DESIGN
CONSTRUCT
OPERATE

PRIMERO

SITE SELECTION REPORT

LITHIUM REFINERY STUDY

36901-REP-GE-002

DATE	REVISION	STATUS	PREPARED	REVIEWED	APPROVED
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TABLE OF CONTENTS

Abstract

Galp is currently developing a pre-feasibility study for a lithium refinery project. Given the significant space requirements for this type of industry, and the potential environmental impacts of its operation, it is important to find an implementation site that leads to the least possible environmental, social, logistical and bureaucratic constraints.

In this sense, eight alternative sites were analysed, namely Matosinhos, Sines, Estarreja, Setúbal, Valongo, Trofa and Fafe, in Portugal, and Vigo, in Spain.

The site selection process seeks to assess each proposed site location for the lithium refinery to determine its strengths and weaknesses based on criteria defined and validated with Galp. This analysis will support the decision-making process in the final selection of the placement of the lithium refinery.

The comparative analysis of the alternatives for the site location presented in this report focuses on a desktop analysis made for a set of environmental aspects, including biophysical, physical and socioeconomic aspects.

Considering that the lithium refinery is a chemical processing industry, the key environmental aspects analysed throughout this report were Climate Change; Water Stress, resources and quality; Contamination of soils and water; Air Quality and Public Health. Nevertheless, Biodiversity, Geology and Geomorphology, Waste treatment, Noise, Socioeconomics and Archaeology were also included in the present analysis.

The project vulnerability to external risks, in each possible site location, was also analysed in this report. The qualitative risk analysis includes natural, technological and mixed risks.

Considering the diversity of the eight site locations, it is expected different requirements for construction work and mitigation measures. Based on that, additionally to environmental assessment, the report includes inputs for the implementation project, that influence the costs, timings and overall considerations.

The adopted methodology, based on desktop assessment aims to rank each site location established by the quantitative, knowledge and importance levels of each environmental aspect. It is also included a discussion of the main red flags to clarify possible risks inherent to each site location.

The main findings show that Sines is the most favorable site location to place the lithium refinery, followed by Setúbal and Trofa, all with very similar impact level (score range between 66 and 70). Considering the construction phase, it should be noted that, from the 3 places the one which presents better conditions is Setúbal.

It should be noted that, in terms of environmental licensing procedure, this study presents an environmental permitting roadmap assessment for the Portuguese and the Spanish territory, concluding that in spite there are no significant differences between both countries, Spain presents lower costs and timings for the procedure.

Keywords: land planning, risk, biodiversity, archaeology, geology, water, contamination, noise, air quality, public health, climate change, socioeconomics, environment and vulnerability

Acronyms

GHG – Greenhouse Gas

IBA - Important Bird and Biodiversity Areas

Lden – Day-evening-night noise level. It is a descriptor of noise level based on energy equivalent noise level (Leq) over a whole day with a penalty of 10 dB(A) for night time noise (23.00-7.00) and an additional penalty of 5 dB(A) for evening noise (i.e. 19.00-23.00).

Ln – night noise level. It is a descriptor of noise level based on energy equivalent noise level (Leq) over night time (23.00-7.00).

NO_2 – Nitrogen dioxide

PM10 – Particullate matter with a diameter of 10 microns or less. These are inhalable into the lungs and can induce adverse health effects

O_3 - Ozone

PGRH – Plano de Gestão da Região Hidrográfica (Hydrographic Management Plan)

PROF – Programa Regional de Ordenamento Florestal (Regional program for Forest management)

PNPOT – Programa Nacional Ordenamento Território (National Spatial Planning Policy Program)

REN – Reserva Ecológica Nacional (National Ecological Reserve)

RAN – Reserva Agrícola Nacional (National Agricultural Reserve)

SNAC - Sistema Nacional de Áreas Classificadas (National system of classified áreas)

SO_2 – Sulphur dioxide

UCC – unidades de cuidados nas comunidades (health centres)

UCS – Cuidados integrados de Saúde (health centres)

URAP - Unidade de Recursos Assistenciais Partilhados (health centres)

USF – Unidade de saúde familiar (health centres)

1 INTRODUCTION

Golder was commissioned by Primero in early 2021 to undertake the location study for a pre-feasibility study for a proposed Lithium Refinery to be located in Portugal.

Galp provided to Primero and Golder a number of sites (8) to be assessed for suitability. The following report details the outcomes of this study.

Golder engaged Portugal based company Quadrante to support the outcomes of this assessment.

Galp Operations and Development Plans

Galp currently operates 1 refinery in Portugal, located in Sines. A second refinery was fully operational in Matosinhos until the end of 2020, and it's currently under a decommissioning phase.

Sines is the only operating refinery in Portugal, with future plans to transform the site into a green energy hub by 2030.

Matosinhos is to discontinue operations from 2021, with decommissioning planned for completion by 2025. Galp is assessing this site for alternative usage.

Galp is in the process of developing solar power generations sites within Portugal and Spain.

1.1. SCOPE OF THE STUDY

The main objective of this study is the environmental assessment of 8 potential sites for the development of a Lithium Refinery Complex. 8 sites have been identified as part of the site selection: 7 sites are located in Portugal – Matosinhos (brownfield site[1]), Sines (greenfield site[2]), Estarreja (greenfield site), Setúbal (greenfield site), Valongo (greenfield), Trofa (greenfield) and Fafe (greenfield), and 1 site is located in Spain – Vigo (greenfield site).

For this report the Spanish based site will be referred to as Vigo, however, the official location is Salvaterra de Miño, within the district of Pontevedra.

The primary objective of the site selection study is to undertake a desktop assessment of each site, assessing the environmental, economic, and social factors and recommend the most favourable site.

Upon selection of a suitable site, the next phase of works will delve further into site specifics and characterisations, confirming assumptions made during the desktop assessment, identifying risks and developing mitigation strategies to support the design process.

It is worth noting that, the first 4 locations (Matosinhos, Sines, Vigo and Estarreja) were analysed in October of 2021, the Setúbal site was analysed in November of 2021 and the remaining locations were analysed in January of 2022. For the next stage gates, it will be necessary to review possible updates in the land planning tools and legislation for the selected site.

[1] Brownfield – a field potentially contaminated by a previous industry
[2] Greenfield – no constraints by a prior industry (no previous industry)

1.1.1. Study Criteria

The site selection criteria was developed using expert opinion relative to the environmental elements pertinent to the development of these works.

Consideration of criteria was factored against the proposed locations and the specific physical properties of each location, the environmental characteristics of each location and the social/economical aspects within the surroundings of each site.

The following report assesses for each site, the environmental parameters described in Table 1-1 . These parameter categories will be used to determine a site recommendation through a Multi-Criteria Analysis, undertaken in conjunction with the outcomes of the logistic and cost assessment included within the Site Selection Study.

FACTOR	ANALYSIS	DEGREE OF IMPORTANCE
Climate change	Focus on the analysis of the project's vulnerability to Climate Change.	High
Biodiversity	Careful analysis at the level of direct installation, with potential habitat allocation, considering the sensitivity areas and the location and characterisation of existing species, using available information, namely the ICNF database.	Medium
Geology and geomorphology	Analysis of existing interferences with geological elements of interest and which change the geomorphology of the installation site. The analysis is based on available information.	Medium
Land use/occupation	It is considered that the impacts are restricted to the area physically occupied by the plant, seeking to identify possible changes and interferences in terms of soil and use.	Medium
Water stress, resources, and quality	Characterisation and identification of areas of springs and catchments, through bibliographic research. The connection between the industry activity and the potential impact in the superficial and underground water.	High
Contamination of Soils, Water	Evaluation of possible environmental liabilities (level of soil and groundwater contamination), considering the previous activities in the project area implementation and surroundings	High
Waste Treatment / Management	The aim would be to identify any legal/or other constraints per region - Portugal versus Spain and assess possible final destinations for the waste produced	Medium
Noise	Noise analysis based on the available municipal noise maps, considering the national legislation, and verification of the existence of housing or other sensitive elements.	Medium
Air Quality	Air quality analysis based on the monitoring network data, for each location, and comparison with current legislation. Analysis of the potential impact considering the receptors location, and the cumulative effects with the other sources.	High
Socioeconomic	Demographic and economic analysis of the population in each one of the locations.	Medium
Public health	Framework of the region, through the Local Health Profile developed by the National Health System. Characterisation of each place in terms of health response (health units, health professionals available) and in terms of population vulnerability.	High

FACTOR	ANALYSIS	DEGREE OF IMPORTANCE
Archaeological and ethnological heritage	Identification of Protected patrimony, considering the bibliographic information.	Low
Risk Analysis	Analyse the vulnerability of the project's location, external risks - natural technological and mixed risks risk which can lead to accidents.	Medium
Permitting roadmap	Comparison of both countries in terms of permitting roadmap and potential constraints during the licensing process.	High

Table 1-1 - Environmental factors analysis and importance

1.1.2. Study Area

The environmental analysis considered a buffer of 1 km from the site location limits, provided for this study, taking into account the type of project and the characteristics of the surrounding areas.

The 1km radius was defined in order to include the closest population clusters or residential areas, the main potential accesses to be used, and external activity which may lead to cumulative impacts, when applicable. The study area was also defined assuming that the influence of the activity in the environment is mainly local in almost all the environmental factors. For air quality and noise, specific information about the process was necessary to be known to define a specific study domain, like number and type of sources, emissions and the refinery layout.

However, it should be noted that the 1km radius is only used as a guideline to assess the vulnerability and potential impacts and to allow a comparison between the 8 site locations. The evaluation boundary is not limited to this buffer and is defined according to the environmental factor and the importance of the collected information for each location, as it can be seen in the drawings and figures, which represent information inside and outside the 1km buffer.

1.2. GENERAL METHODOLOGY

The methodology adopted for this report was based on the following aspects:

1. Collection and analysis of the information relevant to the defined project areas, including:
   - GALP provided reference documentation (project documentation)
   - Publicly available reference documentation such as topographic and thematic cartography study
   - Municipal Master Plans for each site location, local regulations/policies
2. Internal meetings with the different members of the technical team from Golder, Primero, Quadrante and Galp
3. Cartography mapping for project framing and specific analysis in relevant areas, namely Land Use and Occupation, Habitats, Planning, Land Use Constraints, and Heritage
4. Site vulnerability assessment
5. Comparative analysis and development of a site selection ranking matrix

1.2.1. Study Exclusions

- Quadrante was unable to obtain the full suite of information for Vigo
- Site visits were excluded from the assessment

1.2.2. Assumptions

- The specific distance for each environmental factor has been selected based on the degree of risk for each factor, and the relative distance to identified risks. For generic factors (Land planning, geology, water resources) a buffer of 1km has been utilised. Each section will define the methodology used to measure distances.
- For the purpose of this study and in agreeance with GALP, we have assumed there will be no access to existing utilities on site. This will be confirmed during the following project phases. This assumption does not include the Sines site location.
- The impacts underlying the potential construction of wastewater treatment plants and facilities for waste storage and management will be the same for all eight sites. Therefore, the environmental assessment relies only on the operational phase. However, a qualitative analysis considering the work preparations is developed in order to assess the sites with low needs of preparation work before the project installation.

2. SITE LOCATION FRAMEWORK

2.1. LOCATION & LAND USE

2.1.1. Matosinhos

The project site is situated inside the Porto Refinery industrial area in Matosinhos, located in the North of Portugal. Matosinhos is a port and fishing town, with high tourism during the summer months due to the pristine beaches and cultural landmarks, with a cruise terminal located at the entrance to the port area. Situated inside Matosinhos are a large container port and fishing harbour, with the refinery, the only oil&gas company in the municipality, situated to the north of the Matosinhos central district.

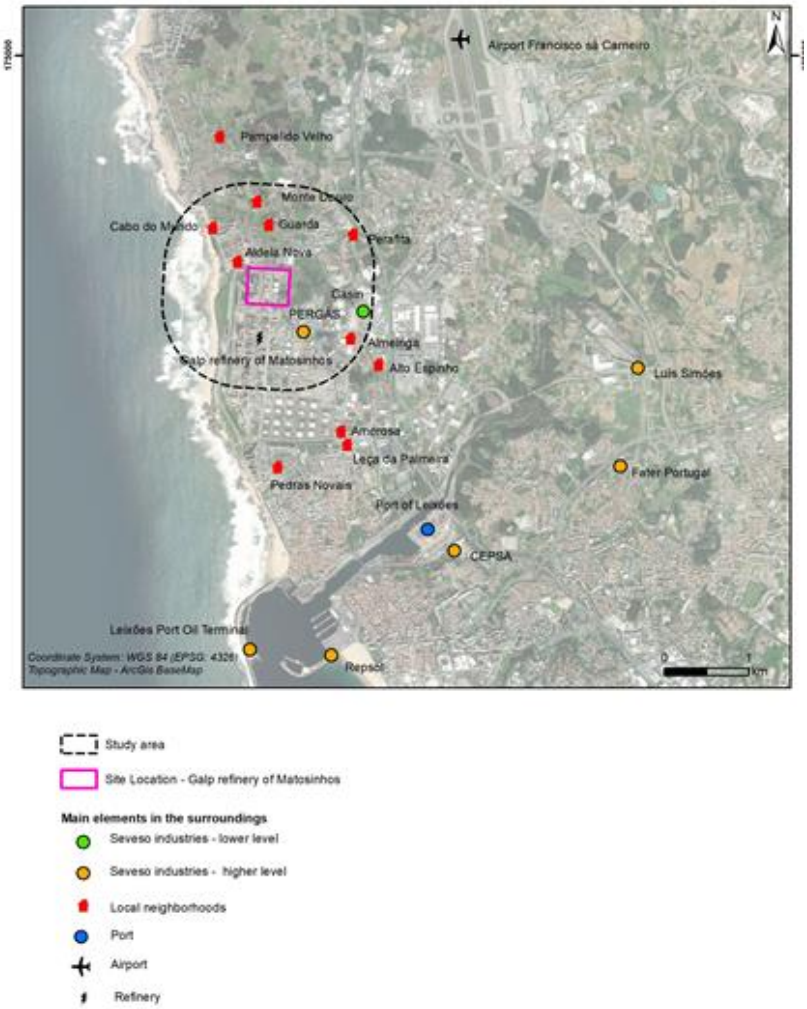


Figure 2-1 – Proposed site location in Matosinhos

The proposed project administrative location is presented in **Appendix A – Site Study Areas**.

The site under assessment is currently operating as a refinery; due to complete full decommissioning in 2025. For the purpose of this study, the site has been classified as a brownfield site.

The main access routes for the site location are highways A28, A4 and A41 . Locally, the refinery area is accessed from the Northeast by the Rua de Almeiriga, from the South by the Rua Belchior Robles, from the West by the Avenida da Liberdade and from the East by the Rua D. Marcos da Cruz.

The population clusters within the study area are Aldeia Nova, Guarda, Monte Douro, Perafita, Cabo do Mundo and Almeiriga. At further distances, but still in the site vicinity, there are important population clusters like Pampelido Velho, Amorosa, Pedras Novais, Leça da Palmeira, Alto Espinho and Perafita.

The surroundings of this site location include a diversity of infrastructures, including Seveso industries, namely the Gasin with a lower-level activity and Pergás with a higher-level activity. Further away is the Leixões Port Oil Terminal, Repsol, Cepsa, Fater Portugal and Luís Simões, all with higher-level activity.

Nearby the site location are numerous tourist locations, restaurants and other dining, hotels and key social amenities such as schools and hospitals. The region has an established arterial network for public transport and private road users.

The Francisco de Sá Carneiro Airport is located approximately 2,6 km northeast from the refinery site location, and the port infrastructure Porto-Leixões, approximately 3 km southeast.

Also, as the refinery is in the littoral zone of Matosinhos, the west vicinity is the coastal area – Caminha-Espinho, which includes the public maritime domain (Matosinhos, Paraíso and Aterro beaches).

2.1.1.1. Land use capacity

The **Figure 1.1 of Appendix B - Drawings** presents the Land Cover Map (2018 (COS) Level 4) prepared by the General Directorate of Territory (DGT).

Table 2-1 presents the soil occupation areas included in the site location of the proposed lithium refinery.

Level 1[3]	Level 4	Site Location	
		Area (ha)	%
1. Artificialised territory	1.2.1.1 Industry	20,9	99,4
5. Forest	5.1.2.1 Pinus Pinaster Forest	0,07	0,4
6.Bushes	6.1.1.1 Bushes	0,05	0,2

Table 2-1 – Soil Occupation in the Site Location – Matosinhos

According to the Portuguese Soil Map on the scale 1: 1 000 000 (SROA, 1971), the study area is located on Humic Cambisols (eruptive rocks) and Humic Cambisols (shale) associated with Luvissolos with a strong Atlantic influence (See **Figure 2.1 of Appendix B – Drawings**).

The Land Use Capacity Chart at scale 1:1 000 000 (Atlas of the Environment, 1982) is an interpretation of the Soils Map, in which soils are grouped according to their potential and limitations, that is, according to their capacity to support the crops most frequently cultivated (excluding shrubs and trees), without suffering deterioration due to wear and tear factors and depletion, through annual, perennial, forestry and wildlife crops.

As illustrated in Figure 2-2**,** the land use capacity classes at the study area are classified as Class **A** and with **Class F** in the south of the study area, however outside the project's implementation area. The relevant classes are briefly described as the following:

- Class A - areas of flat to gently undulating relief, deep soils, with high fertility, supporting intensive and polycultural cropping systems.

[3] Based on the "Nomenclatura da Carta de Uso e Ocupação do Solo de Portugal Continental – Dgterritório"

- Class F - areas with accentuated relief, with high erosion risks, thin or skeletal soils with low fertility and low productive capacity. Class F soils suggest a reasonable aptitude for forestry use and poor agricultural aptitude.

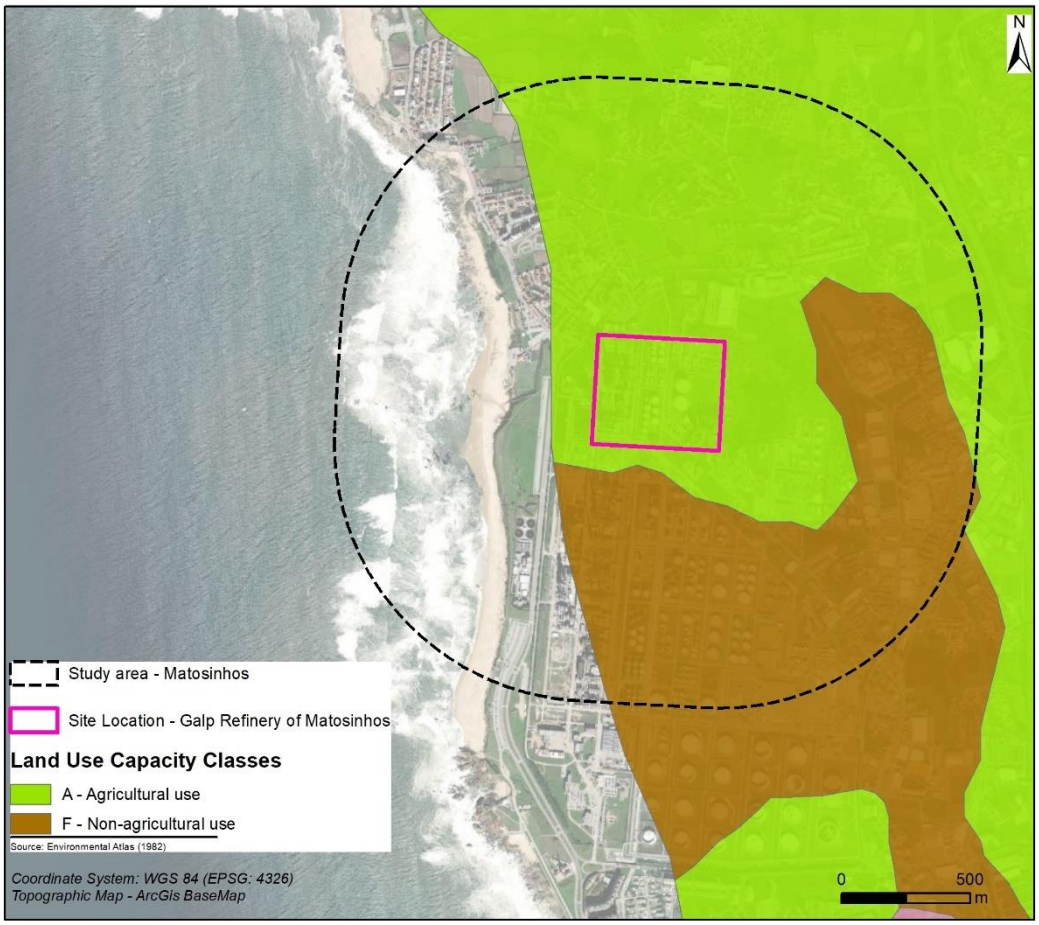


Figure 2-2 – Land Use Capacity in the Study Area – Matosinhos

2.1.2. Sines

The project site is located in the Sines Refinery industrial and logistics area in Sines, South of Portugal. The area is a heavily industrialised port location, with a small residential community situated on the coast to the west of the project implementation area. The surrounding landscape appears to be cleared land, in between small pockets of forest and bushland dotted in between the industrial sites.

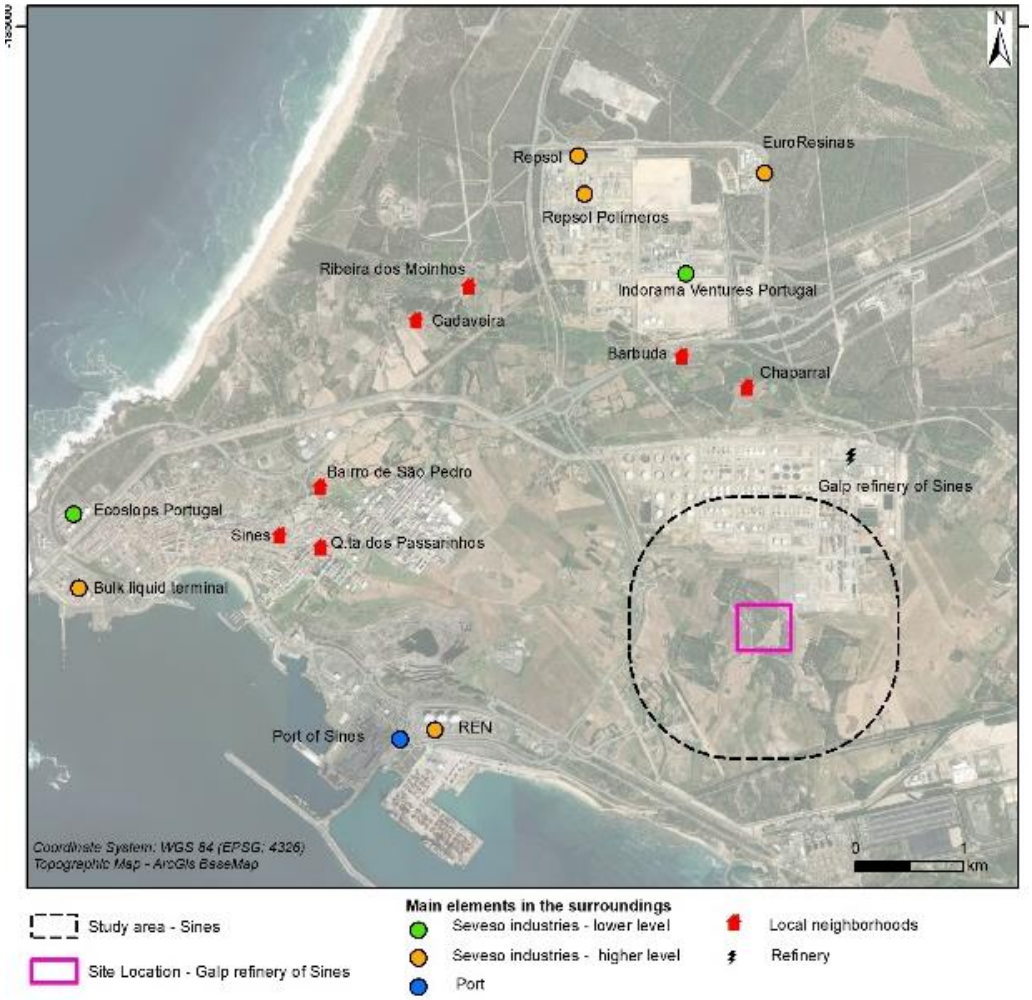


Figure 2-3 – Proposed site location in Sines

The proposed project administrative location is presented in **Appendix A – Site Study Areas**.

The existing refinery is accessed from the North by the A26, from the West by the IP8 and other municipality roads and is located in the nearshore zone of Sines.

The surroundings of this site location include diverse infrastructure, including Seveso industries, the Port of Sines and the already existing refinery. Surrounding the study area there are a few low and high-level Seveso industries, namely, Indorama Ventures Portugal and Ecoslops Portugal with low-level activity and the EuroResinas, Repsol, Repsol Polímeros, REN and bulk liquid terminal with a high-level activity.

The residential neighborhoods within a radius of 6 km of the proposed refinery are Chaparral, Barbuda, Cadaveira, Ribeira dos Moinhos, Bairro de São Pedro, Sines and Quinta dos Passarinhos.

The harbour infrastructure Port of Sines is located approximately 8 km southwest of the site location.

2.1.2.1. Land use capacity

The **Figure 1.2 of Appendix B - Drawings** presents the Land Cover Map (2018 (COS) Level 4) prepared by the General Directorate of Territory (DGT).

Table 2-2 presents the soil occupation areas included in the site location of the proposed lithium refinery.

Level 1[4]	**Level 4**	**Site location**	
		Area (ha)	**%**
1. Artificialized territory	1.3.1.2 Non-renewable energy production infrastructures	0,04	0,2
2.Agricultural	2.1.1.1 Dry and irrigated temporary crops	8,6	40,9
5. Forest	5.1.2.1 Pinus Pinaster Forest	7,9	37,6
5.Forest	5.1.2.2 Pinus Pinea Forest	4,4	20,8
5. Forest	5.1.1.5. Eucalyptus Forest	0,09	0,4

Table 2-2 – Soil occupation in the Site location - Sines

According to Portuguese Soil Map on the scale 1: 25 000 (DGADR), the study area is located on Podzolized Soils - Podzols (Non-Hydromorphic); Slightly unsaturated clayey soils; Solos Podzolizados – Podzóis; Incipient Soils - Psammitic regosols, Normal, not humid; Incipient Soils - Low Soils (Coluviosols); Hydromorphic Soils, Without Eluvial Horizon, Para-Regosols, from detrital arenaceous rocks; Lightly unsaturated clayey soils - Mediterranean, red or yellow soils, of non-calcareous, normal materials, from "rañas" or similar deposits; Litholic, non-humic, slightly unsaturated normal, coarse sandstone and Slightly unsaturated clayey soils. (See **Figure 2.2 of Appendix B – Drawings**). It should be noted that the site location is mostly occupied by incipient soils and hydromorphic soils.

The Land Use Capacity Chart at scale 1:25 000 (DGADR), as illustrated in Figure 2-4, classifies this site as a mixture of:

- Class C - areas with pronounced to severe limitations susceptible to low intensive agricultural uses, except in very special cases, and special cases, and with a very high risk of erosion;
- Class D – areas with severe limitations, not susceptible to agricultural use, except in very special cases and with a maximum high to very high erosion risks.

[4] Based on the “Nomenclatura da Carta de Uso e Ocupação do Solo de Portugal Continental – Dgterritório”

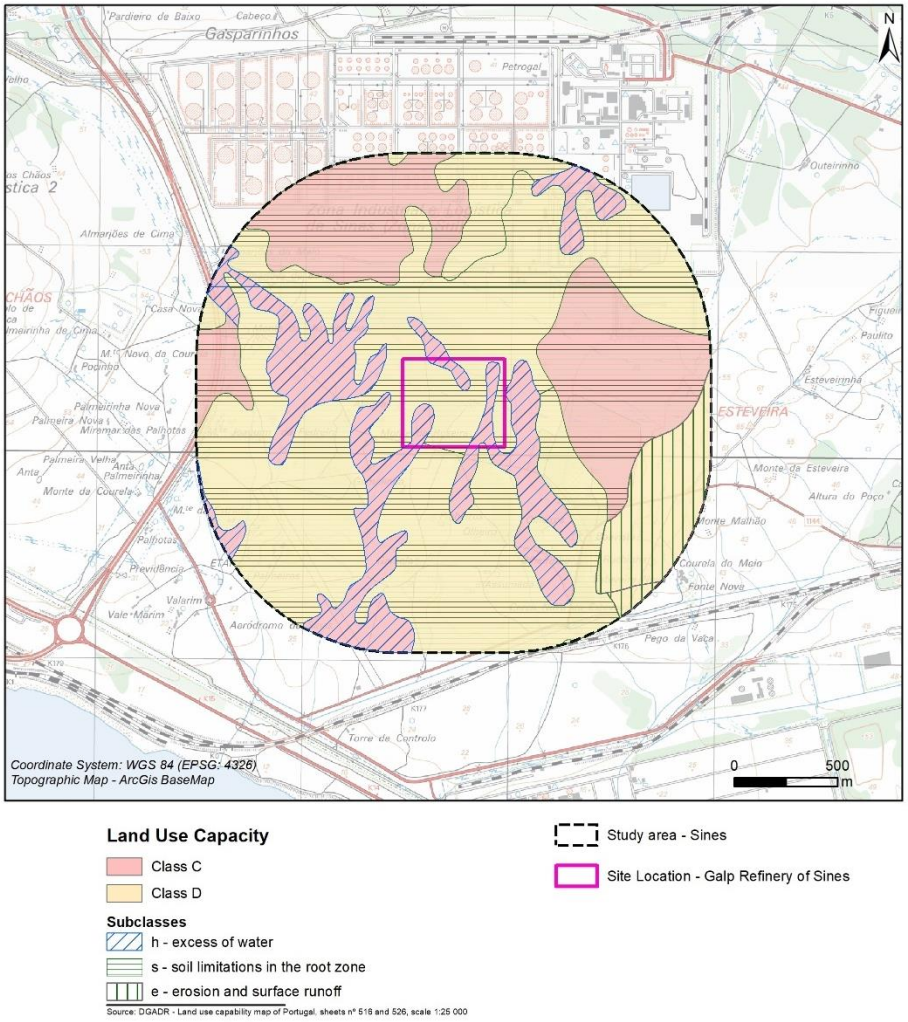


Figure 2-4 – Land Use Capacity in the Study Area – Sines

2.1.3. Estarreja

The project site is located within the Estarreja Eco Business Park. The park was inaugurated in 2009 and covers an area of 290 hectares. The Eco-Business Park provides a platform for infrastructure-structured, industrial, commercial, storage and services business activities while utilizing existing road, rail and port access.

The proposed project administrative location is presented in **Appendix A – Site Study Areas**.

The Ecopark is accessed from the North by the EN224, from the West by the Estrada de Pardilhó and from the East by the EN109 and the A1. The internal accessibility is assured by the Avenida Pacopar and the Avenida Cidade de Estarreja.

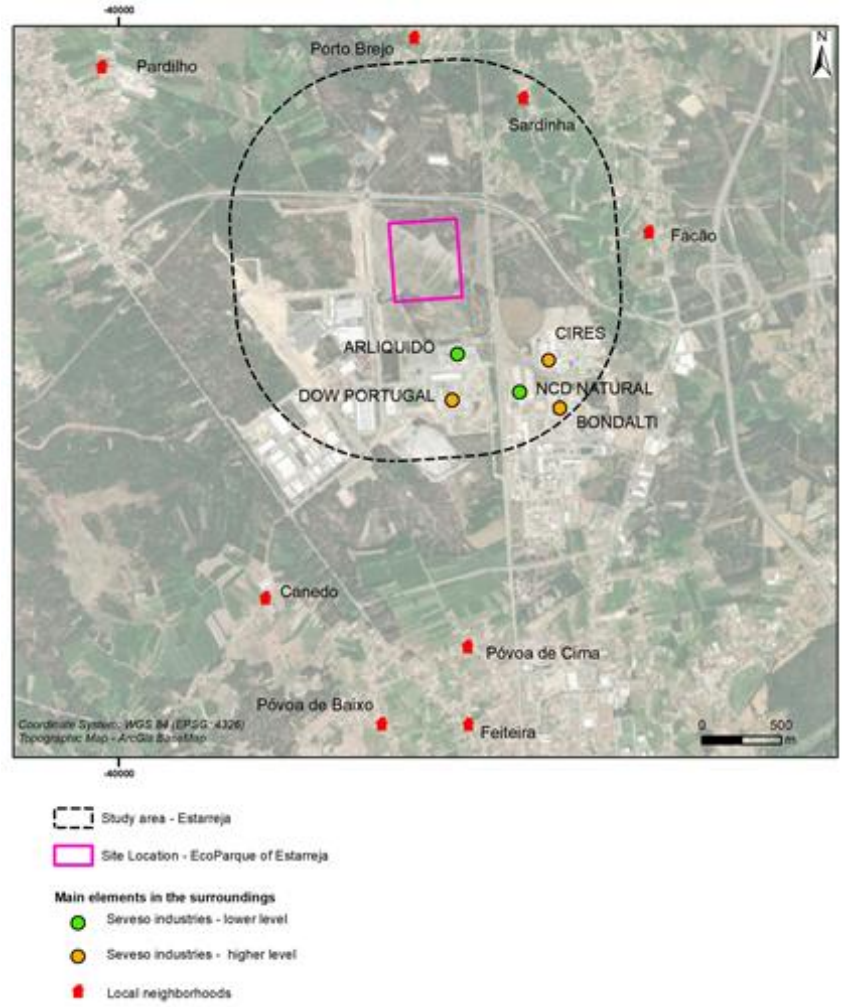


Figure 2-5 – Proposed site location in Estarreja

The surroundings of this site location include a diversity of infrastructures, including Seveso industries, which involves dangerous substances, and local neighbourhoods.

There is a population cluster inside the study area, namely Sardinha and seven in the surroundings of the study area, namely Pardilho and Porto Brejo (North), Facão (East), Póvoa de Cima, Póvoa de Baixo, Feiteira, Canedo (Southwest).

Within the identified study area are a set of Seveso industries, namely, Arliquide and NCD Natural, both with low-level activity and the DOW Portugal, Cires and Bondalti, all with a high-level activity.

2.1.3.1. Land use capacity

The **Figure 1.3 of Appendix B - Drawings** presents the Land Cover Map (2018 (COS) Level 4) prepared by the General Directorate of Territory (DGT).

Soil occupation areas within the site location of the proposed lithium refinery are presented in Table 2-3.

Level 1[5]	Level 4	Site Location	
		Area (ha)	%
5. Forest	5.1.1.5 Eucalyptus forests	21	100

Table 2-3 – Soil occupation in the Site Location - Estarreja

According to Portuguese Soil Map on the scale 1: 25 000 (DGADR), the study area is located on Incipient Soils; Podzolized Soils - Hydromorphic Podzols and Podzols and Hydromorphic Semi-Hierogeneous, Para-Aluviosols (or Para-Coluviosols), light-textured alluvial or colluvial soils as shown in **Figure 2.3 of Appendix B – Drawings.** It should be noted that the site location is mostly occupied by Podzolized Soils – Podzols Hydromorphic and Non-Hydromorphic.

The Land Use Capacity Chart at scale 1:25 000 (DGADR), as illustrated in Figure 2-6 classifies this site as:

- Class C - areas with pronounced to severe limitations susceptible to low intensive agricultural uses, except in very special cases, and special cases, and with a very high risk of erosion;

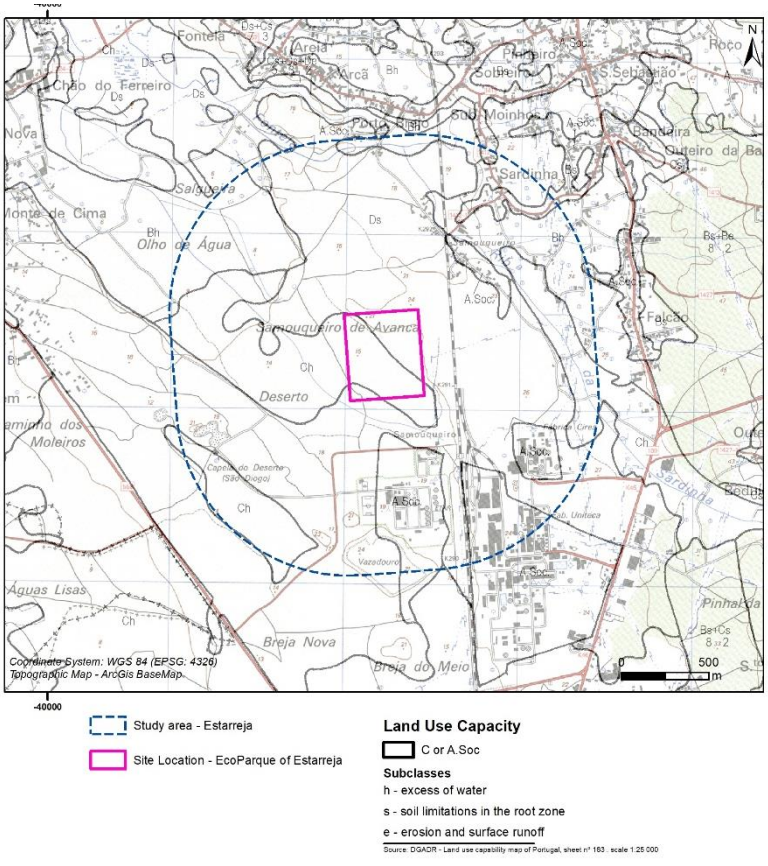


Figure 2-6 – Land Use Capacity in the Study Area - Estarreja

[5] Based on the "Nomenclatura da Carta de Uso e Ocupação do Solo de Portugal Continental – Dgterritório"

2.1.4. Vigo

The project site is located in the Plataforma Logística e Industrial Salvaterra - As Neves (PLISAN), at the Zona Franca Vigo. PLISAN is a specialized area with a concentration of freight logistics services, intermodal transport, industrial and business activities. The proposed project administrative location is presented in **Appendix A – Site Study Areas**.

The site is located 35 km from Vigo and is connected by the A-52 motorway with the Port of Vigo, the Atlantic Motorway by the AP-9 and the North of Portugal by the A-55. The site location is also accessed by a railway line.

Inside the study area the are some populations clusters like A Roda, A Lamela, O Covelo, Nogueiró, O Monte de Arriba, Barreiros, A Salgosa and A Vacaria. The population clusters of As Chans, Corzáns, Petán, Burguete and A Chan de Goia are found in the vicinity of the study area (Figure 2-7).

The Minho transboundary river runs on the south side of the PLISAN area, at a distance of 2 km.

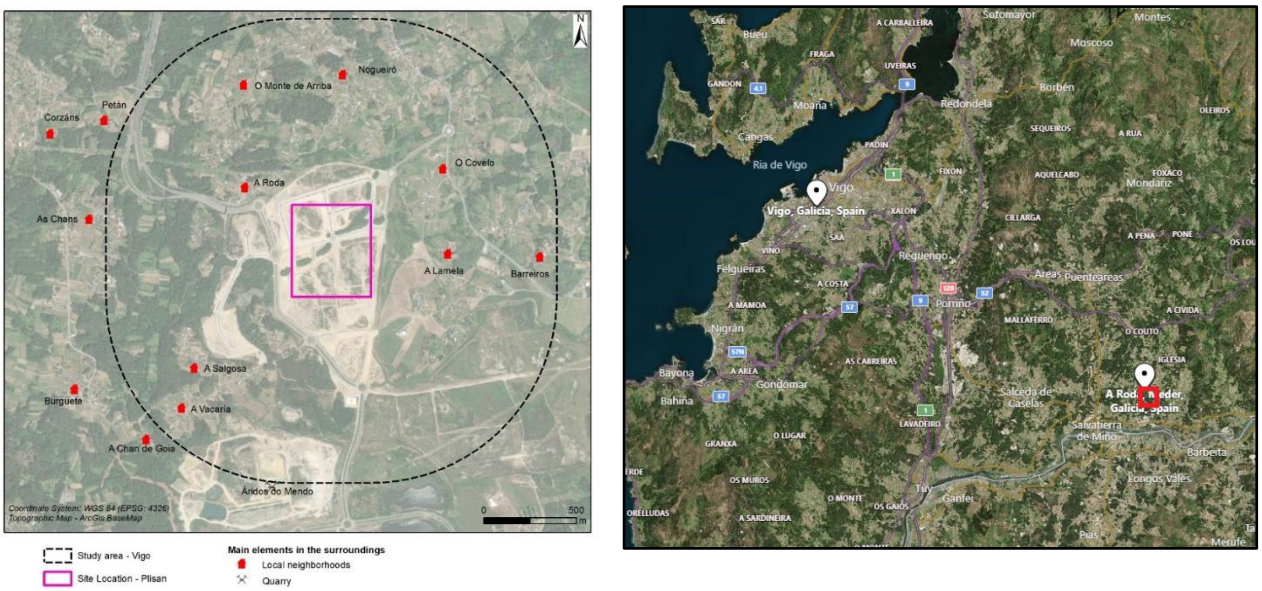


Figure 2-7 – Main elements in the surrounding of the study area - Vigo

Figure 1.4 of Appendix B - Drawings presents the Land Cover Map, produced based on Information System on Land Occupation in Spain (SIOSE 2014) prepared by the National Centre for Geographic Information.

The soil occupation areas in the surrounding areas are diverse and include forest trees (conifers), residential agricultural settlements, sports equipment's, forest trees (evergreen trees, evergreen hardwood), artificial water sheet, road network, artificial composite association (primary - extractive mining and urban mixed – hull); and regular mosaic (various land use classes). However, most of these soil occupation areas do not intercept with the refinery implementation area which is predominantly located in an artificial composite association of primary - extractive mining.

Table 2-4 presents the soil occupation areas included in the site location of the proposed lithium refinery.

SIOSE	HILUCS code	Site location	
		Area (ha)	%
Mining-extractive	Mining and quarrying	21	100

Table 2-4 – Soil occupation in the Site location - Vigo

2.1.5. Setúbal

The project site is situated inside the Sapec Bay Industrial Park area in Mitrena Peninsula, Setúbal, located in the south west of Portugal. Setúbal is a port and fishing town, with high tourism during the summer months due to the pristine beaches and cultural landmarks, with a boat terminal located at the entrance of the port area.

The proposed project administrative location is presented in **Appendix A – Site Study Areas**.

The assessment site has been classified as a greenfield site as there is no information that there has been any industrial activity in the past.

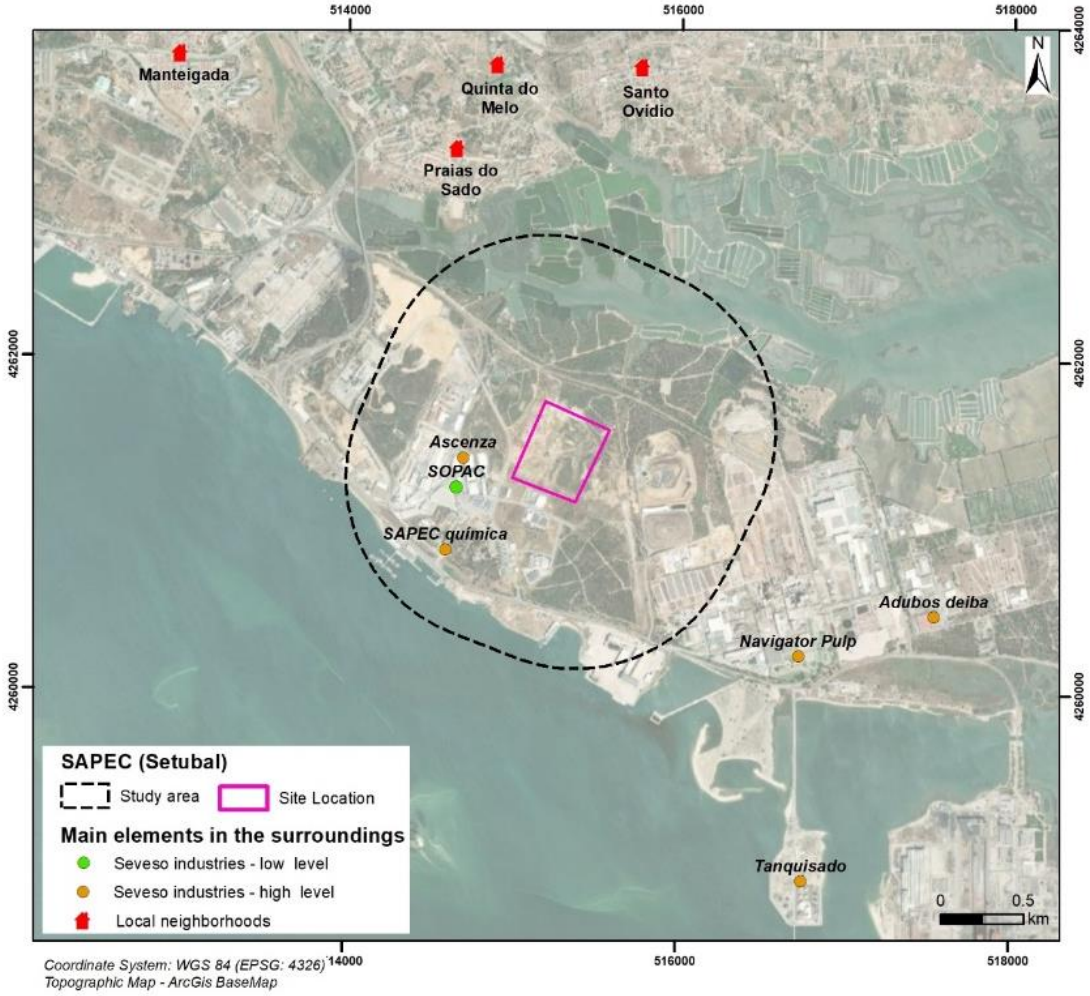


Figure 2-8 – Proposed site location in Setúbal

The only access route for the site location is the national EN10-4. Locally, the refinery area is accessed from the west by the Avenida do Rio Douro.

There are no population clusters within the study area, however within the site vicinity there are important population clusters like Manteigada, Quinta do Melo, Praias do Sado and Santo Ovídio.

The study area overlaps the Sado Estuary Nature Reserve, an area with high level of protection and biodiversity safeguard. However, the site boundaries will be outside this area, as showed in **Figure 4.5.2 of the Appendix B – Drawings.**

The surroundings of this site location include a diversity of infrastructures, including Seveso industries, namely SAPEC Quimica, Adubos Deiba, ASCENZA AGRO, Navigator (Pulp and Paper factory) and Tanquisado.These are classified as upper tier sites (with high quantities of dangerous substances stored). Additionally, Sopac - Sociedade Produtora de Adubos Compostos, a lower tier site, is located nearby.

Nearby the site location there are numerous touristic spots, restaurants, hotels and key cultural and social amenity such as museums, markets, schools and hospitals. The region has an established arterial network for public transport and private road users.

The Comporta's aerodrome is located approximately 11.7 km south east of the refinery site location, and the main port approximately 3.5 km north west. Additionally, some smaller port infrastructures are located within the study area.

The refinery is located in the littoral zone of Setúbal with the west vicinity being the coastal area of which includes the public maritime domain and the Tróia peninsula.

2.1.5.1. Land use capacity

The **Figure 1.5 of Appendix B - Drawings** presents the Land Cover Map (2018 (COS) Level 4) prepared by the General Directorate of Territory (DGT).

Table 2-5 presents the soil occupation areas included in the site assessment.

Level 1	Level 4	Site Location	
		Area (ha)	%
1. Artificialized territory	1.5.1.2 Quarries[6]	18.6	92
5. Forest	5.1.2.1 Pinus Pinaster Forest	0.3	1
5. Forest	5.1.1.5 Eucalyptus forests	0.1	1
6.Bushes	6.1.1.1 Bushes	1.2	6

Table 2-5 – Soil Occupation in the Site Location – Setúbal

According to the Portuguese Soil Map on the scale 1: 25 000 (DGADR), the study area is located on Podzolized Soils – Podzols; Halomorphic Soils; Incipient Soils; Litholic, non-humic, slightly unsaturated normal, coarse sandstone and social area as shown in **Figure 2.4 of Appendix B – Drawings.** It should be noted that the site location is mostly occupied by Litholic, non-humic, slightly unsaturated normal, coarse sandstone.

The Land Use Capacity Chart at scale 1:25 000 (DGADR) is an interpretation of the Soils Map, in which soils are grouped according to their potential and limitations, that is, according to their capacity to support the crops most frequently cultivated (excluding shrubs and trees) without suffering deterioration due to wear and tear factors and depletion, through annual, perennial, forestry and wildlife crops.

The Land Use Capacity Chart at scale 1:25 000 (DGADR), as illustrated in Figure 2-9, classifies this site as:

- Class D – areas with severe limitations, not susceptible to agricultural use, except in very special cases and with a maximum high to very high erosion risks.
- Class E – areas with very severe limitations and a very high risk of erosion. These areas are not susceptible to agricultural use and have severe to very severe limitations to grazing, bush clearing and

[6] See Section 3.6.5. for clarification on this soil occupation

forestry. These areas also include natural vegetation, protective or restorative forest services or areas not susceptible to any use.

The site location is, based on the land use capacity, fully occupied by class E which implies very severe limitations and a very high risk of erosion.

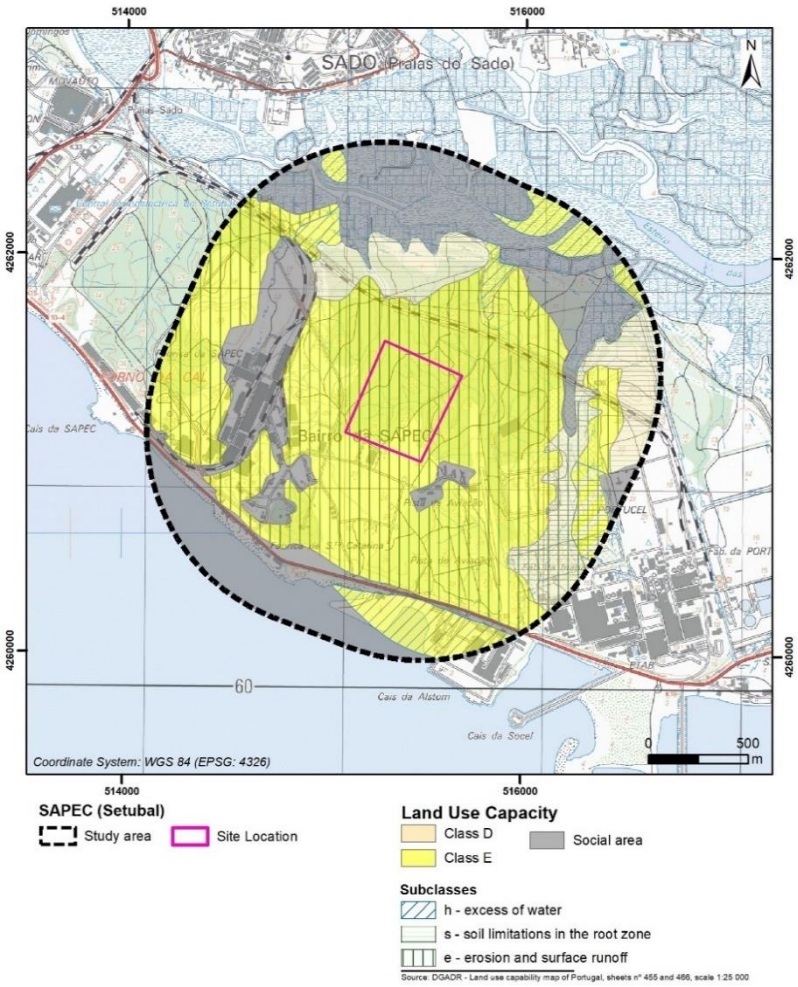


Figure 2-9 – Land Use Capacity in the Study Area - Setúbal

2.1.6. Valongo

The project site is situated inside the Campo industrial area in Valongo, located in the North of Portugal. The Valongo site location is on the south side of the municipality, close to the Paredes border and 4.4 km from the city center.

The proposed project administrative location is presented in **Appendix A – Site Study Areas**.

The population cluster within the study area is Recarei.

The main access routes for the site location are highways A41/IC 24 and N15. Locally, the refinery area is accessed from the North by the Rua do Alto da Mina, and Rua da Costa, and from the East by A41.

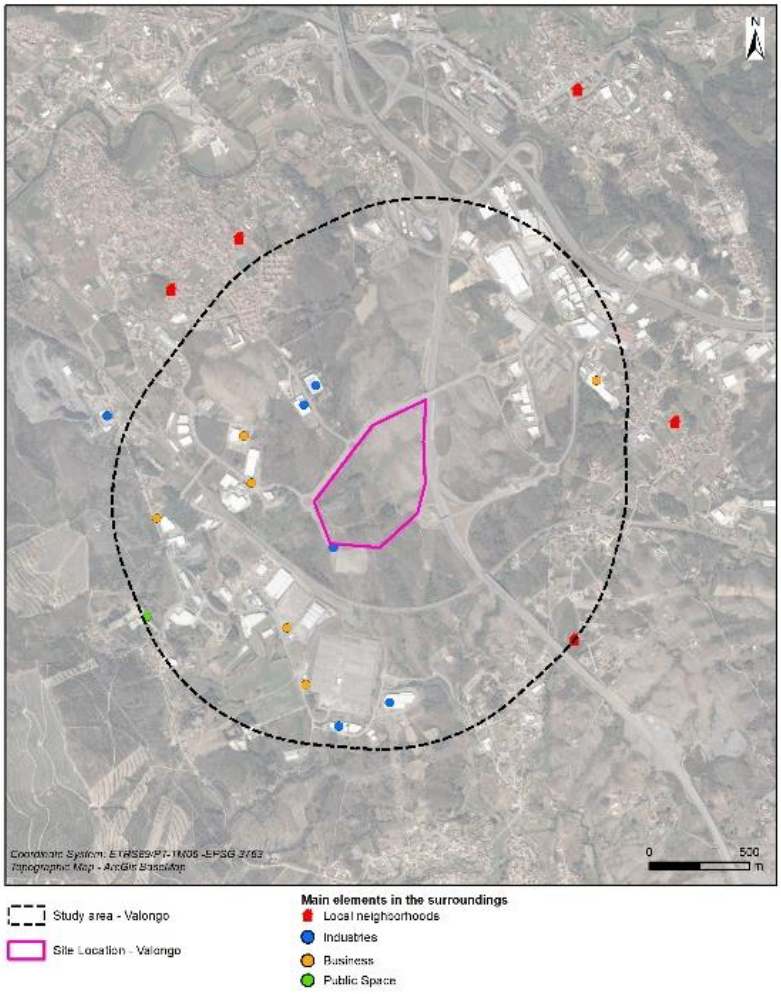


Figure 2-10 – Proposed site location in Valongo

The surroundings of this site location include a diversity of industries, business and logistics, namely SPC, Videira II, S Pintos and Soplast. However, none of these industries are identified as Seveso industries which minimise the risks related to hazardous industrial accidents.

Nearby the site location there is the Valongo equestrian centre, the São Martinho do campo stadium and a few motels and restaurants. The region has an established arterial network for public transport and private road users.

2.1.6.1. Land use capacity

The **Figure 1.6 of Appendix B - Drawings** presents the Land Cover Map (2018 (COS) Level 4) prepared by the General Directorate of Territory (DGT).

Table 2-6 presents the soil occupation areas included in the site assessment.

Level 1	Level 4	Site Location	
		Area (ha)	%
1.Artificialized land	1.4.1.1 Roads an easement	0.7	3
5.Forest	5.1.1.5 Eucalyptus forests	5.2	20

Level 1	Level 4	Site Location	
		Area (ha)	%
5.Forest	5.1.2.1 Pinus pinaster forests	0.7	3
6.Bushes	6.1.1.1 Bushes	19.1	74

Table 2-6 – Soil Occupation in the Site Location – Valongo

According to the Portuguese Soil Map on the scale 1: 25 000 (DGADR), the study area is located on shales and quartzites of Ordovician cambisols with strong Atlantic influence, as shown in **Figure 2.6 of Appendix B – Drawings.**

The Land Use Capacity Chart at scale 1:25 000 (DGADR) is an interpretation of the Soils Map, in which soils are grouped according to their potential and limitations, that is, according to their capacity to support the crops most frequently cultivated (excluding shrubs and trees) without suffering deterioration due to wear and tear factors and depletion, through annual, perennial, forestry and wildlife crops.

The Land Use Capacity Chart at scale 1:25 000 (DGADR), as illustrated in Figure 2-11, classifies this site as:

- Class A - areas of flat to gently undulating relief, deep soils, with high fertility, supporting intensive and polycultural cropping systems.
- Class F - areas with accentuated relief, with high erosion risks, thin or skeletal soils with low fertility and low productive capacity. Class F soils suggest a reasonable aptitude for forestry use and poor agricultural aptitude

The site location covers mainly non-agricultural land, making the project installation compatible with land use capacity.

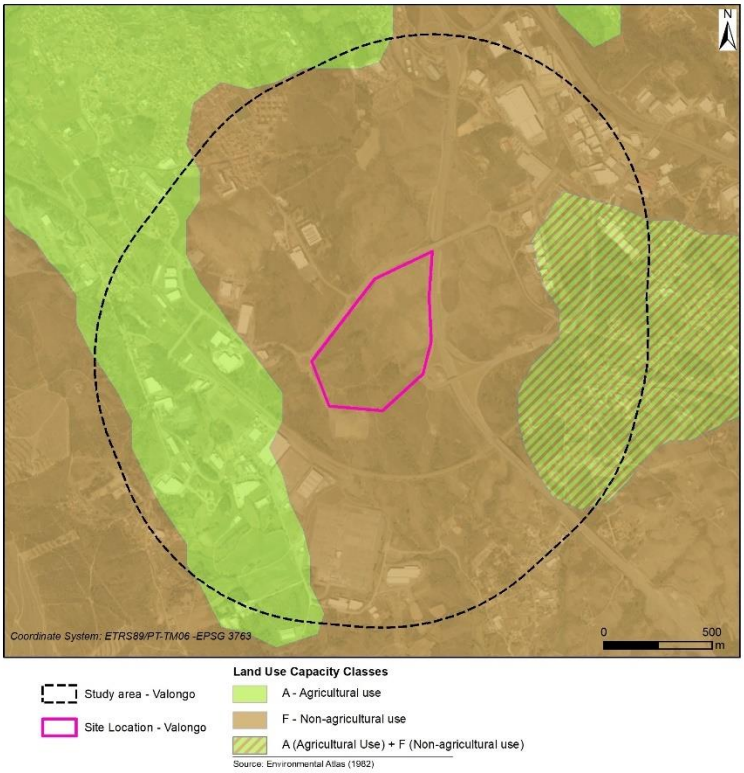


Figure 2-11 – Land Use Capacity in the Study Area – Valongo

2.1.7. Trofa

The project site is situated in the vicinity of the Abelheira Industrial Park, in Trofa, located in the North of Portugal. Trofa site location is in the northeast side of the municipality, close to Santo Tirso border and 3 km from the city center.

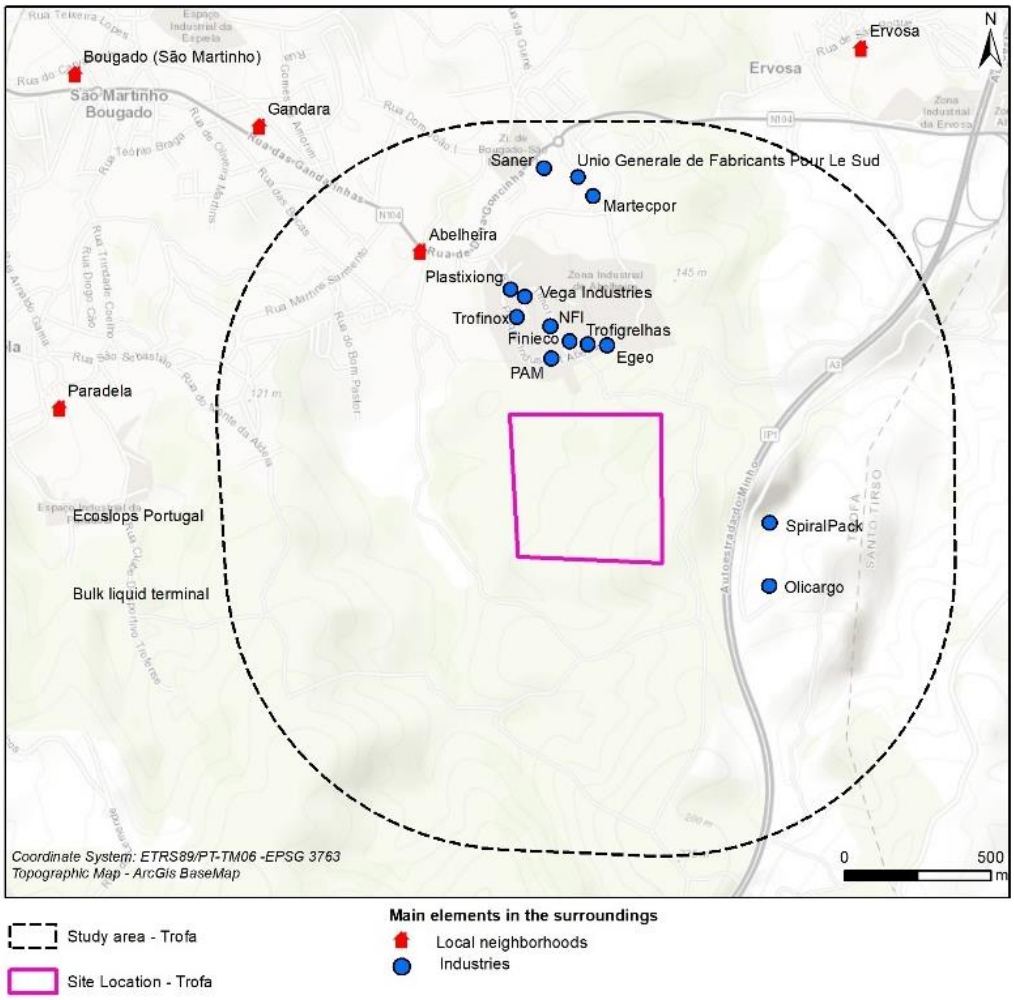


Figure 2-12 – Proposed site location in Trofa

The proposed project administrative location is presented in **Appendix A – Site Study Areas**.

The main access routes for the site location are EN104 and A3. Specifically, the refinery area is directly accessed from the East by highway A3. This highway allows a fast connection to Porto and Lisbon (going south) and Braga and Valença (going north).

The population clusters within the study area are Abelheira, Paradela, Gandara, Bougado (São Martinho) and Ervosa.

The surroundings of this site location include a diversity of industries, namely SpiralPack, Olicargo, Trofinox, PAM, Finieco, Trofigrelhas, NFI, Vega Industries, Plastixiong, Egeo, Saner, Martecpor and Union Generale De Fabricants Pour Le Sud, Unipessoal. However, none of these industries are identified as Seveso industries which minimise the risks related to hazardous industrial accidents.

Nearby the site location is one tourist location, such as Baloiço do Meco, with restaurants and other dining, motels and key social amenities such as sports facilities. The region has an established arterial network for public transport and private road users.

2.1.7.1. Land use capacity

The **Figure 1.7 of Appendix B - Drawings** presents the Land Cover Map (2018 (COS) Level 4) prepared by the General Directorate of Territory (DGT).

Table 2-7 presents the soil occupation areas included in the site location of the proposed lithium refinery.

Level 1[7]	Level 4	Site Location	
		Area (ha)	%
2.Agricultural	2.1.1.1 Dry and irrigated temporary crops	0.68	3
5. Forest	5.1.1.5 Eucalyptus forests	21.7	87
5. Forest	5.1.2.1 Pinus Pinaster Forest	2.5	10

Table 2-7 – Soil Occupation in the Site Location – Trofa

According to the Portuguese Soil Map on the scale 1: 1 000 000 (SROA, 1971), the study area is located on Humic Cambisols (eruptive rocks) and Humic Cambisols (shale) associated with Luvissolos with a strong Atlantic influence (See **Figure 2.7 of Appendix B – Drawings**).

The Land Use Capacity Chart at scale 1:1 000 000 (Atlas of the Environment, 1982) is an interpretation of the Soils Map, in which soils are grouped according to their potential and limitations, that is, according to their capacity to support the crops most frequently cultivated (excluding shrubs and trees), without suffering deterioration due to wear and tear factors and depletion, through annual, perennial, forestry and wildlife crops.

As illustrated in Figure 2-13**,** the land use capacity classes at the study area are classified as Class **A** and Class **F** in the south of the study area, however outside the project's implementation area. The relevant classes are briefly described as the following:

- Class A - areas of flat to gently undulating relief, deep soils, with high fertility, supporting intensive and polycultural cropping systems.
- Class F - areas with accentuated relief, with high erosion risks, thin or skeletal soils with low fertility and low productive capacity. Class F soils suggest a reasonable aptitude for forestry use and poor agricultural aptitude

The site location covers mainly non-agricultural land, making the project installation compatible with land use capacity.

[7] Based on the "Nomenclatura da Carta de Uso e Ocupação do Solo de Portugal Continental – Dgterritório"

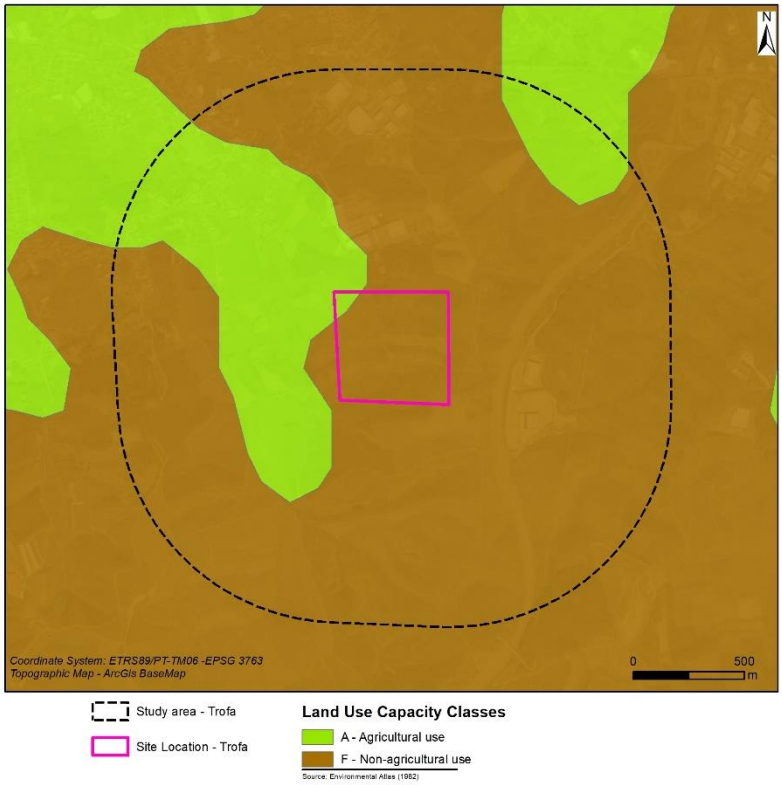


Figure 2-13 – Land Use Capacity in the Study Area – Trofa

2.1.8. Fafe

The project site is situated in the vicinity of the Sendim business/industrial area, in Fafe, located in the North of Portugal. Fafe site location is on the southeast side of the municipality, close to Felgueiras border and 7 km from the city centre.

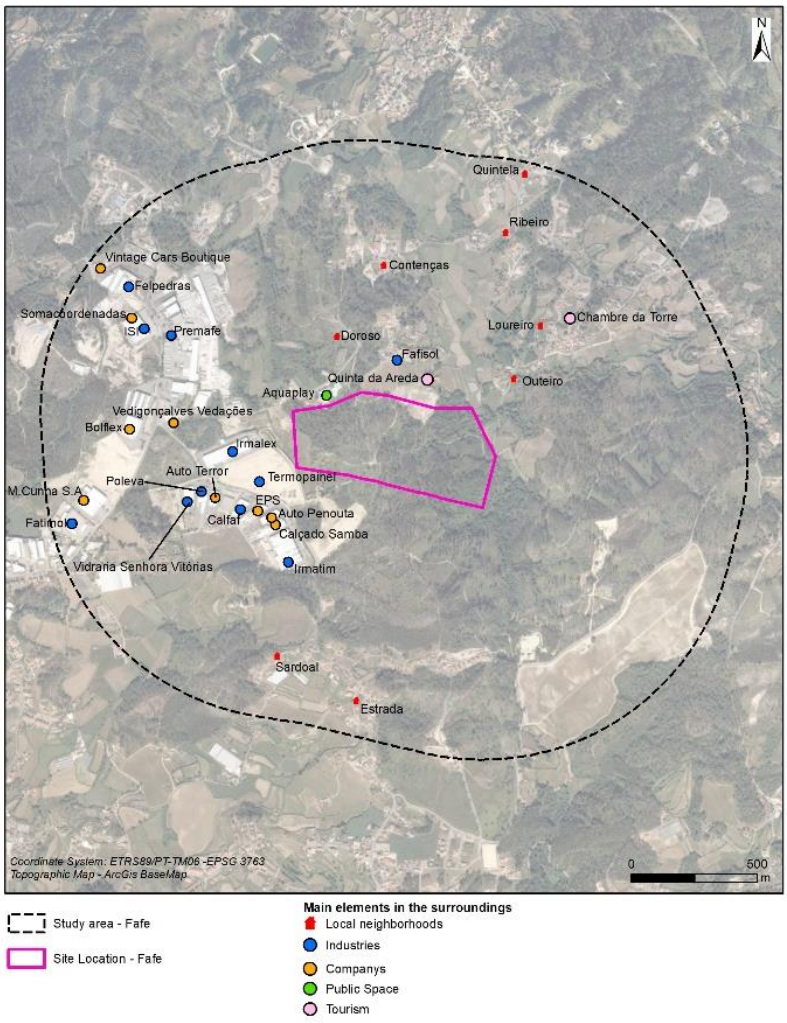


Figure 2-14 – Proposed site location in Fafe

The proposed project administrative location is presented in **Appendix A – Site Study Areas**.

The main access routes for the site location are EN207 and the municipal path CM 1687. Specifically, the refinery area is directly accessed from the West by highway EN207.

The population clusters within the study area are Doroso, Contenças, Ribeiro, Quintela, Loureiro, Outeiro, Sardoal and Estrada.

The surroundings of this site location include a diversity of industries and companies, namely Irmatim, Calçado Samba, Auto Penouta, EPS,Termopainel, Calfaf, Cidraria Vitórias, Termopainel, Irmalex, Poleva, M.Cunha S.A., Fatimol,Vedigonçalves, Bolflex, ISI, Premafe, Somacoordenadas, Felpedras, Fafisol and Vintage Cars Boutiques. However, none of these industries are identified as Seveso industries which minimises the risks related to hazardous industrial accidents.

Nearby the site location are two touristic locations, namely Quinta da Areda and Chambre da Torre, and a public pool (Aquaplay). The region has an established arterial network for public transport and private road users.

2.1.8.1. Land use capacity

The **Figure 1.8 of Appendix B - Drawings** presents the Land Cover Map (2018 (COS) Level 4) prepared by the General Directorate of Territory (DGT).

Table 2-8 presents the soil occupation areas included in the site location of the proposed lithium refinery.

Level 1[8]	Level 4	Site Location	
		Area (ha)	%
1. Artificialised territories	1.1.2.1 Discontinued urban tissue	0.6	0.3
2.Agricultural	2.1.1.1 Dry and irrigated temporary crops	1.4	5.7
2.Agricultural	2.2.1.1 Vineyards	0.9	4.0
5. Forest	5.1.1.3 Other oaks forests	3.6	14.6
5. Forest	5.1.1.5 Eucalyptus forests	16.8	67.3
5. Forest	5.1.2.1 Pinus Pinaster Forest	1.6	6.4
5. Forest	5.1.1.7 Other hardwood forests	0.4	1.8

Table 2-8 – Soil Occupation in the Site Location – Fafe

According to the Portuguese Soil Map on the scale 1: 1 000 000 (SROA, 1971), the study area is located on Humic Cambisols (eruptive rocks) (See **Figure 2.8 of Appendix B – Drawings**).

The Land Use Capacity Chart at scale 1:1 000 000 (Atlas of the Environment, 1982) is an interpretation of the Soils Map, in which soils are grouped according to their potential and limitations, that is, according to their capacity to support the crops most frequently cultivated (excluding shrubs and trees), without suffering deterioration due to wear and tear factors and depletion, through annual, perennial, forestry and wildlife crops.

As illustrated in Figure 2-15**,** the land use capacity classes at the study area are classified as Class **A** and Class **F** in the south of the study area, however outside the project's implementation area. The relevant classes are briefly described as the following:

- Class A - areas of flat to gently undulating relief, deep soils, with high fertility, supporting intensive and polycultural cropping systems.
- Class F - areas with accentuated relief, with high erosion risks, thin or skeletal soils with low fertility and low productive capacity. Class F soils suggest a reasonable aptitude for forestry use and poor agricultural aptitude.
- Class C - areas with pronounced to severe limitations susceptible to low intensive agricultural uses, except in very special cases, and special cases, and with a very high risk of erosion.

[8] Based on the "Nomenclatura da Carta de Uso e Ocupação do Solo de Portugal Continental – Dgterritório"

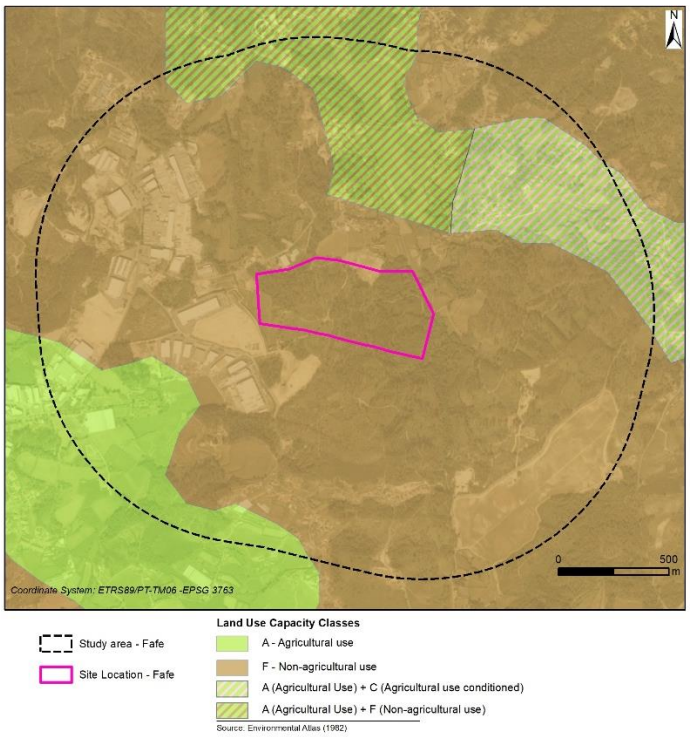


Figure 2-15 – Land Use Capacity in the Study Area –Fafe

2.2. LAND PLANNING

The spatial planning policy is based on a territorial management system, organized within a framework of coordinated interaction, in four distinct areas: national, regional, inter-municipal and municipal. The coordination of this interaction is brought about through a coherent and rational set of land use plans.

Analysis of each location focused on a holistic view considering the characteristics of the Project and the surrounding territory. Thus, the following points were considered:

- Land Management Plans with relevance to the Project, according to the intervention scope, namely, regional and municipal, focusing on the study area
- Constraints, administrative easements and public interest restrictions to land/use analysis

2.2.3. Matosinhos

2.2.3.1. Applicable Plans and programmes

Table 2-9 identifies the main spatial planning instruments in force in the area under study, including special, sectoral, regional and municipal plans. The following sections then present the planning instruments that are of higher priority for consideration to the project.

SCOPE	LAND-USE PLANS AND PROGRAMMES	LEGAL FRAMEWORK
National/ Sectorial	National Spatial Planning Policy Program (*PNPOT*)	Law n. º 58/2007, September 4 Rectification Statement nº. 80-A/2007, September 7 Rectification Statement nº 103-A/2007, November 2
Regional	Management Plan for the Cávado, Ave and Leça (HR2)	Resolution of the Ministers Council no.16-D/2013, March 22 Rectification Statement nº.22-B/2016, November 18
	Flood Risk Management Plan for the Cávado, Ave and Leça (HR2)	Resolution of the Ministers Council n. º 51/2016 Rectification Statement nº. 22-A/2016

SCOPE	LAND-USE PLANS AND PROGRAMMES	LEGAL FRAMEWORK
	Regional Program for Forest Management in between Douro and Minho (PROF-EDM)	Ministerial Normative nº 58/2019, February 11
	Management plan for the Caminha-Espinho coastaline (POOC)	Resolution of the Ministers Council n. º 25/99, April 7, with the following changes: Resolution of the Ministers Council no. 154/2007, October 2; Resolution of the Ministers Council no. 175/2008, November 24.
Municipal	Matosinhos Municipal Master Plan	Resolution of the Ministers Council nº, with the following changes: Notice nº 13198/2019, August 28
	Matosinhos municipal plan for forest defence against fires	Regulation n. º 762/2019

Table 2-9 – Spatial Plans and Programmes in force in the study area - Matosinhos

2.2.3.2. Regional Scope

2.2.3.2.1. Hydrographic Management Plan for the Cávado, Ave and Leça (HR2)

The study area is in the Cávado, Ave and Leça Hydrographic Region (**Figure 3.1 of the Appendix B – Drawings**).

The project under analysis is a lithium refinery which will be required to ensure wastewater treatment is to standard and in adherence to this plan to avoid underground and superficial water resources pollution. Considering the respect of the specific requirements there are no incompatibilities of the project with the hydrographic management plan.

2.2.3.2.2. Flood Risk Management Plan for the Cávado, Ave and Leça (HR2)

This plan is an instrument for water planning in areas of possible flooding and aims to reduce risk by reducing the potentially harmful consequences for human health, economic activities, cultural heritage, and the environment. The plan consists of a set of measures that have a strategic framework aimed to reduce the risks associated with floods, considering the time taken to implement the measure and the time available to carry it out until 2021.

The measures program is one of the most important parts of the Flood Risk Management Plan, defining the actions, technically and economically feasible, that allow reducing the risks associated with floods, in close articulation with the objectives and measures program defined in the Plan of Hydrographic Region Management.

The project's study and implementation area does not include floodable areas within urban areas, neither areas threatened by flooding as shown in Figure 2-16.

Figure 2-16 – Floodable Areas for Matosinhos Municipality

2.2.3.2.3. Regional Program for Forest Management in between Douro and Minho (PROF-EDM)

The Regional Plans for Forestry Planning (PROF) are defined by the National Forest Policy Basic Law (Law Nº 33/96, August 17) as "sectoral instruments for territorial management" that establish the rules for intervention on occupation and the use of forest spaces.

As sectoral instruments for territorial management, the plan is based on an interconnected approach of technical, economic, environmental, social and institutional aspects, involving economic agents and directly interested populations, to establish a consensual strategy for the management and use of forestry spaces.

Figure 2-17 illustrates that the project area is not within a forest protected area and will therefore not impact the project.

