

Station	Coordinates UTM		Altitude (m.a.s.l)	Province	Información o parámetros que registra	Período de Registro
	Este	Norte				
La Higuera	2468516	57295062	450	Neuquén	T°, P y V	2003-2007

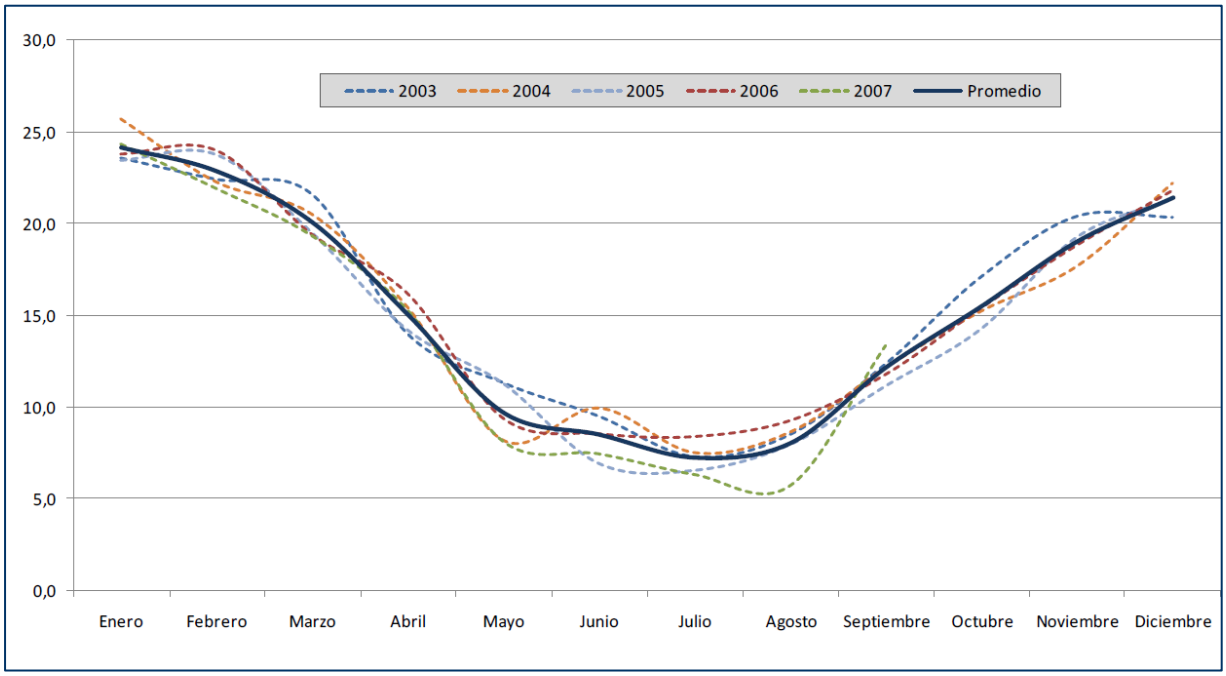
Source: Monitoring Report Annual Environment, 2018.

5.1.1.1 Temperature

At La Higuera Station, the recorded annual average temperatures oscillate between 24 ºC and 7.2 ºC. The average annual temperature is between 15 to 16 ºC, which corresponds to a temperate or cool climate.

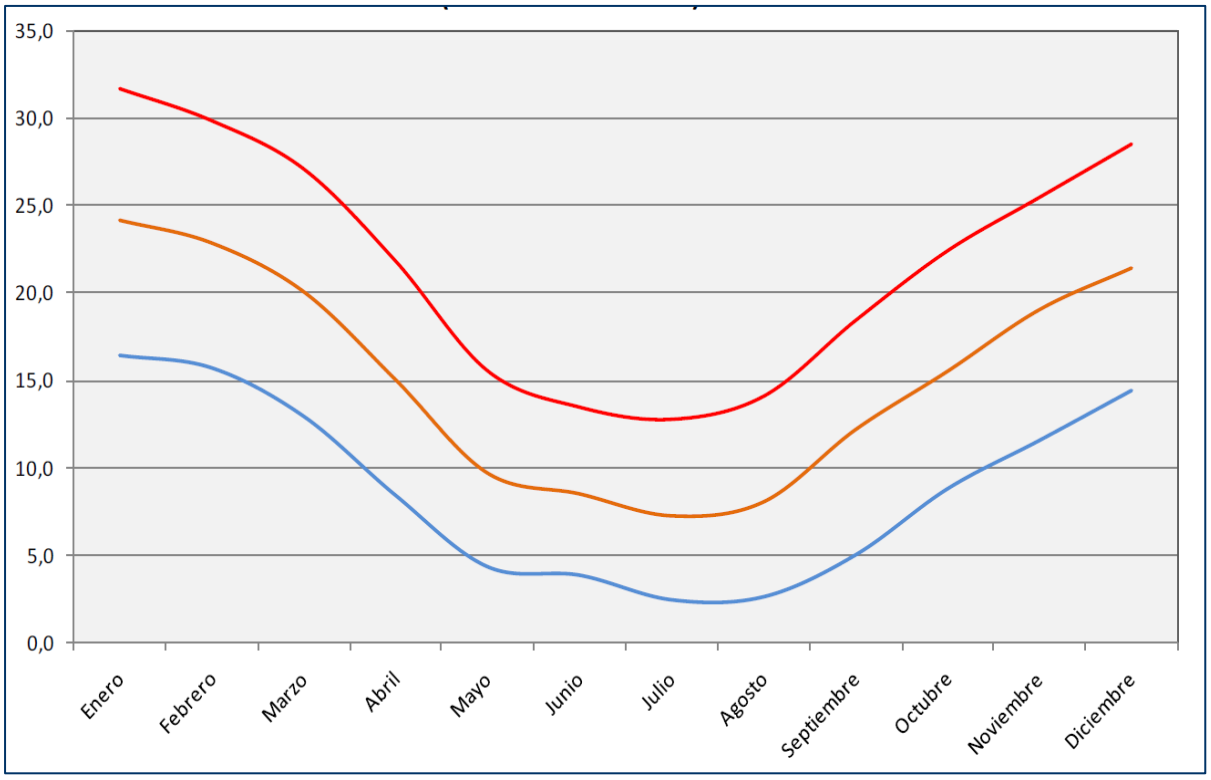
The high temperatures of January are influenced by the entry of warm air masses from the Atlantic Ocean. The low winter temperatures are related to the entry of cold air from the Pacific Ocean. The average temperature of January is high (more than 21 ºC), while the average temperature of July is less than 8 ºC. The rigorous nature of the climate is manifested in the fact that more than 30 frosts per year are registered in the region. The following figures show the average monthly temperatures.

Figure 5-1 Average Monthly Temperature - La Higuera Station (Period 2003-2007)



Source: Monitoring Report Annual Environment, 2018.

Figure 5-2 Monthly Average of Maximum, Minimum and Average Temperature - La Higuera Station (Period 2003-2007)

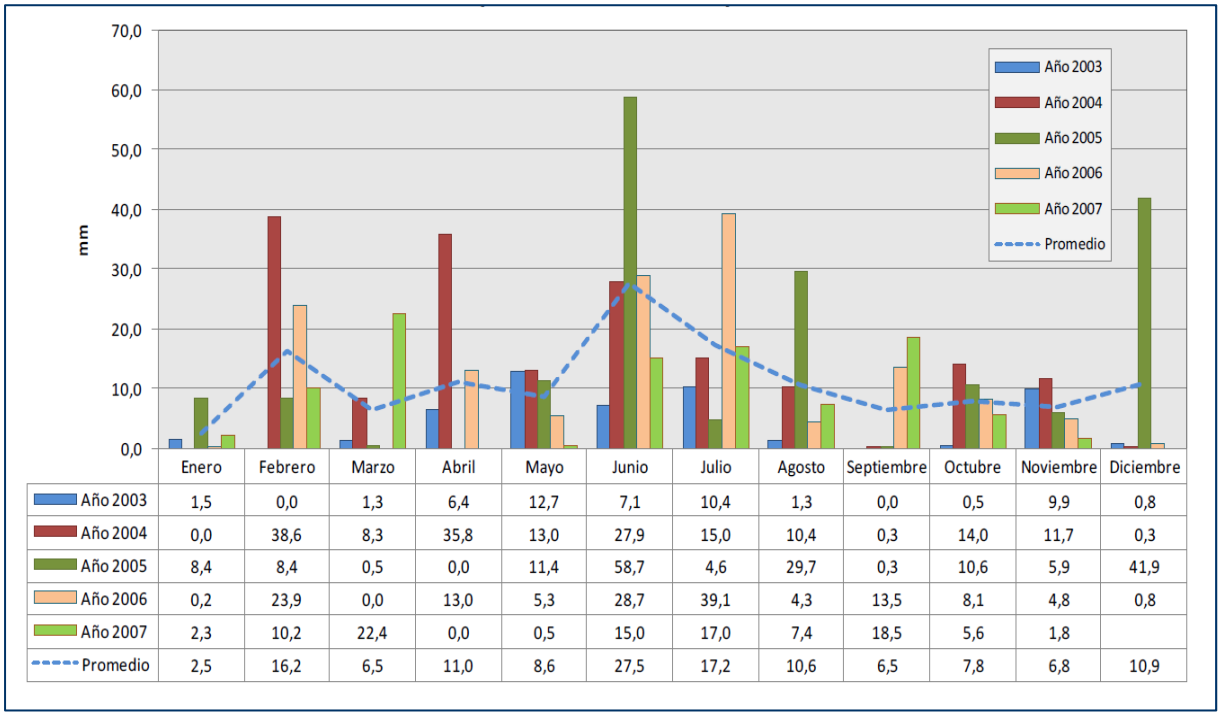


Source: Monitoring Report Annual Environment, 2018.

5.1.1.2 Precipitation

The pluvial regime is of Pacific type with maximums in autumn and winter, and with strong erosive effects. However, annual rainfall does not exceed 220 mm, which places the region within the dry belt of the Argentine Republic, with semi-arid or arid steppe climates. The following figure shows total monthly precipitation between the years 2003 and 2007.

Figure 5-3 Total Monthly Precipitation- La Higuera Station (Period 2003-2007)



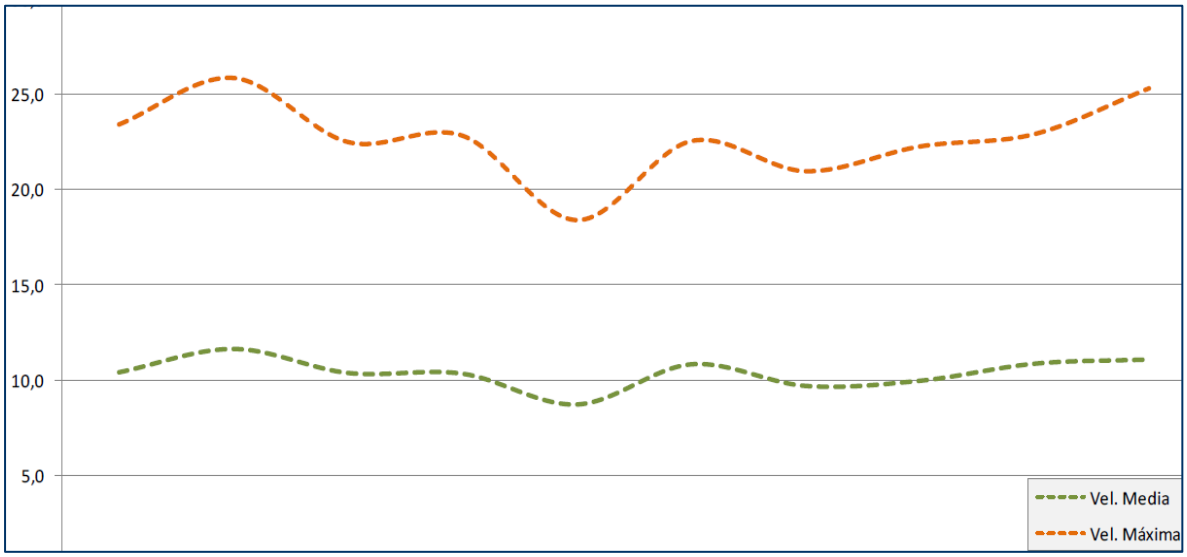
	Enero	Febrero	Marzo	Abril	Mayo	Junio	Julio	Agosto	Septiembre	Octubre	Noviembre	Diciembre
Año 2003	1,5	0,0	1,3	6,4	12,7	7,1	10,4	1,3	0,0	0,5	9,9	0,8
Año 2004	0,0	38,6	8,3	35,8	13,0	27,9	15,0	10,4	0,3	14,0	11,7	0,3
Año 2005	8,4	8,4	0,5	0,0	11,4	58,7	4,6	29,7	0,3	10,6	5,9	41,9
Año 2006	0,2	23,9	0,0	13,0	5,3	28,7	39,1	4,3	13,5	8,1	4,8	0,8
Año 2007	2,3	10,2	22,4	0,0	0,5	15,0	17,0	7,4	18,5	5,6	1,8	
Promedio	2,5	16,2	6,5	11,0	8,6	27,5	17,2	10,6	6,5	7,8	6,8	10,9

Source: Monitoring Report Annual Environment, 2018.

5.1.1.3 Winds

The project area is characterized by persistent and intense winds coming mainly from the West and Southwest throughout the year. The strongest winds occur during the months of August and September due to winds coming from the west, and in the months of January and February due to winds coming from the southwest. In addition, strong winds from the South are present during the months of November, December and January. The following figure shows the monthly average wind speed in 2007.

Figure 5-4 Monthly Total winds - La Higuera Station (Period 2007)



5.1.2 Geology

The area under study (Bajada del Palo and Entre Lomas) is included in the morphostructural area called "Cuenca Neuquén", within the "extra-Andean" environment.

The term “Cuenca Neuquén” refers to a geological province developed mainly in the extra-Andean sector of Neuquén, South of Mendoza, Northwest of Río Negro and Southwest of La Pampa (Digregorio, 1972; Digregorio & Uliana, 1979). Its stratigraphy is characterized by the development of a thick upper Triassic sedimentary sequence overlain by Jurassic and Cretaceous formations. In addition, it includes continental deposits developed in a restricted environment, composed of alternating successions of sandstone and mudstone conglomerates.

In the Bajada del Palo concession area, the outcrops correspond to the south eastern flank of the Cuenca Neuquén, constituting Cretaceous deposits clearly sedimentary. In Entre Lomas concession area, the Neuquén Basin sector corresponds to the Neuquino Engulfment. Much of the Jurassic and Lower Cretaceous that is represented in marine facies of different nature is associated with the Pacific Ocean. (See Annex 5.1 – Geology Maps)

The different geological formations of the two concessions are detailed below.

5.1.2.1 Bajada del Palo

Neuquén Group

It integrates the Rio Limay, Río Neuquén and Río Colorado Formations. The lithology corresponds to a pack of red clastic sedimentites up to 1,400 meters thick. Its composition is monotonous and consists of an alternation of sandstones, occasional conglomerates and river fluges.

The study of the successions of this Group identified three episodes of accumulation that begin with areno-conglomerádicos terms and culminate with pelitic sections. This indicates a reiteration of the habit of intermittent subsidence of the basin. The age of the Neuquén Group is attributed to the Upper Cretaceous.

Malargüe Group

The Allen, Jagüel, Roca and El Carrizo Formations integrate the unit. It represents the final sequence of the Neuquén basin’s process of sedimentary accumulation, and has a thickness of 600 meters. Clays, greenish-grey sandstones, red mudstones, marls, conglomerates, bioclastic limestones and

gypsum banks define the lithological composition. The deposit environment is continental, lacustrine and fluvial, marine shallow and deltaic. Based on the fossiliferous content, the age of the Malargüe Group is considered to cover the Maastrichtino (Upper Cretaceous) -Palaeocene span.

Rayoso Group

It is integrated by the Huitrín, Rayoso Formations and the continental deposits of Bajada Colorada. It is formed by limestones, anhydrite, gypsum, sandstones and claystones that go up to clayey sandstones, intercalations of gypsum banks, sandstones, claystones and limonite. The environment begins with chemical precipitation in shallow marine and saline waters, to culminate in a shallow hypersaline sea with terrigenous contributions from marginal sectors. The age of the Group corresponds to Middle Cretaceous.

Current deposits

The deposits are composed of sand, gravel, silt and blocks, caused by fluvial sedimentation, wind, and processes of mass removal of the Holocene age (wind deposits, fluvial deposits).

El Palo Formation (Lower Miocene-Lower Pliocene)

The El Palo Formation, in general, has good exposure in the upper part of the ravines bordering the extended plateau on the Eastern sector of Neuquén, crowned by the conglomerates of the Bayo Mesa Formation. The dominant lithology consists of thick to very coarse sandstones, sometimes conglomeradic, bluish gray or greenish. They are lithic, with a predominance of basalt clasts, and regular to bad selection.

The strata are thick, with lenticular geometry and cross-stratification in a large-scale trough. The bases of cutting and filling with intraclasts are frequent.

In general, the sediments of the El Palo Formation were deposited in a medium fluvial of variable energy. The lenticular sandy accumulations with current structures and erosive bases indicate the presence of anastomosed rivers, while the fine intercalations with calcareous concretions and paleosols correspond to alluvial plain.

Deposits covering pedimentados levels (Pleistocene)

In these deposits are grouped sandy sediments to conglomerates linked at the source with pedimentation surfaces.

They present variable development and genetically are linked to different base levels. These accumulations take the form of blankets of variable thickness. These mantles exhibit a stronger slope in their sector proximal to the Sierra Blanca, while in the distal sectors the slope decreases and passes transitionally to alluvial, wind and low deposits, and lagoons, among others.

In the study area, many of the deposits in transit come from the destruction of the Bayo Mesa Formation, which is emerging over the Sierra Blanca margin. As a result, their composition is very similar.

5.1.2.2 Entre Lomas

Neuquén Group

The lithology corresponds to a pack of red clastic sediments up to 1,400 meters thick. Its composition is monotonous and consists of an alternation of sandstones, occasional conglomerates and river fluges.

Malargüe Group

The change in the regional paleopendent and the beginning of the marine influence in the basin is shown in the sediments of the Loncoche and Allen formations. These units include marginal marine continental deposits developed during Campanian – Maastrichtian. In the Andean sector of the basin they reach significant thicknesses in fluvial, deltaic and marginal facies, while in the eastern sector of Neuquén there is greater marine influence, with a predominance of tidal deposits and smaller lagoons. The supramsareal evaporitic facies reach a greater development in the eastern sector, reflecting conditions of extreme aridity and reduced detritic contribution in the pericratonic flank of the basin.

Terraced deposits of the rivers Neuquen, Limay, Agrio, Coolon Cura and others

These deposits appear mainly on both banks of the Limay and Neuquén rivers. They are remnants of formerly elevated plains that are dissected. They form structural terraces by calcareous cementation and structural plains. They are constituted by levels of gray conglomerates with vulcanite, mainly basic, and lie randomly over the Neuquén Group. The depositional paleoenvironment is of fluvial origin. The terraced deposits of the Neuquén River constitute fluvial sediments and pedemontane plains composed of gravels and sands of varied granulometry without cementing. They are gravels and polimictic sands of predominant volcanic composition, which are arranged at terraced levels in the current valleys of the mentioned rivers, subject to limited periodic flooding.

Bayo Mesa Formation

This unit is part of the extensive gravel beds which have different development and topographic levels and cover a good part of the Patagonia Extra-Andean plateau. They have received different denominations: Tehuelche Formation, Tehuelches Roads, Patagonian Roads, II Level Piedemonte, among others.

The conglomerates of light gray color predominate, with clasts of 10 to 12 meters of maximum diameter, rounded and with moderate to good selection. The composition is dominated by basalt fragments, with a smaller proportion of other volcanic rocks and quartz. Cobra overlap is common, and stratification is poorly defined.

These gravel beds are interpreted as glacial or fluvioglacial due to their lithological characteristics, morphology and stratigraphic position.

Formation Los Loros (Tertiary)

This unit is located at the foot of the scarp or plain of Bayo Mesa. It shows a predominance of reddish brown to red chestnut, in thick strata internally laminated by slight changes in color and texture, often showing grayish-white calcareous concretions with the presence of fossils; siltstone light brown, somewhat tufa, massive and less frequently fine sandstone, pinkish gray, inconsistent with crossed stratification (Uliana 1979). The total thickness of the formation is 15 to 30 meters. Its age is late Miocene to early Pliocene.

Current deposits

As of the Bajada de Palo concession, the current deposits are composed of sand, gravel, silt and blocks, caused by sedimentation fluvial, wind and processes of mass removal of the Holocene age (wind deposits, fluvial deposits).

The following table shows the different stratigraphic units of the two concessions:

Table 5-2 Stratigraphic Units

Age		Stratigraphic Units	
Quaternary	Holocene	Current deposits	
	Pleistocene	Levels of pedimentation	
		Bayo Mesa Formation	
Tertiary	Neogene	El Palo Formation	
		Chichinales Formation	
	Paleogene	Malargue Group	Roca Formation
Cretaceous	Higher	Malargue Group	Jaguel Formation
			Allen Formation
		Neuquén Group	Rio Colorado Sub Group
			Rio Neuquén Sub Group
			Rio Lima Sub Group
	Lower	Rayoso Group	Rayoso Formation
			Huitrin Formation

5.1.3 Geomorphology

The study area is located within the Eastern Region or the Neuquén Patagonian plateaus. The characteristic morphological feature of the regional relief is represented by broad discontinuous plateaus, whose cuspidal surfaces are markedly flat, evidencing the structural control of the sediments on which they have been carved.

The relief "mesetiforme" predominates in all the extra-Andean area of the province. These are geoforms on a terrace with an eastward slope, strongly eroded. It is not a homogeneous relief. Rather, it alternates between low mountainous areas, such as Sierra Negra or Auca Mahuida in the extreme northeast of the province, and valleys and river terraces resulting from erosive action mainly from the Colorado, Neuque and Limay river. The canyons are similar to the valleys, but are of smaller scale, and are generally formed in these arid zones by intermittent water currents with low and extensive depressions formed by the subsidence of the crust. (See Annex 5.2 – Geomorphology Maps).

The geoforms that are observed in the two concessions are detailed below.

5.1.3.1 Bajada del Palo

Flanking pedimentos and convergent pedimentos

The flank pedimentos develop at the foot of the lateral slopes of the fluvial valleys, forming an erosion, transport and sediment accumulation surface in transit towards the local base level. It therefore constitutes a geoform resulting from alluvial erosion developed on rocks and sediments of different composition. Its development is closely linked to the "retreat" of the erosion scarp that represents the boundary of the adjacent mountainous area.

On the other hand, the convergent pedimentos are related to base levels referred to the lower portions of a depression or closed basin, to which the alluvial currents converge in a centripetal manner (González Díaz y Malagnino, 1984).