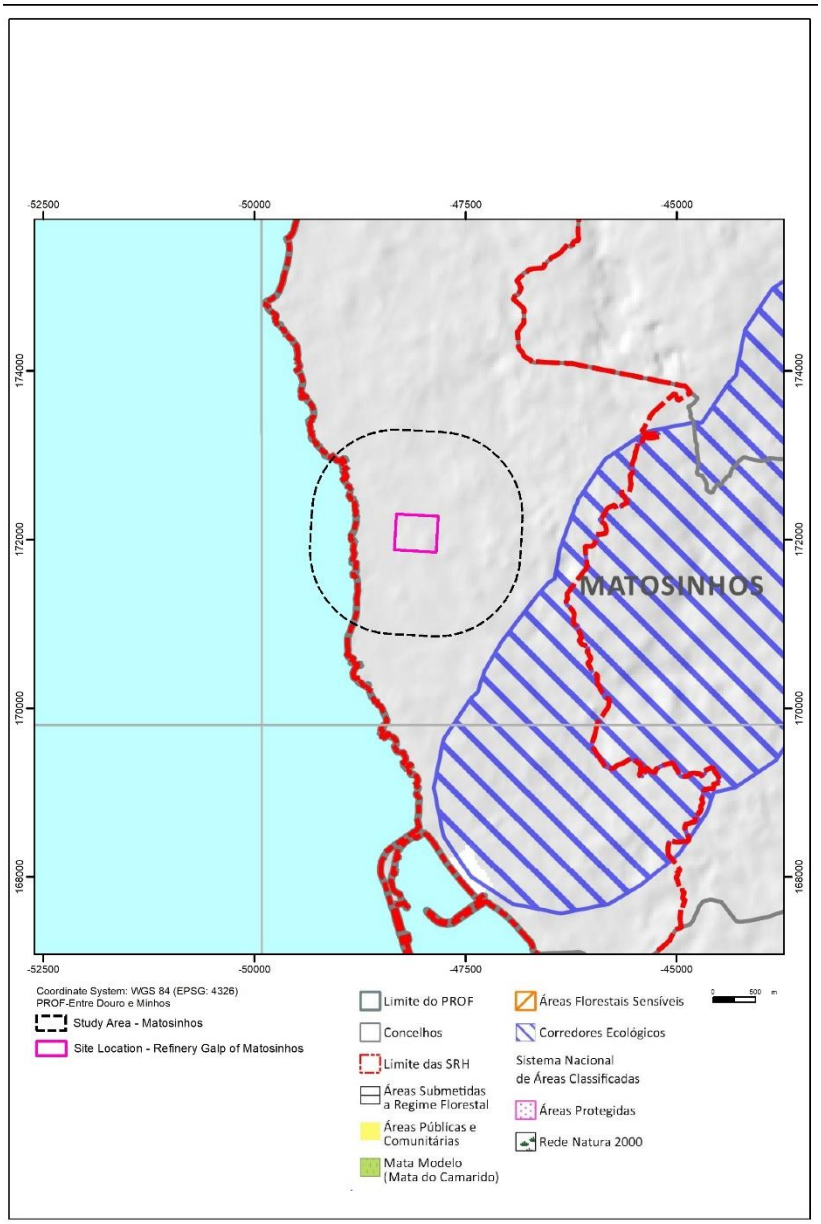


Figure 2-17 – Project framework in the PROF-EDM (Matosinhos)

2.2.3.2.4. Management plan for the Caminha-Espinho coastline (POOC)

The Management Plan for the Caminha-Espinho coastline (POOC) was approved by the Resolution of the Ministers Council n. º 25/99, on April 7 and its area of intervention includes the municipality of Matosinhos.

The POOC regulates the regimes for safeguarding natural resources and values through guidance and management standards alongside the "*strip of coastline known as the terrestrial protection zone, with a maximum width of 500 m counted from the limit of the sea waters to the land and a maritime protection zone up to the 30 m bathymetric line, except for areas under port jurisdiction*", following specific strategic objectives.

The project area 1 km buffer includes areas of low-density vegetation and bushes within the protected coastal area, operational units for planning and management of the coastline and urban equipment on the coastline. While the Matosinhos implementation area of the project does not overlap the protection zone, it is assumed that the project will be required to consider the future mitigation measures to be implemented during and after the implementation.

2.2.3.3. Municipal Scope

2.2.3.3.1. Municipal Master Plan

The study area is under the regulation of the Matosinhos Municipal Master Plan. Depending on the proposed dominant use, the Municipal Master Plan in question categorizes the study area considering the zoning map in the Spatial Planning Plan (**Figure 4.1.1 to 4.1.5 of the Appendix B – Drawings).** It should be noted that the spaces destined to industrial areas were fully considered to choose the site location.

Considering the location of the proposed refinery, namely in an area destined to comprise economic activities, the implementation complies with the municipal master plan as long as it adopts the necessary technical measures to avoid the increase of human and environmental risks. It is also necessary to have validation from the Matosinhos municipality.

2.2.3.3.2. Municipal Plan for Forest Defence against fires

Decree-Law nº 17/2009[9], January 14 structures the Forest Defence System against Fires, which provides a set of measures and actions for institutional articulation, planning and intervention related to prevention and protection of forests against fires. In **Figure 6.1 the Appendix B – Drawings** it is possible to observe the REN restrictions.

Municipal Plans for Forest Defence Against Fires (*PMDFCI*) at the municipal or inter-municipal level has the necessary actions for forest defines and, in addition to the prevention actions, including forecasting and the interventions by the different entities involved in a possible fire.

In the forest spaces defined in the plans, it is mandatory the entity responsible for "*the electrical energy distribution lines in very high voltage and high voltage provides the fuel management networks in a range corresponding to the vertical projection of the outer conductor cables plus a strip of a width not less than 10 m for each side "and" in medium tension (...) of a strip of a width not less than 7 m for each side* " (Article 15 of Decree-Law No. 124/2006 June 28, republished by Decree Law-17/2009, January 14).

Regarding the project's area, it is possible to observe that the fire danger index is not classified for the proposed areas and is mainly moderate in the surrounds of the project (Figure 2-18).

[9] Amends and republishes Decree-Law nº 124/2006, June 2 and whose fifth amendment by Law no. 76/2017, of 17 August, was rectified by Statement of Rectification No. 27/2017 of 2 October,

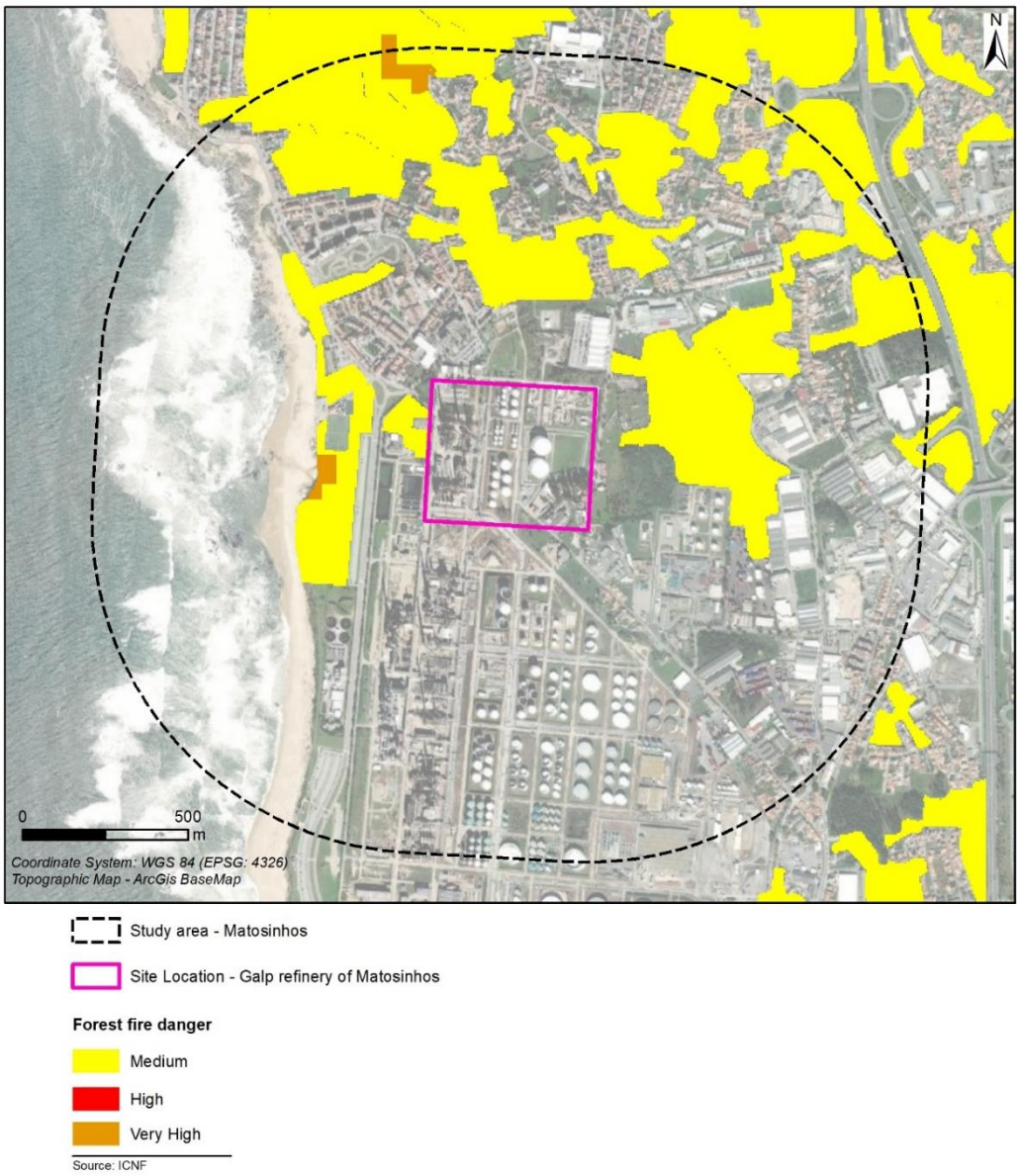


Figure 2-18 - Forest Fire Danger for Matosinhos Municipality

2.2.3.4. Constraints, administrative easements and public interest restrictions

Public easements and restrictions are limitations or impediments to any specific form of land use. The knowledge of these areas is essential to determine the limits of their use and to inform the proponent of the situations in which the change in land use in them requires consultation with specific competence entities, in addition to the municipality to which the area belongs.

In **Figures 5.1.1, 5.1.2 and 5.1.3 of Appendix B – Drawings** it is possible to observe the PMD restrictions.

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
National Ecological Reserve (REN)	Legal regime established by Decree-Law Nº. 166/2008, August 22, amended by Decree-Law Nº. 124/2019, August 28; Normative No. 419/2012, December 20, defines the conditions and requirements to which the uses and actions that are compatible with the objectives of the areas integrated in REN are subject to and the instructive elements of the administrative procedures provided for in the legal regime, as well as the uses and actions that need the authorization of the Portuguese Environment Agency, IP Constructive actions, hydraulic works, landfills, excavations, and destruction of vegetation cover are prohibited, with exceptions subject to authorization or prior communication from CCDR-Norte. Of the actions compatible with REN, the following is noted under the points of number II - Infrastructure of Annex II of Decree-Law No. 124/2019, August 28: • "e) Ampliation of existing edification of industrial use, energy and geologic resources." The Entrance 419/2012, for infrastructures regarding the e) point stated previously, establish that for strategic areas for infiltration, protection and recharge of aquifers, areas at high risk of soil erosion, adjacent areas are subject to prior notification. The compatibilities presented on Annex I from Decree-law 124/2019 are also applicable.	REN areas are intersected: Watercourses, coastal dunes, Beaches, Areas threatened by the sea No uses and actions will be made in this area.	It does not affect REN
National Agricultural Reserve (RAN)	Legal regime established by Decree-Law nº 73/2009, March 31st modified by Decree-Law n.º 199/2015, September 16th is a territorial management instrument, which consists of a restriction of public utility, by establishing a set of constraints on non-agricultural use of the soil, and which plays a key role in preserving the soil resource and its allocation to agriculture. "In RAN areas non-agricultural uses are exceptionally permitted when considered compatible with the goals of agricultural activity protection, subject to a binding prior opinion or prior notification to the territorially competent regional entity (ERRA)"	The study area does not affect RAN	The project area does not affect RAN
Public Water Domain (PWD)	Law nº 54/2005, November 11 (amended by Statement of Rectification nº 4/2006, January 16, and the latest amendment is given by Law nº. 31/2016, August 23), determines that an easement strip of 10 m from the edges of water lines must be respected and not occupied. If it is necessary to proceed with the occupation and use of the Public Water Domain, this action requires authorization / licensing from the Portuguese Environment Agency (APA).	Intersects water lines with little hydrological expression. No actions will be developed in the PWD.	It does not affect PWD

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
Geodesic Vertex	Decree-Law nº 143/82, April 26 (articles 19 and 25) The easement is established based on the construction of the landmarks, being defined protection zones around it, determined case by case, according to the visibility. The visibility must be ensured to the landmark and among the different signs, which will have at least a 15 meters radius. Construction actions in the area surrounding geodesic landmarks are subject to authorization by the Territorial General Directorate (DGT), and their visibility should not be compromised.	It does not include Geodesic Vertex	It does not include Geodesic Vertex
Cork Forest	The Legal Regime for the Protection of Cork oak and Holm Oak is provided for by the Decree-Law Nº 169/2001, May 25 (amended by Decree-Law nº. 155/2004, June 30). The cutting or grubbing up of cork and holm oaks depends on authorization from the ICNF (Nature and Forest Conservation Institute), under the risk that any change in land use will be prohibited for 25 years when areas occupied by cork and/or holm oak have been fire, unauthorized cutting or grubbing, abnormal mortality or depreciation.	It does not include cork forest	It does not include cork forest
Electric Network	The RSLEAT (Regulation for high voltage powerlines safety), approved by Regulation Decree nº1/92, 18 of February, defines protection easements for the electrical network. The article 28º of this legal document defines that: - Low and medium voltage lines have a protection strip of 15 meters (1.5 kV to 40 kV) and 25 meters (40kV to 60 kV) - High and Very High voltage lines have a protection strip of 45 meters An overall distance from obstacles is defined at 3.65 meters	The study area intersects electrical lines from the national distribution network in a small area to the southeast. No constructions or modifications will be done in this area.	It does not include electrical lines
Road Network	According to the article 32° of National Road Network Statute: Non-edificandi strips are established on municipal roads, measured at the axis of the road or the limit of the road or path zone, as follows: "8 - After the publication of the act declaring the public utility of the property and the respective parcel plan, the non-edificandi easement areas for new roads, as well as for existing roads, have the following limits (a) Motorways and expressways: 50 m to each side of the axis of the road and never less than 20 m from the road area b) IP: 50 m on each side of the road axis or within the visibility easement and never less than 20 m from the road	The study area intersects the following routes and their administrative burdens: • National Road IC1/A28 • Municipal Roads No constructions or modifications will be done in this area.	The refinery implementation area does not intercept the administrative burdens national roads or municipal roads.

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
	c) IC: 35 m on either side of the road centreline or within the right-of-way and in no case less than 15 m from the road d) EN and other roads to which this Statute applies: 20 m on either side of the centreline of the road or within the visibility right-of-way and in any case not less than 5 m from the road e) Connection nodes: a circle with a 150 m radius centred on the intersection of the road axes, irrespective of their classification. 9 - For the purposes of the previous number, connections to IP and IC intersections are considered as EN.”		

Table 2-10 – Regulations and constraints - Matosinhos

2.2.4. Sines

2.2.4.1. Applicable Plans and programmes

Table 2-11 identifies the main spatial planning instruments in force in the area under study, including special, sectoral, regional, and municipal plans.

SCOPE	LAND-USE PLANS AND PROGRAMMES	LEGAL FRAMEWORK
Nacional/ Sectorial	National Spatial Planning Policy Program (*PNPOT*)	Law n. º 58/2007, September 4 Rectification Statement n. º 80-A/2007, September 7 Rectification Statement n. º 103-A/2007, November 2
	Urbanisation Plan for the Industrial and Logistics Zone of Sines (PU ZILS)	Public Notice n.º 1090/2008 Notice n.º 4700/2021
Regional	Management Plan for the Sado and Mira (HR6)	Resolution of the Ministers Council no.52/2016, September 20 Rectification Statement nº.22-B/2016, November 18
	Flood Risk Management Plan for Sado and Mira (HR6)	Resolution of the Ministers Council n.º 51/2016
	Regional Program for Forest Management in Alentejo (PROF-ALT)	Order n.º 54/2019, February 11
	Management plan for the Sines-Burgau (POOC)	Resolution of the Ministers Council n. º 152/98, December 12, with the following change: Resolution of the Ministers Council n. º 92/2012, November 9
	Management Plan for the Southwest Alentejo and Vicentine Coast Natural Park (POPNSACV)	Implementation Decree n.º 33/95, December 11, with the following changes: Implementation Decree n.º 9/99, June 15 Resolution of the Ministers Council n. º 19/2008, February 4 Resolution of the Ministers Council n. º 13/2010, February 9
Municipal	Sines Municipal Master Plan	Order n.º 623/90, August 4, with the following changes: Deliberation n.º 2436/2007, December 19 Notice n.º 8219/2017, July 20
	Sines Intermunicipal plan for forest defence against fires	Notice n.º 1525/2020, January 29

Table 2-11 – Spatial Plans and Programmes in force in the study area - Sines

2.2.4.2. Sectorial Scope

2.2.4.2.1. Urbanisation Plan for the Industrial and Logistics Zone of Sines (UP -ZILS)

The Urbanisation Plan structure the occupation of land and its use, providing the reference framework for the application of urban policies and defining the location of the main infrastructures and collective facilities.

The Urbanisation Plan for the Industrial and Logistics Zone of Sines aims to:

- Coordinate industrial growth
- Balancing the responsibilities
- Establish norms for the use and allocation of the soil
- Establish guidelines for the framing of industrial and logistics areas and their infrastructures
- Anticipate the review of ZILS de Sines routes before the conclusion of the PDM review, given the need for changes

- Based on the zoning map of this urbanisation plan[10], the site location for Sines is inside three different categories of land use namely, the tertiary ecological structure (EET), the industrial and energy production area, and the logistics area.

According to the Artº 20 of UP-ZILS, the "*2- Industrial and energy production facilities which could damage the logistics platform are not permitted and should be located elsewhere within the ZILS*."

Also, inside the EET zones "*3- (…) under the terms of the legislation in force, infrastructures may be installed as long as they do not harm the visual compartmentalisation of the landscape".*

In this sense, there are some incompatibilities related to the site proposed for Sines. It will be necessary to request a disclaimer agreement with the ZILS to build the lithium refinery in the proposed site location.

2.2.4.3. Regional Scope

2.2.4.3.1. Hydrographic Management Plan for Sado and Mira (HR6)

Hydrographic Region Management Plans (*PGRH*) constitute the planning and conditioning instrument at the water resources level and aim the management, protection, and environmental, social, and economic valuation of water resources, at the hydrographic basins integrated level. The Resolution of the Ministers Council nº 52/2016 September 20 approved the Hydrographic Region Plans for the Portugal Mainland for the period 2016-2021. The study area is in the Sado and Mira Hydrographic Region **(Figure 3.2 of Appendix B – Drawings).**

The project under analysis is a lithium refinery which will necessarily include wastewater treatment to avoid underground and superficial water resources pollution. Considering the respect of the specific requirements there are no incompatibilities of the project with the hydrographic management plan.

2.2.4.3.2. Flood Risk Management Plan for Sado and Mira (HR6)

This plan is an instrument for water planning in areas of possible flooding and aims to reduce risk by reducing the potentially harmful consequences for human health, economic activities, cultural heritage, and the environment. The plan consists of a set of measures that have a strategic framework with the aim to reduce the risks associated with floods, considering the time taken to implement the measure and the time available to carry it out until 2021.

The measures program is one of the most important parts of the Flood Risk Management Plan, defining the actions, technically and economically feasible, that allow reducing the risks associated with floods, in close articulation with the objectives and measures program defined in the Plan of Hydrographic Region Management. Three types of measures are used - prevention, protection, and preparation – to reduce the adverse consequences of floods.

The implementation area does not include areas threatened by flooding or by the sea as shown in Figure 2-19.

[10] https://www.sines.pt/pages/652

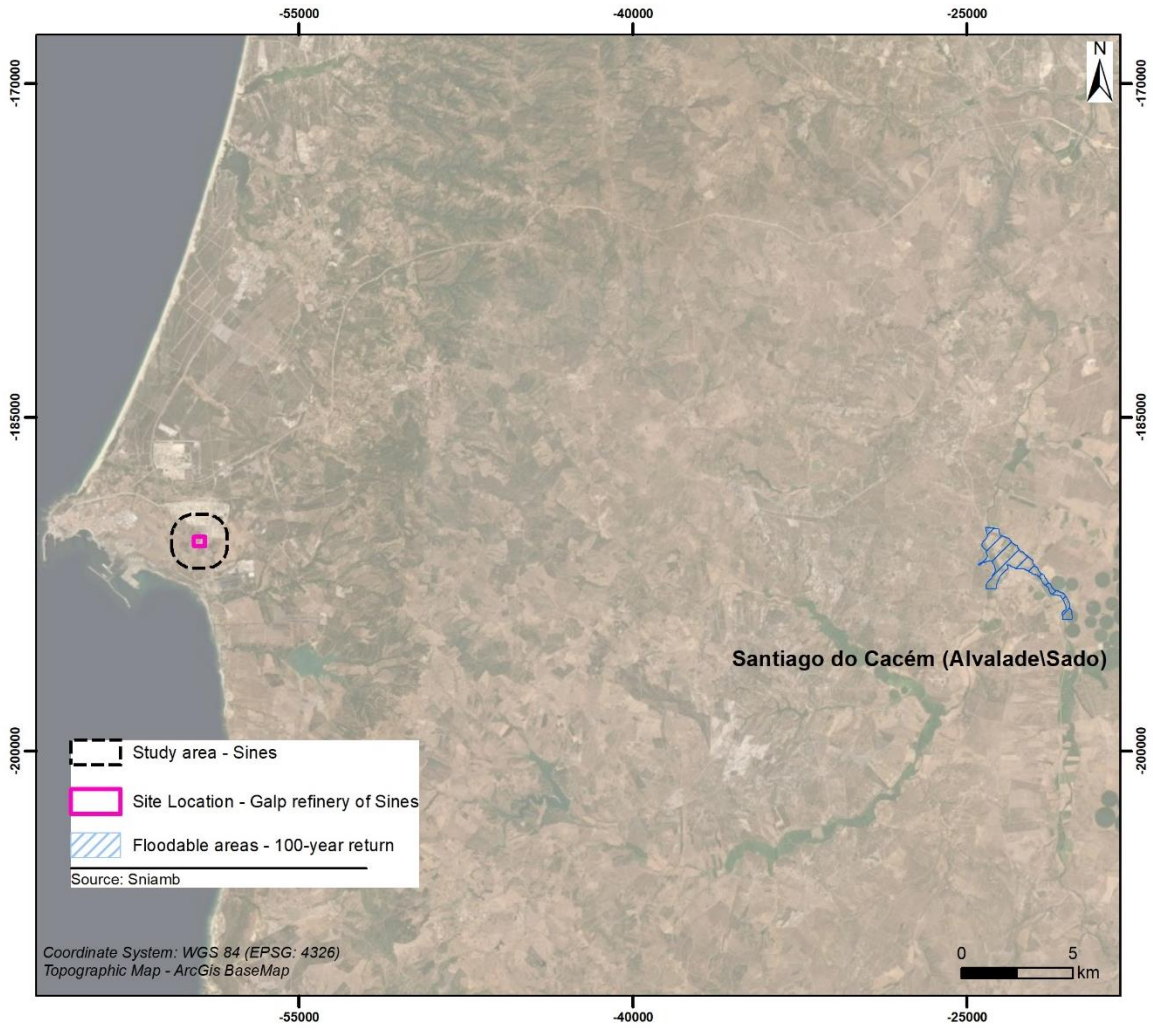


Figure 2-19 – Floodable areas for Sines Municipality

2.2.4.3.3. Regional Program For Forest Management For Alentejo (PROF-ALT)

The Regional Plans for Forestry Planning (PROF) are defined by the National Forest Policy Basic Law (Law Nº 33/96, August 17) as "sectoral instruments for territorial management" that establish the rules for intervention on occupation and the use of forest spaces.

As sectoral instruments for territorial management, the plan is based on an interconnected approach of technical, economic, environmental, social, and institutional aspects, involving economic agents and directly interested populations, to establish a consensual strategy for the management and use of forestry spaces.

Figure 2-20 illustrates the project area, which is not within a forest protected area and will therefore not impact the project.

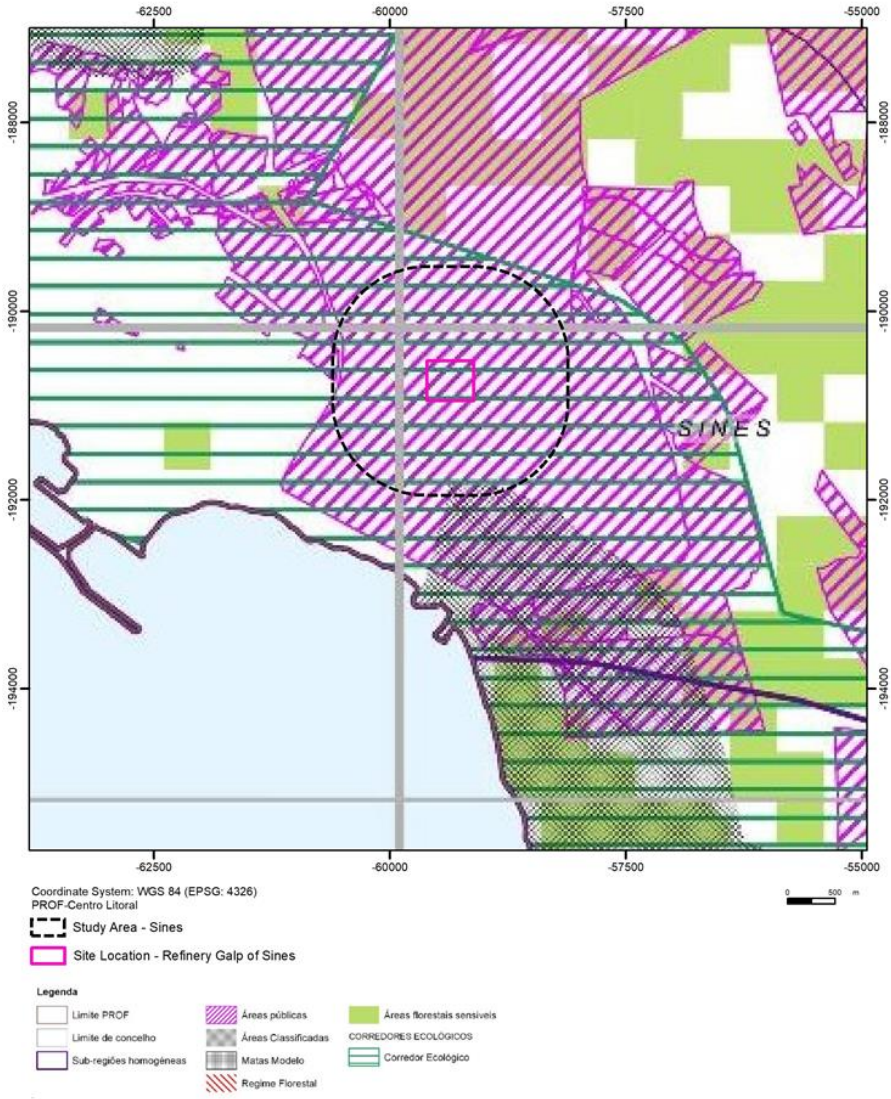


Figure 2-20 – Project framework in the PROF-Alentejo (Sines)

2.2.4.3.4. Management plan for the Sado and Sines and the Sines and Burgau (POOC)

The Management Plan for the Sado and Sines coastline (POOC) was approved by the Resolution of the Ministers Council n. º 136/99, October 29 and the Management Plan for the Sines and Burgau coastline (POOC) was approved by the Resolution of the Ministers Council n. º 152/98, December 30, where the area of intervention includes the municipality of Sines.

The POOC regulates the regimes for safeguarding natural resources and values through guidance and management standards alongside the "*strip of coastline known as the terrestrial protection zone, with a maximum width of 500 m counted from the limit of the sea waters to the land and a maritime protection zone up to the 30 m bathymetric line, except for areas under port jurisdiction*".

As the implementation area of the project does not include this area it is assumed that the project is compatible with this plan.

2.2.4.3.5. Management Plan for the Southwest Alentejo and Vicentine Coast Natural Park (POPNSACV)

The POPNSACV was approved by the Implementation Decree no. 33/95, of December 11, aiming at adequate management that ensures the safeguarding of natural resources, the promotion of sustainable development and quality of life of the populations.

As the implementation area of the project does not include this area it is assumed that the project is compatible with this plan.

2.2.4.4. Municipal Scope

2.2.4.4.1. Municipal Master Plan

The guidelines mentioned on the hierarchically superior plans must be taken into consideration at the municipal level, and it is the responsibility of the municipalities to establish these guidelines into the respective Municipal Master Plan. The study area is under the regulation of the Sines Municipal Master Plan. Depending on the proposed dominant use, the Municipal Master Plan in question categorizes the study area as mapped in the Spatial Planning Plan (**Figure 4.2.1 and 4.2.2 of the Appendix B – Drawings).**

Considering the location of the project area, namely in an area destined for Urban settlements which does not include industries, it leads to the conclusion that the site location does not comply with Municipal Master Plan.

Similarly, to what happens in the UP-ZILS (2.2.2.4.3), it will be necessary to contact the municipality, to ask for a change to the municipal master plan, regarding a disclaimer agreement that legally allows the implementation of the lithium refinery in the proposed site location. This process has some associated risks, namely, the delay of the construction licence, or even the denial of authorization to change the PDM.

2.2.4.4.2. Intermunicipal Plan for Forest Defence against fires

Decree-Law nº 17/2009[11], January 14 structures the Forest Defence System against Fires, which provides a set of measures and actions for institutional articulation, planning and intervention related to prevention and protection of forests against fires. In **Figure 6.2 the Appendix B – Drawings** it is possible to observe the REN restrictions.

Municipal Plans for Forest Defence Against Fires (*PMDFCI*) at the municipal or inter-municipal level has the necessary actions for forest defines and, in addition to the prevention actions, including forecasting and the interventions by the different entities involved in a possible fire.

In the forest spaces defined in the plans, it is mandatory the entity responsible for "*the electrical energy distribution lines in very high voltage and high voltage provides the fuel management networks in a range corresponding to the vertical projection of the outer conductor cables plus a strip of a width not less than 10 m for each side "and" in medium tension (...) of a strip of a width not less than 7 m for each side* " (Article 15 of Decree-Law No. 124/2006 June 28, republished by Decree Law-17/2009, January 14).

Regarding the project's area, it is possible to observe that the fire danger index is mainly low and moderate in the surrounds of the project, with three small areas classified with high forest fire danger in the northwest corner and the southeast corner of the project site location (Figure 2-21).

[11] amends and republishes Decree-Law nº 124/2006, June 2 and whose fifth amendment by Law no. 76/2017, of 17 August, was rectified by Statement of Rectification No. 27/2017 of 2 October,

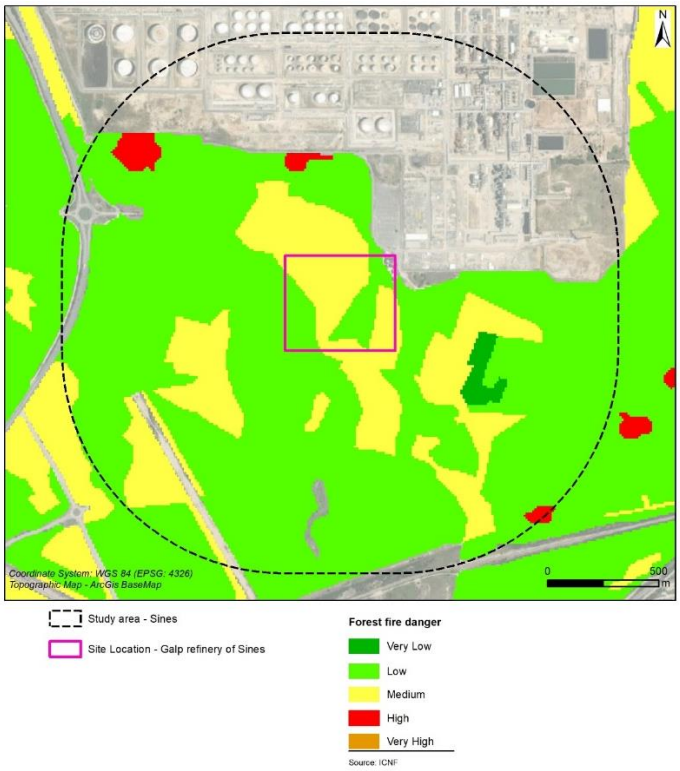


Figure 2-21 - Forest Fire Danger for Sines Municipality

2.2.4.5. Constraints, administrative easements and public interest restrictions

Public easements and restrictions are limitations or impediments to any specific form of land use. The knowledge of these areas is essential to determine the limits of their use and to inform the proponent of the situations in which the change in land use in them requires consultation with specific competence entities, in addition to the municipality to which the area belongs.

In **Figure 6.2 of Appendix B – Drawings** it is possible to observe the REN restrictions.

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
National Ecological Reserve (*REN*)	Legal regime established by Decree-Law Nº. 166/2008, August 22, amended by Decree-Law Nº. 124/2019, August 28; Normative No. 419/2012, December 20, defines the conditions and requirements to which the uses and actions that are compatible with the objectives of the areas integrated in REN are subject to and the instructive elements of the administrative procedures provided for in the legal regime, as well as the uses and actions that need the authorization of the Portuguese Environment Agency, IP Constructive actions, hydraulic works, landfills, excavations and destruction of vegetation cover are prohibited, with exceptions subject to authorization or prior communication from CCDR-Alentejo. Of the actions compatible with REN, the following is noted under the points of number II - Infrastructure of Annex II of Decree-Law No. 124/2019, August 28: • "e) Ampliation of existing edification of industrial use, energy and geologic resources." The Entrance 419/2012, for infrastructures regarding the e) point stated previously, establish that for strategic areas for infiltration, protection and recharge of aquifers, areas at high risk of soil erosion, adjacent areas are subject to prior notification. The compatibilities presented on Annex I from Decree-law 124/2019 are also applicable.	It does not affect REN	It does not affect REN
National Agricultural Reserve (RAN)	Legal regime established by Decree-Law nº 73/2009, March 31st modified by Decree-Law n.º 199/2015, September 16th is a territorial management instrument, which consists of a restriction of public utility, by establishing a set of constraints on non-agricultural use of the soil, and which plays a key role in preserving the soil resource and its allocation to agriculture. "In RAN areas non-agricultural uses are exceptionally permitted when considered compatible with the goals of agricultural activity protection, subject to a binding prior opinion or prior notification to the territorially competent regional entity (ERRA)"	The study area does not affect RAN	The project area does not affect RAN
Public Water Domain	Law nº 54/2005, November 11 (amended by Statement of Rectification nº 4/2006, January 16, and the latest amendment is given by Law nº. 31/2016, August 23), determines that an easement strip of 10 m from the edges of water lines must be respected and not occupied. If it is necessary to proceed with the occupation and use of the Public Water Domain, this action requires authorization / licensing from the Portuguese Environment Agency (APA).	Intersects water lines with little hydrological expression.	It does affect PWD, which means that it is necessary to require licensing from APA

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
Geodesic Vertex	Decree-Law nº 143/82, April 26 (articles 19 and 25) The easement is established based on the construction of the landmarks, being defined protection zones around it, determined case by case, according to the visibility. The visibility must be ensured to the landmark and among the different signs, which will have at least a 15 meters radius. Construction actions in the area surrounding geodesic landmarks are subject to authorization by the Territorial General Directorate (DGT), and their visibility should not be compromised.	It does not intersect geodesic Vertex	It does not intersect geodesic Vertex
Cork Forest	The Legal Regime for the Protection of Cork oak and Holm Oak is provided for by the Decree-Law Nº 169/2001, May 25 (amended by Decree-Law nº. 155/2004, June 30). The cutting or grubbing up of cork and holm oaks depends on authorization from the ICNF (Nature and Forest Conservation Institute), under the risk that any change in land use will be prohibited for 25 years when areas occupied by cork and/or holm oak have been fire, unauthorized cutting or grubbing, abnormal mortality or depreciation.	It does not intersect cork forest	It does not intersect cork forest
Electric Network	The RSLEAT (Regulation for high voltage powerlines safety), approved by Regulation Decree nº1/92, 18 of February, defines protection easements for the electrical network. The article 28º of this legal document defines that: - Low and medium voltage lines have a protection strip of 15 meters (1,5 kV to 40 kV) and 25 meters (40kV to 60 kV) - High and Very High voltage lines have a protection strip of 45 meters An overall distance from obstacles is defined at 3,65 meters Art 17.º of the Sines municipal master plan: "Administrative easements are defined regarding medium and high voltage lines in the municipality, according to the following kV ranges: (a) lines for the 150/400 kV corridor: a non edificandi strip of 130 metres is defined; b) Other lines above 60 kV: a non-edificandi strip of 50 metres is defined; c) 60 kV lines: a 20-meter non-edificandi strip is defined."	The study area intersects electrical lines from the national distribution network	The site selection does intersect the electrical network. Considering this the project must be submitted to EDP or REN for approval
Road Network	Art 5.º of the municipal master plan: "Non-edificandi strips are defined, measured from the IP8 platform, with a width of 100 metres." Art.º12 of the municipal master plan: "On the municipal roads and paths (...), non-edificandi strips are defined, measured from the platform, with 10 metres wide for residential purposes and 20 metres wide for other purposes."	The study area intersects the following routes and their administrative burdens: • National Road IP8/A26 • Municipal Roads	The refinery implementation area does intercept the municipal roads which means it needs to

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
			comply with the Non-edificandi strip defined

Table 2-12 – Regulations and constraints - Sines

2.2.5. Estarreja

2.2.5.1. Applicable Plans and programmes

Table 2-13 identifies the main spatial planning instruments in force in the area under study, including special, sectoral, regional, and municipal plans.

SCOPE	LAND-USE PLANS AND PROGRAMMES	LEGAL FRAMEWORK
Nacional/ Sectorial	National Spatial Planning Policy Program (*PNPOT*)	Law n. º 58/2007, September 4 Rectification Statement n. º 80-A/2007, September 7 Rectification Statement n. º 103-A/2007, November 2
Regional	Management Plan for the Vouga (HR 4)	Resolution of the Ministers Council no.52/2016, September 20 Rectification Statement nº.22-B/2016, November 18
	Flood Risk Management Plan for Vouga (HR4)	Resolution of the Ministers Council n.º 51/2016
	Regional Plan for Forest Management in Centro (PROF-CL)	Order n.º 56/2019, February 11
Municipal	Estarreja Municipal Master Plan	Resolution of the Ministers Council n.º 11/93. February 23, with the following changes: Resolution of the Ministers Council n.º 103/2003, July 10 Resolution of the Ministers Council n.º 173/2003, October 10 Resolution of the Ministers Council n.º 195/2005, November 24 Resolution of the Ministers Council n.º 81/2006, June 8 Resolution of the Ministers Council n.º 102/2006, August 3 Notice n.º 2007/2012, February 9 Notice n.º 8186/2014, July 14
	Estarreja municipal plan for forest defence against fires	Order n.º 4345/2012, March 27
	Detailed Zoning Plan for the industrial Eco Park	Notice. Nº4228/2015, April 20

Table 2-13 – Spatial Plans and Programmes in force in the study area - Estarreja

2.2.5.2. Regional Scope

2.2.5.2.1. Hydrographic Management Plan for Vouga (HR4)

Hydrographic Region Management Plans (*PGRH*) constitute the planning and conditioning instrument at the water resources level and aim the management, protection and environmental, social and economic valuation of water resources, at the hydrographic basins integrated level. The Resolution of the Ministers Council nº 52/2016 September 20 approved the Hydrographic Region Plans for the Portugal Mainland for the period 2016-2021. The study area is in the Vouga, Mondego and Lis Hydrographic Region **(Figure 3.3 of Appendix B – Drawings).**

The project under analysis is a lithium refinery which will necessarily include wastewater treatment to avoid underground and superficial water resources pollution. Considering the respect of the specific requirements there are no incompatibilities of the project with the hydrographic management plan.

2.2.5.2.2. Flood Risk Management Plan for Vouga (HR4)

This plan is an instrument for water planning in areas of possible flooding and aims to reduce risk by reducing the potentially harmful consequences for human health, economic activities, cultural heritage, and the environment. The plan consists of a set of measures that have a strategic framework aimed to reduce the risks

associated with floods, considering the time taken to implement the measure and the time available to carry it out until 2021.

The measures program is one of the most important parts of the Flood Risk Management Plan, defining the actions, technically and economically feasible, that allow reducing the risks associated with floods, in close articulation with the objectives and measures program defined in the Plan of Hydrographic Region Management.

The project's study and implementation area does not include floodable areas within urban areas, neither areas threatened by flooding as shown in Figure 2-22. However, it is one of the site locations more vulnerable to floods due to the proximity to floodable areas of Ria de Aveiro.

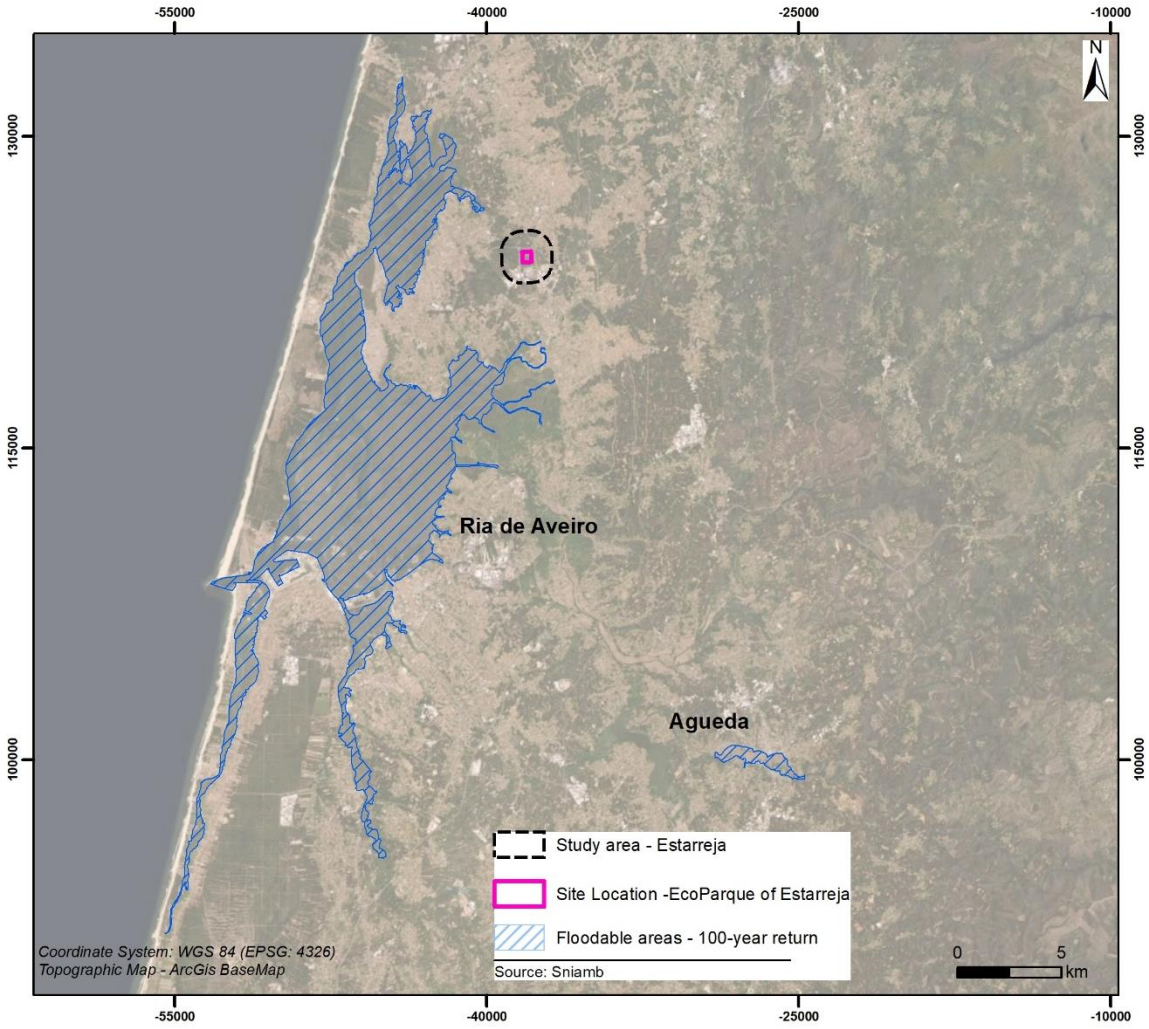


Figure 2-22 – Floodable Areas in Estarreja Municipality

2.2.5.2.3. Regional Program For Forest Management For Centro (PROF-CL)

The Regional Plans for Forestry Planning (PROF) are defined by the National Forest Policy Basic Law (Law Nº 33/96, August 17) as "sectoral instruments for territorial management" that establish the rules for intervention on occupation and the use of forest spaces.

As sectoral instruments for territorial management, the plan is based on an interconnected approach of technical, economic, environmental, social and institutional aspects, involving economic agents and directly interested populations, to establish a consensual strategy for the management and use of forestry spaces.

According to Figure 2-23, the study area includes small areas classified as Sensitive Forested Areas, in contrast, the Site Location does not interfere with these areas.

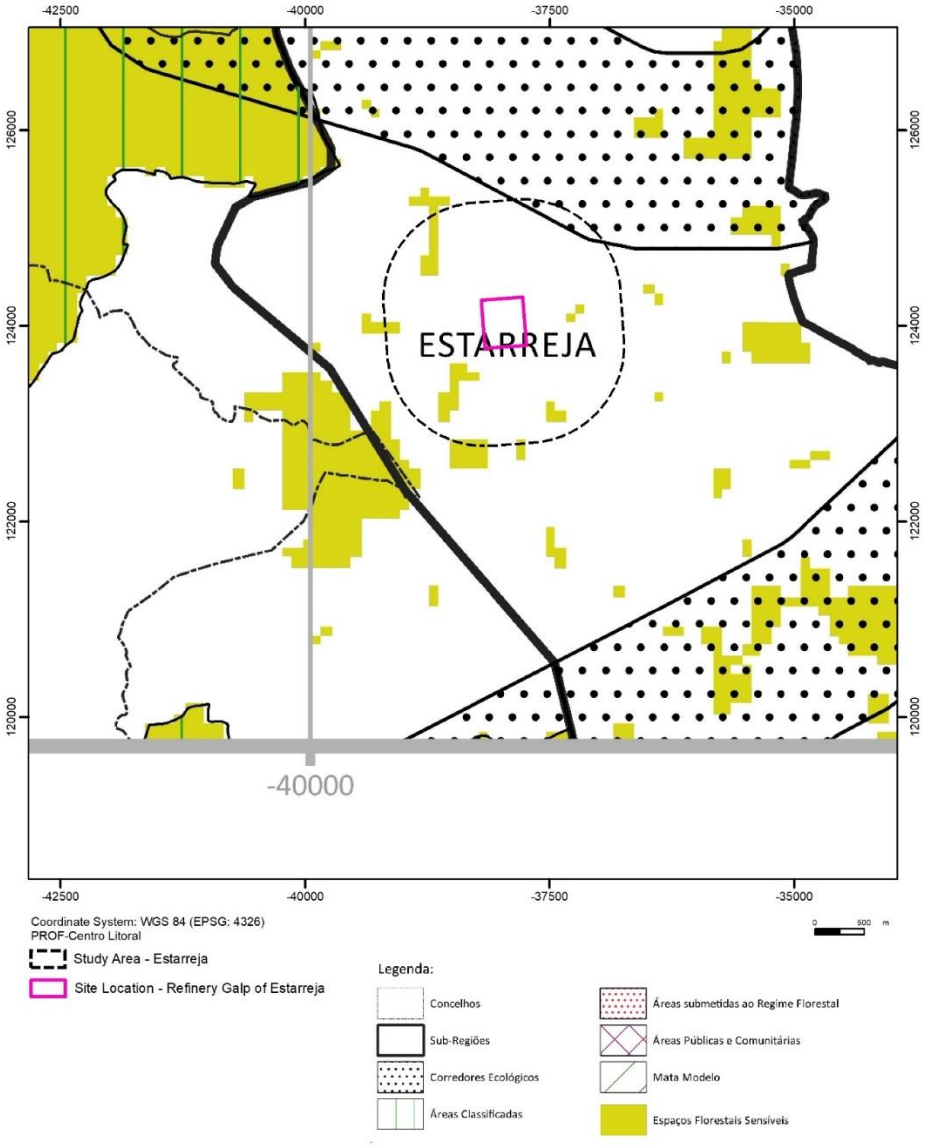


Figure 2-23 – Project framework in the PROF-Centro (Estarreja)

2.2.5.3. Municipal Scope

2.2.5.3.1. Municipal Master Plan

The guidelines mentioned on the hierarchically superior plans must be taken into consideration at the municipal level, and it is the responsibility of the municipalities to establish these guidelines into the respective Municipal Master Plan.

Municipal Plans are the most relevant spatial planning instruments for the present analysis, since the territorial management model they advocate at a local scale may be directly affected due to the implementation of the project under analysis.

The study area is under the regulation of the Estarreja Municipal Master Plan. Depending on the proposed dominant use, the Municipal Master Plan in question categorises the study as mapped in the Spatial Planning Plan **(Figure 4.3.1 to 4.3.4 of Appendix B – Drawings).** It should be noted that the spaces destined to industrial areas were fully considered to choose the site location.

The implementation area is fully included in the land classified as an Economic activities area, which means that the project installation complies with the PDM restrictions.

2.2.5.3.2. Municipal Plan for Forest Defence against fires

Decree-Law nº 17/2009[12], January 14 structures the Forest Defence System against Fires), which provides a set of measures and actions for institutional articulation, planning and intervention related to prevention and protection of forests against fires. Municipal Plans for Forest Defence Against Fires (*PMDFCI*) at the municipal or inter-municipal level has the necessary actions for forest defines and, in addition to the prevention actions, including forecasting and the interventions by the different entities involved in a possible fire.

Regarding the project's area, as shown in Figure 2-24, it is possible to observe that the fire hazard index is very low and medium for most of the study area, with two small areas of high risk, and therefore will not impact the project.

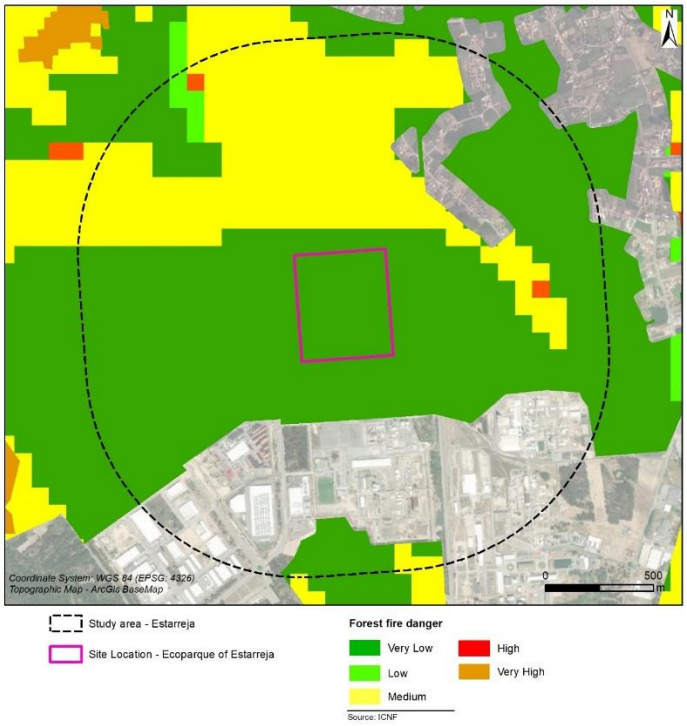


Figure 2-24 - Forest Fire Danger for Estarreja Municipality

2.2.5.3.3. Detailed Zoning Plan for the industrial Eco Park

The area covered by the Detailed Plan (289.7 ha) is part of a classified area, according to the Municipal Master Plan of Estarreja, which is the Economic Activities Area.

[12] amends and republishes Decree-Law nº 124/2006, June 2 and whose fifth amendment by Law no. 76/2017, of 17 August, was rectified by Statement of Rectification No. 27/2017 of 2 October,

The plan consists of a set of measures that have a strategic framework aiming "*to regulate the urban occupation of its area of intervention establishing the rules governing the occupation and use of the urban and urbanise space covered by it and defining the conditions of urbanisation, and the characterisation of public spaces."*

The Detailed Zoning Plan changes the provisions relating to parking and Land Use Index in Occupation and Land Use in the Economic Activities Area. The Economic Activities Area is as defined in the Detailed Zoning Plan and therefore it is assumed that the project area complies with it.

2.2.5.4. Constraints, administrative easements and public interest restrictions

Public easements and restrictions are limitations or impediments to any specific form of land use. The knowledge of these areas is essential to determine the limits of their use and to inform the proponent of the situations in which the change in land use in them requires consultation with specific competence entities, in addition to the municipality to which the area belongs. Such restrictions will impact the proposed lithium refinery as described in Table 10 below.

In **Figures 5.2.1 to 5.2.7 of Appendix B – Drawings** it is possible to observe the PMD restrictions.

In **Figure 6.3 of Appendix B – Drawings** it is possible to observe the REN restrictions.

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	Site location
National Ecological Reserve (*REN*)	Legal regime established by Decree-Law Nº. 166/2008, August 22, amended by Decree-Law Nº. 124/2019, August 28; Normative No. 419/2012, December 20, defines the conditions and requirements to which the uses and actions that are compatible with the objectives of the areas integrated in REN are subject to and the instructive elements of the administrative procedures provided for in the legal regime, as well as the uses and actions that need the authorization of the Portuguese Environment Agency, IP Constructive actions, hydraulic works, landfills, excavations and destruction of vegetation cover are prohibited, with exceptions subject to authorization or prior communication from CCDR-Norte. Of the actions compatible with REN, the following is noted under the points of number II - Infrastructure of Annex II of Decree-Law No. 124/2019, August 28: • "e) Ampliation of existing edification of industrial use, energy and geologic resources." The Entrance 419/2012, for infrastructures regarding the e) point stated previously, establish that for strategic areas for infiltration, protection and recharge of aquifers, areas at high risk of soil erosion, adjacent areas are subject to prior notification. The compatibilities presented on Annex I from Decree-law 124/2019 are also applicable.	REN areas are intersected: Maximum infiltration areas.	The site selection intersects REN, namely the Maximum infiltration areas, which means it is necessary prior notification and get approval from CCDR-Centro
National Agricultural Reserve (RAN)	Legal regime established by Decree-Law nº 73/2009, March 31st modified by Decree-Law n.º 199/2015, September 16th is a territorial management instrument, which consists of a restriction of public utility, by establishing a set of constraints on non-agricultural use of the soil, and which plays a key role in preserving the soil resource and its allocation to agriculture. "In RAN areas non-agricultural uses are exceptionally permitted when considered compatible with the goals of agricultural activity protection, subject to a binding prior opinion or prior notification to the territorially competent regional entity (ERRA)"	The study area does not affect RAN	The project area does not affect RAN
Electric Network	The RSLEAT (Regulation for high voltage powerlines safety), approved by Regulation Decree nº1/92, 18 of February, defines protection easements for the electrical network. The article 28º of this legal document defines that: Low and medium voltage lines have a protection strip of 15 meters (1,5 kV to 40 kV) and 25 meters (40kV to 60 kV) High and Very High voltage lines have a protection strip of 45 meters An overall distance from obstacles is defined at 3.65 meters	The study area intersects medium and high voltage electrical lines	The site location does not intersect the electric network

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	Site location
Road Network	According to the article 32° of National Road Network Statute: *Non-edificandi* strips are established on municipal roads, measured at the axis of the road or the limit of the road or path zone, as follows: "8 - After the publication of the act declaring the public utility of the property and the respective parcel plan, the non-edificandi easement areas for new roads, as well as for existing roads, have the following limits (a) Motorways and expressways: 50 m to each side of the axis of the road and never less than 20 m from the road area; b) IP: 50 m on each side of the road axis or within the visibility easement and never less than 20 m from the road c) IC: 35 m on either side of the road centreline or within the right-of-way and in no case less than 15 m from the road d) EN and other roads to which this Statute applies: 20 m on either side of the centreline of the road or within the visibility right-of-way and in any case not less than 5 m from the road e) Connection nodes: a circle with a 150 m radius centred on the intersection of the road axes, irrespective of their classification. 9 - For the purposes of the previous number, connections to IP and IC intersections are considered as EN."	The study area intersects the following routes and their administrative burdens: • Urban distributor roads • Municipal Roads	The refinery implementation area does not intersect the road network

Table 2-14 – Regulations and constraints - Estarreja

2.2.6. Vigo

2.2.6.1. Applicable Plans and programmes

Table 2-15 identifies the main spatial planning instruments in force in the area under study, including special, sectoral, regional, and municipal plans.

SCOPE	LAND-USE PLANS AND PROGRAMMES	LEGAL FRAMEWORK
Regional/Sectorial	Territorial Planning Guidelines of Galicia (DOT)	Decree 19/2011, February 10
	Plisan's Sectorial Project	Decree DOG n.º 25/2011, February 7
	Management Plan for theMiño-Sil	Decree n.º 1/2016, January 8
	Flood Risk Management Plan Miño-Sil	Decree n.º 18/2016, January 15
	Galicia municipal plan for forest defence against fires (PLADIGA)	Consello da Xunta de 24 de maio de 2007 Consello da Xunta de 26 de maio de 2007
Municipal	As Neves Municipal Master Plan (PGOM)	B.O.P n.º 7/2000, January 12, with the following changes: DOG n.º 67/2004, April 6 DOG n.º 135/2012, July 16
	Salvaterra del Mino Municipal Subsidize standards	Planning regulation nº141/93, July 26, with the following changes: B.O.P n.º142/2001, July 24 B.O.P n.º171/2002, September 6 B.O.P n.º100/2005,May 26 B.O.P n.º211/2008,October 30 B.O.P n.º65/2010,April 8 B.O.P n.º210/2011,November 2 B.O.P n.º194/2019,October 9

Table 2-15 – Spatial Plans and Programmes in force in the study area – Vigo

2.2.6.2. Regional/Sectorial Scope

2.2.6.2.1. Territorial planning guidelines of galicia (DOT)

The Autonomous Communities have been responsible for legislating and developing their spatial planning regulations. The Guidelines for territorial planning "*comply with the Law n.º 10/1995, of November 23, for the Planning of the Galicia territory, which establishes the goals and tools through which the land spatial planning of the Autonomous Community will be developed*." Galicia's territorial framework follows those established in the European Union's territorial policy and the Galician Spatial Planning Act.

Assessment of the proposed location determines there are no incompatibilities related to the implementation of the project with this plan.

2.2.6.2.2. Plisan's Sectorial Project

The goal of the Sectorial Project is to guarantee the adequate insertion of the PLISAN territory, to its connection to the corresponding networks and services without diminishing the existing functionalities, to its adaptation to the existing surrounding environment, and its articulation with the determinations of the current municipal urban plan. It should be noted that the spaces destined to industrial areas were fully considered to choose the

site location. In this context, the project needs to follow the guidelines of the Plisan's sectorial project to assure complete compliance. The constraints related to the sectorial plan are present in Table 2-16.

2.2.6.2.3. Hydrographic Management Plan for Miño-Sil

The Hydrological Plan for Miño-Sil constitutes the hydrographic demarcations of the area of land and sea comprising one or more neighbouring river basins and the transitional, groundwater and coastal waters associated with those basins. The Decree n. º 1/2016, January 8 approved the Hydrological Plan Region Plans for Miño Sil for the period 2016-2021. The study area is in the Miño Sil Hydrological Region **(Figure 3.4 of Appendix B – Drawings).**

The project under analysis is a lithium refinery which will necessarily include wastewater treatment to avoid underground and superficial water resources pollution. If the element of the project lead to the modification of the water line existing in the site location, it will be necessary to build culverts or other infrastructure to allow the normal runoff of the water. Considering the respect of the specific requirements there are no incompatibilities of the project with the hydrographic management plan.

2.2.6.2.4. Flood Risk Management Plan Miño-Sil

The main goal of the flood risk management plans is, for those areas identified in the preliminary risk assessment, to ensure that the existing flood risk has not increased and, as far as possible, reduced through the various action programmes, which shall consider all aspects of flood risk management.

The project's study and implementation area does not include floodable areas within urban areas; neither areas threatened by flooding as shown in Figure 2-25. However, it is one of the site locations more vulnerable to floods due to the proximity of floodable areas.

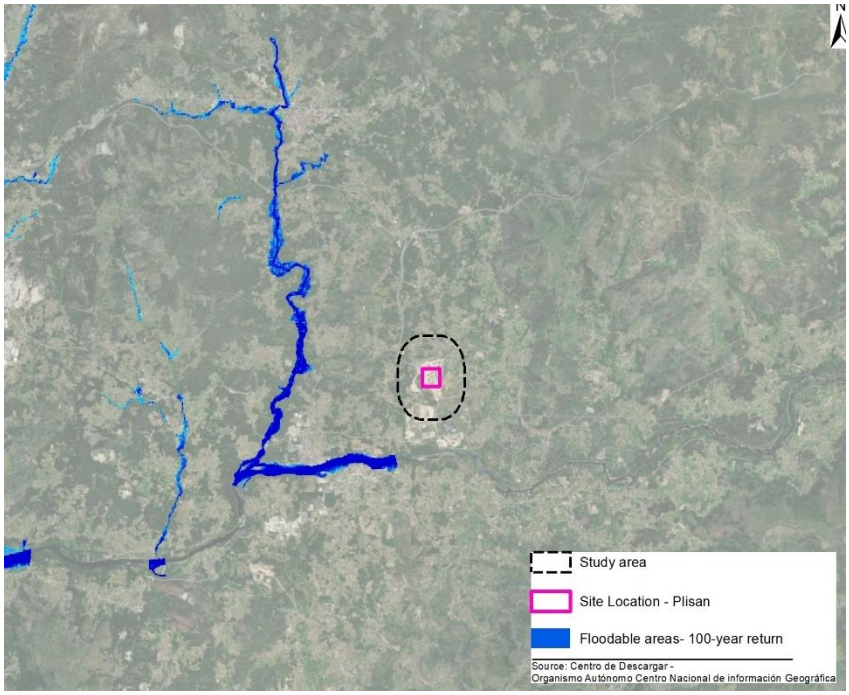


Figure 2-25 - Floodable areas for Salvaterra de Miño Municipality

2.2.6.2.5. Galicia municipal plan for forest defence against fires (PLADIGA)

The purpose of the PLADIGA 2021 (Plan for the Prevention and Defence against Forest Fires in Galicia) is to establish the organization and procedure for the action of the resources and services owned by the Autonomous Community of Galicia, those that may be assigned to it by the General State Administration, as well as those that may be provided by other public or private entities to deal with forest fires within the Galician territory.

According to the PLADIGA the study area is in a high fire hazard risk (ZAR) and Daily Forest Fire Risk Index (IRDI) is classified as extreme. According to the PLADIGA, "*if the IRDI is Very High or Extreme it will not be allowed to access, circulate and stay inside the areas referred to above, as well as on forest roads, rural roads and other roads they cross*".

The General Forest Fire Statistics (EGIF) is the national database that compiles all the fires that take place in Spain, based on the annual information supplied by the Autonomous Communities. This database is the basic instrument for forest fire management in Spain.

According to the data available in the EGIF, in the study area between 2006 and 2015, the number of registered forest fires was somewhere between 101 and 500, as shown in Figure 2-26, which represent a very high frequency of forest fires.

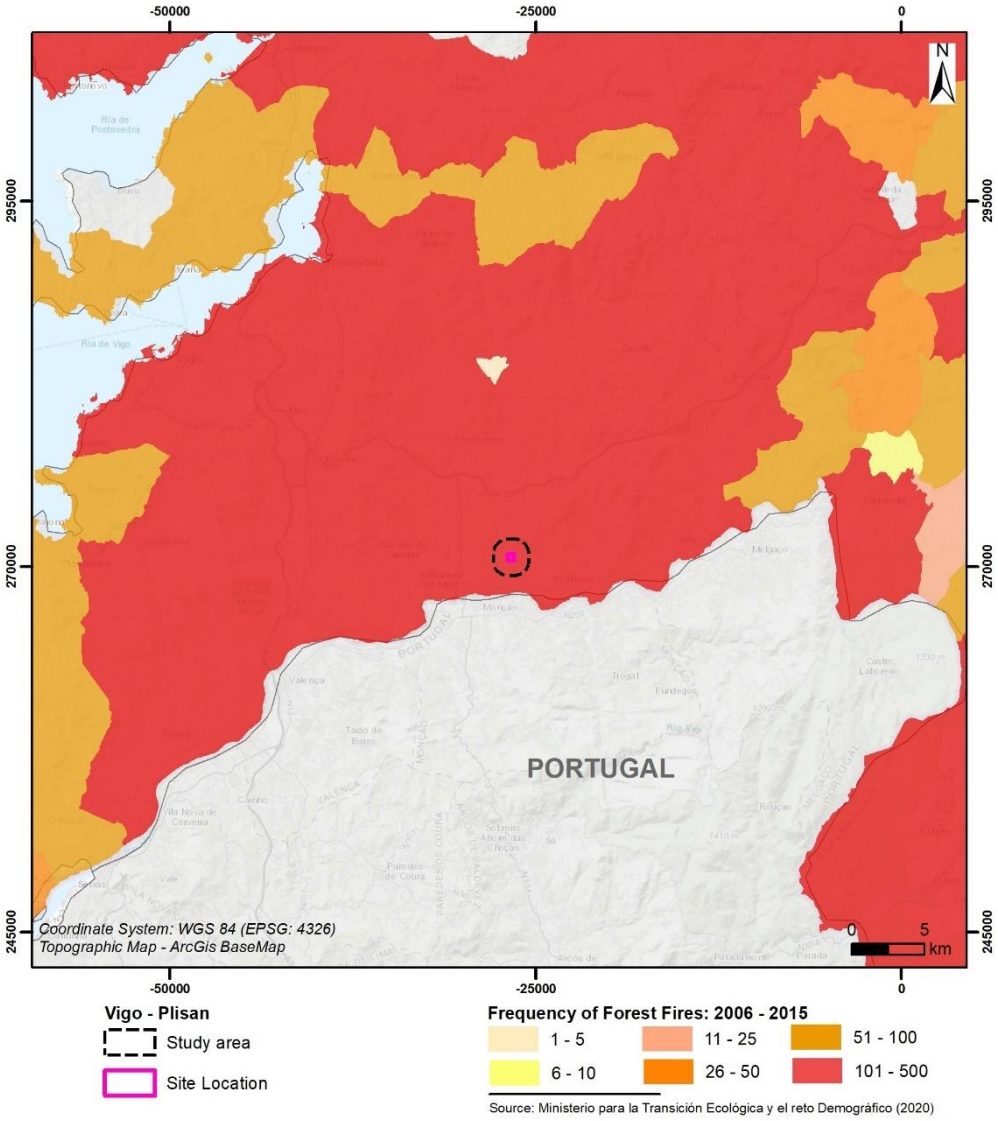


Figure 2-26 - Frequency of Forest Fires for Salvaterra de Miño/As Neves Municipality

2.2.6.3. Municipal Scope

2.2.6.3.1. Salvaterra del Miño Municipal Subsidize standards

Complementary to the national legislation for land planning and soil usage, the subsidised normative standards "regulate the soil usage and edification of the Salvaterra de Miño municipal Land within the Pontevedra province." The constraints related to the Salvaterra de Miño are present in Table 2-17.

Figure 4.4.1 of Appendix B – Drawings presents the soil classification and qualification for Salvaterra de Miño, which currently occupies rustic areas, however, the sectorial plan is above this classification.

2.2.6.3.2. As Neves Municipal Master Plan

The guidelines mentioned on the hierarchically superior plans must be taken into consideration at the municipal level.

The Municipal Master Plan is a "*planning tool, of a normative nature, which establishes the comprehensive urban planning of one or several municipalities, which is essential for development planning and urban development and building activity to take place in accordance with the regime determined in the plan for each class of land*."

Figure 4.4.2 of Appendix B – Drawings presents the soil classification and qualification for As Neves, which currently occupies rustic areas, however, the sectorial plan is above this classification.

CLASS	REGULATIONS	STUDY AREA	SITE LOCATION	COMPLIANCE WITH THE PROJECT
General road system, infrastructures, and landscape corridors	Art. 2.1.3. – " General road, infrastructure and landscape system 1. Given the territorial character of PLISAN, which is articulated with territorial elements of communication and infrastructures, it is related to the environmental configuration of the surroundings, and it is configured as a sector in which different inner functional areas are delimited, some systems of common scale can be distinguished: a. Road System: External road axes that enter the platform, conditioning its tracks, used at the same time as general communication between the Activity Areas. b. Infrastructural services: Networks and nodes common to the operation of the services of the platform, developed basically on the ground outside the Activity Areas. c. Landscape system: Green corridors that accompany the road system, delimiting the Activity Areas; it is compatible with the infrastructures implementation and the enlargement of the road system."	x	x	Due to the classification of the type of industry as chemical industry, the acceptance of the project in this location is dependent of the approval from the regional government of Galicia (environment department). The approval process requires the submission of the project's environmental impact assessment.
Business logistics area	Art. 3.2.2 "1. The **predominant uses**: a. The **industrial use** corresponds to the soil destined to the following: • Establishments for the transformation of primary materials, the production and elaboration, repair, packaging, transport, and distribution of products. • Functions that complement the industrial activity itself, such as packaging and commercial packaging. • The escape industry with tertiary components 2. Compatible uses a. Uses not specifically industrial: • Offices and services, Business Park, warehouses, laboratories,	x	x	Due to the classification of the type of industry as chemical industry, the acceptance of the project in this location is dependent of the approval from the regional government of Galicia (environment department). The approval process requires the submission of the project's environmental impact assessment.

	computer centres, service companies and garages. b. Workshop services and repair shops for vehicles, spare parts or auxiliary machinery. auxiliary. c. Parking garages for heavy vehicles. d. Endowment • Public services, facilities, equipment The maximum building surface corresponding to these compatible uses will not exceed 25% of the total for each plot. 3. Prohibited uses a. Unhealthy, noxious, and dangerous activities b. Recreational and leisure uses."			
Integrated service centre	Art. 3.2.2 – "1. The following are **predominant uses**: a) In intermodal areas, storage in large areas, cars, containers, intermodal terminals, with complementary facilities, consolidation warehouses, etc. b) In logistic areas, or warehousing, including the activities corresponding to the logistic subsystem of physical distribution: storage, packaging, packing, transport, maintenance, etc. 2. They will be compatible uses in all the *quinteiros* of this zone: a) Services of workshops and repair of vehicles, refuelling or auxiliary machinery. b) Local of exhibition or sale of vehicles, refuelling or auxiliary machinery. c) Coffee shop. d) Office of exploitation of the companies. e) Industrial activities of packaging, labelling, etc. e) Activities corresponding to the logistic sub-system of production: assembly of components, painting and finishing, mixing, etc. f) Security and safety services. g) Parking of heavy vehicles. A maximum buildable surface corresponding to	x	x	Due to the classification of the type of industry as chemical industry, the acceptance of the project in this location is dependent of the approval from the regional government of Galicia (environment department). The approval process requires the submission of the project's environmental impact assessment.

	these compatible uses will not exceed 25% of the total in each plot. 3. Prohibited uses a) Unhealthy, noxious, and harmful activities b) Uses of leisure and recreation.”			

Table 2-16 – Space classes covered by the project sectorial - Vigo

CLASS	SUB-CLASS	STUDY AREA	SITE LOCATION	COMPLIANCE WITH THE PROJECT
Rural settlements	Existing traditional rural settlement	X	X	According to the subsidize standards of Salvaterra de Miño plant the implementation area intercepts on the southwest corner, and existing traditional rural settlement. As it is not possible to confirm and consider the small dimension of the interception it assumed that, in case of the selection of this site location, this area should be avoided.
Transport Network	3rd order road network	X	X	According to the subsidize standards of Salvaterra de Miño plant the implementation, area intercepts on the northwest corner, an 3rd order road network. As it is not possible to confirm it is assumed that, in case of the selection of this site location, this area should be checked during the next stage-gate.

Table 2-17 – Impacted space classes covered by the subsidize standards of Salvaterra de Miño

2.2.6.4. Constraints, administrative easements and public interest restrictions

Public easements and restrictions are limitations or impediments to any specific form of land use. The knowledge of these areas is essential to determine the limits of their use and to inform the proponent of the situations in which the change in land use in them requires consultation with specific competence entities, in addition to the municipality to which the area belongs.

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
Electric Network	"The plots supplied in Medium Voltage, have the possibility of supply in Low Voltage from the nearest transformer station, which must be equipped with reserve power for these cases, in addition to having each plot of a connection box for this purpose and reserve channelling."	The study area intersects medium and electrical lines	The study area intersects medium voltage electrical lines, in this sense the project must be submitted to the Red Elétrica
Public Water Domain	Decree-Law nº 9/2008, September 11th, "Artº 6 a) To an easement zone of five metres wide for public use, which is regulated in these regulations. b) To a one-hundred-metre-wide police zone, in which the use of the land and the activities carried out therein will be conditioned."	The study area intersects the public water domain	The study area intersects the public water domain. Authorisation must be provided by the Autonomous Community of Galicia
Quarry Áridos do Mendo	It is necessary to check with the quarry owners for any specific easements related to it	The study area intersects the quarry áridos do Mendo	The implementation does not intersect the quarry area
Road Network	Law 8/2013, June 28th, "Artº37 1. **The public domain area** is made up of the land occupied by all the elements of the public road domain acquired by legitimate title by the administration that owns it. 2. (...) the distance between the outer edge of the road surface corresponding to the carriageways and functional elements and the outer limit of the adjacent public domain, measured horizontally and orthogonally from the former, cannot be greater than: b) **Ten metres in the case of conventional roads** and functional elements. "Artº39, 1-**The easement zone** is made up of two strips of land, one on each side of the road, delimited internally by the outer lines of the public domain area and externally by two lines parallel to these limits and measured horizontally and orthogonally from them, at a distance of: b**) Two metres in the case of conventional** roads and functional elements." "Artº40, 1 - **The affection zone** is made up of two strips of land, one on each side of the road, delimited internally by the exterior lines of the zone of servitude and externally by two lines parallel to the exterior edges of the road surface and measured horizontally and orthogonally from them, at a distance of: b**) Thirty metres in the case of conventional roads** and functional elements." Inside these zones it is not allowed to construct.	The study area intersects road network	The study area intersects the public domain. Authorisation must be provided by the Autonomous Community of Galicia

Table 2-18 – Regulations and constraints - Vigo

2.2.7. Setúbal

2.2.7.1. Applicable Plans and programmes

Table 2-19 identifies the main spatial planning instruments in force in the area under study, including special, sectorial, regional, and municipal plans. The following sections then present the planning instruments that are of higher priority for consideration to the project.

SCOPE	LAND-USE PLANS AND PROGRAMMES	LEGAL FRAMEWORK
National	National Spatial Planning Policy Program (*PNPOT*)	Law n. º 58/2007, September 4 Rectification Statement nº. 80-A/2007, September 7 Rectification Statement nº 103-A/2007, November 2
Regional	Management Plan for the Sado and Mira (HR6)	Resolution of the Ministers Council no.52/2016, September 20 Rectification Statement nº.22-B/2016, November 18
	Management Plan for the Tejo and Ribeiras do Oeste (HR5)	
	Flood Risk Management Plan for the Sado and Mira (HR6)	Resolution of the Ministers Council n.º 51/2016, September 20
	Sado estuary nature reserve Plan (RNES)	Resolution of the Ministers Council n.º 182/2008, November 24
	Regional Program for Forest Management for Lisboa and Vale do Tejo (PROF-LVT)	Order n.º 52/2019, February 11
Municipal	SAPEC Bay Regulation	Ordinance n.º 63/94
	Setúbal Municipal Master Plan	Resolution of the Ministers Council n.º 65/94, August 10 Notice n.º 6619/2018, May 17 (currently being reviewed)
	Setúbal Intermunicipal plan for forest defence against fires	Notice nº 1209/2020, January 23

Table 2-19 – Spatial Plans and Programmes in force in the study area – Setúbal

The regional and municipal scope is particularly relevant for this report. An analysis of the Project compatibility with the objectives set out in the referred plans will be made.

2.2.7.2. Regional Scope

2.2.7.2.1. Hydrographic Management Plan for Sado and Mira (HR6) and Tejo and Ribeiras do Oeste (HR5)

Hydrographic Region Management Plans (*PGRH*) constitute the planning and conditioning instrument at the water resources level and aim the management, protection, and environmental, social, and economic valuation of water resources at the hydrographic basins integrated level. The Resolution of the Ministers Council nº 52/2016 September 20 approved the Hydrographic Region Plans for the Portugal Mainland for the period 2016-2021. The superficial water body in this site location is in the Sado and Mira Hydrographic Region **(Figure 3.5 of the Appendix B – Drawings)** and the groundwater body is in the Tejo and Ribeiras do Oeste Region.

The project under analysis is a lithium refinery which will necessarily include wastewater treatment to avoid underground and superficial water resources pollution. Considering that the site location intersects water lines and is located in the proximity of the Sado estuary it is necessary to request the APA permitting for the occupation of the water domain.

2.2.7.2.2. Flood Risk Management Plan for Sado and Mira (HR6)

This plan is an instrument for water planning in areas of possible flooding and aims to reduce risk by reducing the potentially harmful consequences for human health, economic activities, cultural heritage, and the environment. It consists of a set of measures that have a strategic framework aimed to reduce the risks associated with floods, considering the time taken to implement the measure and the time available to carry it out until 2021.

The measures program is one of the most important parts of the Flood Risk Management Plan, defining the actions, technically and economically feasible, that allow reducing the risks associated with floods, in close articulation with the objectives and measures program defined in the Plan of Hydrographic Region Management.

The project's study area and implementation area do not include floodable areas within urban areas, neither threatened by flooding as shown in Figure 2-27.

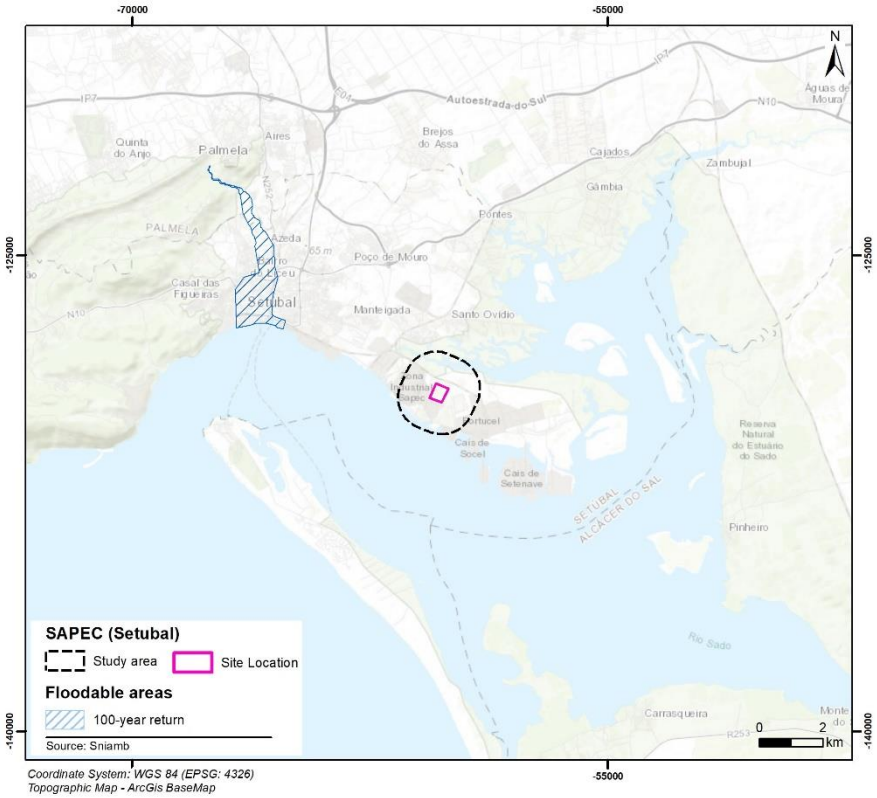


Figure 2-27 – Floodable Areas in Setúbal Municipality

2.2.7.2.3. Sado Estuary Nature Reserve Plan (RNES)

The Management Plan for the Sado Estuary Nature Reserve (RNES) was approved by the Resolution of the Ministers Council n.º 182/2008, November 24 and its area of intervention includes the municipality of Setúbal.

"*PORNES establishes the regimes for the safeguarding of natural resources and values and establishes the uses and to be observed in its area of intervention, to guarantee the conservation of nature and biodiversity and the maintenance and enhancement of the characteristics of natural and semi-natural landscapes.*"

In areas subject to administrative easements or restrictions of public utility, the uses and constructions that may receive a favourable opinion from the competent authorities, under the terms of the applicable legislation, do not exempt the compliance with the provisions of this Regulation.

In the PORNES intervention area, it is forbidden to install type 1 and 2 industrial establishments, which include the refinery, however even though the study area intercepts the PORNES jurisdiction, the elements of the refinery to be implemented are outside of this area, which leads to the conclusion that the project complies with the Sado Estuary Nature Reserve Plan **(Figure 4.5.2 of the Appendix B – Drawings)**.

2.2.7.2.4. Regional Program For Forest Management For Lisboa and Vale do Tejo (PROF-ALT)

The Regional Plans for Forestry Planning (PROF) are defined by the National Forest Policy Basic Law (Law Nº 33/96, August 17) as "sectoral instruments for territorial management" that establish the rules for intervention on occupation and the use of forest spaces.

As sectoral instruments for territorial management, the plan is based on an interconnected approach of technical, economic, environmental, social and institutional aspects involving economic agents and directly interested populations to establish a consensual strategy for the management and use of forestry spaces.

According to Figure 2-28, the study area includes small areas classified as Sensitive Forested Areas and Classified Areas, in contrast, the proposed site location does not intersect with these areas. The plant design (refinery elements) will be developed outside those sensitivity areas, being compatible with the local restrictions, with no risks for the permitting process.

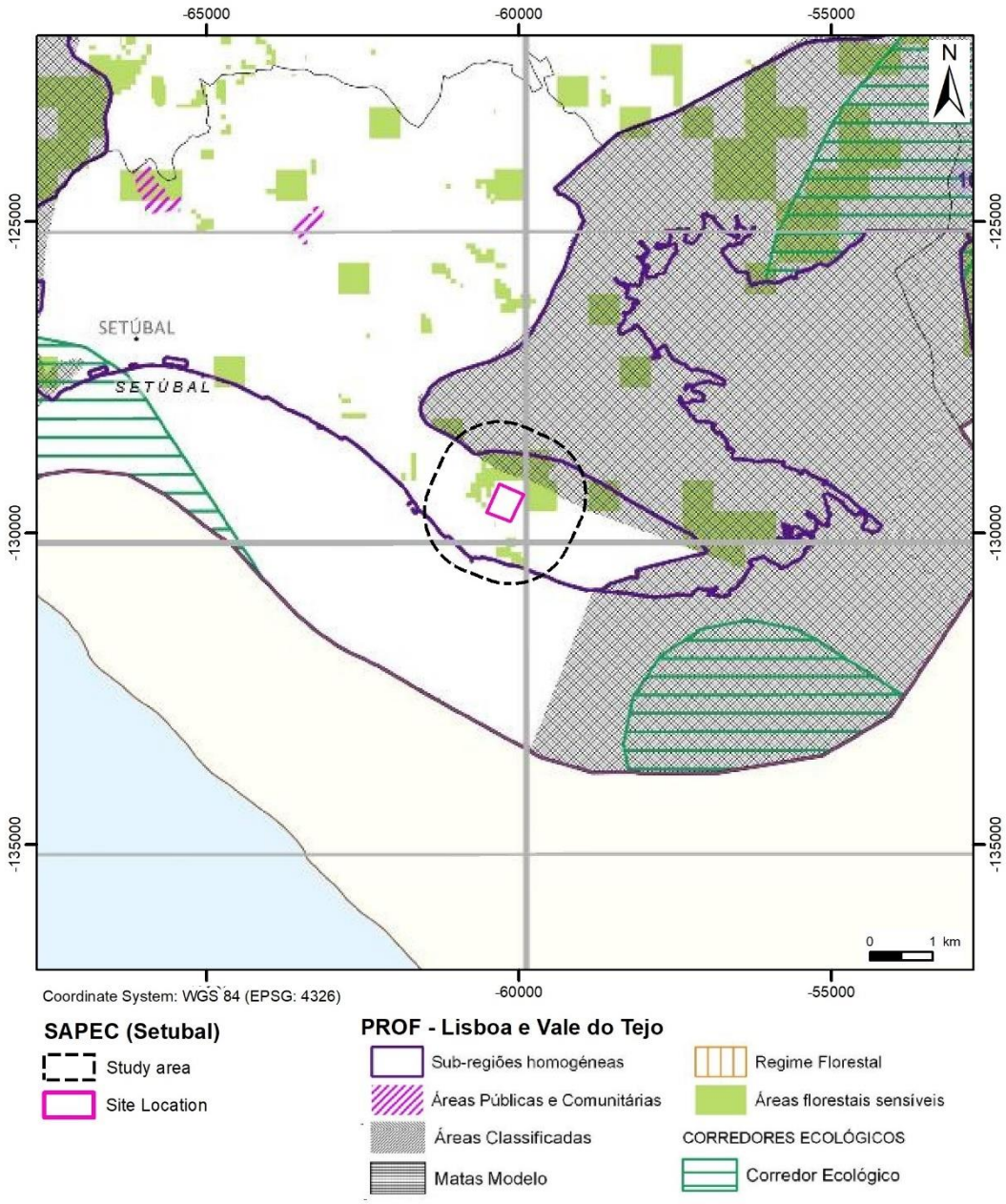


Figure 2-28 – Project framework in the PROF-LVT – Setúbal

2.2.7.3. Municipal Scope

2.2.7.3.1. Setúbal Master Plan

The study area is under the regulation of the Setúbal Municipal Master Plan. Depending on the proposed dominant use, the Municipal Master Plan in question categorizes the study area considering the zoning map in the Spatial Planning Plan (**Figure 4.5.1 to 4.5.3 of the Appendix B – Drawings).**

Considering the location of the proposed refinery, mostly in an area destined to comprise industrial activities, the implementation complies with the municipal master plan as long as it adopts the necessary technical measures to avoid the increase of human and environmental risks.

It should be noted that a small area in the east corner of the defined site location intercepts the “green areas of protection and framing”. In these areas, the construction of any building is **forbidden**, except for those intended to support its preservation, maintenance and support for cycle and pedestrian use. Plant design

should exclude the use of this area once no elements of the refinery can be built here. It is also necessary to have validation from the Setúbal municipality.

The master plan is currently being reviewed which might imply some changes in the soil use and classification therefore impacting the use of this location as a lithium refinery.

2.2.7.3.2. SAPEC Bay Regulation

This SAPEC Bay regulation defines the standards for implementation and management of the industrial park, namely the soil occupation and zoning.

According to Annex I of this regulation it is allowed to install "20 – Chemical's production plants" on the industrial park area destined for industrial occupation, therefore there are no incompatibilities for the proposed refinery with the SAPEC Bay regulation. In terms of occupation, the placement of the proposed refinery must comply with the municipal masterplan constraints.

2.2.7.3.3. Municipal Plan for Forest Defence against fires

Decree-Law nº 17/2009[13], January 14 structures the Forest Defence System against Fires, which provides a set of measures and actions for institutional articulation, planning and intervention related to prevention and protection of forests against fires. Municipal Plans for Forest Defence Against Fires (*PMDFCI*) at the municipal or inter-municipal level has the necessary actions for forest defines and, in addition to the prevention actions, including forecasting and the interventions by the different entities involved in a possible fire.

Regarding the project's area, as shown in Figure 2-29, it is possible to observe that the fire hazard index is non-classified for the majority of the area. There are mixed classifications on the northeast side, with small areas of high and medium danger of fire, but the majority is classified with low or very low danger. For the site location, the area is entirely inside the non-classified zone and therefore it is assumed that it will not impact the project.

[13] amends and republishes Decree-Law nº 124/2006, June 2 and whose fifth amendment by Law no. 76/2017, of 17 August, was rectified by Statement of Rectification No. 27/2017 of 2 October,

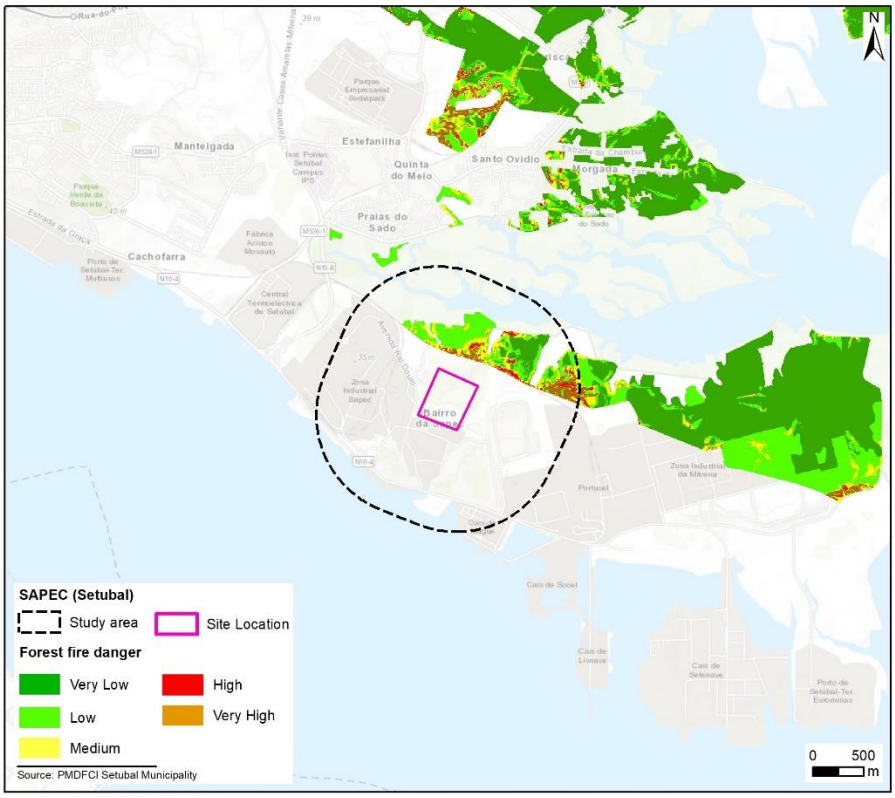


Figure 2-29 – Forest Fire Danger for Setúbal Municipality

2.2.7.4. Constraints, administrative easements and public interest restrictions

Public easements and restrictions are limitations or impediments to any specific form of land use. The knowledge of these areas is essential to determine the limits of their use and to inform the proponent of the situations in which the change in land use requires consultation with specific competence entities, in addition to the municipality to which the area belongs.

In **Figures 5.3.1, 5.3.2 and 5.3.3 of Appendix B – Drawings** it is possible to observe the PMD restrictions.

In **Figure 6.4 of Appendix B – Drawings** it is possible to observe the REN restrictions.

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
National Ecological Reserve (REN)	The legal regime established by Decree-Law Nº. 166/2008, August 22, amended by Decree-Law Nº. 124/2019, August 28; Normative No. 419/2012, December 20, defines the conditions and requirements to which the uses and actions that are compatible with the objectives of the areas integrated in REN are subject to and the instructive elements of the administrative procedures provided for in the legal regime, as well as the uses and actions that need the authorization of the Portuguese Environment Agency, IP Constructive actions, hydraulic works, landfills, excavations and destruction of vegetation cover are prohibited, with exceptions subject to authorization or prior communication from CCDR-LVT. Of the actions compatible with REN, the following is noted under the points of number II - Infrastructure of Annex II of Decree-Law No. 124/2019, August 28: • "*e) Ampliation of existing edification of industrial use, energy and geologic resources*." The Ordinance no. 147/2015, delimits the National Ecological Reserve of the municipality of Setúbal, in Mitrena - SAPEC Bay Industrial Park with the areas to be integrated and excluded.	REN areas are intersected: Estuary and protection strip The plant design is outside of REN areas.	It does not affect REN in the current municipal plan. However, the municipal masterplan is being reviewed and this might change this classification. In the public consultation documents available for the REN map there are interceptions with REN classified areas. In this case it is necessary to make a request to CCDR-LVT to use this area. It should be noted that, as per Figure 6.4 of Appendix B, the official information assumes no REN areas are under the site location.
National Agricultural Reserve (RAN)	The legal regime established by Decree-Law nº 73/2009, March 31st modified by Decree-Law n.º 199/2015, September 16th is a territorial management instrument, which consists of a restriction of public utility, by establishing a set of constraints on non-agricultural use of the soil, and which plays a key role in preserving the soil resource and its allocation to agriculture. "*In RAN areas non-agricultural uses are exceptionally permitted when considered compatible with the goals of agricultural activity protection, subject to a binding prior opinion or prior notification to the territorially competent regional entity (ERRA)"*	The study area does not affect RAN	The site location does not affect RAN
Public Water Domain (PWD)	Law nº 54/2005, November 11 (amended by Statement of Rectification nº 4/2006, January 16, and the latest amendment is given by Law nº. 31/2016, August 23), determines that an easement strip of 10 m from the edges of water lines must be respected and not occupied. It is also necessary to consider the salt marsh associated with the Sado Estuary which falls into the public maritime domain constraints, namely an easement strip of 50 m (article 11) that can not be occupied.	Intersects water lines of 1st , 2nd ,3rd order and maritime public domain	Intersects water lines of 1st , 2nd ,3rd order which means that it does affect Water Domain. A request for usage of this area must be made (TURH), and the project must assure the maintenance of the water course.

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
	If it is necessary to proceed with the occupation and use of the Water Domain, this action requires authorization / licensing from the Portuguese Environment Agency (APA).		
Geodesic Vertex	Decree-Law nº 143/82, April 26 (articles 19 and 25) The easement is established based on the construction of the landmarks being defined protection zones around it, determined case by case, according to the visibility. The visibility must be ensured to the landmark and among the different signs, which will have at least a 15 meter radius. Construction actions in the area surrounding geodesic landmarks are subject to authorization by the Territorial General Directorate (DGT), and their visibility should not be compromised.	It does not include Geodesic Vertex	It does not include Geodesic Vertex
Cork Forest	The Legal Regime for the Protection of Cork oak and Holm Oak is provided for by the Decree-Law Nº 169/2001, May 25 (amended by Decree-Law nº. 155/2004, June 30). The cutting or grubbing up of cork and holm oaks depends on authorization from the ICNF (Nature and Forest Conservation Institute), under the risk that any change in land use will be prohibited for 25 years when areas occupied by cork and/or holm oak have been fire, unauthorized cutting or grubbing, abnormal mortality or depreciation.	It does not include cork forest	It does not include cork forest
Electric Network	The RSLEAT (Regulation for high voltage powerlines safety), approved by Regulation Decree nº1/92, 18 of February, defines protection easements for the electrical network. The article 28º of this legal document defines that: - Low and medium voltage lines have a protection strip of 15 meters (1,5 kV to 40 kV) and 25 meters (40kV to 60 kV) - High and Very High voltage lines have a protection strip of 45 meters An overall distance from obstacles is defined at 3.65 meters	The study area does intersect electrical lines.	The site location does not intersect electrical lines.
Road Network	According to the article 32° of National Road Network Statute: Non-edificandi strips are established on municipal roads, measured at the axis of the road or the limit of the road or path zone, as follows: *"8 - After the publication of the act declaring the public utility of the property and the respective parcel plan, the non-edificandi easement areas for new roads, as well as for existing roads, have the following limits* *(a) Motorways and expressways: 50 m to each side of the axis of the road and never less than 20 m from the road area;*	The study area does intersect national and municipal roads or administrative burdens.	The proposed site location does intercept the administrative burdens of the Tertiary System municipal roads/paths.

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
	b) IP: 50 m on each side of the road axis or within the visibility easement and never less than 20 m from the road *c) IC: 35 m on either side of the road centreline or within the right-of-way and in no case less than 15 m from the road* *d) EN and other roads to which this Statute applies: 20 m on either side of the centreline of the road or within the visibility right-of-way and in any case not less than 5 m from the road* *e) Connection nodes: a circle with a 150 m radius centred on the intersection of the road axes, irrespective of their classification.* *9 - For the previous number, connections to IP and IC intersections are considered as EN*."		
Railway Network	According to art 15º of the Decree-Law 276/2003, November 4 the non edificandi burdens are the following: "*1 - In the buildings adjoining or neighbouring railway lines or sidings or other railway facilities for which the application of the present regime is justified, namely electric traction substations, it is forbidden* *(a) to make constructions, buildings, embankments, deposits of materials or planting of trees at a distance of less than 10 m, without prejudice to the provisions of paragraph 2;* *b) Excavations, whatever their depth, to a distance of fewer than 5 m from the railway line, without prejudice to the provisions of paragraph 3."* "*It is also prohibited, in the cases provided for in paragraph 1 of the preceding article:* *d) Maintain industrial activities at a distance of less than 40 m*."	The study area does intersect railways and administrative burdens	The proposed site location does not intersect railways and administrative burdens

Table 2-20 – Regulations and constraints - Setúbal

2.2.8. Valongo

2.2.8.1. Applicable Plans and programmes

Table 2-21 identifies the main spatial planning instruments in force in the area under study, including special, sectorial, regional, and municipal plans. The following sections then present the planning instruments that are of higher priority for consideration to the project.

SCOPE	LAND-USE PLANS AND PROGRAMMES	LEGAL FRAMEWORK
National/Sectorial	National Spatial Planning Policy Program (*PNPOT*)	Law n. º 58/2007, September 4 Rectification Statement nº. 80-A/2007, September 7 Rectification Statement nº 103-A/2007, November 2
	Urbanisation Plan for the Industrial and business of Campo (PUZIEC)	Order n.º 15753/2021, August 20
Regional	Management Plan for the Douro (RH3)	Resolution of the Ministers Council no.52/2016, September 20 Rectification Statement nº.22-B/2016, November 18
	Flood Risk Management Plan for the Douro (RH3)	Resolution of the Ministers Council n. º 51/2016 Rectification Statement nº. 22-A/2016
	Regional Program for Forest Management in between Douro and Minho (PROF-EDM)	Ministerial Normative nº 58/2019, February 11
Municipal	Valongo Municipal Master Plan	Resolution of the Ministers Council n. º168/95, December 12 Order 1634/2015, February 11 Order 1639/2018, February 5 Order 252/2021, January 6
	Valongo Municipal plan for forest defence against fires	Order nº 443A/2018, January 9 Order nº 1222B/2018, February 2

Table 2-21 – Spatial Plans and Programmes in force in study area – Valongo

The regional and municipal scope is particularly relevant for this report. An analysis of the Project compatibility with the objectives set out in the referred plans will be made.

2.2.8.2. Sectorial Scope

2.2.8.2.1. Urbanisation Plan for the Industrial and business of Campo (PUZIEC)

The Urbanisation Plan establishes the rules and guidelines for the occupation, use and soil transformation within the PUZIEC.

The Urbanisation Plan for the Industrial and Business Zone of Campos aims to:

- Promote adjusted land to new industrial activities
- Guarantee the correct structuring and infrastructure of the business area
- Establish norms for the use and allocation of the soil
- Ensure conditions to urban mobility
- Provide proper environmental and urbanistic conditions to ZIEC

- Ensure equity in the distribution of benefits and burdens to the plan's execution

According to the PUZIEC, there are no constraints to the implementation of chemical industry, such as a lithium refinery, however, the placement needs to be within the “Industries and companies settlement areas”.

The proposed site includes non edificandi areas, such as “Green connectivity corridors” and “Green Spaces”.

According to the Order n. º 15753/2021, August 20, art 29º - green connectivity corridors are non edificandi areas.

Concerning the green spaces, the art 31º of the same legal document shows that it is only possible to build support infrastructures, any other use is **forbidden**.

In this sense, as said before, the placement of the refinery must be inside the “Industries and companies settlement areas” for it to be compliant with the PUZIEC. In case it is impossible to avoid these areas, a re-design of the PUZIEC should be agreed with the municipality.

2.2.8.3. Regional Scope

2.2.8.3.1. Hydrographic Management Plan for Douro (HR3)

Hydrographic Region Management Plans (*PGRH*) constitute the planning and conditioning instrument at the water resources level and aim the management, protection and environmental, social and economic valuation of water resources, at the hydrographic basins integrated level. The Resolution of the Ministers Council nº 52/2016 September 20 approved the Hydrographic Region Plans for the Portugal Mainland for the period 2016-2021. The study area is in the Douro Hydrographic Region **(Figure 3.6 of Appendix B – Drawings).**

The project under analysis is a lithium refinery which will necessarily include wastewater treatment to avoid underground and superficial water resources pollution. Considering the respect of the specific requirements there are no incompatibilities of the project with the hydrographic management plan.

2.2.8.3.2. Flood Risk Management Plan for Douro (HR3)

This plan is an instrument for water planning in areas of possible flooding and aims to reduce risk by reducing the potentially harmful consequences for human health, economic activities, cultural heritage, and the environment. The plan consists of a set of measures that have a strategic framework aimed to reduce the risks associated with floods, considering the time taken to implement the measure and the time available to carry it out until 2021.

The measures program is one of the most important parts of the Flood Risk Management Plan, defining the actions, technically and economically feasible, that allow reducing the risks associated with floods, in close articulation with the objectives and measures program defined in the Plan of Hydrographic Region Management.

The project’s study and implementation area does not include floodable areas, nor areas threatened by flooding as shown in Figure 2-30.

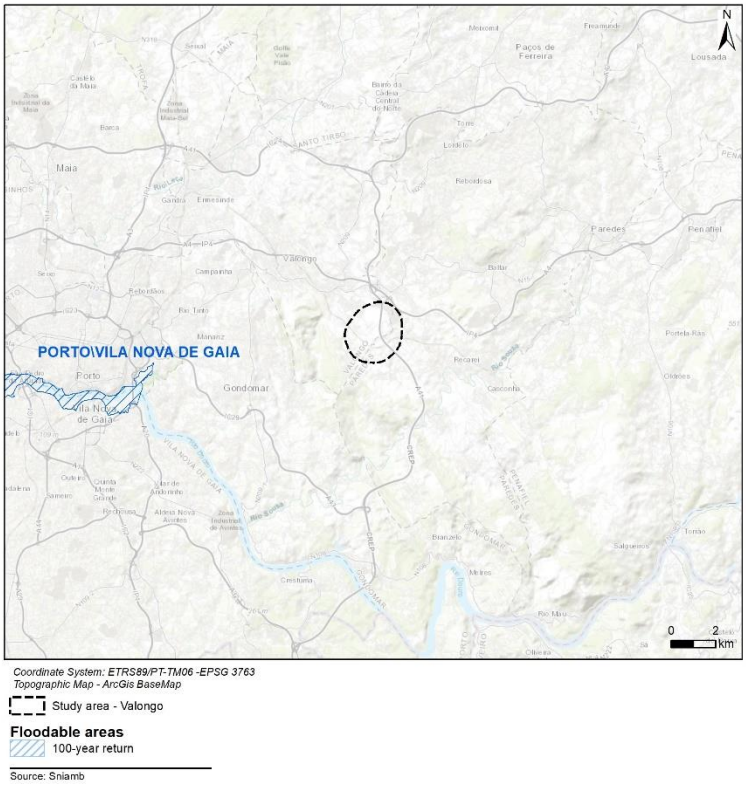


Figure 2-30 – Floodable Areas in Valongo Municipality

2.2.8.3.3. Regional Program For Forest Management For Entre Douro e Minho (PROF-EDM)

The Regional Plans for Forestry Planning (PROF) are defined by the National Forest Policy Basic Law (Law Nº 33/96, August 17) as "sectoral instruments for territorial management" that establish the rules for intervention on occupation and the use of forest spaces.

As sectoral instruments for territorial management, the plan is based on an interconnected approach of technical, economic, environmental, social and institutional aspects, involving economic agents and directly interested populations, to establish a consensual strategy for the management and use of forestry spaces.

According to Figure 2-31, the study intersects protected forest areas and Rede Natura 2000. Regarding the site location, it is within sensitive forest areas.

Sensitive forest areas are, from the point of view of fire risk, exposure to pests and diseases, sensitivity to erosion and ecological, social and cultural importance, require special rules and measures for planning and intervention.

Intervention in sensitive forest areas "*must respect the silvicultural standards set out in Chapter E of the report of the PROF Entre Douro e Minho, specifically for these areas and which are referred to in Annex I*."

From the PROF analysis, it is concluded that it does not present specific impediments concerning the installation of the project on the proposed site.

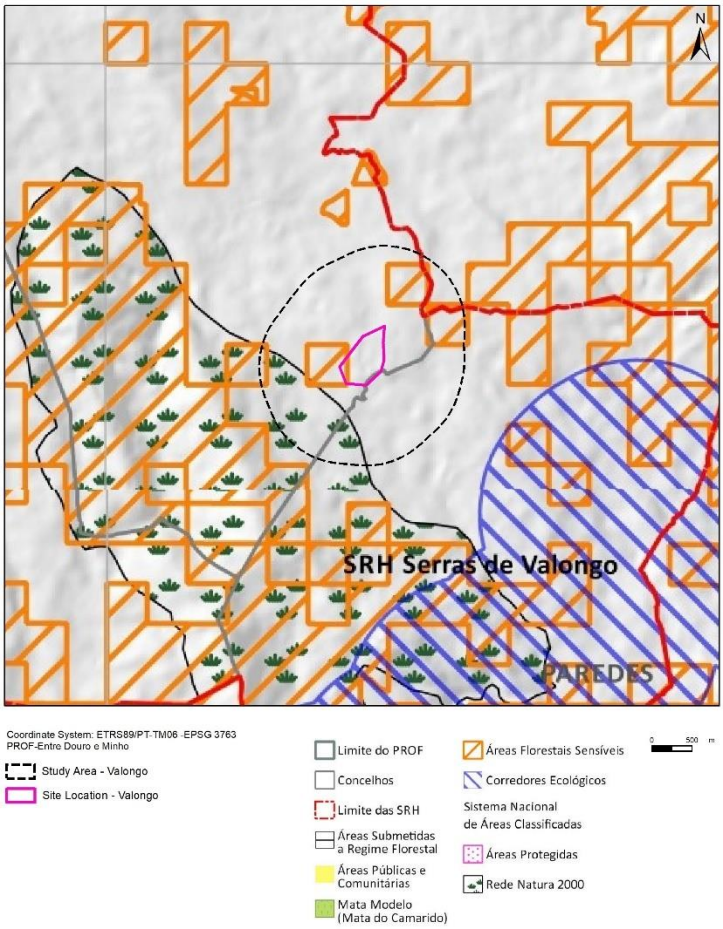


Figure 2-31 – Project framework in the PROF-EDM (Valongo)

2.2.8.3.4. Municipal Scope

2.2.8.3.4.1. Valongo Master Plan

The guidelines mentioned on the hierarchically superior plans must be taken into consideration at the municipal level, and it is the responsibility of the municipalities to establish these guidelines into the respective Municipal Master Plan.

Municipal Plans are the most relevant spatial planning instruments for the present analysis, since the territorial management model they advocate at a local scale may be directly affected due to the implementation of the project under analysis.

The study area is under the regulation of the Valongo Municipal Master Plan. Depending on the proposed dominant use, the Municipal Master Plan in question categorises the study as mapped in the Spatial Planning Plan **(Figure 4.6.1 to 4.6.4 of Appendix B – Drawings).** It should be noted that the spaces destined to industrial areas were fully considered to choose the site location.

The implementation area is mainly within land classified as Business and Industrial Area which allows the compliance with the Valongo master plan, as long as it adopts the necessary technical measures to avoid the increase of human and environmental risks.

However, it is worth noting that there are other classified areas inside the project area, namely, planned distribution route and protection strip, green spaces, and municipal ecological structure. In these areas, the

construction of any building is either **constrained** or **forbidden**, see section "Constraints, administrative easements and public interest restrictions". Plant design should considerer the constraints related to these areas and the validation from the Valongo municipality.

2.2.8.3.4.2. Municipal Plan for Forest Defence against fires

Decree-Law nº 17/2009[14], January 14 structures the Forest Defence System against Fires), which provides a set of measures and actions for institutional articulation, planning and intervention related to prevention and protection of forests against fires. Municipal Plans for Forest Defence Against Fires (*PMDFCI*) at the municipal or inter-municipal level has the necessary actions for forest defines and, in addition to the prevention actions, including forecasting and the interventions by the different entities involved in a possible fire.

Regarding the project's area, as shown in Figure 2-32, it is possible to observe that the fire hazard index is mainly non-classified.

It should be note that the site location was affected in 2016 and 2017 by wildfires, according to the Decree 55/2007, March 12, "*On land with forest stands covered by fire, not included in municipal land management plans as urban land, construction works of any buildings are prohibited for a period of 10 years*". Currently the site location is classified as urban land, allowing the compliance with the legal document.

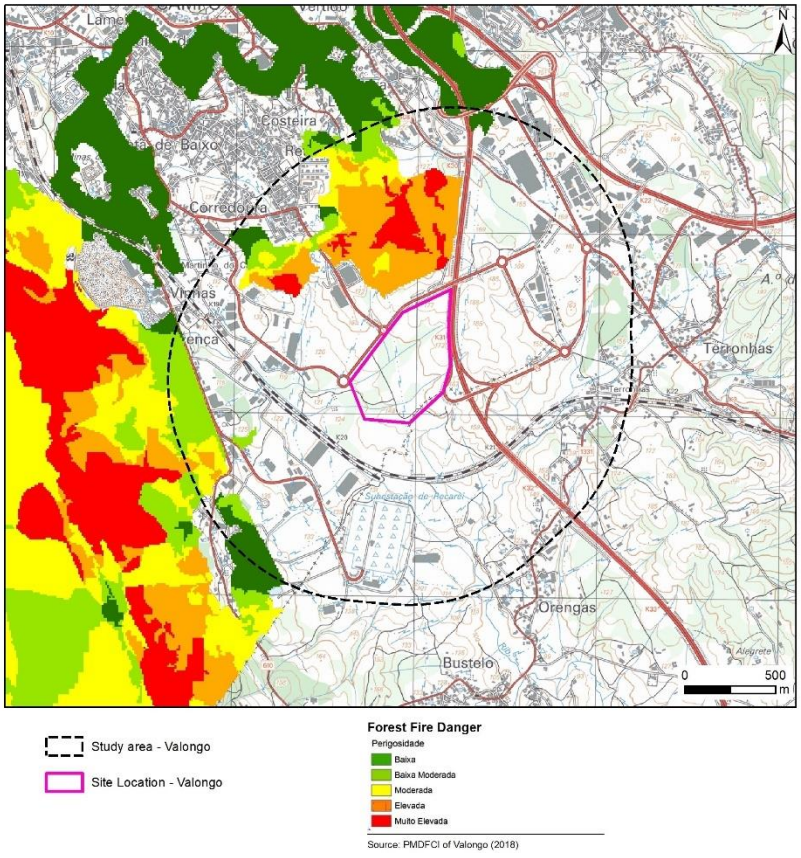


Figure 2-32 - Forest Fire Danger for Valongo Municipality

[14] amends and republishes Decree-Law nº 124/2006, June 2 and whose fifth amendment by Law no. 76/2017, of 17 August, was rectified by Statement of Rectification No. 27/2017 of 2 October,

2.2.8.3.5. Constraints, administrative easements and public interest restrictions

Public easements and restrictions are limitations or impediments to any specific form of land use. The knowledge of these areas is essential to determine the limits of their use and to inform the proponent of the situations in which the change in land use requires consultation with specific competence entities, in addition to the municipality to which the area belongs.

In **Figures 5.6.1, 5.6.2 and 5.6.3 of Appendix B – Drawings** it is possible to observe the PMD restrictions.

In **Figure 6.5 of Appendix B – Drawings** it is possible to observe the REN restrictions.

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
National Ecological Reserve (REN)	The legal regime established by Decree-Law Nº. 166/2008, August 22, amended by Decree-Law Nº. 124/2019, August 28; Normative No. 419/2012, December 20, defines the conditions and requirements to which the uses and actions that are compatible with the objectives of the areas integrated in REN are subject to and the instructive elements of the administrative procedures provided for in the legal regime, as well as the uses and actions that need the authorization of the Portuguese Environment Agency, IP Constructive actions, hydraulic works, landfills, excavations and destruction of vegetation cover are prohibited, with exceptions subject to authorization or prior communication from CCDR-Norte. Of the actions compatible with REN, the following is noted under the points of number II - Infrastructure of Annex II of Decree-Law No. 124/2019, August 28: • "*e) Ampliation of existing edification of industrial use, energy and geologic resources*."	REN areas are intersected: Watercourse	It does not affect REN
National Agricultural Reserve (RAN)	The legal regime established by Decree-Law nº 73/2009, March 31st modified by Decree-Law n.º 199/2015, September 16th is a territorial management instrument, which consists of a restriction of public utility, by establishing a set of constraints on non-agricultural use of the soil, and which plays a key role in preserving the soil resource and its allocation to agriculture. "*In RAN areas non-agricultural uses are exceptionally permitted when considered compatible with the goals of agricultural activity protection, subject to a binding prior opinion or prior notification to the territorially competent regional entity (ERRA)"*	RAN areas are intersected:	It does not affect RAN
Public Water Domain (PWD)	Law nº 54/2005, November 11 (amended by Statement of Rectification nº 4/2006, January 16, and the latest amendment is given by Law nº. 31/2016, August 23), determines that an easement strip of 10 m from the edges of water lines must be respected and not occupied. It is also necessary to consider the salt marsh associated with the Sado Estuary which falls into the public maritime domain constraints, namely an easement strip of 50 m (article 11) that can not be occupied. If it is necessary to proceed with the occupation and use of the Water Domain, this action requires authorization / licensing from the Portuguese Environment Agency (APA).	Intersects water lines of 1st and 2nd order	Intersects water lines of 1st order which means that it does affect Water Domain. A request for usage of this area must be made (TURH), and the project must assure the maintenance of the water course.

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
Electric Network	The RSLEAT (Regulation for high voltage powerlines safety), approved by Regulation Decree nº1/92, 18 of February, defines protection easements for the electrical network. The article 28º of this legal document defines that: - Low and medium voltage lines have a protection strip of 15 meters (1,5 kV to 40 kV) and 25 meters (40kV to 60 kV) - High and Very High voltage lines have a protection strip of 45 meters An overall distance from obstacles is defined at 3,65 meters	The study area intersects high/very high voltage electrical lines	The site selection does intersect the electrical network. Considering this the project must be submitted to EDP or REN for approval.
Road Network	According to the article 32° of National Road Network Statute: Non-edificandi strips are established on municipal roads, measured at the axis of the road or the limit of the road or path zone, as follows: "*8 - After the publication of the act declaring the public utility of the property and the respective parcel plan, the non-edificandi easement areas for new roads, as well as for existing roads, have the following limits* *(a) Motorways and expressways: 50 m to each side of the axis of the road and never less than 20 m from the road area;* *b) IP: 50 m on each side of the road axis or within the visibility easement and never less than 20 m from the road* *c) IC: 35 m on either side of the road centreline or within the right-of-way and in no case less than 15 m from the road* *d) EN and other roads to which this Statute applies: 20 m on either side of the centreline of the road or within the visibility right-of-way and in any case not less than 5 m from the road* *e) Connection nodes: a circle with a 150 m radius centred on the intersection of the road axes, irrespective of their classification.* *9 - For the previous number, connections to IP and IC intersections are considered as EN*."	The study area intersects the highway A41/IC24 and the municipal network	The site selection does not intersect any classified road network. However, being in the close vicinity it is necessary to assure the legal assessment form the national road (in this case, 50 m)
Railway Network	According to art 15º of the Decree-Law 276/2003, November 4 the non edificandi burdens are the following: "*1 - In the buildings adjoining or neighbouring railway lines or sidings or other railway facilities for which the application of the present regime is justified, namely electric traction substations, it is forbidden* *(a) to make constructions, buildings, embankments, deposits of materials or planting of trees at a distance of less than 10 m, without prejudice to the provisions of paragraph 2;*	The study area intersects the railway network	The site selection does not intersect the railway network

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
	b) Excavations, whatever their depth, to a distance of fewer than 5 m from the railway line, without prejudice to the provisions of paragraph 3." "*It is also prohibited, in the cases provided for in paragraph 1 of the preceding article: d) Maintain industrial activities at a distance of less than 40 m*."		

Table 2-22 – Regulations and constraints – Valongo

2.2.9. Trofa

2.2.9.1. Applicable Plans and programmes

Table 2-23 identifies the main spatial planning instruments in force in the area under study, including special, sectoral, regional, and municipal plans. The following sections then present the planning instruments that are of higher priority for consideration to the project.

SCOPE	LAND-USE PLANS AND PROGRAMMES	LEGAL FRAMEWORK
National	National Spatial Planning Policy Program (*PNPOT*)	Law n. º 58/2007, September 4 Rectification Statement nº. 80-A/2007, September 7 Rectification Statement nº 103-A/2007, November 2
Regional	Management Plan for the Cávado, Ave and Leça (RH2)	Resolution of the Ministers Council no.52/2016, September 20 Rectification Statement nº.22-B/2016, November 18
	Flood Risk Management Plan for the Cávado, Ave and Leça (RH2)	Resolution of the Ministers Council n. º 51/2016 Rectification Statement nº. 22-A/2016
	Regional Program for Forest Management for Baixo Minho (PROF EDM)	Ministerial Normative nº 58/2019, February 11
Municipal	Trofa Municipal Master Plan	Order nº 6116/2018, May 9 Order nº 12983/2019, August 14 Order 18694/2021,October 1
	Trofa Municipal plan for forest defence against fires	Order nº 443A/2018, January 9 Order nº 1222B/2018, February 2

Table 2-23 – Spatial Plans and Programmes in force in the study area - Trofa

The regional and municipal scopes are particularly relevant for this report. An analysis of the Project compatibility with the objectives set out in the referred plans will be made.

2.2.9.2. Regional Scope

2.2.9.2.1. Hydrographic Management Plan for Cávado, Ave and Leça (HR2)

Hydrographic Region Management Plans (*PGRH*) constitute the planning and conditioning instrument at the water resources level and aim the management, protection and environmental, social and economic valuation of water resources, at the hydrographic basins integrated level. The Resolution of the Ministers Council nº 52/2016 September 20 approved the Hydrographic Region Plans for the Portugal Mainland for the period 2016-2021. The study area is in the Cávado, Ave and Leça Hydrographic Region **(Figure 3.7 of Appendix B – Drawings).**

The project under analysis is a lithium refinery which will necessarily include wastewater treatment to avoid underground and superficial water resources pollution. Considering the respect of the specific requirements there are no incompatibilities of the project with the hydrographic management plan.

2.2.9.2.2. Flood Risk Management Plan for Cávado, Ave and Leça (HR2)

This plan is an instrument for water planning in areas of possible flooding and aims to reduce risk by reducing the potentially harmful consequences for human health, economic activities, cultural heritage, and the environment. The plan consists of a set of measures that have a strategic framework aimed to reduce the risks

associated with floods, considering the time taken to implement the measure and the time available to carry it out until 2021.

The measures program is one of the most important parts of the Flood Risk Management Plan, defining the actions, technically and economically feasible, that allow reducing the risks associated with floods, in close articulation with the objectives and measures program defined in the Plan of Hydrographic Region Management.

The project's study and implementation area does not include floodable areas, nor areas threatened by flooding as shown in Figure 2-33.

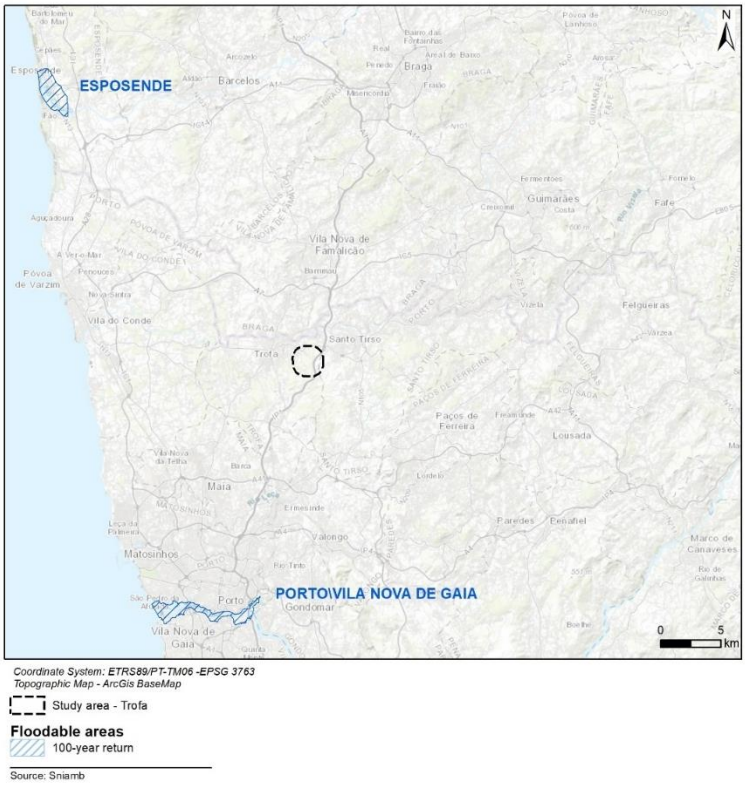


Figure 2-33 – Floodable Areas in the surroundings of Trofa Municipality

2.2.9.2.3. Regional Program for Forest Management of Entre Douro e Minho (PROF-EDM)

The Regional Plans for Forestry Planning (PROF) are defined by the National Forest Policy Basic Law (Law Nº 33/96, August 17) as "sectoral instruments for territorial management" that establish the rules for intervention on occupation and the use of forest spaces.

As sectoral instruments for territorial management, the plan is based on an interconnected approach of technical, economic, environmental, social and institutional aspects, involving economic agents and directly interested populations, to establish a consensual strategy for the management and use of forestry spaces.

According to Figure 2-34, the study area intersects sensitive forest areas and an ecological corridor. Regarding the site location, it is within sensitive forest areas.

Sensitive forest areas are, from the point of view of fire risk, exposure to pests and diseases, sensitivity to erosion and ecological, social and cultural importance, require special rules and measures for planning and intervention.

Intervention in sensitive forest areas "must respect the silvicultural standards set out in Chapter E of the report of the PROF Entre Douro e Minho, specifically for these areas and which are referred to in Annex I."

From the PROF analysis, it is concluded that it does not present specific impediments concerning the installation of the project on the proposed site.

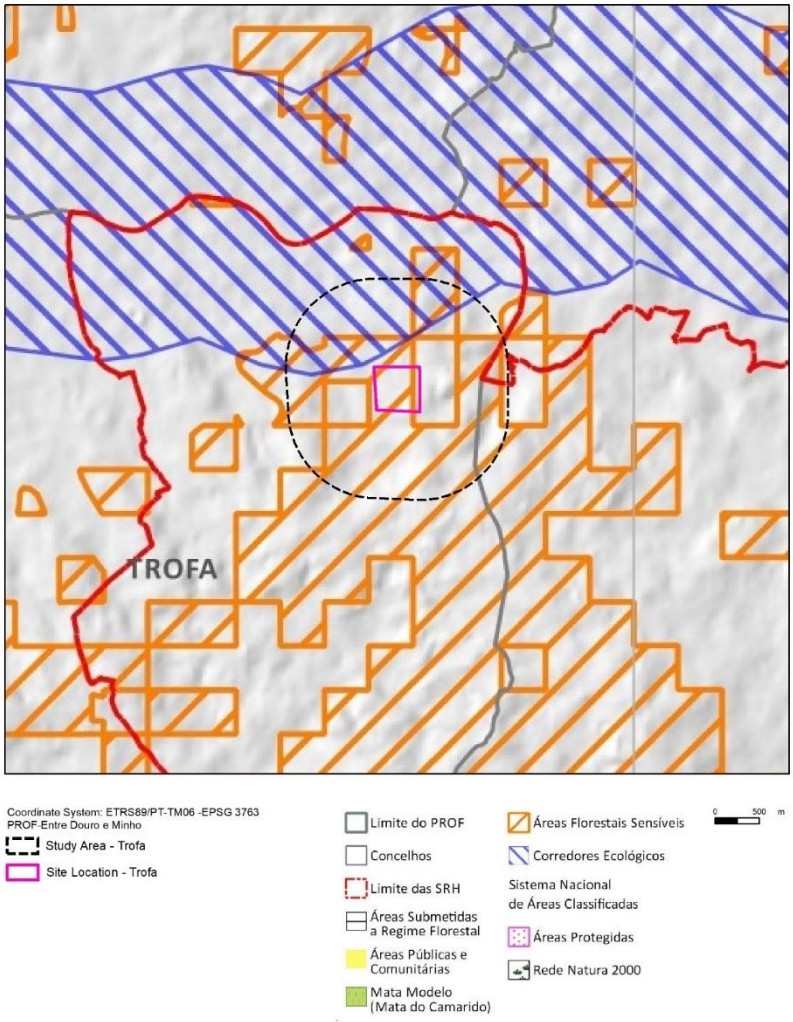


Figure 2-34 – Project framework in the PROF-EDM (Trofa)

2.2.9.3. Municipal Scope

2.2.9.3.1. Trofa Master Plan

The guidelines mentioned on the hierarchically superior plans must be taken into consideration at the municipal level, and it is the responsibility of the municipalities to establish these guidelines into the respective Municipal Master Plan.

Municipal Plans are the most relevant spatial planning instruments for the present analysis, since the territorial management model they advocate at a local scale may be directly affected due to the implementation of the project under analysis.

The study area is under the regulation of the Trofa Municipal Master Plan. Depending on the proposed dominant use, the Municipal Master Plan in question categorises the study as mapped in the Spatial Planning Plan **(Figure 4.7.1 to 4.7.4 of Appendix B – Drawings).** It should be noted that the spaces designated as industrial areas were fully considered against the site location.

The implementation area is within land classified as Economic Activities Areas which allows compliance with the Trofa master plan, as long as it adopts the necessary technical measures to avoid the increase of human and environmental risks.

It is worth noting that there are other classified areas inside the project area in analysis, namely, production forest areas, and municipal ecological structure. In these areas, which only occupies a small piece of land in the south, the construction of any building is either **constrained** or **forbidden.** In spite of it being small, the Plant design should considerer the constraints related to these areas.

CLASS	REGULATIONS
Production forest areas	Art 32º - These areas are intended to take advantage of the productive potential according to forestry models aimed at protecting and restoring the ecological balance of the stations, protecting the hydrographic network, controlling water erosion or increasing pedogenesis. Art 33º - On Forest Areas the building permit regime, without prejudice to specific legislation legislation in force, is restricted to the following cases: (…) f) Works for the construction of non-linear infrastructures of public interest, recognized by the Municipality as essential for the implementation of the Municipality's development strategies;
Municipal ecological structure	Art 87º - In the municipal ecological structure areas on rural land, the regime of the different categories and subcategories of spaces defined in the Plan applies, cumulatively with the following provisions: a) Preservation of traditional structures associated with agricultural activity, such as wells, tanks, mills and stone walls; b) Maintenance of the hedges dividing the landscape; c) Compliance with the code of good agricultural practice for the protection of water against nitrate pollution from agricultural sources; d) Preservation of the riparian gallery of watercourses.

Table 2-24 – Space classes with edification constraints and prohibitions - Trofa

2.2.9.3.2. Municipal Plan for Forest Defence against fires

Decree-Law nº 17/2009[15], January 14 structures the Forest Defence System against Fires, which provides a set of measures and actions for institutional articulation, planning and intervention related to prevention and protection of forests against fires. Municipal Plans for Forest Defence Against Fires (*PMDFCI*) at the municipal or inter-municipal level has the necessary actions for forest defines and, in addition to the prevention actions, including forecasting and the interventions by the different entities involved in a possible fire.

Regarding the project's area, as shown in Figure 2-35, it is possible to observe that the fire hazard index is mainly non-classified, with a few areas with medium and high indexes on the southside of the site location. According to the Decree n. º 82/2021, October 13:

[15] amends and republishes Decree-Law nº 124/2006, June 2 and whose fifth amendment by Law no. 76/2017, of 17 August, was rectified by Statement of Rectification No. 27/2017 of 2 October,

Art 60º

"1 - *In the APPS areas corresponding to the "high" and "very high" rural fire hazard classes (…) under article 41(6),* ***on rural land****, except for rural settlements,* ***the uses and actions of public or private*** *initiative that result in* ***allotment operations and construction works are prohibited.***"

Considering that the plant will be placed within the urban land of the proposed site location, this constraint does not apply and therefore complies with the legal document for the Integrated Management of Rural Fires.

It should be noted that the site location was affected in 2015 and 2017 by wildfires, according to the Decree 55/2007, March 12, "*On land with forest stands covered by fire, not included in municipal land management plans as urban land, construction works of any buildings are prohibited for 10 years*". Currently, the majority of the site location is classified as urban land, allowing compliance with the legal document.

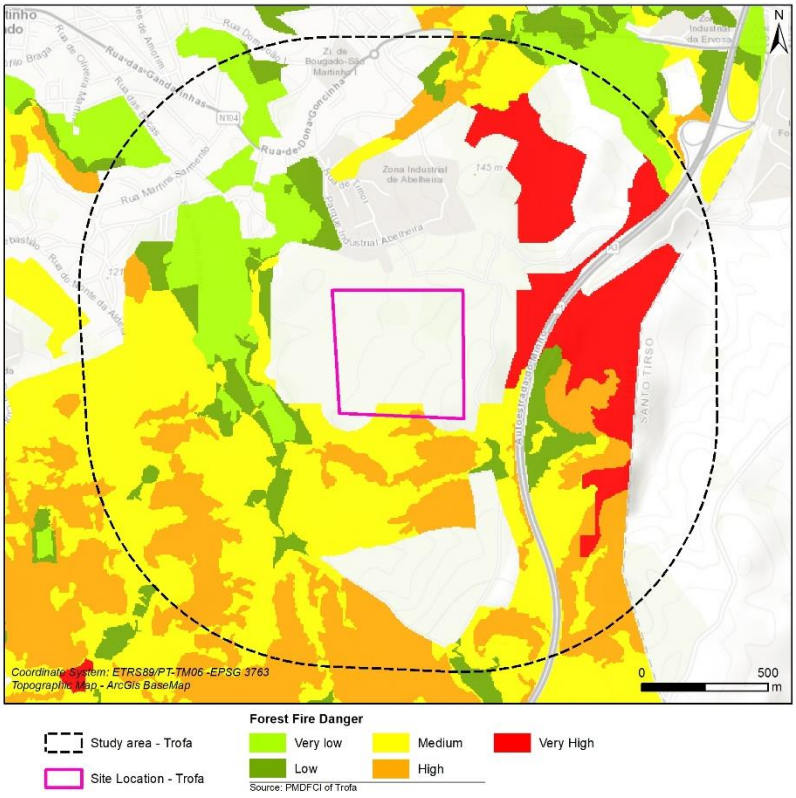


Figure 2-35 - Forest Fire Danger for Trofa Municipality

2.2.9.4. Constraints, administrative easements and public interest restrictions

Public easements and restrictions are limitations or impediments to any specific form of land use. The knowledge of these areas is essential to determine the limits of their use and to inform the proponent of the situations in which the change in land use requires consultation with specific competence entities, in addition to the municipality to which the area belongs.

In **Figures 5.7.1, and 5.7.2 of Appendix B – Drawings** it is possible to observe the PMD restrictions.

In **Figure 6.6 of Appendix B – Drawings** it is possible to observe the REN restrictions.

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
National Ecological Reserve (REN)	The legal regime established by Decree-Law Nº. 166/2008, August 22, amended by Decree-Law Nº. 124/2019, August 28; Normative No. 419/2012, December 20, defines the conditions and requirements to which the uses and actions that are compatible with the objectives of the areas integrated in REN are subject to and the instructive elements of the administrative procedures provided for in the legal regime, as well as the uses and actions that need the authorization of the Portuguese Environment Agency, IP Constructive actions, hydraulic works, landfills, excavations and destruction of vegetation cover are prohibited, with exceptions subject to authorization or prior communication from CCDR-Norte. Of the actions compatible with REN, the following is noted under the points of number II - Infrastructure of Annex II of Decree-Law No. 124/2019, August 28: • "*e) Ampliation of existing edification of industrial use, energy and geologic resources*."	REN areas are intersected: Areas threatened by floods Erosion risk areas Headwaters	The site location and the plant design do not affect REN
National Agricultural Reserve (RAN)	The legal regime established by Decree-Law nº 73/2009, March 31st modified by Decree-Law n.º 199/2015, September 16th is a territorial management instrument, which consists of a restriction of public utility, by establishing a set of constraints on non-agricultural use of the soil, and which plays a key role in preserving the soil resource and its allocation to agriculture. "*In RAN areas non-agricultural uses are exceptionally permitted when considered compatible with the goals of agricultural activity protection, subject to a binding prior opinion or prior notification to the territorially competent regional entity (ERRA)"*	RAN is intersected	The site location and the plant design do not affect RAN
Public Water Domain (PWD)	Law nº 54/2005, November 11 (amended by Statement of Rectification nº 4/2006, January 16, and the latest amendment is given by Law nº. 31/2016, August 23), determines that an easement strip of 10 m from the edges of water lines must be respected and not occupied. It is also necessary to consider the salt marsh associated with the Sado Estuary which falls into the public maritime domain constraints, namely an easement strip of 50 m (article 11) that cannot be occupied. If it is necessary to proceed with the occupation and use of the Water Domain, this action requires authorization / licensing from the Portuguese Environment Agency (APA – ARH Norte).	Intersects water lines with hydrological expression.	Intersects water lines of 1st and 2nd order which means that it does affect Water Domain. A request for usage of this area must be made (TURH), and the project must assure the maintenance of the water course.

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
Electric Network	The RSLEAT (Regulation for high voltage powerlines safety), approved by Regulation Decree nº1/92, 18 of February, defines protection easements for the electrical network. The article 28º of this legal document defines that: - Low and medium voltage lines have a protection strip of 15 meters (1,5 kV to 40 kV) and 25 meters (40kV to 60 kV) - High and Very High voltage lines have a protection strip of 45 meters An overall distance from obstacles is defined at 3,65 meters	The study area intersects high voltage electrical lines	The site selection does not intersect the electrical network
Road Network	According to the article 32° of National Road Network Statute: Non-edificandi strips are established on municipal roads, measured at the axis of the road or the limit of the road or path zone, as follows: "*8 - After the publication of the act declaring the public utility of the property and the respective parcel plan, the non-edificandi easement areas for new roads, as well as for existing roads, have the following limits* *(a) Motorways and expressways: 50 m to each side of the axis of the road and never less than 20 m from the road area;* *b) IP: 50 m on each side of the road axis or within the visibility easement and never less than 20 m from the road* *c) IC: 35 m on either side of the road centreline or within the right-of-way and in no case less than 15 m from the road* *d) EN and other roads to which this Statute applies: 20 m on either side of the centreline of the road or within the visibility right-of-way and in any case not less than 5 m from the road* *e) Connection nodes: a circle with a 150 m radius centred on the intersection of the road axes, irrespective of their classification.* *9 - For the previous number, connections to IP and IC intersections are considered as EN*."	The study area intersects the highway A3 and the EN 104	The site selection does not intersect any classified road network

Table 2-25 – Regulations and constraints – Trofa

2.2.10. Fafe

2.2.10.1. Applicable Plans and programmes

Table 2-23 identifies the main spatial planning instruments in force in the area under study, including special, sectorial, regional, and municipal plans. The following sections then present the planning instruments that are of higher priority for consideration to the project.

SCOPE	LAND-USE PLANS AND PROGRAMMES	LEGAL FRAMEWORK
National	National Spatial Planning Policy Program (*PNPOT*)	Law n. º 58/2007, September 4 Rectification Statement nº. 80-A/2007, September 7 Rectification Statement nº 103-A/2007, November 2
Regional	Management Plan for the Cávado, Ave and Leça (RH2)	Resolution of the Ministers Council no.52/2016, September 20 Rectification Statement nº.22-B/2016, November 18
	Management Plan for the Douro (RH3)	Resolution of the Ministers Council no.52/2016, September 20 Rectification Statement nº.22-B/2016, November 18
	Flood Risk Management Plan for the Cávado, Ave and Leça (RH2)	Resolution of the Ministers Council n. º 51/2016 Rectification Statement nº. 22-A/2016
	Flood Risk Management Plan for the Douru (RH3)	Resolution of the Ministers Council n. º 51/2016 Rectification Statement nº. 22-A/2016
	Regional Program for Forest Management for Baixo Minho (PROF EDM)	Ministerial Normative nº 58/2019, February 11
Municipal	Fafe Municipal Master Plan	Order nº 10198/2015, September 7 Order nº 9711/2016, August 5 Order nº 6053/2019, April 3 Order nº 10346/2020, July 13
	Fafe Municipal plan for forest defence against fires	Order nº 443A/2018, January 9 Order nº 1222B/2018, February 2

Table 2-26 – Spatial Plans and Programmes in force in the study area - Fafe

The regional and municipal scope is particularly relevant for this report. An analysis of the Project compatibility with the objectives set out in the referred plans will be made.

2.2.10.2. Regional Scope

2.2.10.2.1. Hydrographic Management Plan for Cávado, Ave and Leça (HR2) and Douro (RH3)

Hydrographic Region Management Plans (*PGRH*) constitute the planning and conditioning instrument at the water resources level and aim the management, protection and environmental, social and economic valuation of water resources, at the hydrographic basins integrated level. The Resolution of the Ministers Council nº 52/2016 September 20 approved the Hydrographic Region Plans for the Portugal Mainland for the period 2016-2021. The study area is in the Cávado, Ave and Leça Hydrographic Region and the Douro Hydrographic Region **(Figure 3.8 of Appendix B – Drawings).**

The project under analysis is a lithium refinery which will necessarily include wastewater treatment to avoid underground and superficial water resources pollution. Considering the respect of the specific requirements there are no incompatibilities of the project with the hydrographic management plan.

2.2.10.2.2. Flood Risk Management Plan for Cávado, Ave and Leça (HR2) and Douro (HR3)

This plan is an instrument for water planning in areas of possible flooding and aims to reduce risk by reducing the potentially harmful consequences for human health, economic activities, cultural heritage, and the environment. The plan consists of a set of measures that have a strategic framework aimed to reduce the risks associated with floods, considering the time taken to implement the measure and the time available to carry it out until 2021.

The measures program is one of the most important parts of the Flood Risk Management Plan, defining the actions, technically and economically feasible, that allow reducing the risks associated with floods, in close articulation with the objectives and measures program defined in the Plan of Hydrographic Region Management.

The project's study and implementation area does not include floodable areas, nor areas threatened by flooding as shown in Figure 2-36.

Figure 2-36 – Floodable Areas in the surroundings of Fafe Municipality

2.2.10.2.3. Regional Program For Forest Management Entre Douro e Minho (PROF-EDM)

The Regional Plans for Forestry Planning (PROF) are defined by the National Forest Policy Basic Law (Law Nº 33/96, August 17) as "sectoral instruments for territorial management" that establish the rules for intervention on occupation and the use of forest spaces.

As sectoral instruments for territorial management, the plan is based on an interconnected approach of technical, economic, environmental, social and institutional aspects, involving economic agents and directly interested populations, to establish a consensual strategy for the management and use of forestry spaces.

According to Figure 2-37, the study area intersects protected forest areas and an ecological corridor . Therefore the site location, it is within forest protected areas and the ecological corridor.

Sensitive forest areas are, from the point of view of fire risk, exposure to pests and diseases, sensitivity to erosion and ecological, social and cultural importance, require special rules and measures for planning and intervention.

Ecological corridors promote the maintenance of biodiversity and the suitable development of human activities in these areas.

Intervention in sensitive forest areas and ecological corridors "*must respect the silvicultural standards set out in Chapter E of the report of the PROF Entre Douro e Minho, specifically for these areas and which are referred to in Annex I.*"

From the PROF analysis, it is concluded that it does not present specific impediments concerning the installation of the project on the proposed site.

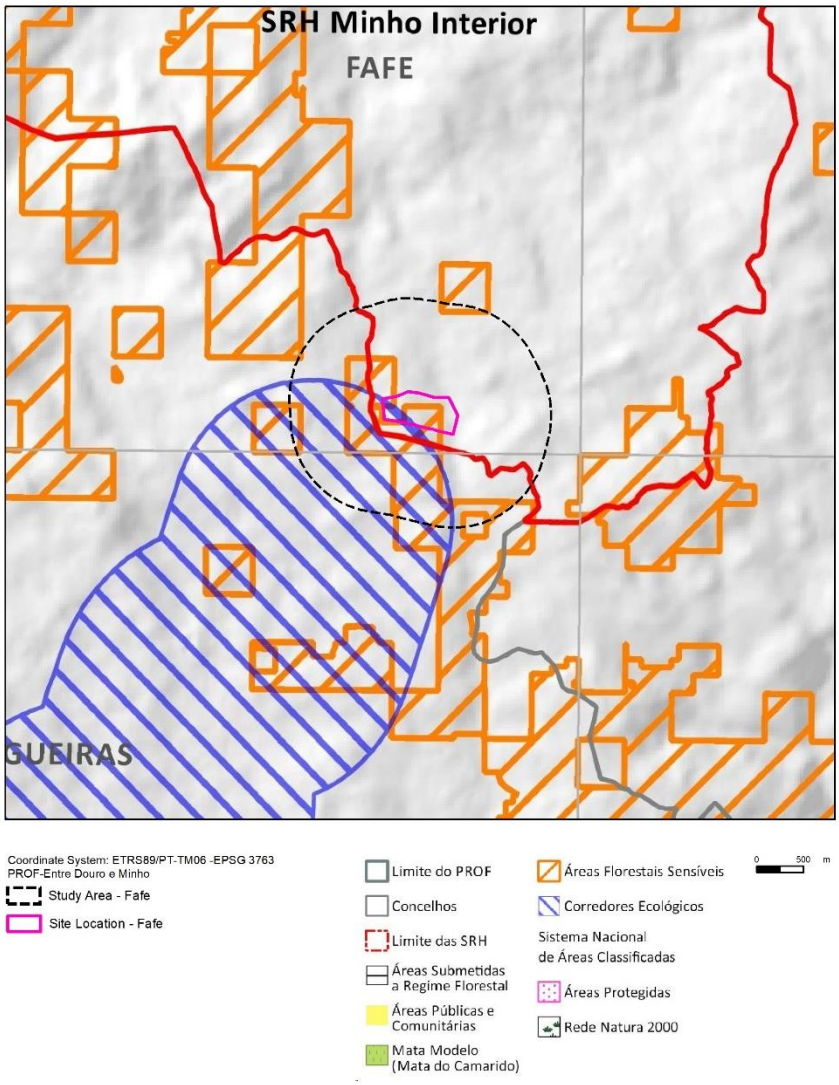


Figure 2-37 – Project framework in the PROF-EDM (Fafe)

2.2.10.3. Municipal Scope

2.2.10.3.1. Fafe Master Plan

The guidelines mentioned on the hierarchically superior plans must be taken into consideration at the municipal level, and it is the responsibility of the municipalities to establish these guidelines into the respective Municipal Master Plan.

Municipal Plans are the most relevant spatial planning instruments for the present analysis, since the territorial management model they advocate at a local scale may be directly affected due to the implementation of the project under analysis.

The study area is under the regulation of the Fafe Municipal Master Plan. Depending on the proposed dominant use, the Municipal Master Plan in question categorises the study as mapped in the Spatial Planning Plan **(Figure 4.8.1 to 4.8.4 of Appendix B – Drawings).** It should be noted that the spaces designated as industrial areas were fully considered against the site location.

The implementation area is mainly within land classified as Economic Activities Areas which allows the compliance with the Fafe master plan, as long as it adopts the necessary technical measures to avoid the increase of human and environmental risks.

Worth noting that there are other classified areas inside the project area, namely, agricultural areas and production forest areas. In these areas, the construction of any building is either **constrained** or **forbidden**. The plant design should considerer the constraints related to these areas and the validation from the Fafe municipality.

CLASS	REGULATIONS
Agricultural areas	Art 38º - Building in agricultural areas is exceptional Art 39º - 5- Construction for other uses is only admissible, on an exceptional basis and if permitted by applicable legislation and regulations, and is subject to compliance with the conditions set forth in Article 27 and Article 28 and also the following conditions: (a) The maximum land use index (Iu) of 0.90; b) Soil occupation index (Io) maximum of 45 % c) The number of floors cannot exceed two, with an optional basement; d) The height of the main façade shall not exceed 9 m; e) Compliance with the applicable legislation and regulations, namely those relating to the SNDFCI and the PMDFCI rules for the new buildings on rural land; f) One parking space for light vehicles must be guaranteed f) One parking space for light vehicles must be provided for every 100m² of the construction area of the building.
Production forest areas	Art 45º - 5- Construction for other uses is only admissible, on an exceptional basis and if permitted by applicable legislation and regulations, and is subject to compliance with the conditions set forth in Article 27 and Article 28 and also the following conditions: (a) The maximum land use index (Iu) of 0.90; b) Soil occupation index (Io) maximum of 45 % c) The number of floors cannot exceed two, with an optional basement; d) The height of the main façade shall not exceed 9 m; e) One parking space for light vehicles must be provided for every 100m² of construction area.

Table 2-27 – Space classes with edification constraints and prohibitions - Fafe

2.2.10.3.2. Municipal Plan for Forest Defence against fires

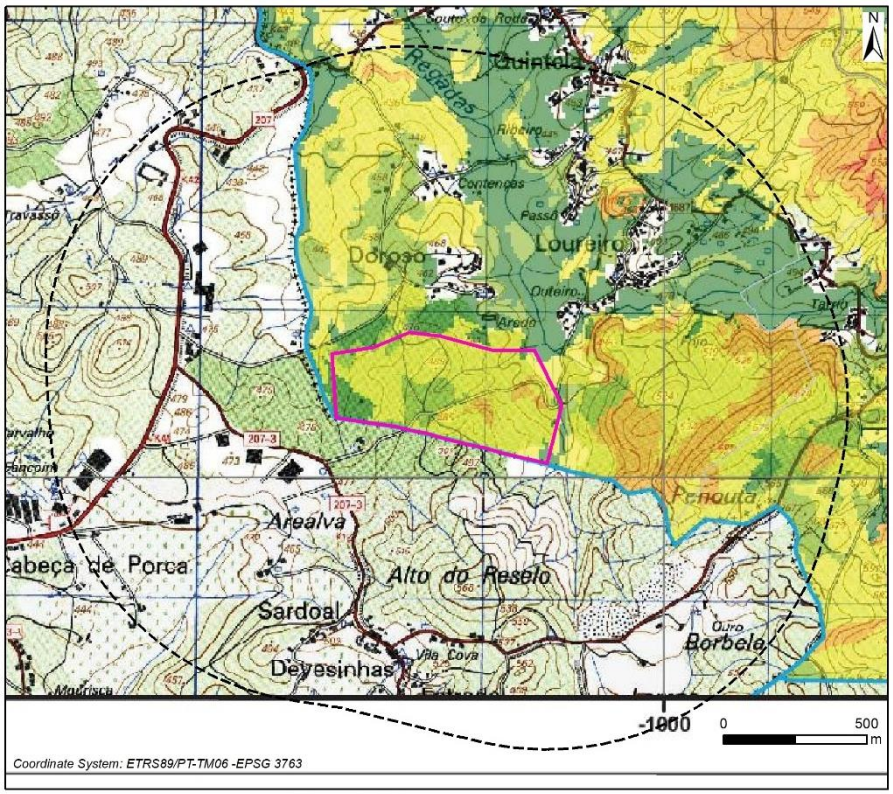
Decree-Law nº 17/2009[16], January 14 structures the Forest Defence System against Fires), which provides a set of measures and actions for institutional articulation, planning and intervention related to prevention and protection of forests against fires. Municipal Plans for Forest Defence Against Fires (*PMDFCI*) at the municipal or inter-municipal level has the necessary actions for forest defines and, in addition to the prevention actions, including forecasting and the interventions by the different entities involved in a possible fire.

Regarding the project's area, as shown in Figure 2-38, it is possible to observe that the fire hazard index is mainly medium, with the occurrence of a few areas with high, low and very low indexes. According to the Decree n. º 82/2021, October 13:

Art 60º

"*1 - In the APPS areas corresponding to the "high" and "very high" rural fire hazard classes (…) under article 41(6),* ***on rural land****, except for rural settlements,* ***the uses and actions of public or private*** *initiative that result in* ***allotment operations and construction works are prohibited*****."**

Although the proposed site location is mainly within urban land, the area defined has forest protected areas within the site location and therefore cannot be occupied with new construction as it is an APPS area.



[16] amends and republishes Decree-Law nº 124/2006, June 2 and whose fifth amendment by Law no. 76/2017, of 17 August, was rectified by Statement of Rectification No. 27/2017 of 2 October,

Figure 2-38 - Forest Fire Danger for Fafe Municipality

2.2.10.4. Constraints, administrative easements and public interest restrictions

Public easements and restrictions are limitations or impediments to any specific form of land use. The knowledge of these areas is essential to determine the limits of their use and to inform the proponent of the situations in which the change in land use requires consultation with specific competence entities, in addition to the municipality to which the area belongs.

In **Figures 5.8.1 to 5.8.5 of Appendix B – Drawings** it is possible to observe the PMD restrictions.

In **Figure 6.7 of Appendix B – Drawings** it is possible to observe the REN restrictions.

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
National Ecological Reserve (REN)	The legal regime established by Decree-Law Nº. 166/2008, August 22, amended by Decree-Law Nº. 124/2019, August 28; Normative No. 419/2012, December 20, defines the conditions and requirements to which the uses and actions that are compatible with the objectives of the areas integrated in REN are subject to and the instructive elements of the administrative procedures provided for in the legal regime, as well as the uses and actions that need the authorization of the Portuguese Environment Agency, IP Constructive actions, hydraulic works, landfills, excavations and destruction of vegetation cover are prohibited, with exceptions subject to authorization or prior communication from CCDR-Norte. Of the actions compatible with REN, the following is noted under the points of number II - Infrastructure of Annex II of Decree-Law No. 124/2019, August 28: • "*e) Ampliation of existing edification of industrial use, energy and geologic resources*."	REN areas are intersected: Erosion risk areas Headwaters Areas of maximum infiltration Areas threatened by flooding Watercourses	The site location intersects a small REN area on the east side, that includes a watercourse, an area of maximum infiltration and an area threatened by flooding. The plant design should avoid these REN areas. If the occupation of these areas cannot be avoided, it is necessary to issue a prior communication CCDR – Norte.
National Agricultural Reserve (RAN)	The legal regime established by Decree-Law nº 73/2009, March 31st modified by Decree-Law n.º 199/2015, September 16th is a territorial management instrument, which consists of a restriction of public utility, by establishing a set of constraints on non-agricultural use of the soil, and which plays a key role in preserving the soil resource and its allocation to agriculture. "*In RAN areas non-agricultural uses are exceptionally permitted when considered compatible with the goals of agricultural activity protection, subject to a binding prior opinion or prior notification to the territorially competent regional entity (ERRA)"*	RAN areas are intersected	The site location intersects small RAN areas on the east and west side. The plant design should avoid these RAN areas. If the occupation of these areas cannot be avoided, it is necessary to issue a prior communication DRAP – Norte requesting RAN decommissioning
Public Water Domain (PWD)	Law nº 54/2005, November 11 (amended by Statement of Rectification nº 4/2006, January 16, and the latest amendment is given by Law nº. 31/2016, August 23), determines that an easement strip of 10 m from the edges of water lines must be respected and not occupied.	Intersects water lines with hydrological expression.	Intersects water lines of 1st and 2nd order which means that it does affect Water Domain. A request for usage of this area must be made (TURH), and the

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
	It is also necessary to consider the salt marsh associated with the Sado Estuary which falls into the public maritime domain constraints, namely an easement strip of 50 m (article 11) that cannot be occupied. If it is necessary to proceed with the occupation and use of the Water Domain, this action requires authorization / licensing from the Portuguese Environment Agency (APA).		project must assure the maintenance of the water course.
Electric Network	The RSLEAT (Regulation for high voltage powerlines safety), approved by Regulation Decree nº1/92, 18 of February, defines protection easements for the electrical network. The article 28º of this legal document defines that: - Low and medium voltage lines have a protection strip of 15 meters (1,5 kV to 40 kV) and 25 meters (40kV to 60 kV) - High and Very High voltage lines have a protection strip of 45 meters An overall distance from obstacles is defined at 3.65 meters	The study area intersects medium/high voltage electrical lines	The site selection does not intersect the electrical network
Road Network	According to the article 32° of National Road Network Statute: Non-edificandi strips are established on municipal roads, measured at the axis of the road or the limit of the road or path zone, as follows: "*8 - After the publication of the act declaring the public utility of the property and the respective parcel plan, the non-edificandi easement areas for new roads, as well as for existing roads, have the following limits* *(a) Motorways and expressways: 50 m to each side of the axis of the road and never less than 20 m from the road area;* *b) IP: 50 m on each side of the road axis or within the visibility easement and never less than 20 m from the road* *c) IC: 35 m on either side of the road centreline or within the right-of-way and in no case less than 15 m from the road* *d) EN and other roads to which this Statute applies: 20 m on either side of the centreline of the road or within the visibility right-of-way and in any case not less than 5 m from the road* *e) Connection nodes: a circle with a 150 m radius centred on the intersection of the road axes, irrespective of their classification.* *9 - For the previous number, connections to IP and IC intersections are considered as EN*." According article 58º of Law n.º 2110: "No construction may be carried out on land adjacent to municipal roads:	The study area intersects municipal paths	The study area intersects municipal paths which implies an easement of 4.5 meters for each side of the road that cannot be occupied

FACTOR /INDICATOR	APPLICABLE LEGAL CONDITIONING FRAMEWORK AND POTENTIAL IMPACT	STUDY AREA	SITE LOCATION
	- Within the non edificandi servitude zones, limited on each side of the road by a line that is 6 m and 4.5 m away from its axis, respectively for municipal roads and paths."		

Table 2-28 – Regulations and constraints – Fafe

3. ENVIRONMENTAL ASSESSMENT

3.1. GENERAL CONSIDERATIONS

This chapter presents the current characterisation of the affected environment. As part of the environmental diagnosis, data was collected only from secondary sources (bibliographic consultation, official documentation and entities consultation) in the most updated version possible.

3.2. CLIMATE CHANGE RISK

The 6th and Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC, 2021) has concluded:

- It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.
- The scale of recent changes across the climate system as a whole and the present state of many aspects of the climate system are unprecedented over many centuries to many thousands of years.
- Human-induced climate change is already affecting many weather and climate extremes in every region across the globe. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened since AR5.
- Improved knowledge of climate processes, paleoclimate evidence and the response of the climate system to increasing radiative forcing gives the best estimate of equilibrium climate sensitivity of 3°C with a narrower range compared to AR5.

New to the AR6 assessment is an interactive online tool[17] that enables users to evaluate regional observational climate data, and individual and ensemble model predictions for future climate. Various regional-scale climate-related variables can be inspected for different climate scenarios and different temporal periods.

Here we provide a regional-scale assessment of potential climate-related impacts of the Project and a discussion of more local potential impacts for each prospective GALP lithium refinery site.

Regional Assessment

Using the IPCC Working Group Interactive Atlas, the future climate for the Iberian Peninsula was assessed. This assessment is based on and/or includes the following:

- The assessment is based on the CMIP6 ensemble of predictions from more than 30 climate models for climate scenario SSP5 8.5.
- The assessment considers the medium-term changes over the period 2041 to 2060 compared to an 1850 to 1900 baseline climate period.
- Regional-scale variables included in the assessment include the following:
    - Maximum temperature change, in degrees Celsius;
    - Number of days with maximum daily temperatures above 40°C, expressed as change in the number of days;
    - Consecutive dry days, expressed as change in the number of days;
    - Total precipitation change expressed as a change in per cent (%); and
    - Maximum 5-day precipitation expressed as a change in per cent (%).

[17] https://interactive-atlas.ipcc.ch/

- Using the "point information" tool, the grid-box specific values for each variable were obtained for the grid boxes corresponding to the proposed locations of the GALP lithium refinery.

Figure 3-1 plots the change in degrees ˚C, of mean temperature. As indicated, predicted increases in mean temperature are highest inland in Portugal and Spain, with lower predicted changes in mean temperature along the coasts. The absence of shading in the figure indicates there is high agreement among predictions from 34 models included in the ensemble prediction.

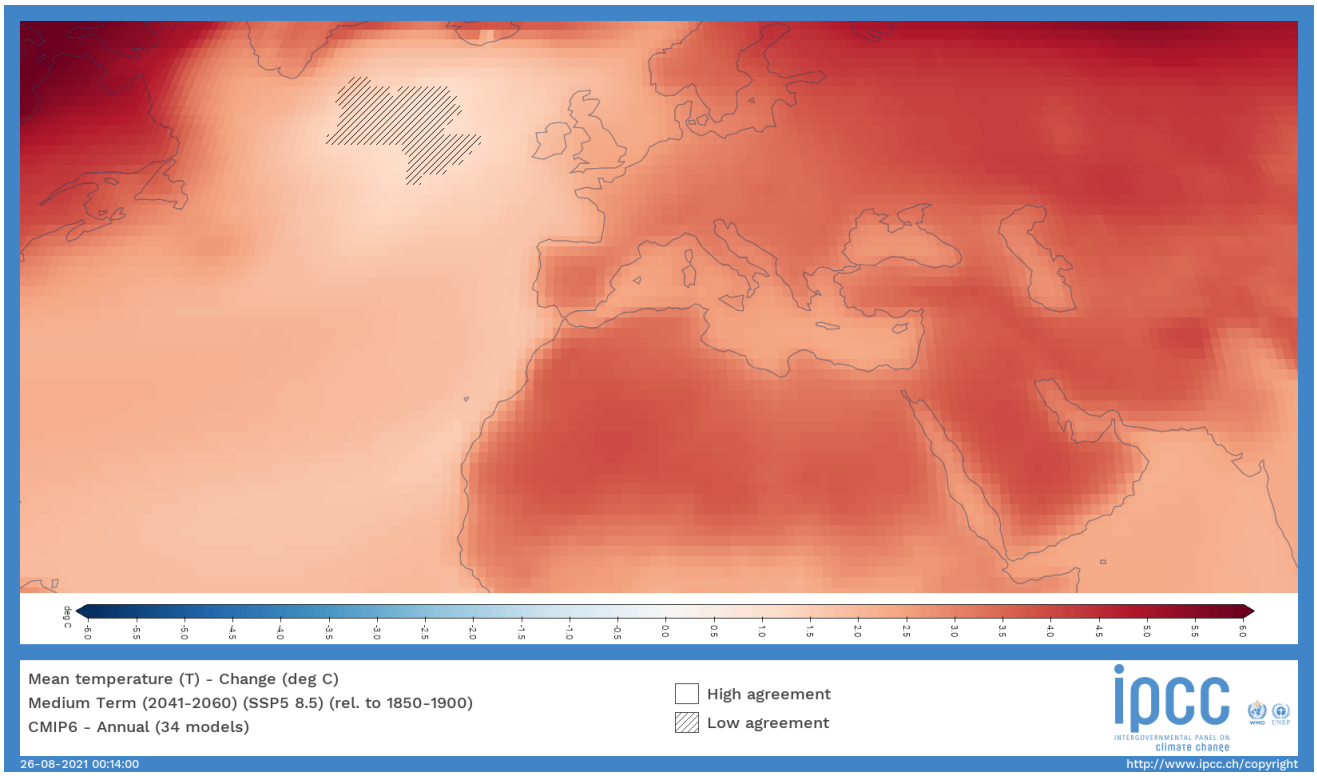


Figure 3-1 - CMIP6 annual predicted change, in degrees Celsius, of mean daily air temperature for the 2041 to 2060 period compared to the 1850 to 1900 baseline under climate scenario SSP5 8.5.

Figure 3-2 plots the change, in days, where maximum daily surface air temperatures are predicted to exceed 40ºC. As indicated, changes along the Portuguese coast are relatively small due to the moderating effects of the ocean. These predictions are also uncertain with shading indicating low agreement among the predictions from the 27 models included in the ensemble prediction.

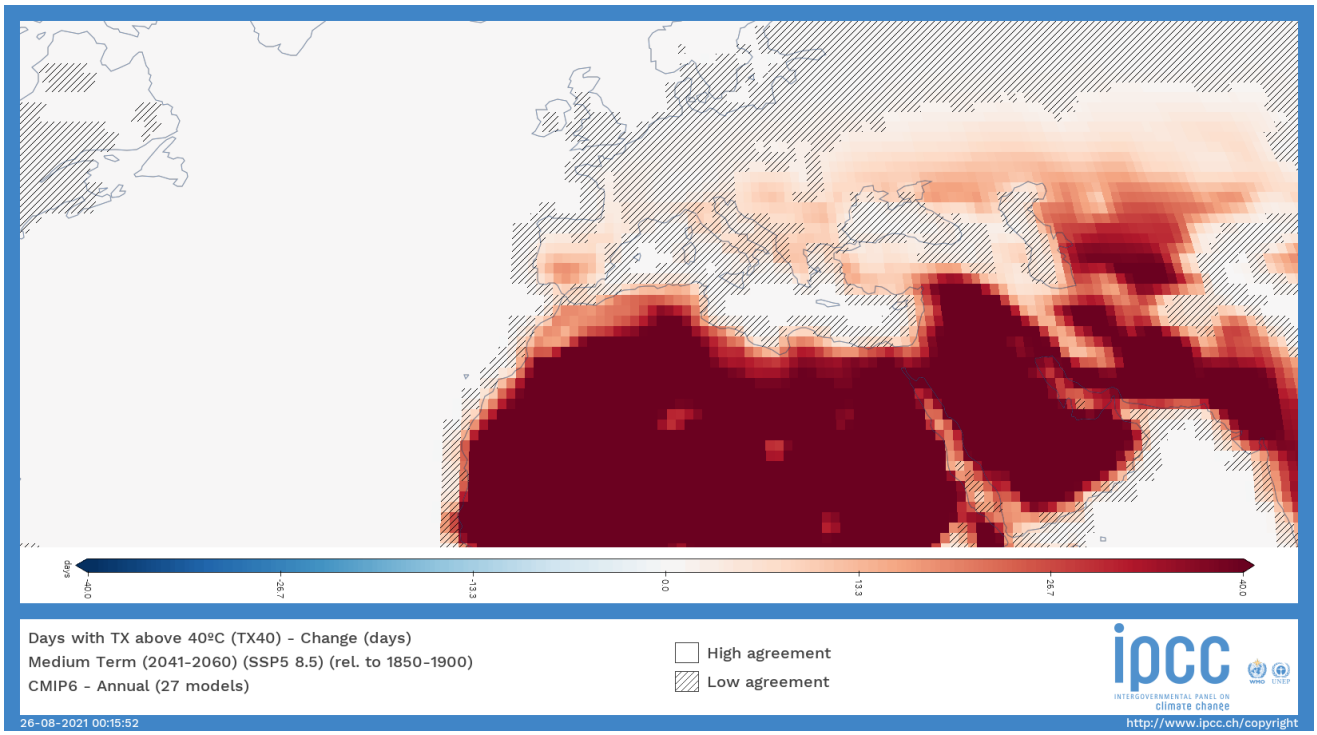


Figure 3-2 - CMIP6 annual predicted to change, in days, of days with maximum daily air temperatures above 40ºC for the 2041 to 2060 period compared to the 1850 to 1900 baseline under climate scenario SSP5 8.5.