Semi-Desert Pedimentos

These consist of a surface plane of angular relief, with reduced general inclination or slope. They are called semi-desert pedimentos because in arid zones, this landscape of transition is more abrupt than in humid regions, which have breaks of the slope. In the distal part of the pediment, the passage to an accumulation plain is observed, the descent.

Depending on the condition of the local base level, the descent can cover and invade the pedimentos. In this case, we speak of "pedemonte".

Alluvial plain pedemontana (lowered) and alluvial fans

These geoforms together with the pedimentos constitute the so-called pedemontana association.

They constitute local erosion plains, assimilable to pedimentos, which appear controlled in their development by local base levels, such as the course of a river or a closed basin (barreales and bajos). (González Díaz y Ferrer, 1986). The alluvial fans constitute detrital accumulations whose surfaces have a cone shape (in plan), with a convex profile upwards.

They develop at the point where the alluvial channel loses slope, so the particles that it carries are deposited. This point of change of slope is called apex of the fan or alluvial apex, where the granulometric of deposited sediments decreases as the distance to the apex increases.

This area constitutes an elevated plain with a gentle slope towards the east-northeast. The same can be considered as a pediment of convergent type, given that it constitutes an area of slope characterized by erosion and transport of detritus, mainly alluvial-colluvial. This level of erosion is controlled by the base levels established by the closed basins located in the central sector of the Huantraico fossa, and which develop in a "chained" way to the north, with the lowest base level constituted by Las Aguadas Grande and del Porteño (endorheic basin).

The plain is interrupted by topographic elevations of reduced areal extension, represented by hills that have lasted on the land as a result of differential erosion, due to their greater lithological and structural resistance.

Depressions of uncertain origin

A common form of depression is the ramblón, whose bottom is covered by silty-clayey sediments. They are widely developed in the Bajada del Palo concession area, linked to the change of slope east of the Sierra Negra and northwest of Barda Auca Mahuida. They consist of depressions or closed basins, with a tendency to centripetal drainage and accumulations of alluvial sediments of fine granulometry. Eventually, they are flooded by bodies of ephemeral water or salitrales.

Geoforms derived from the fluvial process with evident structural control (influence of folded structures, syncline and anticline valleys, and contributed anticlinies).

The fluvial process contributes to the degradation of the landscape, which is very sensitive to the variations of geological environments. Areas that show marked structural weaknesses, or that are less resistant, will be quickly eroded or taken advantage of by the passage of water.

The homoclinal structures are characterized by two types of slopes. One is called erosion escarpment, which has high degrees of inclination, and the other is called sloping slope, which has an intensity of medium-smooth.

The anticline valleys and syncline valleys tend to have different degrees of evolution according to their horizontal folding or axes. In this situation, the structurally controlled forms reach their greatest degree of complexity.

The differential erodability of the different lithological types of sedimentites is another structural control that influences the morphology of this sector.

This unit is characterized in the area by the Sierra Negra anticline, which extends southwest-northeast-east, in the western sector of the Bajada del Palo concession area.

The hills have steep slopes (greater than 30%), include erosion escarpments, and are dissected by a temporary drainage network with a dendritic design, which has excavated deep ravines in an easterly direction. This has generated a landscape of crests, hills, canyons and remnants of erosion, formed on friable sediments by differential erosion.

The highest topographic point (Sierra Negra) is characterized by the presence of claystones from Huitrin and Rayoso formations in the nucleus of the anticline, and by the lava flows from basalt or palaoco formations.

The oldest rocks in the region are continental red layers of the Neuquén Group, made up of sandstones and pelites with little intercalations of lenticular banks of sabulitas and conglomerates. Towards the west, the Neuquén Group is covered in low angle unconformity by basalts and tuffs.

5.1.3.2 Entre Lomas

Alluvial plain

It constitutes the current zones of aeolian accumulation of alluvial sediments, forming numerous channels between which the anastomosed habit predominates. They present slopes from 0.5º to 2º, they are flat and are covered by ephemeral channels whose depth exceeds one meter. These channels are covered by torrents that deposit fine material.

In the Alluvial Plain, there is an ancient paleocanal or channel possibly from the Neuquén River, which runs in a northeast direction and drains into the lower part of Añelo.

Erosion escarpment

It is located to the north of the plateau. On these slopes, bad-lans (reliefs caused by river degradation) have developed. These are located near the base of the marginal escarpment of the structural plain. In this type of relief, the drainage network is dendritic and dense, which when added to the slope, results in active water erosion.

Polygenic geoforms and Pedimentos

These are relief forms that involve several processes in their formation.

The pedimentos constitute the western watershed, whose centripetal regional drainage concurs to the local base level represented by the Bajo de Añelo and responds to the characteristics of “convergent pedimentos” (González Díaz et al. 1984). These surfaces of erosion appear carved on the friable successions of the Mesozoic superior (Forms. Allén and Jaguel). These pedimentos dominate the area of Bajada del Palo.

Wind Geoforms

These geoforms are formed by the action of the wind. Although they are not very noticeable, they are of great environmental importance because the most productive soils of the area form on them. Scattered, discontinuous sandy accumulations, called nebkas or vestiges of sand, are also present.

5.1.4 Topography

5.1.4.1 Bajada del Palo

The Bajada del Palo concession area has the highest elevations on the eastern flank, with elevations ranging from 530 to 660 m.a.s.l. The lowest altitudes are in the extreme west of the area, with elevations between 325 - 390 m.a.s.l.

The general slope develops in an east direction. There are slopes in a northwest direction in the south sector and slopes in a southeast direction in the north zone.

In the central zone, which has the highest density of oil wells and facilities, the elevation is between 566 meters above sea level in the west and 546 m.a.s.l in the east. The topography in this area is largely irregular. Some sectors are flat, some are more elevated and there is high alluvial transport. In addition, isolated remnants of erosion are present.

5.1.4.2 Entre Lomas

Most of the study area is located between 300 and 600 meters above sea level. The sectors with higher elevation are in the central north of the study area. The North sector is the most extensive, has a flat to gently undulating relief with slopes of 1 to 2%, with a cord of slopes of up to approximately 100 meters in the central north area.

To the northeast of the area, there is a depressed and flooded sector, alluvial and colluvial deposits and deposits that cover pedimentos dissected with slopes to the Colorado River. In these situations, the sediments are silty and sandy with low bearing capacities. The alluvial deposits culminate at the cord of slopes (which geologically coincides with the El Palo Formation) before this sector. In this sector the water courses are of little importance, but there is alluvial risk for the facilities located in the area. These watercourses are rain-fed and are activated after intense and / or prolonged rainfall.

5.1.5 Soils

5.1.5.1 Bajada del Palo

The soils of the project area correspond to environments with annual water deficit (edafoclimaaridic). The water balance of these soils is negative, which implies very little mobilization of constituents in their profile. Therefore, soluble salts accumulate very close to the surface, and soft and cemented forms of limestone and gypsum are frequently found.

In the area, the soil orders of Entisols and Aridisoles are present. Entisols are soils from null to incipient genetic development. Therefore, they often lack diagnostic horizons. Most of its properties (colour, texture, etc.) are inherited from its original materials and have been little altered by the natural environment. The order of Entisoles includes the subgroups of typical Torriortentes, typical Torripsamentes, Torriortentesxéricolíticos, typical Torrifluventes, Torriortentesvérticos and typical Salortides.

Los Aridisoles are characterized by sparse shrub steppe, so the organic matter content is very low, and they have a negative water balance that prevents or reduces the mobility of the constituents in their profile. They differ to Entisols because they exhibit one or more diagnostic horizon, such as calcium, petrocalcic, gypsic, petroglyptic, etc. The order of the Aridisoles includes the typical Calciortides and typical Gypsiortides subgroups (see Annex 5.3 - Soil type map).

5.1.5.2 Entre Lomas

Aridisols are predominant in "high places" and Entisols are predominant in "low places". Aridisols present greater pedogenetic development, with more horizons that are reddish in colour and structured with respect to the supre or underlying, or with a higher percentage of clays. Its texture is loamy clayey or sandy clayey and, in some cases, some incipient varnishes are observed.

The soils have a sandy layer of 15 cm due to wind accumulation, and below it another layer with a finer clay loam to sandy clay loam texture, whose thickness varies according to the depth of the petrocalcic horizon. This cemented horizon conditions the depth of the soil and consequently the depth of vegetation rooting. Depending on its depth, it is classified into shallow, moderate or deep. The water erosion observed in these soils is mild to moderate and the wind varies from moderate to severe. In some sectors, the strong winds have caused the roots of bushes to be exposed.

Regarding soils from the Entisols order, deposits of sand of wind origin and of variable thickness have masked the fluvial imprints. In turn, they present little to no pedogenetic development. In these basses, the petrocalcic horizon can be found at different depths, varying by several tens of centimetres to more than one meter.

The main limitation of these soils is the low retention of moisture. Other limitations include water erosion for the Entisols order and susceptibility to wind erosion for the Aridisoles order. Finally, the order Entisols shows salinity in the first 50 cm of soil.

5.1.6 Hydrology and Hydrogeology

The watershed is a surface on which water and materials drain to a point of control. It is taken as a unit of analysis where rainfall-runoff processes occur and is characterized by its boundary, surface, perimeter, maximum and minimum heights, slope, drainage network, length of the main channel, average slope, and parameters derived from these aspects which reflect some property in relation to runoff.

The drainage network is related to the resistance of the rock to erosion and its permeability. Specifically, the type of drainage reflects the lithological, structural and climatic conditions of the area. It is necessary to analyse the frequency of courses or drainage texture, network design and the transversal profile of courses and gullies.

The shape of the basin influences the travel times of the water in the channels; a round basin will have a higher concentration time than an equivalent but oval basin, since the runoff water travels longer paths through the secondary tributaries to the central channel. (see Annex 5.4 - Hydrology map).

As a general description, the project area is a desertic plain in northern Patagonia.

Only main rivers coming from the Andes ridge located to the west flow East-SE towards the Atlantic Ocean, located South (Neuquén River) and East (Rio Colorado) of the project area.

Some minor creeks cross the area; they carry water in sporadic rainfalls, and are dry all year long. Some of them run towards a depression called Bajo de Añelo located NorthWest of the area.

The first aquifer in the project area is at about 100 mbgl or more, but needs to be protected from drilling activities, as it will be explained in this report in next pages.

5.1.6.1 Bajada del Palo

Surface Water

Some minor creeks are found within the project area, they carry water in sporadic rainfalls. Hydrologically, the most important element in the area is the Neuquen River, which flows between 20km south of the boundary area and Bajo de Añelo. Also, in the centre of the department of Añelo, a great depression is located. Many alluvial creeks (temporary streams), including those that begin in the western sector of the concession area, drain into this depression.

The course of the Neuquén River has an approximate length of 510 km, with an average slope of 4.22 m / km, and drains into a basin of 32,450 km². The "active" basin is approximately 17,000 km². This means that 15,450 km² consists of either sub-basins which provide non-permanent flows or areas without contributions.

The spills of the river come from a mountainous front of 270 km in length. The isohyet estimated on this front is 1,500 mm, with values rapidly decreasing towards the east, and sporadic increases in other condensation fronts such as Domuyo volcano, Cordillera del Viento and Tromen volcano.

The most remote springs of the river are in the Andes mountain range on the border with Chile at an altitude of 2,280 meters. They receive numerous streams from the mountainous cords on both margins, which become plentiful in the summer.

Groundwater

In the description of the Inventory of Natural Resources of the Province of Neuquén, the concession area Bajada del Palo and the surrounding areas are located within the group of aquifers corresponding to plateaus.

The most notable difference of these aquifers is their topographic location. Furthermore, these aquifers have a geometric distribution and a design of the underground flow network that is consistent with the topography of the surface of each site.

The Meseta (plateau) aquifers are developed in the flat and sub horizontal areas of gentle slope to the east that crown the plateaus that are located in the area of Patagonia Extrandina.

They are usually covered by gravel and, eventually, by lava flows. The gravel levels are of variable thickness and decrease progressively towards the east.

The contribution of water is local and comes directly from rainfall or the melting of seasonal snow. The movement of the water is initially verified in vertical form from the surface of the referred gravels until it makes contact with the sediments of lower permeability, which are usually related to the sediments of tertiary age (continental and marine)In addition, the slope of the aforementioned stratigraphic horizons conditions the movement of the flow, which is generally to the east. In the case of plateaus with basaltic cover, the vertical percolation is governed by the system of vertical fractures that the lava flows present.

The characteristics of this group are described below:

- The geological environments that receive water are sediments of coarse granulometry, such as boulders, gravels and coarse sands.
- The water comes from local and direct recharge and is provided by rainfall and seasonal snow melting. Only along the shore of the main rivers, also recharge of the banks by river water is observed.
- In general, they have fresh or brackish water. The clastic medium through which the water moves depends on the characteristics of the mineralogical components.
- They consist of layers phreatic or layers free
- They form bodies of water that have a high vulnerability to pollution.

5.1.6.2 Entre Lomas

Surface Water

The permanent water courses closest to the concession area are the Negro River (75 km from the project area), the Colorado River (20 km from the project area) and the Neuquén River and Pellegrini Lake (both 35 km from the project).

The Negro River is formed by the combination of the Neuquén and Limay rivers, and has a flow of approximately 930 m3 / sec. It is the most important hydrographic system of the national territory. This river advances through arid plateaus with variable valley width and does not receive contributions from any tributary throughout its course.

The Neuquén River drains an area of 30,000 km2, with a module of 280 m3 / sec. Its hydrologic regime is of pluvionival type, and it presents violent floods during the winter and at the end of the spring.

The Ballester dam is located approximately 40 km upstream from the confluence with the Limay river. It enables the diversion of water for irrigation of the Alto Valle and diverts excess to an important natural receptacle where Lake Pellegrini has been artificially formed.

Groundwater

The underground hydrology of the study area shows that the water supply is local and comes directly from rainfall or snow-melting. Only along the main rivers, riverwater infiltration into the banks is observed.

The study area is located in a mesetiforme environment with an arid climate and steppe vegetation, which leaves the soil directly exposed to precipitation and convective storms. This environment is more conducive to the presence of the alluvial phenomenon. In general, the channels travel short distances due to their non-permanent regime and are normally dry. They can, however, reach peaks for short periods of time (floods or flash floods) and become part of the complex drainage network of the dendritic type, driving waters to the lower sectors. In the study area, these watersheds are closed or endorheic and are only activated during short periods of rainfall that reach depressed areas of low permeability. This creates "sweeping", where the water remains until its complete infiltration and/or evaporation.

On the surface of the plateaus, it is common to find isolated or partially aligned endorheic basins. In the lower depressions there are brackish and / or salt-water bodies of seasonal regime that largely influence the composition of groundwater to which they transfer similar chemical characteristics.

The dissected Pedemontana alluvial plain is present in much of the area. Its low slope (< 2%) and low coefficient of runoff favours infiltration over surface runoff. Therefore, ephemeral channels are not found in the central part of the area.

In the Pedimentadas units, there is a dendritic drainage network of important collecting channels that drain into both the Colorado River and into the reservoir Embalse Casa de Piedra east of the area, as well as into the Barreales de la Amarga to the South.

“Shallow Aquifer” description and protection measures

The infiltrated surface water recharges gravelly to coarse sand layers of the Grupo Neuquen.

Based on public information, the water is fresh to brackish with pH values of 7 to 8, a dry residue of 1,000 to 2,500 ppm, chlorides of 400 to 500 ppm, sulfates of 100 to 200 ppm and fluorides of 0.5 to 2.6 ppm.

In the project in general the first phreatic aquifer is at about 100 meter below ground level (mbgl) or more.

Although, given the sandy and gravelly lithology, which is quite permeable, the vulnerability of contamination from surface is moderate.

On the other hand, drilling operations that cross all the aquifers until reaching the oil bearing formations at over 2000mbgl, may affect the shallow aquifers due to drilling fluids infiltration and or hydrocarbons affection.

To prevent this potential, local legistation has been developed to allow to establish the depth to which “the shallow aquifers with potential for human use water abstraction” has to be considered and protected.

This protection measures include:

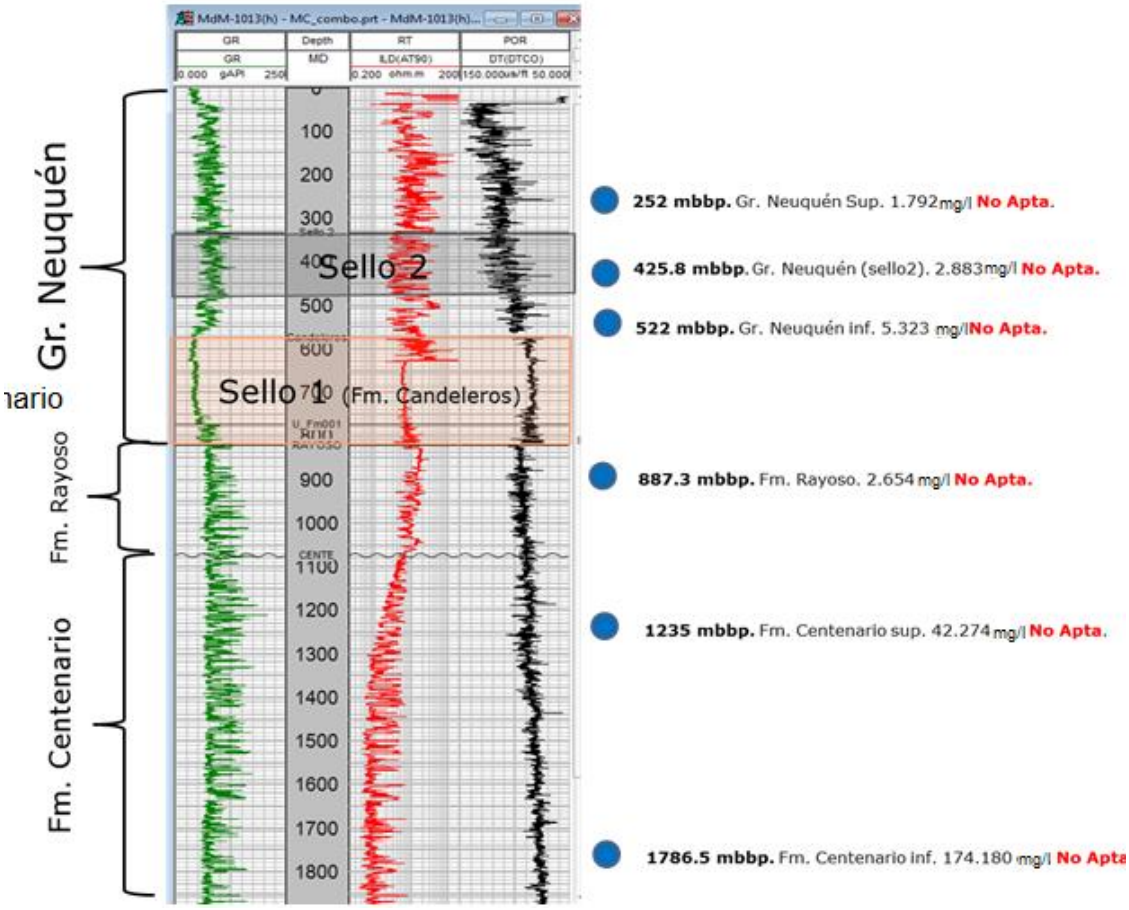
- Drilling through shallow aquifers only with water-Bentonite drilling fluids (no hydrocarbons or potentially polluting additives allowed).

- Installing the Protection casing (Cañeria Guia) with complete annular space cementation up to the surface, to a depth that protects all shallow aquifers with total salinity of less than 3000 mg/l.

In order to comply with the requiremts, Vista O&G drilled at the first Unconventional Well of the Proyect VOG.Nq.MdM-2013(h) located in the SW of Bajada del Palo Oeste block over 700 m with water bentonite mud, and logged the well to detected the aquifers, as well as sampled them with the MDT toll, allowing chemical analisis of the quality of 6 aquiefrs.

The log, the sampling points/depths and the detected “Seals” (Sello 1 and Sello 2) are shown in the following figure:

Figure 5-5 Sampling points/depths and the detected “Seals



Source: Vista Oil&Gas.