Figure 3-3 plots the change, in days, of consecutive dry days. This is a metric related to the occurrence of short-term drought that would affect things like annual agricultural productivity or seasonal freshwater availability. Confidence among the predictions from 32 models is high and indicates a significant increase in the number of consecutive dry days across the Iberian Peninsula.

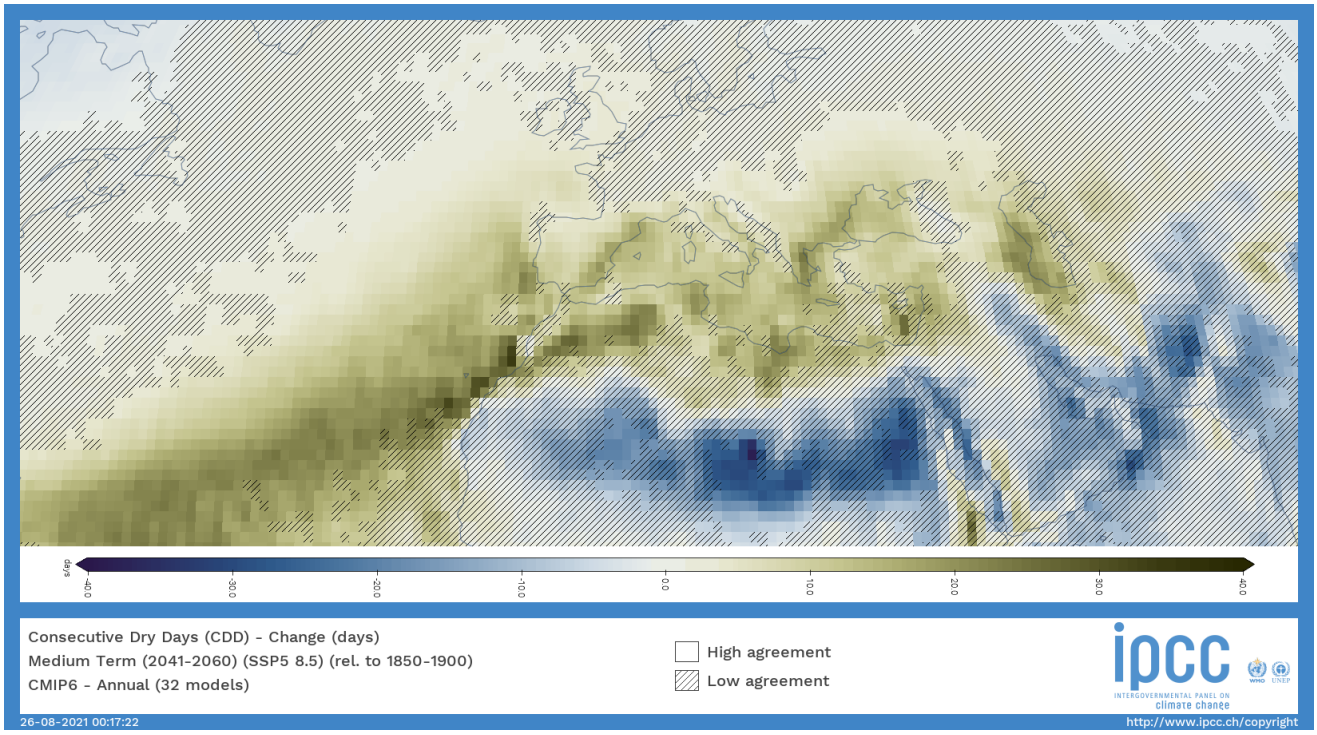


Figure 3-3 - CMIP6 annual predicted to change, in days, of consecutive dry days for the 2041 to 2060 period compared to the 1850 to 1900 baseline under climate scenario SSP5 8.5.

Figure 3-4 plots the change, as a percent in annual total precipitation. There is high agreement among the predictions from 32 models which predict a significant decrease in total annual precipitation. Reductions in total precipitation are higher for southern Portugal compared to central and northern Portugal, including northwestern Spain.

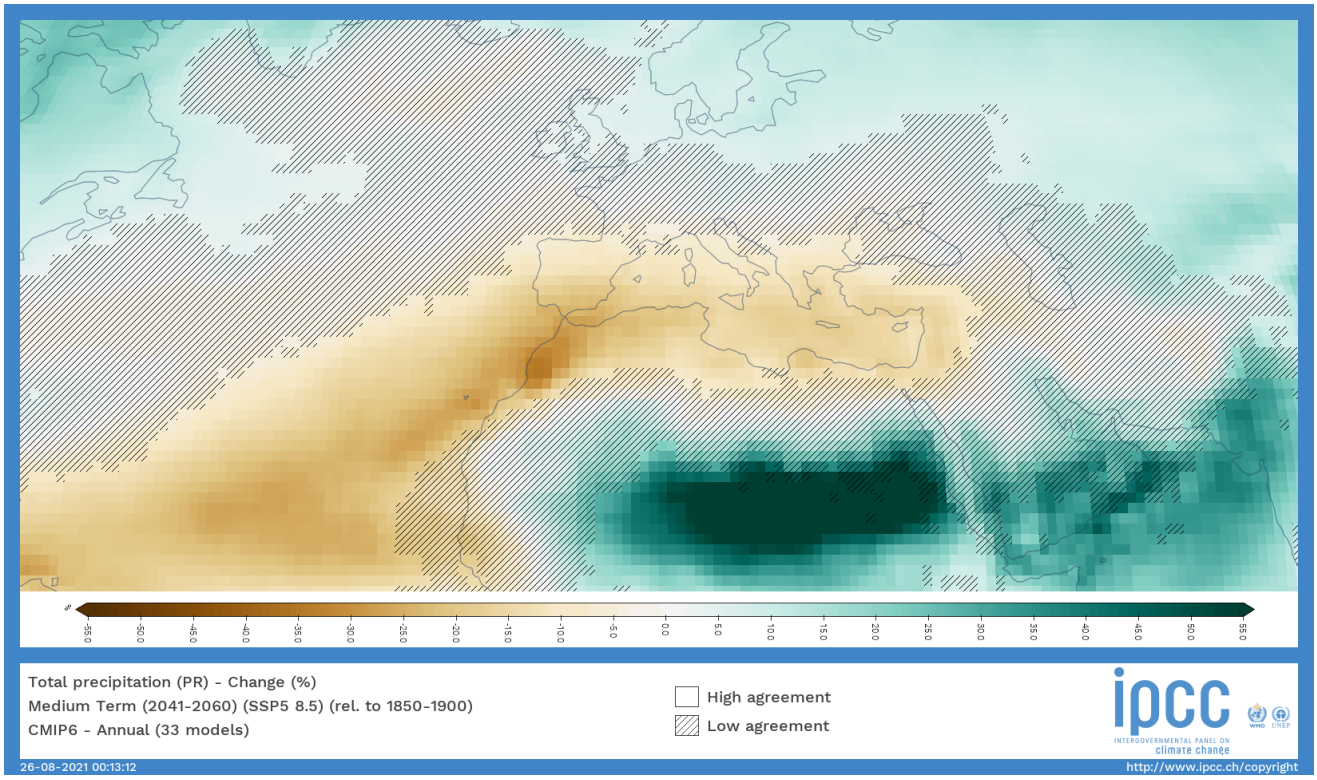


Figure 3-4 - CMIP6 annual predicted to change, in per cent, of total precipitation for the 2041 to 2060 period compared to the 1850 to 1900 baseline under climate scenario SSP5 8.5.

Figure 3-5 plots the change, as a per cent, in the maximum 5-day precipitation. This metric is a measure of the change in short-term intense rainfall events that can contribute to flooding. As indicated southern Portugal is predicted to see a moderate decrease in maximum 5-day precipitation whereas central and north Portugal and northwestern Spain may see no change. Note that agreement among the predictions from the 33 models is low for this climate variable.

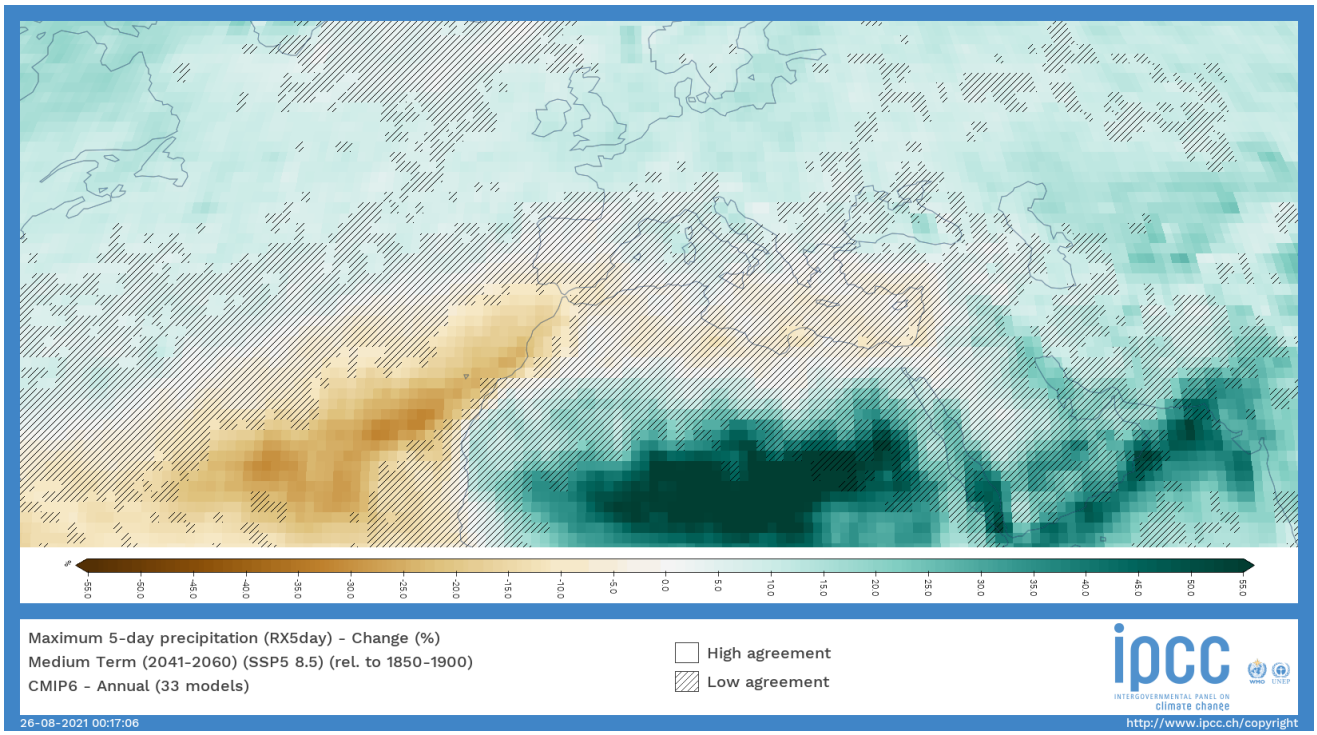


Figure 3-5 - CMIP6 annual predicted to change, in per cent, of maximum 5-day precipitation for the 2041 to 2060 period compared to the 1850 to 1900 baseline under climate scenario SSP5 8.5.

3.2.1. IPCC AR6 Model Summary

On a regional basis these results are summarized as follows:

- Ensemble model predictions indicate **significant increases in annual mean air temperatures** and the number of days with maximum daily temperatures exceeding 40˚C. These predictions have the potential to **increase the occurrence of drought and wildfires**.
- Ensemble model predictions indicate **significant decreases in annual precipitation**, which has the potential to **increase the occurrence of drought and wildfires** and to **decrease the availability of fresh water**.
- Ensemble predictions do not predict a significant change in maximum 5-day precipitation indicating that potential project locations may not be at an increased risk of deluge and flooding in the midterm (i.e., 2040 to 2060).

Table 3-1 summarizes the site-specific changes in these climate metrics for each prospective GALP refinery location. Note briefly:

Climate Parameter	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
Maximum Temperature (change)	2.1	2	2.1	2	2.2	2.5	2.1	2.1
Days above 40oC (change)	2.6	6.2	2.6	0.8	9.6	3.7	2.6	2.6
Total Precipitation (change)	-9.1%	-16.8%	-9.1%	-7%	-16.8%	-9.2%	-9.1%	-9.1%
Max 5-day Precipitation (change)	1.7%	-6.8%	1.7%	-3.7%	-4%	1.7%	1.7%	1.7%
Consecutive Dry days (change)	5.4	13	5.4	4.5	11.1	5.4	5.4	5.4

Table 3-1 – Summary of site-specific climate predictions

1) these estimates are based on gridded model output at a resolution of approximately 100 km x 100 km. This means there is no difference between the predictions for Matosinhos, Estarreja, Trofa and Fafe.

A discussion of location-specific potential climate risks is included in the following sections.

3.2.2. Preliminary Risk Assessment by Location

Table 3-3 summarises the likely risks due to impacts of climate change in the event that no global action is taken. Sites have been numerically categorised with consideration to the level of impact, 4 being the highest impact and therefore the highest risk for each category.

Mitigation strategies have been excluded from this study and may be covered in future studies once a preferred site for the Lithium Refinery has been identified. Mitigation in this context refers to reducing GHG emissions addressing project contributions to climate change. “Adaptation” is the term preferred when referring to steps taken to avoid or minimize climate-change related risks to the Project.

Assessment has been based on data collected from public online climate change models and compared against data collected as part of the environmental site selection analysis. Selected categories are in line with IPCC predictions for Europe and more specifically Portugal and Spain.

It is important to note that GALP continues to seek to improve and optimise its operational carbon footprint through design and sustainable processing methodologies where possible.

Risk	Consequence	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
Sea level rise and Flooding Coastal Flooding River Flooding **Low Probability**	• Damage to Infrastructure (building instability, landslides, unsafe road conditions, effects on transportation - road, rail, shipping) • Loss of livestock and crops • Communication and critical infrastructure (health, utilities, transportation, emergency services) disruption • Risk to human life, fatalities	1 • Coastal location, rocky outcrops, white sand beaches • Port location • Critical port infrastructure – trade and tourism • High rise dwellings on beach, heavily populated coastline • Project away of floodable areas • LOW Flood Risk	1 • Coastal location, rocky outcrop (erosion risk) • Port location • Flat geology • Industrial and technology, ports, fishing • Critical port location • LOW Flood Risk	4 • Inland location • High industry • Region already feeling impacts of extreme weather events and under pressure from environmental threats • Runoff from nearby mountain tops • HIGH flood risk	2 • Inland location • Low industry in the study area • High number of population clusters • Forest area in the vicinity (natural barrier) • Project outside, but close to floodable areas • MEDIUM Flood Risk	3 • Coastal location • Port Location • Flat geology and gently sloping towards the sea • Industrial and technology, ports, fishing • Project outside, but close to floodable areas • MEDIUM Flood Risk	1 • Inland location • Few population clusters within the study area • Urban area in the vicinity • Steeper slopes in the northern sector of the site; remaining area of gentle slope • Project outside, and far way of floodable areas • LOW flood risk	1 • Inland location • Industrial area • A low number of population clusters in the study area • Important slopes • Forest area and bushlands in the vicinity (natural barrier) • Project outside, and far way of floodable areas • LOW Flood risk	1 • Inland location • Industry and businesses area • Some sloping • A high number of population clusters in the study area • Forest area in the vicinity (natural barrier) • Project outside, and far way of floodable areas • LOW Flood risk

Risk	Consequence	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
	• Overloading river systems • Coastal erosion • Saltwater intrusion into freshwater bodies • Damage or destruction of heritage								
Drought **HIGH Probability**	• More frequent, severe and longer lasting drought • Risk to biodiversity, transport and other infrastructure, agricultural losses • Most severe impacts to Europe in Mediterranean • Food risk – human health and population strength	1 • SPI - Normal precipitation regime at 3-month scale (2021) • Densely populated, more drain on resources in small area (172 586) • LOW drought Risk	1 • SPI - Normal precipitation regime at 3-month scale (2021) • Industrial area • Low population density (114 200) • LOW drought risk	1 • SPI -Normal precipitation regime at 3-month scale (2021) • High agriculture • Lowest population density (26 224) • LOW drought risk	1 • SPI -Normal precipitation regime at 6-months scale (2019) • Small population clusters • Producing industry represents only 10% of economic activity • Low drought Risk	1 • SPi -Normal precipitation regime at 3-month scale (2021) • Industrial area • Low population density (123 684) • LOW drought risk	1 • SPI - Normal precipitation regime at 3-month scale (2021) • Inland location • Low population density (94 697) • Industrial and business area • LOW drought Risk	1 • SPI - Normal precipitation regime at 3-month scale (2021) • Industrial area • Low population density (38 554) • LOW drought Risk	1 • SPI -Normal precipitation regime at 3-month scale (2021) • Industrial and business area • Low population density (48 506) • LOW drought Risk
Availability of Fresh Water **HIGH Probability**	• Risk to human health • Growth in bacteria, toxic algae, other pathogens • Risk to industry (heavy users of groundwater)	1 • No large superficial fresh waterbodies nearby • Good quality of groundwater	3 • Productive but contaminated fresh groundwater sources (heavy minerals) • No identified lakes	3 • Productive but contaminated fresh groundwater sources (nitrates) • No identified lakes	3 • Contaminated fresh groundwater sources (pesticides) • MEDIUM Risk	3 • No large superficial fresh waterbodies nearby • Good quality of groundwater body but with	1 • No large superficial fresh waterbodies nearby • Good quality of groundwater body and with little too variable	3 • A medium-large superficial freshwater body nearby (Rio Ave) • Good quality of groundwater body and with little too	1 • No large superficial fresh waterbodies nearby • Good quality of groundwater body and with little too

Risk	Consequence	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
		body but low productive • LOW Risk	• MEDIUM Risk	• MEDIUM Risk		vulnerable areas • MEDIUM Risk	vulnerability areas • LOW Risk	variable vulnerability areas • MEDIUM Risk	variable vulnerability areas • LOW Risk
Higher Temperatures Hot days, tropical nights, heat waves **HIGH Probability**	• Risk to human health, increased mortality - specifically the vulnerable (elderly and infants) • Damage to infrastructure from extreme heatwaves (buckling of rail, increased road usage) • Changes to distribution of plant and animal species, affects to habitats, increased pests and invasive species • Changes to livestock distribution and survival (access to water, cool air) • Evaporation may lead to droughts • Increased, intense forest fires • Increased sea levels – flooding,	1 • Fire danger index is mainly moderate in the study area. • High density population (172 586) • No forestation in site location • Shaded areas • Modern living, swimming pools • Higher electricity consumption • LOW Risk	1 • Fire danger index is low to medium in the project site area • Minimal vegetation, coastal shrubland • Low population density Minimal shade • LOW Risk	2 • Fire danger index mainly very low to moderate in the study area. • Within the site location, the fire danger index is very low. • Surrounded by forest, bushland • LOW Risk	3 • High frequency of forest fire. • Included in an artificialized area. Surrounded by forest and bushland intercalated with population clusters. • MEDIUM Risk	2 • Fire danger index is mainly unclassified for the study area, with very low to very high spots on the north side. • Within the site location, the fire danger index is unclassified. • Surrounded by industry and small population clusters • LOW Risk	4 • Fire danger index mainly unclassified for the study area with very high and high spots in the northern limit. • Fire danger index unclassified for the project area • Historically affected by wildfires (most recent ones in 2016 and 2017) • Surrounded by bushes and forest, with occasional presence of industry. Traffic roads in the terrain boundaries. • HIGH RISK	4 • Fire danger index variable between very high and very low spots in the study area. • Within the site location, the fire danger index is unclassified for the project area, with medium to high spots in the southern limits. • Historically affected by fires (2017 and 2015) • Surrounded by forest, with occasional presence of industry (north and east). • HIGH RISK	2 • Fire danger index mainly moderate and very low in the study area • Within the site location, the fire danger index is mainly moderate for the project area, with high, low and very low spots • Surrounded by industry, business, small population clusters and forest • LOW Risk

Risk	Consequence	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
	shipping load impacts • Increased electricity demands and pressure on grids								
	Total Score	4	6	10	9	9	7	9	5
	Quantitative level	1	3	4	4	4	3	4	2

Table 3-2 – Summary of preliminary risks of climate change by location

Rank: 1 – lowest impact, 4 – highest impact

3.2.3. Additional Considerations by Site

3.2.3.1. Matosinhos

Flood Risk: Historic flooding is related to the Rio Douro floods covering the Region of Porto of the hydrographic region 3. No other flood risk areas have been identified within the proximity of the project buffer zone. The potential for flooding, *without consideration of climate change*, is considered to be of low risk for the operation of the refinery (see Section 2.2.3.2.2)

Sea Level Rise: According to the coastal risk screening tool via climatecentral.org, the land projected to be below the annual flood level in 2050 doesn't cover the study area. This map is based on the year 2100 temperature increase of 2 degrees Celsius. The risks are therefore low (Figure 3-6 and Figure 3-7).

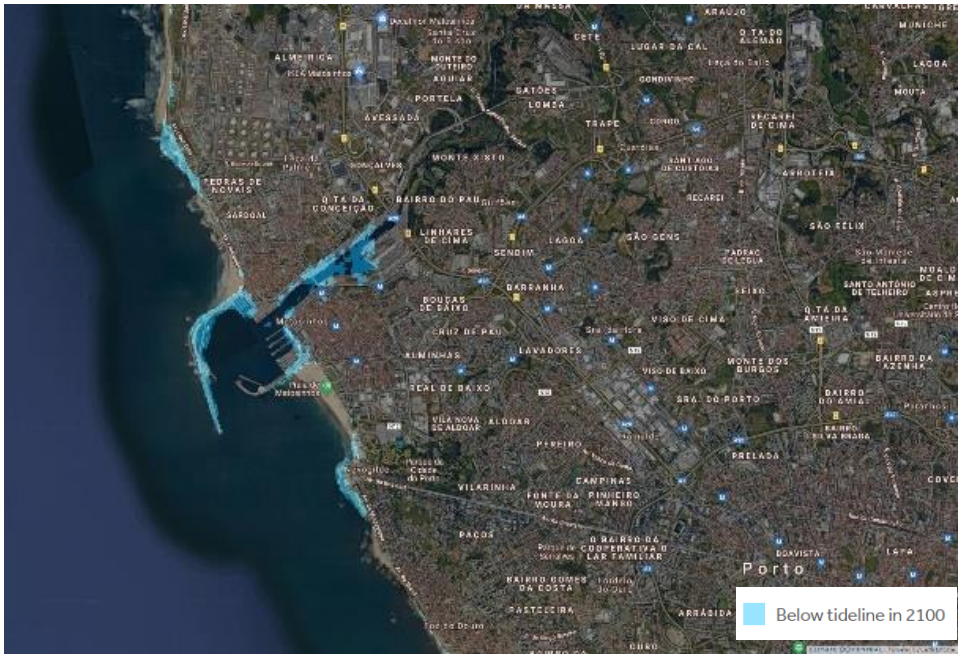


Figure 3-6 – Sea level Rise in Matosinhos Municipality

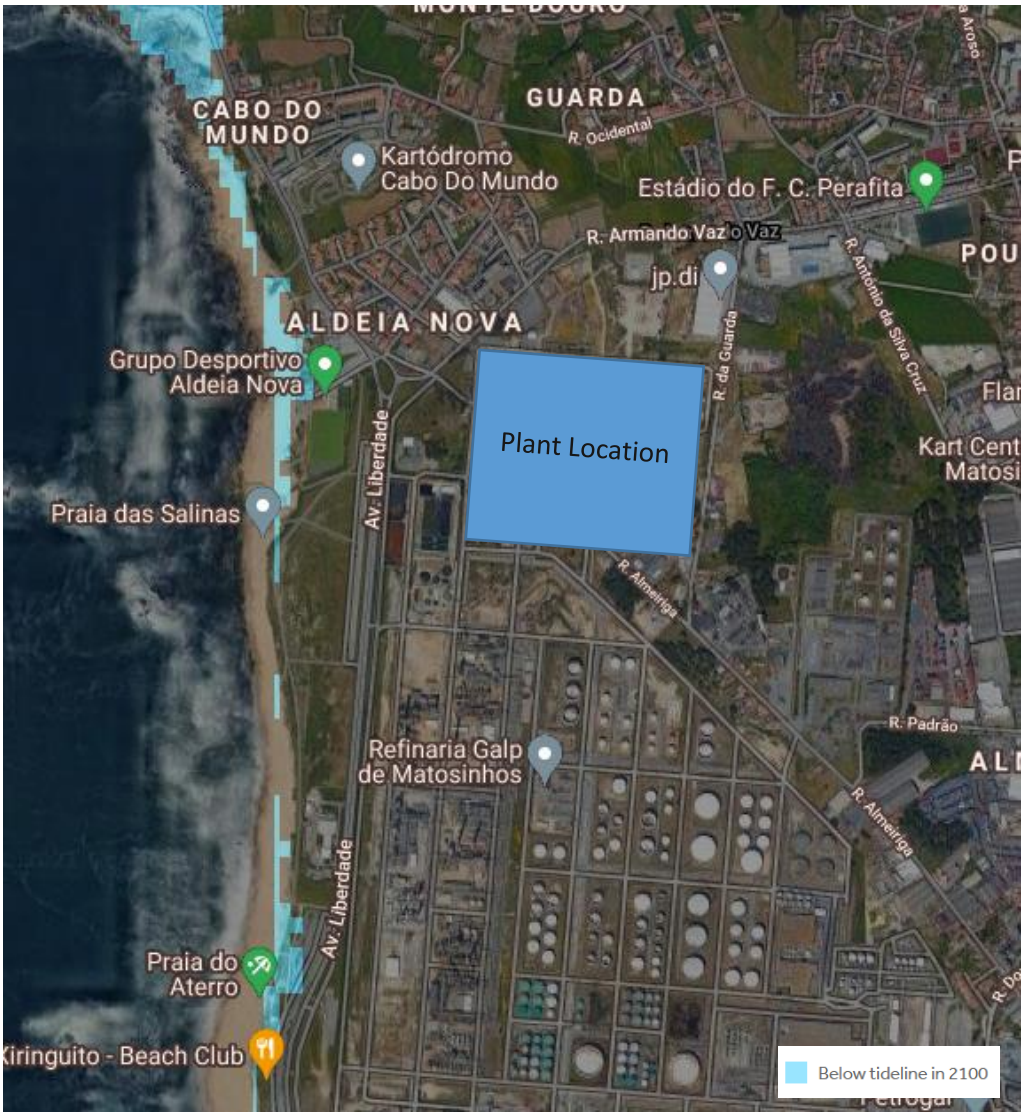


Figure 3-7 – Sea level rise in the proposed Plant Location - Matosinhos

These maps do not account for potential future erosion, development, or coastal defence engineering.

Fire Risk: According to current modelling data, the surrounding area of the proposed project site has a bushfire classification of moderate risk. *Without consideration of climate change,* it is assumed the project implementation area has a moderate risk of being affected by fire (see Section 2.2.3.2.3)

As per the summary of site-specific climate predictions, made under the Municipal Strategy of Adaptation to Climate Change (EMAAC, 2015), it should also be noted that the weather forecasts for the region suggest a **decrease in average annual precipitation** and an **increase of the average annual maximum temperature**.

Risk of Landslide: These events can occur in situations of intense precipitation and affect livelihood, property loss and damage, and loss of lives.

3.2.3.2. Sines

Flood Risk: According to the mapping provided, the proposed project location is not within the proximity of any identified flood risk areas, with the closest area being Santiago do Cacém. *Without considering climate change impacts*, the potential for flooding is thus considered to be of low risk for the operation of the refinery (See Section 2.2.4.3.2).

Sea Level Rise: According to the coastal risk screening tool via climatecentral.org, the land projected to be below the annual flood level in 2050 doesn't cover the study area. This map is based on the year 2100 temperature increase of 2 degrees Celsius. (Figure 3-8 and Figure 3-9)

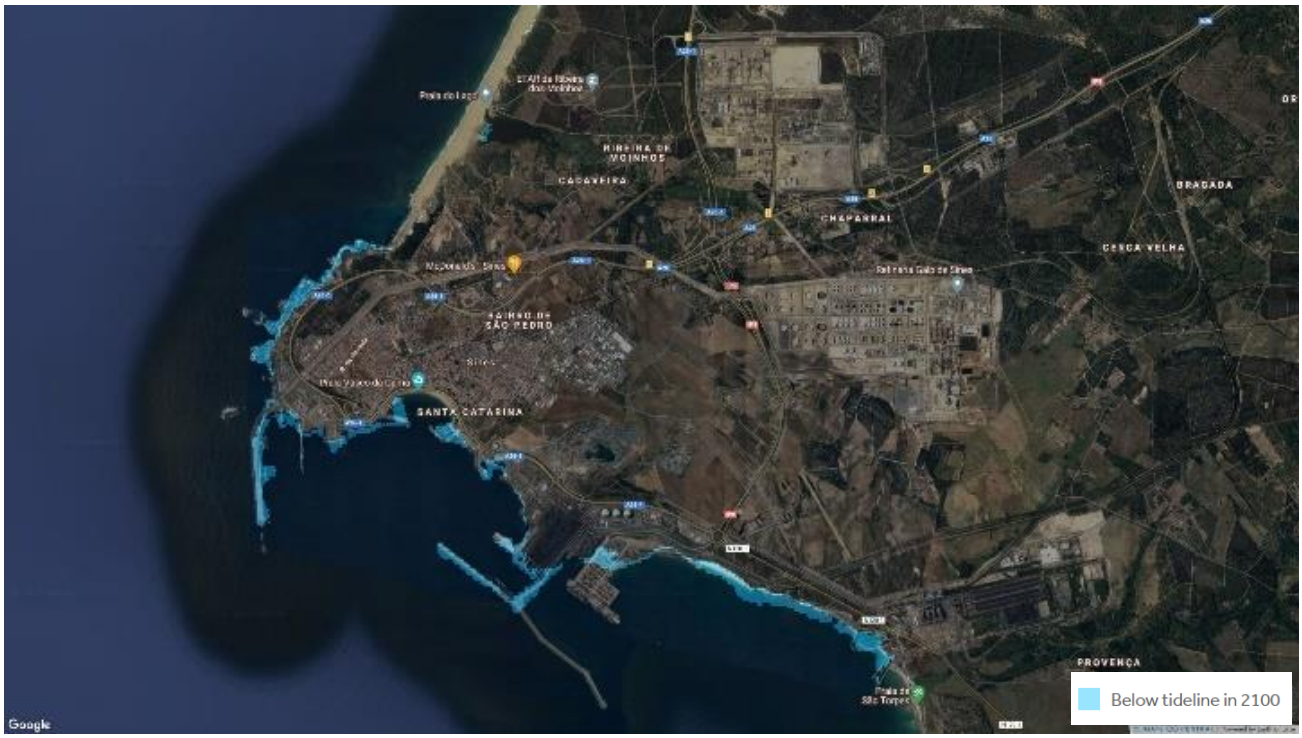


Figure 3-8 – Sea level rise in Sines Municipality

Figure 3-9 – Sea-level Rise in the proposed plant location - Sines

These maps do not account for potential future erosion, development, or coastal defence engineering.

Fire Risk: *Without consideration of climate change,* the identified project area has a bushfire classification ranging from very low to very high, with the immediate surrounding of the refinery location, classified with a medium risk rating. Mitigation measures will need to be considered with regards to design and the operational planning of the project to minimise impact to the project in the event of a fire.

Based upon this data the forest fire danger classification risk for the project is moderate (See Section 2.2.4.3.3). As per the summary of site-specific climate predictions, made under the Municipal Strategy for Adaptation to Climate Change of Odemira (EMAAC 2015), located in the same region of Sines, it should also be noted that the weather forecasts for the region suggest a **decrease in average annual precipitation** and an **increase of the average annual maximum temperature**.

Risk of Landslide: These events can occur in situations of intense precipitation and affect livelihood, property loss and damage, and loss of lives. The area surrounding the defined project area as presented in the supplied mapping does not present steep slopes, thus not being at significant risk of mass movement. The Municipal Emergency Plan for the region has not identified future landslides as a potential risk.

3.2.3.3. Estarreja

Flood Risk: Estarreja has a history of seasonal flooding due to the rise of the aquifer. It is reasonable to assume that this will likely increase due to climate change impacts, such as heavier and more frequent rain events.
As discussed in section 2.2.5.2.2., the site is located near the flood area covering the Region of Ria de Aveiro. The potential for flooding is thus considered to be of high risk for the operation of the Refinery.

Sea Level Rise: According to the coastal risk screening tool via climatecentral.org, the land projected to be below the annual flood level in 2050 doesn't cover the study area, however levels are predicted to increase near the site location. This map is based on the year 2100 temperature increase of 2 degrees Celsius.

Based on this map, the risk must be considered moderate.

Figure 3-10 – Sea level Rise in Estarreja Municipality

Figure 3-11 – Sea level rise in the proposed plant location - Estarreja

These maps do not account for potential future erosion, development, or coastal defence engineering.

Fire Risk: As shown in Section 2.2.5.2.3., the current classification for the area surrounding the project location ranges between very low and medium, with a small area to the southwest of very high risk. The design options adopted will be key determinants to conclude the dimension of the affectation by fires. The compliance with the safety distances will allow the minimization of this risk.

As per the summary of site-specific climate predictions, made under the Climate Change Adaptation Strategy of the Municipality of Aveiro (PMAAC, 2021), in the same region as Estarreja, it should also be noted that the weather forecasts for the region suggest a **decrease in average annual precipitation** and an **increase of the average annual maximum temperature**.

Risk of Landslide: These events can occur in situations of intense precipitation and affect livelihood, property loss and damage, and loss of lives. The area surrounding the defined project area as presented in the supplied mapping does not present steep slopes, thus not being at significant risk of mass movement.

3.2.3.4. Vigo

Flood Risk: Salvaterra de Miño is identified as being affected by historic floods. In turn, the municipality is located within the flood area identified in the Flood Risk Management Plan Miño-Sil. However, the site location is not covered by the floodable areas as shown in Section 2.2.6.2.4.

Without the consideration of climate change impacts, the potential for flooding is thus considered to be of moderate risk for the operation of the Refinery.

Sea Level Rise: According to the coastal risk screening tool via climatecentral.org, the land projected to be below the annual flood level in 2050 doesn't cover the study area. This map is based on a year 2100 temperature increase of 2 degrees Celsius (Figure 3-12 and Figure 3-13).

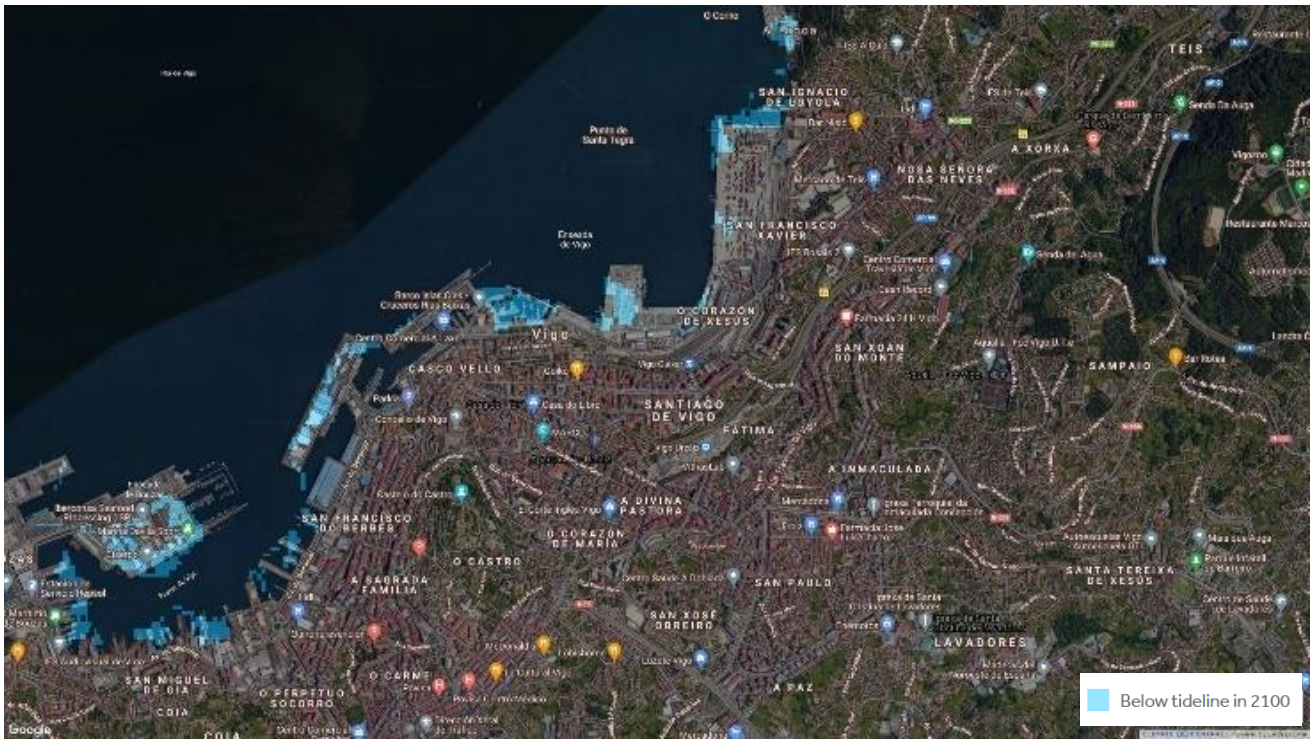


Figure 3-12 – Sea level Rise in Vigo Municipality

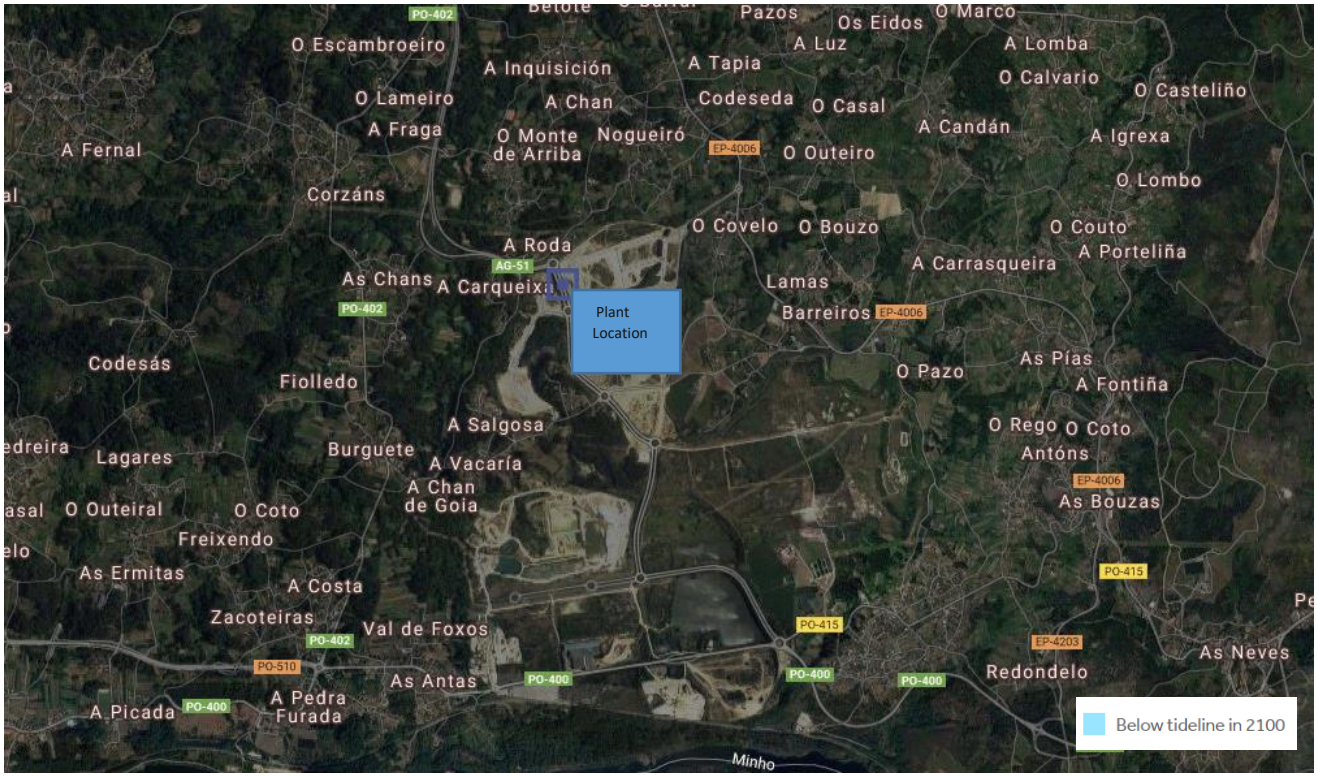


Figure 3-13 – Sea level rise in the proposed plant location - Vigo

These maps do not account for potential future erosion, development, or coastal defence engineering.

Fire Risk: The identified study area is classified as a high fire hazard risk zone (ZAR) with the current Daily Forest Fire Risk Index (IRDI) classified as extreme. Up to 500 fires were registered within the proximity of the study area between 2006 and 2015.

Without considering the impacts of climate change, and in view of the historical events, the site is to be considered a high-risk site (See Section 2.2.6.2.5).As per the summary of site-specific climate predictions (Galician Climate Change and Energy Strategy 2050), it should also be noted that the weather forecasts for the region suggest an **increase of the average annual maximum temperature**. The strategic plan of Galicia does not have a conclusion for the precipitation due to oscillations in the data.

Risk of Landslide: These events can occur in situations of intense precipitation and have effect on livelihood, property loss and damage, and loss of lives. The area surrounding the defined project area as presented in the supplied mapping, does not present steep slopes, thus not being at significant risk of mass movement.

3.2.3.5. Setúbal

Flood Risk: Historic flooding is related to the Rio Sado floods covering the Region of Setúbal (HR6). No other flood risk areas have been identified within the proximity of the project buffer zone. The potential for flooding, *without consideration of climate change*, is considered to be of low risk for the operation of the refinery (see Section 2.2.7.2.2).

Sea Level Rise: According to the coastal risk screening tool via climatecentral.org, the land projected to be below the annual flood level in 2050 does not cover the study area. This map is based on the year 2100, assuming a temperature increase of 2 degrees Celsius. (Figure 3-13 and Figure 3-14).

Based on this map, the risk must be considered moderate, because the affected areas are outside the site location, however very close.

Figure 3-14 – Sea level Rise in Setúbal Municipality

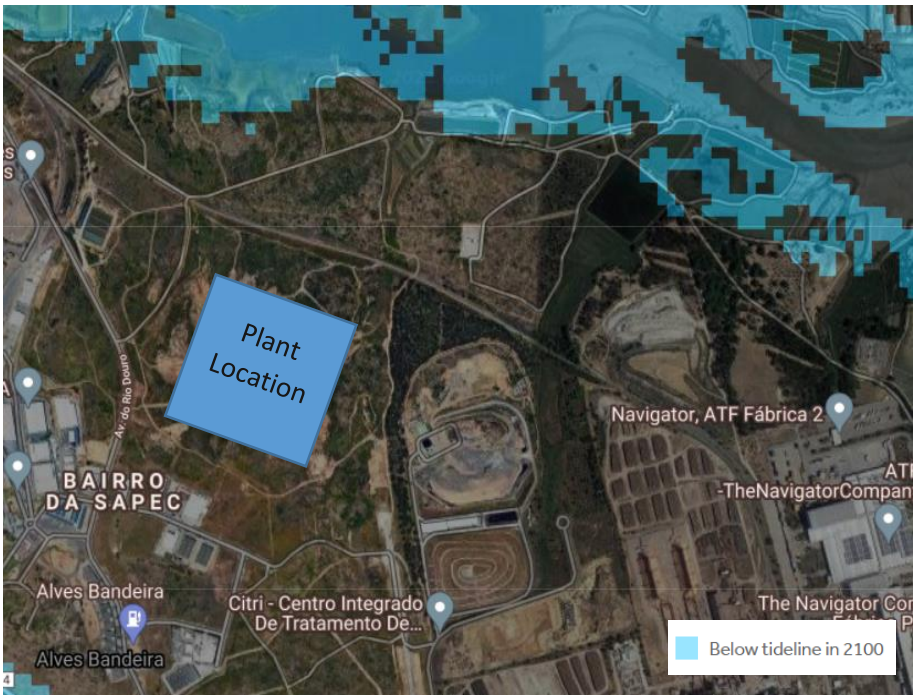


Figure 3-15 – Sea level rise in the proposed plant location – Setúbal

Fire Risk: As shown in Section 2.2.7.2.4., the area of the project location is not classified. The design options adopted will be key determinants to conclude the risk of fires. The compliance with the safety distances will allow the minimization of this risk.

The site-specific climate predictions, made under the Municipal Strategy for Adaptation to Climate Change of Lisbon Metropolitan Area (PMAAC - AML 2019), located in the same region of Setúbal, suggest a **decrease in average annual precipitation** and an **increase of the average annual maximum temperature**.

Risk of Landslide: These events can occur in situations of intense precipitation and affect livelihood, property loss and damage, and loss of lives. The Municipal Emergency Plan for the region has not identified future landslides as a potential risk for this region.

3.2.3.6. Valongo

Flood Risk: No flood risk areas have been identified within the proximity of the project buffer zone. The potential for flooding, *without consideration of climate change*, is considered to be of low risk for the operation of the refinery (see Section 2.2.8.3.2.).

Sea Level Rise: According to the coastal risk screening tool via climatecentral.org, the land projected to be below the annual flood level in 2050 does not cover the study area. This map is based on the year 2100, assuming a temperature increase of 2 degrees Celsius (Figure 3-16 and Figure 3-17).

Based on this map, the risk must be considered non-existent, because predictably the site location will not be affected by sea level rise.

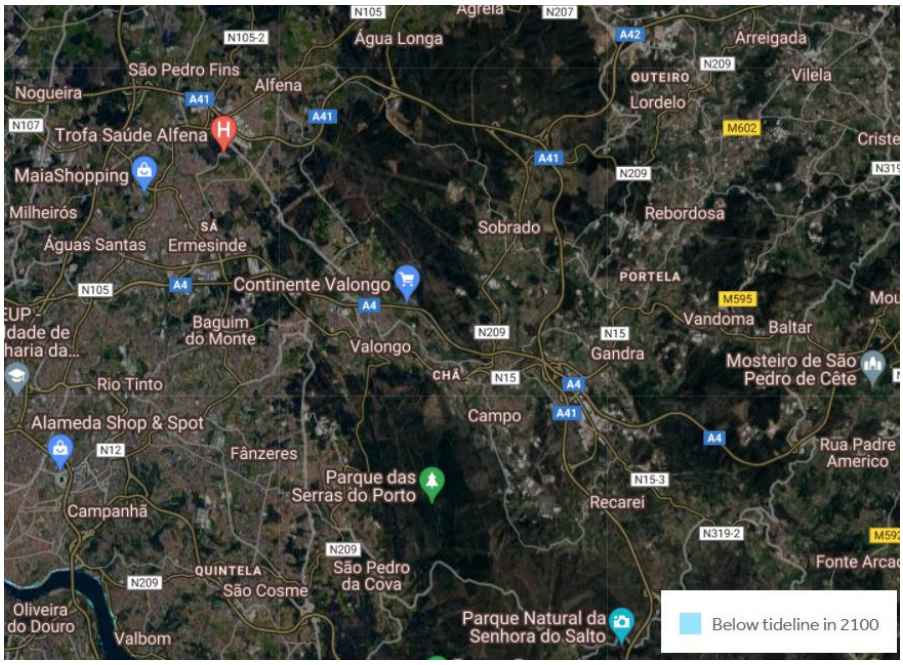


Figure 3-16 – Sea level Rise in Valongo Municipality

Figure 3-17 – Sea level rise in the proposed plant location – Valongo

Fire Risk: As shown in Section 2.2.8.3.4.2., the area of the project location is not classified. However historically it is an area affected by wildfires, with many fire events occurring between 2005 and 2017. In this sense, the

design options adopted will be key determinants to conclude the risk of fires. The compliance with the safety distances will allow the minimization of this risk.

As per the summary of site-specific climate predictions, made under the Municipal Strategy of Adaptation to Climate Change (EMAAC, 2015), it should also be noted that the weather forecasts for the region suggest a **decrease in average annual precipitation** and an **increase of the average annual maximum temperature**.

Risk of Landslide: These events can occur in situations of intense precipitation and affect livelihood, property loss and damage, and loss of lives. There are no indications of future landslides as a potential risk for this region and the area surrounding the defined project area, does not present significant steep slopes, thus not being at significant risk of mass movement.

3.2.3.7. Trofa

Flood Risk: No flood risk areas have been identified within the proximity of the project buffer zone. The potential for flooding, *without consideration of climate change*, is considered to be of very low risk for the operation of the refinery (see Section 2.2.9.2.2).

Sea Level Rise: According to the coastal risk screening tool via climatecentral.org, the land projected to be below the annual flood level in 2050 does not cover the study area. This map is based on the year 2100, assuming a temperature increase of 2 degrees Celsius (Figure 3-18 and Figure 3-19).

Based on this map, the risk must be considered non-existent, because predictably the site location will not be affected by sea level rise.

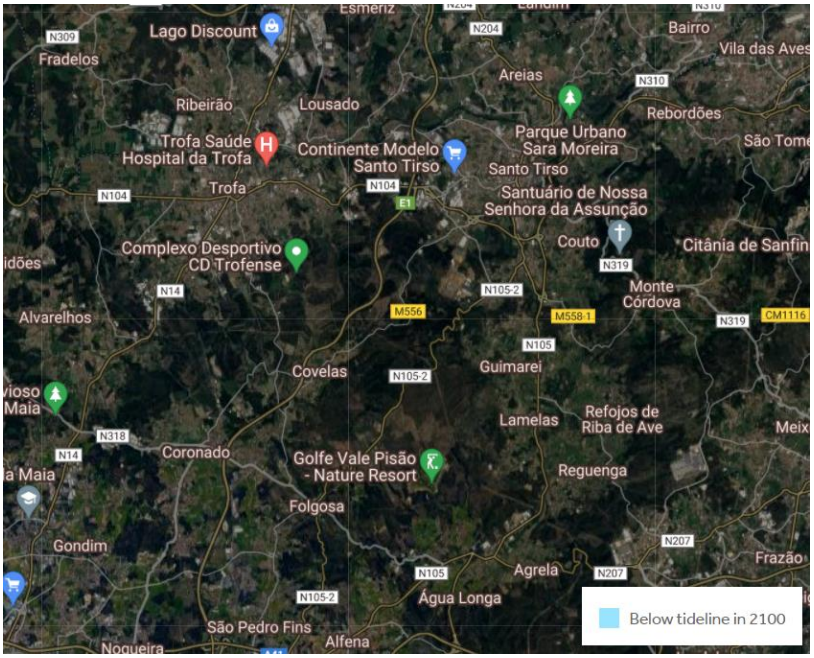


Figure 3-18 – Sea level Rise in Trofa Municipality

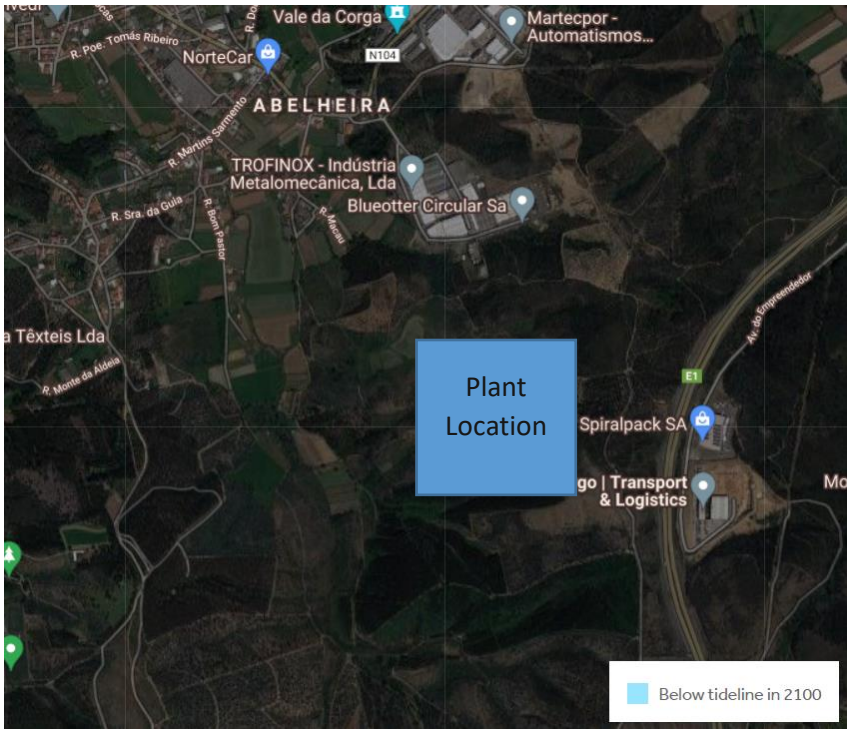


Figure 3-19 – Sea level rise in the proposed plant location – Trofa

Fire Risk: As shown in Section 2.2.9.3.2, the area of the project location is predominantly non-classified. However, historically it is an area affected by wildfires, with fire events occurrences in 2015 and 2017. In this sense, the design options adopted will be key determinants to conclude the risk of fires. The compliance with the safety distances will allow the minimization of this risk.

As per the summary of site-specific climate predictions, made under the Municipal Strategy of Adaptation to Climate Change (EMAAC, 2015), it should also be noted that the weather forecasts for the region suggest a **decrease in average annual precipitation** and an **increase of the average annual maximum temperature**.

Risk of Landslide: These events can occur in situations of intense precipitation and affect livelihood, property loss and damage, and loss of lives. There are no indications of future landslides as a potential risk for this region however the area surrounding the defined project area has some slopes, resulting from the water streams valleys which might increase the risk of mass movement.

3.2.3.8. Fafe

Flood Risk: No flood risk areas have been identified within the proximity of the project buffer zone. The potential for flooding, *without consideration of climate change*, is considered to be of very low risk for the operation of the refinery (see Section 2.2.10.2.2).

Sea Level Rise: According to the coastal risk screening tool via climatecentral.org, the land projected to be below the annual flood level in 2050 does not cover the study area. This map is based on the year 2100, assuming a temperature increase of 2 degrees Celsius (Figure 3-20 and Figure 3-21).

Based on this map, the risk must be considered non-existent, because predictably the site location will not be affected by sea level rise.

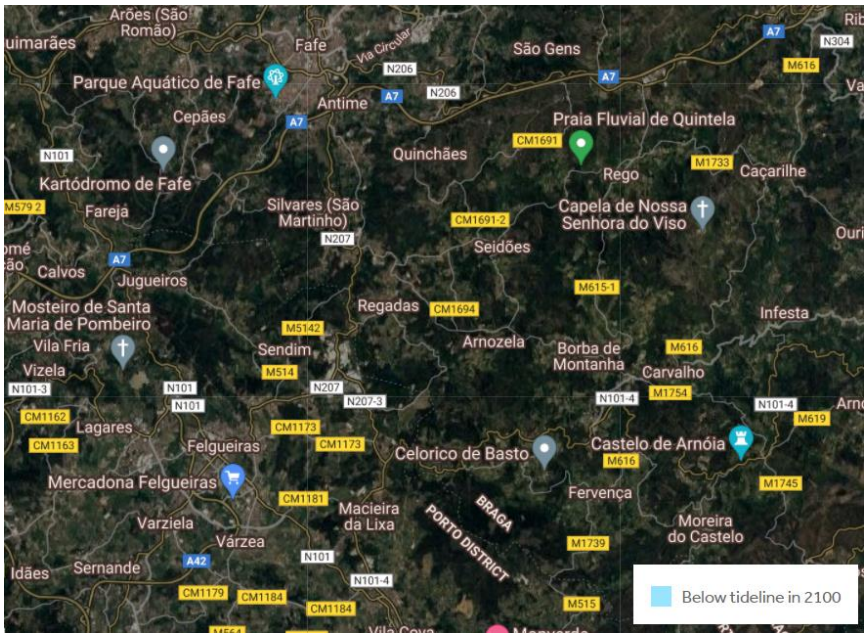


Figure 3-20 – Sea level Rise in Fafe Municipality

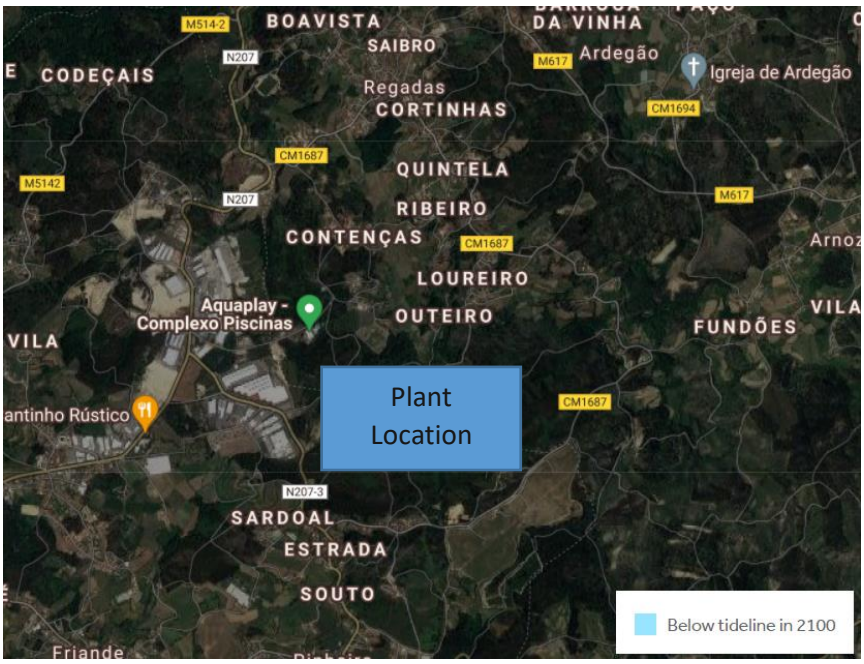


Figure 3-21 – Sea level rise in the proposed plant location – Fafe

Fire Risk: As shown in Section 2.2.10.3.2, the area of the project location predominantly medium and low index. The design options adopted will be key determinants to conclude the risk of fires. The compliance with the safety distances will allow the minimization of this risk.

As per the summary of site-specific climate predictions, made under the Intermunicipal Strategy of Adaptation to Climate Change (PIAAC, 2020), it should also be noted that the weather forecasts for the region suggest a **decrease in average annual precipitation** and an **increase of the average annual maximum temperature**.

Risk of Landslide: These events can occur in situations of intense precipitation and affect livelihood, property loss and damage, and loss of lives. There are no indications of future landslides as a potential risk for this region and the area surrounding the defined project area does not present significant steep slopes, thus not being at significant risk of mass movement.

3.3. BIODIVERSITY

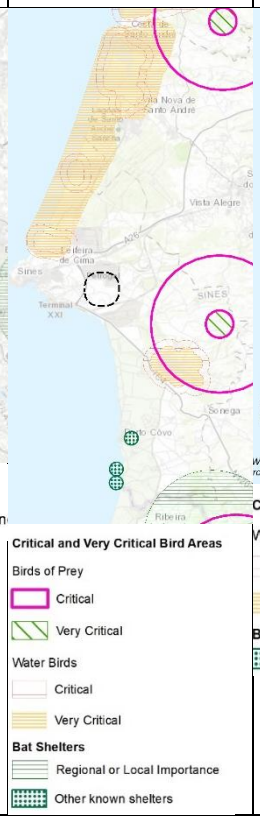
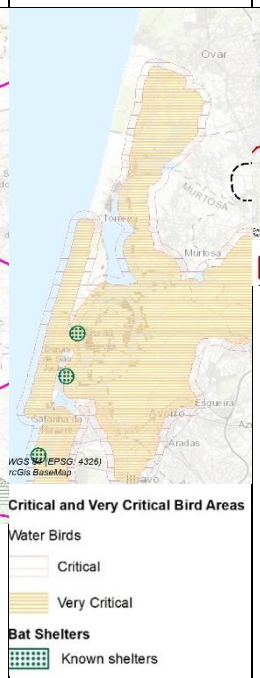
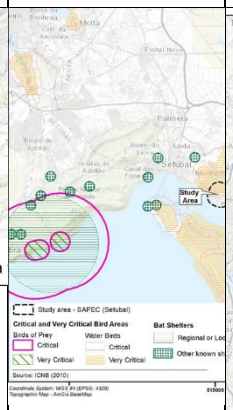
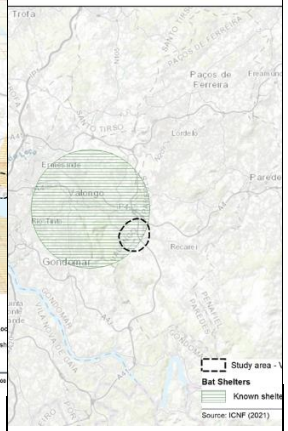
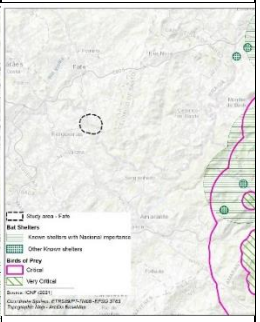
The biodiversity assessment performed in this section is based on the desktop analysis and the data publicly available. In this sense, it does not include the "International Union for Conservation of Nature (IUCN) protected areas (category I to VI)" and the "Alliance for Zero Extinction Sites (AZE)". It is expected that the next stage of the environmental studies, including fieldwork performed for the selected site location, will include a more specific data assessment.

The Official Gazette of the Republic of Portugal through the Decree-Law nº151-B/2013, October 31, amended and republished by Decree-Law nº 152-B/2017, December 11, defines *sensitive areas* as:

- **Protected areas**, classified under Decree-Law nº 142/2008, July 24;
- **Natura 2000 sites, special conservation zones** and **special protection zones**, classified under the terms of Decree-Law nº 140/99, April 24, within the scope of Directives nº 79/409/CEE, of the Council, 2 April 1979, on the conservation of wild birds, and 92/43/CEE, of the Council, 21 May 1992, on the preservation of natural habitats and wild fauna and flora.
- **Classified Protection zones for cultural heritage or in the process of being classified**, defined under the terms of Law Nº. 107/2001, September 8.

In the biodiversity analysis, the site location has been assessed considering the sensitive areas in the surroundings, namely the protected areas and natura 2000 sites, special conservation zones and special protection zones, and other protection areas included in the database of the ICNF - Nature and Forest Conservation Institute.

The table below summarizes critical zones for biodiversity and ranks the 8 selected sites against potential for impact to protected zones, identifying the nearest critical zone compared to the site, in a scale of 1 (lowest impact) to 4 (highest impact).

Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
							
Closest SNAC or Important conservation Areas							
6.7km	2.9km	2.8km	2km	Within the study area	Within the study area	15km	14km
2	3	3	3	4	4	1	1
Closest UNESCO Area							
12 km	88 km	50 km	74 km	40 km	13 km	22 km	13 km
4	1	2	1	2	4	3	4
Total score							
6	4	5	4	6	8	4	5
Quantitative level							

3	**1**	**3**	**2**	**3**	**4**	**1**	**3**

Table 3-3 – Summary of the critical zones for biodiversity

3.3.1. Matosinhos

The implementation area located in Matosinhos does not overlap any of the National System of Classified Areas (SNAC), structured by the Decree Law n. º 142/2008, July 24, altered and republished by the Decree Law n. º 242/2015, October 15. Also, in the study area (considering a 1 km buffer) there are no areas included on the National System of Classified Areas (SNAC) or other non-classified areas, but important for the conservation (e.g., Important Bird Areas [IBAs]).

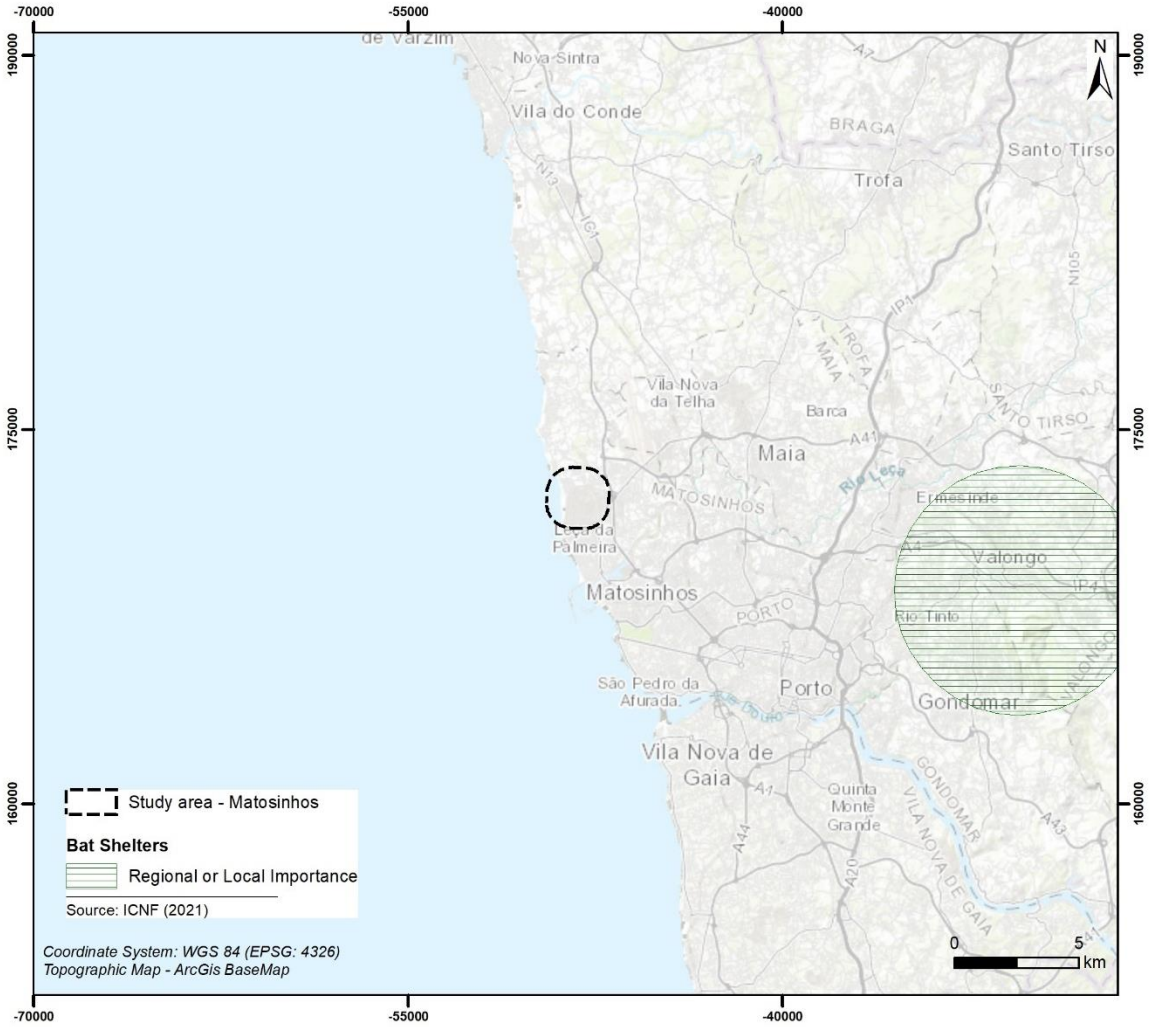


Figure 3-22 – Bat Shelters in the Study Area of Matosinhos

The closest SNAC and important areas to the study area are listed on Table 3-4. In the **Figure 7.1 the Appendix B – Drawings** it is possible to observe the sensitive areas.

SNAC areas or others with ecological importance	**Approximate Distances from the site location**
Corine Biotope - Mindelo	12 km
Corine Biotope – Santa Justa/Pias	20 km
Regional Protected Landscape -Reserva Ornitologica do Mindelo	7 km
Regional Protected Landscape - Parques das Serras do Porto	17 km
Special Conservation Zone (PTCON0063) Maceda/Praia da Vieira	14 km

SNAC areas or others with ecological importance	Approximate Distances from the site location
Special Conservation Zone (PTCON0024) Valongo	18 km
Douro Estuarine	8 km

Table 3-4 – SNAC Areas and other relevant areas in the vicinity of the study area located in Matosinhos

According to the Cartography of the Manual to support the analysis of projects related to the installation of overhead power distribution and transportation lines (ICNB/Actual ICNF, 2010), the study area of Matosinhos does not overlap with any known national, regional, or local bat shelter as shown in Figure 3-22. It should be noted that in the projected area there are no protection areas for critical birds, like water birds, or birds of prey.

Even though it is not represented on the text figures, the closest UNESCO World Heritage sites are presented on Table 3-5:

UNESCO World Heritage	Distance from the site location
Historic center of Oporto	12 km southeast
Alto douro wine region	77 km east
Historic center of Guimarães	43 km northwest

Table 3-5 – UNESCO World Heritage in the vicinity of the study area located in Matosinhos

3.3.2. Sines

The implementation area located in Sines does not overlap any of the National System of Classified Areas (SNAC), structured by the Decree Law n. º 142/2008, July 24, altered and republished by the Decree Law n. º 242/2015, October 15. Also, in the study area (considering a 1 km buffer) there are no areas included on the National System of Classified Areas (SNAC) or other non-classified areas, but important for the conservation (e.g., Important Bird Areas [IBAs]).

According to the *Cartography of the Manual to support the analysis of projects related to the installation of overhead power distribution and transportation lines* (ICNB/Actual ICNF, 2010), the study area of Sines does not overlap with any known national, regional, or local bat shelter (Figure 3-23). Similarly, the study area does not overlap with any critical and very critical bird areas, either for birds of prey or water birds.

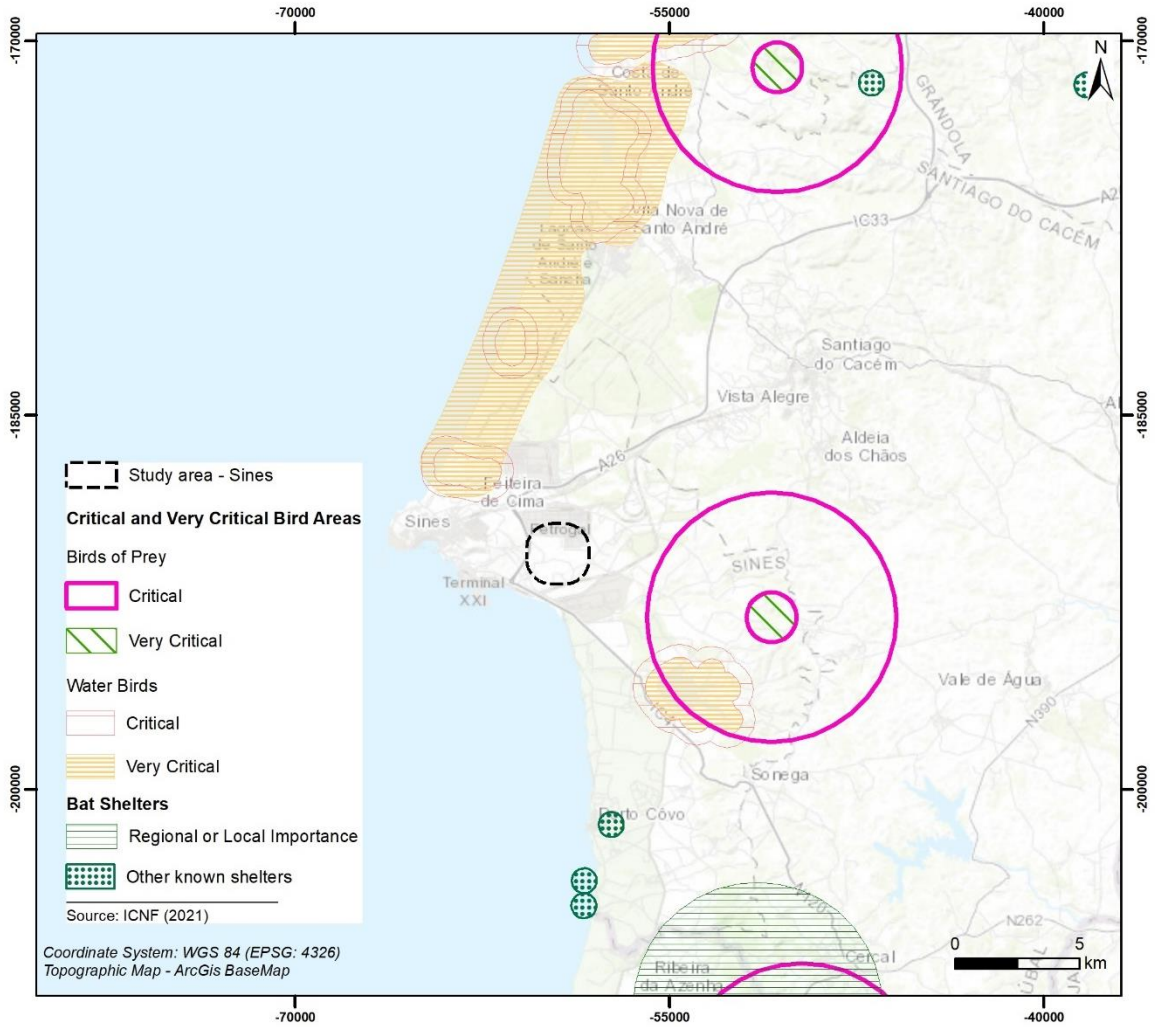


Figure 3-23 – Balt Shelters in the Study Area of Sines

The closest SNAC and important areas to the study area are listed on Table 3-6. In the **Figure 7.2 the Appendix B – Drawings** it is possible to observe the sensitive areas.

SNAC areas or others with ecological importance	**Approximate distances from the site location**
Special Protection Zone (PTZPE0014) Lagoa da Sancha	7 km
Special Protection Zone (PTZPE0013) Lagoa de Santo André	11 km
Special Protection Zone (PTZPE0015) Costa Sudoeste	13 km
Corine Biotope – Costa da Galé	4 km
Corine Biotope – Serra da Grandôla	12 km
Corine Biotope – Área de P.P da Costa Vicentina Sudoeste e Alentejano	3 km
Corine Biotope – Serra do Cercal	17 km
Corine Biotope – Ribeira do Torgal	26 km
Special Conservation Zone (PTCON0034) Comporta/Gale	4 km
Special Conservation Zone (PTCON0012) Costa Sudoeste	3 km
Natural Reserve – Lagoas de Santo André e Sancha	5 km
Natural Park – Sudoeste Alentejano e Costa Vicentina	3 km
Important Bird Area Lagoas de Santo André e Sancha	5 km
Important Bird Area Costa Sudoeste	13 km

Table 3-6 – SNAC Areas and other relevant areas in the vicinity of the study area located in Sines

Even though it is not represented on the text figures, the closest UNESCO World Heritage sites are presented on the table below:

UNESCO World Heritage	Distance from the site location
Monastery of the Hieronymites and Tower of Belém in Lisbon	100 km northeast
Historic center of Evora	88 km northwest

Table 3-7 – UNESCO World Heritage in the vicinity of the study area located in Sines

3.3.3. Estarreja

The implementation area and the study area (considering a 1 km buffer) are included in the Corine Biotope - Ria de Aveiro, which means it is a site “of interest for nature conservation”.

Besides the Corine Biotope - Ria de Aveiro, in the vicinity of the study area the closest SNAC and important areas to the refinery location are listed below. The Important bird area, the special protection zone and the special conservation zone of Ria de Aveiro are at less than 3 km from the study area. In spite of not being directly affected by the project, it can be potentially affected by indirect activity, like product and raw material transportation.

According to the *Cartography of the Manual to support the analysis of projects related to the installation of overhead power distribution and transportation lines* (ICNB/Actual ICNF, 2010), the study area of Estarreja does not overlap with any known national, regional, or local bat shelter.

Similarly, the study area does not overlap with any critical and very critical bird areas, specifically the areas related to water birds (Figure 3-24).

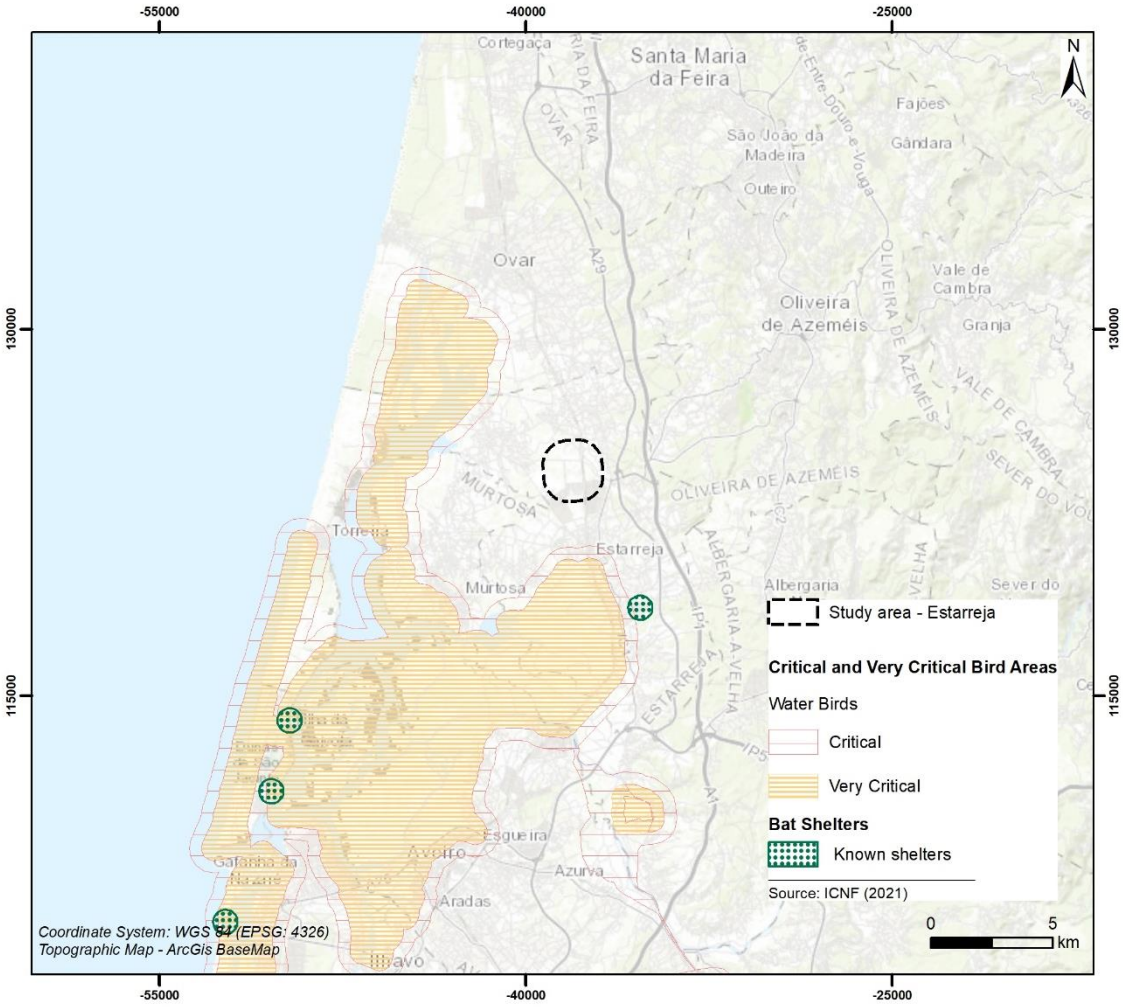


Figure 3-24 – Balt Shelters in the Study Area of Estarreja

The closest SNAC and important areas to the study area are listed onTable 3-8. In the **Figure 7.3 the Appendix B – Drawings** it is possible to observe the sensitive areas.

SNAC areas or others with ecological importance	**Approximate distances from the site location**
Corine Biotope Costa do Furadouro	14 km
Corine Biotope Barrinha de Esmoriz	20 km
Important Bird Area Ria de Aveiro	**3 km**
Important Bird Area Costa do Sudoeste	9 km
Important Bird Area Barrinha de Esmoriz	20 km
Special Protection Zone (PTZPE0004) Ria de Aveiro	**3 km**
Special Protection Zone (PTZPE0015) Costa Sudoeste	9 km
Special Conservation Zone (PTCON0061) Ria de Aveiro	**3 km**
Special Conservation Zone (PTCON0055) Dunas de Mira Gândara e Gafanhas	27 km
Special Conservation Zone (PTCON0026) Rio Vouga	15 km
Special Conservation Zone (PTCON0063) Maceda/Praia da Vieira	10 km
Special Conservation Zone (PTCON0018) Barrinha de Esmoriz	20 km
Special Conservation Zone (PTCON0047) Serras da Freita e Arada	22 km
Natural Reserve – Dunas de São Jacinto	14 km

Table 3-8 – SNAC Areas and other relevant areas in the vicinity of the study area located in Estarreja

Even though it is not represented on the text figures, the closest UNESCO World Heritage sites are presented on Table 3-9.

UNESCO World Heritage	Distance from the site location
University of Coimbra	79 km south
Historic center of Oporto	50 km north
Alto Douro wine region	75 km northwest

Table 3-9 – UNESCO World Heritage in the vicinity of the study area located in Estarreja

3.3.4. Vigo

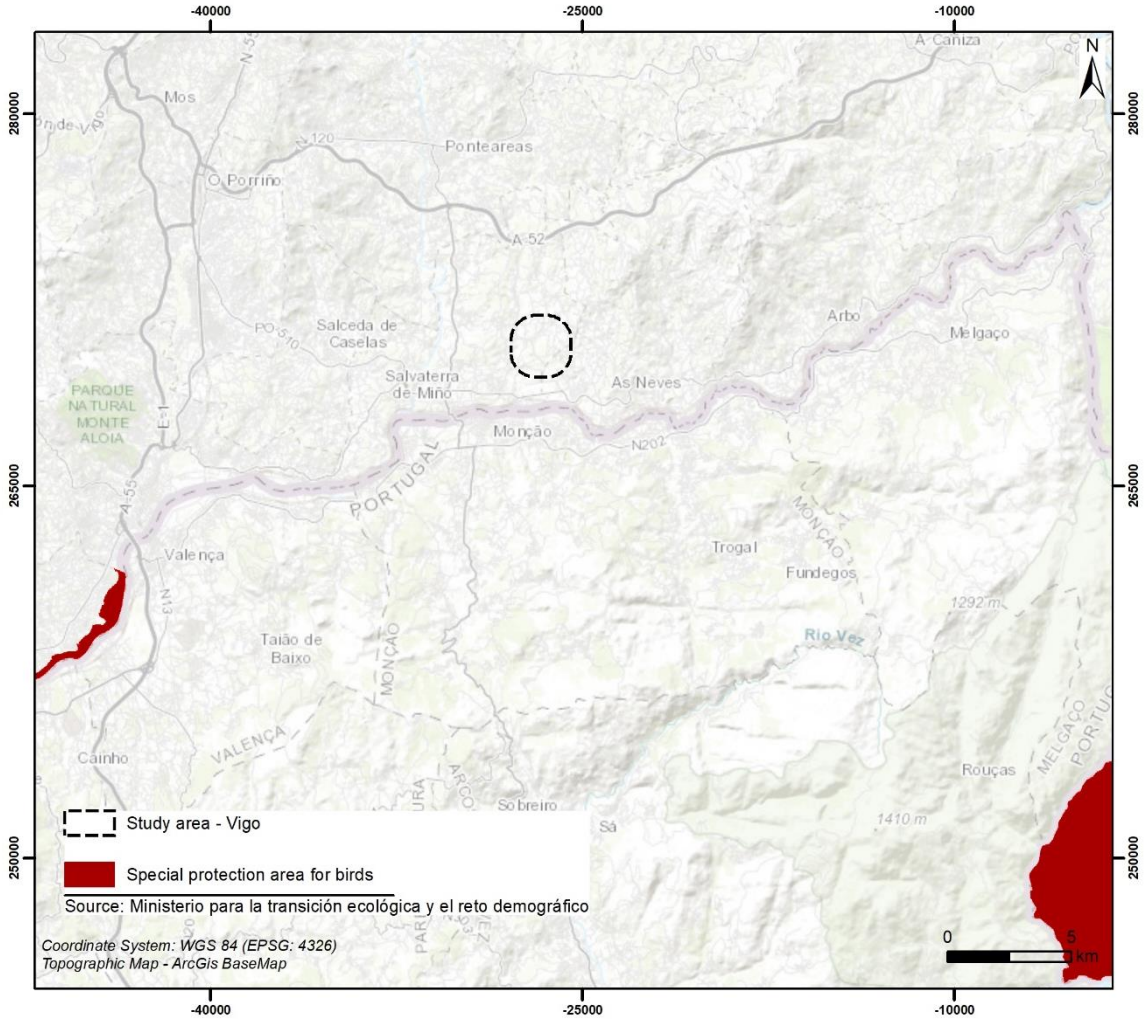


Figure 3-25 – Special protection area for birds in the Study Area of Vigo

The implementation area located in Pontevedra does not overlap with any Special Areas of Conservation (SAC) structured by the Decree 37/2014, of 27 March, for the Autonomous Community of Galicia. Also, in the study area (considering a 1 km buffer) there are not areas included in the Special Areas of Conservation (SAC) or

other areas important for the conservation, namely special protection areas for birds (ZEPA), classified under the Agreement of the Council of the Xunta de Galicia of 2 April 2004.

According to Cartography in the Directory of the Biodiversity and Forestry services of activity of the Spain Government the study area of Vigo does not overlap with any known Special protection areas for birds (Figure 3-25).

The closest SNAC and important areas to the study area are listed on Table 3-10. In the **Figure 7.4 the Appendix B – Drawings** it is possible to observe the sensitive areas.

Protected Sites	**Approximate distances from the site location**
ES1140007 - Baixo Miño	2 km
ES1140006 – Río Tea	4 km
ES11401 - Gandaras de Budiño	14 km
ES114010 - Esteiro do Miño	19 km
ES114001- Monte Aloia	16 km
ES114009 - Enseada de San Simon	25 km

Table 3-10 - Relevant areas in the vicinity of the study area located in Vigo

Even though it is not represented on the text figures, the closest UNESCO World Heritage sites are presented on the Table 3-11.

UNESCO World Heritage	**Distance from the site location**
Santiago de Compostela (old town)	90 km north
Historic center of Guimarães	74 km south

Table 3-11 – UNESCO World Heritage in the vicinity of the study area located in Vigo

3.3.5. Setúbal

The north border of the proposed site location in Setúbal is coincident with the Corine Biotope of Sado Estuary classified as a National System of Classified Areas (SNAC), structured by the Decree-Law n. º 142/2008, July 24, altered and republished by the Decree-Law n. º 242/2015, October 15. This means that it is a site "*of interest for nature conservation*".

Also, in the study area (considering a 1 km buffer) there are other protected areas included on the National System of Classified Areas (SNAC) or other non-classified areas, but important for conservation (e.g., Important Bird Areas [IBAs]).

According to the Cartography of the Manual to support the analysis of projects related to the installation of overhead power distribution and transportation lines (ICNB/Atual ICNF, 2010), the study area of Setúbal does not overlap with any known national, regional, or local bat shelter as shown in Figure 3-26.

However, it is important to highlight that the **site location is within a very critical water bird area**. The main biodiversity issue is the interaction between powerlines and water birds, which in this case might not be a problem. Considering that the project **is a lithium refinery, that will be installed in an existing industrial area, it is not expected to raise additional pressures to the waterbird's dynamics**.

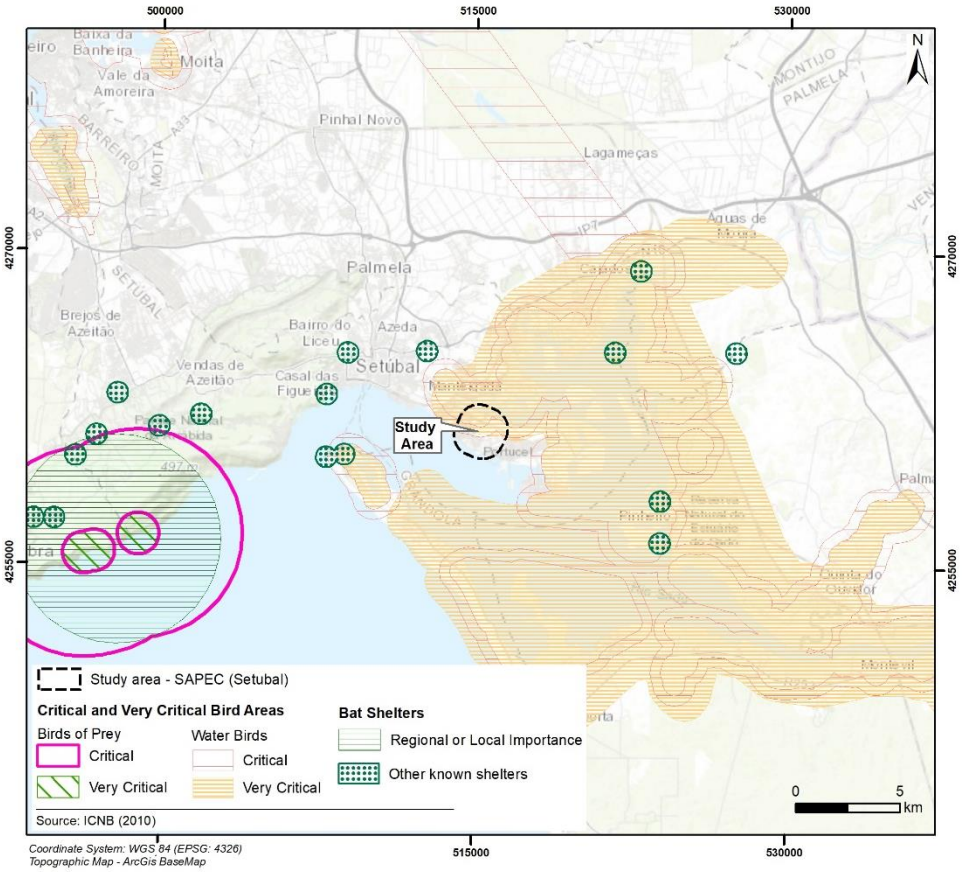


Figure 3-26 – Bat Shelters and Critical Bird Areas in the Study Area of Setúbal

The closest SNAC and important areas to the study area are listed in Table 3-12. In **Figure 7.5 of Appendix B – Drawings** it is possible to observe the sensitive areas.

SNAC areas or others with ecological importance	Approximate distances from the site location
Natural Reserve – Estuário do Sado	**0.7 km**
Important Bird Area – Estuário do Sado	**2 km**
Important Bird Area – Estuário do Tejo	24 km
Biotope Corine – Estuário do Sado	**0 km**
Biotope Corine – Comporta	14 km
Biotope Corine – Estuário do Tejo	26 km
Biotope Corine – Parque Natural da Arrábida	7 km
Special Conservation Zone (PTCON0011) – Estuário do Sado	**1 km**
Special Conservation Zone (PTCON0034) - Comporta/Gale	14 km
Special Conservation Zone (PTCON0009) – Estuário do Tejo	24 km
Special Protection Zone (PTZPE0012) - Açude da Murta	14 km
Special Protection Zone (PTZPE0011) – Estuário do Sado	2 km
Special Protection Zone (PTZPE0010) – Estuário do Tejo	24 km
Natural Park – Arrábida	7 km

Table 3-12 – SNAC Areas and other relevant areas in the vicinity of the study area located in Setúbal

Even though it is not represented in the text figures, the closest UNESCO World Heritage sites are presented in Table 3-13.

UNESCO World Heritage	Distance from the site location

Monastery of the Hieronymites and Tower of Belém in Lisbon	40 km northwest
The cultural landscape of Sintra	60 km northwest
The historic centre of Evora	80 km northeast

Table 3-13 – UNESCO World Heritage in the vicinity of the study area located in Setúbal

3.3.6. Valongo

The west border of the proposed site location in Valongo coincides with the Corine Biotope of Santa Justa/Pias classified as a National System of Classified Areas (SNAC), structured by the Decree-Law n. º 142/2008, July 24, altered and republished by the Decree-Law n. º 242/2015, October 15. This means that it is a site "*of interest for nature conservation*".

Also, in the study area (considering a 1 km buffer) there are other protected areas included on the National System of Classified Areas (SNAC).

According to the Cartography of the Manual to support the analysis of projects related to the installation of overhead power distribution and transportation lines (ICNB/Atual ICNF, 2010), the study area of Valongo does overlap known national, regional, or local bat shelters as shown in Figure 3-27.

The main biodiversity issue is the interaction between the bat's habitats and the refinery, specifically related to vibrations and air quality. Although the project **is a lithium refinery, that will be installed in an existing business/industrial area, it is necessary** to safeguard the wellbeing of the bat population through impact **protection, reduction and/or compensation measures**.

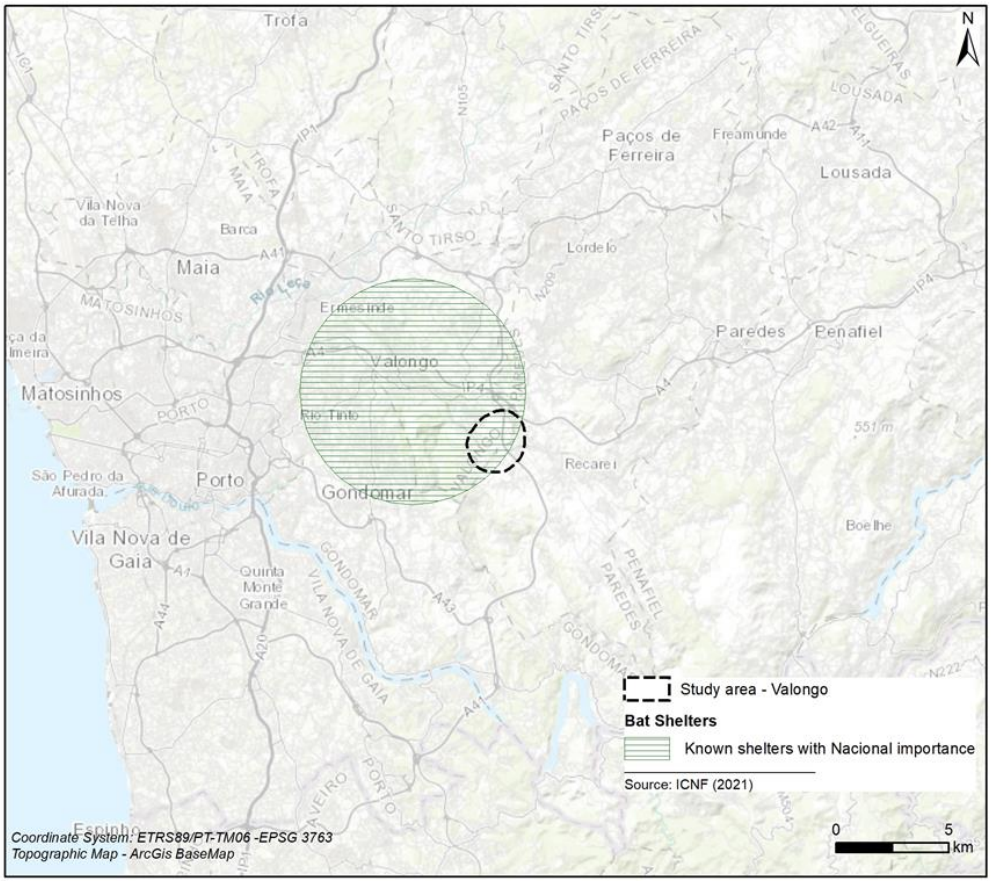


Figure 3-27 – Bat Shelters and Critical Bird Areas in the Study Area of Valongo

The closest SNAC and important areas to the study area are listed in Table 3-14. In **Figure 7.6 of Appendix B – Drawings** it is possible to observe the sensitive areas.

SNAC areas or others with ecological importance	Approximate distances from the site location
Corine Biotope -Santa Justa/Pias	178 m
Special Conservation Zone (PTCON0024) - Valongo	267 m
Regional Protected Landscape – Parque das serras do porto	267 m

Table 3-14 – SNAC Areas and other relevant areas in the vicinity of the study area located in Valongo

Even though it is not represented in the text figures, the closest UNESCO World Heritage sites are presented in Table 3-15.

UNESCO World Heritage	Distance from the site location
Historic Centre of Guimarães	35 km
Alto douro wine region	55 km
Historic Centre of Porto	13 km

Table 3-15 – UNESCO World Heritage in the vicinity of the study area located in Valongo

3.3.7. Trofa

The site location and the study area (considering a 1 km buffer) do not overlap with protected areas included on the National System of Classified Areas (SNAC).

According to the Cartography of the Manual to support the analysis of projects related to the installation of overhead power distribution and transportation lines (ICNB/Current ICNF, 2010), the study area of Trofa does not overlap known national, regional, or local bat shelters nor critical or very critical aquatic birds as shown in Figure 3-28.

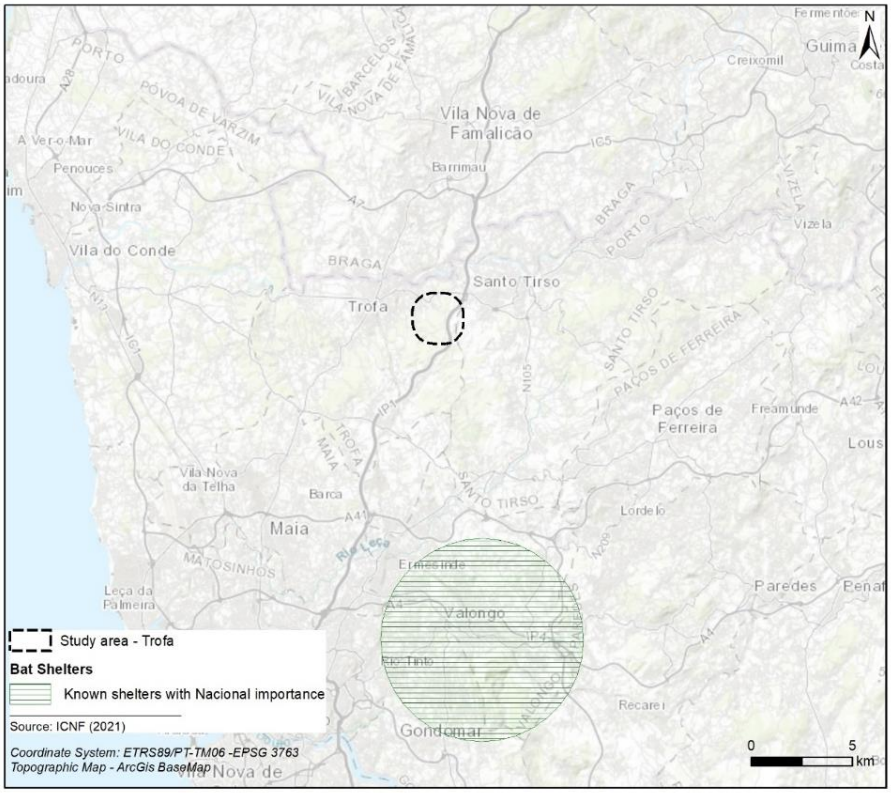


Figure 3-28 – Bat Shelters and Critical Bird Areas in the Study Area of Trofa

The closest SNAC and important areas to the study area are listed in table 3-16. In **Figure 7.7 of Appendix B – Drawings** it is possible to observe the sensitive areas.

SNAC areas or others with ecological importance	Approximate distances from the site location
Corine Biotope – Mindelo	16 km
Corine Biotope - Santa justa/Pias	15 km
Regional protected landscape - Vila Conde Coastal Line	16 km
Regional protected landscape - Mindelo Ornithologival Reserve	16 km
Special Conservation Zone (PTCON0024) - Valongo	15 km
Regional Protected Landscape – Parque das serras do porto	15 km

Table 3-16 – SNAC Areas and other relevant areas in the vicinity of the study area located in Trofa

Even though it is not represented in the text figures, the closest UNESCO World Heritage sites are presented in Table 3-17.

UNESCO World Heritage	Distance from the site location
Historic Centre of Guimarães	23 km
Historic Centre of Porto	22 km
Alto douro wine region	66 km

Table 3-17 – UNESCO World Heritage in the vicinity of the study area located in Trofa

3.3.8. Fafe

The site location and the study area (considering a 1 km buffer) do not overlap with protected areas included on the National System of Classified Areas (SNAC).

According to the Cartography of the Manual to support the analysis of projects related to the installation of overhead power distribution and transportation lines (ICNB/Current ICNF, 2010), the study area of Fafe does not overlap known national, regional, or local bat shelters nor critical or very critical aquatic birds as shown in Figure 3-29.

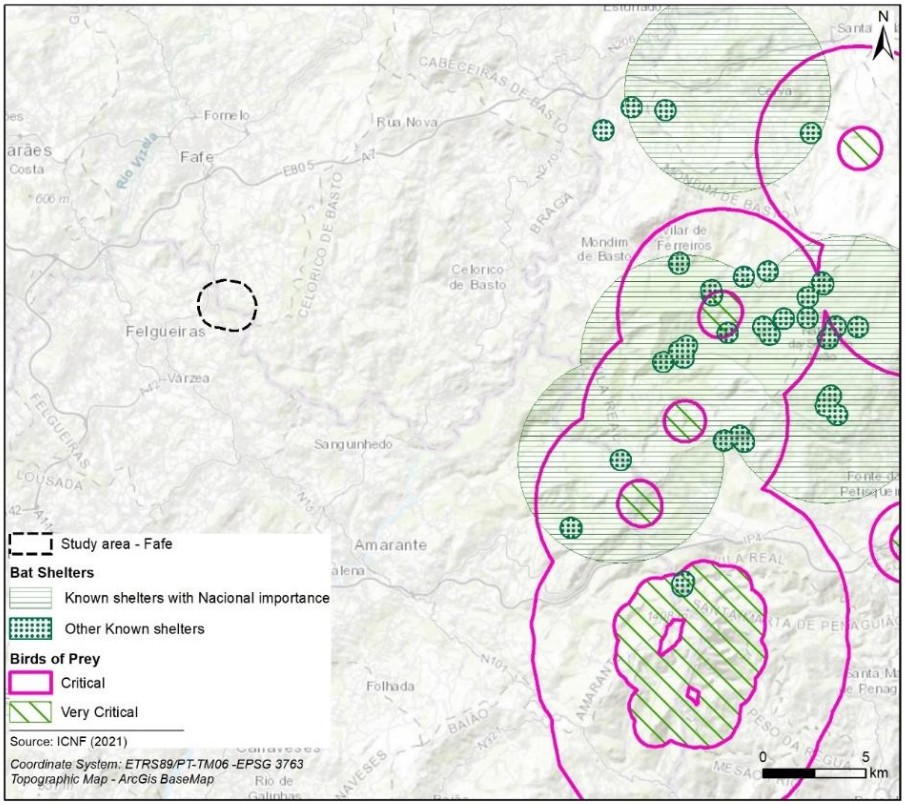


Figure 3-29 – Bat Shelters and Critical Bird Areas in the Study Area of Fafe

The closest SNAC and important areas to the study area are listed in Table 3-18. In **Figure 7.8 of Appendix B – Drawings** it is possible to observe the sensitive areas.

SNAC areas or others with ecological importance	Approximate distances from the site location
Special Conservation Zone (PTCON0003) – Alvão/Marão	14 km
Biotope Corine – Marão	16.5 km
Natural Park - Marão	14 km

Table 3-18 – SNAC Areas and other relevant areas in the vicinity of the study area located in Fafe

Even though it is not represented in the text figures, the closest UNESCO World Heritage sites are presented in Table 3-19.

UNESCO World Heritage	Distance from the site location
Historic Centre of Guimarães	13 km
Historic Centre of Porto	43 km
Alto douro wine region	44 km

Table 3-19 – UNESCO World Heritage in the vicinity of the study area located in Fafe

3.4. GEOLOGY AND GEOMORPHOLOGY

The characterisation of the geology and geomorphology carried out in this section is based on the available specialised bibliography and the interpretation of the local morphology based on aerial photography and military cartography. Detailed analysis and geotechnical constraints were not assessed at this stage.

Thus, the geology was assessed considering the local morphological framework, the lithologies present, the seismicity and neotectonics and the presence or not of geological resources and geological heritage.

Table 3-20 summarises the information compiled and ranks the 8 selected sites according to the potential for impact on geology and geomorphology, considering that the higher the score the greater the impact.

Category	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
Geology/Lithology	1	2	2	1	1	2	4	3
	• Granites from the Ancient Massif, the Oldest morpho structural unit in Portugal, covered by beach and dune sands.	• Sedimentary rocks • Marine deposits, mixed with gravel and sands (highland and coastal)	• Lowlands • Alluvium (beach sands and gravel), dune sands • Continental sedimentary rocks	• Minho River deposits (conglomerates, sands, calcarenites, travertine…) cover • Biotitic granitoid	• Flat land and gently sloping towards the sea • Cenozoic carbonate and continental sedimentary rocks and facies	• Schists from the Ancient Massif, the Oldest morpho structural unit in Portugal • Steeper slopes in the northern sector of the site; remaining area of gentle slope	• Schists from the Ancient Massif, the Oldest morpho structural unit in Portugal • Important slopes	• Granites from the Ancient Massif, the Oldest morpho structural unit in Portugal • Some sloping
Tectonics, Neotectonics and seismicity	1	4	2	1	4	1	1	1

	• No active faults or geological lineaments in the study area
	• Seismic Zoning:
	  • RSAEEP - Zone D
	  • EC8 - Type 1 Seismic - Zone 1,6
	  • EC8 - Type 2 Seismic Zone 2,5
		• No active faults or geological lineaments in the study area
		• Seismic Zoning:
		  • RSAEEP - Zone A
		  • EC8 - Type 1 Seismic Zone 1,3
		  • EC8 - Type 2 Seismic Zone 2,3
			• No active faults or geological lineaments in the study area
			• Seismic Zoning:
			  • RSAEEP - Zone C
			  • EC8 - Type 1 Seismic Zone 1,6
			  • EC8 - Type 2 Seismic Zone 2,4
				• No active faults or geological lineaments in the study area
				• Seismic Zoning:
				  • RSAEEP - Zone D
				  • EC8 - Type 1 Seismic Zone 1,6
				  • EC8 - Type 2 Seismic Zone 2,5
					• No active faults or geological lineaments in the study area
					• Seismic Zoning:
					  • RSAEEP - Zone A
					  • EC8 - Type 1 Seismic Zone 1,3
					  • EC8 - Type 2 Seismic Zone 2,3
						• No active faults or geological lineaments in the study area
						• Seismic Zoning:
						  • RSAEEP - Zone D
						  • EC8 - Type 1 Seismic - Zone 1,6
						• EC8 - Type 2 Seismic Zone 2,5
							• No active faults or geological lineaments in the study area
							• Seismic Zoning:
							  • RSAEEP - Zone D
							  • EC8 - Type 1 Seismic - Zone 1,6
							• EC8 - Type 2 Seismic Zone 2,5
								• No active faults or geological lineaments in the study area
								• Seismic Zoning:
								  • RSAEEP - Zone D
								  • EC8 - Type 1 Seismic - Zone 1,6
								• EC8 - Type 2 Seismic Zone 2,5

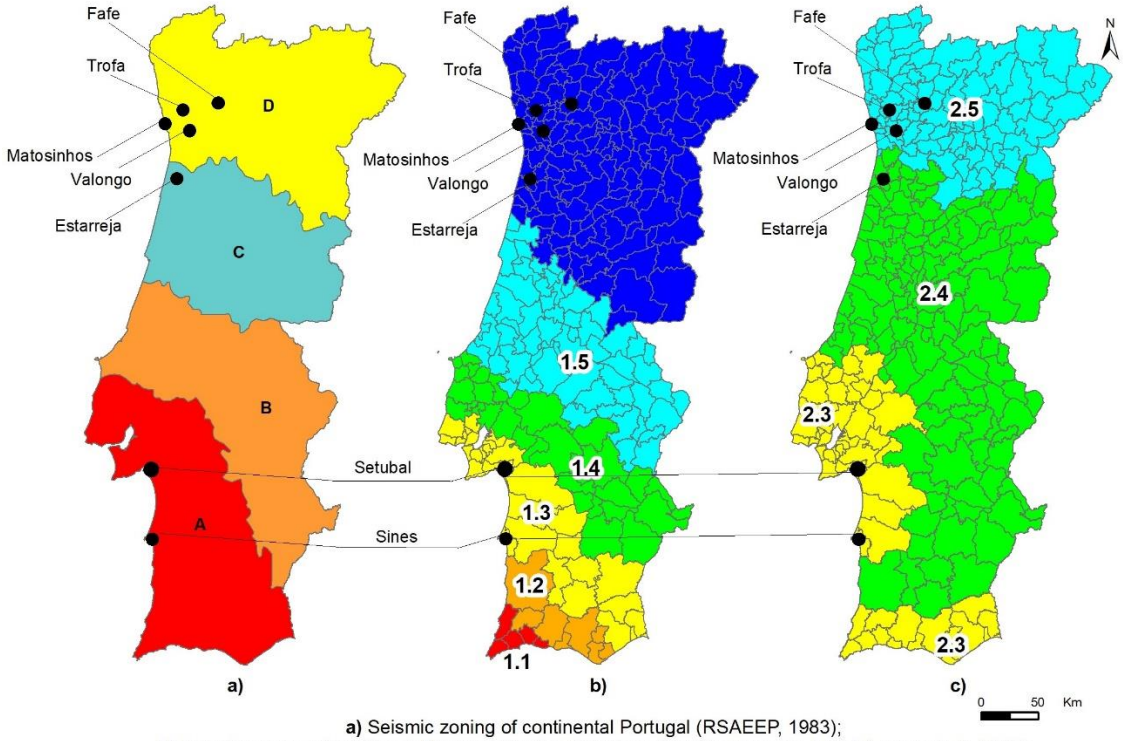
Geological Heritage and Geological Resources	1	1	1	2	1	2	1	2
	• No identified issues – heritage, mineral resources	• No identified issues – heritage, mineral resources	• No identified issues – heritage, mineral resources	• No heritage issues noted • Located near protected thermal waters • Known geological exploit area	• No identified issues – heritage, mineral resources	• No heritage issues noted • Mineral exploration area (quarry) within the study area	• No identified issues – heritage, mineral resources	• No heritage issues noted • Mineral exploration area (quarry) within the study area
Total Score	3	7	5	4	6	5	6	6
Quantitative level	**1**	**4**	**2**	**2**	**3**	**2**	**3**	**3**

Table 3-20 – Summary of site-specific impact on geology and geomorphology

In the evaluation of the geology of the present project, and given the different locations under analysis, seismic seems to be one of the differentiating factors and so some general considerations are presented below.

The seismic activity of the Portuguese territory results from phenomena located on the border of the African and Eurasian plates (inter-plate seismicity) and from phenomena that happen inside the Eurasian plate (intra-plate seismicity). Inside this plate, the seismicity is diffuse, and the epicentres roughly coincide with the major accidents at the level of the ancient massif, which they reject during the Miocene compression and show signs of seismic activity in the Quaternary (last 2 million years).

The seismicity of a region can also be assessed based on the degree of seismicity attributed by the Safety and Actions Regulation for Building and Bridge Structures (RSAEEP). This regulation contains information that allows the definition of seismic actions at the construction sites, either for distant earthquakes or for near earthquakes, depending on the four zones in which the country was divided, A, B, C and D, in decreasing order of degree of seismicity. The influence of the degree of seismicity is translated by the seismicity coefficient, α.



a) Seismic zoning of continental Portugal (RSAEEP, 1983);
b) Seismic zoning of continental Portugal for the distant earthquake scenario, type I (Eurocode 8, 2010):
c) Seismic zoning of continental Portugal for the near earthquake scenario, type II (Eurocode 8, 2010)

Figure 3-30 – Seismic zoning framework of the study areas in Portugal

According to Eurocode 8 - Structures for earthquake resistance Design (EC8), the action of severe seismic phenomena can be systematized into two major types:

- **Type 1 seismic action**, corresponding to distant earthquakes, of great magnitude and with epicentre at sea (Eurasian and African inter-plate seismicity);
- **Type 2 seismic action**, associated with local earthquakes, of moderate magnitude and short focal distance (Eurasian intraplate seismicity).

The regulation document defines the project reference acceleration value (agR), as outlined in Figure 3-30b) and c), according to the type of seismic action considered and for each of the defined seismic zones. The maximum project reference accelerations to be considered are highlighted below.

TYPE 1 SEISMIC ACTION		TYPE 2 SEISMIC ACTION	
Seismic Zone	**agR (m/s²)**	**Seismic Zone**	**agR (m/s²)**
1.1	2.5	2.1	2.5
1.2	2.0	2.2	2.0
1.3	1.5	2.3	1.7
1.4	1.0	2.4	1.1
1.5	0.6	2.5	0.8
1.6	0.35	-	-

Table 3-21 - Maximum design reference acceleration for the seismic zones defined in EC8

3.4.1. Matosinhos

3.4.1.1.1. Geomorphological Framework

The Matosinhos site is situated a few hundred meters from the coastline. The elevations of the study area range from 30 m in the eastern sector to zero near the coast. At the site location, which is already heavily artificialized, elevations are around 20 m. The areas slopes are gentle and slope westwards towards the sea.

The hydrographic network is practically non-existent in the study area due to its artificialisation, except for a water line that crosses the study area in an E-W direction, north of Perafita, and which flows into the sea near Montedouro.

3.4.1.1.2. Geological Framework

The study area of the Matosinhos site is part of the Ancient Massif, the oldest morphostructural unit in Portugal, more specifically in the Central Iberian Zone, constituted here by granites. In the site location, these granites are covered by modern detrital formations correlated to the sea level and transported by the wind.

At the regional scale, the area under study is covered by sheet 9-C (Porto) of the Geological Map of Portugal at scale 1: 50,000. According to this sheet and the respective Explanatory Note (Carrington da Costa, et al., 1957) in the Matosinhos site area, there are sand dunes deposited in the Plio-Pliocene and beach pebbles or dismantling terraces, which cover a medium to coarse grained, leucocratic, two mica granite (Granito do Porto).

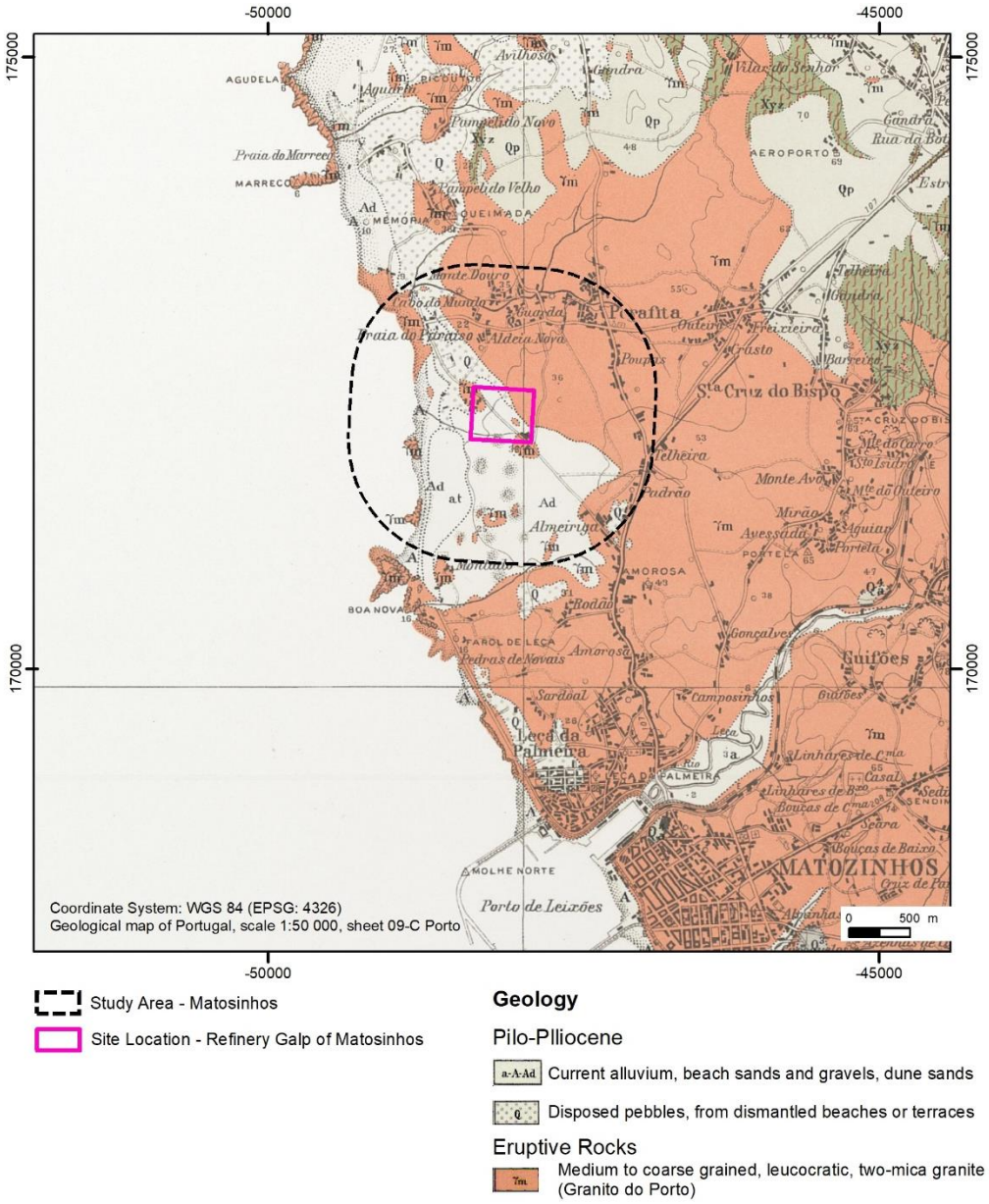


Figure 3-31 – Framing of the study area of Matosinhos in the geological map

3.4.1.1.3. Tectonics, Neotectonics and seismicity

From the geological chart interpretation (Figure 3-31), no faults or geological lineaments are identified in the study area. On the Neotectonic Map (Cabral & Ribeiro, 1988; Figure 3-32) it is possible to observe the proximity of the study area two probable faults with unknown movement type.

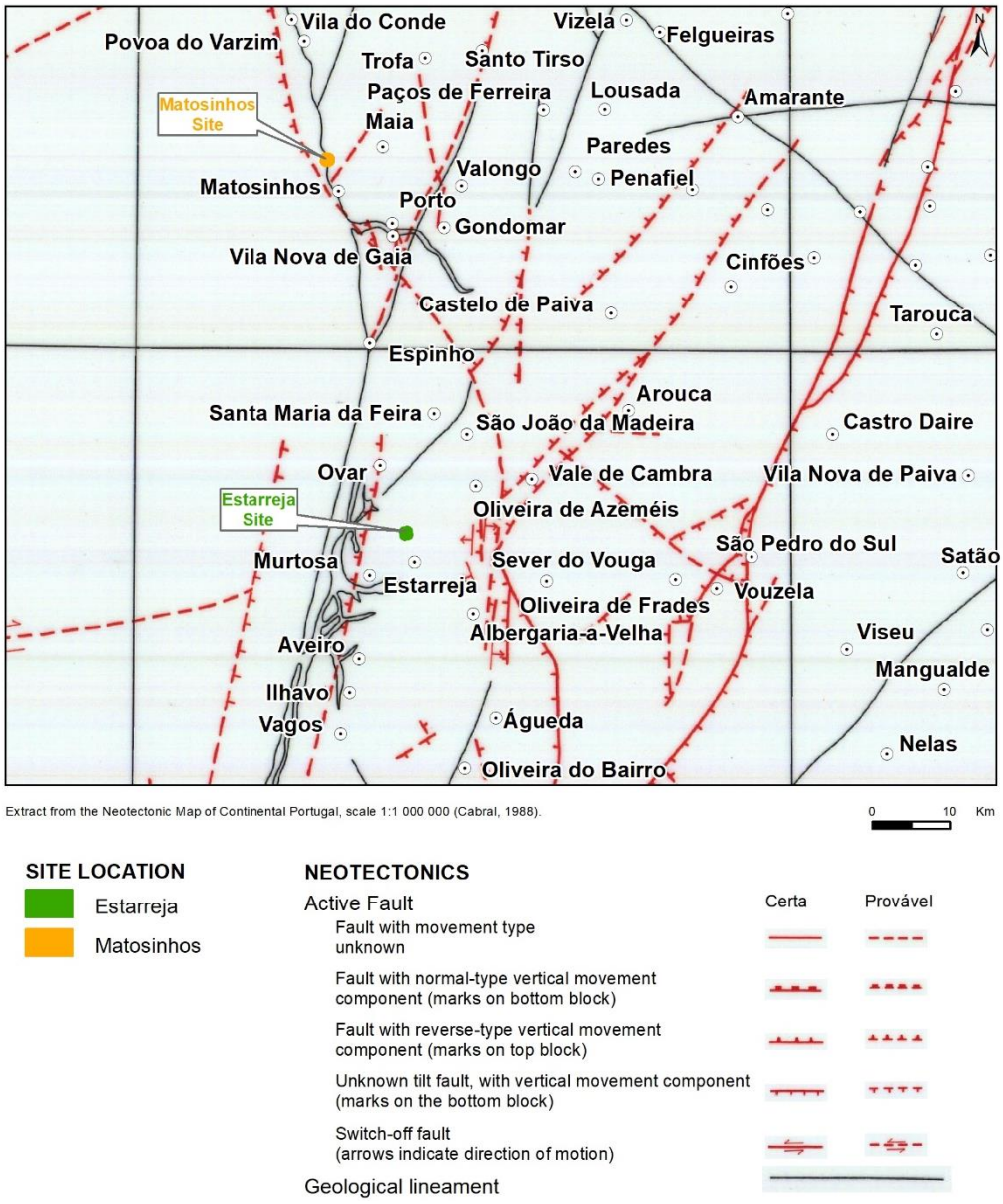


Figure 3-32 – Framing of the study area of Matosinhos and Estarreja in the neotectonic map

In the Seismic Zoning Map for Portugal Mainland, the study of Matosinhos area is in zone D (Figure 3-30a), which corresponds to a value of α = 0,3.

The zone where the study area is located corresponds to the seismic zone 1,6, in relation to the Type 1 seismic action (Figure 3-30b), and to the zone 2,5 in relation to the Type 2 action (Figure 3-30c).The maximum project reference accelerations to be considered are presented in (Table 3-21).

3.4.1.1.4. Geological Heritage and Geological Resources

To identify and characterize the geological heritage, the LNEG geoportal was consulted and the portal that integrates the Progeo Group's Inventory of National Relevance Geosites. These consultations did not return results for the study area.

Regarding easements in the mining field, the DGEG platform (mining concessions, areas requested or granted for prospecting and researching mineral resources, among others) was consulted and it was found that the study area does not overlap with any easement.

3.4.2. Sines

3.4.2.1.1. Geomorphological Framework

The Sines site is located on the so-called *Planicie Litoral Ocidental* where the land is flat and gently sloping towards the sea. The elevations of the study area range from 60 m in the eastern sector to 30 m in the south sector. At the site location elevations are around 40 m.

The hydrographic network in the study area is made up of negligible water courses in a roughly north-south direction that flow into the sea.

3.4.2.1.2. Geological Framework

The study area of Sines site is in the Western Meso Cenozoic border morphostructural unit, close to the contact with the Portuguese Southern Massif. The sedimentary filling reaches a thickness of more than 1 000 m, corresponding essentially to Mezo-Cenozoic carbonate and continental sedimentary rocks and facies, associated to the deposition of sediments in the basins generated during the distensional process of the opening of the Atlantic Ocean and whose process is particularly evident in the Sines region. The superficial stratigraphy in the Sines area is essentially limited to the Quaternary and Tertiary, although some Miocene, Jurassic and Palaeozoic outcrops appear on the surface, together with the Sines Eruptive Complex.

At the regional scale, the area under study is covered by sheet 42-C (Santiago do Cacém) of the Geological Map of Portugal at scale 1: 50,000. According to this sheet (Figure 3-33) and the respective Explanatory Note (Inverno et al., 1986) the geological characteristics are mainly represented by sedimentary rocks of the Plio-Plistocene, and there are also formations referring to the ancient massif.

Only Plio-Plistocene formations occur in the site location. The Plio-Plistocene formations outcrop to a great extent on the coastal plain, corresponding to marine and continental deposits made up of orange and reddish sands with scattered pebbles.

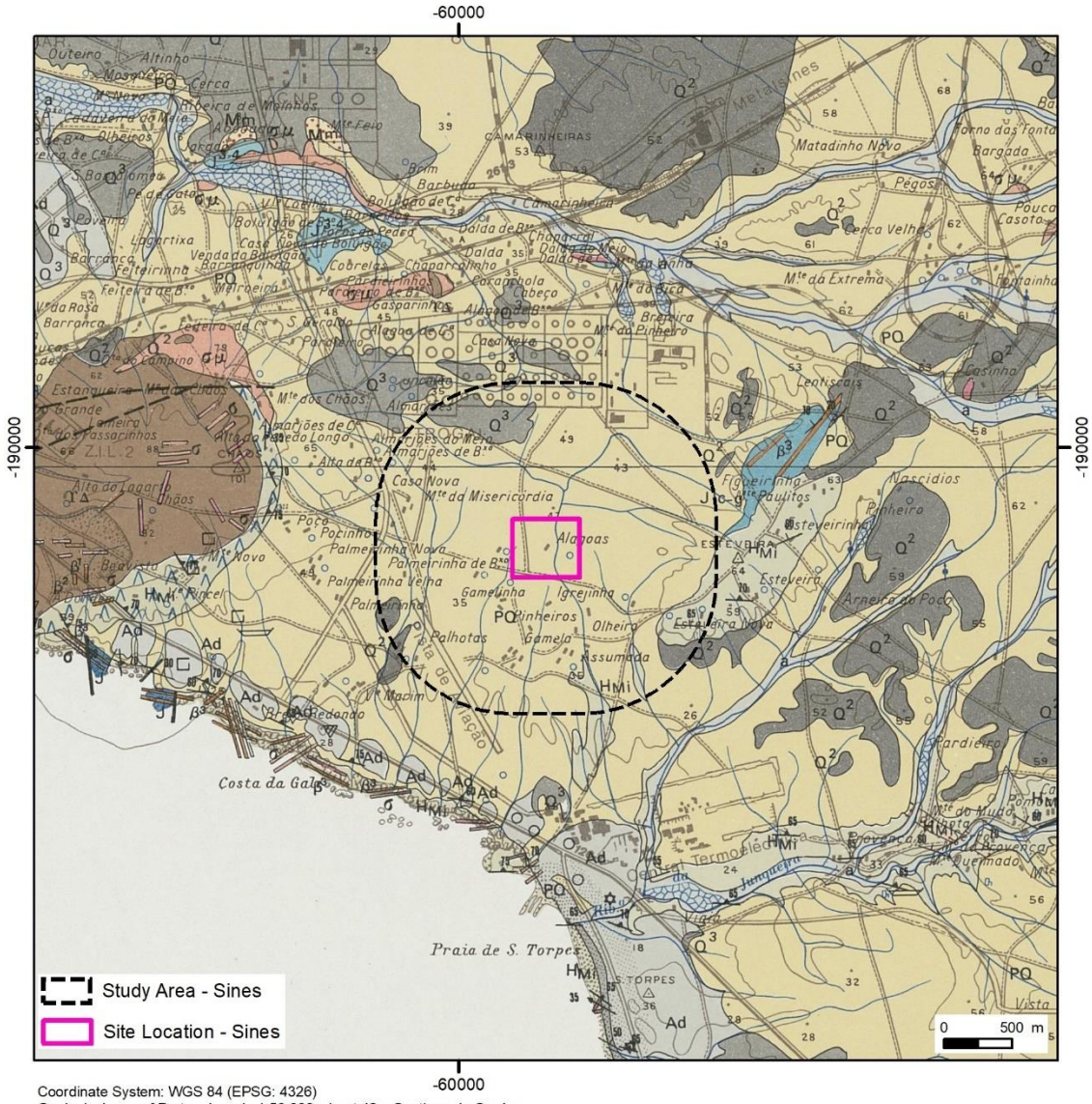


Figure 3-33 – Framing of the study area of Sines in the geological map

3.4.2.1.3. Tectonics, Neotectonics and seismicity

During the region's geological evolution, the movements were controlled by faults, along their preferential orientations, such as the Santo André, Santa Cruz and Grândola faults and by the structural alignment of Monchique - Sines - Sesimbra - Sintra. Because of these volcanic movements and intrusions and the existence of folds, monoclinic structures and grabens, the Tertiary Sado Basin constitutes a deep graben (mega-structure of distending compartmentation) elongated along a NE-SW direction, related to tectonic activity during the various stages of the Alpine Orogeny.

However, from the geological chart interpretation, no faults or geological lineaments are identified in the study area. On the Neotectonic Map (Cabral & Ribeiro, 1988; Figure 3-34) it is possible to observe the proximity of the study area as a probable fault with unknown movement type.

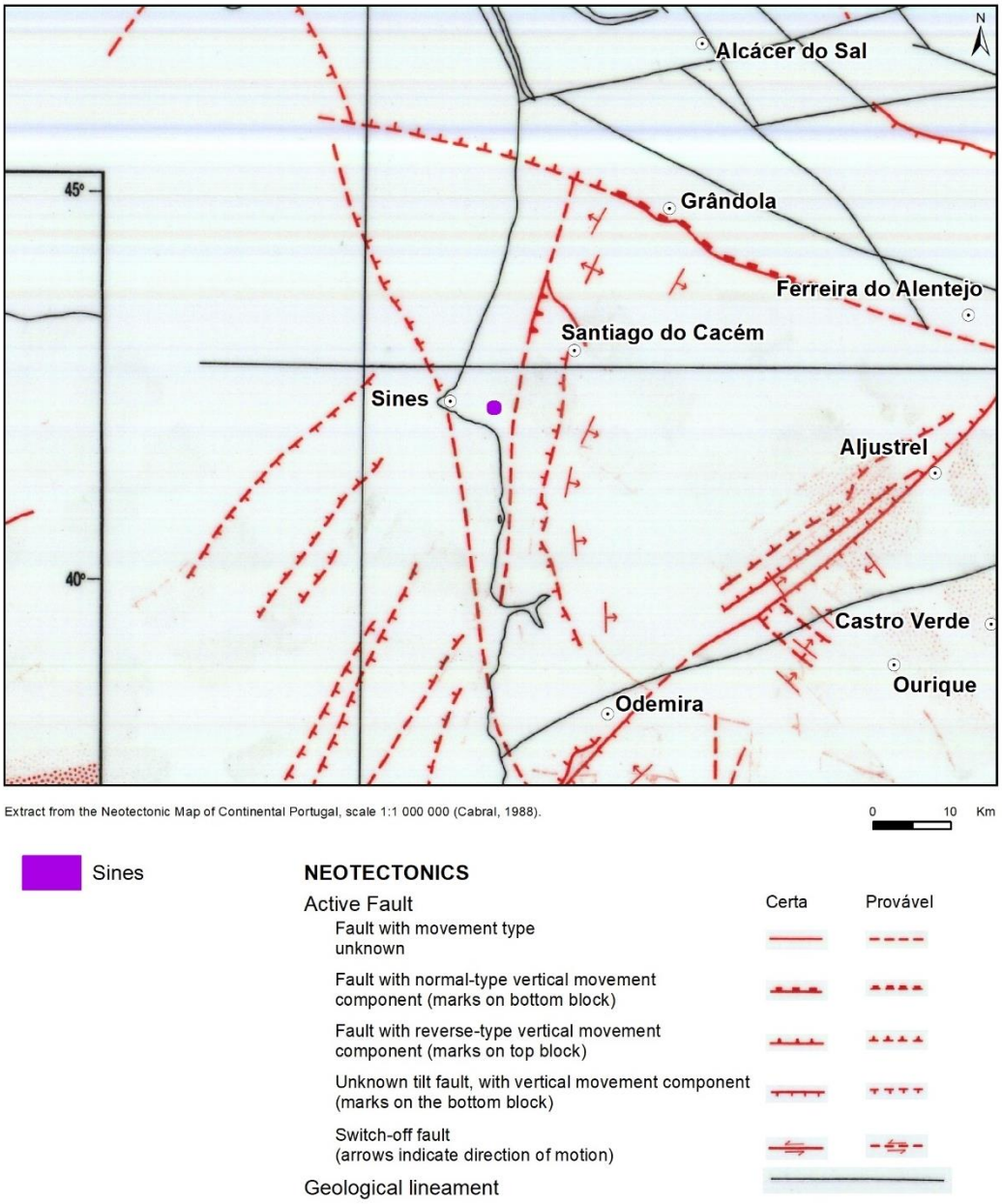


Figure 3-34 – Framing of the study area of Sines in the neotectonics map

The seismicity of a region can also be assessed based on the degree of seismicity attributed by the Safety and Actions Regulation for Building and Bridge Structures (RSAEEP). In the Seismic Zoning Map for Portugal Mainland, the study area is in zone A (Figure 3-30a), which corresponds to a value of α = 1,0.

Eurocode 8 - Structures for earthquake resistance design (EC8) defines the reference value of acceleration, as outlined in Figure 3-30b) and c), according to the type of seismic action considered and for each of the defined seismic zones.

The zone where the study area is located corresponds to the seismic zone 1,3, in relation to the Type 1 seismic action (Figure 3-30b), and to the zone 2,3 in relation to the Type 2 action (Figure 3-30c). The maximum project reference accelerations to be considered are presented in (Table 3-21).

3.4.2.1.4. Geological Heritage and Geological Resources

To identify and characterize the geological heritage, the LNEG geoportal was consulted and the portal that integrates the Progeo Group's Inventory of National Relevance Geosites. These consultations did not return results for the study area.

Regarding easements in the mining field, the DGEG platform (mining concessions, areas requested or granted for prospecting and researching mineral resources, among others) was consulted and it was found that the study area does not overlap with any easement.

3.4.3. Estarreja

3.4.3.1.1. Geomorphological Framework

The Estarreja site is located in the coastal region were occupied by a large of lowlands (alluvium and dune sands) that constitute the western part of the delta (Ria de Aveiro).

The elevations of the study area range between 30 and 10 m. At the site, location elevations are around 15 m.

3.4.3.1.2. Geological Framework

The study area of Estarreja site is located on the Western Meso Cenozoic border morphostructural unit. The sedimentary filling reaches a thickness of more than 1 000 m, corresponding essentially to Mezo-Cenozoic carbonate and continental sedimentary rocks and facies, associated with the deposition of sediments in the basins generated during the distensional process of the opening of the Atlantic Ocean. The superficial stratigraphy in the Estarreja area is essentially limited to the Quaternary detrital formations.

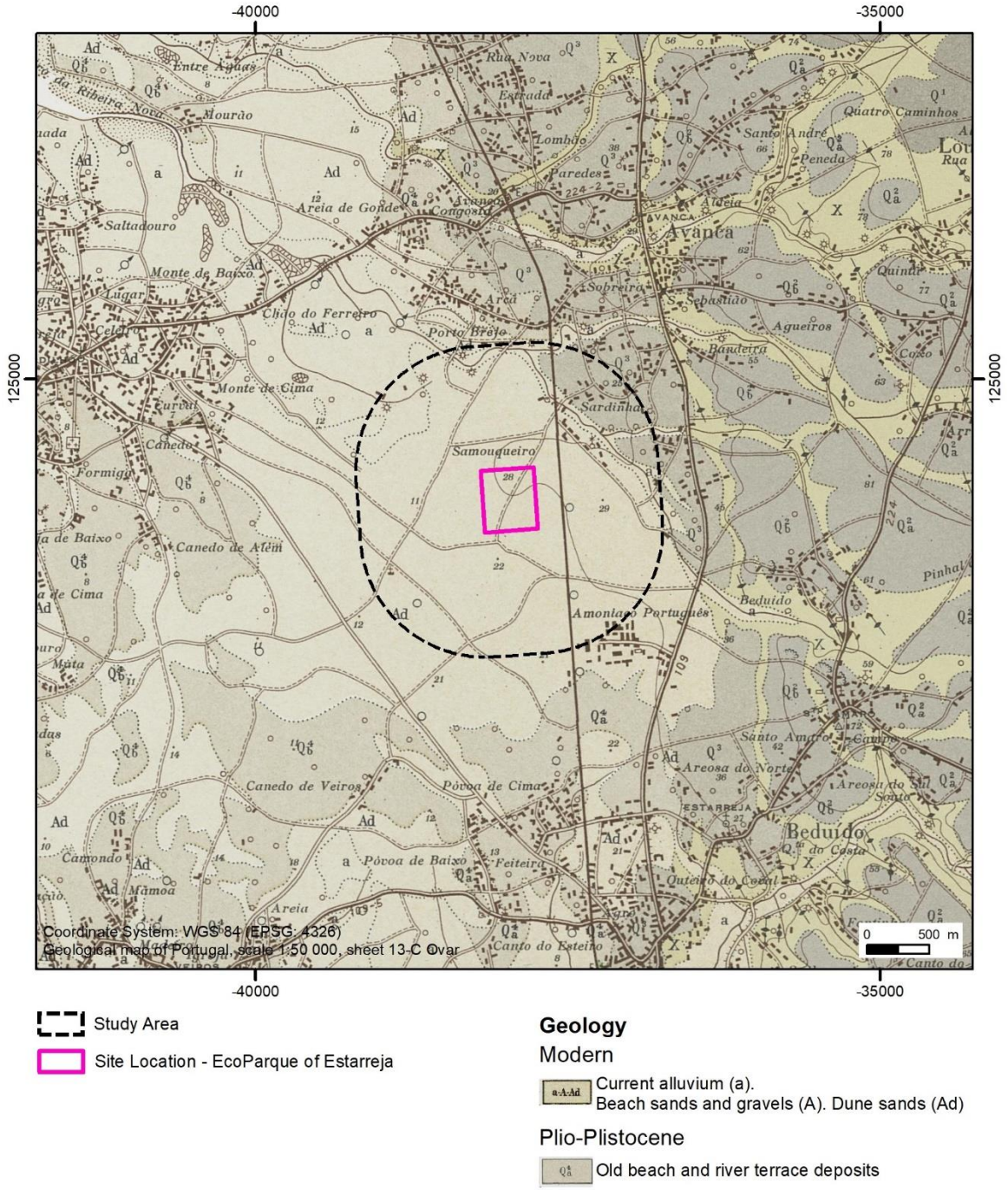


Figure 3-35 – Framing of the study area of Estarreja in the geological map

At the regional scale, the area under study is covered by sheet 13-C (Ovar) of the Geological Map of Portugal at scale 1: 50,000. According to this sheet (Figure 3-35) and the respective Explanatory Note (Teixeira, 1963) there are detrimental cenozoic sediments deposited in the Plio-Plistocene and Holocene, consisting of dune sands and old beach and river terrace deposits.

3.4.3.1.3. Tectonics, Neotectonics and seismicity

From the geological chart interpretation (Figure 3-35), no faults or geological lineaments are identified in the study area. The Neotectonic Map (Cabral & Ribeiro, 1988; Figure 3-36) did not identify any certain or probable fault near the Estarreja study area.

The seismicity of a region can also be assessed based on the degree of seismicity attributed by the Safety and Actions Regulation for Building and Bridge Structures (RSAEEP). In the Seismic Zoning Map for Portugal Mainland, the study area is in zone C (Figure 3-30a), which corresponds to a value of α = 0,5.

Eurocode 8 - Structures for earthquake resistance design (EC8) defines the reference value of acceleration, as outlined in Figure 3.3 b) and c), according to the type of seismic action considered and for each of the defined seismic zones.

The zone where the study area is located corresponds to the seismic zone 1,6, in relation to the Type 1 seismic action (Figure 3-30b), and to the zone 2,4 in relation to the Type 2 action (Figure 3-30c). The maximum project reference accelerations to be considered are presented in (Table 3-21).

3.4.3.1.4. Geological Heritage and Geological Resources

To identify and characterize the geological heritage, the LNEG geoportal was consulted and the portal that integrates the Progeo Group's Inventory of National Relevance Geosites. These consultations did not return results for the study area.

Regarding easements in the mining field, the DGEG platform (mining concessions, areas requested or granted for prospecting and researching mineral resources, among others) was consulted and it was found that the study area does not overlap with any easement.

3.4.4. Vigo

Although the Vigo area under analysis is in Spain, it is very close to the border with Portugal (less than 3 km away). Thus, regarding the environmental factor of geology and geomorphology, when possible, the Portuguese information was used to allow the comparison with the other areas under analysis.

3.4.4.1.1. Geomorphological Framework

The Vigo site is situated on the right bank of the Minho River, where the elevations of the study area range from 100 m in the north east sector to 30 m to south wester sector. At the site location, which already has some interventions that can be observed on aerial photography, elevations are between 50 m and 70 m.

The hydrographic network is practically non-existent in the study area. There is only one water line, Rego Cumaro, which crosses the Vigo site. There is also a series of water bodies in the southern sector of the study area, resulting from the exploitation of geological resources.

3.4.4.1.2. Geological Framework

The study area of the Vigo site is part of the Ancient Massif, the oldest morphostructural unit in Portugal, more specifically in the Central Iberian Zone, constituted here by granites. In the site location these granites are covered by modern detrital formations associated with the Minho river.

At the regional scale, the area under study is covered by Geological Map of Spain and Portugal at scale 1: 1 000 000. According to this map (Figure 3-36) there are Cenozoic fluvial sediments deposited between the Pleistocene and Holocene, consisting of conglomerates, gravels, sands, lutites, martes, calcarenites, travertine limestones and tuffs. This formation covers a biotite granitoid.

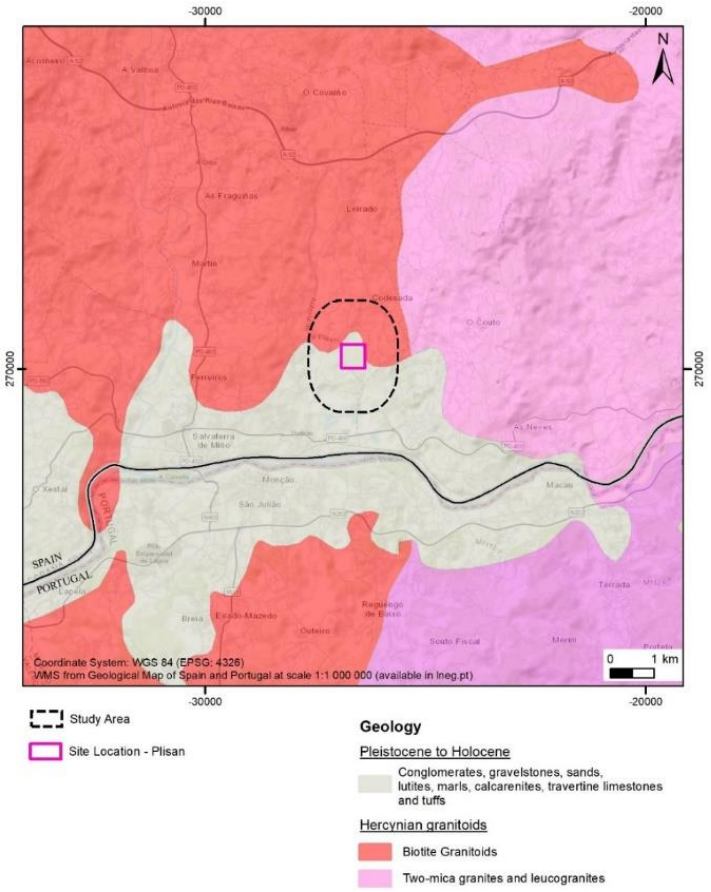


Figure 3-36 – Framing of the study area of Vigo in the geological map

3.4.4.1.3. Tectonics, Neotectonics and seismicity

From the geological chart interpretation (Figure 3-36), no faults or geological lineaments are identified in the study area.

The seismicity of a region can also be assessed based on the degree of seismicity attributed by the Safety and Actions Regulation for Building and Bridge Structures (RSAEEP). In the Seismic Zoning Map for Portugal Mainland, the study area is in zone D which corresponds to a value of α = 0,3.

Eurocode 8 - Structures for earthquake resistance design (EC8) defines the reference value of acceleration, as outlined in Figure 3.3 b) and c), considering the municipality of Monção given its proximity to the study area, according to the type of seismic action considered and for each of the defined seismic zones.

The zone where the study area is located corresponds to the seismic zone 1,3, in relation to the Type 1 seismic action (Figure 3-30b), and to the zone 2,3 in relation to the Type 2 action (Figure 3-30c). The maximum project reference accelerations to be considered are presented in (Table 3-21).

3.4.4.1.4. Geological Heritage and Geological Resources

On the geological heritage in the Vigo Study area, no information has been found. Regarding geological resources, its exploitation is reported in the southern sector of the study area, although it is unknown whether it is still in operation or not. It is also worth mentioning the proximity of the study area to the Perimeters of protection to the spring of mineral-medicinal and thermal waters, called Caldelas de Tui (DOG núm. 246, 22/12/2002, pág. 17.541).

The Áridos do Mendo quarry is located on the fluvial terraces of the river Miño, south side of the study area and has been operating in the open and uninterruptedly since 1985.

The benefited materials are mainly sand and gravel, as well as gold and other dense minerals. The aggregates obtained are marketed mainly for the manufacture of asphalt agglomerates and concretes and given their high quality, they are especially suitable for use in the construction of roads and concrete structures.

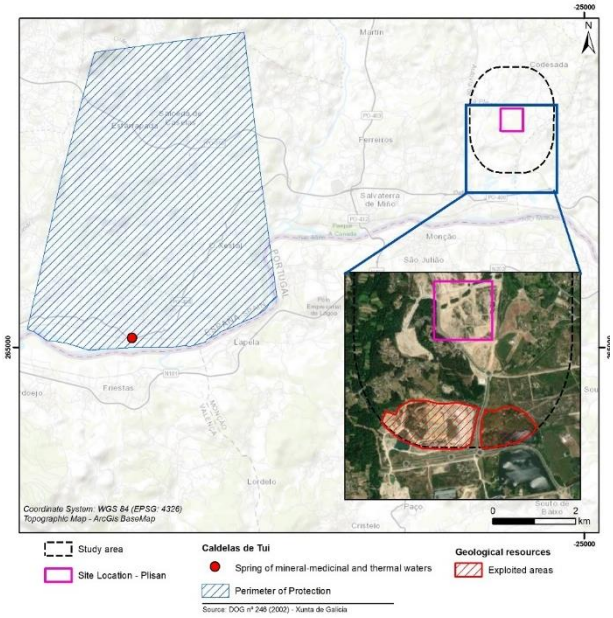


Figure 3-37 – Geological resources in and around the Vigo study area

3.4.5. Setúbal

3.4.5.1.1. Geomorphological Framework

The Setúbal site is located about 700 meters from the Sado estuary, on the Mitrena Peninsula, where the land is flat and gently sloping towards the sea. The elevations of the study area range from 38 m in the western sector to 0 m in the south sector. The site elevations are controlled by the existing drainage network where elevations vary between 28 and 15 m forming a gentle slope to the northeast sector.

The hydrographic network in the study area is made up of watercourses, of dendritic type and torrential regime, which flow in an approximately southwest to north east direction towards the Esteiro das praias.

3.4.5.1.2. Geological Framework

The study area of the Setúbal site is located in the Cenozoic Tejo-Sado Basin, more specifically in the Sado Basin. The sedimentary filling reaches a thickness of more than 500 m, corresponding essentially to Cenozoic carbonate and continental sedimentary rocks and facies, associated with the deposition of sediments in the basins. The superficial stratigraphy in the Setubal area is essentially limited to the Pliocene detrital formations.

At the regional scale, the area under study is covered by sheet 39-A (Setubal) of the Geological Map of Portugal at scale 1: 50,000. According to this sheet (Figure 3-33) and the respective Explanatory Note (zbyszewski et al., 1976) the geological characteristics are mainly represented by sedimentary rocks of the Pliocene, and there are also formations referring to alluvion deposit from the Sado estuary in the north area.

Only Pliocene formations occur on the site location. The Pliocene formations outcrop in a large part of the Mitrena peninsula, consisting of sands, sandstones and grey or greenish clays, associated with a fluvial-estuarine environment.

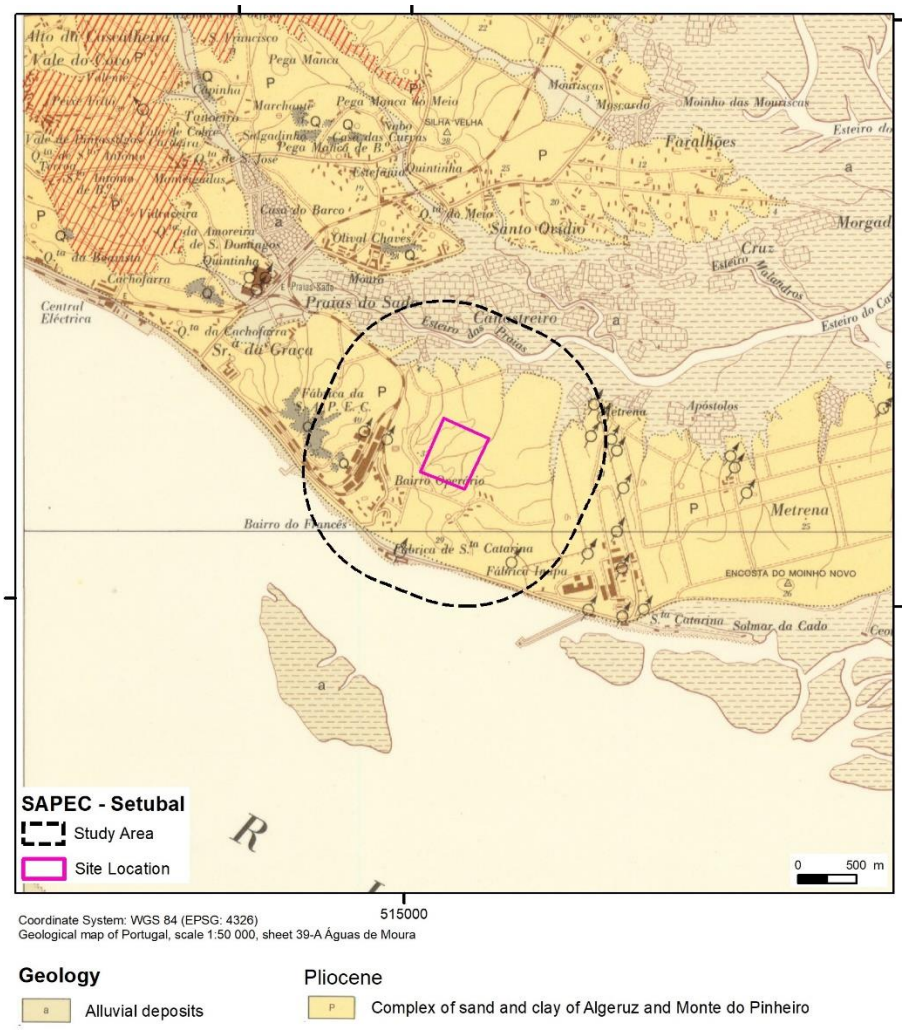


Figure 3-38 – Framing of the study area of Setubal in the geological map

3.4.5.1.3. Tectonics, Neotectonics and seismicity

However, from the geological chart interpretation (Figure 3-34), no faults or geological lineaments are identified in the study area. On the Neotectonic Map (Cabral & Ribeiro, 1988; Figure 3-34) it is possible to observe the proximity of the study area as a probable fault with unknown movement type.

The seismicity of a region can also be assessed based on the degree of seismicity attributed by the Safety and Actions Regulation for Building and Bridge Structures (RSAEEP). In the Seismic Zoning Map for Portugal Mainland, the study area is in zone A (Figure 3-30a), which corresponds to a value of α = 1.0.

Eurocode 8 - Structures for earthquake resistance design (EC8) defines the reference value of acceleration, as outlined in Figure 3-30b) and c), according to the type of seismic action considered and for each of the defined seismic zones.

The zone where the study area is located corresponds to the seismic zone 1.3, in relation to the Type 1 seismic action (Figure 3-30b), and to the zone 2.3 in relation to the Type 2 action (Figure 3-30c). The maximum project reference accelerations to be considered are presented in (Table 3-21).

3.4.5.1.4. Geological Heritage and Geological Resources

To identify and characterize the geological heritage the LNEG geoportal and the portal that integrates the Progeo Group's Inventory of National Relevance Geosites was consulted. These consultations did not return results for the study area.

Regarding easements in the mining field, the DGEG platform (mining concessions, areas requested or granted for prospecting and researching mineral resources, among others) was consulted and it was found that the study area does not overlap with any easement.

3.4.6. Valongo

3.4.6.1.1. Geomorphological Framework

The Valongo site is situated a few hundred meters from the elevations denominated Serras do Porto. The elevations of the study area range from 115 m in the western sector to 190 m in the eastern area of site location. At the site location elevations range from 180 m to 130 m. The areas slopes are, generally, gentle and slope westwards towards the local waterline. The exception is for the north sector where the slopes are higher.

The site location it's crossed by water lines that runoff to the west side.

3.4.6.1.2. Geological Framework

The study area of the Valongo site is part of the Ancient Massif, the oldest morphostructural unit in Portugal, more specifically in the Central Iberian Zone, constituted here by Shists and grauvaques.

At the regional scale, the area under study is covered by sheet 9-D (Penafiel) of the Geological Map of Portugal at scale 1: 50,000. According to this sheet and the respective Explanatory Note in the Valongo site location, there are clay shales formation (Xistos de Valongo).

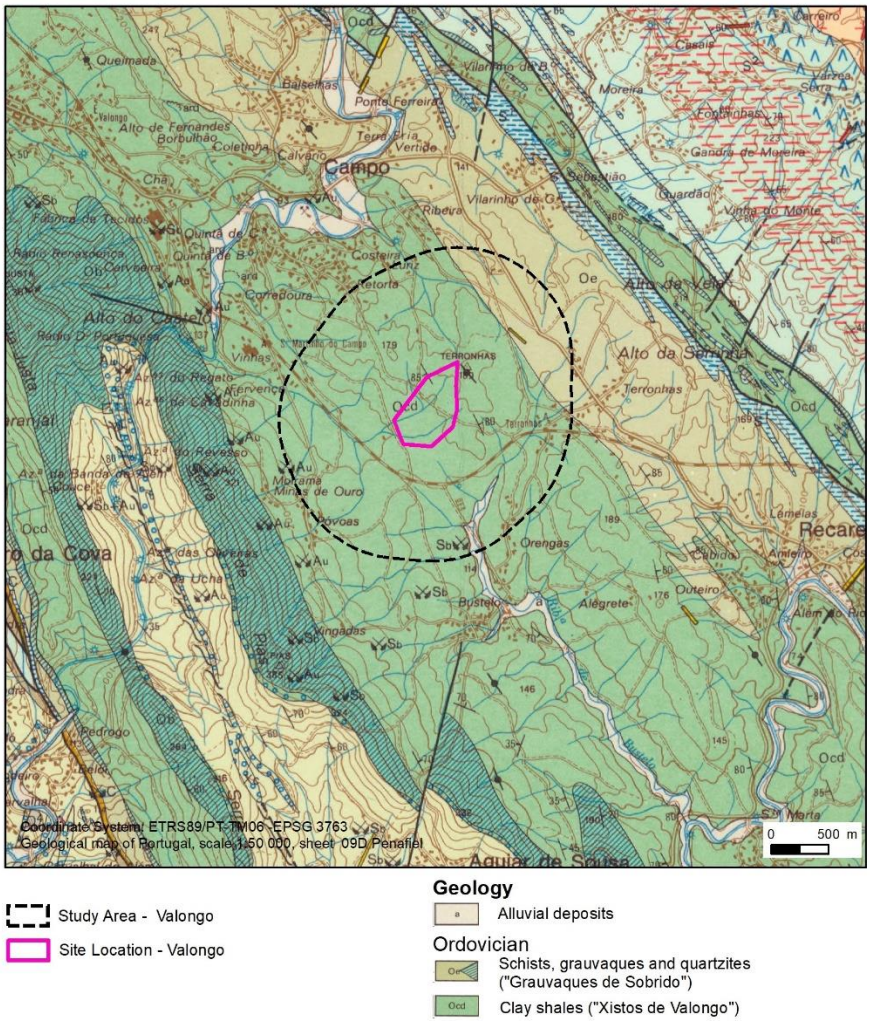


Figure 3-39 – Framing of the study area of Valongo in the geological map

3.4.6.1.3. Tectonics, Neotectonics and seismicity

From the geological chart interpretation (Figure 3 39), no faults or geological lineaments are identified in the study area. The Neotectonic Map (Cabral & Ribeiro, 1988; Figure 3-40) did not identify any certain or probable fault near the Valongo study area.

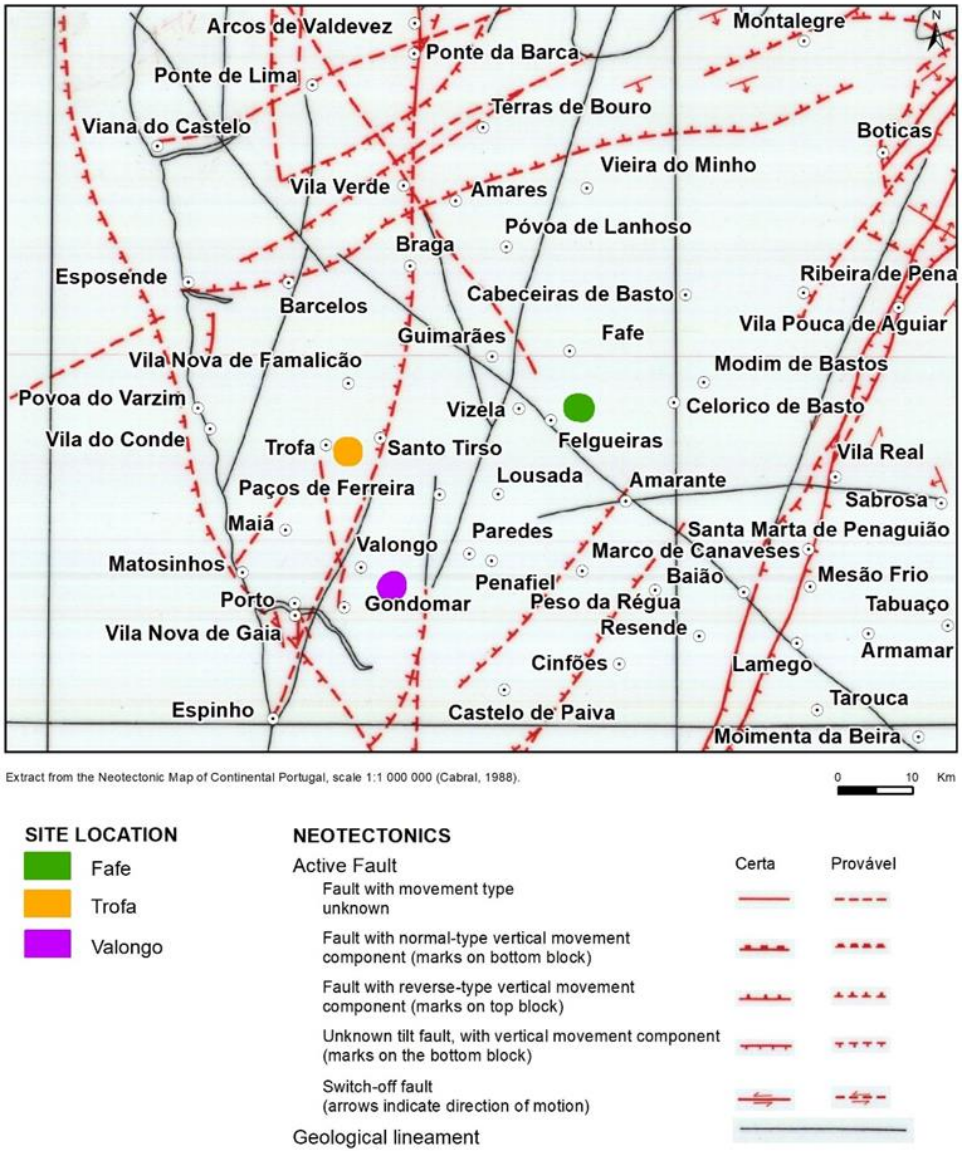


Figure 3-40– Framing of the study area of Valongo, Fafe e Trofa in the neotectonics map

In the Seismic Zoning Map for Portugal Mainland, the study of Valongo area is in zone D (Figure 3 30a), which corresponds to a value of $\alpha = 0.3$.

The zone where the study area is located corresponds to the seismic zone 1.6, in relation to the Type 1 seismic action (Figure 3 30b), and to the zone 2.5 in relation to the Type 2 action (Figure 3 30c). The maximum project reference accelerations to be considered are presented in (Table 3 19).

3.4.6.1.4. Geological Heritage and Geological Resources

To identify and characterize the geological heritage the LNEG geoportal and the portal that integrates the Progeo Group's Inventory of National Relevance Geosites was consulted. These consultations did not return results for the study area.