The analytical results of those samples is summarized in the following table:

Table 5-3 Analytical Results

		MdM.1013					
Unidad		Gr. Neuquén Sup.	Gr. Neuquén. Sello 2	Gr. Neuquén inf.	Fm. Rayoso	Fm. Cente. Sup.	Fm. Cente. Inf.
Parámetro	CAA Art. 982	252 m	425,80 m	522 m	887,30 m	1235 m	1786 m
Características físicas							
Conductividad eléctrica (25ºC)	LEY 1875 4000 umhos/cm	1448.1	1293	3100.3	5459.1	84946	349517.7
Características químicas							
pH	6,5 - 8,5	9,74 UpH	8,11 UpH	8,12 UpH	8,65 UpH	7,34 UpH	6,29 UpH
Substancias inorgánicas							
Aluminio residual (Al) máx.	0,20 mg/l	<0,008 mg/l	<0,008 mg/l	<0,008 mg/l	<0,008 mg/l	<0,008 mg/l	<0,008 mg/l
Arsénico (As) máx.	0,01 mg/l	0,01 mg/l	<0,002 mg/l	<0,002 mg/l	<0,008 mg/l	0,006 mg/l	0,004 mg/l
Boro (B) máx.	0,5 mg/l	1,2 mg/l	1,2 mg/l	2,40 mg/l	0,40 mg/l	2,8 mg/l	6,8 mg/l
Cadmio (Cd) máx.	0,005 mg/l	< 0,02 mg/l	< 0,02 mg/l	< 0,02 mg/l	< 0,02 mg/l	< 0,02 mg/l	< 0,02 mg/l
Cianuro (CN) máx.	0,10 mg/l	0,003 mg/l	0,002 mg/l	0,002 mg/l	<0,002 mg/l	<0,002 mg/l	<0,002 mg/l
Cinc (Zn) máx.	5,0 mg/l	0,12 mg/l	<0,03 mg/l	<0,03 mg/l	0,06 mg/l	<0,03 mg/l	0,09 mg/l
Cloruros mg/l	350 mg/g	84,03 mg/l	124,05 mg/l	232,09 mg/l	620,24 mg/l	24809,8 mg/l	108042,66 mg/l
Cobre (Cu) máx.	1,00 mg/l	0,08 mg/l	<0,06 mg/l	<0,06 mg/l	<0,06 mg/l	<0,06 mg/l	<0,06 mg/l
Cromo (Cr) máx.	0,05 mg/l	< 0,1 mg/l	< 0,1 mg/l	< 0,1 mg/l	< 0,1 mg/l	< 0,1 mg/l	0,16 mg/l
Dureza total (CaCO3) máx.	400 mg/l	220 mg/l	56 mg/l	100 mg/l	58 mg/l	1980 mg/l	42400 mg/l
Flúor	Lím.inf.: 0,6 mg/l ; Lím. sup.: 0,8 mg/l	< 0,02 mg/l	< 0,02 mg/l	< 0,02 mg/l	< 0,02 mg/l	< 0,02 mg/l	< 0,02 mg/l
Hierro total (Fe) máx	0,30 mg/l	16,38 mg/l	1,44 mg/l	0,35	1,33 mg/l	0,28 mg/l	41,5 mg/l
Manganeso (Mn) máx.	0,10 mg/l	0,497 mg/l	<0,05 mg/l	<0,05 mg/l	<0,05 mg/l	0,49 mg/l	24,7 mg/l
Mercurio (Hg) máx.	0,001 mg/l	< 0,001 mg/l	< 0,001 mg/l	< 0,001 mg/l	< 0,001 mg/l	< 0,001 mg/l	< 0,001 mg/l
Níquel (Ni) máx.	0,02 mg/l	< 0,3 mg/l	< 0,3 mg/l	< 0,3 mg/l	0,65 mg/l	0,32 mg/l	0,99 mg/l
Nitrito (NO2) máx.	0,10 mg/l						
Plomo (Pb) máx.:	0,05 mg/l	< 0,17 mg/l	< 0,17 mg/l	< 0,17 mg/l	< 0,17 mg/l	0,26 mg/l	0,38 mg/l
Sulfatos (SO4=) máx.:	400 mg/l	537,5 mg/l	450 mg/l	637,5 mg/l	612,5 mg/l	925 mg/l	0 mg/l
Hidrocarburos totales de petróleo		7,32 mg/l	0,02 mg/l	0,6 mg/l	721,04 mg/l	28,89 mg/l	41,61 mg/l
Grasas y aceites		7,45 mg/l	0,13 mg/l	0,7 mg/l	721,04 mg/l	29,55 mg/l	41,61 mg/l
Fenoles		0,204 mg/l	0,15 mg/l	0,174 mg/l	0,054 mg/l	0,048 mg/l	0,114 mg/l
Detergentes		0,008 mg/l	0,026 mg/l	0,147 mg/l	0,026 mg/l	0,21 mg/l	0,6 mg/l
Carbonatos		90 mg/l	0	42 mg/l	114 mg/l	0	0
Bicarbonatos		512,55 mg/l	1464,43 mg/l	2855,64 mg/l	439,33 mg/l	305,09 mg/l	244,07 mg/l
Calcio		60,92 mg/l	16,03 mg/l	27,25 mg/l	18,44 mg/l	589,18 mg/l	14108,16 mg/l
Magnesio		16,51 mg/l	3,88 mg/l	7,77 mg/l	2,9 mg/l	123,67 mg/l	1738,93 mg/l
Sodio		472,45 mg/l	821,43 mg/l	1517,01 mg/l	844,81 mg/l	15518,72 mg/l	49970,27 mg/l
Cromo Hexavalente		<0,1 mg/l	< 0,1 mg/l	< 0,1 mg/l	< 0,1 mg/l	< 0,1 mg/l	< 0,1 mg/l
Vanadio		<0,5 mg/l	<0,5 mg/l	<0,5 mg/l	0,71 mg/l	<0,5 mg/l	1,59 mg/l
Residuo salino		1790	1671	2916	2528	42518	202256
SALINIDAD TOTAL	LEY 1875 3000 mg/l	1792	2883	5323	2654	42274	174180

Source: Vista Oil&Gas.

Reviewing this analytical data, it can be concluded that:

- The water with less than 3000mg/l Total Salinity is located up to about 430 mbgl in the area, within the Seal 2 section;
- Although, due to other components (SO4; B, Fe) that exceed drinking water standards of local Alimentary Code, the water is not potable in all tested aquifers;

This was checked with data o other wells in the area, being consistent in the conclusions.

- Given that the Neuquen Province's Hydraulic Resources Authority considers that up to 3000 mg/l, although not potable, future potential use for abstraction has to be considered (irrigation, cattle drinking water, etc) and protected.

Based on these facts, the depth of protecting casing for the next wells was established to be installed down to 430 mbgl and into Seal 2 and said design was approved by Neuquen Province's Hydraulic Resources Authority.

Depending on the following location of the PADS, authorities may request a permit, who could request some additional Groundwater sampling in other Pads, at different topographical locations and altitude, to verify the required depth of the protective casing in those other locations.

5.1.7 Air quality

The main objective is to evaluate the current state of air quality in the project area, and to identify the base level for the selected air and noise quality parameters within the study area.

5.1.7.1 Methodology

Monitoring was conducted at different points within the project's area to determine ambient conditions at the receptor level. The analysis of basic parameters included: VOC's, Hydrogen Sulfides and

Particulate Material as required in Annex II of National Decree 831/93. In addition, the field measurements, collection with absorbents and preservation of the samples were carried out according to the established analytical methods. The methodological framework for the field and laboratory study also adopted the procedural guidelines of the USEPA (United States Environmental Protection Agency).

The following table presents the methodologies used to measure the different parameters of air quality.

Table 5-4 Analytical Methodologies Used for the Evaluation of Air Quality

Parameter	Caudal (L/min)	Time (minute)	Methodologic
VOC´s	0.375	60	ASTM D 3686/3687
Total particulate material	1.70	60	EPA 40CRF PT 50 App.J
Hydrogen sulfide	0.60	60	EPA 9030 B

Source: Cromaquim S.R.L, 2018.

Values Guide for Atmospheric Air Quality

The guideline values used for analysing air quality are those outlined in Annex II of National Decree 831/93, the regulations of the province of Buenos Aires (not applicable, just taken as reference) and the Ambient Air Quality of the IFC General EHS Guideline (2007).

Table 5-5 Values Guide for Atmospheric Air Quality

Parameters	Concentration (mg/m^3)	Period average (min)
Acetaldehyde	0.01	30
Vinyl Acetate	0.15	30
Ammoniac	1.5	30
Aniline	0.05	30
Arsenic	0.01	20
Benzene	0.2	20
Cadmium	0.01	30
Hydrogen Cyanide	0.015	30
Cyclohexane	1.4	30
Chlorine	0.01	20
Chlorobenzene	0.1	30

Parameters	Concentration (mg/m^3)	Period average (min)
Hydrogen chloride	0.05	30
Cresols	0.6	30
Chrome	0.0015	30
Dichloroethane (1,2-)	3	30
Di-Isocyanate of Tolueno	0.05	30
Styrene	0.01	30
Phenol	0.01	20
Fluorides	0.02	30
Formaldehyde	0.035	30
Polynuclear Aromatic Hydrocarbon	5	30
Manganese	0.03	30
Meth Paration	0.008	30
Naphthalene	0.003	30
Acid fog (H2s04)	0.006	30
Nitrogen oxides	0.9	60
Ozone-Photochemical Oxidizers	0.3	60
Lead	0.002	30
Carbon Sulfide	0.03	30
Hydrogen sulfide	0.008	30
Carbon tetrachloride	4	30
Toluene	0.6	30
Trichlorethylene	0.2	30
Xylenes	0.2	30

Source: Annex II of National Decree 831/93, 1993.

Table 5-6 Values Guide for Atmospheric Air Quality

Parameters	Guideline Value (mg/m3)	Guideline Value (ppm)	Period average
Sulfur dioxide (SO2)	1,300 0,365 0,080	0,50 0,14 0,03	3 horas 4 horas 1 año
Particulate Matter (PM 10)	0,050 0,150		1 año 24 horas
Nitrogen oxides (NO2) (expressed as nitrogen oxide)	0,367 0,100	0,2 0,053	1 hora 1 año
Ozone	0,235	0,235	0,235

Source: Ambient Air Quality Standard of Buenos Aires (not applicable)

Table 5-7 IFC EHS -Ambient Air Quality Guidelines

Parameters	Period average	Guideline Value (ug/m3)	Guideline Value (mg/m3)
Sulfur dioxide (SO2)	10 minute	500	0.5
Nitrogen dioxide (NO2)	1 hour	200	0.2
Particulate Matter (PM 10)	24 hours	50	0.05
Particulate Matter (PM 2.5)	24 hours	25	0.025
Ozone	8 hours daily maximun	100	0.1

Source: Environmental, Health, and Safety Guidelines- General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality, 2007.

5.1.7.2 Location of Sampling Stations

The georeferenced location of the sampling stations is presented in the following table.

Table 5-8 Sampling Stations Air Quality

Area	Location	Installation	Coordinates	
			East	North
EL	Oficinas	Oficina-Campamento	2580516	5770169
CB	PTC	Pileta PTC-API	2580593	5771113
CB	PTC	Pileta PTC-PIE	2580608	5771095
CB	PTC	Pileta PTAS-PIE	2580608	5771095
CB	PIAD-PIAS	PIAD-PIAS CB/Oficina	2577104	5773475
CB	PIAD-PIAS	PIAD-PIAS CB/Cargadero	2577104	5773454
CB	Bateria 1CB	Bat. 1CB	2580329	5770376
CB	Bateria 2CB	Bat. 2CB	2577614	5772542
CB	Bateria 3CB	Bat. 3CB	2575876	5777296
CB	Bateria 4CB	Bat. 4CB	2581808	5768267
CB	Bateria 6CB	Bat. 6CB	2578187	5773951
PB	Bateria 1PB	Bat. 1PB	2573881	5776791
PB	Bateria 2PB	Bat. 2PB	2569683	5779962
PB	Bateria 4PB	Bat. 4PB	2571803	5778278
PB	Bateria 6PB	Bat. 6PB	2568147	5781751
PB	Bateria 7PB	Bat. 7PB	2574829	5774505
BOMO	Bateria BM	Bat. BoMo	2563228	5777966
EL	Bateria 1EL	Bat. 1EL	2559272	5792263
EL	Bateria 2EL	Bat. 2EL	2557273	5795044
EC	Bateria 1EC	Bat. 1EC	2550452	5805293
LO	Bateria 1LO	Bat. 1LO	2554941	5798724
BMO	Batería 1 BMo	Bat. 1BMo	2542163	5769577
BP	Batería 1 BP	Bat. 1BP	2557991	5776467
JQ	PAJQ	Planta de acondicionamiento de gas JQ	2591172	5742246
CB	PTGas	PTG- Zona Ofic/lab	2579369	5770788
CB	PTGas	Piletas Mechero de LPG	2579453	5770931
CB	EMC2	E.Motocompresora 2	2577636	5772431
PB	EMC3	E.Motocompresora 3	2573957	5776707
PB	EMC4	E.Motocompresora 4	2569836	5780130
EL	EMC5	E.Motocompresora 5	2557343	5795082
BMO	EMC8	E.Motocompresora 8	2542294	5769605
BMO	EMC9	E.Motocompresora 9	2558041	5776444
JQ	EMC10	E.Motocompresora 10	2591172	5742246
EL	CTEL	Planta Motogeneradora Entre Lomas	2577142	5773640

Source: Vista Oil&Gas, 2019.

5.1.7.3 Result of the evaluation

The following table presents a summary of the air quality results obtained at the monitoring points and compares these with the guideline values for air quality.

Table 5-9 Result of Sampling

Puntos	Location	Installation	Parameters (mg/m3)								
			Benzene	Chlorobenzene	Styrene	Naphthalene	Nitrogen oxides	Hydrogen sulfide	Toluene	Xylenes	Particulate material
EL	Oficinas	Oficina-Campamento	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
CB	PTC	Pileta PTC-API	< 0.05	< 0.10	< 0.10	< 0.10	-	< 0.04	< 0.10	< 0.10	<0,05
CB	PTC	Pileta PTC-PIE	< 0.05	< 0.10	< 0.10	< 0.10	-	< 0.04	< 0.10	< 0.10	<0,05
CB	PTC	Pileta PTAS-PIE	< 0.05	< 0.10	< 0.10	< 0.10	-	< 0.04	< 0.10	< 0.10	<0,05
CB	PIAD-PIAS	PIAD-PIAS CB/Oficina	< 0.05	< 0.10	< 0.10	< 0.10	-	< 0.04	< 0.10	< 0.10	0,88
CB	PIAD-PIAS	PIAD-PIAS CB/Cargadero	< 0.05	< 0.10	< 0.10	< 0.10	-	< 0.04	< 0.10	< 0.10	<0.05
CB	Bateria 1CB	Bat. 1CB	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
CB	Bateria 2CB	Bat. 2CB	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
CB	Bateria 3CB	Bat. 3CB	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
CB	Bateria 4CB	Bat. 4CB	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
CB	Bateria 6CB	Bat. 6CB	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
PB	Bateria 1PB	Bat. 1PB	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
PB	Bateria 2PB	Bat. 2PB	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
PB	Bateria 4PB	Bat. 4PB	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
PB	Bateria 6PB	Bat. 6PB	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
PB	Bateria 7PB	Bat. 7PB	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
BOMO	Bateria BM	Bat. BoMo	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
EL	Bateria 1EL	Bat. 1EL	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
EL	Bateria 2EL	Bat. 2EL	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	1.24	-
EC	Bateria 1EC	Bat. 1EC	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-

Puntos	Location	Installation	Parameters (mg/m3)								
			Benzene	Chlorobenzene	Styrene	Naphthalene	Nitrogen oxides	Hydrogen sulfide	Toluene	Xylenes	Particulate material
LO	Bateria 1LO	Bat. 1LO	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
BMO	Batería 1 BMo	Bat. 1BMo	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
BP	Batería 1 BP	Bat. 1BP	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
JQ	PAJQ	Planta de acondicionamiento de gas JQ	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
CB	PTGas	PTG- Zona Ofic/lab	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
CB	PTGas	Piletas Mechero de LPG	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	< 0.05
CB	EMC2	E.Motocompresora 2	-	-	-	-	-	< 0.04	-	-	-
PB	EMC3	E.Motocompresora 3	-	-	-	-	-	< 0.04	-	-	-
PB	EMC4	E.Motocompresora 4	-	-	-	-	-	< 0.04	-	-	-
EL	EMC5	E.Motocompresora 5	-	-	-	-	-	< 0.04	-	-	-
JQ	EMC10	E.Motocompresora 10	-	-	-	-	-	< 0.04	-	-	-
EL	CTEL	Planta Motogeneradora Entre Lomas	< 0.05	< 0.10	< 0.10	< 0.10	< 0.25	< 0.04	< 0.10	< 0.10	-
Annex II of National Decree 831/93, 1993.-Guide Values (mg/m3)			**0.2**	**0.1**	**0.01**	**0.003**	**0.9**	**0.008**	**0.6**	**0.2**	**-**
Ambient Air Quality Guidelines (IFC) –PM 10 (mg/m3)			-	-	-	-	-	-	-	-	**0.05**
Ambient Air Quality Guidelines (IFC) –PM 2.5 (mg/m3)			-	-	-	-	-	-	-	-	**0.025**

Source: Cromaquim, 2018

As shown in the previous table, some of the parameters in sampling points are below the detection limits of the laboratory's analytical methods. It should be noted that in some cases (Styrene, Naphthalene and Hydrogen Sulphide), the detection value is greater than the value established in the national Argentina guideline values. As such, it cannot be determined the results exceed the national standard.

Particulate material was evaluated in six stations. In one of these stations, the registered value (0.88 mg/m3) surpasses the guideline values of the IFC std (PM10 = 0.05 and PM2.5= 0.025).

The Physicochemical Sampling Points map is shown in Annex 5.5 and the reports issued by the laboratory are attached in Annex 5.6.

5.1.8 Emissions

In Neuquén province, there are regulations that prohibit gas venting in exploration wells and during production operations at gas wells, as well as limits on air emissions at oil wells. Provincial Law Nº 2.175 and National Resolution SE N° 143/98 are the regulations specific to flaring and venting. These regulations establish the mechanisms to request an exception for flaring/venting for exploratory and completion activities. Flaring during well testing will require approval by the enforcement authority (Undersecretariat of Energy). Exceptions for venting are considered in some cases, for example: well testing, gas treatment plants, and maintenance activities.

5.1.8.1 Methodology

The following table presents the guides values for the different emission parameters in accordance with the Emissions Guidelines of the IFC General EHS Guideline (2007).

Table 5-10 Small Combustion Facilities Emissions Guidelines (IFC)

Combustion Technology	Particulate Matter (PM)	Sufur Dioxide (SO2)	Nitrogen Oxides (NOx)	Dry Gas, Excess O2 Content (%)
Engine				
Gas (mg/Nm3)	N/A	N/A	200 (Spark Ignition) 400 (Dual Fuel) 1,600 (Compression Ignition)	15

Source: Environmental, Health, and Safety Guidelines- General EHS Guidelines

As a reference, the following table presents the guides values for the different emission parameters in accordance with Decree 3395/96 of the province of Buenos Aires (not applicable, but taken as a reference) Please note that said guideline does not establish the O2 excess percentage at which the emissions are to be corrected.

Constituent Dangerous	Guide Level (mg/Nm3)	Mass flow (gr/seg)
Sulfur Dioxide (SO2)	500	NE
Carbon monoxide (CO)	100	NE
Nitrogen oxides (NOx)	450	NE

5.1.8.2 Location of Sampling Stations

Motor generators (gas) of the Entre Lomas thermal power station, as principal sources of emission in the area.

5.1.8.3 Result of the evaluation

The following table presents a summary of the emission results obtained in the motor generator and compares them with the reference values for emission.

Table 5-11 Result of Sampling

Puntos	Location (Entre Lomas)	Installation	Parameters			
			NOx (mg/Nm3) 5% O2 excess	NOx (mg/Nm3) 15% O2 excess	CO (mg/Nm3)	SO2 (mg/Nm3)
MTG 01	Chimenea MG01	Moto Generador 1	198.9	303.5	163.2	0
MTG 03	Chimenea MG03	Moto Generador 3	278.7	432.5	214.4	0
MTG 04	Chimenea MG04	Moto Generador 4	233.6	362.5	191.8	0
MTG 05	Chimenea MG05	Moto Generador 5	209.7	325.4	172.7	0
MTG 06	Chimenea MG06	Moto Generador 1	192.6	315.2	201.9	0
MTG 07	Chimenea MG07	Moto Generador 1	225.4	355.8	181.0	0
MTG 08	Chimenea MG08	Moto Generador 1	210.0	325.8	192.0	0
MTG 09	Chimenea MG09	Moto Generador 1	229.2	355.7	186.9	0
MTG 10	Chimenea MG10	Moto Generador 1	194.4	306.9	188.7	0
MTG 11	Chimenea MG11	Moto Generador 1	246.4	382.4	235.8	0
MTG 12	Chimenea MG12	Moto Generador 1	253.9	380.9	208.9	0
MTG 13	Chimenea MG13	Moto Generador 1	230.8	358.2	201.1	0
MTG 14	Chimenea MG14	Moto Generador 1	253.8	393.8	228.2	0
MTG 15	Chimenea MG15	Moto Generador 1	240.8	367.3	207.8	0
MTG 17	Chimenea MG17	Moto Generador 1	229.8	369.3	217.9	0
MTG 18	Chimenea MG18	Moto Generador 1	230.2	345.3	195.7	0
MTG 19	Chimenea MG19	Moto Generador 1	254.6	395.1	210.4	0
MTG 20	Chimenea MG20	Moto Generador 1	235.3	353.0	212.1	0
MTG 21	Chimenea MG21	Moto Generador 1	231.6	347.4	211.7	0
MTG 22	Chimenea MG22	Moto Generador 1	219.3	334.5	200.3	0
MTG 24	Chimenea MG24	Moto Generador 1	250.5	395.6	216.7	0
Guide Values Environmental, Health, and Safety Guidelines- General EHS Guidelines IFC (mg/Nm3)			**-**	**1,600**	**N/A**	**N/A**

Source: (L.J.D.) Servicios Industriales – Junio 2018

Considering that the power generators present at the Entre Lomas Power Generation Plant are engines with compression ignition and that for this type of sources the Ambient Air Quality of the IFC General EHS Guideline (2007) has only established a NOx emission guide level of 1,600 mg/Nm3, it

can be assessed that all NOx results included in the table before are in compliance with the guide level set by IFC.

The reports issued by the laboratory are attached in Annex 5.7.

5.1.9 Water quality

5.1.9.1 Deep Wells

According to permit Disposition SRH N° 281/18, VOG is authorized for extraction of up to 800 m3 / day water flow from the converted water producing well called BMo-4, destined to satisfy water requirements for industrial use, injection for secondary recovery, fracking, and other industrial uses in the Bajada del Palo area.

The converted deep well BMo-4 has a total depth of 3,375 meters, and was converted to water abstraction well, punctured between 312 and 619 meters (Grupo Neuquen) for fresh / brakish water abstraction. .The extracted water was tested for water quality and high concentrations of residual Aluminum and Total Iron were observed, so it does not meet the potability conditions established by the Argentine Food Code; also according to the values of electrical conductivity and the Na, Mg, and Ca cations to determine the RAS, the permit concluded that the salinity did not allow the use for irrigation water. Based on this, the authorities allowed the use for industrial application for hydrocarbons exploitation.

The monitoring was carried out in the deep aquifers (300-700m deep) of the project facilities. The following table presents the parameters evaluated, as well as the analytical methodologies used to measure the different parameters of the samples.

Similarly, other industrial abstraction wells are BMo-90, and BMo-91; the PTAD (Planta tratamiento de Agua dulce) provides water for fracking/industrial use. The data for industrial water sources is summarized and analysed bellow:

Table 5-12 Analytical Methodologies Used

Parameter	Methodologie
Conductivity	S.M. 2510 A
pH	M.N. 4500 H-B
Temperature	S.M. 2550 B
aline residue	S.M. 2540 B
Metal	S.M. 3111 – D / S.M. 3500-D / S.M. 3112-B
TPH	E.P.A. 418.1
Oil and facts	E.P.A. 418.1
Phenol	S.M. 5530 D
Detergents	S.M. 5540 C (MBAS)
Chlorides	S.M. 4500 Cl -B
Sulphates	S.M. 4500 SO4-E
Carbonates	S.M. 2320 B
Bicarbonates	S.M. 2320 B
Cyanuric	S.M. 4500 -B

Parameter	Methodologie
Calcio	S.M. 2340 C
Magnesium	
Total Harness	
Sodium	Estequiométrico

Source: INDUSLAB, 2018.

Location of Sampling Stations

The georeferenced location of the sampling stations is presented in the following table

Table 5-13 Sampling Stations

Area	Location	Installation	Coordinates	
			East	North
PB	PTAD	Planta de Transferencia Agua Dulce	2574345	5779409
Bmo production of water	BMo-4 A	-	2541607	5770039
Bmo production of water	BMo-90	-		
Bmo production of water	BMo-91	-		

Source: INDUSLAB, 2018.

Result of the evaluation

The following table presents a summary of the deep aquifers results obtained at the monitoring points and compares these with the guide value for water quality.

Considering that there is no national standard for groundwater quality, the following guide values have been considered as a reference guideline:

- The guide values used for the environmental water quality are those indicated in Annex II of National Decree 831/93, Table 1 (Water for Human use with conventional treatment)
- Argentinean Alimentary Code (drinking water parameters).
- The guide values used for the environmental water quality are those indicated in Annex II of National Decree 831/93, Table 5 (Irrigation water)
- DPA N°886/15 (Rio Negro) Maximum limits allowed for discharges
- Decree N°790/99 (Neuquen) Maximum limits allowed for discharges

Table 5-14 Results of Deep Wells Sampling

Parameter	BMo-4A mg/l	BMo-90 mg/l	BMo-91 mg/l	PTA Dulce mg/l	Decree 831/93 Water for Human use with conventional treatment (mg/l)	Argentinean Alimentary Code (drinking water parameters) (mg/l)	Decree 831/93 Irrigation water (mg/l)	DPA N°886/15 (mg/l)	Decree N°790/99 (mg/l)
Conductivity	1424,3	57206,6	64284,2	3610,6				-	-
pH (UpH)	9,91	7,70	7,54	9,05		6.5-8.5		6-9	6,5 – 9,5
Temperature (°C)	22,50	22,70	22,30	23,70				30	45
Saline residue	830	28604	32280	1805,32		1.500		-	-
TPH	<0,014	<0,014	<0,014	<0,014				5,0	30
Oil and fats	<0,014	0,018	<0,014	0,028				10	-
Phenols (Total)	0,197	0,174	0,240	0.008	0.002			0,5	0,5
Detergents	<0,002	0,027	0,053	<0,1		0.5		1,0	1,0
Chlorides	68,03	8003,16	10003,95	300,12		350		-	-
Sulphates	100,00	6625,00	6750,00	600,00		400		-	-
Carbonates	45,60	0	0	14,10				-	-
Bicarbonates	268,48	4881,44	4881,44	292,89				-	-
Total Hardness	40,00	8000,00	7000,00	36,00		400		-	-
Calcio	6,41	163,20	1202,49	6,41				-	-
Magnesium	5,85	973,66	974,15	4,87				-	-
Sodium	209,57	6515,43	8330,90	586,35				-	-
Iron	8,25	1,83	1,15	0,38	0.3	0.3	5	0,5	2,0
Manganese (Total)	<0,05	0,06	0,09	<0,055	0.1	0.1	0.20	-	0,5
Arsenic	0,007	<0,005	<0,005	0,006	0.05	0.01	0.1	0,05	0,5
Fluor	<0,02	0,07	0,13	0,03		0.7-1.7	1	-	-
Aluminum (Total)	<0,5	<0,5	<0,5	<0.5	0.2	0.2	5	2,0	-
Chrome (Total)	<0,1	<0,1	<0,5	<0,1	0.05	0.05	0.10	-	0,5
Chrome (+6)	<0,1	<0,1	<0,1	0.008				0,1	-
Zinc (Total)	<0,03	<0,03	<0,03	<0.03	5	5	2	0,2	2,0
Copper (Total)	<0,06	<0,06	<0,06	<0.06	1	1	0.20	1,0	0,1
Nickel (Total)	<0,3	<0,3	<0,3	<0.3	0.025	0.02	0.2	0,5	2,0
Vanadium (Total)	<0,5	<0,5	<0,5	<0.5			0.10	0,5	-

Parameter	BMo-4A mg/l	BMo-90 mg/l	BMo-91 mg/l	PTA Dulce mg/l	Decree 831/93 Water for Human use with conventional treatment (mg/l)	Argentinean Alimentary Code (drinking water parameters) (mg/l)	Decree 831/93 Irrigation water (mg/l)	DPA N°886/15 (mg/l)	Decree N°790/99 (mg/l)
Mercury (Total)	<0,001	<0,001	<0,001	<0.001	0.001	0.001		0,001	0,005
Cyanuric (Total)	<0,002	0,002	<0,002	< 0,002	0.10	0.10		0,5	0,1
Lead (Total)	<0,17	<0,17	<0,17	<0.17	0.050	0.050	0.20	0,1	0,005
Cadmium (Total)	<0,02	<0,02	<0,02	<0.02	0.005	0.005	0.01	0,1	0,1

Source: INDUSLAB, 2018.

The above results for water quality does not meet the potability conditions established by the Argentine Food Code, nor the Guidelines for Human use with conventional treatment, nor the Guidelines for Irrigation use.

Based on this, the authorities allowed the use for industrial application for hydrocarbons exploitation. The reports issued by the laboratory are attached in Annex 5.8.1.

5.1.9.2 Produced Water

Produced water is the high salty water associated to the exploitation of hydrocarbons (oil and gas).

Monitoring was conducted at Battery 1 BMo to determine produced water quality. The following table presents the evaluated parameters as well as the analytical methodologies used to measure the different parameters of the produced water sample.

Table 5-15 Evaluated Parameters and Analytical Methodologies Used for the Evaluation of Produced Water

Parameter	Methodology
Electrical Conductivity (25 °C)	Standard Method 2510-A
pH	Standard Method 4500-H+B
Temperature	Standard Method 2550-B
Saline Residue	Standard Method 2540-B
Total Petroleum Hydrocarbons	EPA 418.1
Oil and Grease	EPA 418.1
Phenols	Standard Method 5530-D
Detergents	Methylene Blue Active Sustances (MBAS) Method
Chlorides	Standard Method 4500-Cl-B
Sulphates	Standard Method 4500-SO4-E
Carbonates	Standard Method 2320-B
Bicarbonates	Standard Method 2320-B
Total Hardness	Standard Method 2340-C
Calcium	Standard Method 2340-C

Parameter	Methodology
Magnesium	Standard Method 2340-C
Sodium	Stoichiometry
Iron	Standard Method 4500-Fe-D
Manganese	Standard Method 3111-Mn-D
Arsenic	Standard Method 3111-As-B
Fluoride	Standard Method 3500-F-A
Aluminum	Standard Method 3111-Al-D
Total Chromium	Standard Method 3111-Cr-D
Hexavalent Chromium	Standard Method 3500-Cr-D
Trivalent Chromium	Calculation
Zinc	Standard Method 3111-Zn-D
Copper	Standard Method 3111-Cu-D
Nickel	Standard Method 3111-Ni-D
Vanadium	Standard Method 3111-V-D
Mercury	Standard Method 3112-Hg-B
Cyanide	Standard Method 4500-CN-B
Lead	Standard Method 3111-Pb-D
Cadmium	Standard Method 3111-Cd-D
BTEX (Benzene, Toluene, Ethylbenzene and Xylenes)	EPA 5021-A / EPA 8260-B
Poly Aromatic Hydrocarbons (PAH)	EPA 8270-B

Source: INDUSLAB, 2018

Values Guide for Produced Water

The produced water in the VOG project is being reinjected (previous treatment) to deep well.

The guideline values used for evaluating produced water quality are those outlined in Disposition N° 0372/15 from the SRH of the Province of Neuquén, in which VOG is authorized to deep injection of fluids originated during the exploration and/or operation of Bajada del Palo oilfield (including flow back fluids from the exploration and/or exploitation of non-conventional hydrocarbons) with previous treatment at disposal well BMo.s 2040.

In the following tables, the analytical results are also compared against the Emissions, Effluent and Waste Levels from Onshore Oil & Gas Development included in the IFC EHS Guideline for Onshore Oil and Gas Development (2007) for discharging treated produced water to surface water stream or to the land. This paramenters do not apply given the deep reinjection process used.

Table 5-16 Neuquén SRH permit for reinjection- Guideline Values Guide for Treated Produced Water

Constituent Dangerous	Unit	Guideline Level
Total Petroleum Hydrocarbons	mg/l	< 300
Majority Ions (chlorides, sulphates, carbonates and bicarbonates)	mg/l	≤ 110% of majority ions concentration in produced water
Phenols	mg/l	0.450
Arsenic	mg/l	< 0.005
Total Lead	mg/l	< 0.003
Cyanides	mg/l	< 0.01
Hexavalent Chromium	mg/l	< 0.002
Mercury	mg/l	< 0.001
Cadmium	mg/l	< 0.003

Source: Disposition SRH N° 0372, 2015 for reinjection.

Table 5-17 Treated Produced Water IFC Guidelines for discharge to surface water and land disposal

Constituent Dangerous	Unit	Guideline Value
Total Petroleum Hydrocarbons	mg/l	10
pH	UpH	6 - 9
Biological Oxygen Demand	mg/l	25
Chemical Oxygen Demand	mg/l	125
Total Suspended Solids	mg/l	35
Phenols	mg/l	0.5
Sulfides	mg/l	1
Chlorides	Mg/l	600
Arsenic	mg/l	5
Cadmium	mg/l	5
Total Chromium	mg/l	5
Copper	mg/l	5
Lead	mg/l	5
Mercury	mg/l	5
Nickel	mg/l	5
Silver	mg/l	5
Vanadium	mg/l	5
Zinc	mg/l	5

Source: IFC EHS Guideline for Onshore Oil and Gas Development (2007).

Location of Sampling Stations

The georeferenced location of the sampling stations is presented in the following table.

Table 5-18 Sampling Stations of Raw Produced Water

Area	Location	Installation	Coordinates	
			East	North
BMo	Battery 1 BMo	Saltwater Treatment Plant (PTAS) entrance	2542163	5769577

Source: Vista Oil&Gas, 2019.

Table 5-19 Sampling Stations of Treated Produced Water

Area	Location	Installation	Coordinates	
			East	North
BMo	BMo.s 2040	BMo.s 2040	2542057	5769265

Result of the evaluation

The following table presents a summary of the results obtained for raw produced water sample at the monitoring points.

Table 5-20 Result of Sampling of Raw Produced Water

Parameter	Unit	Bmo
Electrical Conductivity (25 °C)	µohm/cm	416,605.40
pH	UpH	5.86
Temperature	°C	33.40
Saline Residue	mg/l	230,750
Total Petroleum Hydrocarbons	mg/l	2,93
Oil and Grease	mg/l	4,18
Phenols	mg/l	0.119
Detergents	mg/l	< 0.10
Chlorides	mg/l	124,048.98
Sulphates	mg/l	150.00
Carbonates	mg/l	0.00
Bicarbonates	mg/l	7,322.16
Total Hardness	mg/l	101,000.00
Calcium	mg/l	39,278.40
Magnesium	mg/l	683.90
Sodium	mg/l	36,766.23
Iron	mg/l	17.50
Manganese	mg/l	5.30
Arsenic	mg/l	0.39
Fluoride	mg/l	< 0.02
Aluminum	mg/l	< 0.50
Total Chromium	mg/l	< 0.10

Parameter	Unit	Bmo
Hexavalent Chromium	mg/l	< 0.10
Trivalent Chromium	mg/l	< 0.10
Zinc	mg/l	< 0.03
Copper	mg/l	< 0.06
Nickel	mg/l	0.80
Vanadium	mg/l	0.60
Mercury	mg/l	< 0.001
Cyanide	mg/l	0.041
Lead	mg/l	0.34
Cadmium	mg/l	< 0.02
BTEX (Benzene, Toluene, Ethylbenzene and Xylenes)	mg/l	0.463
Poli Aromatic Hydrocarbons (PAH)	mg/l	< 0.003

Source: INDUSLAB, 2018.

Table 5-21 Result of Sampling of Treated Produced Water

Parameter	Unit	Result	Neuquén Disposition SRH N° 0372/15 treated produced water for re-injection	IFC EHS Guideline for Onshore Oil and Gas Development (2007).
Electrical Conductivity (25 °C)	µmhos/cm	387,826.20		
pH	UpH	6.82		6 – 9
Temperature	°C	20.50		
Saline Residue	mg/l	235,510		
Total Petroleum Hydrocarbons	mg/l	11.01	<300	10
Oil and Grease	mg/l	15.67		
Phenols	mg/l	< 0.002	0.450	0.5
Detergents	mg/l	0.852		
Chlorides	mg/l	119,047.01	⩽ 110% of majority ions concentration in produced water	600-1,200
Sulphates	mg/l	500.00	⩽ 110% of majority ions concentration	

Parameter	Unit	Result	Neuquén Disposition SRH N° 0372/15 treated produced water for re-injection	IFC EHS Guideline for Onshore Oil and Gas Development (2007).
			in produced water	
Carbonates	mg/l	0.00	≤ 110% of majority ions concentration in produced water	
Bicarbonates	mg/l	3,661.80	⩽ 110% of majority ions concentration in produced water	
Total Hardness	mg/l	103,000.00		
Calcium	mg/l	36,072.00		
Magnesium	mg/l	3,126.83		
Sodium	mg/l	31,395.49		
Iron	mg/l	63.00		
Manganese	mg/l	17.20		
Arsenic	mg/l	< 0.05	0.005	<5
Fluoride	mg/l	< 0.02		
Aluminum	mg/l	< 0.50		
Total Chromium	mg/l	0.18		<5
Hexavalent Chromium	mg/l	< 0.10	<0.002	
Trivalent Chromium	mg/l	NA		
Zinc	mg/l	0.21		<5
Copper	mg/l	< 0.06		<5
Nickel	mg/l	1.10		<5
Vanadium	mg/l	1.10		
Mercury	mg/l	< 0.001	0.001	<5
Cyanide	mg/l	< 0.002	<0.01	
Lead	mg/l	0.40	<0.003	<5
Cadmium	mg/l	< 0.02	0.003	<5
BTEX (Benzene, Toluene, Ethylbenzene and Xylenes)	mg/l	NA		
Poly Aromatic Hydrocarbons (PAH)	mg/l	NA		

Source: INDUSLAB, 2019.

Concentrations for total petroleum hydrocarbons, mercury, cyanide and phenols are in compliance with guidelines levels established for deep well injection as established in the SRH injection permit. Given that detection limits for hexavalent chromium, cadmium and arsenic are greater than the value established in Disposition SRH N° 0372/2015, it is not possible to assess whether concentration of these parameters in treated produced water complies with guidelines levels established for deep well injection. Lead concentration resulted in a higher value than the established by Disposition SRH N° 0372/2015. . The reports issued by the laboratory are attached in Annex 5.8.2.
Given that treated produced water is injected in disposal deep wells and that IFC EHS Guideline for Onshore Oil and Gas Development are established for discharging treated produced water to surface water stream or to the land, evaluation of the compliance of the results for the treated produced water with IFC EHS Guideline. is not applicable.

Taking into account the results of the monitoring, it will be necessary to adjust the laboratory's detection limits in order to allow assessing whether treated produced water complies with guidelines levels established for deep well injection. Additionally, once compliance (or not) is determined, it will be necessary to adjust the produced water treatment in order that those exceeded parameters reach the guideline levels set by Disposition SRH N° 0372/2015.

5.1.9.3 Freatimeter

The monitoring was performed in the two freatimeters of the project facilities. The following table presents the parameters evaluated, as well as the analytical methodologies used to measure the different parameters of the freatimeters samples.

Table 5-22 Analytical Methodologies Used for the Evaluation of Water Quality

Parameter	Methodologic
PAHs	EPA 8270-B
BTEX	EPA 5021 A / 8260 B
Conductivity	S.M. 2510 A
pH	M.N. 4500 H-B
Temperature	S.M. 2550 B
saline residue	S.M. 2540 B
Metal	S.M. 3111 – D / S.M. 3500-D / S.M. 3112-B
Hydrocarbon	E.P.A. 418.1
Oil and facts	E.P.A. 418.1
Phenol	S.M. 5530 D
Detergents	S.M. 5540 C (MBAS)
Chlorides	S.M. 4500 -B
Sulphates	S.M. 4500 -B
Carbonates	S.M. 2320 B
Bicarbonates	S.M. 2320 B
Cyanuric	S.M. 4500 -B
Calcio	S.M. 2340 C
Magnesium	

Parameter	Methodologic
Sodium	

Source: Induslab 2019.

Location of Sampling Stations

The georeferenced location of the sampling stations is presented in the following table.

Table 5-23 Sampling Stations Water Quality

Area	Location	Coordinates	
		East	North
Freatimetro 1	Yacimiento Entre Lomas (Entre Lomas)	2580642	5771101
Freatimetro 1 PB	Yacimiento Piedras Blancas (Entre Lomas)		

Source: Vista Oil&Gas, 2019.

Result of the evaluation

The following table presents a summary of the results of the freatimeters. It should be noted that currently Argentina does not have legislation to evaluate groundwater. The following guide values have been considered as a reference guideline:

- The guide values used for the environmental water quality are those indicated in Annex II of National Decree 831/93, Table 1 (Water for Human use with conventional treatment)
- Argentinean Alimentary Code (drinking wáter parameters).
- The guide values used for the environmental water quality are those indicated in Annex II of National Decree 831/93, Table 5 (Irrigation water)
- DPA N°886/15 (Rio Negro) Maximum limits allowed for discharges
- Decree N°790/99 (Neuquen) Maximum limits allowed for discharges

Table 5-24 Result of Sampling of Freatimeter

Parameters	Freatimetro N° 1 PB (**)	Freatimetro 1 (**)	Decree 831/93 Water for Human use with conventional treatment (mg/l)	Argentinean Alimentary Code (drinking water parameters) (mg/l)	Decree 831/93 Irrigation water (mg/l)	DPA N°886/15 (mg/l)	Decree N°790/99 (mg/l)
PAHs							
Acenaphthylene	N.D	N.D		-	-	-	-
Naphthalene	0.017	N.D		-	-	-	-
Fluoranthene	N.D	N.D	0.19	-	-	-	-
BTEX							

Parameters	Freatimetro N° 1 PB (**)	Freatimetro 1 (**)	Decree 831/93 Water for Human use with conventional treatment (mg/l)	Argentinean Alimentary Code (drinking water parameters) (mg/l)	Decree 831/93 Irrigation water (mg/l)	DPA N°886/15 (mg/l)	Decree N°790/99 (mg/l)
Benzene	N.D	0.008	0.01	0.01	-	-	-
Toluene	N.D	0.020	1	-	-	-	-
Ethylbenzene	N.D	N.D	0.7	-	-	-	-
Aluminum (Total)	<0.5	<0.5	0.2	0.2	5	2,0	-
Cadmium (Total)	<0.02	<0.02	0.005	0.005	0.010	0,1	0,1
Cyanuric (Total)	<0.10	<0.10	0.1	0.1		0,5	0,1
Zinc (Total)	<0.03	<0.03	5	5	2	0,2	2,0
Copper (Total)	<0.06	<0.06	1	1	0.2	1,0	0,1
Chrome (Total)	<0.1	<0.1	0.05	0.05	0.1	-	0,5
Chrome (+6)	0.028	0.028	0.05			0,1	-
Phenols (Total)	0.097	0.097	0.002			0,5	0,5
Manganese (Total)	<0.05	<0.05	0.1	0.1	0.2	-	0,5
Mercury (Total)	0.0013	0.0013	0.001	0.001		0,001	0,005
Nickel (Total)	0.6	0.6	0.025	0.02	0.2	0,5	2,0
Lead (Total)	<0.17	<0.17	0.05	0.05	0.2	0,1	0,005

Source: INDUSLAB, 2019. Note: ND: Non Detectable / (**) The information of stations are of January 2019

According to the results obtained, it is observed that the results comply with the Irrigation gwater guide values of the National Decree N° 831/93. Only for a few metals driking water standards are slightly exceeded.

Naphthalene analytical results readings is in low concentration with no guide values for Irrigation water or drinking water in freatimeter N°1 located within Piedras Blancas, in Entre Lomas area. These feratimeters are located in areas that have undergone rhistorical remediation close to critical locations within production facilities, so it is indicating minor residual contamination of the shallow acquifer. Further monitoring will determine if there is naturaral attenuation trend. The reports issued by the laboratory are attached in Annex 5.8.3.

5.1.10 Effluent - Domestic Wastewater

Monitoring was conducted at domestic wastewater treatment plant (WWTP) present at three drilling rigs to determine domestic wastewater quality. The following table presents the evaluated parameters as well as the analytical methodologies used to measure the different parameters of the domestic wastewater samples.

Table 5-25 Evaluated Parameters and Analytical Methodologies Used for the Evaluation of Domestic Wastewater

Parameter	Methodology
Electrical Conductivity	Standard Method 2510-A

Parameter	Methodology
pH	Standard Method 4500-H+B
Temperature	Standard Method 2550-B
Biological Oxygen Demand	Standard Method 5210-B
Chemical Oxygen Demand	Standard Method 5210-D
Residual Free Chlorine	Standard Method 4500-Cl
Ammoniacal Nitrogen	Standard Method 4500-NH3
Total Nitrogen	Digestion with Perosulphate
Total Phosforus	Standard Method 4500-P-B-E
Sedimentable Solids	Standard Method 2540-F
Detergents	Methylene Blue Active Sustances (MBAS) Method
Phenols	Standard Method 5530-C
Oils and Fats	Standard Method 5520-B
Total Petroleun Hydrocarbons	TNRCC 1005
Fecal Coliforms	Standard Method 9221-F
Esterichia Coli	Standard Method 9222-D

Source: PRAXIS Laboratorio, 2019.

Values Guide for Domestic Wastewater

The guideline values used for analyzing domestic wastewater quality are those outlined in Disposition N° 0084/17 from the SRH of the Province of Neuquén, in which BACS S.A., the manufacturer of the WWTP, is authorized to treated wastewater from the WWTP for natural vegetation irrigation, as well as the Indicative Values for Treated Sanitary Sewage Discharges included in the IFC EHS General Guidelines (2007) for discharging treated sanitary wastewater.

Table 5-26 Values Guide for Treated Wastewater permit for BACS

Constituent Dangerous	Unit	Guideline Level
Electrical Conductivity	µS/cm	6 - 8
pH	UpH	1,750
Biological Oxygen Demand	mg/l	< 100
Chemical Oxygen Demand	mg/l	< 250
Residual Free Chlorine	mg/l	0.05 - 2
Total Nitrogen	mg/l	< 50
Total Phosforus	mg/l	< 5
Detergents	mg/l	< 3
Phenols	mg/l	< 0.05
Oils and Fats	mg/l	50
Total Petroleun Hydrocarbons	mg/l	< 0.2
Esterichia Coli	mg/l	250

Source: Disposition SRH N° 0084, 2017.permiso vuelco

Table 5-27 IFC EHS- Indicative Values for Treated Sanitary Sewage Discharges

Constituent Dangerous	Unit	Guideline Value
pH	UpH	6 - 9
Biological Oxygen Demand	mg/l	30
Chemical Oxygen Demand	mg/l	125
Total Suspended Solids	mg/l	50
Total Nitrogen	mg/l	10
Total Phosforus	mg/l	2
Oils and Fats	mg/l	10
Total Coliform Bacteria	mg/l	400

Source: IFC EHS General Guidelines, 2007.

Location of Sampling Stations

The georeferenced location of the sampling stations is presented in the following table.