Regarding easements in the mining field, the DGEG platform (mining concessions, areas requested or granted for prospecting and researching mineral resources, among others) was consulted and a slate quarry was found within the study area.

3.4.7. Trofa

3.4.7.1.1. Geomorphological Framework

The elevations of the Trofa study area vary from 60 m in the north western sector to 220 m in the southern area. In the site location, elevations vary from 170 m to 90 m that generate steep slopes with westward inclination, in line with the water lines that flow.

3.4.7.1.2. Geological Framework

The study area of the Trofa site is part of the Ancient Massif, the oldest morphostructural unit in Portugal, more specifically in the Central Iberian Zone, constituted hereby Shists and grauvaques.

At the regional scale, the area under study is covered by sheet 9-A (Póvoa de Varzim) and 9-B (Guimarães) of the Geological Map of Portugal at scale 1: 50,000. According to these sheets and the respective Explanatory Notes in the Trofa site location, there are Shists and grauvaques with quartzites intercalations.

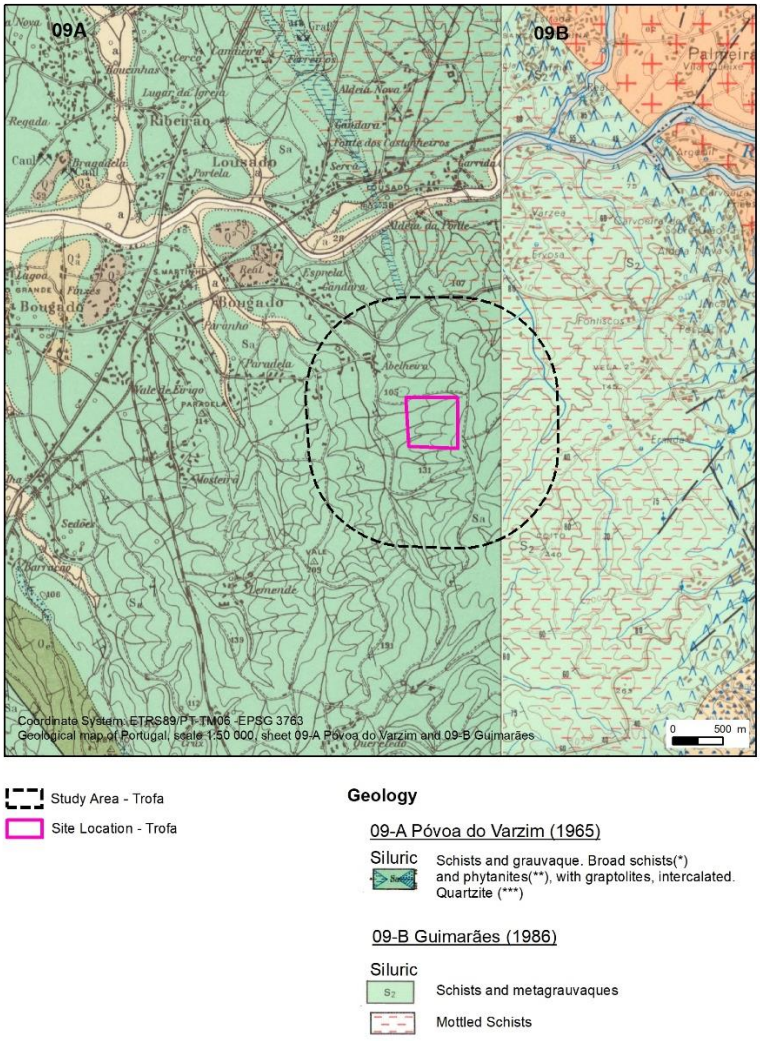


Figure 3-41 – Framing of the study area of Trofa in the geological map

3.4.7.1.3. Tectonics, Neotectonics and seismicity

From the geological chart interpretation (Figure 3 41), no faults or geological lineaments are identified in the study area. The Neotectonic Map (Cabral & Ribeiro, 1988; Figure 3 40) did not identify any certain or probable fault near the Trofa study area.

In the Seismic Zoning Map for Portugal Mainland, the study of Trofa area is in zone D (Figure 3 30a), which corresponds to a value of $\alpha = 0.3$.

The zone where the study area is located corresponds to the seismic zone 1,6, in relation to the Type 1 seismic action (Figure 3 30b), and to the zone 2.5 in relation to the Type 2 action (Figure 3 30c). The maximum project reference accelerations to be considered are presented in (Table 3 19).

3.4.7.1.4. Geological Heritage and Geological Resources

To identify and characterize the geological heritage the LNEG geoportal and the portal that integrates the Progeo Group's Inventory of National Relevance Geosites was consulted. These consultations did not return results for the study area.

Regarding easements in the mining field, the DGEG platform (mining concessions, areas requested or granted for prospecting and researching mineral resources, among others) was consulted and it was found that the study area does not overlap with any easement.

3.4.8. Fafe

3.4.8.1.1. Geomorphological Framework

The elevations of the Fafe study area vary from 430 m in the northwestern sector to 570 m in the southern area at Senhora do Pinheiro geodesic datum. In the site location, elevations vary from 490 m to 450 m. The highest point is located in the middle of the site location so the inclination of the slopes goes towards the west and east.

3.4.8.1.2. Geological Framework

The study area of the Fafe site is part of the Ancient Massif, the oldest morphostructural unit in Portugal, more specifically in the Central Iberian Zone, constituted hereby Shists, grauvaques and granites

At the regional scale, the area under study is covered by sheet 9-B (Guimarães) of the Geological Map of Portugal at scale 1: 50,000. According to this sheet and the respective Explanatory Note in the Fafe site location, there are Granites from Guimarães and Santo Tirso: biotic, porphyroid, coarse-grained monzogranites.

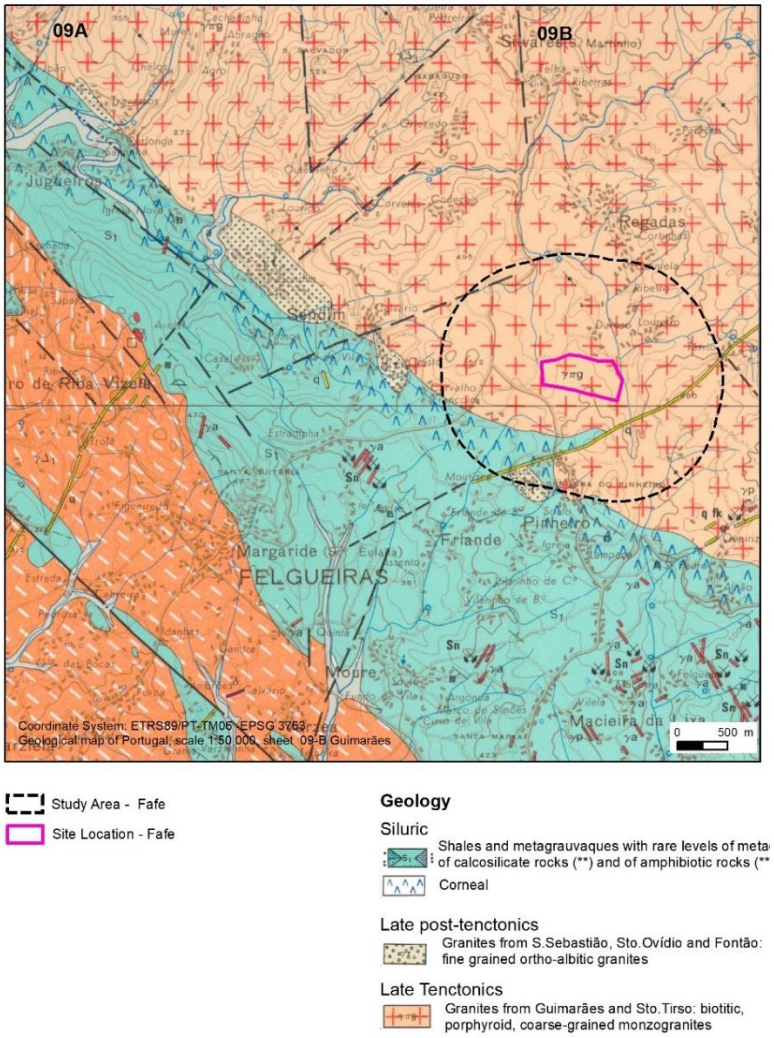


Figure 3-42 – Framing of the study area of Fafe in the geological map

3.4.8.1.3. Tectonics, Neotectonics and seismicity

From the geological chart interpretation (Figure 3 42), no faults or geological lineaments are identified in the study area. The Neotectonic Map (Cabral & Ribeiro, 1988; Figure 3 40) did not identify any certain or probable fault near the Fafe study area.

In the Seismic Zoning Map for Portugal Mainland, the study of Fafe area is in zone D (Figure 3 30a), which corresponds to a value of $\alpha = 0.3$.

The zone where the study area is located corresponds to the seismic zone 1.6, in relation to the Type 1 seismic action (Figure 3 30b), and to the zone 2.5 in relation to the Type 2 action (Figure 3 30c). The maximum project reference accelerations to be considered are presented in (Table 3 19).

3.4.8.1.4. Geological Heritage and Geological Resources

To identify and characterize the geological heritage the LNEG geoportal and the portal that integrates the Progeo Group's Inventory of National Relevance Geosites was consulted. These consultations did not return results for the study area.

Regarding easements in the mining field, the DGEG platform (mining concessions, areas requested or granted for prospecting and researching mineral resources, among others) was consulted and it a gravel and sand quarry was found within the study area a gravel and sand quarry.

3.5. WATER STRESS, RESOURCES AND QUALITY

The following table divides the water resources by categories of analysis: protection areas, water quality and vulnerability to pollution. These categories are analysed for both groundwater and superficial water bodies. These categories are assigned scores between 1 and 4, with 1 being the least impactful and 4 being the most impactful relative to the refinery location. Finally, a ranking is presented, in which the lowest score has the best position in the ranking.

SITE LOCATION	CATEGORIES	WATER BODY	OVERVIEW	SCORE	TOTAL SCORE	QUANTITATIVE LEVEL
Matosinhos	Protected Areas	Superficial water body	Public Water domain in study area	2	23	3
			Bathing area	4		
			Aquatic Species of Economic Interest	4		
		Groundwater Body	Pumping intended for human consumption	4		
	Water Quality	Superficial water body	Global State: Less than good	4		
		Groundwater Body	Global State: Good	1		
	Vulnerability to pollution	Groundwater Body	Class V3 - medium to high	3		
	Water Stress	n.a	Non-existent	1		
Sines	Protected Areas	Superficial water body	Public Water domain in site area	4	25	4
			Aquatic Species of Economic Interest	4		
		Groundwater Body	Pumping intended for human consumption	4		
	Water Quality	Superficial water body	Global State: Less than good	4		
		Groundwater Body	Global State: Less than good	4		
	Vulnerability to pollution	Groundwater Body	Class V3 - medium to high	4		
	Water Stress	n.a.	Non-existent	1		
Estarreja	Protected Areas	Superficial water body	Public Water domain in study area	2	19	2
		Groundwater Body	Pumping intended for human consumption	4		
	Water Quality	Superficial water body	Global State: Less than good	4		
		Groundwater Body	Global State: Less than good	4		
	Vulnerability to pollution	Groundwater Body	Class V3 - medium to high	4		
	Water Stress	n.a.	Non-existent	1		
Vigo	Protected Areas	Superficial water body	Public Water domain in site area	4	18	2
		Groundwater Body	Pumping intended for human consumption	1		
	Water Quality	Superficial water body	Global State: Less than good	4		
		Groundwater Body	Global State: Less than good	4		
	Vulnerability to pollution	Groundwater Body	Class V3 - medium to high	3		
	Water Stress	n.a.	Low	2		
Setúbal	Protected Areas	Superficial water body	Public Water domain in the study area	4	20	2
			Aquatic Species of Economic Interest	4		
		Groundwater Body	Pumping intended for human consumption	4		

	Water Quality	Superficial water body	Global State: Below Good	4		
		Groundwater Body	Global State: Good	1		
	Vulnerability to pollution	Groundwater Body	Class V4 - medium	2		
	Water Stress	n.a.	Non-existent	1		
Valongo	Protected Areas	Superficial water body	Public Water domain in the site area	4	16	**1**
		Groundwater Body	Pumping intended for human consumption	4		
	Water Quality	Superficial water body	Global State: Less than good	4		
		Groundwater Body	Global State: Good	1		
	Vulnerability to pollution	Groundwater Body	Class V6 - Low to variable	2		
	Water Stress	n.a.	Non-existent	1		
Trofa	Protected Areas	Superficial water body	Public Water domain in the site area	4	16	**1**
		Groundwater Body	Pumping intended for human consumption	4		
	Water Quality	Superficial water body	Global State: Less than good	4		
		Groundwater Body	Global State: Good	1		
	Vulnerability to pollution	Groundwater Body	Class V6 - low to variable	2		
	Water stress	n.a.	Non-existent	1		
Fafe	Protected Areas	Superficial water body	Public Water domain in the site area	4	16	**1**
		Groundwater Body	Pumping intended for human consumption	4		
	Water Quality	Superficial water body	Global State: Good and Less than good	4		
		Groundwater Body	Global State: Good	1		
	Vulnerability to pollution	Groundwater Body	Class V6 - low to variable	2		
	Water stress	n.a.	Non-existent	1		

Table 3-22 – Water Resources by categories of analyses

3.5.1. Matosinhos

3.5.1.1.1. Superficial water resources

The study area is part of the Cávado, Ave and Leça Rivers Hydrographic Region (RH2) and, according to the PGRH2 (Hydrographic Region Management Plans), covers the sub-basin of the coastal water CWB-I-1B (PTCOST2) (**Figure 3.1 of Appendix B - Drawings**).

Surface water body	Code	Typology	Naturity
CWB-I-1B	PTCOST2	Mesotidal exposed Atlantic coast	Natural (Coastal Water)

Table 3-23 - Characterisation of the surface water body in the study area. Source: APA, (2016-2021), 2021

In relation to the public water domain (river and sea) existing in the study area (Figure 3-43), it should be noted that in addition to not being intercepted by the Site Location, the area is currently occupied by the refinery. Therefore, it is possible to confirm, in this case, the compliance of the project's area with the water public domain.

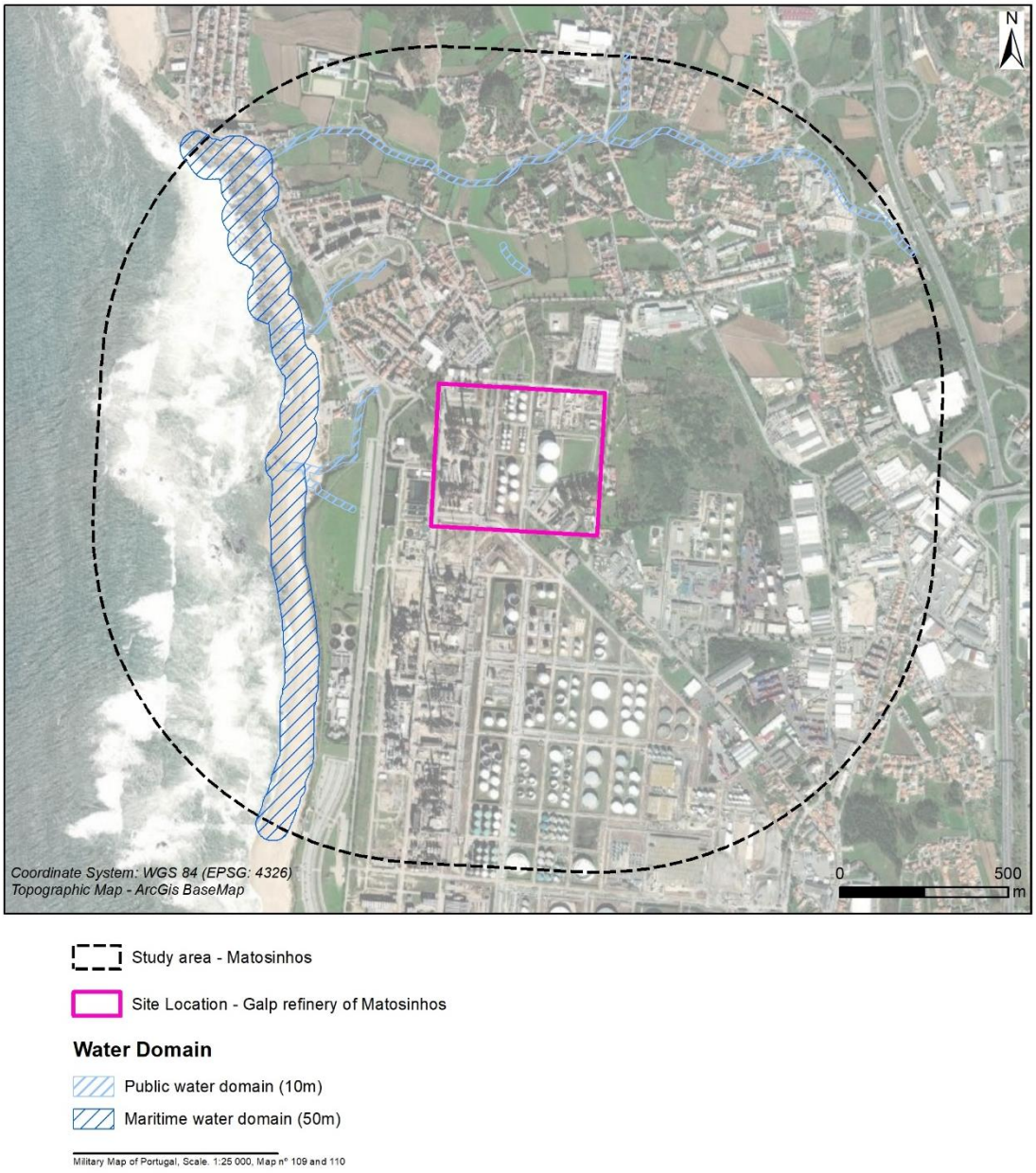


Figure 3-43 – Water Public Domain on Matosinhos study area

3.5.1.1.2. Groundwater resources

The area under analysis is in the Hydrogeological Unit of the Ancient Massif (Figure 3-44), on groundwater body of the Ancient Undifferentiated Massif of the Ave Basin.

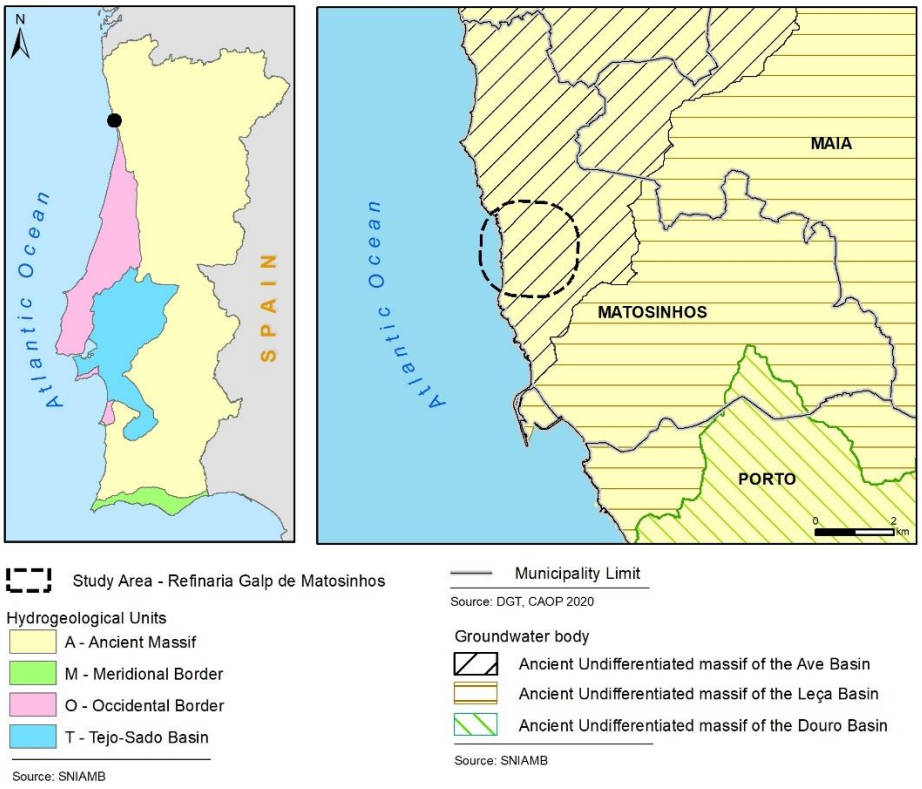


Figure 3-44– Hydrogeological framework of the Matosinhos study area

The groundwater body of the Undifferentiated Ancient Massif of the Ave Basin, is characterized by fissured systems, supported by granitoid and metasedimentary rocks of the Ancient Massif. As a rule, the geological characteristics of this hydrographic region are associated with low hydraulic conductivity, strong spatial heterogeneity, and uncertainty of its hydrogeological suitability, resulting in reduced productivity. However, the existence of local groundwater bodies should not be neglected, as they are generally the source of agricultural and domestic water supply for local populations.

3.5.1.1.3. Water Quality and uses

In the study area under analysis, the main pressures on the quality of surface and underground water are identified as the industrial sector (manufacturing industry), port infrastructures and the urban sector. According to the environmental assessment carried out in 2019, within the scope of the revision of the Municipal Master Plan, the groundwater bodies in the municipality are strongly subjected to urban and industrial pressures that negatively affect the status of the water bodies (Câmara Municipal de Matosinhos, 2019).

No groundwater pumping wells for public supply were inventoried at the Matosinhos site nor was their protection perimeter.

The coastal water body CWB-I-1B is a protected area because it is a bathing area (PTCV7F - Azul Conchinha, PTCD8P – Cabo do Mundo) and because it is classified as "Protection of Aquatic Species of Economic Interest (Bivalve Molluscs) (PTL2 - Litoral Matosinhos). The groundwater body is an area designated for pumping intended for human consumption (Artº 7, DQA).

According to the SNIAmb platform (sniamb.pt - National Environment Information System), concerning quality data, the coastal water body CWB-I-1B presents an overall status of *Below Good*, due to the good quality presented in terms of ecological status and insufficient chemical status (Table 3-24).

Code	Superficial water body	Ecological State	Chemical State	Global State
PTCOST2	CWB-I-1B	Good	Not good enough	Less than good

Table 3-24 - Characterisation of the quality of the superficial water body present in the study area[18].

Regarding groundwater bodies, and according to the SNIAmb database, its overall status is Good and Superior, considering the classification of its quantitative and chemical status (Table 3-25).

Groundwater Body	Quantitative State	Chemical Status	Global state
Ancient undifferentiated massif of the Ave Basin	Good	Good	Good

Table 3-25 - Quality status of groundwater water body

Aquifer pollution vulnerability, according to the EPPNA Qualitative Method (INAG, 1998), is based on qualitative methodologies based on the lithological criteria of aquifers or undifferentiated hydrogeological formations. The Portuguese Environment Agency (APA) has applied this methodology to continental Portugal where the main part of the Matosinhos study area fits into class V3 - high vulnerability to pollution, due to the presence of unconsolidated detrital sediments.

3.5.2. Sines

3.5.2.1.1. Superficial water resources

The study area is part of the Sado and Mira Rivers Hydrographic Region (RH6) and, according to the PGRH6 (Hydrographic Region Management Plans), covers the sub-basin of the Ribeira de Moinhos (PT06SUL1642), CWB-II-SA (PTCOST13) and Ribeira da Junqueira (PT06SUL1643) (**Figure 3.2 of Appendix B - Drawings**).

Surface water body	Code	Typology	Naturity
Ribeira de Moinhos	PT06SUL1642	Small Southern Rivers	Natural
CWB-II-SA	PTCOST13	Small Southern Rivers	Natural (Coastal Water)
Ribeira da Junqueira	PT06SUL1643	Small Southern Rivers	Natural

Table 3-26 - Characterisation of the surfaces water bodies in the study area[19].

In terms of the Public Waterways Domain (DPH), there are waterways that cross the study area (Figure 3-45), however, at the level of the Location Site, which currently corresponds to the Sines refinery (Petrogal), there is, according to the Military Map, only the marginal intersection of a waterway and the respective DPH (southwest area), in an area that has not been intervened on and is not occupied by the refinery facilities. The project development should avoid this specific area, however if necessary, they can be occupied, although authorization is required to ARH (the national authority in term of water resources).

[18] Source: DatabaseSNIAmb (2º Ciclo de Planeamento 2016-2021), 2021
19 Source: APA, (2016-2021), 2021

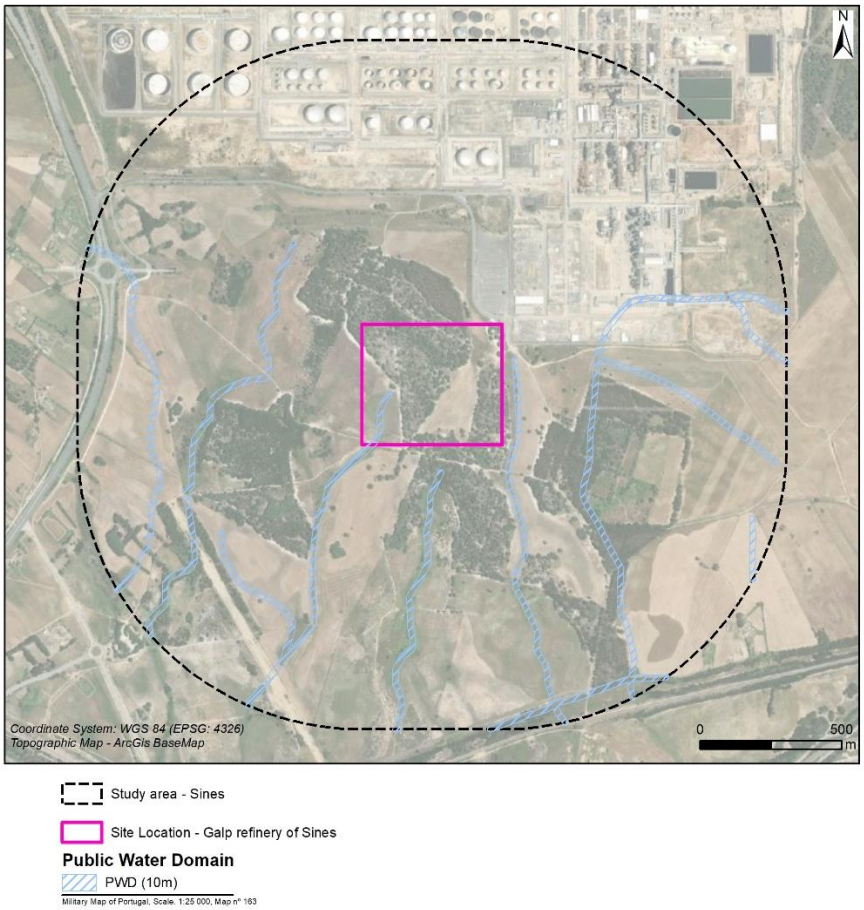


Figure 3-45 – Water Public Domain on Sines study area

3.5.2.1.2. Groundwater resources

The area under analysis is located on the boundary between the Hydrogeological Unit of the Western Border and the Ancient Massif (Figure 3-46), between on and South Portuguese zone of the Sado Basin. It should be noted that the project is located exclusively on groundwater body of the Sines-South Zone (PT035).

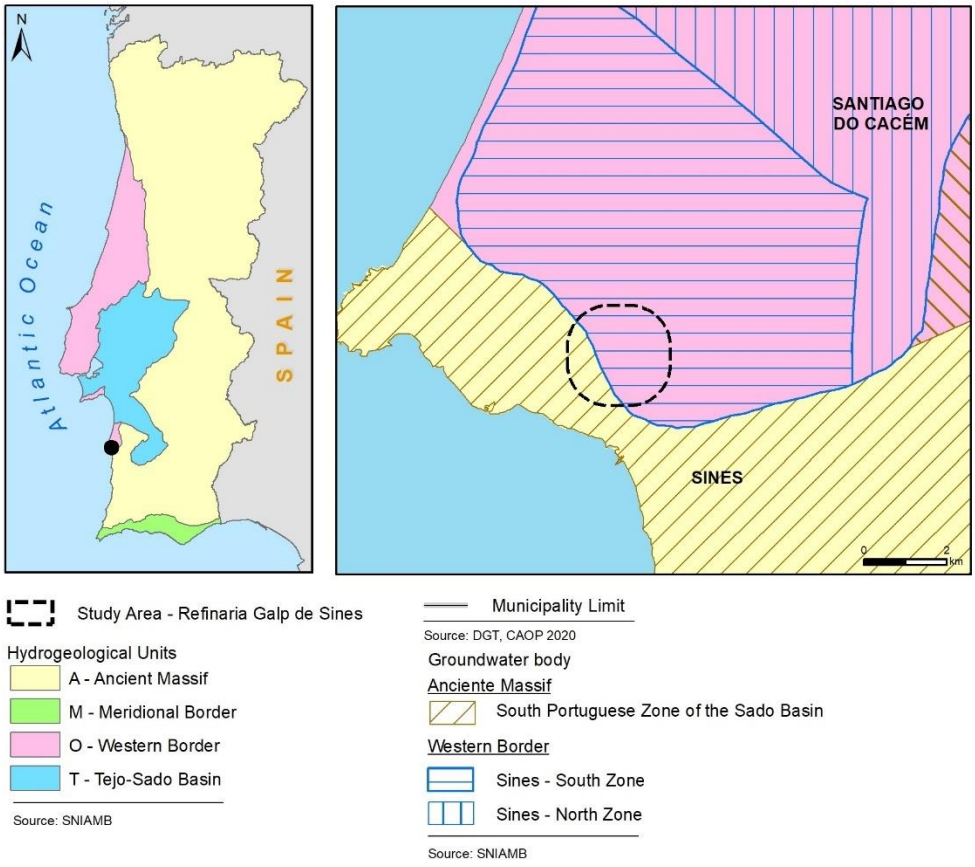


Figure 3-46– Hydrogeological framework of the Sines study area

According to the PGRH6, the groundwater mass of Sines-Zona Sul is a free continuous aquifer of fissured type (including moderately productive karstic), with an area of 67 km^2 and a long-term average annual recharge of 13.7 hm^3/year. The recharge of the system occurs both by precipitation (direct recharge of the lower aquifer in the areas where the Jurassic formations outcrop and the porous upper aquifer) and by drainage processes of the overlying aquifers.

3.5.2.1.3. Water Quality and uses

In the study area under analysis, the main pressures on the quality of surface and groundwater are identified as the industrial sector (manufacturing industry), port infrastructures, landfills, and the urban sector.

No groundwater pumping wells for public supply were inventoried at the Sines site nor was their protection perimeter.

The water bodies Ribeira de Moinhos and Ribeira da Junqueira are not protected areas. The coastal water body CWB-II-5A is a protected area because it is classified as "Protection of Aquatic Species of Economic Interest (Bivalve Molluscs) (PTL6 - Litoral Setúbal-Sines).

The groundwater body is an area designated for pumping intended for human consumption (Artº 7, DQA).

According to the SNIAmb plataform (sniamb.pt - National Environment Information System), concerning quality data (Table 3-27), the Ribeira de Moinhos water body presents an overall status of Below Good, due to the poor quality presented in terms of ecological status and unknown chemical status. As for Ribeira da Junqueira. its global status is also Below Good, due to the poor quality presented in terms of ecological status and unknown chemical status.

Code	Superficial water body	Ecological State	Chemical State	Global State
PT06SUL1642	Ribeira de Moinhos	Bad	Unknown	Less than good
PTCOST13	CWB-II-SA	Good	Not good enough	Less than good
PT06SUL1643	Ribeira da Junqueira	Not enough	Unknown	Less than good

Table 3-27 - Characterisation of the quality of the superficial water body present in the study area[20].

Regarding groundwater body, and according to the SNIAmb database, its overall status is Below Good, considering the classification of its quantitative (good) and chemical status (Not enough) (Table 3-28). The parameters responsible for the chemical state evaluation are Toluene, Acenaphthene, Fluorene, Pyrene, Xylene and Phenanthrene. ZISL (Sines Industrial and Logistics Zone) currently monitors surface and groundwater resources to assess trends in water quality and quantity.

Groundwater Body	Quantitative State	Chemical Status	Global state
Sines – South Zone	Good	Not good enough	Below Good

Table 3-28 - Quality status of groundwater water body

Aquifer pollution vulnerability, according to the EPPNA Qualitative Method (INAG, 1998), is based on qualitative methodologies based on the lithological criteria of aquifers or undifferentiated hydrogeological formations. The Portuguese Environment Agency (APA) has applied this methodology to continental Portugal where the main part of the Sines study area fits into class V3 – medium to high vulnerability to pollution, due to the presence of unconsolidated detrital sediments.

3.5.3. Estarreja

3.5.3.1.1. Superficial water resources

The study area is part of the Vouga, Mondego e Lis Rivers Hydrographic Region (RH4) and, according to the PGRH4 (Hydrographic Region Management Plans), covers the sub-basin of the Rio Fontela (PTC04VOU0510), Ria Aveiro- WB5 (PTC04VOU0514) and Ria Aveiro-WB4 (PTC04VOU0536) (**Figure 3.3 of Appendix B - Drawings**).

Surface water body	Code	Typology	Naturity
Rio Fontela	PTC04VOU0510	Small Northern Rivers	Natural
Ria Aveiro-WB4	PTC04VOU0536	Small Southern Rivers	Natural
Ria Aveiro-WB5	PTC04VOU0514	Small Southern Rivers	Natural

Table 3-29 - Characterisation of the surfaces water bodies in the study area. Source: APA, (2016-2021), 2021

According to the Military Map, in terms of the Public Waterways Domain (DPH), there are waterways that cross the study area, however the Site Location, corresponding to the Estarreja Ecopark, does not intersect any water line (Figure 3-47)**.**

[20] Source: Database SNIAmb (2º Ciclo de Planeamento 2016-2021), 2021

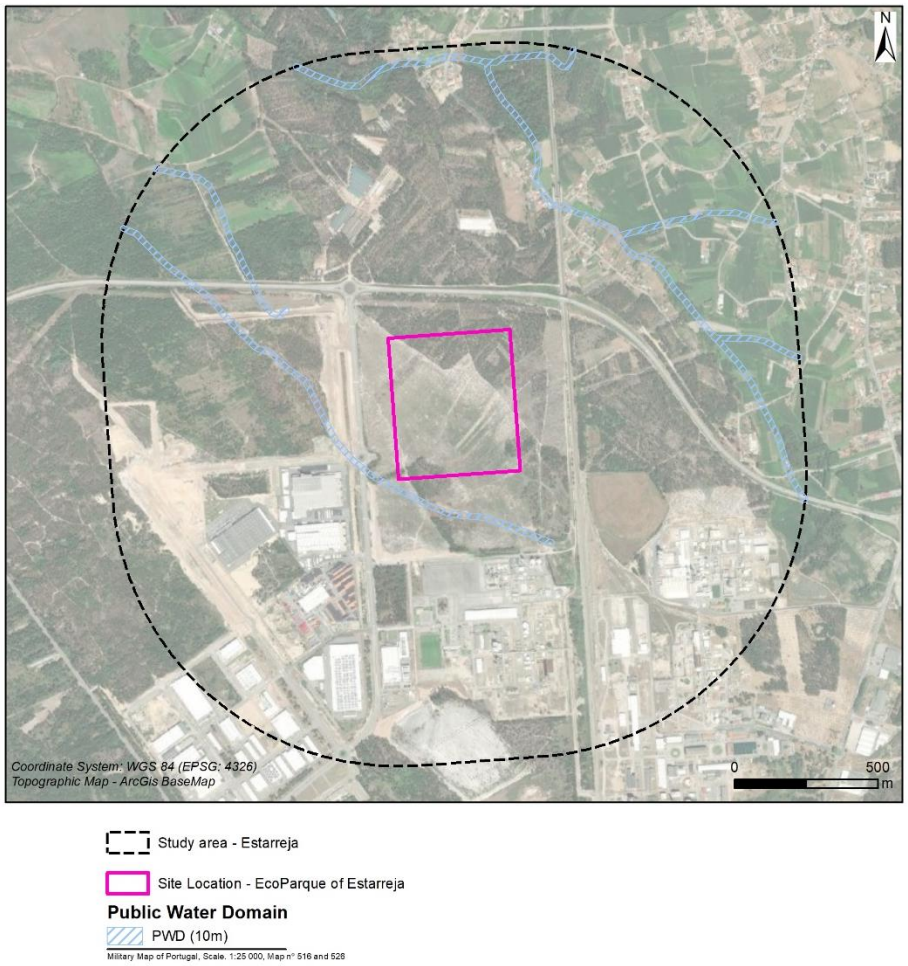


Figure 3-47 – Water Public Domain on Estarreja study area

3.5.3.1.2. Groundwater resources

The area under analysis is in the Hydrogeological Unit of the Western Border (Figure 3-48), on groundwater body of the Aveiro Quaternary Aquifer (O1).

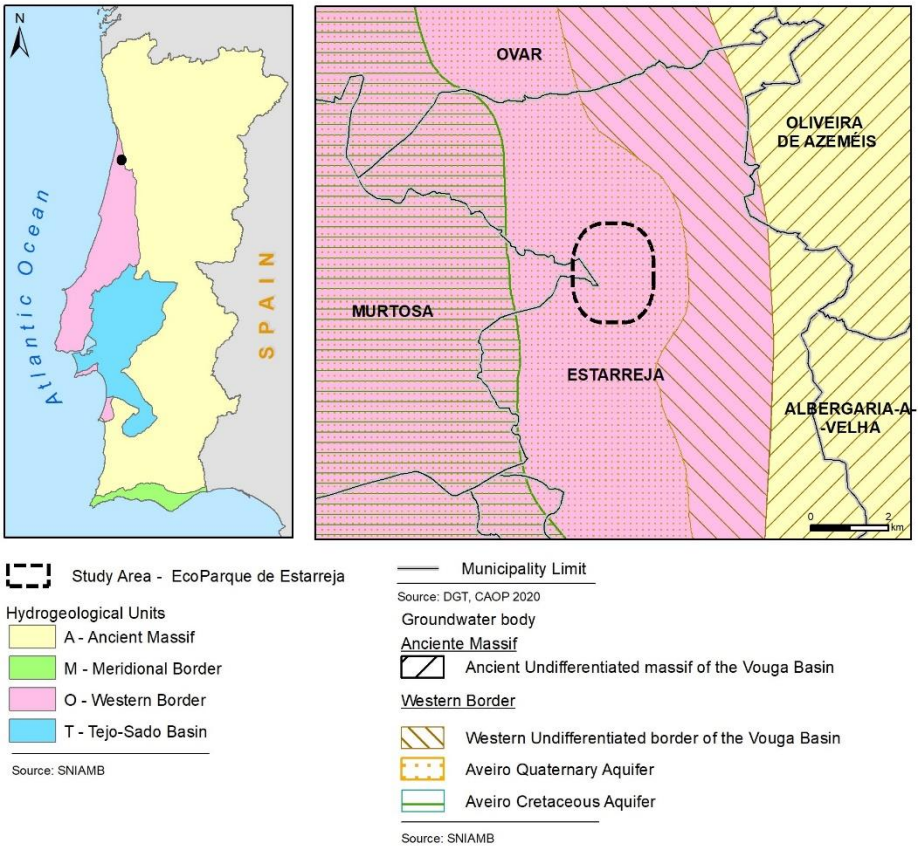


Figure 3-48– Hydrogeological framework of the Estarreja study area

The Quaternary Aveiro Aquifer (O1) consists mainly of detrital sediments of Pleistocene and Holocene ages, formed mainly by marine beach levels, and associated fluvial deposits. They constitute aquifer units of the phreatic or semi-confined type, sometimes of local character. This unit is easily recharged by local precipitation, especially the sand dunes, thus being quite vulnerable to contamination by external agents.

3.5.3.1.3. Water Quality and uses

In the study area under analysis, the main pressures on the quality of surface and groundwater are identified as the industrial sector (manufacturing industry), port infrastructures, landfills, and moderate inputs from the agriculture and forestry sector.

No groundwater pumping wells for public supply were inventoried at the Estarreja site nor was their protection perimeter.

The water bodies Ribeira de Moinhos and Ribeira da Junqueira are not protected areas but the groundwater bodies are an area designated for pumping intended for human consumption (Artº 7, DQA). This area is also protected due to nitrate vulnerability from agriculture activities.

According to the SNIAmb plataform (sniamb.pt - National Environment Information System), concerning quality data (Table 3-30), the water body Rio Fontela has an overall status of Less than Good, according to the reasonable quality presented in terms of ecological state and good chemical state. As for the water body Ria Aveiro-WB4, its overall state is also below Good, according to the reasonable quality presented in terms of ecological state and good chemical state.

Code	Superficial water body	Ecological State	Chemical State	Global State
PTC04VOU0510	Rio Fontela	Reasonable	Good	Less than Good
PTC04VOU0536	Ria Aveiro-WB4	Reasonable	Good	Less than Good

Table 3-30 - Characterisation of the quality of the superficial water body present in the study area[21].

Regarding groundwater body, and according to the SNIAmb database, its overall status is Below Good, considering the classification of its quantitative (good) and chemical state (Not enough) (Table 3-31). The parameter Nitrate has been responsible for the poor chemical status.

Groundwater Body	Quantitative State	Chemical Status	Global state
Aveiro Quaternary Aquifer	Good	Not good enough	Less than Good

Table 3-31 - Quality status of groundwater water body

Aquifer pollution vulnerability, according to the EPPNA Qualitative Method (INAG, 1998), is based on qualitative methodologies based on the lithological criteria of aquifers or undifferentiated hydrogeological formations. The Portuguese Environment Agency (APA) has applied this methodology to continental Portugal where the main part of the Estarreja study area fits into class V3 – medium to high vulnerability to pollution, due to the presence of unconsolidated detrital sediments.

3.5.4. Vigo

3.5.4.1.1. Superficial water resources

According to the Hydrological Plan of the Spanish part of the demarcation of the Miño-Sil river basin, the area under study is located on the superficial water body "Rio Loveiro" (**Figure 3.4 of Appendix B - Drawings**),

In relation to the Public Water Domain (PWD), it should be noted that there are watercourses in the study area (Loveiro river and a tributary of the Loveiro river), one of which intersects the Location Site - tributary of the Loveiro river. The compliance of the project with this constraint is analysed in subchapter “2.2.4.4 constraints, administrative easements and public interest restrictions”.

3.5.4.1.2. Groundwater resources

In the study area under analysis, the main pressures on the quality of surface and groundwater are identified as the industrial sector (manufacturing, mining, and quarrying industry), port infrastructures, and moderate inputs from the urban, agriculture and forestry sector.

No groundwater pumping wells for public supply were inventoried at the Vigo site nor was their protection perimeter.

Regarding surface water body, and according to the Hydrological Plan of the Spanish part of the demarcation of the Miño-Sil river basin, its overall status is Less than good, considering the classification of its quantitative (good) and chemical state (Not enough) (Table 3-32).

Code	Superficial water body	Ecological State	Chemical State	Global State
ES495MAR002160	Rio Loveiro	Good	Good	Less than good

Table 3-32 - Characterisation of the quality of the surface water body present in the study area

[21] Source:Database SNIAmb (2º Ciclo de Planeamento 2016-2021), 2021

Regarding groundwater body, and according to the Hydrological Plan of the Spanish part of the demarcation of the Miño-Sil river basin, its overall status is Less than good, considering the classification of its quantitative (good) and chemical state (Not enough) (Table 3-33). The pesticides have been responsible for the poor chemical status.

Groundwater Body	Quantitative State	Chemical Status	Global state
Aluvial del Bajo Minho	Good	Not good enough	Less than Good

Table 3-33 - Quality status of groundwater water body

Aquifer pollution vulnerability. according to the EPPNA Qualitative Method (INAG, 1998), is based on qualitative methodologies based on the lithological criteria of aquifers or undifferentiated hydrogeological formations. The Vigo study area fits into class V3 – medium to high vulnerability to pollution, due to the presence of unconsolidated detrital sediments under the hard rock (granites).

3.5.5. Setúbal

3.5.5.1.1. Superficial water resources

The study area is part of the Sado and Mira (HR6) Hydrographic Region and, according to the PGRH6 (Hydrographic Region Management Plans), covers the sub-basin of the Sado WB6 (PT06SAD1217) and Sado WB3 (PT06SAD1207) (**Figure 3.5 of Appendix B - Drawings**).

Surface water body	Code	Typology	Naturity
Sado WB6	PT06SAD1217	Homogeneous mesotidal estuary with irregular river discharge	Natural
Sado WB3	PT06SAD1207	Homogeneous mesotidal estuary with irregular river discharge	Heavily modified

Table 3-34 - Characterisation of the surfaces water bodies in the study area – Setúbal[22].

According to the Military Map, in terms of the Public Waterways Domain (DPH), some waterways cross the study area and the site location. In this case, it is necessary to get the use of water resources permitting (TURH) from APA and guarantee the normal runoff of the water lines (Figure 3-49)**.**

[22] Source: APA, (2016-2021), 2021

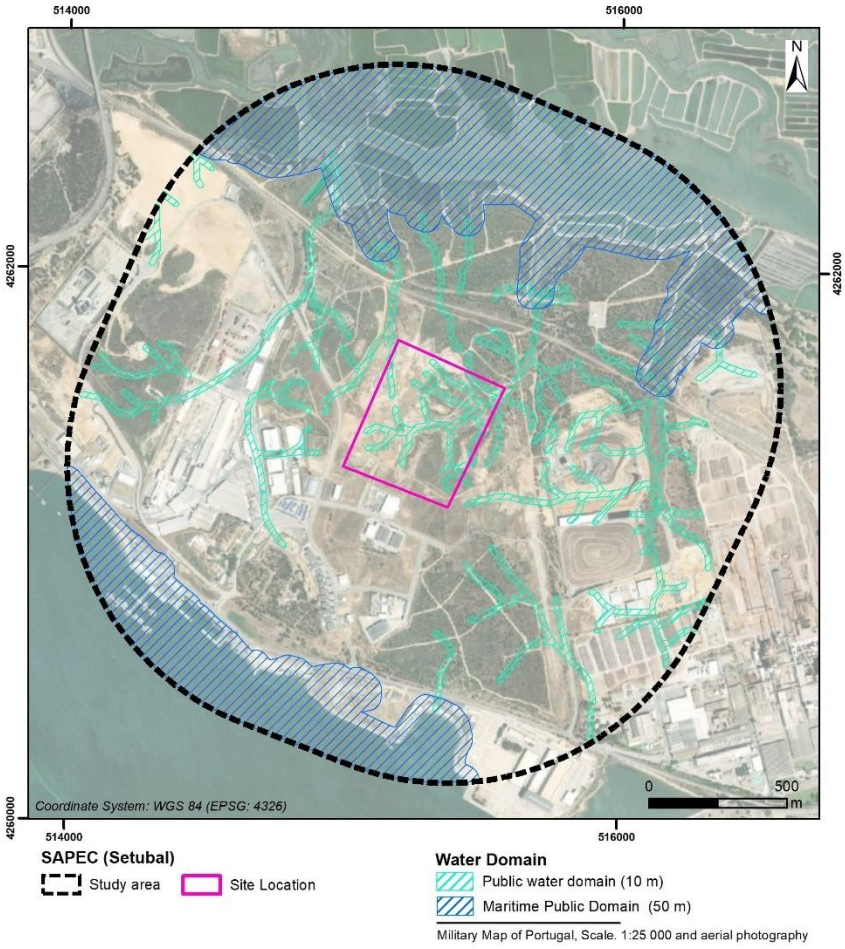


Figure 3-49 – Water Public Domain on Setúbal study area

3.5.5.1.2. Groundwater resources

In terms of groundwater level, the management is divided between RH6 and RH5, noting that the pressures related to tourism and ETARs are expressed in the RH5 management plan.

The area under analysis is in the Hydrogeological Unit of the Tejo-Sado Basin (Figure 3-50), on the groundwater body of the Tejo-Sado basin/ Left Bank.

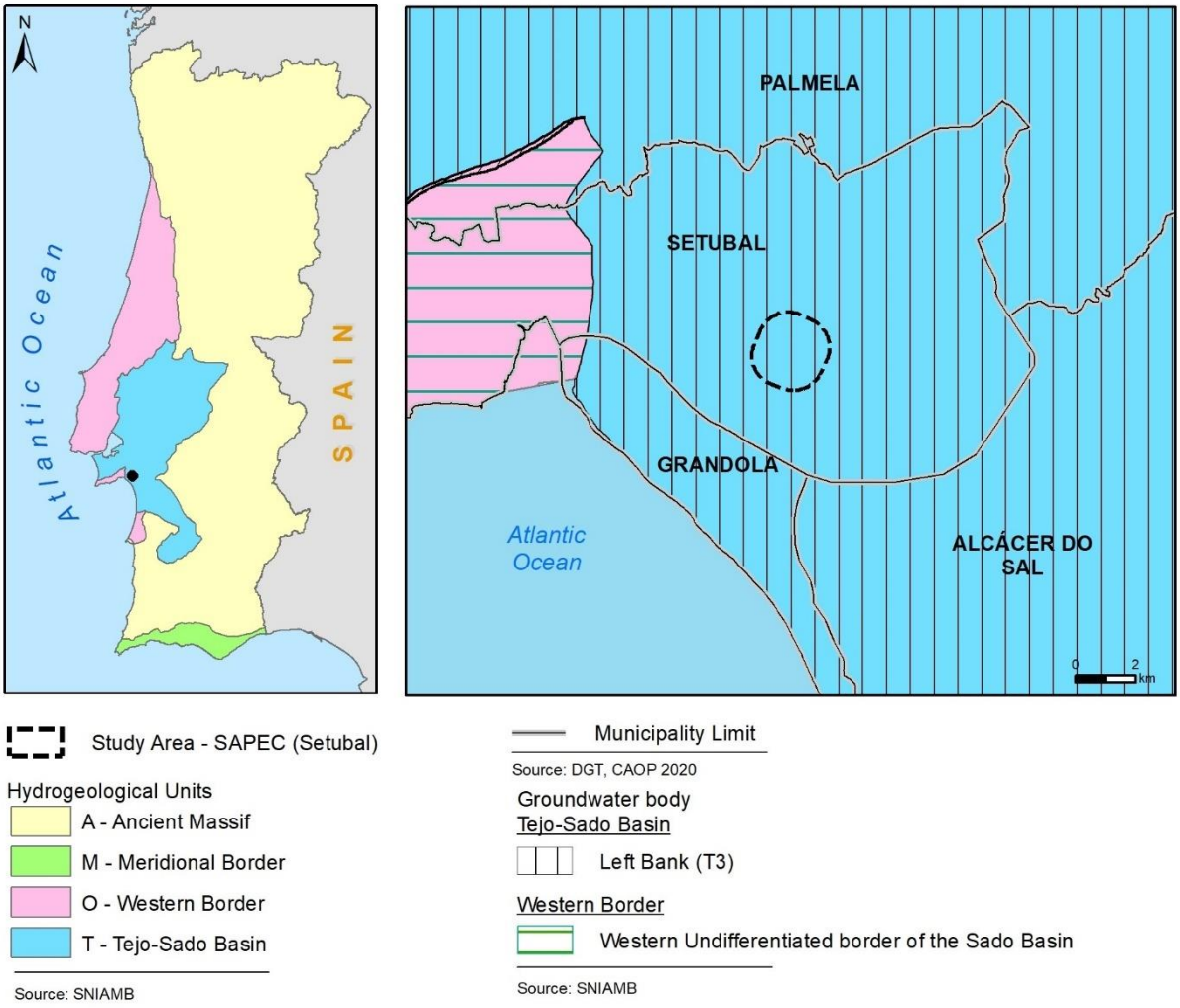


Figure 3-50– Hydrogeological framework of the Setúbal study area

In the Tejo-Sado Basin, the aquifer systems defined are four in number and the most productive formations that constitute the support of the systems are quaternary formations (alluvium and terraces) and Tertiary formations mostly Pliocene and Miocene (Ota Sandstone, Almoster Limestone, Greso-calcareous series, etc.).

This unit is subjected to pressures related to tourism (golf course) and the high load of effluent discharged from wastewater treatment plants, thus being quite vulnerable to contamination by external agents.

3.5.5.1.3. Water Quality and uses

In the study area under analysis, the main pressures on the quality of surface and groundwater are identified as the extensive and semi-intensive aquaculture, land fill, port infrastructures, industry (manufacturing and food and wine), urban, agriculture and livestock.

No groundwater pumping wells for public supply were inventoried at the Setubal site nor was their protection perimeter.

The coastal water body Sado-WB6 and Sado-WB3 are classified as "Protection of Aquatic Species of Economic Interest (Bivalve Molluscs) (PTESD1 - Estuário do Sado - Esteiro da Marateca). The groundwater body is an area designated for pumping intended for human consumption (Artº 7, DQA).

According to the SNIAmb platform (sniamb.pt - National Environment Information System), concerning quality data (Table 3-35), the water bodies Sado-WB6 and Sado-WB3 have an overall status of Less than Good, according to the reasonable quality presented in terms of ecological state and good chemical state.

Code	Superficial water body	Ecological State	Chemical State	Global State
PT06SAD1217	Sado-WB6	Reasonable	Good	Less than Good
PT06SAD1207	Sado-WB3	Reasonable	Good	Less than Good

Table 3-35 - Characterization of the quality of the superficial water body present in the study area[23].

According to the SNIAmb database, the overall groundwater status is Good, considering the classification of its quantitative (good) and chemical state (good) (Table 3-36).

Groundwater Body	Quantitative State	Chemical Status	Global state
Tejo-Sado Basin/Left Bank	Good	Good	Good

Table 3-36 - Quality status of the groundwater water body

Aquifer pollution vulnerability, according to the EPPNA Qualitative Method (INAG, 1998), is based on qualitative methodologies based on the lithological criteria of aquifers or undifferentiated hydrogeological formations. The Portuguese Environment Agency (APA) has applied this methodology to continental Portugal where the main part of the Setubal study area fits into class V4 – medium vulnerability to pollution, due to the presence of unconsolidated detrital sediments.

3.5.6. Valongo

3.5.6.1. Superficial water resources

The study area is part of the Douro (HR3) Hydrographic Region and, according to the PGRH3 (Hydrographic Region Management Plans), covers the sub-basin of the Rio Sousa (PT03DOU0399) (**Figure 3.6 of Appendix B - Drawings**).

Surface water body	Code	Typology	Naturity
Rio Sousa	PT03DOU0399	Small Northern Rivers	Natural

Table 3-37 - Characterisation of the surfaces water bodies in the study area – Valongo[24].

According to the Military Map, in terms of the Public Waterways Domain (DPH), some waterways cross the study area and the site location. In this case, it is necessary to get the use of water resources permitting (TURH) from APA and guarantee the normal runoff of the water lines (Figure 3-51)**.**

[23] Database SNIAmb (2º Ciclo de Planeamento 2016-2021), 2021

[24] Source: APA, (2016-2021), 2021

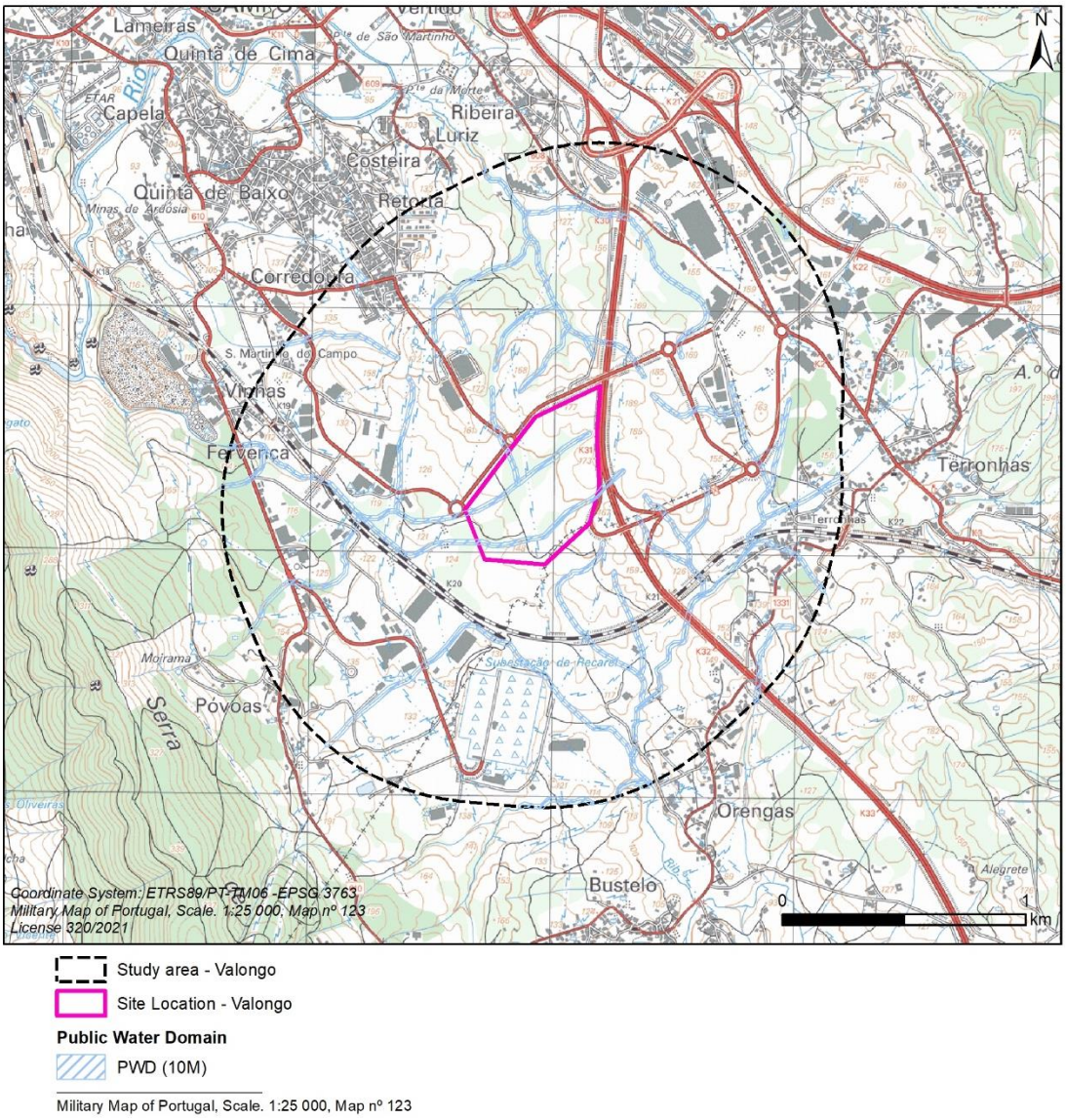


Figure 3-51 – Water Public Domain on Valongo study area

3.5.6.2. Groundwater resources

The area under analysis is in the Hydrogeological Unit of the Ancient Massif (Figure 3-52), in the groundwater of the Ancient Undifferentiated Massif of the Douro Basin.

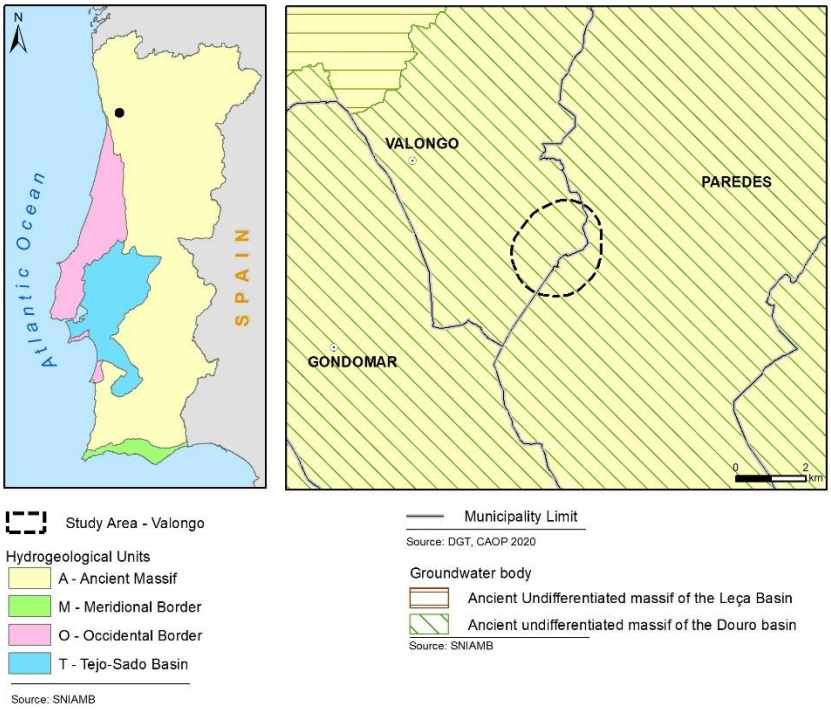


Figure 3-52– Hydrogeological framework of the Valongo study area

The groundwater body of the Undifferentiated Ancient Massif of the Douro Basin is characterized, within the study area, by fissured systems, supported by metasedimentary rocks of the Ancient Massif. As a rule, the geological characteristics of this hydrographic region are associated with low hydraulic conductivity, strong spatial heterogeneity, and uncertainty of its hydrogeological suitability, resulting in reduced productivity. However, the existence of local groundwater bodies should not be neglected, as they are generally the source of agricultural water supply for local population.

3.5.6.3. Water Quality and uses

In the study area under analysis, the main pressures on the quality of surface and groundwater are identified as the urban discharges to water and soil, agriculture and livestock. Additionally, the manufacturing industry has low pressure access to the superficial waterbody.

No groundwater pumping wells for public supply were inventoried at the Valongo site nor was their protection perimeter.

At the Valongo site location no protected areas for superficial water were identified. The groundwater body is an area designated for pumping intended for human consumption (Artº 7, DQA).

According to the SNIAmb platform (sniamb.pt - National Environment Information System), concerning quality data (Table 3-38), the water body Rio Sousa has an overall status of Less than Good, according to the mediocre quality presented in terms of ecological state and low chemical state (Not enough).

Code	Superficial water body	Ecological State	Chemical State	Global State
PT03DOU0399	Rio Sousa	Mediocre	Not enough	Less than good

Table 3-38 - Characterization of the quality of the superficial water body present in the study area[25].

According to the SNIAmb database, the overall groundwater status is Good, considering the classification of its quantitative (good) and chemical state (good) (Table 3-39).

Groundwater Body	Quantitative State	Chemical Status	Global state
Ancient undifferentiated massif of the Douro Basin	Good	Good	Good

Table 3-39 - Quality status of the groundwater water body

Aquifer pollution vulnerability, according to the EPPNA Qualitative Method (INAG, 1998), is based on qualitative methodologies based on the lithological criteria of aquifers or undifferentiated hydrogeological formations. The Portuguese Environment Agency (APA) has applied this methodology to continental Portugal where the main part of the Setubal study area fits into class V6 – low to variable vulnerability to pollution due to the presence of fissured rocks.

3.5.7. Trofa

3.5.7.1. Superficial water resources

The study area is part of the Cávado, Ave and Leça Rivers Hydrographic Region (RH2) and, according to the PGRH2 (Hydrographic Region Management Plans), covers the sub-basin of the Rio Ave (PT02AVE0130) (**Figure 3.1 of Appendix B - Drawings**).

Surface water body	Code	Typology	Naturity
Rio Ave	PT02AVE0130	Medium-Large Northern Rivers	Natural

Table 3-40 - Characterisation of the surfaces water bodies in the study area – Trofa[26].

According to the Military Map, in terms of the Public Waterways Domain (DPH), some waterways cross the study area and the site location. In this case, it is necessary to get the use of water resources permitting (TURH) from APA and guarantee the normal runoff of the water lines (Figure 3-53)**.**

[25] Database SNIAmb (2º Ciclo de Planeamento 2016-2021), 2021
[26] Source: APA, (2016-2021), 2021

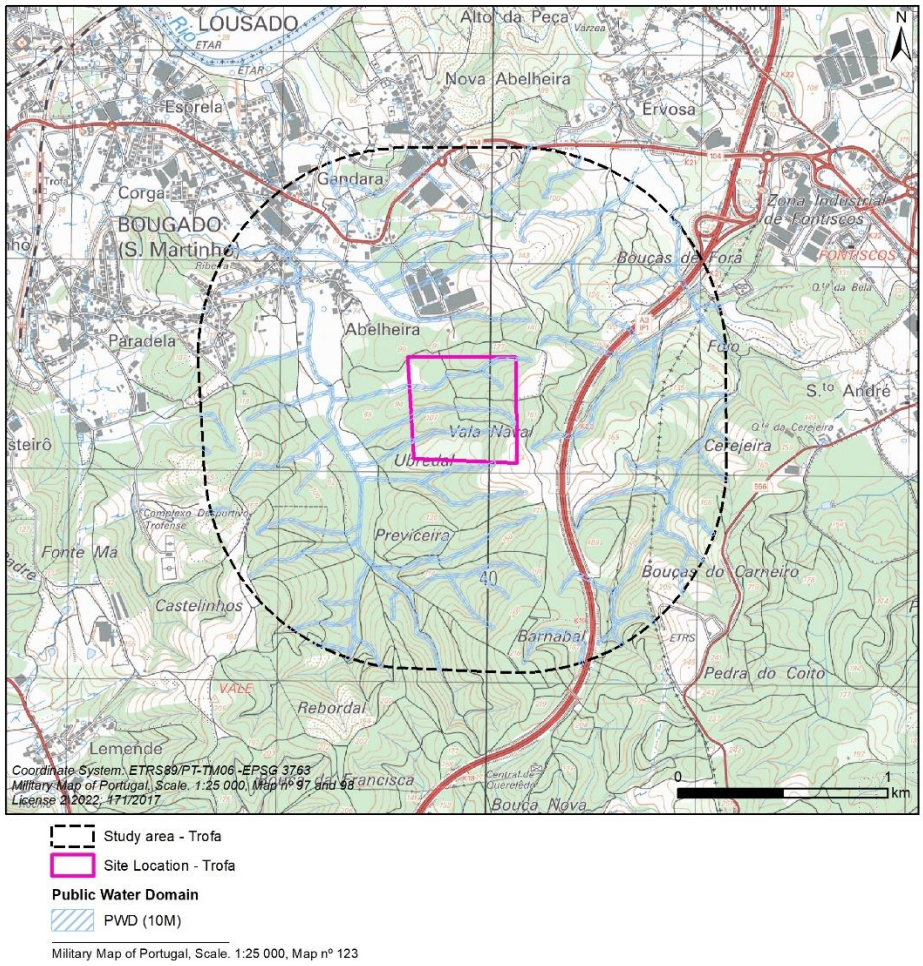


Figure 3-53 – Water Public Domain on Trofa study area

3.5.7.1.1. Groundwater resources

The area under analysis is in the Hydrogeological Unit of the Ancient Massif (Figure 3-54), in the groundwater body of the Ancient Undifferentiated Massif of the Ave Basin.

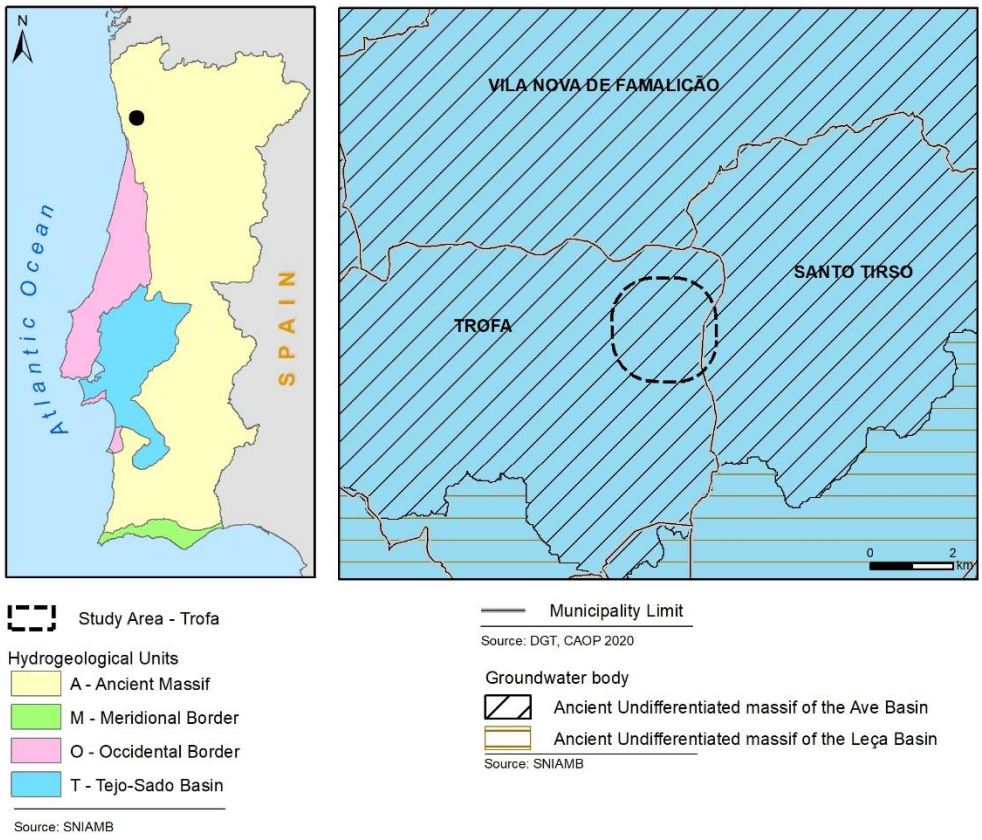


Figure 3-54– Hydrogeological framework of the Trofa study area

The groundwater body of the Undifferentiated Ancient Massif of the Ave Basin, is characterized by fissured systems, supported by metasedimentary rocks of the Ancient Massif. As a rule, the geological characteristics of this hydrographic region are associated with low hydraulic conductivity, strong spatial heterogeneity, and uncertainty of its hydrogeological suitability, resulting in reduced productivity. However, the existence of local groundwater bodies should not be neglected.

3.5.7.1.2. Water Quality and uses

In the study area under analysis, the main pressures on the quality of surface and underground water are identified as the livestock, agriculture and forestry sectors and in a lower pressure level the industrial sector (manufacturing industry), and the urban sector.

It should be noted that the Rio Ave dam represents hydro morphological pressure to the surface water mass and the Pisão golf course a low charge of diffuse pressure to the groundwater mass.

Also, the landfills placed 1 km southeast from the site location may represent sources of water pollution, depending on their operation mode.

No groundwater pumping wells for public supply were inventoried at the Trofa site nor was their protection perimeter.

The groundwater body is an area designated for pumping intended for human consumption (Artº 7, DQA).

According to the SNIAmb platform (sniamb.pt - National Environment Information System), concerning quality data (Table 3-41), the water body Rio Ave has an overall status of Less than Good.

Code	Superficial water body	Ecological State	Chemical State	Global State
PT02AVE0130	Rio Ave	Mediocre	Not Good Enough	Less than Good

Table 3-41 - Characterization of the quality of the superficial water body present in the study area[27].

According to the SNIAmb database, the overall groundwater status is Good, considering the classification of its quantitative (good) and chemical state (good) (Table 3-42).

Groundwater Body	Quantitative State	Chemical Status	Global state
Ancient undifferentiated massif of the Ave Basin	Good	Good	Good

Table 3-42 - Quality status of the groundwater water body

Aquifer pollution vulnerability, according to the EPPNA Qualitative Method (INAG, 1998), is based on qualitative methodologies based on the lithological criteria of aquifers or undifferentiated hydrogeological formations. The Portuguese Environment Agency (APA) has applied this methodology to continental Portugal where the main part of the Setubal study area is within class V6 – low to variable vulnerability to pollution, due to the presence of fissured rocks.

3.5.8. Fafe

3.5.8.1. Superficial water resources

The study area is part of the Cávado, Ave and Leça Rivers Hydrographic Region (RH2) and Douro River Hydrographic Region (RH3). Nevertheless, the proposed site location is entirely within the RH2. According to the PGRH (Hydrographic Region Management Plans), covers the sub-basin of the Rio Ferro, Rio Sousa and Ribeira de Santa Natália (**Figure 3.1 of Appendix B - Drawings**).

Surface water body	Code	Typology	Naturity
Rio Ferro	PT02AVE0120	Small Northern Rivers	Natural
Rio Sousa	PT03DOU0316	Small Northern Rivers	Natural
Ribeira de Santa Natália	PT03DOU297	Small Northern Rivers	Natural

Table 3-43 - Characterisation of the surfaces water bodies in the study area – Fafe[28].

According to the Military Map, in terms of the Public Waterways Domain (DPH), some waterways cross the study area and the site location. In this case, it is necessary to get the use of water resources permit (TURH) from APA and guarantee the normal runoff of the water lines (Figure 3-55)**.**

[27] Database SNIAmb (2º Ciclo de Planeamento 2016-2021), 2021
[28] Source: APA, (2016-2021), 2021

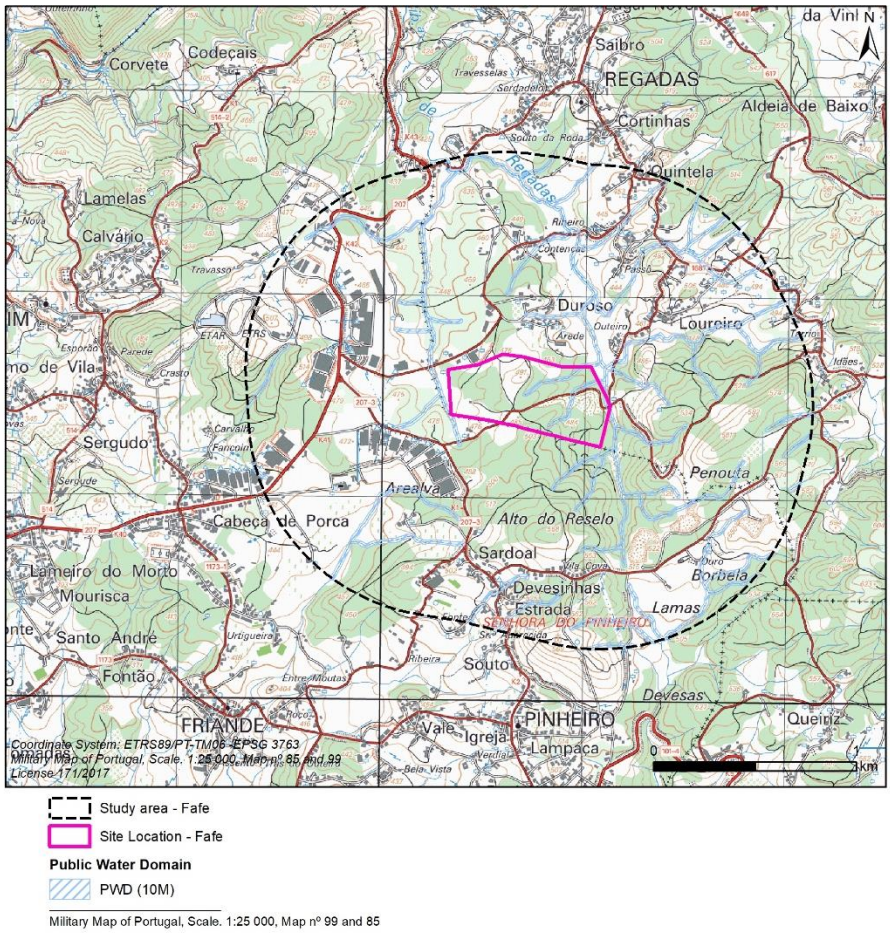


Figure 3-55 – Water Public Domain on Fafe study area

3.5.8.1.1. Groundwater resources

The area under analysis is in the Hydrogeological Unit of the Ancient Massif (Figure 3-56), on groundwater body of the Ancient Undifferentiated Massif of the Ave and Douro Basin.

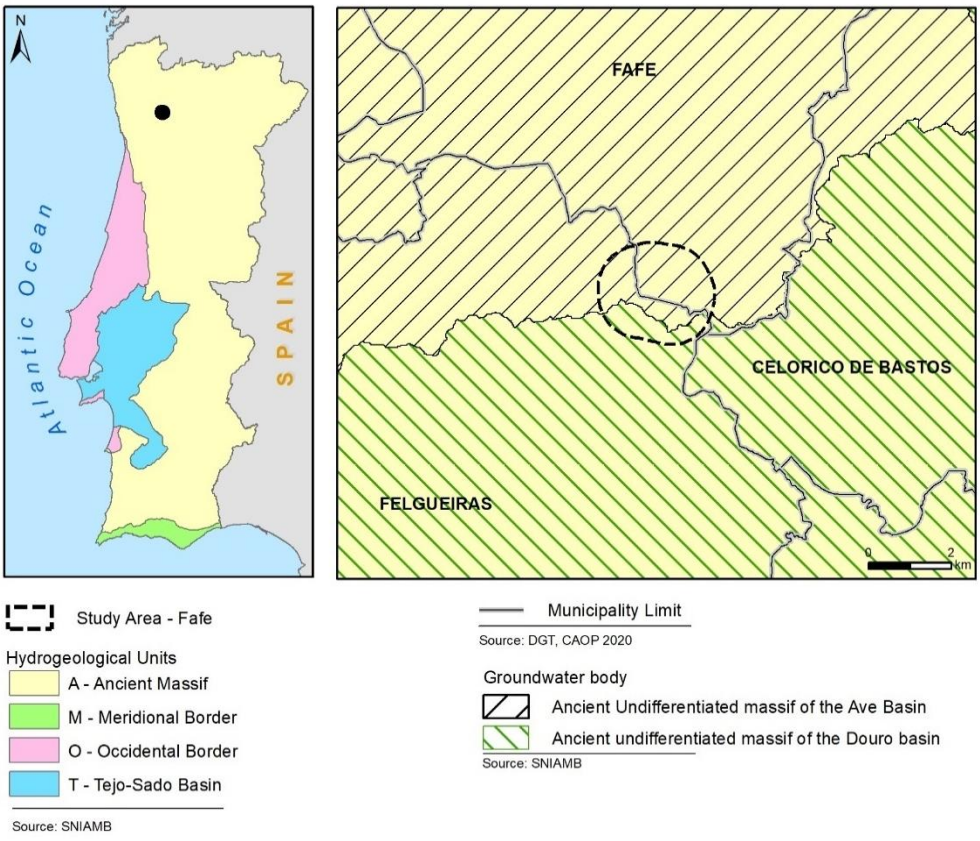


Figure 3-56– Hydrogeological framework of the Fafe study area

The groundwater bodies of the Ancient Undifferentiated Massif of Ave and Douro are characterised by fissured systems, supported by granitoid and metasedimentary rocks of the Ancient Massif. As a rule, the geological characteristics of this hydrographic region are associated with low hydraulic conductivity, strong spatial heterogeneity, and uncertainty of its hydrogeological suitability, resulting in reduced productivity. However, the existence of local groundwater bodies should not be neglected, as they are generally the source of agricultural and domestic water supply for local populations.

3.5.8.1.2. Water Quality and uses

In the study area under analysis, the main pressures on the quality of surface and underground water are identified as the livestock, agriculture, and forestry sectors and in a lower pressure level the urban sector (discharges to the water environment).

It should be noted that the Rio Ferro has 3 micro-hydroelectric power that represents hydro morphological pressure to the surface water mass and the Rilhadas golf course has a low charge of diffuse pressure to the groundwater mass.

Also, the landfills placed 1 km northwest from the site location may represent sources of water pollution, depending on their operation mode.

No groundwater pumping wells for public supply were inventoried at the Fafe site nor was their protection perimeter.

The groundwater body is an area designated for pumping intended for human consumption (Artº 7, DQA).

According to the SNIAmb platform (sniamb.pt - National Environment Information System), concerning quality data (Table 3-44), the water body Rio Ferro has an overall status of Good and the Rio Sousa and Ribeira de Santa Natália have a Less than good overall status.

Code	Superficial water body	Ecological State	Chemical State	Global State
PT02AVE0120	Rio Ferro	Good	Unknown	Good
PT03DOU0316	Rio Sousa	Reasonable	Unknown	Less than good
PT03DOU297	Ribeira de Santa Natália	Mediocre	Unknown	Less than good

Table 3-44 - Characterization of the quality of the superficial water body present in the study area[29].

According to the SNIAmb database, the overall groundwater status is Good, considering the classification of its quantitative (good) and chemical state (good) (Table 3-45).