Table 5-28 Sampling Stations of Sanitary Wastewater

Area	Location	Installation	Coordinates	
			East	North
MdM	PAD 6 – MdM 2062	WWTP at drilling rig H-103	2530370	5769833
MdM	PAD 4 - MdM 1032	WWTP at drilling rig NB F-19	2529368	5769433
MdM	PAD 6 – MdM 2061	WWTP at drilling rig Q-12	2530360	5769833

Source: ERM, 2019.

Result of the evaluation

The following table presents a summary of the results obtained for treated sanitary wastewater samples.

Table 5-29 Result of Sampling of Treated Sanitary Wastewater

Parameter	Unit	Result H-103	Result NB F-19	Result Q-12
pH	UpH	6.55	7.11	6.93
Electrical Conductivity	µS/cm	1,270	1,310	1,370
Temperature	°C	21	21	22
Biological Oxygen Demand	mg/l	17	21	25
Chemical Oxygen Demand	mg/l	34	37	45
Residual Free Chlorine	mg/l	0.95	1.01	1.01
Ammoniacal Nitrogen	mg/l	8	1.33	0.88
Total Nitrogen	mg/l	10	11	10.5
Total Phosforus	mg/l	0.65	0.39	0.74
Suspended Solids 2 hs.	mg/l	10	10	10
Detergents	mg/l	0.87	0.95	0.65

Parameter	Unit	Result H-103	Result NB F-19	Result Q-12
Phenols	mg/l	0.01	0.01	0.01
Oils and Fats	mg/l	25	28	30
Total Petroleun Hydrocarbons	mg/l	< 0.1	< 0.1	< 0.1
Fecal Coliform Bacteria	mg/l	< 3	< 3	< 3
Esterichia Coli	mg/l	< 3	< 3	< 3

Source: PRAXIS Laboratorio, 2019.

As shown in the previous tables, all the parameters analysed in treated sanitary wastewater are below the guideline values established in Disposition SRH N° 0084/2017.

With regards to IFC standards, all results for pH, BOD, COD and total phosphorus, are below the guide levels, while all oil and fats results are not in compliance with guide levels. In addition, the result for total nitrogen at the WWTP present at drilling rig H-103 is below the correspondent guide level established by IFC, while results obtained for WWTP present at drilling rigs NB F-19 and Q-12 do not comply with IFC guide levels. Lastly, it is not possible to assess compliance with IFC guide levels for total suspended solids and total coliform bacteria, given that sedimentable solids and fecal coliform bacteria were analyzed instead of these.

The reports issued by the laboratory are attached in Annex 5.9.

5.1.11 Environmental Liabilities

Bajada del Palo

The contract for extension of the concession area Bajada el Palo, in the province of Neuquén, was made by the previous operators under provincial law Nº Q 2615 /08. This legislation required the inventory of environmental situations needing remedial action. This generated a schedule of actions, which was completed by the previous operators. At this moment, there are no long-standing environmental issues which need to be remedied.

The legislation states that any remediable environmental situations identified during operations in the area must be reported, along with proposals for appropriate actions to resolve the situation.

Entre Lomas

The extension of the concession area Entre Lomas, in the province of Río Negro, was made by the previous operators under provincial law Nº Q 4818/12. This legislation required the inventory of environmental situations needing remedial actions. This generated a schedule of actions to be conducted between 2014 and 2019.

These actions included the closure of redundant access road (picadas), the cleaning of locations which presented waste or old surface contamination, the management of waste collected in enclosures, the decommissioning of old disused pipes, and the remediation of contaminated soil collected within enclosures.

These actions were conducted by the previous operators and have been continued until this date by Vista. These actions are being reported and monitored periodically by the Enforcement Authority. The actions conducted in 2018 and scheduled for 2019 are as follows:

Table 5-30 Environmental Liabilities Execution Plan

Type	Location		Magnitude of impact		Method of remediation	Execution Plan		
	Deposit	Sector – Area- Installation	Affected area (m2)	Affected volume (m3)		Start	End	Current status
Waste repository	Charco Bayo	Waste facility	10.000	N/C	Assimilable to RSU (Recycle)	01/01/14	31/12/19	Permanently in place
					Special (segregate and send for external treatment)	01/01/14	31/12/19	Permanently in place
Sites affected by incidents	Charco Bayo, Piedras Blancas, La Pista y Borde Mocho	Wells, locations, pipeline rights-of-way, gas pipelines, power lines, facilities and related facilities, camp, warehouses, repositories, enclosures, etc.	1822 Has	N/A	Treatment of soils with bio-piles	01/01/14	31/12/19	In action
Disused facilities	Charco Bayo y Piedras Blancas	Líneas aéreas y subsuperficiales	N/A	47,1	Definitive abandonment	01/01/14	31/12/18	Completed note PELSA-2017-E-143
		Ex Bat 3PB	1,5	N/A	Definitive abandonment	01/01/16	31/12/18	Act GFO N°170/17
		Ex Bat 5PB	1,5	N/A	Definitive abandonment	01/01/16	31/12/18	Acta GFO N°170/17
Disused roads and picadas	Charco Bayo y Piedras Blancas	Picadas closed up until now	28,681 m		Definitive abandonment	01/01/17	31/12/19	Permanently in place
Contaminated sites	Piedras Blancas	PB-111 a Bat 4PB	N/A	50	Treatment of soils using bio-piles	01/01/18	31/12/19	scheduled
Contaminated sites	Piedras Blancas	PB-28 a Bat 4PB	N/A	400	Treatment of soils using bio-piles	01/01/18	31/12/19	scheduled
Contaminated sites	Piedras	PB-3a ex Bat 3PB	N/A	20	Treatment of soils	01/01/18	31/12/19	scheduled

Type	Location		Magnitude of impact		Method of remediation	Execution Plan		
	Deposit	Sector – Area- Installation	Affected area (m2)	Affected volume (m3)		Start	End	Current status
	Blancas				using bio-piles			
Contaminated sites	Piedras Blancas	PB-91 a Bat 4PB	N/A	150	Treatment of soils using bio-piles	01/01/18	31/12/18	Completed Act GFO N°196/18
Contaminated sites	Piedras Blancas	PB-24 a PB-140	N/A	200	Treatment of soils using bio-piles	01/01/18	31/12/18	Completed Act GFO N°141/18

Source: Vista, Remediation Plan AEL 2018- 2019

The legislation requires any remediable environmental situation detected during the operation of the area to be reported, along with proposals of appropriate actions to resolve the situation.
In both Bajada del Palo and Entre Lomas, any environmental situation resulting from the operations in progress is attended to immediately in accordance with the Vista policy and procedures. In short, this consists of an internal report and notification to the enforcement authorities in accordance with current legislation (Nación, Res SEN 24/04; Neuquén Ley 1875/99 y Res. 347/10; Río Negro Decreto 452/05 y Res. 083/06). It also requires execution of any actions necessary using the response and sanitation resources which Vista permanently has as part of its Operational Management and Contingency Plan.

5.2 Biological component

5.2.1 Terrestrial Flora

The Project Area is in the Argentine Monte Ecoregion as defined by WWF[1] (See Annex 5.10 - Ecoregion Map). This biogeographic province is characterized as shrub land steppe. The jarillal is the climax community dominated by species of the family Zygophyllaceae (*Larrea cuneifolia* and *Larrea divaricata*). The vegetation is of low height and sparse coverage, not exceeding three meters and 50% ground cover.

Five vegetation communities were found and classified into the following coverage units: lute vegetation, hydrophilic vegetation, jarillal, monte de zampa, and psammophilous vegetation. In a lower scale, three types of floristic associations where found: vegetation of “huayquerias” and “bardas”[2], *Atriplex lampa-Sueda divaricata* association and *Larrea divaricata-Larrea cuneifolia* association. (See Annex 5.11 - Vegetation Map).

[1] https://www.worldwildlife.org/ecoregions/nt0802

[2] Las “bardas” are the steep and cut edges of the plateus or fragments of plateus, while the “huayquerias” are soils of fine clay dust soils, very poor in organic matter, of fine material, of clayey type

A total of 36 species of plants, belonging to 15 families were registered in the EIAs[3] and the Environmental Reports[4]. The richest family was Asteraceae with 12 species. *Atriplex lampa* and *Pappostipa* sp. were the most abundant species.

Most of the species reported are native, only one being exotic (*Tamarix gallica*).

Table 5-31 Vegetation Species recorded in the Project Area

Family	Species	Native/exotic	IUCN Category
Amaryllidaceae	*Habranthus jamesonii*	Native	Not listed
Anachardaceae	*Schinus molle*	Native	Not listed
Asteraceae	*Baccharis rhomboidalis*	Native	Not listed
Asteraceae	*Baccharis salicifolia*	Cosmopolitan	Not listed
Asteraceae	*Chuquiraga erinacea*	Native	Not listed
Asteraceae	*Chuquiraga rosulata*	Native	Not listed
Asteraceae	*Chuquiraga hystrix*	Native	Not listed
Asteraceae	*Cyclolepis genistoides*	Native	Not listed
Asteraceae	*Grindelia chiloensis*	Native	Not listed
Asteraceae	*Gutierrezia solbrigii*	Native	Not listed
Asteraceae	*Hyalis argentea*	Native	Not listed
Asteraceae	*Psila spartioides*	Native	Not listed
Asteraceae	*Senecio subulatus*	Native	Not listed
Asteraceae	*Thymophylla belenedium*	Native	Not listed
Chenopodiaceae	*Atriplex lampa*	Native	Not listed
Chenopodiaceae	*Suaeda divaricata*	Native	Not listed
Ephedraceae	*Ephedra ochreata*	Native	Not listed
Fabaceae	*Cercidium praecox*	Native	Not listed
Fabaceae	*Prosopis flexuosa*	Native	Not listed
Fabaceae	*Prosopis alpataco*	Native	Not listed
Fabaceae	*Senna aphylla*	Native	Not listed
Nyctaginaceae	*Bougainvillea spinosa*	Native	Not listed
Malvaceae	*Lecanophora ecristata*	Native	Not listed
Olaceae	*Menodora robusta*	Native	Not listed
Poaceae	*Pappostipa sp.*	Native	Not listed
Poaceae	*Poa luguginosa*	Native	Not listed
Poaceae	*Stipa speciosa*	Native	Not listed

[3] EIA "Tendido de Oleoducto 12" desde su Cabecera en BMo, sita en zona aledaña a futura EMC-11, Área Bajada del Palo – NQN; hasta la PTC Charco Bayo, Área Entre Lomas – RN

[4] Informe Ambiental: "Perforación de 16 pozos productores de petróleo y/o gas. Yacimiento Médano de la Mora - Área Bajada del Palo. Petrolera Entre Lomas S.A. - Provincia de Neuquén".
Informe Ambiental: "Perforación de 32 pozos en 6 locaciones (PAD 5,6,7,8,9 y 10) Yacimiento Médano de la Mora. Área de Concesión Bajada del Palo".
Informe Ambiental: "Tendido de acueducto, oleoducto y gasoducto. Área de Concesión Bajada del Palo – Provincia de Neuquén".
Informe Ambiental: "Construcción y montaje de EMC11. Área de Concesión Bajada del Palo – Provincia de Neuquén"

Family	Species	Native/exotic	IUCN Category
Poaceae	*Sporobolus rigens*	Native	Not listed
Scrophulariaceae	*Monttea aphylla*	Native	Not listed
Solanaceae	*Lycium chilense*	Native	Not listed
Tamaricaceae	*Tamarix gallica*	Exotic	Least Concern
Verbenaceae	*Acantholippia seriphioides*	Native	Not listed
Verbenaceae	*Mulguraea ligustrina*	Native	Not listed
Zygophyllaceae	*Larrea cuneifolia*	Native	Not listed
Zygophyllaceae	*Larrea divaricata*	Native	Not listed
Zygophyllaceae	*Larrea nitida*	Native	Not listed

The woody shrubs are important to the functionality and integrity of this ecosystem. They accumulate organic matter and provide the ecological service of soil enrichment and microhabitat for native fauna such as lizards and insects.

5.2.2 Terrestrial Fauna

Presence of wild species adapted to arid environments and large daily temperature variations were registered in the EIA and Environmental reports. Presence of domestic fauna (cattle, sheep, goats and horses) in the surrounding of the Project site is sporadic.

Line transect sampling was used to survey the wild fauna. A total of 31 species where recorded consisting of 16 birds, eight mammals and seven reptiles. Most of the records consists of indirect evidence as feces, footprints and burrows. Direct sighting of *Lycalopex griseus* and *Zaedyus pichiy* was reported.

Table 5-32 List of Fauna Species registered in the Study Area

Class	Order	Family	Species
Birds	Accipitriformes	Accipitridae	*Buteo polyosoma*
	Falconiformes	Cathartidae	*Cathartes aura*
	Falconiformes	Falconidae	*Falco sparverius*
	Passeriformes	Emberezidae	*Zonotrichia capensis*
	Passeriformes	Furnaridae	*Pseudoseisura gutturalis*
	Passeriformes	Furnaridae	*Ochetorhynchus phoenicurus*
	Passeriformes	Furnaridae	*Leptasthenura aegithaloides*
	Passeriformes	Furnariidae	*Pseudoasthenes patagonica*
	Passeriformes	Rhinocryptidae	*Rhinocrypta lanceolata*
	Passeriformes	Rhinocryptidae	*Teledromas fuscus*
	Passeriformes	Mimidae	*Mimus saturninus*
	Passeriformes	Mimidae	*Mimus patagonicus*
	Passeriformes	Thraupidae	*Phrygilus fruticeti*
	Strigiformes	Strigidae	*Athene cunicularia*
	Sthruthioniformes	Rheidae	*Pterocnemia pennata*

Class	Order	Family	Species
	Sthruthioniformes	Tinamidae	*Eudromia elegans*
Mammals	Carnívora	Canidae	*Lycalopex griseus*
	Carnívora	Felidae	*Puma concolor*
	Cetartiodactyla	Camelidae	*Lama guanicoe*
	Cingulata	Chlamyphoridae	*Zaedyus pichiy*
	Rodentia	Caviidae	*Microcavia australis*
	Rodentia	Cetomyidae	*Ctenomys sp.*
	Lagomorpha	Leporidae	*Lepus europaeus*
Reptilia	Squamata	Liolaemidae	*Liolaemus darwinii*
	Squamata	Liolaemidae	*Liolaemus gracilis*
	Squamata	Liolaemidae	*Liolaemus grosseorum*
	Squamata	Dipsadidae	*Philodryas trilineata*
	Squamata	Elapidae	*Micrurus frontalis*
	Squamata	Crotalidae	*Bothrops ammodytoides*
	Squamata	*Testudinidae*	*Chelonoidis donosobarrosi*

There is potential for the presence of additional species in the project area due to their occurrence in the region. These include:

- Mammals
  - *Dolichotis patagonum* (mara) IUCN Near Threatened;
  - *Chlamyphorus truncates* (pink faery armadillo);
  - Conepatus humboldti (Hog-nose skunk);
  - Oncifelis geoffroyi (geoffroy's cat);
- Birds
  - *Geranoaetus melanoleucus* (black-chested buzzard eagle);
  - *Eudromia elegans* (elegant crested tinamou);
  - Cyanoliseus patagonus (burrowing parrot);
  - Phalcoboenus chimango (chimango);
- Reptiles
  - *Bothrops alternatus* (crossed pit viper);
  - Bothrops neuwiedi;
  - Bothrops ammodytoides; and
  - *Micrurus pyrrhocryptus* (Argentinian coral snake).

5.2.3 Threatened and Endangered Species, Endemic Species

5.2.3.1 Flora

No threatened or endangered species were identified; however, two endemic species were reported, *Ephedra ochreata*, an Argentine endemic, and *Menodora robusta,* a Patagonian endemic.

Ephedra ochreata is a small shrub with edible fruits which is abundant and has a wide geographic distribution in several of the phytogreographic region of Argentina (Selva Misionera, Selva Tucumano-Oranense, Chaco, Espinal, Pampa, Monte, Puna, Patagonia). The population appears to be stable. *Menodora robusta* is a common though not abundant shrub, and very palatable to cattle. It grows in sandy dry soils.

5.2.3.2 Fauna

Most of the species reported in the project area are considered Least Concern (LC) and none are Endangered or Critically Endangered according to the International Union for Conservation of Nature (IUCN) and to Argentinian legislation respectively. However, national legislation recognizes conservation status for five species, the IUCN for one species and CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) for four (see Table 3 below). These species are:

Pterocnemia pennata - inhabits steppe, shrub land, shrub-steppe and mallines (successional wetlands with bog, meadows and ponds) (Bellis *et al*. 2006), up to 1,500 m, generally breeding in upland areas (del Hoyo *et al*. 1992). They are known to be a polygonous species. The principal threats are hunting, egg-collection and overgrazing. The global population size has not been quantified, but this species is described as 'uncommon' (Stotz *et al.* 1996).

Puma concolor has a wide geographical distribution, from Canada to the southern tip of Chile, but is locally extinct in some areas. It could be found in every major habitat type of the Americas. Home ranges of pumas vary considerably across their geographic distribution, and the smallest ranges tend to occur in areas where prey densities are high and prey are not migratory (Sunquist and Sunquist 2002). Pumas are threatened by habitat loss and fragmentation and poaching of their wild prey base.

Lama guanicoe is a widespread species with an extensive, although discontinuous range. Most of the world's remaining guanacos are found in Argentine Patagonia. Habitat degradation due to overgrazing, competition with introduced herbivores, habitat degradation due to extractive industries and illegal hunting are the principal threats (Wildlife Conservation Society 2012).

Zaedyus pichiy is found in desert, xeric grassland/shrubland, and Patagonian steppe habitats, always with sandy soils (Superina 2008). It can be found in some degraded habitats, such as pastureland and plantations. Although widespread and present in several protected areas, it is heavily hunted, especially in northern and eastern portions of its range, with local extinctions recorded in some areas.

Chelonoidis donosobarrosi, the Patagonian tortoise has not been well studied and there is little literature on this species. In the IUCN red list there are no specific references.

Table 5-33 Species with Conservation Status identified in the Project Area

Class	Order	Family	Species	Common name	Argentinian legislation	IUCN	CITES
Birds	Sthruthioniforme	Rheidae	*Pterocnemia pennata*	lesser rhea, ñandu	VU	LC	II

Mammals	Carnívora	Felidae	*Puma concolor*	cougar, mountain lion	VU	LC	II
	Cetartiodactyla	Camelidae	*Lama guanicoe*	guanaco	VU	LC	II
	Cingulata	Chlamyphoridae	*Zaedyus pichiy*	small armadillo	VU	NT	-
Reptilia	Squamata	Testudinidae	*Chelonoidis donosobarrosi*	Patagonian tortoise	VU	VU	II

LC = Least concern, NT = Near Threat, VU = Vulnerable
II = Appendix II, species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled.

In addition, four endemic species were identified, three lizards and one snake.

Table 5-34 Endemic species identified in the Project area

Class	Family	Species	Common name
Reptilia	Liolameidae	*Liolaemus darwinii*	*Darwin´s tree iguana*
	Liolameidae	*Liolaemus gracilis*	*Graceful tree iguana*
	Liolameidae	*Liolaemus grosseorum*	*iguana*
	Dipsadidae	*Philodryas trilineata*	*snake*

5.2.4 Protected Areas, National Parks and Biological Sensitive Areas

The Project does not affect any national parks or protected areas. The closest Protected Area is Auca Mahuida National Park located at 50 km north-west from the Project site (See Annex 5.12 Map of Protected Natural Areas).

5.2.5 Critical Habitat Screening and Preliminary Assessment

The Project does not affect any national parks or protected areas, however as endangered/endemic species have been identified, an analysis to establish if the project is in a potential sensitive area or critical habitat is required.

According to IFC Performance Standard 6, “critical habitats” are areas with high biodiversity value, that includes areas that meet one or more of these criteria:

(i) *Criterion 1*: habitat of significant importance to Critically Endangered and/or Endangered species (as listed in IUCN);

(ii) *Criterion 2:* habitat of significant importance to endemic and/or restricted-range species;

(iii) *Criterion 3:* habitat supporting globally significant concentrations of migratory species and/or congregator species;

(iv) *Criterion 4:* highly threatened and/or unique ecosystems; and/or

(v) *Criterion 5:* areas associated with key evolutionary processes.

Criteria 1 through *3* are focused on species level, whilst *Criteria 4* and *5* focus on ecosystem and landscape levels. Each criterion has quantitative threshold that rely in the availability of estimates of

species global/local population (either from published sources or obtainable by reasonable means through an in-field assessment in the case of the local population).

Table 5-35 Quantitative thresholds for Critical Habitat Criteria

Criteria	Thresholds
1. Critically Endangered (CR)/ Endangered (EN) Species	(a) areas that support globally-important concentrations of an IUCN Red-listed EN or CR species (≥0.5% of the global population AND ≥ 5 reproductive units[5] of a CR or EN species). (b) Areas that support globally-important concentrations of an IUCN Red-listed VU species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in (a). (c) As appropriate, areas containing nationally/regionally-important concentrations of an IUCN Red-listed EN or CR species.
2. Endemic and Restricted-range Species	(a) For terrestrial vertebrates and plants, a restricted-range species is defined as those species that have an EOO less than 50,000 km^2. (b) For marine systems, restricted-range species are provisionally being considered those with an EOO of less than 100,000 km^2. (c) For coastal, riverine and other aquatic species in habitats that do not exceed 200 km width at any point (e.g., rivers), restricted range is defined as having a global range less than or equal to 500 km linear geographic span (i.e., the distance between occupied locations furthest apart)
3. Migratory and Congregatory Species	(a) Areas known to sustain, on a cyclical or otherwise regular basis, ⩾ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle. (b) Areas that predictably support ⩾10 percent of the global population of a species during periods of environmental stress
4. Highly Threatened or Unique Ecosystems	(a) areas representing ⩾ 5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN. (b) other areas, not yet assessed by IUCN, but determined to be of high priority for conservation by regional or national systematic conservation planning.

Criterion 5

This criterion involves structural attributes of a region such as its topography, geology, soil and climate over a period of time.

Guidance Note GN80 provides the following examples of spatial features that are associated with evolutionary processes:

[5] The IUCN KBA Standard uses the following definition for reproductive unit: "the minimum number and combination of mature individuals necessary to trigger a successful reproductive event at a site (Eisenberg 1977). Examples of five reproductive units include five pairs, five reproducing females in one harem, and five reproductive individuals of a plant species."

- Landscapes with high spatial heterogeneity are a driving force in speciation as species are naturally selected on their ability to adapt and diversify.
- Environmental gradients, also known as ecotones, produce transitional habitat which has been associated with the process of speciation and high species and genetic diversity.
- Edaphic interfaces are specific juxtapositions of soil types (e.g., serpentine outcrops, limestone and gypsum deposits), which have led to the formation of unique plant communities characterized by both rarity and endemism.
- Connectivity between habitats (e.g., biological corridors) ensures species migration and gene flow, which is especially important in fragmented habitats and for the conservation of metapopulations. This also includes biological corridors across altitudinal and climatic gradients and from “crest to coast.”
- Sites of demonstrated importance to climate change adaptation for either species or ecosystems are also included within this criterion.

Criterion 5 is usually considered to be heavily reliant on scientific knowledge, and thus would be triggered in areas that have already been investigated or where significant research results are available to indicate the potential or existence of unique evolutionary processes.

5.2.5.1 General Methodology

As the critical habitat determination is based on species, it can occur in either modified or natural habitats. The process of recognizing critical habitats therefore follows an approach that can be summarized in three key steps (*Paragraph 59, GN6; IFC 2018).*

1. Stakeholder Consultation and Initial Literature Review.
2. Field-survey data collection and verification of existing information.
3. Critical Habitat determination.

Terrestrial Unit of Analysis for Critical Habitat Determination

The scale at which a critical habitat determination takes places depends on underlying ecological processes for the habitat in question and is not limited to the footprint of the project. IFC/WB PS6 Guidance Note GN65 states that for Criteria 1 to 4: “*the client should define the boundaries of this area taking into account the distribution of species or ecosystems (within and sometimes extending beyond the project’s area of influence) and the ecological patterns, processes, features and functions that are necessary for maintaining them*.”

5.2.5.2 Critical Habitat Screening

Application of Criteria 1 and 2

Species with conservation status identified in the project area are not IUCN Endangered or Critically Endangered, so, at first glance, Criterion 1 would not apply. However, one Argentine endemic plant and four Argentine endemic animals were identified in the project area. All these endemic species are not listed as endangered, no major threats affecting them are known and are common and/or abundant.

However, a more sampling effort is necessary to confirm that no species of conservation concern are present in the Project Area.

Table 5-36 Terrestrial species identified within the Project Area that have an Endangered/Critically Endangered status on the IUCN Red list or are considered Endemic to Argentina

Group	Species	Common name	IUCN	Endemic	Range restricted
Reptiles	*Liolaemus darwinii*	*Darwin´s tree iguana*	LC	Yes	No
	Liolaemus gracilis	*Graceful tree iguana*	LC	Yes	No
	Liolaemus grosseorum	*iguana*	LC	Yes	No
	Philodryas trilineata	*snake*	LC	Yes	No
Plants	*Ephedra ochreata*	-	LC	Yes	No

Information of potential occurrence of endangered species in the Project Area provided by the Integrated Biodiversity Assessment Tool (IBAT) is taking into consideration for the identification of Critical Habitats (See below table).

Table 5-37Species with probability of occurrence within the Project area and its surroundings that have a conservation status on the IUCN Red list

Group	Species	Common name	IUCN	Endemic	Range restricted
Birds	*Buteogallus coronatus*	Crowned solitary eagle	EN	No	No
	Gubernatrix cristata	Yellow cardinal	EN	No	No
Mammals	*Leopardus jacobita*	Andean cat	EN	No	No
Reptilia	*Liolaemus cuyumhue*	-	CR	Yes	Yes

Relevant species discussion

Buteogallus coronatus

This species has a very large range in Brazil, Bolivia, Paraguay and Argentina. It inhabits lowland areas of semi-open seasonal dry country (palm-savanna, sparse woodland, steppes with bushes), chaco and campo cerrado. It sometimes occurs in moderate altitude hill-ranges in south-east Brazil and Argentina and has also been reported in caatinga, gallery forest, marsh and buriti groves. Given the species has not been observed on site, and the wide range of appearance, it is deemed that this species is likely to not trigger Critical Habitat under Criterion 1.

Gubernatrix cristata

Gubernatrix cristata, was formerly widespread and common throughout much of Argentina and Uruguay, with a few records from Rio Grande do Sul, Brazil, as a non-breeder. In Argentina, it is now rare except very locally in San Luis, Buenos Aires, La Pampa and Río Negro, and especially between General Conesa, San Antonio Oeste and Viedma. There are further important populations in Pay Urbe and Estancia San Antonio, Corrientes; the Montiel area, Ceibas and Estancia la Choza, Entre Ríos, and Chancaní, Córdoba (Chebez et al. 1998). Given that the meso-scale range of this species is very large, and still common in some localities, it is deemed that this species is likely to not trigger Critical Habitat under Criterion 1.

Leopardus jacobita

The Andean Cat has a patchy distribution due to a specialization for naturally fragmented rocky habitats and most presence records are from the central Andes above 3,600 meters in Argentina, Bolivia, Chile

and Peru. However it has also been found at lower elevations in the southern Andes of Argentina at 1,800 m (Sorli et al. 2006) and more recent records of the Andean Cat in Argentina and Chile extend its distribution range to the south and outside the Andes, into Patagonian steppe and scrub habitats in Argentina, at elevations as low as 650 m (Novaro et al. 2010, Martinez et al. 2008). Given the species has not been observed on site, and its preference to the highlands, it is deemed that this species is likely to not trigger Critical Habitat under Criterion 1.

Liolaemus cuyumhue

Liolaemus cuyumhue is a rare species known only from an isolated sand dune system in the region known as Bajo de Añelo close to the Provincial Road 7, in the east of the Neuquén Province (Avila *et al*. 2009). The dunes are sparsely covered by clumps of *Sporobolus rigens, Neosparton darwinii, Larrea divaricata, Prosopis flexuosa var depressa*, and *Atriplex zampa*. Individuals of *L. cuyumhue* are observed only on bare or sparsely vegetated dunes with extensive areas of open sand. They appear not to extend out into the more vegetated sandy flats or rocky areas that usually border the dunes. The area of occupancy of this species is estimated to be around 5 km^2, confined to the dune system, that is about 25 km from the Project Area. Given that the surroundings of the Project site a shrubland with medium vegetation cover and the habitat preference of this species is open sand, this species is likely to not trigger Critical Habitat under Criterion 1.

Application of Criterion 3

Species that are of migratory/congregatory nature other than birds have been screened and there are not present. For birds, Criterion 3 threshold is the habitat that meets Birdlife International's Criterion A4 for congregations, which is the site is known or thought to hold congregations of ≥1% of the global population of one or more species on a regular or predictable basis. IBA trigger species under the birdlife A4 category are not present on site. The nearest IBA is the Auca Mahuida National Park, 50 km north west of the Project site.

Application of Criterion 4

According to WWF, the project location is within the Argentina Monte ecoregion, which is restricted to the pre-Andean region of western Argentina ranging from Salta (24º 35'S) to Chubut (44º 20'S) provinces. It extends from 62º 54'S on the Atlantic coast to 69º 50'S, then from see level to 2800 m elevation. It size is about 157,900 square miles (408 959.123 km^2).

The dominant vegetative formation of this ecoregion is scrublands. The steppe is formed by resinous evergreen bushes dominated by representatives of the Zygophyllaceae family. Other types of vegetation are cactus scrub, xerophilous open woodland, rock associations, psammophilous associations, and halophilous associations. The "jarillal" is the most characteristic community of the Monte ecoregion developing in pockets on plains of sandy or rocky-sandy soil.

There are national and provincial protected areas in the ecoregion that represent less than 2% of the surface area. They are placed within the central and southern parts of the ecoregion so, the northern part of the Monte ecoregion is not protected nor are large tracts of land needed by many species to compete their life cycles.

Screening

The whole of the Project site lies on shrubland steppe biotope. It is deemed that this habitat is well represented within the Monte ecoregion, thus the Criterion 4 is not deemed to be triggered as Critical Habitat.

Application of Criterion 5

As mentioned for Criterion 4, the area is not considered to be within any Global 200 or hotspot WWF sites[6]. The Table below compares the project area with the items which help to interpret Criterion 5. Thus *Criterion 5* is not deemed to be triggered.

Table 5-38 Criterion 5 Summary table

Location	Isolation	High endemism/flora and or fauna with unique evolutionary histories	Spatial Heterogeneity	Presence of environmental gradients	Connectivity between habitats
Project Area	*No*	No	No	No	No

5.2.5.3 Implications of the Modified, Natural and Critical Habitat Classification

The IFC Performance Standard 6 (PS6) provides various mitigation requirements for proposed projects located within modified, natural and critical habitats. These requirements should, and are in this case, addressed through the EIA's biodiversity management plan, and if necessary, associated Biodiversity Action Plan/s focused on specific species or habitats.

Endangered and endemic fauna and flora species (see C*riteria 1 and 2* discussion) species will not suffer net losses by application of the mitigation measures included in the EIA's Biodiversity Management Plans. In terms of the dwarf shrub land steppe habitat itself, it is debatable if it would qualify as Natural Habitat when it shows signs of evident modification, considering the overgrazing and land clearing for agriculture and oil projects, but in any case, the percentage of habitat which will be transformed with regards to the surrounding habitat in the region is insignificant.

5.2.6 Ecosystem Services Preliminary Assesment

The IFC Performance Standard 6 (PS6) defines ecosystem services as the benefits that people, including businesses, derive from ecosystems. Ecosystem services valued by humans are often underpinned by biodiversity. Impacts on biodiversity can therefore often adversely affect the delivery of ecosystem services.

Ecosystem services are organized into four types:

(i) provisioning services, which are the products people obtain from ecosystems;

(ii) regulating services, which are the benefits people obtain from the regulation of ecosystem processes;

(iii) cultural services, which are the nonmaterial benefits people obtain from ecosystems; and

(iv) supporting services, which are the natural processes that maintain the other services.

[6] WWF's Global 200/hotspots is a first attempt to identify a set of ecoregions whose conservation would achieve the goal of saving a broad diversity of the Earth's ecosystems. These ecoregions include those with exceptional levels of biodiversity, such as high species richness or endemism, or those with unusual ecological or evolutionary phenomena (https://databasin.org/datasets/a5b34649cc69417ba52ac8e2dce34c3b).

There have been identified five main ecosystems services in the Project area as presented in the table below.

Table 5-39 Ecosystem services present in the Project area and potentially affected by the Project

Ecosystem Service	Description, Examples	Comments
Regulating Services		
Climate regulation: local	Regulation of temperature, shade air, and quality by vegetated areas	The regulation of temperature provided by shrubs is specially in a meso and micro scale. Shrubs provide microclimatic conditions that serves as shelter for some animals including herpetofauna and insects. That microclimatic conditions also contribute with the settlement of new seedling (nodricism)
Pest regulation	Predators from forests, grassland areas, etc. may control pests attacking crops or livestock	The presence of *Lepus europaeus* (European hare) has had negative effect because of the interspecific competition with the livestock and the native mammals for food (grass). Nevertheless the presence of the european hare, has had also a positive effect, considering that it is an important part of the diet of one major predators registered in the Project area, *Puma concolor* and possibly of *Lycalopex griseus* and *Leopardus jacobita* (Andean cat).
Erosion regulation	Role of vegetation in regulating erosion on slopes and riparian areas	Shrubs and herbaceous vegetation plays and important role protecting soil form compaction and erosion. A compact soil reduces water infiltration and increases water run-off.
Soil fertility	Soil fertility is maintained through hydrological processes, leaf litter, natural nitrogen fixation among others.	In semi-arid environments with spatial heterogeneity, greatest biomass and highest species diversity are found in shrub patches, mainly because they concentrate resources (water and nutrients), act as sink for seeds dispersed from open areas and facilitate biotic interactions that promote microbial processes under the shrubs, thus contributing to soil fertility.
Supporting Services		
Water cycling	Flow of water through ecosystems in its solid, liquid, or gaseous forms.	Shrub clumps play and important role in determining soil characteristics. Plant cover affects hydrological soil properties that determine the infiltration rate. Plants roots as well influence soil aggregation and organic matter that enrichment of soil.

Source: ERM, 2019

5.3 Social Component

The social baseline was developed through the review and analysis of secondary information from official sources, including the National Institute of Statistics and Census of Argentina, the Provincial Government of Río Negro, and the Provincial Government of Neuquen. In addition, an external factor review of Project news was also included in the analysis.

Additionally, a site visit was carried out on May 16 and 17, 2019. The purpose of the site visit was to understand the magnitude of the Project area, confirm social impacts and conduct semi-structured interviews in order to better understand the socio-economic and cultural environment in which the Project is operating and expanding into.

Note that the main limitation related to the use of secondary information was the lack of updated data. The most recent data for the localities of the area of influence dates from the national census in 2010.

5.3.1 Geopolitical configuration

The Province of Neuquén is one of the twenty-three provinces of Argentina. The province has an area of 94,078 km^2, and is divided into 16 departments, one of them being the Department of Añelo, in which the Municipality of Añelo is located.

The province takes its name from the Neuquén River and limits to the north with the province of Mendoza, to the east with La Pampa and Río Negro, to the south with Río Negro and to the west with the Republic of Chile.

The Governor is the highest authority of the provincial administration. The Governor of the Province of Neuquén is elected every four years in free, secret and obligatory elections, in a second-round system and limited to two terms. The current Governor of Neuquén is Mr. Omar Gutierrez.

Añelo is a town located in the Añelo department, in the center-east of the province of Neuquén, belonging to the Argentinian Patagonia. It is the capital of the Añelo department. It is located 100 km north of the provincial capital, on the left bank of the Neuquén River. It has an area of 8,427 ha. As for temperatures, the annual average is 14°C, with an average temperature higher than 21°C in January and less than 8°C average in July. They usually register more than 30 frosts a year in the area.

Río Negro is one of the six provinces of Patagonia. Its natural borders are to the north with the Colorado River; to the east, with the Argentinian sea; to the west, the Andes mountains and the Limay river; to the south is the parallel 42º. Its capital is Viedma and its most populated city is San Carlos de Bariloche.

The territory has an area of 203,013 km^2 that is administratively divided into 13 departments. The Municipality of Catriel is located within the Department of General Roca.

The Governor of the province of Río Negro is in charge of fulfilling the functions of the Executive Power according to the Provincial Constitution. The Governor is elected by popular suffrage for 4 years and there is a two term limit.

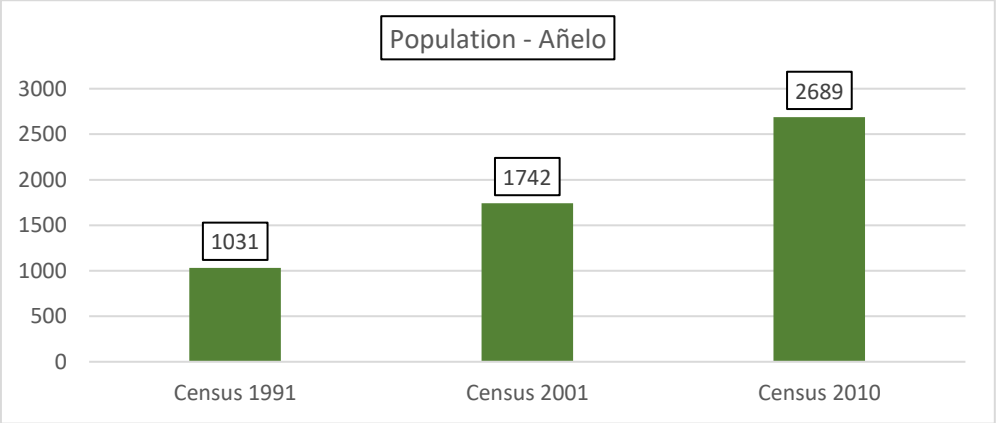
The Municipality of Catriel is located in the extreme north of the province of Río Negro, in the department of General Roca. The city is on the right bank of the Colorado River, in the north of the General Roca department. The climate is arid continental, with a frost-free period lasting less than 150 days. It is characterized by low rainfall and strong winds. The average altitude is 300 meters above sea level.

5.3.2 Socio economic indicators

5.3.2.1 Population

According to the 2010 Census, the population of Añelo was 2,689 (1,398 men and 1,291 women). As it is shown in the figure below; since the 1991 census, Añelo's population has grown by more than 100%.

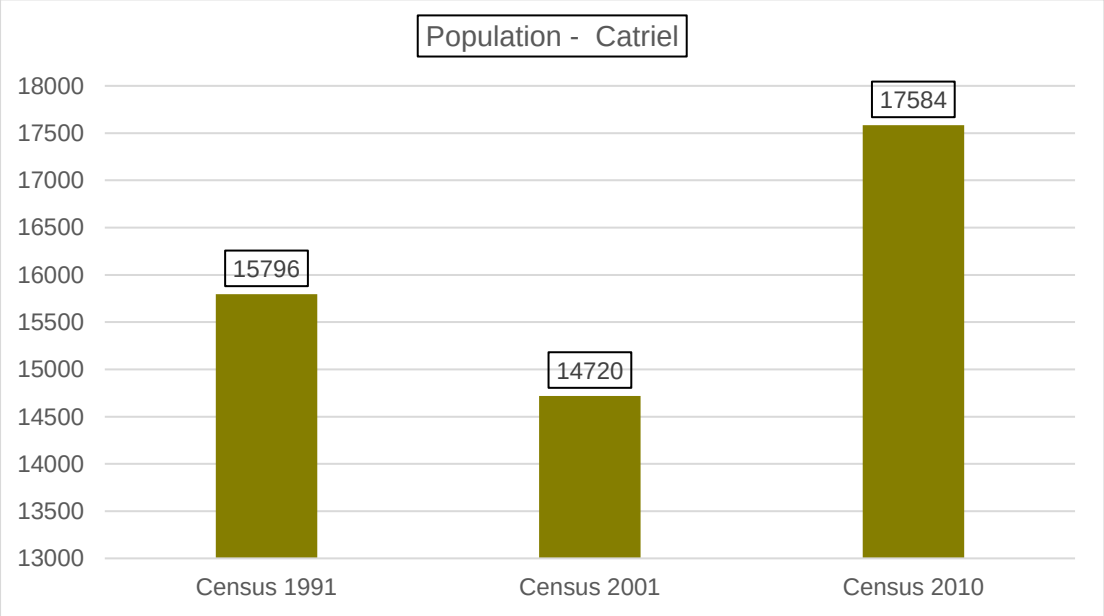
Figure 5-6 Demographic evolution of Añelo in accordance with the National Census of Population, Housing and Households of 1991, 2001 and 2010.



Source: INDEC, INDEC, 1999; INDEC, 2001; and INDEC, 2010.

Based on the 2010 Census, the population of Catriel was 17,584 (8,812 men and 8,772 women). As it is shown in the figure below, between 2001 and 2010 (census periods), the population of Catriel grew by 19.46%. In 2018, Catriel had an estimated population of 19,956 people[7].

Figure 5-7 Demographic evolution of Catriel in accordance with the National Census of Population, Housing and Households of 1991, 2001 and 2010

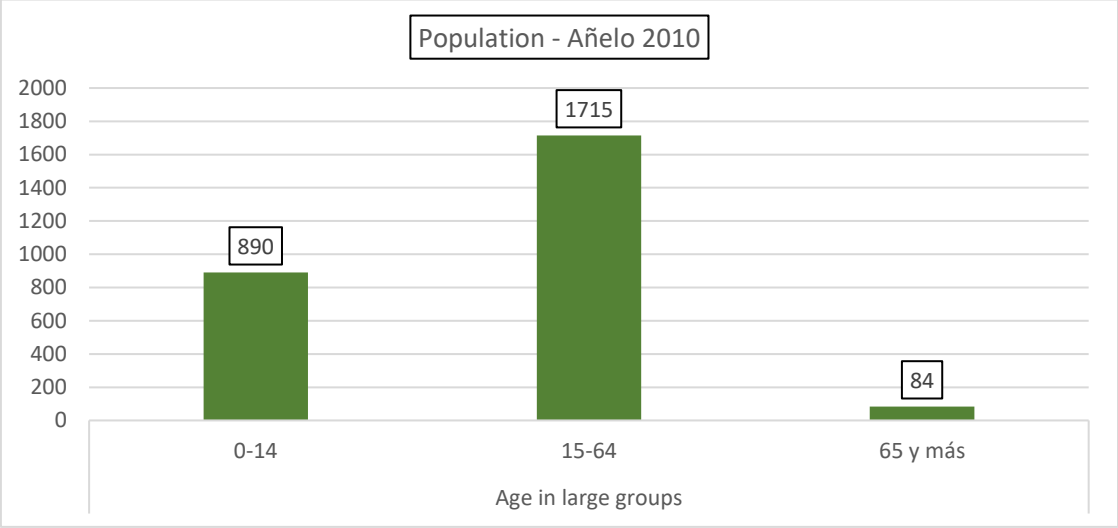


Source: INDEC, INDEC, 1999; INDEC, 2001; and INDEC, 2010.

In terms of age groups, in Añelo (2010), 63.78% of the population were between 15 and 64 years of age. Only 3.12% of the population were 65 years or older. Unfortunately, an age-sex pyramid for Añelo was not available.

[7] Estimated population based on sex, age and area, Río Negro, 2018. Health Ministry, Río Negro.

Figure 5-8 Population of Añelo by Age Group



Source: Provincial Office of Statistics and Census of the Province of Neuquén based on data from the National Population Censuses 2010. INDEC

According to the data of the Statistical Services Center of the Provincial Office of Statistics and Census of Neuquen, for the year 2017, the highest percentage of the population of Añelo had some level of secondary (57.4% with either complete or incomplete secondary level), as shown in the table below. It is important to point out that there is no updated information on the educational level in Catriel.