Groundwater Body	Quantitative State	Chemical Status	Global state
Ancient undifferentiated massif of the Ave Basin	Good	Good	Good
Ancient undifferentiated massif of the Douro Basin	Good	Good	Good

Table 3-45 - Quality status of the groundwater water body

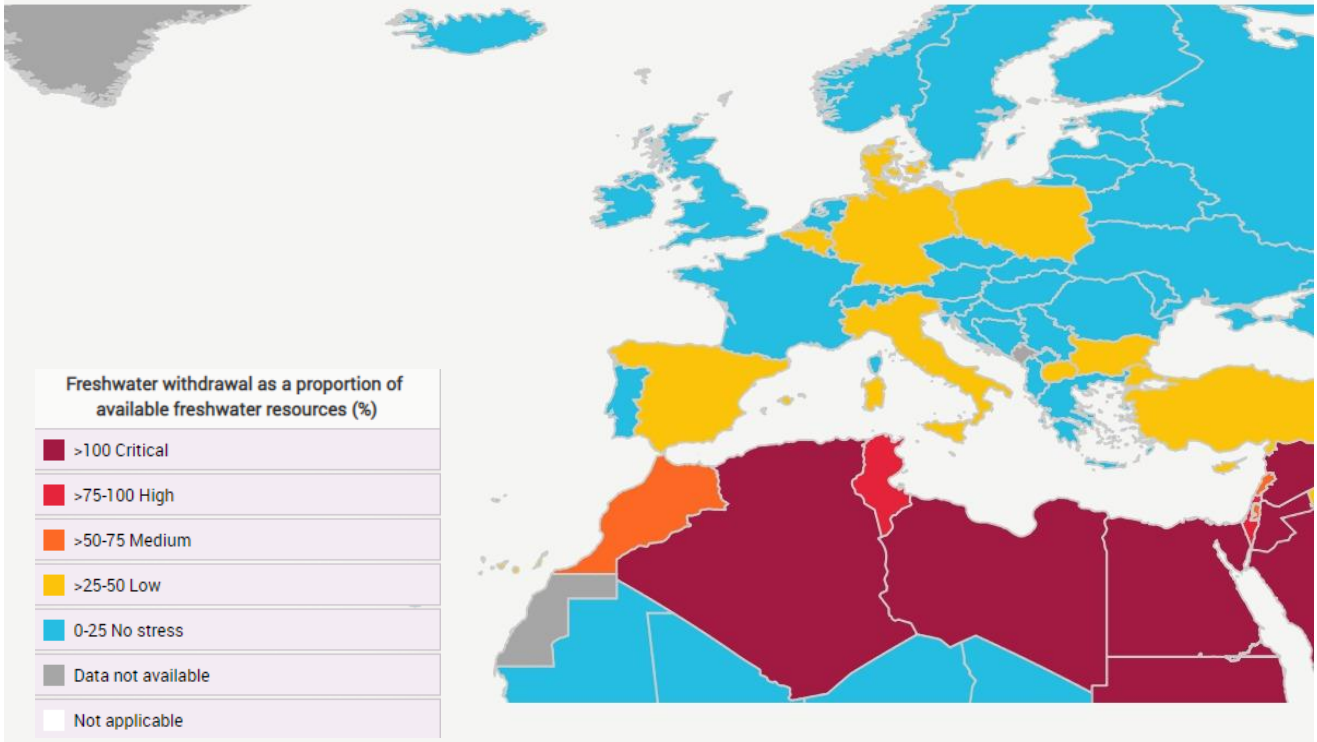
Aquifer pollution vulnerability, according to the EPPNA Qualitative Method (INAG, 1998), is based on qualitative methodologies based on the lithological criteria of aquifers or undifferentiated hydrogeological formations. The Portuguese Environment Agency (APA) has applied this methodology to continental Portugal where the main part of the Fafe study area fits into class V6 – low to variable vulnerability to pollution, due to the presence of fissured rocks.

3.5.9. Water Stress

According to the UN-Water (2018) “The level of water stress is defined as the ratio between total freshwater withdrawals by all economic activities and total available freshwater resources (…)”

[29] Database SNIAmb (2º Ciclo de Planeamento 2016-2021), 2021

6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources (2018)



Data source: FAO
Exported from UN-Water https://www.sdg6data.org on 26 Aug 2021

The water withdrawals taken from the ground or surface water bodies and transported to a place of use is an indicator of the level of pressure that anthropogenic activities apply over the natural resources, thus the indication of the environmental sustainability of water usage (FAO,2018).

"*A high level of water stress has negative effects on social and economic development, increasing competition and potential conflict among users (…), securing environmental flow requirements is essential to maintaining ecosystems healthy, resilient and available for future generations*"

From the map provided by FAO through AQUASTAT, it is possible to understand that the **Spanish territory** has a **low level** of water stress (>25-50%) and the **Portuguese territory** is classified as **no water stress** (0-25%).

To analyse the water stress in each site location it is necessary to use environmental modelling tools for which, currently, we do not have enough input. Although, it is suggested that the modelling of water stress is performed in the next stage-gate.

3.6. CONTAMINATION OF SOILS / WATER

To assess if there is soil/water contamination it is necessary to collect samples (of both soil and water), at properly justified sites, for the chemical analysis of key contaminants, at an accredited and independent laboratory. The lab report will indicate the concentration of contaminants, which can be under/over reference values accepted for each specific site situation.

At this stage-gate, the analytical data on soil and baseline water quality have not been reviewed and should be referred to in future phases of project design. The following descriptive assessment evaluates the potential contamination of soils and water at the site location and the pressures to contamination in the study area based on publicly available desktop information.

The table below summarises the compiled information and ranks the 8 selected sites according to potential soil and water contamination, considering that the higher the score, the higher the potential contamination of the site.

Category	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
Overview	4	3	3	1	**3**	**2**	**2**	**2**
	Important Urban and industrial pressures in the study area.	Industry pressure in the study area.	Industry pressure in the study area.	Urban and industrial pressure with low relevance	Industry pressure in the study area.	Urban and industrial pressure with low relevance	Urban and industrial pressure with low relevance	Urban and industrial pressure with low relevance
Potential Soil Contamination	4	1	1	1	4	1	1	1
	The Matosinhos refinery started operations in the 1970s. By 2013, most of the current infrastructure was already in place, according to the available aerial photography	In the last 15 years, the site has never been occupied with industrial or urban infrastructure, according to the available aerial photography.	In the last 18 years, the site has never been occupied with industrial or urban infrastructure, according to the available aerial photography.	There is a lack of historical information on the land, but it is assumed that the pressures are lower considering the current uses and occupations.	The Mitrena Peninsula started operations in the 1920s. In the last 17 years, the site has never been occupied with industrial or urban infrastructure, according to the available aerial photography.	In the last almost two decades, the site has never been occupied with industrial or urban infrastructure, according to the available aerial photography.	In the last almost two decades, the site has never been occupied with industrial or urban infrastructure, according to the available aerial photography.	In the last almost two decades, the site has never been occupied with industrial or urban infrastructure, according to the available aerial photography.
Potential Water Contamination	2	4	4	1	3	2	2	2
	The groundwater system is a medium to high vulnerability to contamination. There is no information on groundwater contamination in the study area	The groundwater system is a medium to high vulnerability to contamination. There is historic contamination with industrial sources (see chapter 3.6.2).	The groundwater system is a medium to high vulnerability to contamination. The history of activities in the Estarreja Industrial Complex has contaminated groundwater (ERASE 2014).	There is a lack of historical information on the land, it is assumed that the pressures are lower considering the current uses and occupations.	The groundwater system has a medium vulnerability to contamination. There is historic contamination with industrial sources (see chapter 3.6.5).	The groundwater system has low to variable vulnerability to contamination. There is no information on groundwater contamination in the study area	The groundwater system has low to variable vulnerability to contamination. There is no information on groundwater contamination in the study area	The groundwater system has low to variable vulnerability to contamination. There is no information on groundwater contamination in the study area
Total Score	10	8	8	3	10	5	5	5
Quantitative level	4	3	3	1	4	2	2	2

Table 3-46 - Characterisation of water and soils contamination in the study area

3.6.1. Matosinhos

According to the environmental evaluation performed in 2019, under the review of the municipal Master Plan, the **groundwater bodies** in the municipality are **strongly subject to urban and industrial pressures** that **adversely affect** the condition of the water bodies (Câmara Municipal Matosinhos, 2019).

Similarly, the **soil is subject to various pressures** from human occupation and activity, such as artificialization (non-greenfield) and construction, industrial activities, and agricultural practices.

The project area is currently occupied by the Matosinhos Refinery, which has been operating there since the 1970s. The Matosinhos refinery comprises, in its 290-hectare industrial complex, an aromatics plant, a base oils plant and a lubricants plant. The industrial complex is also interconnected to the tanker terminal in the port of Leixões by several pipelines of about two kilometres in length. The site is in the northernmost sector of the entire industrial complex, which, according to the figure below, has been occupied with industrial infrastructure since at least 2006.

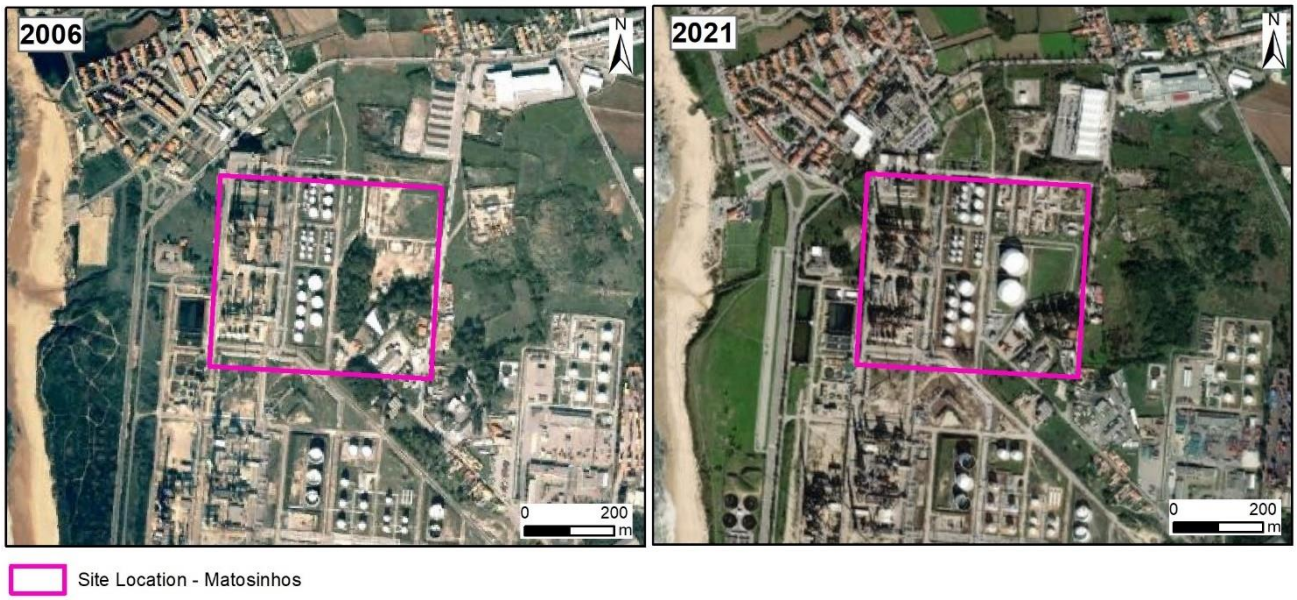


Figure 3-57– Historic aerial photography available for Matosinhos Site

Matosinhos refinery, produce a wide variety of derivatives or aromatics products, important raw materials for the chemical and petrochemical industry, and plastic, textiles, fertilisers, rubber, paints and solvents, such as paraxylene; orthoxylene; toluene and benzene for the Portuguese market and also for export.

This type of activity can potentially contaminate the soils and water present there, so a detailed soil and water contamination assessment study should be required in the next phase.

3.6.2. Sines

The main potential sources of contamination to soil and the Sines Aquifer System are fundamentally related to the predominant land uses such as uncontrolled deposition of industrial and urban waste and discharges, unlicensed groundwater captures and saline intrusion (Câmara Municipal de Sines, 2007).

The hydrogeological characteristics of the Sines Aquifer System (South Zone) give it a **medium to high vulnerability to contamination** (variable with the amount of clay in the geological formations) since the free

surface aquifer is made up of porous formations and has direct recharge from rainwater, which is recharged by drainage from the deeper aquifer (which can also be fed by direct recharge in areas where it outcrops).

Thus, in cases of contamination by pollutant discharge, leaching rainwater or excess washing, the **soil's very permeable characteristics** allow them to **infiltrate and affect the free surface aquifer** and eventually the deeper one.

On the site location, there is no current industrial and urban infrastructure according to the historic aerial photography available since 2006 (Figure 3-58). In the immediate vicinity of the site location, the current Sines Industrial Zone located to the north is the main pressure for soil and groundwater contamination through migration of a potential contamination plume.

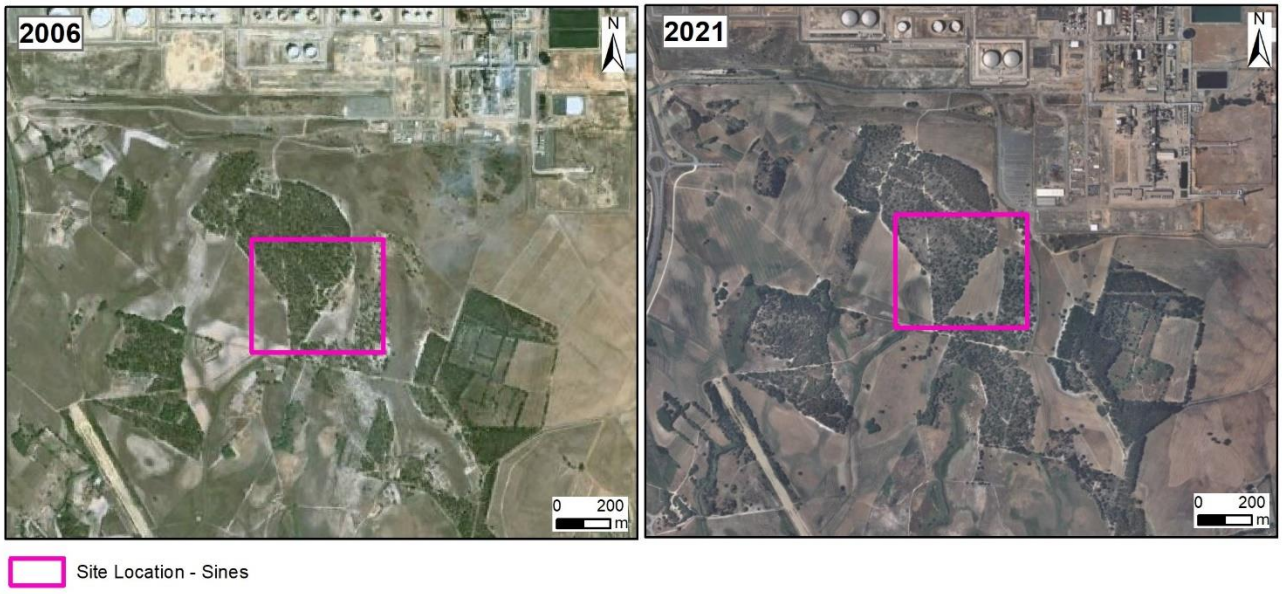


Figure 3-58– Historic aerial photography available for Sines Site

3.6.3. Estarreja

The chemical industrial complex of Estarreja is one of the most important chemical industry centres in Portugal. Since it is in a region with **a medium to high vulnerable aquifer system** (reduced depth of the water table and the high permeability of the soil), the Estarreja municipality has been developing studies towards soil decontamination.

The industrial development and urbanization of the Estarreja chemical industry led to several pressures on surface and groundwater resources due to industrial and domestic effluents discharging into water lines and the negligent accumulation of potentially contaminated waste in the soil without any treatment. This then impacted the surrounding area, namely the Ria de Aveiro, which is a special protection area according to Rede Natura 2000 (ERASE 2014).

The chemical industry complex, which nowadays includes the previously identified Seveso industries such as Bondalti, CIRES, Dow Portugal and Air Liquide, for many years has been the focus of contamination of this aquifer system and whose **negative impact on groundwater** quality is still being felt today. The effluent from the industrial area has been discharged for years into the drainage ditches without any treatment.

In recent years, measures have been promoted by the *Agrupamento para Regeneração Ambiental Solos Estarreja*, Ace to minimize pollution inside and around the Chemical Complex of Estarreja, namely the ERASE project (2000), aiming to eliminate the liabilities of the Chemical Complex.

Currently, the **groundwater bodies** are classified as mediocre, being essentially affected by the industrial discharges (ERASE 2014). However, according to the river basin management plan (PGRH4), the underground body where the site is located (Aveiro Quaternary Aquifer) has an **insufficient chemical status** due to the presence of **nitrates** (agricultural pollution).

On the site location, there is no current industrial and urban infrastructure according to the historic aerial photography available since 2003 (Figure 3-59). Near the site location, the Estarreja Ecoparque is the main pressure for soil and groundwater contamination through the migration of a potential contamination plume.

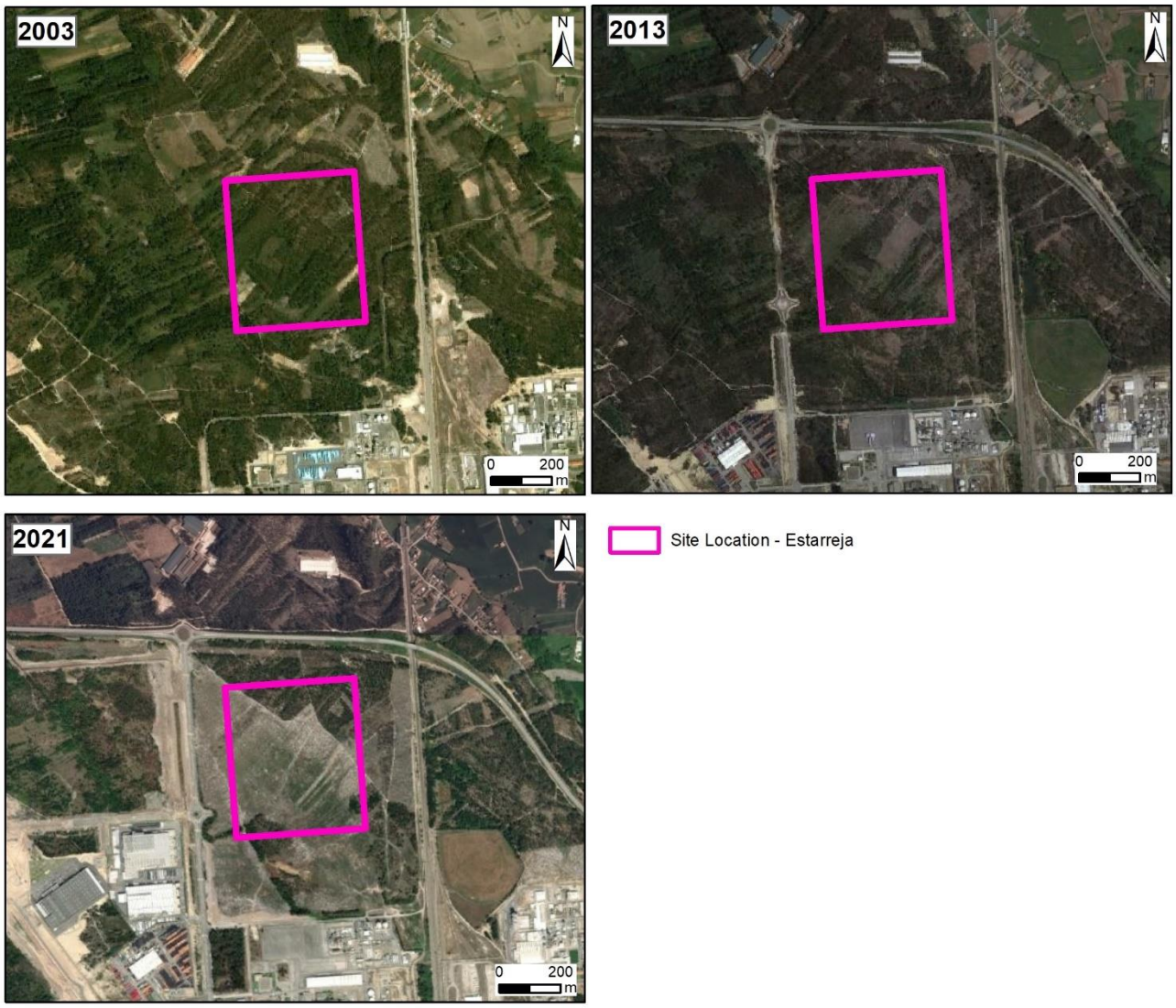


Figure 3-59– Historic aerial photography available for Estarreja Site

3.6.4. Vigo

The main potential sources of contamination of the Vigo soils and aquifers are the quarry and the roads traffic. Although the surrounding of the site location has some small rural agglomerations, it is expected that the crops and pastures developed in these areas have a small expression in terms of soil and water contamination.

In terms of soil and water contamination, the Galicia autonomous community (AC) does not have Preliminary situation reports. To carry out an activity classified as potentially polluting to the soil building a facility in the Autonomous community of Galicia it is necessary to submit a Soil Situation Report to the Department of the Environment.

There is currently no industrial infrastructure on the site location, and, according to historical aerial photography available since 2003 it was only intervened/urbanized in 2008.

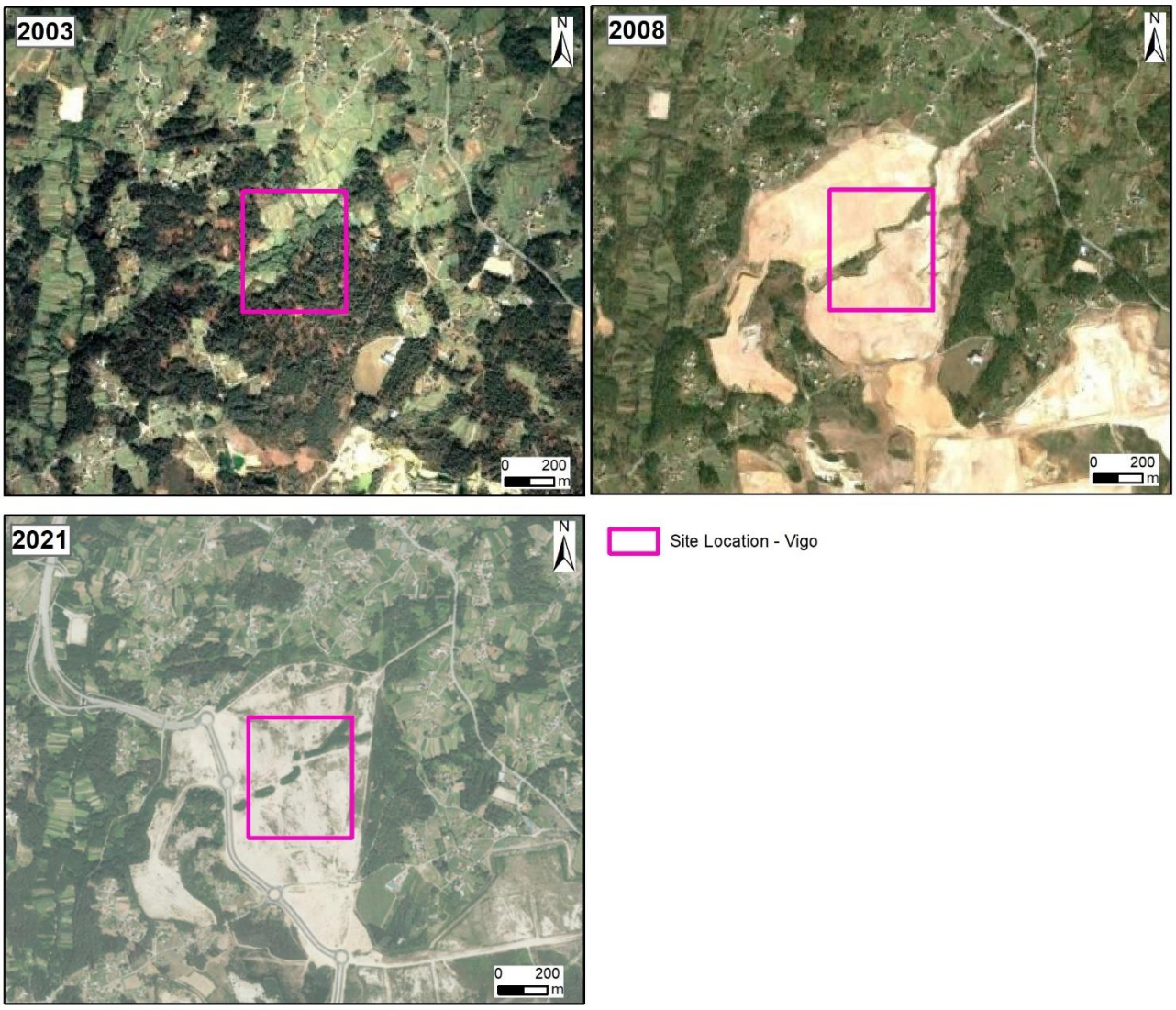


Figure 3-60– Historic aerial photography available for Vigo Site

3.6.5. Setúbal

Considering the historical activities developed in the Mitrena Peninsula since the late 1920s, it is likely that there are situations of environmental liabilities (historical contamination) in the surroundings of the project site area. The Mitrena Peninsula has been occupied/used by industrial activities essentially with the production of phosphate fertilizers. In this activity, which reached its peak in the mid-1980s, sulphuric acid was used, its production being made from pyrite ash, corresponding transport, and uncontrolled deposition of pyrite ash. However, it should be noted that the desktop analysis of the site location does not indicate previous sources of contamination from buildings or industries in the implementation area. It's a greenfield surrounded by brownfields and polluting industries.

According to the available aerial photography, it can be seen that on the site location, at least since 2004, the area has not been occupied by any building. From the information available there is no information that in the recent past there has been any activity on the site location.

Between 2007 and 2010 there was some earth movement, but it is not possible to determine whether this was landfill or excavation (Figure 3-61). These changes in morphology may be responsible for the fact that the COS (Land Cover Map) considers this area as a "quarry".

It should also be noted that the buildings in the south and lower-left corner corresponds to SAPEC Bay, a sulphur production plant that had an Environmental Impact Study in 2014. This study indicates high levels of arsenic, CQO, CBO_5 and pH above the maximum recommended for groundwater intended to produce water for human consumption.

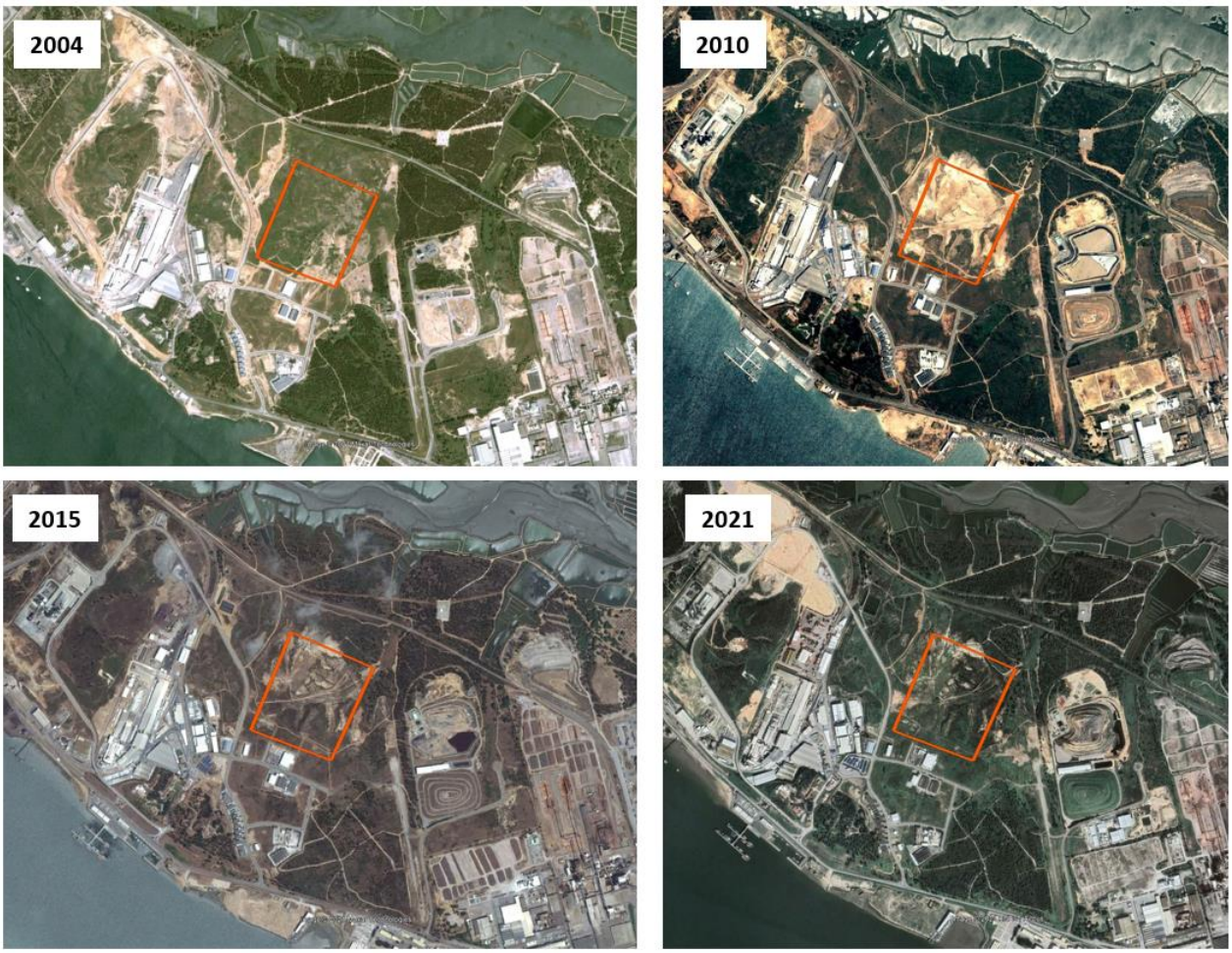


Figure 3-61– Historic aerial photography available from Setubal Site

3.6.6. Valongo

According to the aerial photography available for the area under analysis (Figure 3-62), since 2004 until the present, the location site has not been artificially developed.

In 2004, the entire site location area as well as its immediate surroundings were naturalised, filled with vegetation.

Between 2009 and 2012 a series of interventions associated with the construction of the IC24 highway and other access roads took place on the northern (north-eastern and north-western) limits of the site location. More recently, the Futerra Fuels (Black Pellets) factory was installed in the southern sector of the site location.

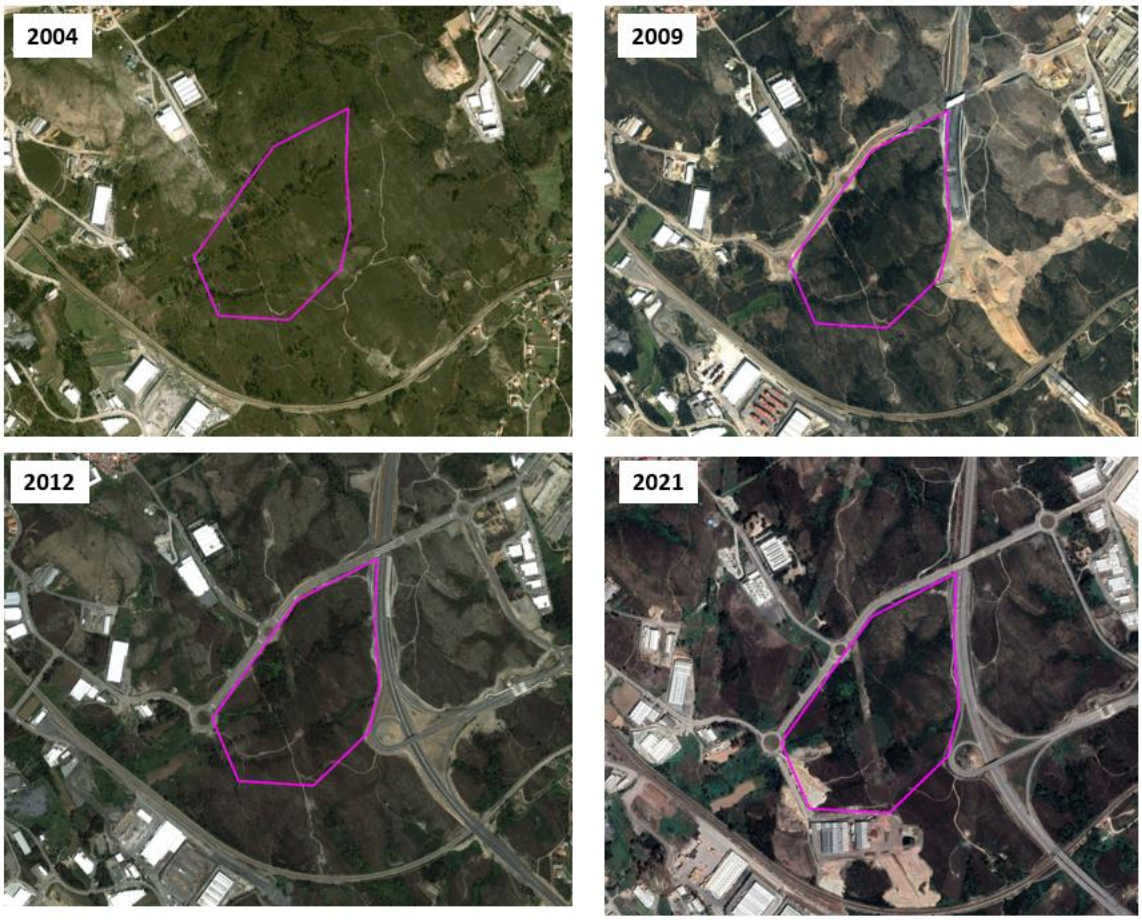


Figure 3-62– Historic aerial photography available from Valongo Site

In accordance with the above, the site location is a greenfield because no activities likely to contaminate the soils have occurred. Only the proximity of the site to roads may facilitate the deposition of undesirable waste, but that, given the available data, is only hypothetical.

3.6.7. Trofa

There is currently no industrial infrastructure on the site location, and, according to historical aerial photography available since 2006, Figure 3-63, it was not intervened/urbanized before. Therefore, the site location is a greenfield because no activities likely to contaminate the soils have occurred.

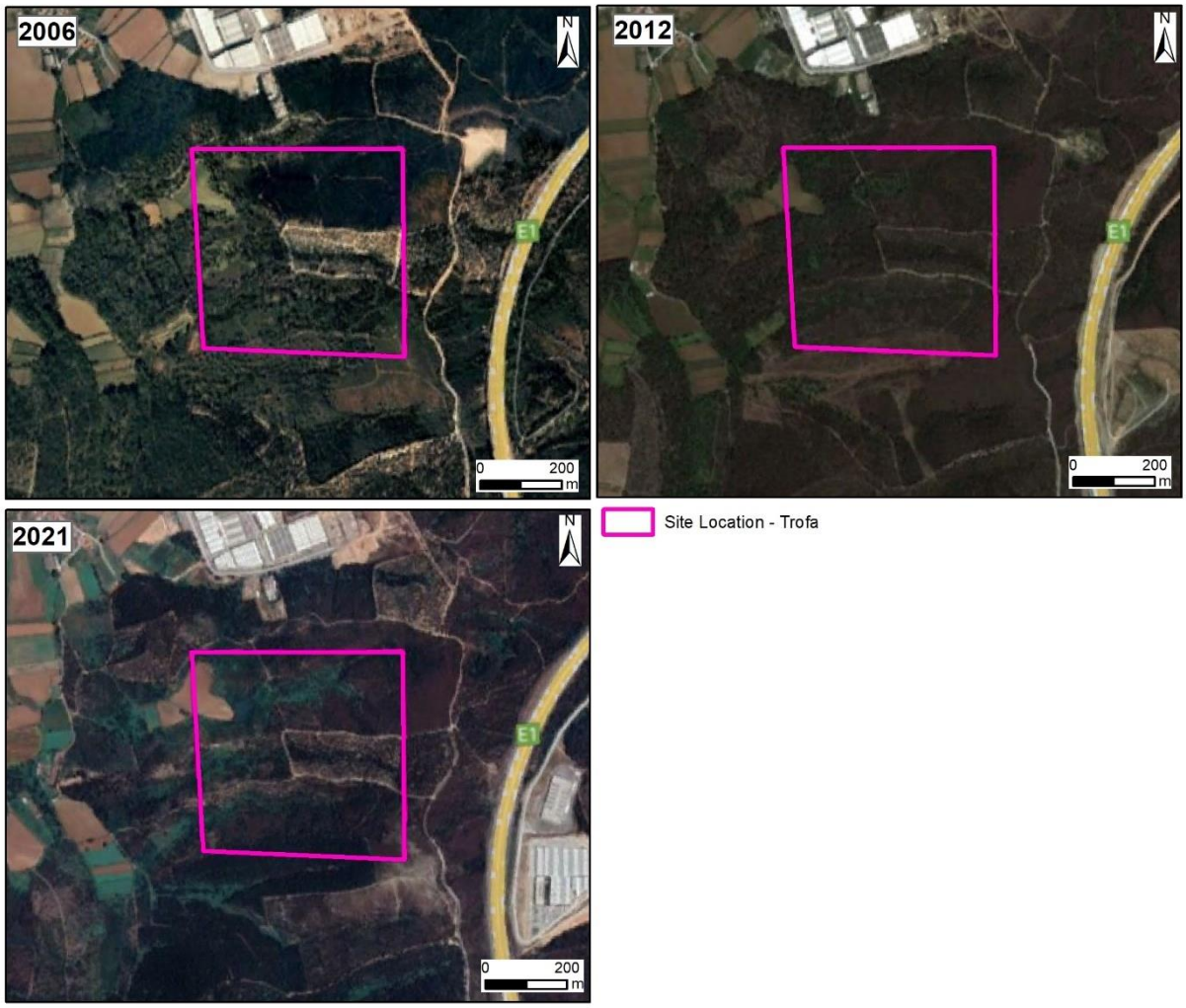


Figure 3-63– Historic aerial photography available from Trofa Site

3.6.8. Fafe

There is currently no industrial infrastructure on the site location, and, according to historical aerial photography available since 2006 (Figure 3-64) it was not intervened/urbanized before.

In accordance with the above, the site location is a greenfield because no activities likely to contaminate the soils have occurred.

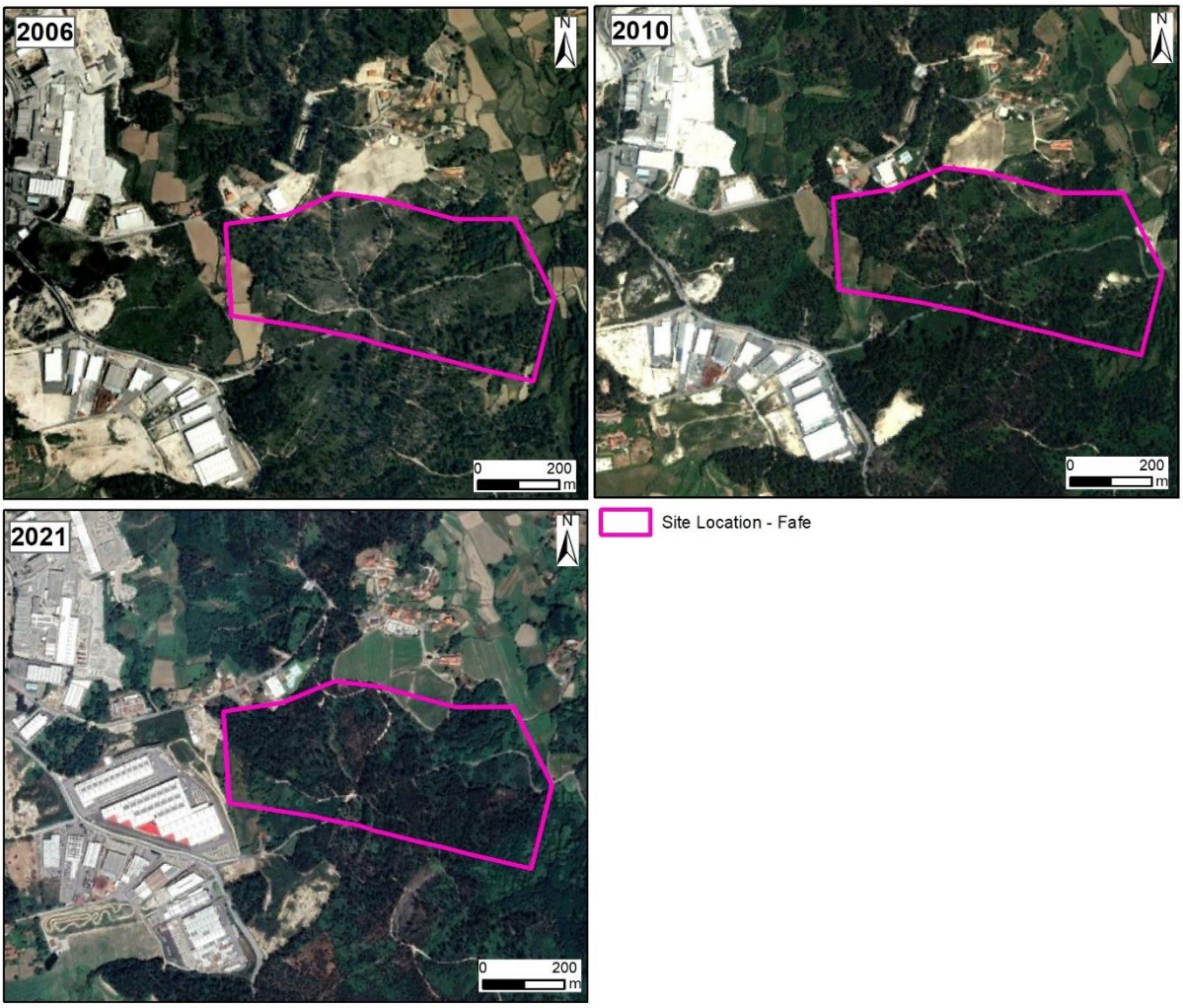


Figure 3-64– Historic aerial photography available from Fafe Site

3.7. WASTE TREATMENT / MANAGEMENT

Category	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
Quantitative level	**4**	**2**	**3**	**1**	**2**	**3**	**4**	**4**
	The site location does not have in the surroundings hazardous industrial waste treatment installations	The site location has 1 hazardous industrial waste treatment installation and 1 non-hazardous industrial waste treatment installation in the surroundings.	The site location has 1 hazardous and non-hazardous industrial waste treatment installation	The site location has the highest number of industrial waste treatment installations both for hazardous and non-hazardous on the surroundings	The site location has 1 hazardous industrial waste treatment installation and 1 non-hazardous industrial waste treatment installation in the surroundings.	The site location has 1 non-hazardous industrial waste treatment installation in the surroundings	The site location does not have in the surroundings hazardous industrial waste treatment installations	The site location does not have in the surroundings hazardous industrial waste treatment installations

Table 3-47 - Characterisation of waste treatment in the study area

The main difficulties encountered in the management of industrial waste are due to factors such as the nature and composition of the waste generated and of the production processes that generate it, which implies in many cases difficulties and discrepancies in the identification of the waste European codes. Also, the determination of the hazardous characteristics of the waste or difficulties at the time of identifying the most appropriate treatments applicable to each type of waste.

The sub-products and residues from the lithium refinery have the following classification (European List of Waste):

Sub product/Residue	Waste Code
Leach Residue	060205[30] (*) or 060299[31]
Gypsum	060205 (*) or 060299
Sodium Sulfate	060205 (*) or 060299
Purification Residue	060205 (*) or 060299

(*) – hazardous waste

Table 3-48 – Residues and respective waste code

The main goal of the waste management for the specific case of the lithium refinery is to avoid the disposal and move towards the circularity. The industrial waste has a high potential of being introduced in a circular chain, which means there is a necessity ofto find the clients interested in the valorisation of the above sub products.

For this to happen, it is still necessary to confirm the classification of the sub products thought the assessment of the hazardousness in the waste and specific studies.

[30] Wastes from the manufacture, formulation, supply and use of bases – other bases (Hazardous)

[31] Wastes from the manufacture, formulation, supply and use of bases - Wastes not otherwise specified

3.7.1. Matosinhos

Through the consultation of the *Information System for Licensing Waste Management Operations* (SILOGR) provided by APA, it is understandable that in the Oporto region there is one waste operator licensed to dispose this type of waste.

Waste Operator	Location	Operation
(APA00145836) Recivalongo – Gestão de Resíduos, LDA	Oporto - Valongo	D1 - Deposit into or onto land (e.g. landfill, etc.)

Table 3-49 – Waste Operator and Operation in Oporto

3.7.2. Sines

In the Setúbal region, there are two waste operators licensed to manage this type of waste.

Waste Operator	Location	Operation
(APA00086461) Centro Integrado de Tratamento de Resíduos Industriais Não Perigosos de Setúbal	Setúbal	D1 - Deposit into or onto land (e.g. landfill, etc.)
(APA01083363) Unidade de Gestão de resíduos – ECOPATROL Lote 13	Setúbal	D15 - Storage prior to any of the operations numbered D1 to D14

Table 3-50 – Waste Operator and Operation in Setúbal

3.7.3. Estarreja

In the Aveiro region, there is one waste operator licensed to manage this type of waste.

Waste Operator	Location	Operation
(APA01453183) Auto Rafael Cruz, Unipessoal, Lda	Aveiro - Ovar	D15 - Storage prior to any of the operations numbered D1 to D14

Table 3-51 – Waste Operator and Operation in Aveiro

3.7.4. Vigo

Galicia has a wide network of recycling and treatment of industrial waste, namely the industrial waste treatment centre of Galicia (CTRIG), as a global reference facility for dangerous industrial waste treatment.

According to the Galician industrial waste management plan 2016-2022, the locations of the waste treatment installations are:

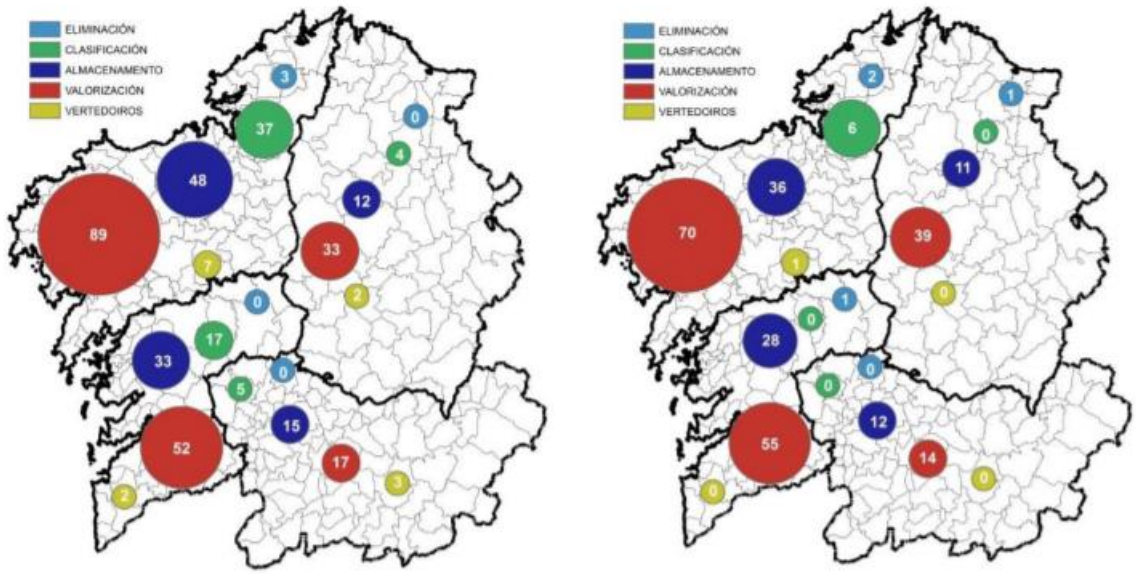


Figure 3-65– Location of waste treatment installations

Source: Retrieved Galician industrial waste management plan 2016-202232 (Hazardous industrial waste treatment installations on the left and hazardous industrial waste treatment installations on the right)

In terms of the project area, there are 52 installations for valorisation of nonhazardous waste and 55 installations for valorisation of hazardous waste on the surroundings (Figure 3-65).

In Pontevedra the closest hazardous industrial waste recovery facilities, are located in O Porriño and Ponteareas.

Waste Operator	Operation
Vigoto Uno S.L. - Hazardous industrial waste recovery facility	R5
Rogelio González Amil - Desguaces González- Hazardous industrial waste recovery facility	R5
Recuperadora Gallega de Disolventes S.L. (REGADI)- Hazardous industrial waste recovery facility	R2
Codisoil S.A- Hazardous industrial waste recovery facility	R5
Luis Rivas S.L.- Hazardous industrial waste recovery facility	R5

Table 3-52 – Waste Operator and Operation in O Porriño and Ponteareas

Particularly, in Salvaterra de Miño the identified installations are presented in Table 3-53.

Waste Operator	Operation
Áridos dos Mendos - Non-hazardous industrial waste recovery facility	R10
Uxma Nature S.L. - Non-hazardous industrial waste recovery facility	R3
Reciclados Xinzo S.L.U - Non-hazardous industrial waste recovery facility	R10

[32] https://sirga.xunta.gal/plans-e-programas-sirga?content=/Portal-Web/Contidos/Plan/plan_0021.html

Table 3-53 – Waste Operator and Operation in O Salvaterra de Miño

3.7.5. Setúbal

In the Setúbal region, there are two waste operators licensed to manage the type of waste to be produced by the Refinery.

Waste Operator	Operation
(APA00086461) Centro Integrado de Tratamento de Resíduos Industriais, SA	D1 - Deposit into or onto land (e.g. landfill, etc.)
(APA07249723) Carmona - Sociedade de Limpeza e Tratamento de Combustíveis, S.A.	D13 - Blending or mixing prior to submission to any of the operations numbered D1 to D12

Table 3-54 – Waste Operator and Operation in Setúbal

3.7.6. Valongo

In the Valongo region, there is one waste operators licensed to manage the type of waste to be produced by the Refinery.

Waste Operator	Operation
(APA00145836) Recivalongo - Gestão de Resíduos, LDA	D1 - Deposit into or onto land (e.g. landfill, etc.)

Table 3-55 – Waste Operator and Operation in Valongo

3.7.7. Trofa

In the Trofa region, there are no waste operators licensed to manage the type of waste to be produced by the Refinery.

3.7.8. Fafe

In the Fafe region, there are no waste operators licensed to manage the type of waste to be produced by the Refinery.

3.8. NOISE

The intention of assessing noise in relation to each proposed site location is to illustrate if the potential affected nearby populations are already exposed to high levels of noise, such as traffic and other industrial facilities, considering the noise maps produced for each municipality. Assuming all 4 proposed site locations present noise levels below the relevant legal limit values, the intention is to select the site location with the lowest existing noise level, in conjunction with the population density to be potentially affected.

It is expected that a refinery will contain sources of noise pollution higher than typical background levels that may affect the surrounding receptors. Generally, however, noise levels of an industrial plant located in larger suburban areas may often be masked by highways, railways, streets, construction works, other industries and airports, which could lead to refinery sound being restricted to the refinery footprint and is therefore of low risk to the local community. In these cases, the noise presents a higher risk to the health and safety of the refinery workers due to exposure time and proximity.

In addition, noise levels from refinery activities are not expected to be higher than those experienced in existing refinery operations at brownfield sites.

There is limited environmental noise legislation and criteria in Europe for refinery industries, the only regulation related to industrial activities are the noise maps and action plans to reduce environmental noise. "The noise map is a descriptor of the outside ambient noise expressed by the indicators: LDen (average long-term sound level associated with discomfort in the 24-hour period) and Ln (average long-term sound level associated with discomfort at night, from 23:00 to 7:00 a.m.)"[33].

Acoustic surveys or modelling has not been completed as part of this assessment and therefore is recommended once a site is selected to further ascertain expected noise impacts.

[33] Retrieved from: https://www.apambiente.pt/ar-e-ruido/mapas-municipais-de-ruido

Category	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
Impact level	4	2	3	1	2	3	3	3
	• Already affected by high noise sources such as a port, traffic and airport. • High density population	• Already affected by noise sources such as road traffic. • Low population density in the study area.	• Already affected by noise sources such as road and railway traffic. • Some important population clusters located within the study area with high potential to be considerably affected	• Low noise pollution without relevant noise sources. • Some important population clusters located within the study area with high potential to be considerably affected	• Already affected by noise sources such as road traffic. • Low population density in the study area.	• Already affected by noise sources such as highway and railway traffics, industries and other economic activity • Small population clusters located within the study area with some potential to be considerably affected	• Already affected by noise sources such as road traffic and industries • Small population clusters located within the study area with some potential to be considerably affected	• Low noise pollution with the main source being the industries and other economic activities • Some important population clusters, public spaces and tourist developments located within the study area with high potential to be considerably affected

Table 3-56 – Characterisation of noise present in the study area

Rank: 1 – lowest impact, 4 – highest impact

3.8.1. Matosinhos

The Municipality of Matosinhos presents, in the municipal master plan, an acoustic and conflict zoning map of 2019 that includes the area where the refinery will be implemented.

Considering that the city of Matosinhos has a broad transportation network, a port, and that includes a part of the Francisco de Sá Carneiro Airport it is understandable that all these structures constitute noise pollution sources. Also, other industries based around this city represent important sources of noise pollution.

The proposed implementation area for the Matosinhos site location is located in an unclassified area in terms of acoustic zoning, according to the General Noise Regulation (RGR). The study area intercepts mixed and Lden conflict zones which means that for mixed zones, the urbanistic operation needs to follow the legally established exposure limit values by the RGR. The conflict zones, in which the noise exceeds the limits established in the RGR, must be subject to Municipal Noise Reduction Plans (PMRR).

According to the data available in the latest Matosinhos Noise action plan, developed by dBwave.i in 2018, namely the Appendix 1 and 2, it is possible to verify that the potentially affected sensitive receptors under analysis are currently affected by noise values mostly in compliance with the Exposure Limit Values for unclassified areas, according to that established in the General Noise Regulation (Decree-Law no. 9/2007, of 17 January, with subsequent rectification and amendment) for the prevention and control of disturbing and harmful noise emissions:

General Noise Regulation	
LDEN ≤ 63 DB(A)	*LN ≤ 53 DB(A)*

Table 3-57 – General Noise Regulation according to Decree – law nº.9/2007 of 17 January

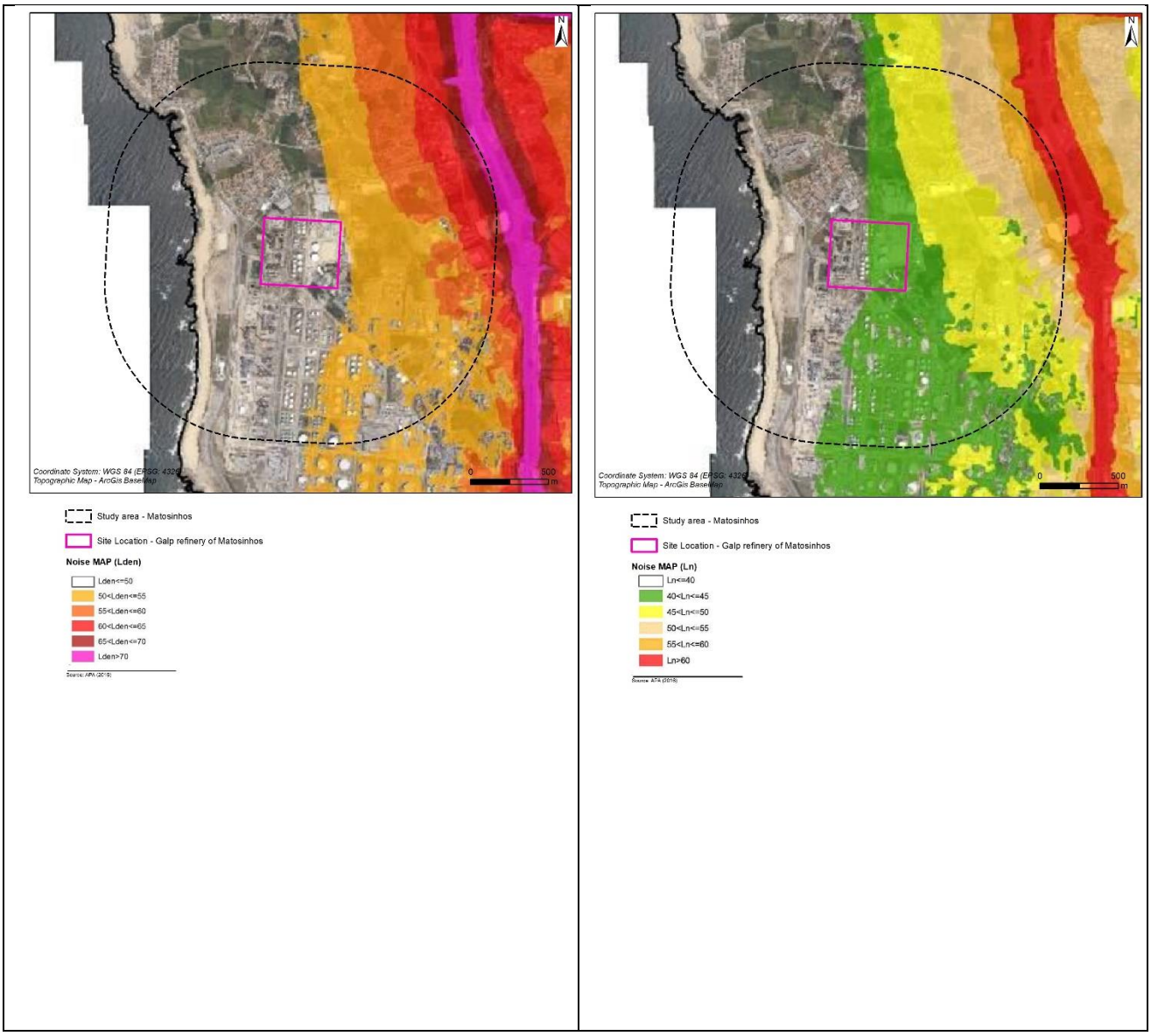


Figure 3-66 – Noise maps in the Study Area (left image represents the Lden Values and right image represents the Ln values) - Matosinhos

The zones intercepted by the study area are directly affected by the national and municipal road traffic noise sources which represent the main contributor to noise pollution in the area, whereas industry is reported to be a lesser contributor. This considered, the placement of a refinery in this area is not expected to dramatically increase the noise impacts to local receptors.

It should also be noted that the noise maps were developed in 2018, assuming the Matosinhos Refinery in operation. In 2025, with the refinery decommissioning plan full implemented, it is expected to have lower noise levels (however other noise sources might be added to the scenario).

3.8.2. Sines

The municipality of Sines has a Noise Map[34], prepared in 2007, covering Lithium Refinery implementation area. The main source of noise in the municipality is road traffic, namely the A26 and IP8.

[34] Retrieved from: https://www.apambiente.pt/ar-e-ruido/mapas-municipais-de-ruido

According to the Noise Map it is possible to verify that the potentially affected sensitive receptors under analysis are currently affected by road and industrial noise (including the Sines Refinery), and values are mostly in compliance with the Exposure Limit Values for unclassified areas, according to that established in the General Noise Regulation (Decree-Law no. 9/2007, of 17 January, with subsequent rectification and amendment) for the prevention and control of disturbing and harmful noise emissions:

General Noise Regulation	
LDEN ≤ 63 DB(A)	*LN ≤ 53 DB(A)*

Table 3-58 – General Noise Regulation according to Decree – law nº.9/2007 of 17 January

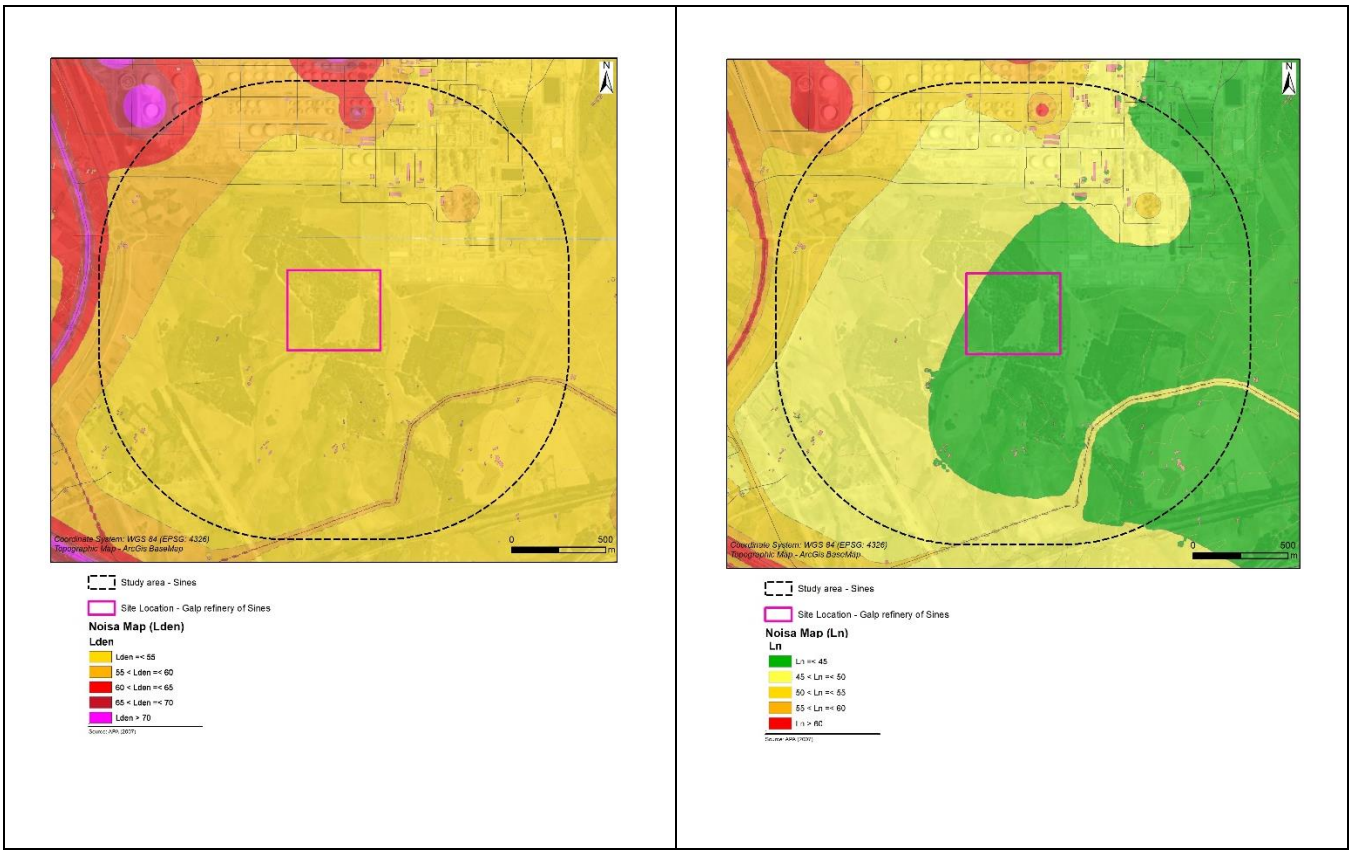


Figure 3-67 – Noise maps in the Study Area (left image represents the Lden Values and right image represents the Ln values) - Sines

The "*Environmental Impact Assessment of the Sines Refinery Conversion and Land Consolidation Projects*" developed in 2008 by Galp, reports that background noise levels were within the limits imposed by law.

The potentially affected sensitive receptors under analysis are currently affected by road and industrial noise therefore the placement of a refinery in this area is not expected to dramatically increase the noise impacts to local receptors.

3.8.3. Estarreja

The municipality of Estarreja has a Noise Map[35], prepared in 2010, covering the Lithium Refinery implementation area. The main source of noise in the municipality is road traffic, namely the traffic in A1, EN109 and A25. The railway traffic is also an important nearby noise pollution source to be considered.

According to the municipal master plan, the implementation area is classified as an industrial zone which has no further specifications on the land planning document. The Noise Maps classifies the site location as a superficial source of noise.

In terms of the national legislation, the area needs to comply with the Exposure Limit Values for unclassified areas, according to that established in the General Noise Regulation (Decree-Law no. 9/2007, of 17 January, with subsequent rectification and amendment) for the prevention and control of disturbing and harmful noise emissions:

General Noise Regulation	
LDEN ≤ 63 DB(A)	*LN ≤ 53 DB(A)*

Table 3-59 – General Noise Regulation according to Decree – law nº.9/2007 of 17 January

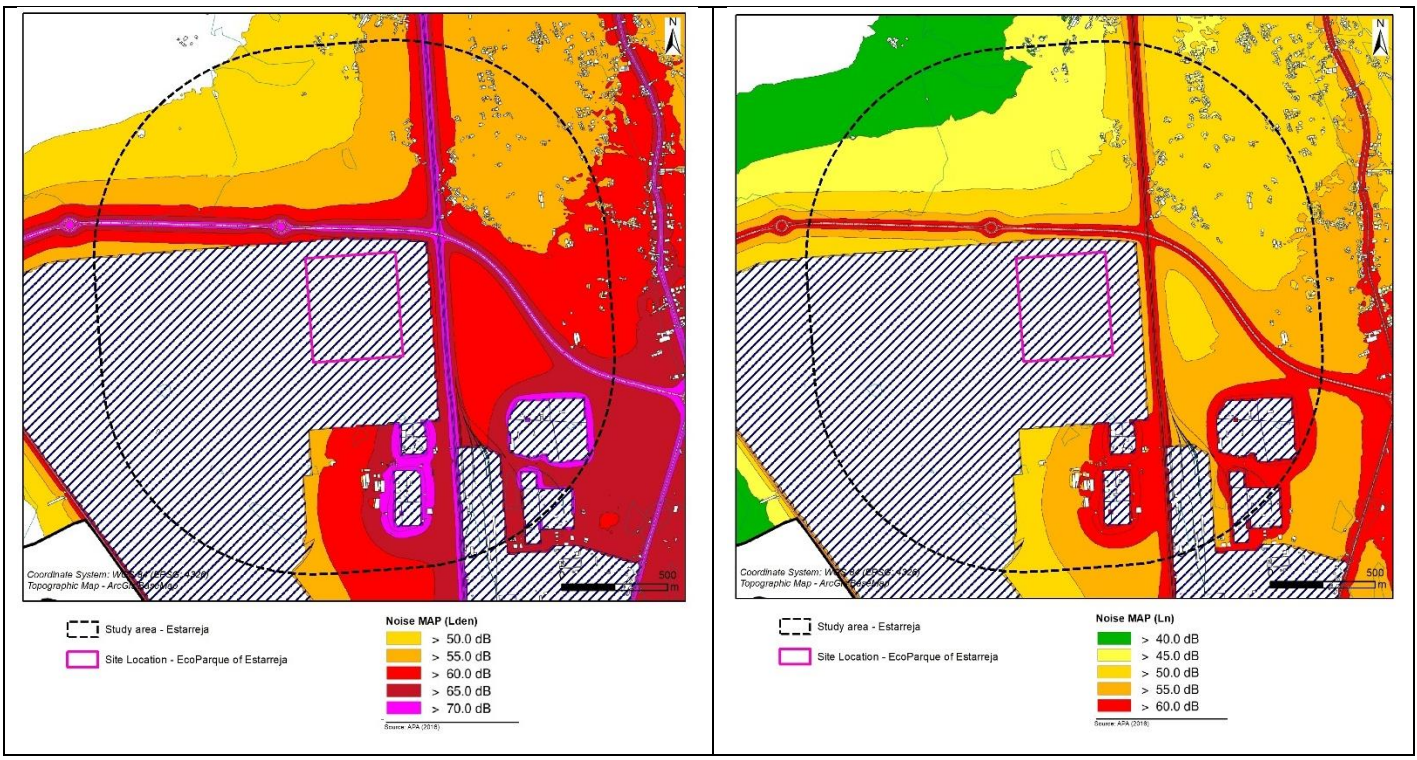


Figure 3-68 – Noise maps in the Study Area (left image represents the Lden Values and right image represents the Ln values) - Estarreja

In this sense and as stated by the municipality, the Eco Business Park is located outside the general population cluster and the existing industries have a low noise impact in the surrounding populations. Therefore, the placement of a refinery in this area is not expected to dramatically increase the noise impacts to local receptors.

[35] Retrieved from: https://www.apambiente.pt/ar-e-ruido/mapas-municipais-de-ruido

3.8.4. Vigo

According to the Methodology for developing strategic noise maps under the Environmental Noise Assessment and Management Scheme:

"*…there are obligations to characterise the sound environment through the development of strategic noise maps (MER) for large road, rail and air transport infrastructure (GIT) above certain traffic thresholds and for agglomerations - municipalities with more than 100,000 inhabitants and population density of 2500 inhabitants per square kilometre or more. ”*[36]

The proposed Vigo refinery site is in the municipalities of Salvaterra do Miño and As Neves which according to INE has a population of 9900 and 3803 (2020 data), respectively. These values represent a population density of 158 inhabitants per square kilometre and 58 inhabitants per square kilometre, accordingly.

In this sense, these municipalities do not have the conditions necessary for the agglomeration noise maps production.

Nevertheless, the site analysis shows an area currently experiencing low levels of noise pollution, without relevant sources, either industrial or traffic.

It should be noted that considering the Decree number 106/2015, of 9th July, in regards to the acoustic pollution in Galicia, the maximum sound level for industries is 76 to 80 dB. Therefore, the placement of a refinery in this area is expected to increase the noise impacts to local receptors.

3.8.5. Setúbal

The Municipality of Setúbal presents, in the municipal master plan, an acoustic and conflict zoning map of 2021 that includes the proposed area for the proposed lithium refinery.

According to the Municipal Master Plan, the city of Setúbal has a broad transportation network (roads and railways) and a port. It is understandable that all these structures constitute noise pollution sources. Also, other industries based around the site location represent important sources of noise pollution. However, the area of influence of these industries is in a low noise-sensitive occupation which means that they do not cause situations of significant overexposure.

The proposed implementation area for the Setúbal site location is within an unclassified area in terms of acoustic zoning, according to the General Noise Regulation (RGR). Sensitive receptors integrated into non-classified areas are considered as mixed areas in terms of the corresponding noise limit values, however there are no sensitivity receptors in the surroundings of the proposed refinery.

The site location is over an area with Lden values between 55 and 60 dB, which is below the threshold limits (63 dB), and Ln values between 50 and 55 dB, which might be above the threshold limit value, for night period (53 dB). It should be noted that the refinery operations will increment the overall noise values, but will not significantly influence the current values to the sensitivity receptors located at distances of at least 1.3 km from the proposed noise source.

General Noise Regulation	
LDEN ≤ 63 DB(A)	*LN ≤ 53 DB(A)*

Table 3-60 – General Noise Regulation according to Decree-law nº.9/2007 of 17 January

[36] Retrieved from: www.apambiente.pt/ar-e-ruido/mapas-municipais-de-ruido-e-mapas-estrategicos-de-ruido

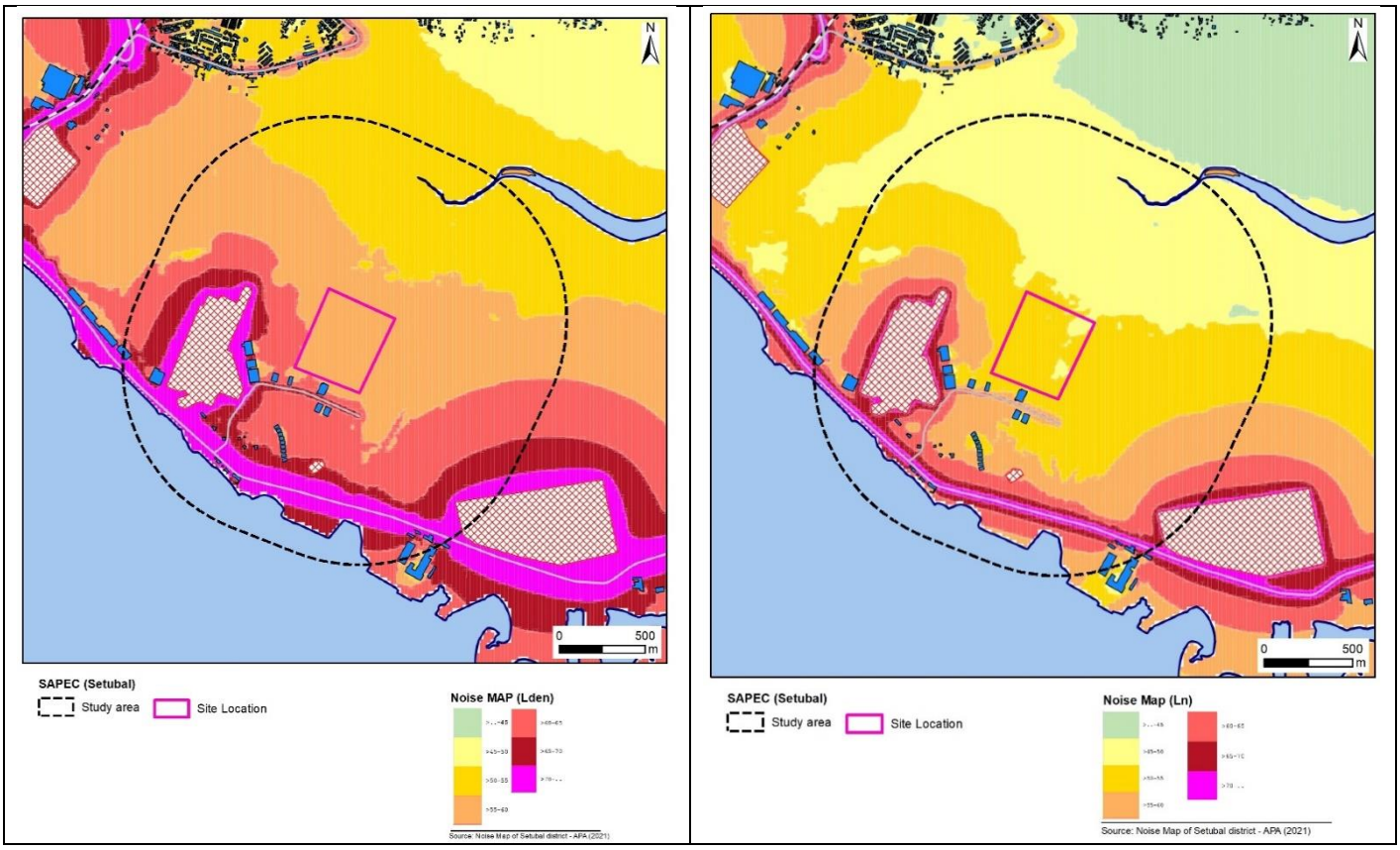


Figure 3-69 – Noise maps in the Study Area (left image represents the Lden Values and right image represents the Ln values) - Setúbal

The zones intercepted by the study area are directly affected by the railway traffic noise sources and the other industries located nearby, which represent the main contributor to noise pollution in the area. Additionally, the proposed placement for the lithium refinery will be in a low noise-sensitive occupation influence area. Therefore, is not expected to dramatically increase the noise impacts to local receptors.

3.8.6. Valongo

The Municipality of Valongo presents, in the municipal master plan, an acoustic and conflict zoning map of 2017 that includes the proposed area for the proposed lithium refinery.

According to the Municipal Master Plan, the city of Valongo has a broad transportation network (roads and railways). It is understandable that all these structures constitute noise pollution sources. Also, other industries and companies based around the site location represent important sources of noise pollution.

The proposed implementation area for the Valongo site location is within an unclassified area in terms of acoustic zoning, according to the General Noise Regulation (RGR). Sensitive receptors integrated into non-classified areas are considered as mixed areas in terms of the corresponding noise limit values.

The site location, which does not include any sensitive receptors, is over an area with Lden values between 0 and 55 dB, which is below the threshold limits (63 dB), and Ln values between 0 and 45 db, also below the threshold limit which might be above the threshold for night period (53 dB).

The closest sensitive receptors (Retorta and Recarei clusters) are currently affected by highway A41 and rail network and the industries located at 300 meters and 750 from the population cluster, respectively. Therefore, the placement of a refinery in this area is not expected to dramatically increase the noise impacts to local receptors.

General Noise Regulation	
LDEN ≤ 63 DB(A)	*LN ≤ 53 DB(A)*

Table 3-61 – General Noise Regulation according to Decree-law nº.9/2007 of 17 January

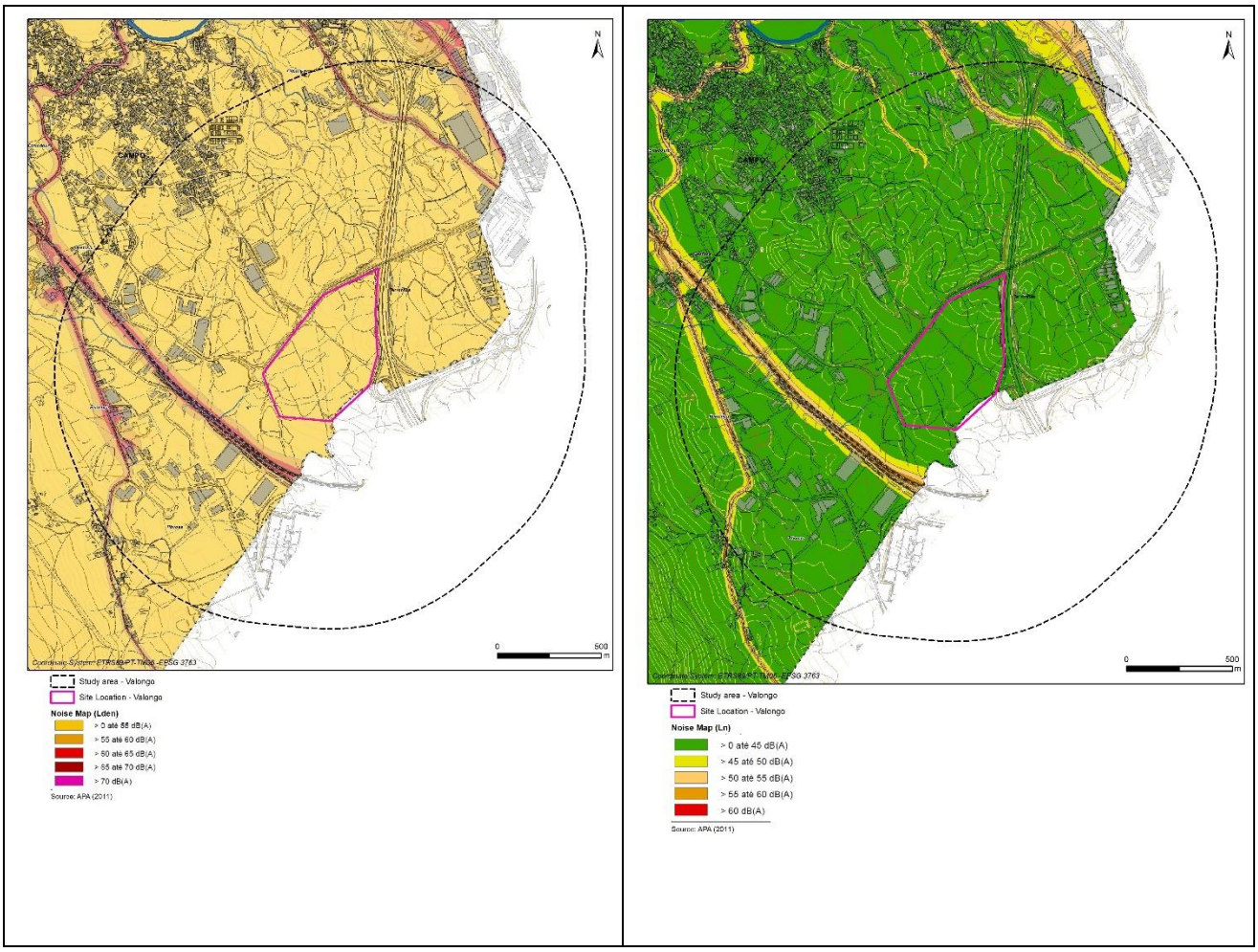


Figure 3-70 – Noise maps in the Study Area (left image represents the Lden Values and right image represents the Ln values) - Valongo

3.8.7. Trofa

The Municipality of Trofa presents, in the municipal master plan, an acoustic and conflict zoning map of 2021 that includes the proposed area for the proposed lithium refinery.

According to the Municipal Master Plan, the city of Trofa has a well stablished transportation network (roads and railways). It is understandable that all these structures constitute noise pollution sources. Besides road traffic circulating on the bordering and nearby roads, namely the A3 and the EN104, the site location is also surrounded by industries and warehouses. Abelheira is the closest population cluster to the site location, about 500 m northwest. Considering this proximity, a noise study is suggested for the next stage gate.

The proposed implementation area for the Trofa site location is within a mixed area in terms of acoustic zoning, according to the General Noise Regulation (RGR).

The site location, which does not include any sensitive receptors, is over an area with Lden values between 45 and 50 dB, which is below the threshold limits (63 dB), and Ln values between 45 and 50 db, also below the threshold limit which might be above the threshold for night period (53 dB).

The closest sensitive receptor (Abelheira cluster) is currently affected by road network and the industries, such as Trofinox, PAM and EGEO located at 150 meters from the population cluster.

It should be noted that the refinery operations will increment the overall noise values but may not significantly influence the current values to the sensitivity of receptors located in the surroundings.