Table 5-40 Educational level of the population of Añelo, 2017

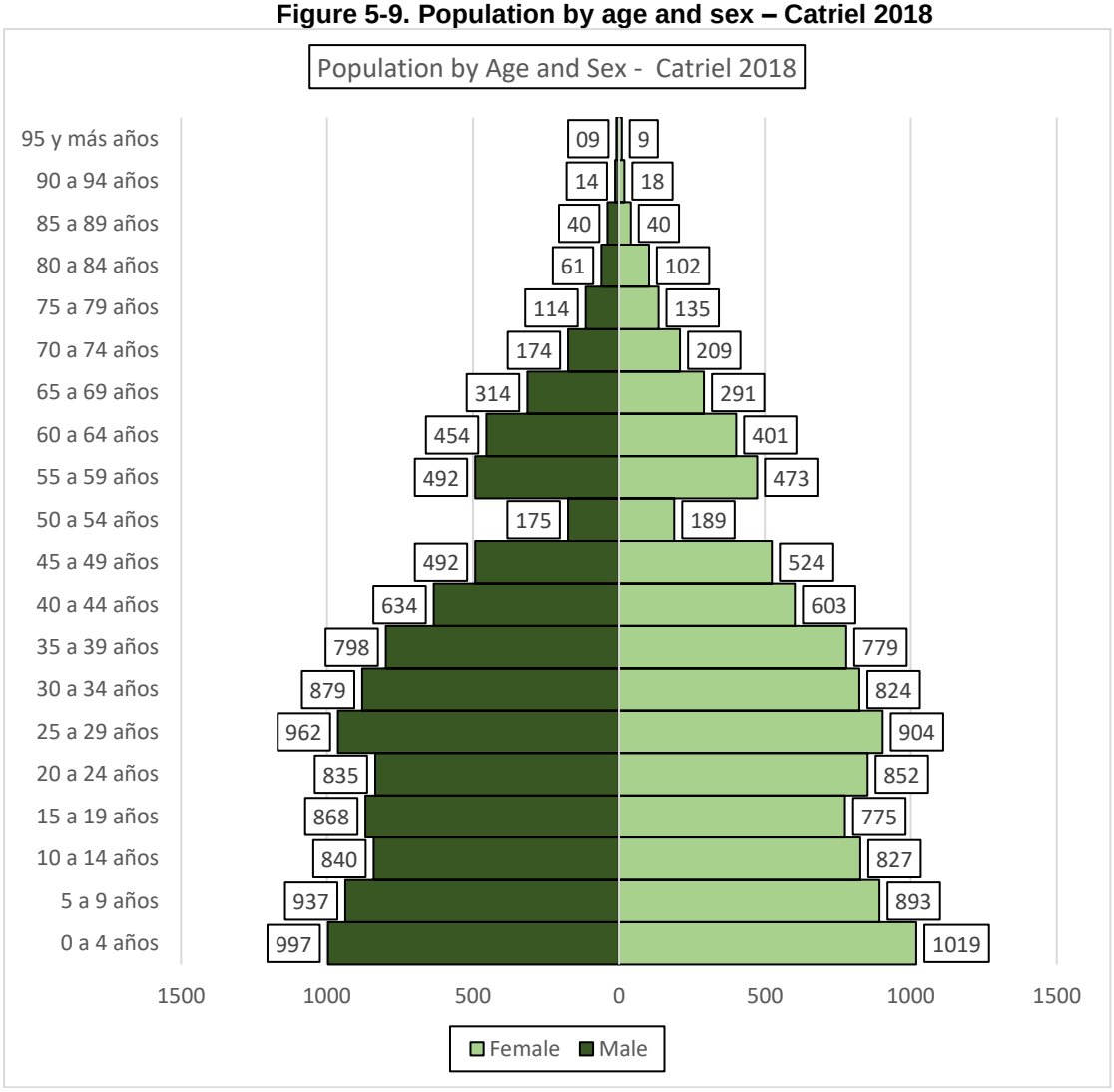
Maximum level of education achieved: Añelo	%
Without Instruction (Includes Special Education and Garden / Preschool)	1.9
Incomplete primary	10.1
Complete primary	23.3
Incomplete Secondary	34.3
Secondary complete	23.1
Superior Non-University or University incomplete	4.7
Superior No University or Full University	2.2
Do not know not answer	0.4
Total	100.0

Source: Statistical Services Center of the Provincial Office of Statistics and Census of the Province of Neuquen.

The shape of the age-sex pyramid is an important tool for analyzing the composition of a population. The age-sex pyramid of Catriel shows the number of men (on the left) and the number of women (on the right). The figure below shows that in 2018, 5,513 people (27.62% of the total population) were in between 0 and 14 years old. When it comes to the work force population, 12,913 people (64.71% of the total population) were in between 15 and 64 years old. Finally, approximately 1,530 people (7.66% of the total population) were aged 65 years and over.

When disaggregated by sex, the population in Catriel is reasonably balanced, with 10,089 men (50.55%) and 9,867 women (49.45%). Additionally, the top end of the pyramid indicates no substantial gender difference between the elderly.

Figure 5-9. Population by age and sex – Catriel 2018



Source: Ministry of Health, Government of Río Negro, Projections prepared on the basis of the National Population, Household and Housing Census 2010. Processing S. Roldan.

According to demographic projections, by 2018, the population of Añelo had tripled to approximately 8 thousand people[8], due to the development of the "Vaca Muerta" Hydrocarbons Project and the high employment expectations that the sector generates. According to an article published in the newspaper Río Negro, Añelo forecasts further growth in the future and 25,000 inhabitants by 2023-2024.[9]

5.3.2.2 Indigenous population

Historical records from XVIII century establish that the original population existing in the Patagonia region before the formation of the Argentine nation occupied a vast territory that extended from the South of Mendoza to the North of Chubut and from the Cordillera de los Andes to the Southwest of the

[8] https://www.lmneuquen.com/por-trabajo-llegan-anelo-unas-7-familias-semana-n599544

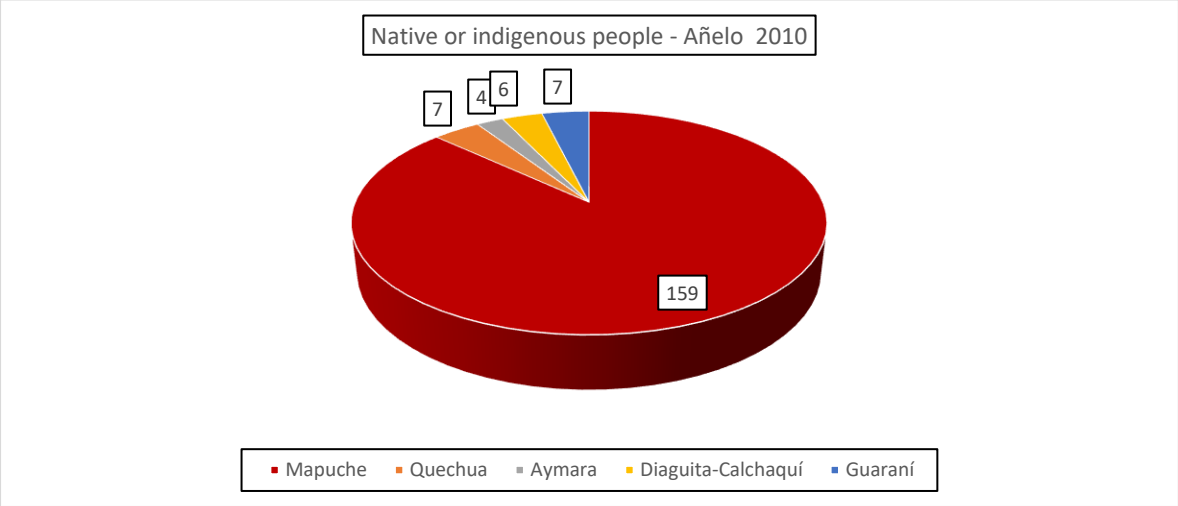
[9] https://www.rionegro.com.ar/anelo-se-prepara-para-una-ciudad-de-25-000-habitantes-MH5867952/

La Pampa, Rio Negro and Buenos Aires. In today's Neuquen Province territory, there are four groups: Huiliche, Picunche, Puelche and Nguluiche or Pehuenche. (Golluscio, 1995).

At the national level, according to the INDEC census of 2010, 21.5% of the population that declared to be native in Argentina, is of Mapuche origin. Neuquen is the third province of the country that concentrates in greater proportion indigenous population, being its representative the Mapuche Confederation of the Nequen Province.

According to the same census, 183 inhabitants of Añelo belonged to an indigenous or native population group; 86% (159 people) were from the Mapuche people. Other native and indigenous groups registered in the same year include Quechua (7 people), Aymara (4 people), Diaguita-Calchaquí (6 people) and Guarani (7 people).[10.] It is important to mention that the 183 indigenous people registered in the 2010 Census represented 6.8% of the total population of Añelo.

Figure 5-10 Native or indigenous people – Añelo 2010



Source: Basic Municipal Information, Volume 18, Year 2016, Provincial Directorate of Statistics and Census, Province of Neuquen.

In Argentina, the existence of an ethnic group is fundamentally based on self-identification. According to the INDEC and the categories established to census the population, an indigenous population is considered to be the one that is self-recognized as descendant or belonging to an indigenous or original people. In this sense, this is the procedure used by the state to identify a population.

In the Province of Neuquen there are currently 57 Mapuche communities settled in rural areas. This number corresponds to self-identification to the territory, although the provincial authorities do not legally recognize them. These coexist alongside the "indigenous reserves" recognized by the decree 360 from 1976 and other complementary legislation.

As indicated in a map prepared by INAI (Instituto Nacional de Asuntos Indígenas) with information from the National Registry of Indigenous Communities and the Territorial Survey of Indigenous Communities Program, a large part of the Neuquen and Rio Negro provinces are territories occupied by the Mapuche. [11] However, according to the same institution, and based on the list of Indigenous Communities with registered legal status, with registration in process and not registered but with technical, legal and cadastral survey, implemented by the National Program for Territorial Survey of

[10] Basic Municipal Information, Volume 18, Year 2016, Provincial Directorate of Statistics and Census, Province of Neuquen.

[11] https://www.argentina.gob.ar/derechoshumanos/inai/mapa

Indigenous Communities, there are no legally recognized indigenous reserves in the direct Project area.[12].

According to the land access process implemented by Vista, none of the landholders to which negotiations has took place, has been identified as Mapuche descendent. Environmental Impact Assessment studies performed for the development of the Project has not identified indigenous peoples or traditional communities in the Project area as well.

Based on the site visit and interviews with local stakeholders, there are no indigenous peoples settlements within the Project area. The inhabitants in the project area owners of ranches for animal grazing and the ranch workers. Finally, no formal contacts were made with indigenous groups since it is clearly mapped that there are no indigenous groups in the project area.

5.3.2.3 Economically Active Population (EAP)

According to the 2010 Census, 63.23% of the population aged 14 years and older in Añelo was part of the economically active population. Similarly, 62.46% of the population aged 14 years and over in Catriel was part of the economically active population.

Table 5-41 Economically active population (EAP)

	Añelo 2010		Catriel 2010	
	N	%	N	%
Economically active population (EAP)	1171	63.23	8056	62.46
Economically inactive population (EIP)	90	4.85	396	3.07
Non-EAP	591	31.92	4446	34.47
Total population of 14 years and over	1852	100	12898	100

Source: Basic Municipal Information, Volume 18, Year 2016, Provincial Directorate of Statistics and Census, Province of Neuquen. http://www.rionegro.gov.ar/index.php?contID=15965

The oil and gas industry is central to the economy of the province of Neuquén. In 2015, a total of 36 mineral extraction establishments were registered. In the same year, there were also 218 oil and gas extraction establishments, as shown in the table below.

Table 5-42 Oil and Gas extraction establishments 2015

Category / Municipality		Extraction establishments 2015	
		Minerals	Oil and gas
First category	Chos Malal	5	0
	Cutral Co	0	2
	Plaza Huincul	0	6
	Plottier	0	3
	Rincón de los Sauces	0	205
	San Martín de los Andes	3	0
	Zapala	21	0

[12] http://datos.jus.gob.ar/dataset/listado-de-comunidades-indigenas

Second Category	Andacollo	1	0
	Añelo	0	0
	Buta Ranquil	0	2
	Las Lajas	1	0
	Picún Leufú	1	0
Third Category	Barrancas	1	0
	Huinganco	1	0
	Las Ovejas	2	0
Total		36	218

Source: Basic Municipal Information, Volume 17, Year 2015, Provincial Directorate of Statistics and Census, Province of Neuquen. http://www.rionegro.gov.ar/index.php?contID=15965

Primary activity is the main source of investment within the Department of Añelo´s economy (55%), which has been growing considerably in recent years. It involves both oil and mining industries, with the oil industry the most significant. Industrial minerals have greater significance in the area, with bentonite, clay, sand and gravel quarries and aggregate quarries. In addition, in the last decade there is an incipient agricultural activity, highlighting the horticultural and fruit production, as well as the forestry and wine industry.

As a counterpart, the secondary sector corresponds to the 15% of the economy; this is a symptom of the limited industrial development of the area and of the wide gap between the production of basic primary goods and value added goods. The tertiary sector has a 30% share, with a strong dependence on the primary sector.

The Municipality of Añelo has three main economic activities (2017): services (29.4%), construction (19.6%) and primary activities (22.4%), which are linked to the exploitation of oil and gas in the Vaca Muerta area.

Table 5-43 Economic activity Añelo - 2017

Economic activity Añelo - 2017	%
Primary activities	22.4
Manufacturing industry	2.1
Building	19.6
Commerce	12.5
Hospitality and Restaurant	10.4
Services	29.4
Domestic service	2.6
Other Branches	1

Economic activity Añelo - 2017	%
Ns / Nr	0
Total	100

Source: Statistical Services Center of the Provincial Office of Statistics and Census of the Province of Neuquen

In terms of economic activities, the main occupation in the study area is related to the oil industry and its associated services, as well as extensive livestock farming.

5.3.3 Essential Social Services

5.3.3.1 Education Services

According to the data from the Ministry of Education, Culture, Science and Technology, Añelo has educational infrastructure for preschool, elementary and secondary school levels (01 preschool, 03 elementary schools, and 02 secondary schools). Añelo schools belong to the public sector and are located in the urban area.

Similarly, Catriel has 08 preschools, 10 elementary schools, 04 secondary schools and 02 non-university higher education schools. Catriel schools belong to the public sector (with the exception of one: Centro de Educación Técnica Nro.21) and are located in the urban area.

Table 5-44 Education services in the Municipalities of Añelo and Catriel

Location	Name of the Educational Institution	Educational Level
Añelo	Jardín de Infantes 52 soles del futuro	Preschool
	Escuela Primaria 350	Primary
	E.P.A. 8 Anexo Añelo	Primary for adults
	Escuela Primaria 100	Regular and Special Primary
	Escuela provincial de enseñanza técnica 23	Secondary
	Centro Provincial de Enseñanza Media 39	Regular and Adult Secondary
	Jardín de Infantes Independiente nro. 7 Ayenhue	Preschool
	Jardín de Infantes Independiente nro.42 Rincon de Sueños	Preschool
	Jardín maternal nro. 3 Ruca Huirin	Preschool
	Jardín de Infantes Independiente nro.43 Misquihue	Preschool
	Escuela Cooperativa Catriel	Preschool
	Centro de Educación Técnica nro.21	Preschool
	Jardín Maternal nro. 14 “Rupu mogñen”	Preschool
	Jardín de Infantes Independiente nro.121	Preschool
	Escuela de Educación Especial nro.10 Rosario Vera Peñaloza	Special Primary
	Escuela Primaria nro.306 “José de San Martín”	Primary
	Escuela Primaria nro.195 Capitán de los Andes	Primary
	Escuela Primaria nro.241 Juana Paula Manso	Primary
	Escuela Primaria nro.281 Malvinas Argentinas	Primary

Location	Name of the Educational Institution	Educational Level
Catriel	Escuela Primaria nro. 21 Padre Pedro Martinengo	Primary
	Escuela Primaria nro.204 Crucero a.r.a. General Belgrano	Primary
	Escuela Primaria nro.218 Ingeniero Enrique Mosconi	Primary
	Escuela de Educación Básica para Adultos nro.21	Primary for Adults
	Centro de Educación Básica para adultos nro.21	Primary for Adults
	Centro de Educación Media nro.93	Adult Secondary
	Centro de Educación Técnica nro. 7	Technical Secondary
	Escuela Secundaria Rio Negro nro.78	Secondary
	Escuela Secundaria Rio Negro nro.21 "Azucena Villaflor"	Secondary
	Centro educativo nivel terciario nro.44	Non-University Higher Education
	Instituto de Formación Docente Continua	Non-University Higher Education

Source: Ministry of Education, Culture, Science and Technology, Directorate of Information and Educational Statistics, 2019.

There is one university (Universidad Nacional del Comahue) within the study area, where residents from Añelo and Catriel usually assist. The Universidad Nacional del Comahue is a public university in between the provinces of Neuquén and Río Negro. According to the SCImago SIR ranking[13], the university ranks among the ten national universities in Argentina that produce the most science and technology.

The University has twelve Faculties, six in Neuquén (Faculties of economics and administration, engineering, humanities, environmental and health sciences, tourism and informatics) and six in Río Negro (Medical sciences, education sciences, language, law and social sciences, agricultural sciences, and food science and technology). It also has two dependent university settlements, a high school (Marine Sciences) and two regional centers in several cities of the Provinces of Neuquén and Río Negro.

5.3.3.2 Health Services

Argentina has a public health subsystem which provides national coverage. As a federal country, the public health system operates across the three levels of government: national, provincial and municipal. The provinces and municipalities provide direct assistance and health services to the population. This responsibility for public health services remains at the provincial level.

The national government is responsible for managing the sector as a whole through the design of programs, the establishment of regulations, and the execution of actions which enable coordination between the different subsectors.

According to the newspaper Río Negro, in 2017 there were only two doctors to serve the population of Añelo[14]. However, in October 2018, the Añelo Hospital was opened within an area of 2,366 square meters. The hospital employs 127 people, including doctors, nurses, ambulance drivers, cooks and administrative and operative personnel. The YPF Foundation and the Baylor Foundation of Chevron contributed with part of the equipment required for the hospital.[15]

[13] Scimago Institutions Rankings is a science evaluation resource to assess worldwide universities and research-focused institutions.

[14] https://www.rionegro.com.ar/solo-dos-medicos-para-atender-a-ocho-mil-habitantes-en-anelo-DE3017522/

[15] https://www.rionegro.com.ar/anelo-ya-cuenta-con-su-hospital-de-complejidad-iii-BJ5784175/

The new Añelo Hospital has become the model health facility for the entire municipality, as it will strengthen the health system of Añelo through the provision of faster, cheaper and more effective responses to the community's health needs. It will provide access to a range of services, including hospitalization, a delivery room, laboratory and radiology.

In addition, it has services in general medicine, pediatrics, gynecology, obstetrics, pneumonology, laboratory, dentistry, x-rays, hospitalization, nursing and patients transfer. The building also offers a protected outdoor area for the recreation of patients and staff.

Photography 5.1: Añelo Hospital

Source: https://www.rionegro.com.ar/anelo-ya-cuenta-con-su-hospital-de-complejidad-iii-BJ5784175/

In 2017, there was 5.8 medical personnel per 1,000 inhabitants in Catriel[16]. The data available does not provide further information about the distribution of these personnel across different health professions.

Nowadays, the Municipality of Añelo has one health center plus the new Añelo hospital, while the Municipality of Catriel has one hospital and seven health centers. See table below.

Table 5-45 Health Services in Añelo and Catriel

Place	Type of health establishment 2018	Name of health establishment	Address	CUIE
Municipality of Añelo	Hospital Level of Complexity III	Añelo Hospital	Vera de la Autovía Norte	No data
	Health Center	Centro de Salud Añelo	INT, TANUZ E/ CALLE 3 Y CALLE 13	Q03102
Municipality of Catriel	Hospital Level (IVB)	Hospital Catriel	ESPAÑA 50	R04079
	Health Center	CENTRO DE SALUD BARRIO CAROD	PEDRO HERNANDEZ 780	R12024
	Health Center	CTRO DE SALUD 4 ESQUINAS	EXCOMBATIENTES S/N	R12005
	Health Center	CENTRO DE SALUD LOTE 6	ROQUE SAENZ PEÑA S/N	R04108
	Health Center	CTRO. DE SALUD MARINI	CORDOBA S/N	R12006

[16] Estadísticas de Servicios de Salud, Ministerio de Salud de la Provincia de Río Negro, 2017. Pg.36.

Place	Type of health establishment 2018	Name of health establishment	Address	CUIE
	Health Center	CENTRO DE SALUD BARRIO PREISS	QUITO Nº 44	R03197
	Health Center	CENTRO DE SALUD SANTA CRUZ	RUMANIA Nº 171	R03198
	Health Center	PUESTO SANITARIO VALLE VERDE	VALLE VERDE	R04080

Source: http://programasumar.com.ar/efectores/neuquen.php; http://programasumar.com.ar/efectores/rionegro.php

5.3.3.3 Housing

According to the census data, in 2010 there were 1,105 houses in the Municipality of Añelo. In the Municipality of Catriel, there was 5,002. In both jurisdictions, the highest percentage of houses were independent (86.97% in Añelo, and 80.95% in Catriel). Rented houses represented less than 3% of the total in both Añelo (1.35%) and Catriel (2.07%).

Table 5-46 Housing in Añelo and Catriel

Type of housing	Añelo 2010	%	Catriel 2010	%
Home	961	86.97	4049	80.95
Ranch	44	3.98	18	0.35
Hovel	42	3.80	39	0.77
Department	43	3.89	782	15.64
Room rented	15	1.35	104	2.07
Other	0	0	10	0.19
Total	1105	100	5002	100

Source: Basic Municipal Information, Volume 17, Year 2015, Provincial Directorate of Statistics and Census, Province of Neuquen. http://www.rionegro.gov.ar/index.php?contID=15965

5.3.4 Land use

The land use in the Project's area of influence is characterized by its natural conditions. This is mostly included in the Monte ecoregion of plains and plateaus and, to a lesser extent, in the Patagonian steppe. It is located in the semidesert climate domain known as arid diagonal, characterized by its scarce precipitation, its orographic features -a stepped relief that reaches up to 1,000 meters above sea level - and an arid temperate climate - with average annual temperatures of 10 to 14 degrees Celsius[17].

In these natural conditions, together with the oil activity, an incipient livestock activity is developed in some extent in the Project area, by landholders who maintain subsistence economies. This is characterized by the development of extensive mixed livestock, based on traditional practices with low investment in infrastructure and technology. There are no fruticulture in the Project area of any other type of crops.

[17] COPADE, Estudios estratégicos para el desarrollo territorial de la región Vaca muerta, 2012.

From the historical point of view, livestock in the Province of Neuquen dates back to the end of the XIX century through the ancient practice of extensive transhumant livestock (mostly goats) in the north and centre. In the first decades of the twentieth century, breeding ranches of cattle and sheep were established in the fields of the south. These differentiated practices per territory are still largely maintained to date.

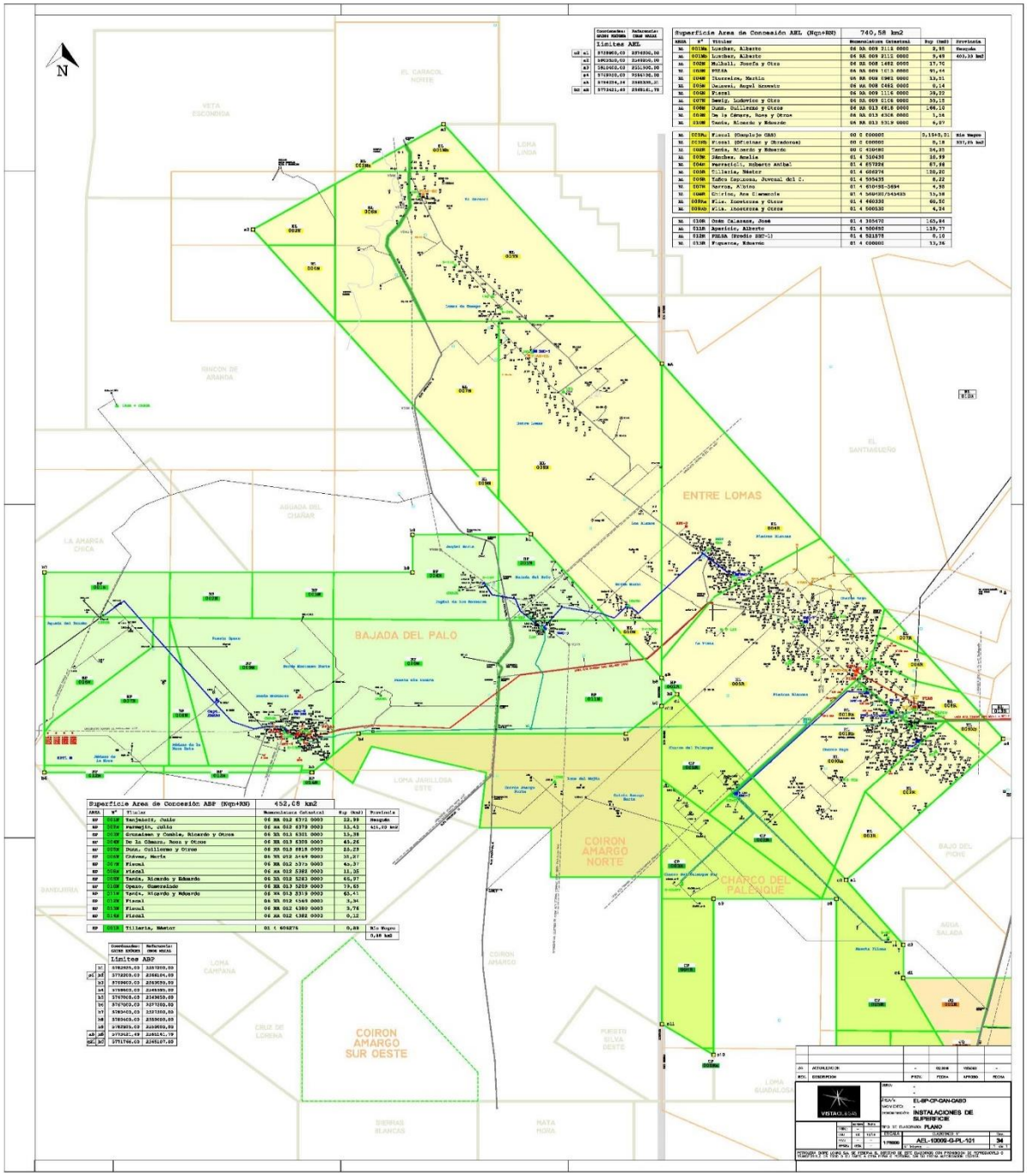
In general, the animal load is causing a negative environmental impact due to overgrazing. The degradation of natural pastures and the disappearance of species valued by livestock, with evidence of soil erosion, is one of the oldest and most widespread environmental impacts in the region.

Land access process implemented by Vista

The lands are very large fractions of desert terrain bordering the 250 hectares and above. It is a subsistence economy mainly based on cattle; therefore, it is assumed that most Project landowners (see Figure below) used to be very vulnerable actors, at least in terms of income and lack of access to basic services, as observed during the site visit.

Vista has a Territorial Occupation Baseline for the Bajada de Palo area. This document contains the location of 16 housing facilities in the area, 03 of which were uninhabited. However, as part of the mitigation measures proposed in this document (chapter 8), a complete characterization of residence in the project area is included within the action plan. This characterization must contain specific information on residence (temporary or permanent) as well as socio-economic living conditions of landowners and caregivers.

Figure 5-11 Project Landowners



Source: Vista.

Since the land purchase requires willingness to sell, and causes speculation and delays in the process, Vista decided to guarantee the Project access to land through right of way agreements in between Vista and landowners. Except in places where the density of the operations makes the development of another activity impossible, the activities of Vista and landowners coexist. The agreement requires that the activities coexist. In cases where greater activity is required, Aleph will evaluate the purchase of land.

There are easement agreements with all landowners within the concession area. As facilities are being built, the easement agreements are updated, incorporating additional properties.

Before Vista, many companies (South American Petroleum, Oil, YPF, etc.) came first and all of them had different ways of dealing with the matter. There was no systematic way to access land. The relationship between landowners and oil companies was characterized by problems of coexistence.

Vista's land access process is framed under the following regulations: At the national level, the Law Nº 17.319[18], the Decree 861/96 Indemnifications Cuyana and Neuquén Areas[19] and the Decree 860/96 Indemnifications South Zone[20], whose values were updated in 2018 through the Joint Resolution-E 1/2018[21] and Joint Resolution-E 2 / 2018[22]. One year later, the values were re-established through the Joint Resolution 1/2019[23] and the Joint Resolution 2/2019[24]. At Neuquén provincial level, the Law 2183[25] and the Provincial Decree 353_98[26] clarify that the terms and amounts are those established in National Decree 861/96 and the regulations that modify / update it.

Agreements between companies and landowners do not entitle companies to expropriate landowners' real property. Companies are not entitled, under no circumstance, to expropriate landowners' real property. Expropriation may only be carried out by national and provincial authorities, only once it is declared as of public utility. Companies are entitled to occupy and pass through third parties' real property to develop their activities. In such regard, a compensation must always be paid to the landowner for such occupation. National and provincial authorities understand that oil & gas exploitation activities are considered of public interest, so landowner's objection to the occupation or failure to agree with respect to compensation does not constitute a reason to suspend or prevent oil companies' works. Companies may agree amounts payable to landowners although there is a minimum established by law. The values established by law presume, with no need of evidence made by the landowner, the damages, loss of profit, and the expenses for control and surveillance sustained by the landowner as a result of the activity within the property.

Regulations set reference tables of compensation values according to installation (well, roads, pipelines, conduits) and surface; the amount of compensation is a result of the agreement between the parties, and in that sense, refers to the negotiating power of the landowners. The easement compensations correspond to 1) lost profit, and, 2) control and surveillance. First, the norms assume that the producer will continue producing while receiving the compensation, which does not happen in the majority of cases. Second, the compensation for reimbursement of expenses for controlling / supervising the activity of others within their lands, understood as pawns, petrol, fences, etc.; whose reference values correspond to the surface. Once the negotiation has been completed, a negotiation act is signed. Most agreements are re-negotiated annually, meaning that this impact runs during construction and operational phases.

If there is no agreement, the authority could intervene and prosecute. The landowner can refuse, but there are ways to enable the access to exercise the activity in the concession area and in that sense, it is not allow blocking the activity. Still, the expropriation is a different process, where the ownership of the property is at stake, and this is not the case with easement agreements. If there is a specific problem with a landowner, an administrative easement can be applied. The hydrocarbon activity is of public interest, so the landowner cannot avoid giving access to the land. Still, there is no precedent in which that has been done in the area.

[18] http://servicios.infoleg.gob.ar/infolegInternet/anexos/15000-19999/16078/norma.htm
[19] http://servicios.infoleg.gob.ar/infolegInternet/anexos/35000-39999/38236/norma.htm
[20] http://servicios.infoleg.gob.ar/infolegInternet/anexos/35000-39999/38235/norma.htm
[21] http://servicios.infoleg.gob.ar/infolegInternet/anexos/305000-309999/305499/norma.htm
[22] https://www.argentina.gob.ar/normativa/nacional/resoluci%C3%B3n-2-2018-305500/texto
[23] http://servicios.infoleg.gob.ar/infolegInternet/anexos/320000-324999/322396/norma.htm
[24] http://servicios.infoleg.gob.ar/infolegInternet/anexos/320000-324999/322397/norma.htm
[25] http://hidrocarburos.energianeuquen.gov.ar/MARCOLEGAL/LEYESPROVINCIALES/Ley%202.183.pdf
[26] http://hidrocarburos.energianeuquen.gov.ar/MARCOLEGAL/DECRETOS_PROVINCIALES/Dec0353_98.pdf

5.3.5 Stakeholder mapping

In the Project's area of influence, several organizations and public institutions coexists related to the oil and gas industry and constitute Vista's stakeholders. These are:

- Landholder: known and "superficiarios", this group is conformed to date by 80 landholders approximately, with whom a series of agreements has been established for access to their lands through easement contracts. Vista has a Territorial Occupation Base Line for the Bajada de Palo area. This document contains the location of 16 housing facilities in the area, 03 of which were uninhabited. However, as part of the mitigation measures proposed in this document (chapter 8), a complete characterization of residence in the project area is included within the action plan. This characterization must contain specific information on residence (temporary or permanent) as well as socio-economic living conditions of landowners and caregivers. Vista, through its Land Access area, is committed to establishing transparent economic agreements based on real compensation in respect to the legislation, in order to break with the practices of the past. Likewise, Vista aims to consolidate collaborative relationships with landowners, so that they are allies of the project. A harmonious coexistence is the result of a series of social initiatives from Vista, such as: (i) opening, improvement and maintenance of roads with access restrictions to the process areas, (ii) improvement and maintenance of palisades (tranqueras) and livestock guards (guarda ganado) (iii) agreement for the installation of cellular signal, (iv) specific supports such as livestock storage, and provision of water for animals and in some cases for personal consumption.
- Local companies of services and goods with potential to be suppliers of the Project. There is an important number of local companies that are offering goods and services to the O&G industry, while many others are struggling to be part of the sector due to its limitations to adapt to the standards required by some of the companies that operate in Vaca Muerta, among which is Vista. In order to help them close their gaps and be more competitive, Vista has been working with different Chambers of commerce through information on Vista's investment plans and Vista's supply requirements, and training them on those aspects that were identified as gaps. Some of the groups of entrepreneurs with whom Vista has been working include CASEPE (Chamber of oil services of Catriel), PIMA Center, and CEIPA, CAPESPE, ACIPAN in Neuquen, which are members of the Federation of Energy Chambers of the Province of Neuquen.
- Municipalities of Añelo and San Patricio de Chañar (Province of Neuquen) and Catriel (Province of Rio Negro). With these three municipalities, Vista has maintain biweekly meetings in order to define the specific intervention lines of cooperation. The objective of Vista is to support governments to improve their management so that they can take advantage of the benefits generated by the oil industry (taxes, employment, and business). Specifically, Vista has established an agreement with RIL (Red de Innovacion Local), an organization that works with 250 municipalities national wide, to support these initiatives.
- Workers unions: There are two groups, the base or operational union, and the supervisors or "hierarchies" union. The Union of Petroleum and Private Gas of Rio Negro, Neuquén and La Pampa represent base workers. It is the strongest, biggest and oldest of the two unions. It is led by a Republic Senator of the Neuquen (Guillermo Pereyra). The agreement that binds them and under which the entire industry in the region is organized, is 644/2012. All the operators Vista hires are under this agreement.

  The other union is Hierarchical and Professional Personnel and Private Gas of Neuquén, Rio Negro and La Pampa. This was formed in the 80s because it was leaving aside a significant portion of workers. The Collective Agreement that binds them is 637/2011. Vista has a large part of its supervisors under this agreement; however, those considered as "trusted personnel" and administrative are excluded. Vista's Labor Relations area is in charge of permanently coordinate with unions participate in meetings and apply all new regulations that are agreed collectively. Vista has not had any workers strikes to date, although under previous administrative a big strike related to La Pampa dismissed took place.

- Local institutions: Vista has been supporting various sports, cultural and social organizations of Catriel and Añelo in specific demands. In order to make these supports viable, Vista seeks to have two requirements: that these initiatives have synergies with other operators or public resources, or that they are structural projects that may have a long-term impact on society.

Although is not identified as a Project stakeholder, since there are no indigenous communities in the area of influence, the Mapuche Confederation of Neuquen is an important group in the region. Created in 1970 with the participation of representatives of 30 communities of the province. They obtained his legal status only in 1976 by decree No. 360. Vista is mapping this group due to its social relevance in the region and because they maintain an agenda that opposes some oil projects that are located in the Añelo area. Vista's relationships with this group are positive today.

Likewise, Greepeace has been identified as an environmental organization opposed to the development of Vaca Muerta, although its intervention is periodic and to date no actions have been reported that have been directly related to Vista.

Finally, although there is an instance that aggregates the oil companies at the national level (IAPG), it maintains a low profile at the local level, so it does not count -for now- among Vista's stakeholders.

5.3.5.1 Citizen participation process

In relation with the citizen participation process related to the Environmental Impact Assessments that Vista has presented to the authority, according to legislation, only one permit required the implementation of a Public Audience. The Sub-Secretariat of Environment, of the Ministry of Territorial Development and Environment of Neuquen province, organized a public hearing in Añelo on May 3, 2019 for the Pipeline Project of BMo located in zone next to the future EMC-11 Bajada del Palo Neuquén area until the PTC Charco Bayo Entre Lomas Río Negro.

This public hearing is part of the requirements established by the Environmental Application Authority that must be met in order to obtain the environmental license for the EIA. In the case of the "Pipeline Project from BMo to PTC AEL, the public hearing was convened by the Environmental Authority, through the publication of informative edicts in the regional media, 45 days in advance. Attached as Annex 5.13 is a copy of the edicts published in the Official Gazette of the Province of Neuquén, in the Diario Río Negro and in the newspaper La Mañana de Neuquén. In addition, the call was published on the website of the Environmental Authority[27]. Additionally, a formal invitation was sent to the authorities of the municipality of Añelo inviting them to participate. The invitation note is attached as Annex 5.14.
Despite the wide call that the Environmental Authority usually makes for these hearings, citizen participation is scarce. In response, the Environmental Authority films the whole event and publishes it in its official website and YouTube account[28].
The Environmental Authority issues an act that records the completion, development and outcome of this hearing. The same is attached as Annex 5.15. The edicts are also published for comments.

Now well, as part of the Stakeholder engagement program (Q1-2020), it is planned to hold complementary communication meetings with stakeholders around technical issues, as addressed in chapter 9.

Vista has permanent relationships with interest groups. As indicated in Chapter 9, Vista is working on systematizing the documentation and mapping of Project stakeholders. The Stakeholder Engagement Program (SEP) will consider the specificities of external stakeholders while designing its strategy. To this end, frequent updating of the Stakeholder Map will be scheduled. Vista will conduct a Stakeholder Mapping, at least annually, to keep an updated record of their stakeholders (mainly: national, provincial and municipal authorities, landholders, unions and their representatives, workers and contractors workers and their representatives). The Map will include a list of all stakeholders that the Project will

[27] https://ambiente.neuquen.gov.ar/convocatoria-audiencia-publica-en-la-localidad-de-anelo/

[28] https://www.youtube.com/watch?v=F4FoYNX6dxY&t=801s

inform and consult. This list must consider groups directly or indirectly affected by the Project, groups interested in the Project, and groups that can influence Project operations and/or results. It is crucial for the success of the Program that this identification is followed up by an analysis of the stakeholders' most important features (mainly: influence and interest in the Project), so that Vista can prioritize between stakeholders and craft appropriate engagement strategies for each one.
Regarding external communication and reporting, Vista will provide affected external stakeholders with accessible information, according to Project impact severity, information which might include: descriptions of the Project, its main relevant risks and impacts, the management measures developed to address them, Vista's plan for engagement and the grievance mechanism (while avoiding sharing company sensitive or confidential information. The SEP must plan and authorize/clear all communication with external stakeholders). Vista must also report Project external stakeholders frequently regarding impacts and impact management monitoring, also according to impact severity. For example, engagement with landholders to manage easement agreements (currently ongoing) will include information on land use, schedules and potential impacts (as currently performed by Vista). Finally, it is worth mentioning that Mapuche communities have not communicated any concern about the Project, since no Mapuche recognized communities nor traditional families are located in the Project area.

5.3.6 Archaeologic, historical and cultural resources; and Paleontological heritage

The following information and conclusions were based on the archaeological and paleontological assessments, included in the following environmental documents, which were submitted and approved by the provincial environmental authorities from both Neuquén (SubSecretariat of the environment) and Rio Negro (Secretariat of environment and Sustainable Development):

Table 5-47 Assessment Submitted and Approved by Authorities

Assessment submitted by VOG	*Approval by the local authorities*
EIA for the Oil pipeline from BMo-AEL (Neuquén province section)	*SubSecretariat of Environment of Neuquén, Disposition* 483/19*, dated June 07, 201*9
EIA for the Oil pipeline from BMo-AEL (Rio Negro province section)	Secretariat of Environment and Sustainable Development, Resolution N° 848/SAyDS, dated June 03, 2019.
IA (Environmental Report) 16 well PAD 1,2,3,4, MdM	SubSecretariat of Environment of Neuquén, Disposition 524/18, dated June 04, 2018
IA (Environmental Report) 32 wells PAD 5,6,7,8,9,10) MdM	SubSecretariat of Environment of Neuquén, Disposition 225/19, dated March 25, 2019
IA (Environmental Report) aqueduct, oil pipeline and gas pipeline MdM to BMo	SubSecretariat of Environment of Neuquén, Disposition 1124/18, dated Sept 26, 2018
IA (Environmental Report) EMC11 Bajada del Palo	SubSecretariat of Environment of Neuquén, Disposition 1372/18, dated Nov 28, 2018
IA (Environmental Report) Assembly of FP1 MdM	SubSecretariat of Environment of Neuquén, Disposition 1229/18, dated Oct 29, 2018

Source: Vista Oil&Gas, 2019

5.3.6.1 Archaeological background of the area

The closest archaeological data come from surveys linked to environmental studies carried out during the latest years, which provide a general characterization of the area, allowing to generate predictions as far as archaeological findings are concerned (Ambasch and Andueza, 2010, 2011, 2013, 2014 b-c-d-e, 2015 a-b-c-d-e-f-g-h-i, 2016, 2017 a-b-c).

At the Macro regional level, the first human groups, composed of hunter-gatherer societies, would have arrived the western Norpatagonia approximately 10,000 years BP. The archaeological record of the macro-region indicates the predominance of society nomads characterized by high mobility. This has implications in the structure and general properties of the archaeological heritage that, in a broad analysis scale, is usually of low density.

Some examples of it are located on the banks of Limay River, south of Neuquén city such as the Epullán Grande Cave (9,978 years BP), Traful Cave (9,430 years BP) and Cuyín Manzano Cave (9,920 years BP) (*Cabal et al., 2011; Crivelli, 2010; Miotti & Saleme, 2004; Silveira, 1995*). Some other evidences come from the archaeological site called Cueva Huenul 1 (Barberena et al 2010; Barberena 2013) located within the Department Pehuenches, some 70 km south from the project site.

Towards the north of Neuquén Province, the archaeological remains show occupations that did not exceed 4,000 years BP. The documented sites are located in sandy areas (dunes) and nearby of lagoons or watercourses. It was an extractive economy, typical of hunter-gatherer societies (Sanguinetti de Bórmida, Schlegel 1972; Sanguinetti de Bórmida, 1974; Silveira, 1995).

The ergological component, is constituted largely, by materials of lithic origin, both formatted (projectile tips, drillers, scrapers, etc.), as well as non-formatted (carving waste) and archaeofaunistic remains, linking their functionality to areas of hunting. Between 1,000 and 1,500 years BP, the archaeological record of the region is also composed of ceramics (Della Negra sf; Silveira, 1995), although the latter may not have been manufactured in the region, and it has a transandean origin, a situation linked to the exchange networks that were maintained even in the historical period (Fernández & Vitores, 2008).

Cerro de Las Brujas (approx. 35 km west from BPO), Piedra Pintada, Cueva del Cañadón de la Piedra Pintada and Agua Escondida both located at the south west of the province over 250 km from the project area, where prehistoric records were found, varying patterns and techniques used. On the other hand, in areas close to Bajo de Añelo (some 40 km south from the project area), burials are recorded, such as the ‘Museo de Sitio de Añelo’ (500 years BP) and ‘Loma de la Lata’ (600 to 750 years BP), among others. All of them present associated archaeological material, corresponding to lithic pieces, ceramics and metal (rings, punches, knives, etc.), varying its occurrence of these according to the temporal depth (Cúneo, 2003; Cúneo & Della Negra 1999; Della Negra, sf; Della Negra 2005; Della Negra & Novellino, 2005; Hajduk & Biset, 1996).

Another archaeological site with presence of prehistoric records is 'Aguada de la Piedra Pintada'. Although an absolute temporary assignment was not possible, it is thought to belong to the Late Holocene (Sanguinetti de Bórmida, 1974; Schobinger, 1978; Schobinger & Gradín, 1985).

The abovementioned EIA and IA assessments approved by the local environmental authorities concluded that: “*There are no previous studies that record evidences of sites of historical interest, archaeological and / or paleontological in the study area (BPO and AEL)”.*

In case of any chance finding that may occur during the execution and operation of the project, the developer should proceed in accordance with the provisions set forth by the Environmental and Social Management Plan, according to the legal requirements of Law 2184 Protection of the archaeological and paleontological historical heritage; and the IFC PS8 which aims to ensure that clients protect cultural heritage in the course of their project activities

5.3.6.2 Paleonthological Heritage

The El Palo Formation is constituted fundamentally by sandstones, mudstones (fangolitas), tufitas, limestones rocks that were deposited in a Fluvial medium of variable energy; the lenticular sandy accumulations with current structures and erosive bases indicate the presence of anastomosed rivers, while fine intercalations with calcareous concretions and paleosols correspond to alluvial plain (see Uliana, 1979).

Lake Barreales (approx 40 km south of BPO) in particular, is a prominent space at the level of the paleontological record. This sector is characterized by the presence of geological formations carrying Cretaceous dinosaur fossils, among many other *taxa* (Coria 2000, Calvo et al 2007, Kramarz et al 2011, etc.) This applies to the region in particular and to large spaces linked to the basins of the Neuquén and Limay rivers.

Uliana (1979) indicated the presence of mammalian tooth remains at the northern slope of Cerro Vaca Mahuida. Pascual et al. (1984) reported several taxa of fossil mammals: Kraglievichia sp. Y

Palaehoplophorinii inc. sed. (Vaca Mahuida hill); Plohophorini inc. sed. (Aguada del Piche);Aspidocalyptus sp. and Panochtini inc. sed. (Angostura). This cast corresponds to the Huayqueriense Mammal Age, of the Late Miocene. For their part, Hugo and Leanza (2001b) cited the finding of a Megalonychidae in the Bajo of Santa Rosa, within the Hoja Villa Regina, attributed by Scillato Yané et al. (1976) to the Lower Pliocene. This occurrence is referred to the Late Miocene - Pliocene by Alberdi et al.to the. (1997), who considered the sedimentary carriers as "rionegrenses".

As stated before, the abovementioned EIA and IA assessments that VOG submitted and were approved by the local environmental authorities concluded that: "*There are no previous studies that record evidences of sites of historical interest, archaeological and / or paleontological in the study area (BPO and AEL)".*

In case of any chance finding that may occur during the execution and operation of the project, the developer should proceed in accordance with the provisions set forth by the Chance Finding Procedure' (See chapter 8) according to the legal requirements of Law 2184 Protection of the archaeological and paleontological historical heritage; and the IFC PS8 which aims to ensure that clients protect cultural heritage in the course of their project activities.

Map with principal paleontological and archaeological findings is presented in Annex 5.16.

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Indonesia
Ireland
Italy
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Kenya
Malaysia
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