General Noise Regulation	
LDEN ≤ 63 DB(A)	*LN ≤ 53 DB(A)*

Table 3-62 – General Noise Regulation according to Decree-law nº.9/2007 of 17 January

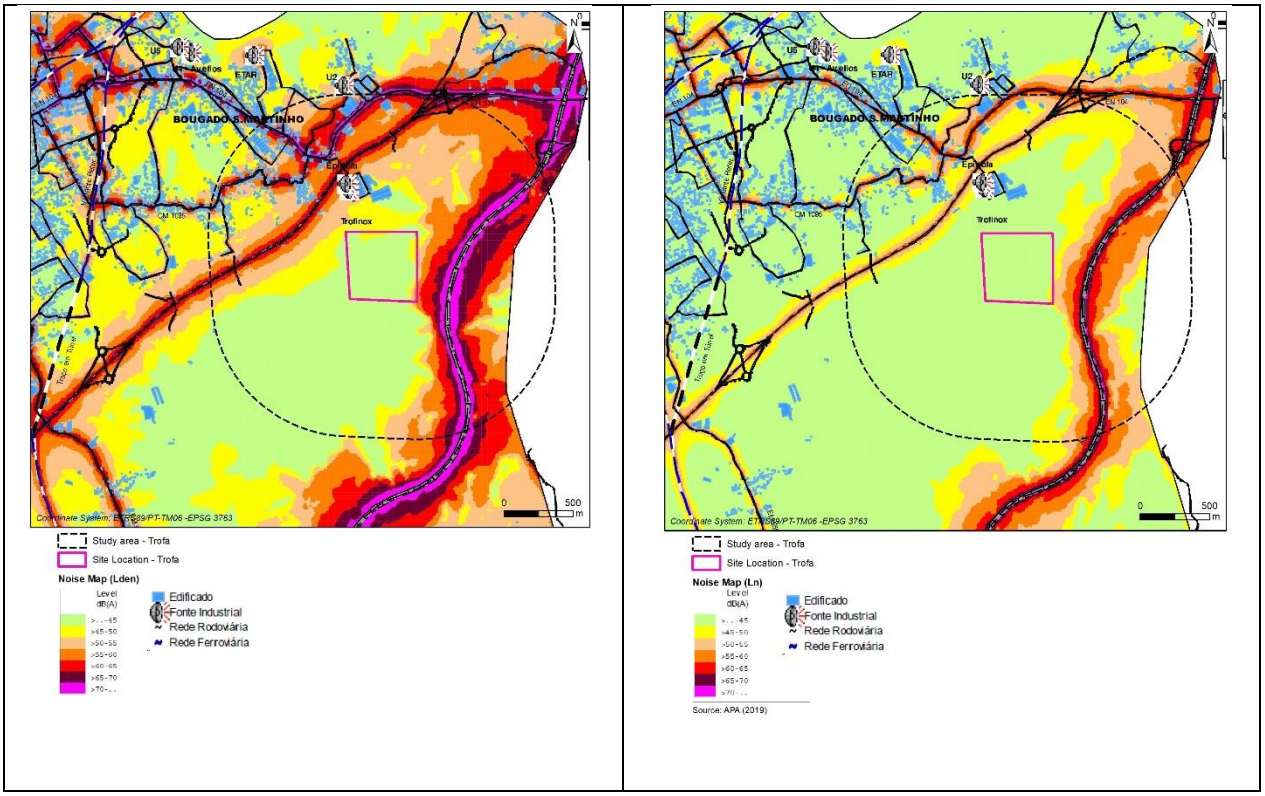


Figure 3-71 – Noise maps in the Study Area (left image represents the Lden Values and right image represents the Ln values) - Trofa

The zones intercepted by the study area are directly affected by the highway traffic noise sources and the other industries located nearby, which represent the main contributor to noise pollution in the area.

3.8.8. Fafe

The Municipality of Fafe presents, in the municipal master plan, an acoustic and conflict zoning map of 2015 that includes the proposed area for the proposed lithium refinery.

According to the Municipal Master Plan, in Fafe, the conflict zones, where the noise levels are greater than the exposure limits, are mainly related to road traffic. The proposed site for the lithium refinery is outside the conflict zones which indicates compliance with noise law.

It should be noted that, although the site location is within a non-conflict area, in terms of noise pollution, there are sensitive receptors in the surroundings of the site location. Doroso and Outeiro are the, less than 200 m north. Also, the Quinta da Areda, a touristic development, is 120 m north and the Aquaplay Swimming Pool is 30 m northwest; and should be referenced as sensitive receptors. Considering this proximity, a noise study is suggested for the next stage gate.

The proposed implementation area for the Fafe site location is within a mixed area in terms of acoustic zoning, according to the General Noise Regulation (RGR).

The site location, which does not include any sensitive receptors, is over an area compliant with the threshold limits Lden (63 dB), and Ln for night period (53 dB).

The closest sensitive receptors (Populations, touristic developments, and public spaces) are currently affected by the industries and business located in the vicinity. The Doroso population and the Aquaplay - Swimming Pool are located at 200 and 500 meters, respectively, from the industrial and business complex.

Worth noting that the refinery operations will increment the overall noise values but will not significantly influence the current values to the sensitivity receptors located in the surroundings.

General Noise Regulation	
LDEN ≤ 63 DB(A)	*LN ≤ 53 DB(A)*

Table 3-63 – General Noise Regulation according to Decree-law nº.9/2007 of 17 January

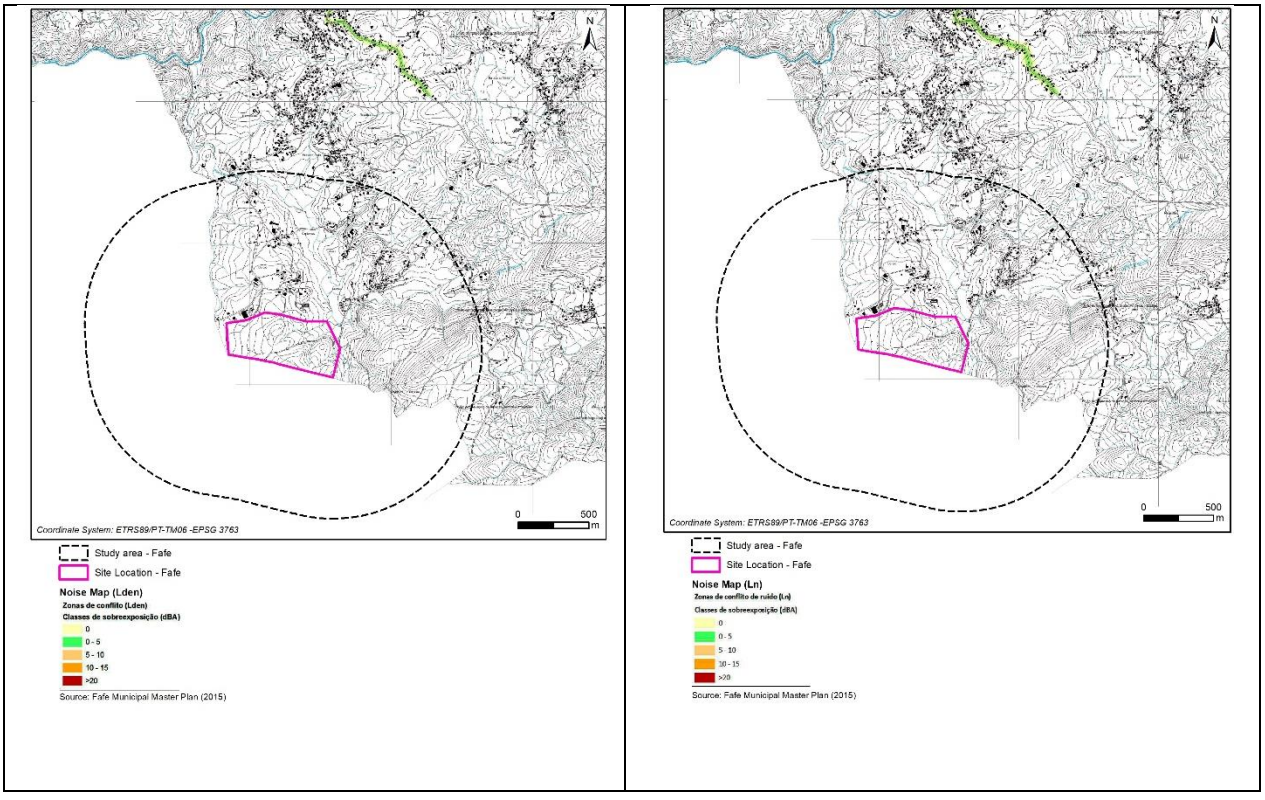


Figure 3-72 – Noise maps in the Study Area (left image represents the Lden Values and right image represents the Ln values) - Fafe

3.9. AIR QUALITY

Category	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
Overview	PM10 and ozone with concentrations higher than the legislated limit values in some periods through the year. Prevailing wind direction from Northwest.	PM10 and ozone with concentrations higher than the legislated limit values in some periods through the year. Prevailing wind direction from North.	PM10 and ozone with concentrations higher than the legislated limit values in some periods through the year. Prevailing wind direction from North.	Ozone with concentrations higher than the legislated limit values in some periods through the year. PM10 not measured, however similarly results to the north of Portugal are expected.	PM10 and ozone with concentrations higher than the legislated limit values in some periods through the year. Prevailing wind direction from North.	PM10 and ozone with concentrations higher than the legislated limit values in some periods through the year. Prevailing wind direction from East.	PM10 and ozone with concentrations higher than the legislated limit values in some periods through the year. Prevailing wind direction from Southwest.	PM10 and ozone with concentrations higher than the legislated limit values in some periods through the year. Prevailing wind direction from Northeast.
Quantitative level	4	1	3	2	1	3	2	3
	• 1 and 10 daily exceedances of PM10 limit value, in 2017 and 2015. • Two important populations clusters, Amorosa and Leça da Palmeira, located within the study area, close to the site limits, with high potential to be considerably affected by the atmospheric emissions from the refinery. • Annual average wind speed of 5.6 $m.s^{-1}$.	• Daily exceedances between 1 and 3 during the last 5 years (with available information). • Small residential area (Outeirinho) located within the study area, with high potential to be considerably affected by the atmospheric emissions from the refinery. • The nearest location downstream of the refinery is 6 km away from it.	• Worst case in terms of PM10 daily exceedances, with more than 20 days with concentrations higher than 50 $\mu g.m^{-3}$ in 3 of the 5 years analysed. • One important population cluster, Póvoa de Cima, located within the study area, with high potential to be considerably affected by the atmospheric emissions from the refinery. • Canedo is very close to the site limits, with high probability of being	• PM10 not measured, however similarly results to the north of Portugal are expected. • Annual average wind speed of 1.0 $m.s^{-1}$. • One important population cluster, Covelo, located within the study area, with high potential to be considerably affected by the atmospheric emissions from the refinery.	• Daily exceedances between 4 and 16 during the last 5 years (with available information). • All the population clusters are located outside the study area, on the north side • Annual average wind speed of 3.0 $m.s^{-1}$.	• Daily exceedances between 1 and 6 during the last 5 years (with available information). • One important population cluster, Campo (800 meters from the site location), located within the study area, with high potential to be considerably affected by the atmospheric emissions from the refinery.	• Daily exceedances between 1 and 7 during the last 5 years (with available information). • Small residential area (Abelheira) located within the study area, with significant potential to be considerably affected by the atmospheric emissions from the refinery. • Annual average wind speed of 3.1 $m.s^{-1}$.	• Daily exceedances between 0 and 8 during the last 5 years (with available information). • Small residential areas (Sardoal and Estrada) located within the study area and a public swimming pool with high potential to be considerably affected by the atmospheric emissions from the refinery.

Category	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
		• Annual average wind speed of 6,0 $m.s^{-1}$.	affected by the refinery emissions. • Annual average wind speed of 5,0 $m.s^{-1}$.	• A Roda e A Lamela also very close to the site limits, with high probability of being affected by the refinery emissions.		• Annual average wind speed of 4.6 $m.s^{-1}$.		• Annual average wind speed of 1.64 $m.s^{-1}$.

Table 3-64 – Characterisation of air quality present in the study area

The refinery's atmospheric pollutant emissions can only have impact on the sensitive receptor through specific meteorological conditions, namely the wind direction and intensity.

The wind speed determines the capacity of dispersion, and consequently the air pollutant transport distance. The wind direction will determine the locations which will be the affected of the polluted plume.

It is important to note that if the source of the emissions is a stack, projecting to the atmosphere at higher velocity rates than the ones legally defined, the plume radius will be higher. This means that, even more distant receptors can be affected by it.

For diffuse emissions the plume radius is smaller, with the higher concentration occurring most likely close to the source.

The main atmospheric emissions from the refinery that must be considered in the analysis is odours and particulate matter.

For particulate matter (PM10) Portugal and Spain have defined limit values for daily concentration (50 µ.m-3) and annual concentration (40 µ.m-3), being, as indicated previously, exceed in all Portuguese locations. For Vigo, no measurements of PM10 have been made in the air quality station. However, being so close to the north of Portugal it is assumed similarly values, which means, concentrations higher that the limit value.

Even though odours don't have a legal value established in Portuguese and Spanish legislation, there are some European reference values which can be used for next phases of the project's impact assessment.

The air quality assessment for the site selection was made using the statistical data available from the Portuguese and Spanish Air Quality Stations Network. The pollutants measured in the air quality stations, don't include PM2.5. Nevertheless, it is an important pollutant considering the refinery emissions, so it is important to include this pollutant in future environmental assessments.

3.9.1. Matosinhos

3.9.1.1.1. Air quality characterisation

The characterisation of the air quality of the study area is made by comparing the concentration values measured at the Meco-Perafita Industrial Suburban Station, located at 2,2 km north of the implementation area, with the values of Decree-Law no. 102/2010, of 23 September, amended by Decree-Law no. No. 43/2015, of March 27, and by Decree-Law No. 47/2017, of May 10. This legal document establishes measures aimed at defining and setting targets relating to the environment's air quality to avoid, prevent or reduce harmful effects on human health and the environment.

The data available at Meco-Perafita Suburban Station only covered SO_2 and PM_{10}, but for the ozone (O_3) and the nitrogen dioxide (NO_2) it was necessary to use other stations has reference due to lack of data available in the Meco-Perafita one.

In this sense, for the nitrogen dioxide (NO_2), it was considered the data available at the Custóias - Matosinhos Suburban Station (5,6 km southeast) for background emissions which lead to the following results.

Regarding the ozone (O_3), the data was retrieved from the Leça do Balio – Matosinhos Suburban Station (6.5 km east) for background emissions which lead to the following results (Figure 3-73).

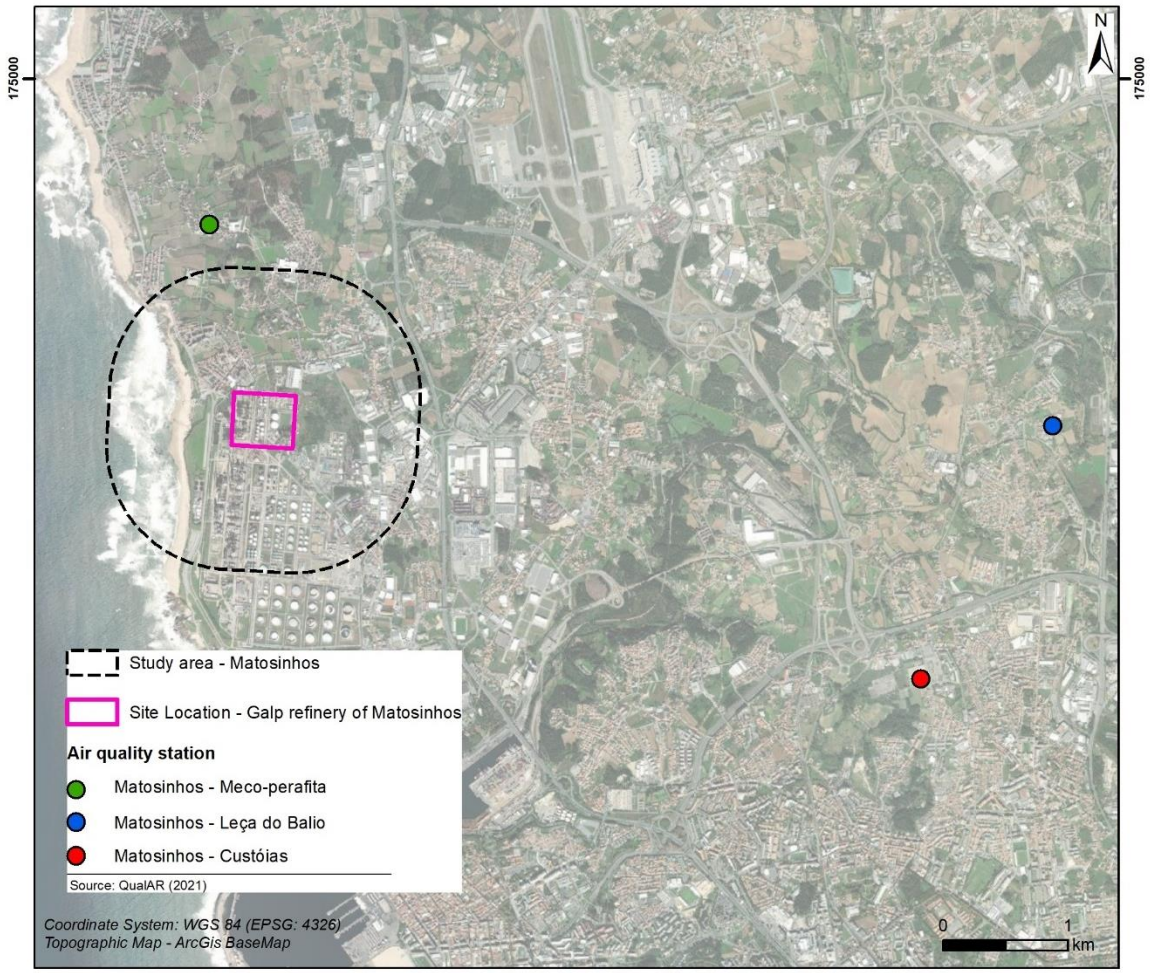


Figure 3-73 – Location of the air quality stations for Matosinhos site location

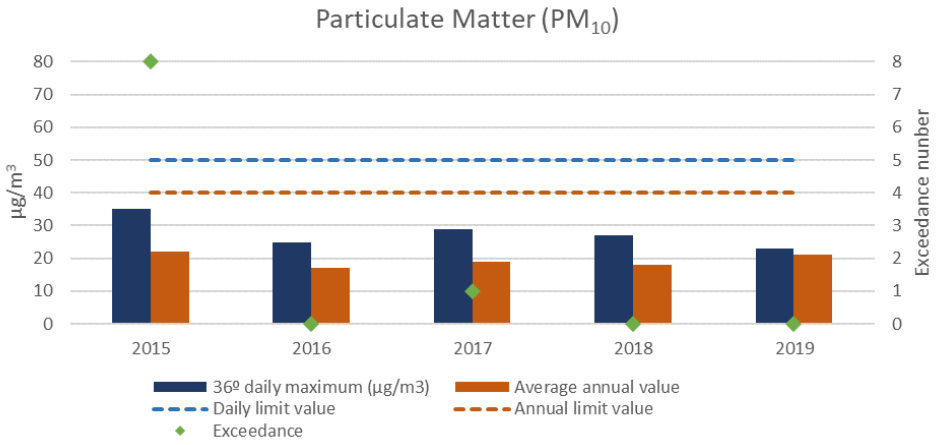


Figure 3-74 – Air quality monitoring in Meco-Perafita Station for PM_{10} (2015-2019)

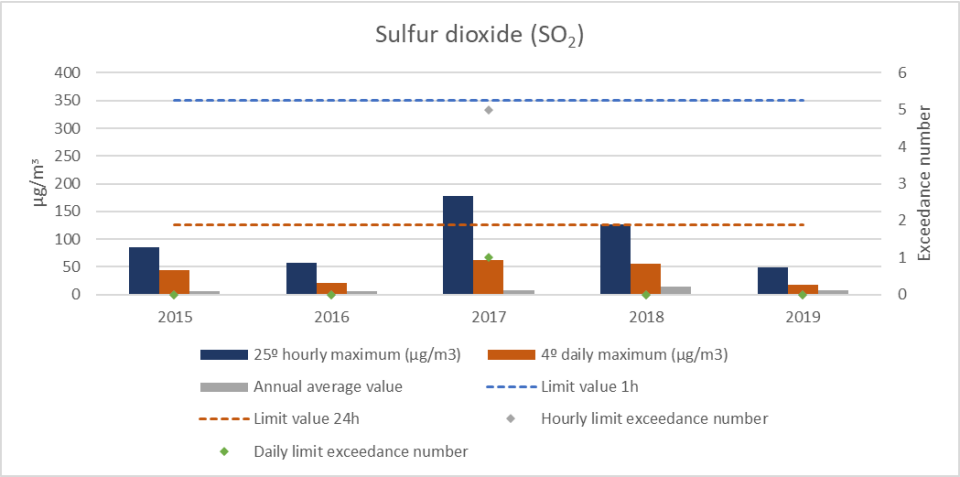


Figure 3-75 – Air quality monitoring in Meco-Perafita Station for SO_2 (2015-2019)

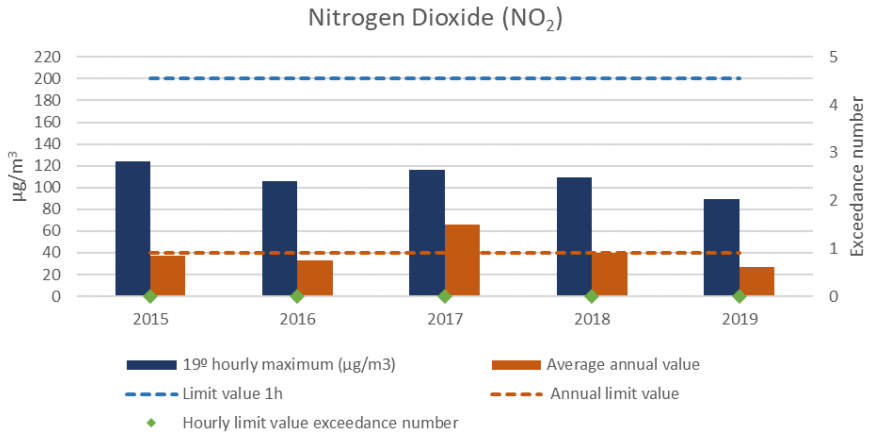


Figure 3-76 – Air quality monitoring in Custóias Station for NO_2 (2015-2019)

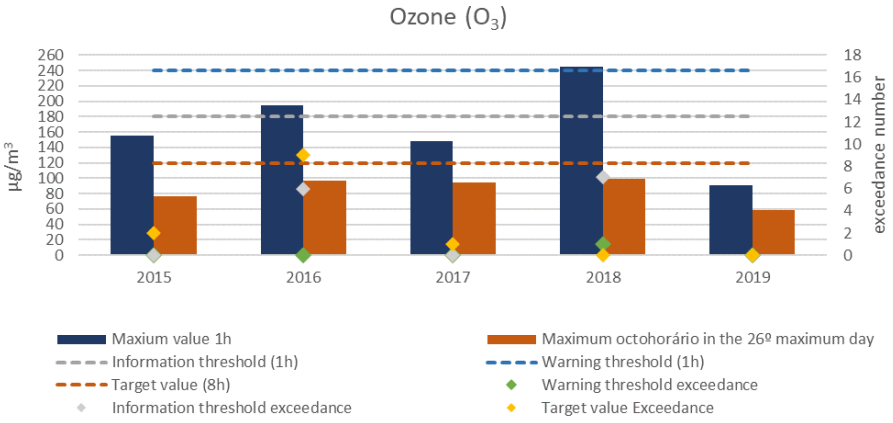


Figure 3-77 – Air quality monitoring in Leça do Balio Station for O_3 (2015-2019)

The monitorization results show that:

- There are exceedances of the daily limit value of PM_{10} in 2015 and 2017. However, these exceedances occur in a number of days inferior than the one legally defined. It also should be noticed that, except for 2015, the 36º maximum value is always inferior to 30 $\mu g.m^{-3}$. The annual averages comply with the annual limit value for all the temporal scope analyzed. Noteworthy that, the PM_{10} emissions result both from human activities and natural sources;
- Regarding the SO_2, the maximum daily and hourly concentrations are lower than respective limit values related to the human health. It is also noticeable that 2017 recorded the highest values for 25º maximum hourly value and 4º maximum daily value, with an exceedance number lower than the legally permitted;
- For NO_2, the maximum hourly concentration is lower than the legally defined limit value related to the human health for all the study years. No exceedances of the hourly limit value were recorded. Regarding the maximum daily average in 2017 and 2018 are higher and equal to the annual limit value, respectively;
- In 2016, the maximum hourly concentration of O_3 is higher than the population information threshold (180 $\mu g.m^{-3}$), but lower than the population warning threshold (240 $\mu g.m^{-3}$). In 2018, both thresholds are exceeded. For the target-value it is possible to verify the compliance with the maximum exceedance number allowed (120 $\mu g.m^{-3}$ on less than 25 days a year) for the analyzed period. For 2019 the maximum hourly concentrations of O_3 were significatively lower than the previous years. It should be noted that, this pollutant is not directly sent out to the atmosphere by local sources as it is produced in atmosphere by the action of solar radiation when combined with NO_2 and VOC's. These are normally from pollution source located further from the place where the ozone is monitored.

The main atmospheric pollutants emitted by the lithium refinery are particulate matter (PM10 and PM2.5),SOx and odour compounds.

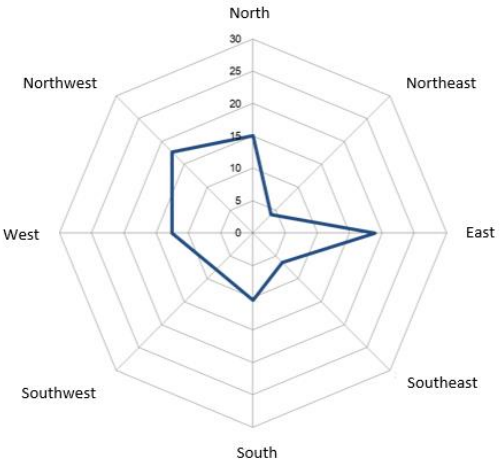
Considering that the study area is already strongly affected by high PM10 concentrations (exceeding the threshold values in 2 of the 5 years analysed), it can be assumed that the contribution of the refinery emissions to air pollution is going to be of little relevance.

The human health of the sensitive receptors of the study area is not currently affected by SO_2, the impact of the refinery in the SO_2 is going to be significant, unless mitigation measures are implemented. It should be noted that, Sox emissions are directly related to the route selected in the Scoping Study (Conventional Direct to Hydroxide).

In terms of odour compounds, it is not known the baseline air quality, however it can be assumed that, considering the proximity of the refinery to the population clusters, and the inexistence of other relevant sources of odour compounds, the impact of the refinery in the odour levels is going to be significant, unless mitigation measures are implemented.

3.9.1.1.2. Air dispersion analysis

Considering that the prevailing direction of the wind in Matosinhos is from east and northwest, the population cluster at southeast, located at about 1 km from the site location boundaries, will be the most exposed to the refinery activity. At west from the refinery stays the ocean.



Parish	Population
Guifões	9495
Leça da Palmeira	18502
Santa Cruz do Bispo	5767
Perafita	13607

Figure 3-78 – Air dispersion analysis on Matosinhos site location

Considering the predominant winds, Leça da Palmeira, with a population density of 18502 inhabitants, will be highly exposed to the atmospheric emissions from the refinery. This applies for odour, PM10 and other atmospheric pollutant that will be emitted during the lifespan of the refinery.

The annual average wind speed of Matosinhos is 20 km/h[37], and annually 7% of the winds are calms (speed <1,0 km/h). It should be noted that highest average wind velocity enhances air circulation, leading to a good dispersion of pollutants.

3.9.2. Sines

3.9.2.1.1. Air quality characterisation

The characterisation of the air quality of the study area is made by comparing the concentration values measured at the Sines Industrial Suburban Station, located at 3.5 km west of the implementation area (Figure 3-79), with the values of Decree-Law no. 102/2010, of 23 September, amended by Decree-Law no. No. 43/2015, of March 27, and by Decree-Law No. 47/2017, of May 10. This legal document establishes measures aimed at defining and setting targets relating to the environment's air quality to avoid, prevent or reduce harmful effects on human health and the environment.

[37] Retrieved from the "Site Data Matosinhos" provided by GALP

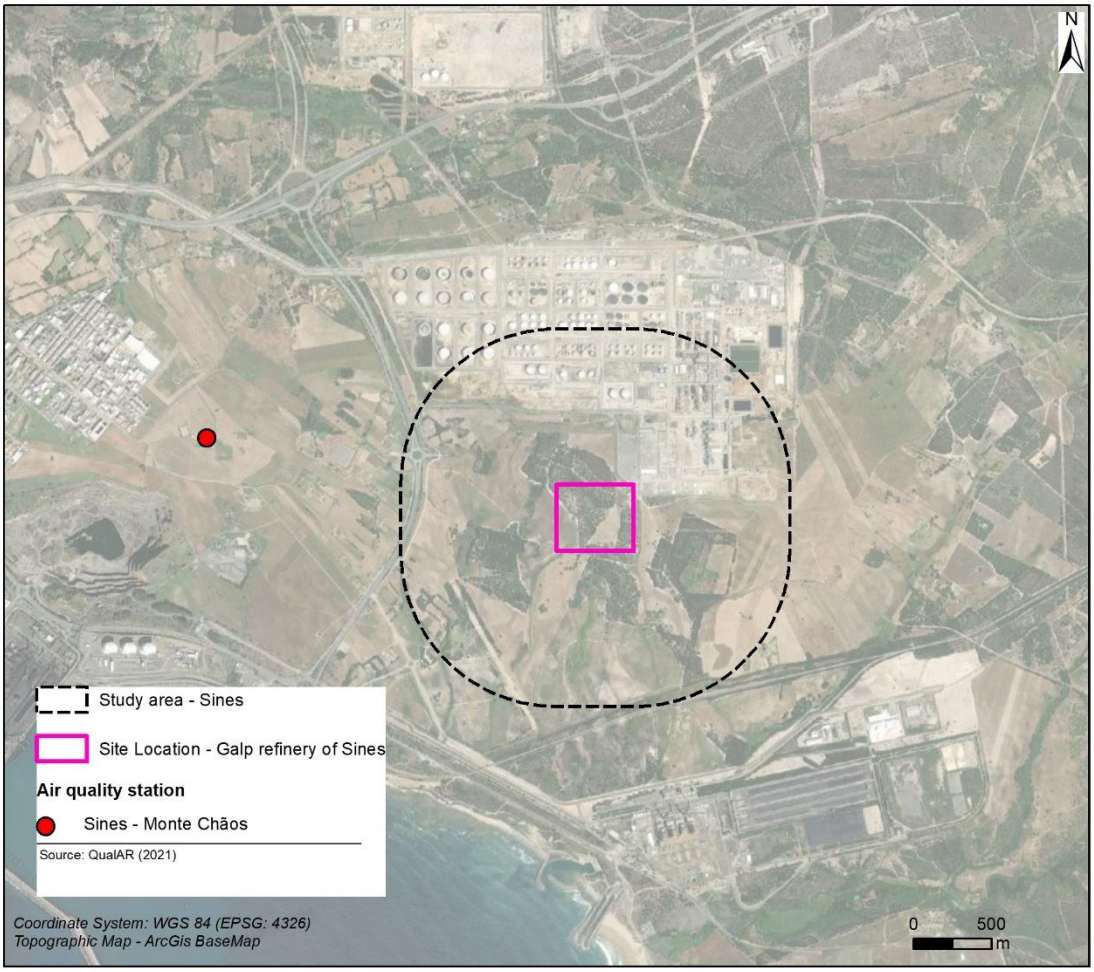


Figure 3-79 – Location of the air quality stations for Sines site location

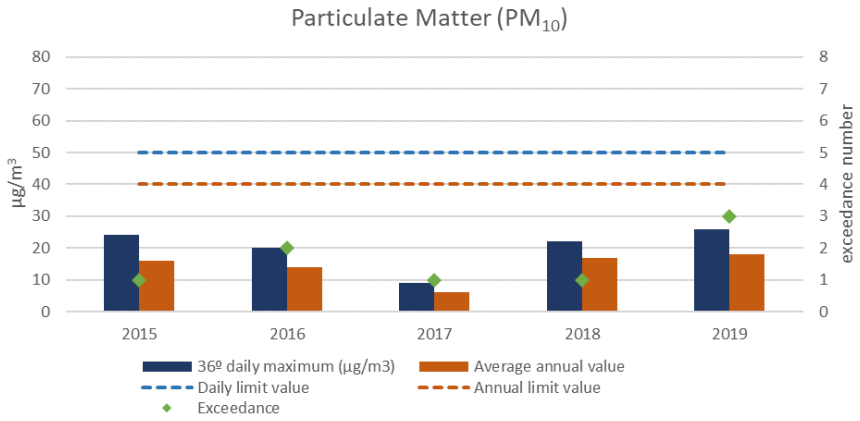


Figure 3-80 – Air quality monitoring in Monte-Chãos Station for PM_{10} (2015-2019)

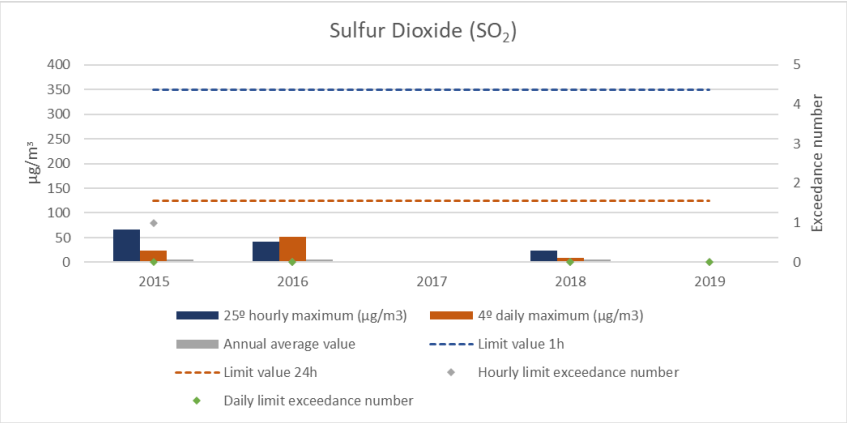


Figure 3-81 – Air quality monitoring in Monte-Chãos Station for SO_2 (2015-2019)

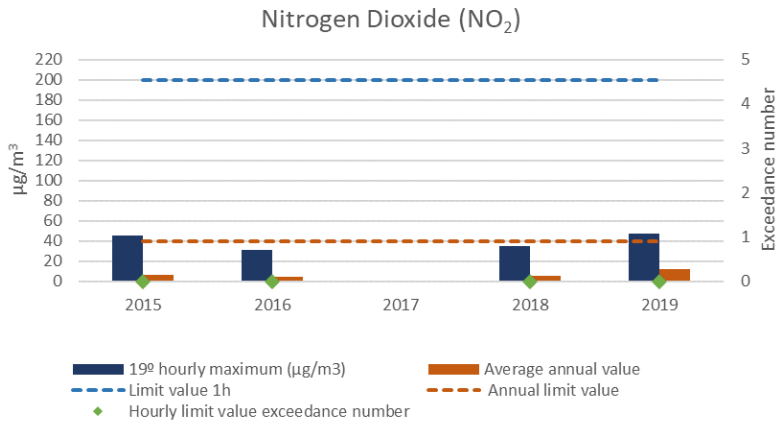


Figure 3-82 – Air quality monitoring in Monte-Chãos Station for NO_2 (2015-2019)

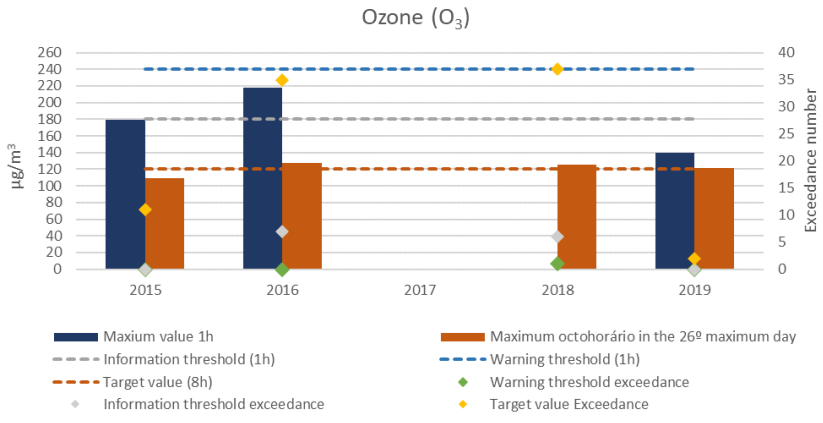


Figure 3-83 – Air quality monitoring in Monte-Chãos Station for O_3 (2015-2019)

The monitorization results show that:

- There are exceedances of the daily limit value of PM_{10} in all the five study years. However, these exceedances occur in a number of days smaller than the one legally defined. It also should be noticed

that, the 36º maximum value is always inferior to 30 µg.m^{-3}. The annual averages comply with the annual limit value for all the temporal scope analyzed. Noteworthy that, the PM_{10} emissions result both from human activities and natural sources;

- Regarding the SO_2, the maximum daily and hourly concentrations are lower than respective limit values related to the human health. It should be noted that for 2017 there is no available data. It is also noticeable that for 2015 there is one exceedance registered which represents a number lower than the legally permitted;
- For NO_2, the maximum hourly and the average annual concentrations are lower than the legally defined limit values related to the human health for all the study years. No exceedances of the hourly limit value were registered. Similarly to SO_2, for the 2017 there is no data available;
- In 2016, the maximum hourly concentration of O_3 is higher than the population information threshold (180 µg.m^{-3}), but lower than the population warning threshold (240 µg.m^{-3}). For the target-value it is possible to verify that it is exceeded in all of the study years, noticing that 2017 does not have available data. Even though for 2015 and 2019 the number of target value exceedance complies with the maximum exceedance number allowed (120 µg.m^{-3} on less than 25 days a year), for 2018 and 2016 that has not happened. It should be noted that this pollutant is not directly sent out to the atmosphere by local sources as it is produced in atmosphere by the action of solar radiation when combined with NO2 and VOC's. These are normally from a pollution source located further from the place where the ozone is monitored.

The main atmospheric pollutants emitted by the lithium refinery are particulate matter (PM10 and PM2.5),SOx and odour compounds.

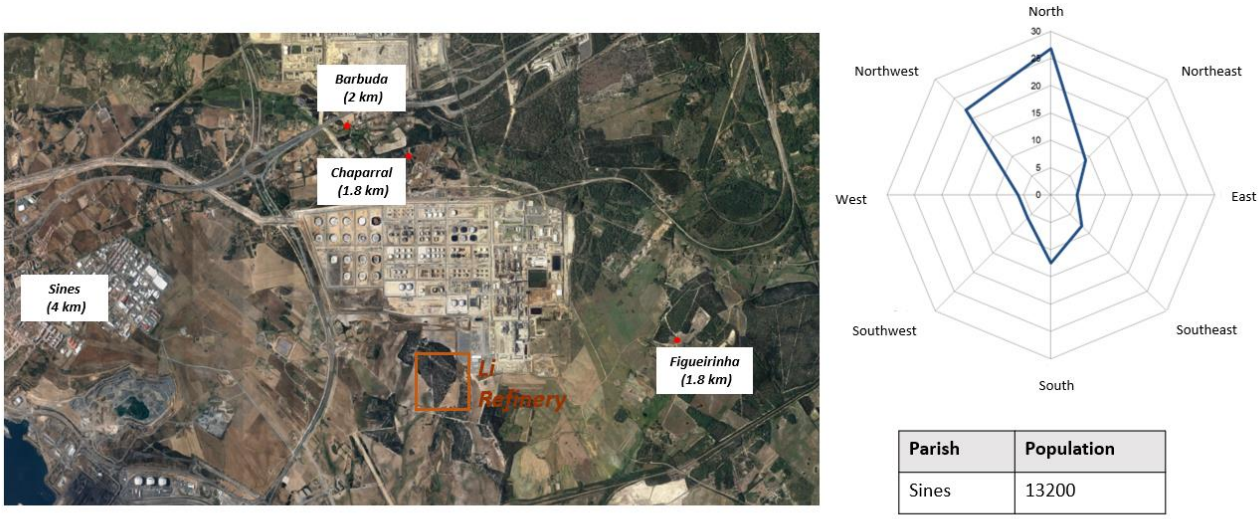
Considering that the study area is already strongly affected by high PM10 concentrations (exceeding the threshold in all the analysed period), it can be assumed that the contribution of the refinery emissions to air pollution is going to be of little relevance.

The human health of the sensitive receptors of the study area is not currently affected by SO_2, the impact of the refinery in the SO_2 is going to be significant, unless mitigation measures are implemented. It should be noted that, Sox emissions are directly related to the route selected in the Scoping Study (Conventional Direct to Hydroxide).

In terms of odour compounds, it is not known the baseline air quality, however it can be assumed that, considering the distance of the refinery to the population clusters, and the inexistence of other relevant sources of odour compounds, the impact of the refinery in the odour levels is going to be moderate to reduced, if mitigation measures are implemented.

3.9.2.1.2. Air dispersion analysis

Considering that the prevailing direction of the wind in Sines is from Northwest, similar to the Matosinhos case, the population cluster at southeast will be the most exposed to the refinery activity.



Parish	Population
Sines	13200

Figure 3-84 – Air dispersion analysis on Sines site location

In this specific case, considering the predominant winds, there is one small residential area, called Figuerinha, located at 1.8 km from the refinery limits, which might be exposed to the refinery emissions.

The average wind speed of Sines varies between 12 km/h and 18 km/h[38]. It should be noted that highest average wind velocity enhances air circulation, leading to a good dispersion of pollutants.

3.9.3. Estarreja

3.9.3.1.1. Air quality characterisation

The characterisation of the air quality of the study area is made by comparing the concentration values measured at the Estarreja Suburban Station for background emissions, located at 2.6 km southeast of the implementation area (Figure 3-85), with the values of Decree-Law no. 102/2010, of 23 September, amended by Decree-Law no. No. 43/2015, of March 27, and by Decree-Law No. 47/2017, of May 10. This legal document establishes measures aimed at defining and setting targets relating to the environment's air quality to avoid, prevent or reduce harmful effects on human health and the environment.

[38] Climatological Normal of Sines (1971-2000). Values consulted in the Refinery dispersion study for SO2 emissions (2014)

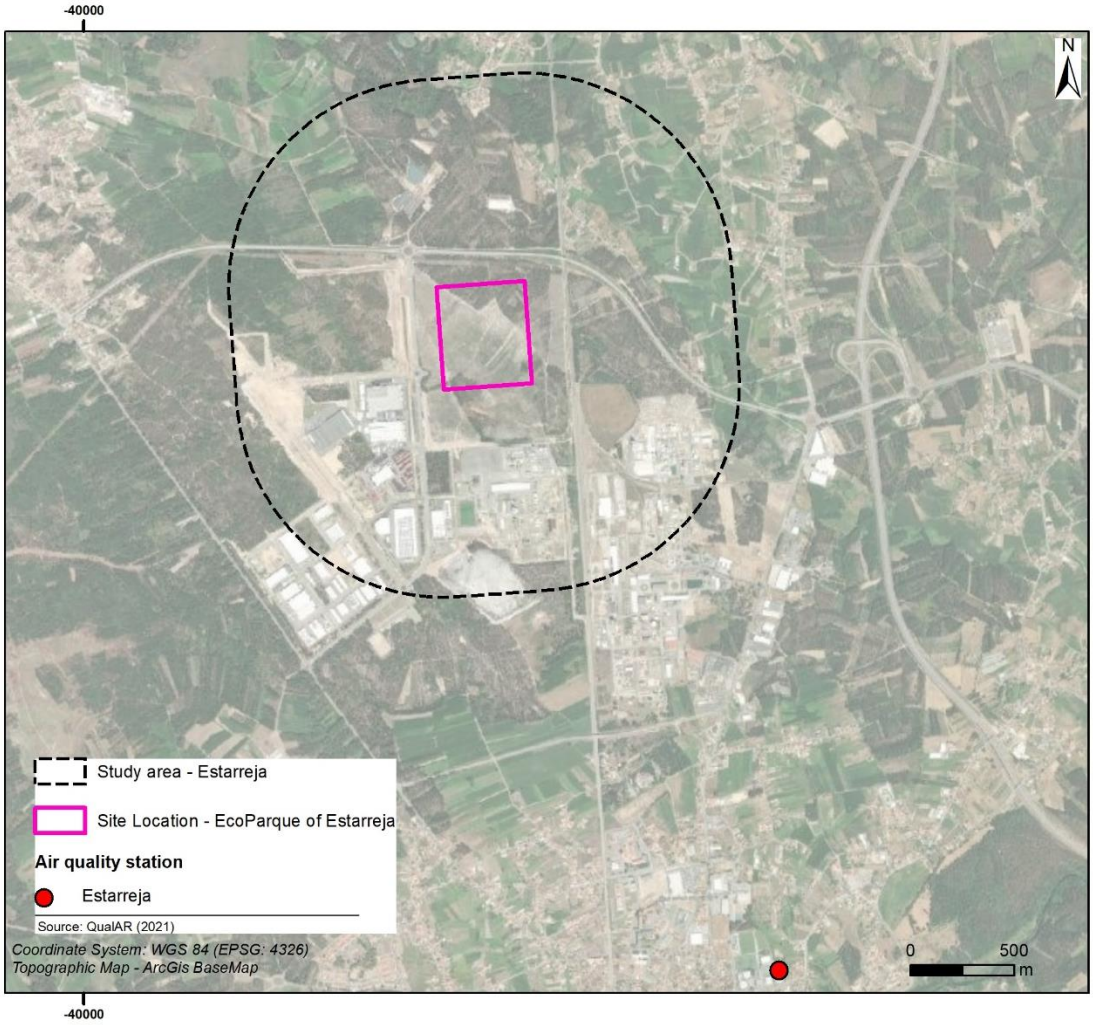


Figure 3-85 – Location of the suburban air quality station for Estarreja site location

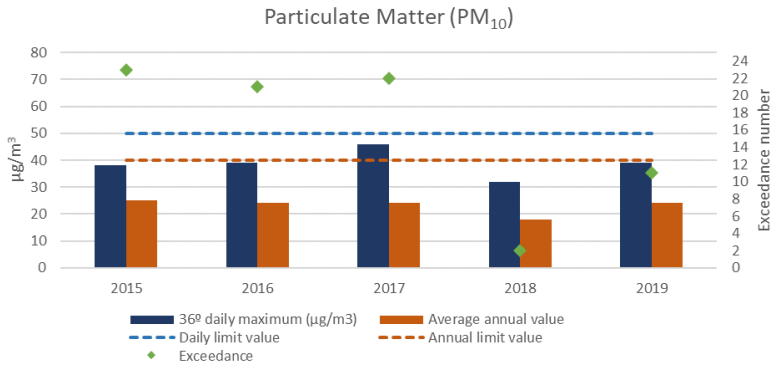


Figure 3-86 – Air quality monitoring in Estarreja Station for PM_{10} (2015-2019)

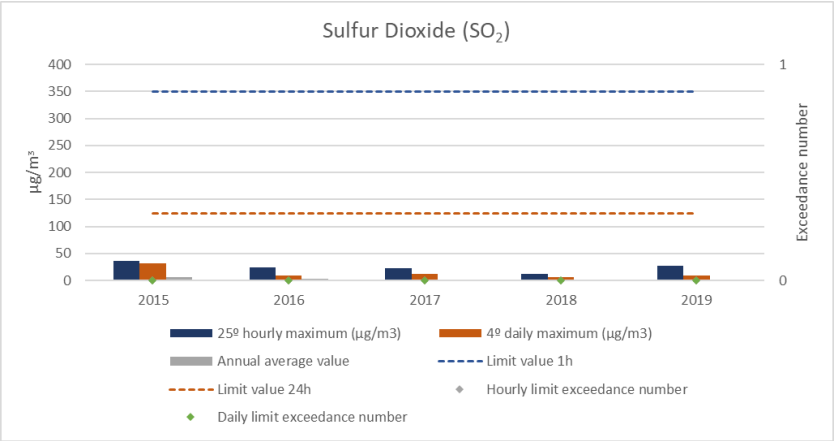


Figure 3-87 – Air quality monitoring in Estarreja Station for SO_2 (2015-2019)

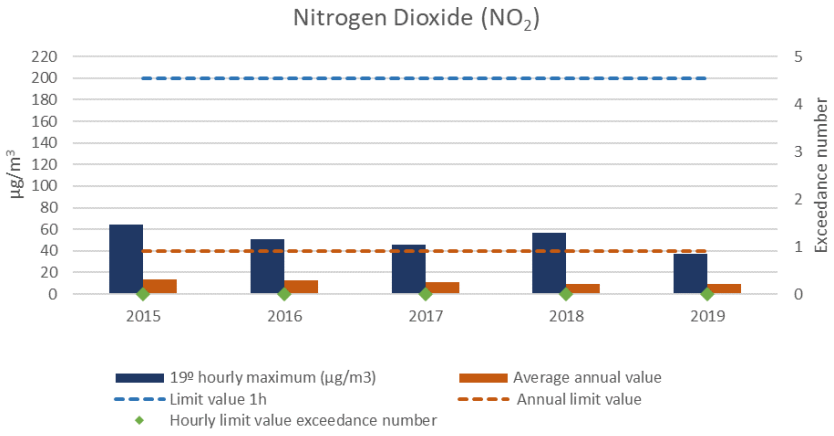


Figure 3-88 – Air quality monitoring in Estarreja Station for NO_2 (2015-2019)

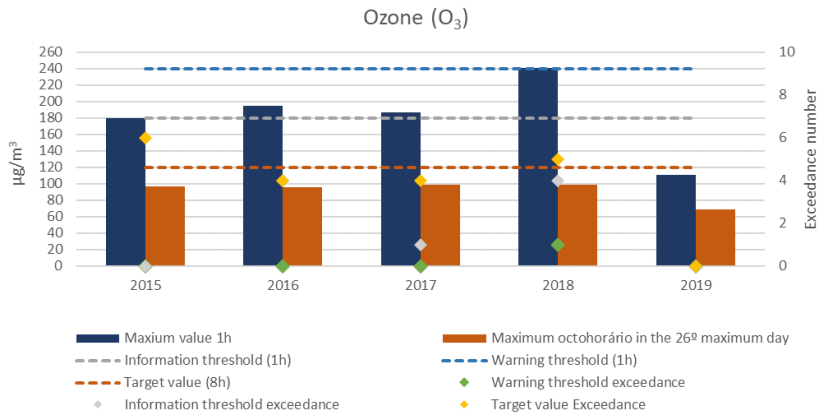


Figure 3-89 – Air quality monitoring in Estarreja Station for O_3 (2015-2019)

The monitorization results show that:

- There are exceedances of the daily limit value of PM_{10} in all the five study years. However, these exceedances occur in a number of days smaller than the one legally defined. The annual averages

comply with the annual limit value for all the temporal scope analyzed. Noteworthy that, the PM_{10} emissions result both from human activities and natural sources;

- Regarding the SO_2, the maximum daily and hourly concentrations are lower than respective limit values related to the human health. It is also noticeable that there is no exceedance registered for any of the five years in study;
- For NO_2, the maximum hourly and the average annual concentrations are lower than the legally defined limit values related to the human health for all the study years. No exceedances of the hourly limit value were registered;
- In 2016 and 2017, the maximum hourly concentration of O_3 is higher than the population information threshold (180 $\mu g.m^{-3}$), but lower than the population warning threshold (240 $\mu g.m^{-3}$). In 2018, both thresholds are exceeded. For the target-value it is possible to verify that it is exceeded in all of the study years, except for 2019. The number of target value exceedance complies with the maximum exceedance number allowed (120 $\mu g.m^{-3}$ on less than 25 days a year), for all the study years that had exceedances. It should be noted that this pollutant is not directly sent out to the atmosphere by local sources as it is produced in atmosphere by the action of solar radiation when combined with NO2 and VOC's. These are normally from pollution sources located further from the place where the ozone is monitored.

The main atmospheric pollutants emitted by the lithium refinery are particulate matter (PM10 and PM2.5),SOx and odour compounds.

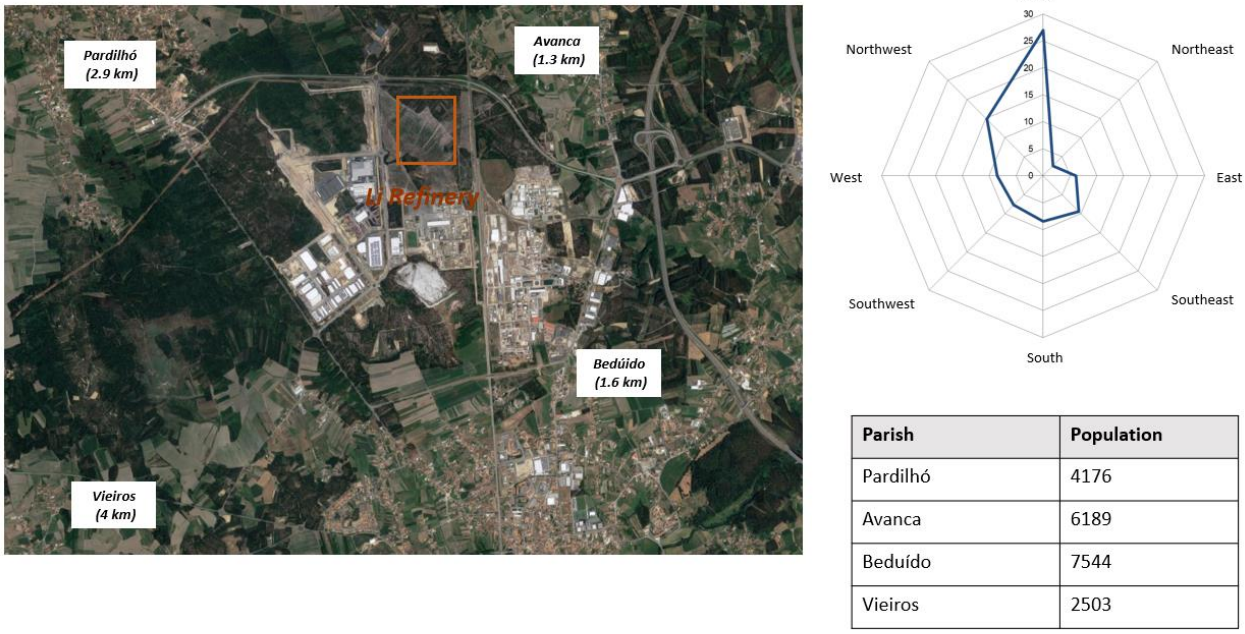
Considering that the study area is already strongly affected by high PM10 concentrations (exceeding the threshold values in all the analysed period), it can be assumed that the contribution of the refinery emissions to air pollution is going to be of little relevance.

The human health of the sensitive receptors of the study area is not currently affected by SO_2, the impact of the refinery in the SO_2 is going to be significant, unless mitigation measures are implemented. It should be noted that, Sox emissions are directly related to the route selected in the Scoping Study (Conventional Direct to Hydroxide).

In terms of odour compounds, it is not known the baseline air quality, however it can be assumed that, considering the proximity of the refinery to the population clusters, and the inexistence of other relevant sources of odour compounds, the impact of the refinery in the odour levels is going to be significant, unless mitigation measures are implemented.

3.9.3.1.2. Air dispersion analysis

Considering that the prevailing direction of the wind in Estarreja is from North and Northwest, the population cluster at south and southeast will be the ones more exposed to the pollutant's transportation through dispersion.



Parish	Population
Pardilhó	4176
Avanca	6189
Beduído	7544
Vieiros	2503

Figure 3-90 – Air dispersion analysis on Estarreja site location

Considering the predominant winds, Beduído, with a population density of 7544 inhabitants, will be highly exposed to the atmospheric emissions from the refinery. This applies for odour, PM10 and other atmospheric pollutant that will be emitted during the lifespan of the refinery.

The annual average wind speed of Estarreja is 18 km/h[39]. It should be noted that highest average wind velocity enhances air circulation, leading to a good dispersion of pollutants.

3.9.4. Vigo

3.9.4.1.1. Air quality characterisation

The characterisation of the air quality of the study area is made by comparing the concentration values measured at the Ponteareas Suburban Station for background emissions, located at 10.3 km west of the implementation area (Figure 3-91), with the values of Decree-Law 102/2011, of January 28, amended by Decree-Law 39/2017, of January 27. This legal document establishes measures aimed at defining and setting targets relating to the environment's air quality to avoid, prevent or reduce harmful effects on human health and the environment.

There were no measurements of PM10 in the air quality station, and there were no other stations to be used as complementary.

[39] Retrieved from the "Estudo de Impacte Ambiental – Projeto de infraestruturas da ampliação do Eco-Parque empresarial de Estarreja"

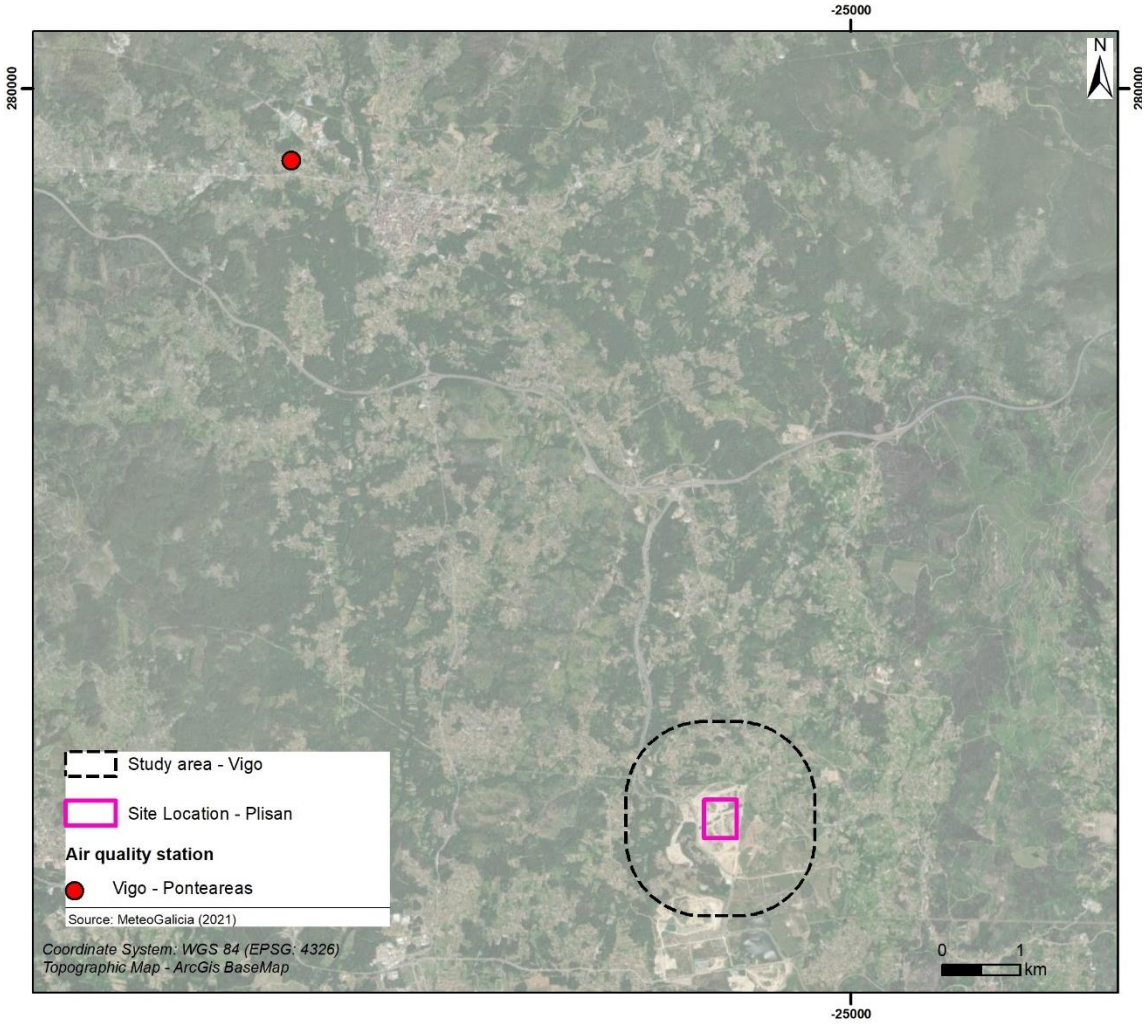


Figure 3-91 – Location of the air quality stations for Vigo site location

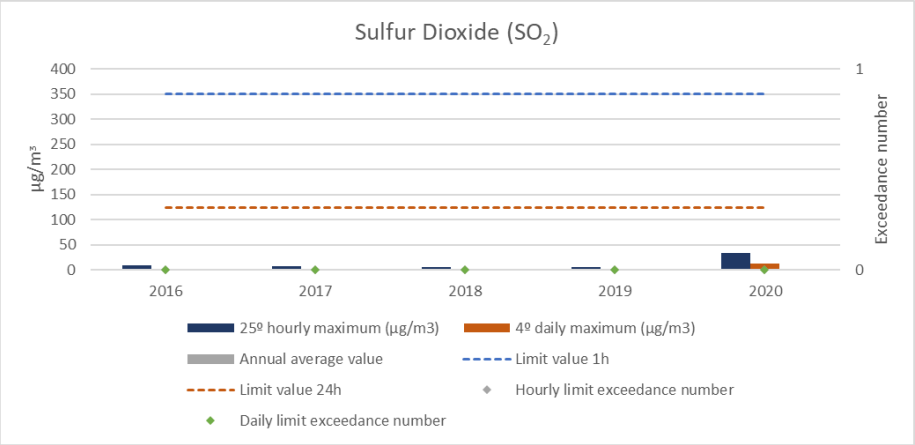


Figure 3-92 – Air quality monitoring in Ponteareas Station for SO_2 (2016-2020)

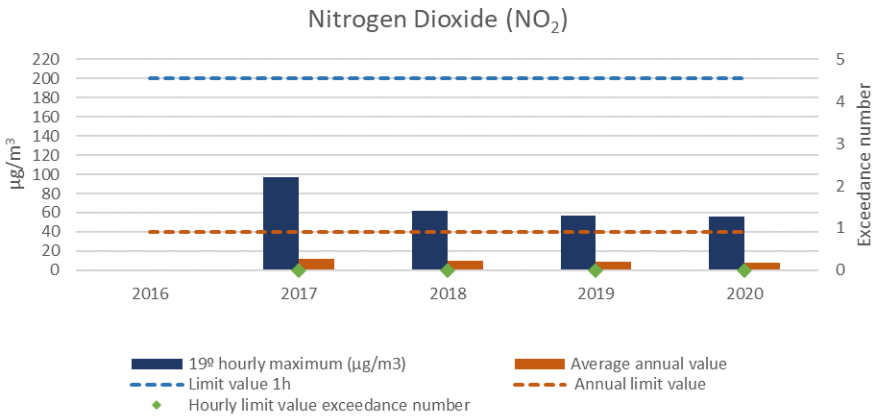


Figure 3-93 – Air quality monitoring in Ponteareas Station for NO_2 (2016-2020)

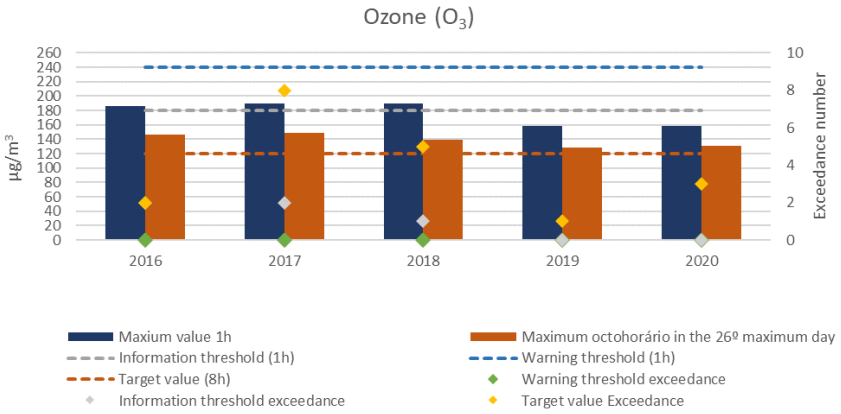


Figure 3-94 – Air quality monitoring in Ponteareas Station for O_3 (2016-2020)

The monitorization results show that:

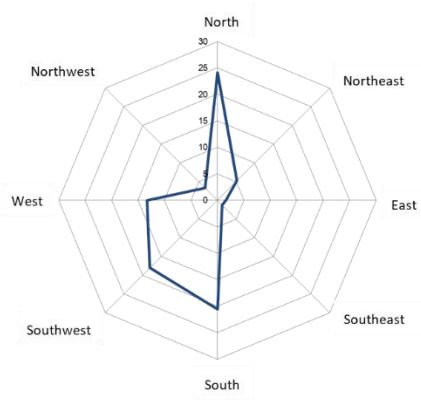
- Regarding the SO_2, the maximum daily and hourly concentrations are lower than respective limit values related to the human health. It is also noticeable that there is no exceedance registered for any of the five years in study;
- For NO_2, the maximum hourly and the average annual concentrations are lower than the legally defined limit values related to the human health for all the study years. No exceedances of the hourly limit value were registered;
- In 2016, 2017 and 2018, the maximum hourly concentration of O_3 is higher than the population information threshold (180 µg.m^{-3}), but lower than the population warning threshold (240 µg.m^{-3}). For the target-value it is possible to verify that it is exceeded in all of the study years, however the number of target value exceedance complies with the maximum exceedance number allowed (120 µg.m^{-3} on less than 25 days a year), for all the study years;
- It should be noted that, this pollutant is not directly sent out to the atmosphere by local sources as it is produced in atmosphere by the action of solar radiation when combined with NO2 and VOC's. These are normally from pollution sources located further from the place where the ozone is monitored.

The main atmospheric pollutants emitted by the lithium refinery are particulate matter (PM10 and PM2.5),SOx and odour compounds.

Considering that the study area is potentially affected by high PM10 concentrations, taking into account the air quality conditions of the north of Portugal, it can be assumed that the contribution of the refinery emissions to air pollution is going to be of little relevance.
The human health of the sensitive receptors of the study area is not currently affected by SO_2, the impact of the refinery in the SO_2 is going to be significant, unless mitigation measures are implemented. It should be noted that, Sox emissions are directly related to the route selected in the Scoping Study (Conventional Direct to Hydroxide).In terms of odour compounds, it can be assumed that, considering the proximity of the refinery to the population clusters, and the inexistence of other relevant sources of odour compounds, the impact of the refinery in the odour levels is going to be significant, unless mitigation measures are implemented.

3.9.4.1.2. Air dispersion analysis

Considering that the prevailing direction of the wind in Pontevedra is from North, South and Southwest[40], the population cluster at northeast will be the ones more exposed to the pollutant's transportation through dispersion.



Municipality	Population
Pontevedra	954877

Figure 3-95 – Air dispersion analysis on Vigo site location

Considering the predominant winds, the population clusters of A Roda, Nogueiró and Covelo, within the study area, have a higher potential to be considerably affected by the atmospheric emission from the refinery. This applies for odour, PM10 and other atmospheric pollutant that will be emitted during the lifespan of the refinery.

The annual average wind speed of Pontevedra is 3,6 km/h[41]. It should be noted that highest average wind velocity enhances air circulation, leading to a good dispersion of pollutants.

[40] Climatological normal (1995-2004) for Vigo, consulted in the Masterplan of Vigo Airport (AENA)
[41] Calculated from the "Histórico de la estación Meder. Salvaterra do Miño. Pontevedra" 2011-2020 (https://www.meteogalicia.gal/observacion/estacionshistorico/consultar.action)

3.9.5. Setúbal

3.9.5.1.1. Air quality characterization

The characterization of the air quality of the study area is made by comparing the concentration values measured at the Arcos Urban Station, located at 6.7 km northwest of the implementation area and Quebedo Traffic Urban Station, located at 6 km northwest (Figure 3-79), with the values of Decree-Law no. 102/2010, of 23 September, amended by Decree-Law no. No. 43/2015, of March 27, and by Decree-Law No. 47/2017, of May 10. This legal document establishes measures aimed at defining and setting targets relating to the environment's air quality to avoid, prevent or reduce harmful effects on human health and the environment.

It should be noted that the Camarinha Urban Station is the closest to the proposed site location (5 km), however air quality data is not available for this station.

The data available at Arcos Urban Station only covered NO_2, PM_{10}, and ozone (O_3), so, for the sulfur dioxide (SO_2) it was necessary to use the Quebedo Traffic Urban Station as a reference due to the lack of data available in the Arcos station. Normally, it is not good to use a traffic station to characterize the air quality in a region, because these stations have small representativeness, however, in Portugal, mobile combustion is not responsible for relevant emissions of SO_2, once fuels have limitation on sulfur content of 1%. Therefore, the measured concentrations have contribution of other sources than traffic, like industries.

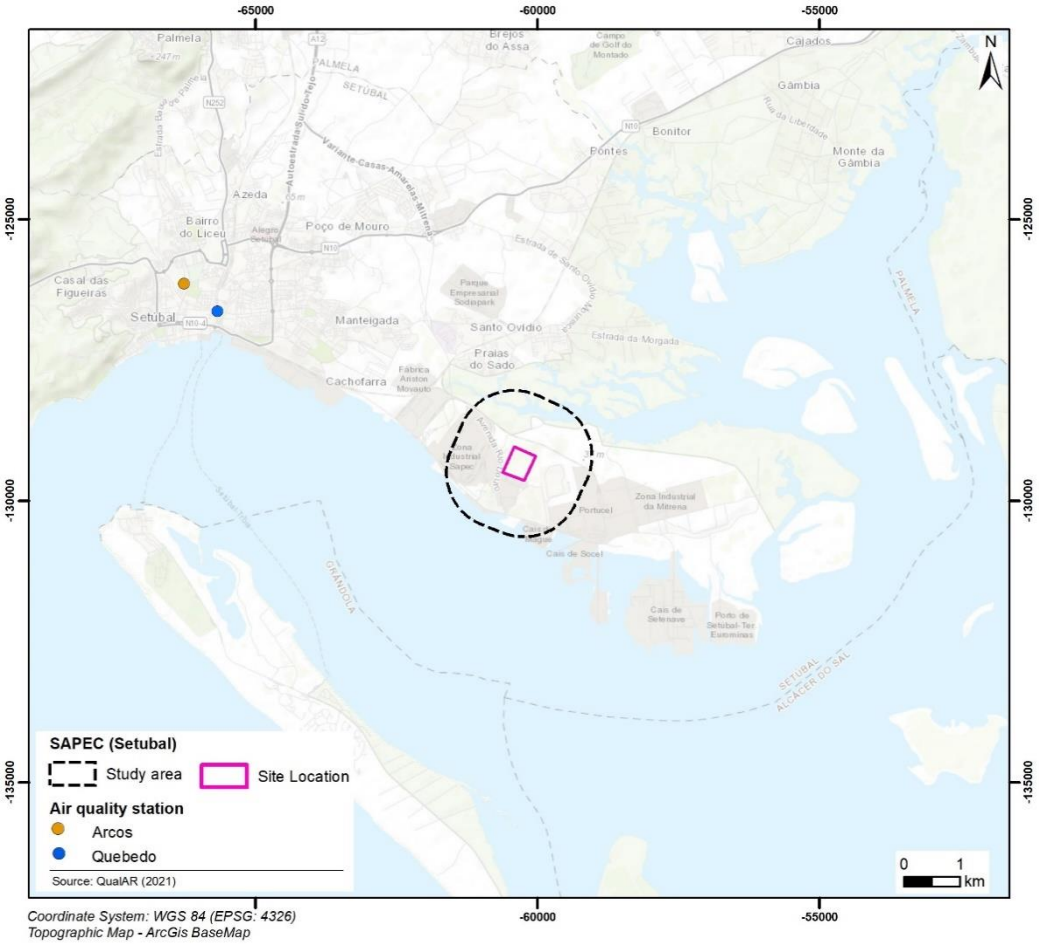


Figure 3-96 – Location of the air quality stations for Setúbal site location

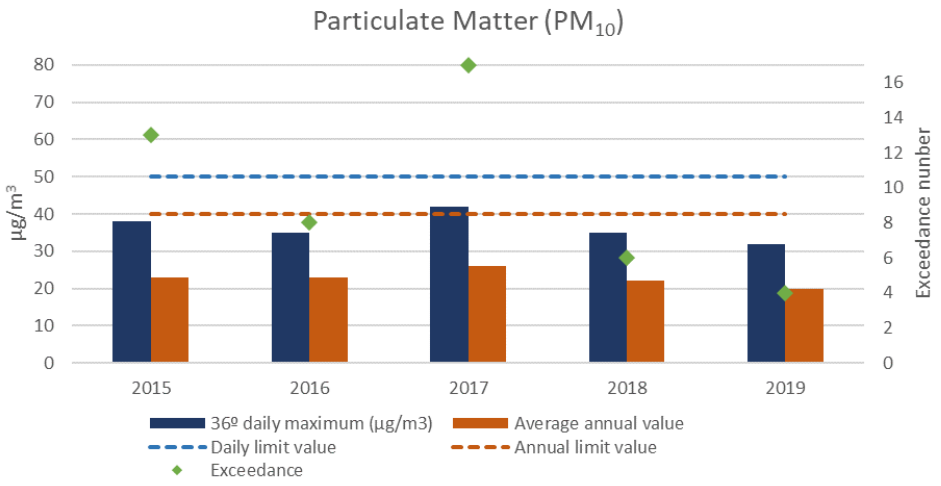


Figure 3-97 – Air quality monitoring in Arcos Station for PM_{10} (2015-2019)

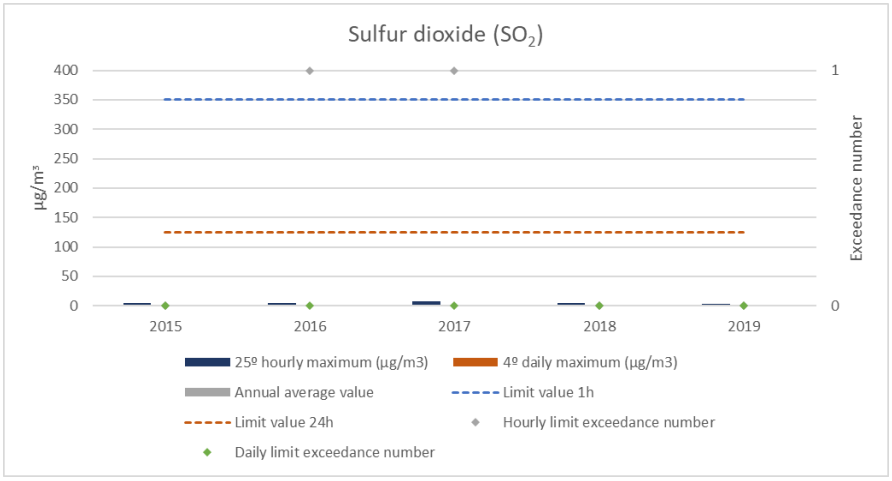


Figure 3-98 – Air quality monitoring in Quebedo Station for SO_2 (2015-2019)

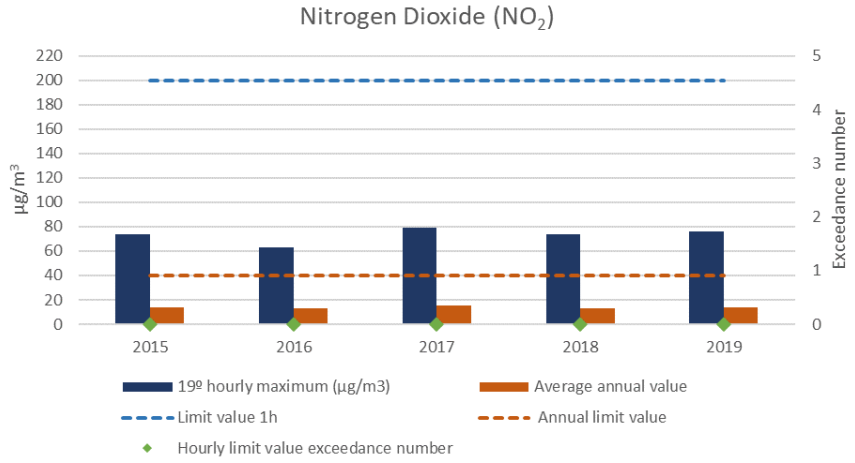


Figure 3-99 – Air quality monitoring in Arcos Station for NO_2 (2015-2019)

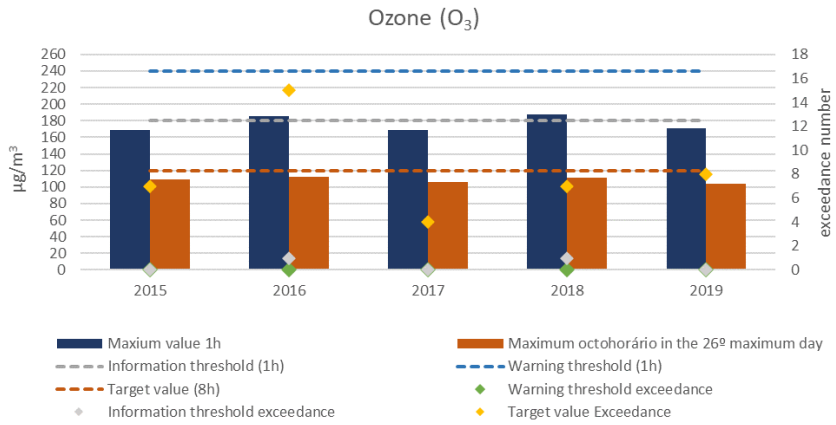


Figure 3-100 – Air quality monitoring in Arcos Station for O_3 (2015-2019)

The monitorization results show that:

- There are exceedances of the daily limit value of PM_{10} in all five study years. However, these exceedances occur in a number of days smaller than the one legally defined. It also should be noticed that the 36º maximum value is always higher than 30 µg.m^{-3}. The annual averages comply with the annual limit value for all the temporal scope analyzed. Noteworthy that, the PM_{10} emissions result both from human activities and natural sources;
- Regarding the SO_2, the maximum daily and hourly concentrations are lower than respective limit values related to human health. It is noticeable that for 2016 and 2017 there is one exceedance registered which represents a number lower than the legally permitted;
- For NO_2, the maximum hourly and the average annual concentrations are lower than the legally defined limit values related to human health for all the study years. No exceedances of the hourly limit value were registered;
- In 2016 and 2018, the maximum hourly concentration of O_3 is higher than the population information threshold (180 µg.m^{-3}) but lower than the population warning threshold (240 µg.m^{-3}). For the target value, it is possible to verify that it is exceeded in all of the study years. The number of target value exceedance complies with the maximum exceedance number allowed (120 µg.m^{-3} on less than 25 days a year) for all the study scope. It should be noted that this pollutant is not directly sent out to the atmosphere by local sources as it is produced in the atmosphere by the action of solar radiation when combined with NO2 and VOC's. These are normally from a pollution source located further from the place where the ozone is monitored.

The main atmospheric pollutants emitted by the lithium refinery are particulate matter (PM10 and PM2.5), SOx and odour compounds.

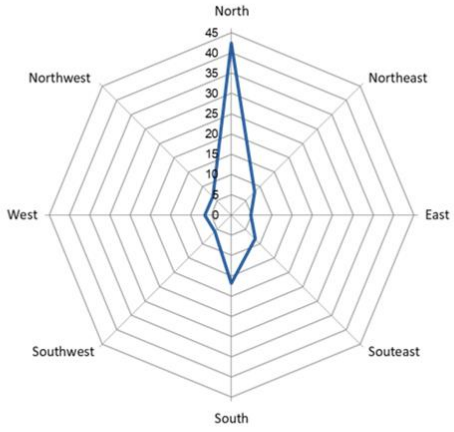
Considering that the study area is already strongly affected by high PM10 concentrations (exceeding the threshold in all the analysed periods), it can be assumed that the contribution of the refinery emissions to air pollution is going to be of little relevance.

The human health of the sensitive receptors of the study area is not currently affected by pollution in terms of SO_2, therefore the impact of the refinery on SO_2 is going to be significant unless mitigation measures are implemented. It should be noted that SOx emissions are directly related to the route selected in the Scoping Study (Conventional Direct to Hydroxide).

The baseline air quality is not known in terms of odour compounds, however, considering the proximity to a pulp and paper factory it can be assumed that the population clusters are potentially already affected by odours. The refinery should, in order to minimize cumulative impacts, implement mitigation measures.

3.9.5.1.2. Air dispersion analysis

Considering that the prevailing direction of the wind in Setúbal is from the north, the population cluster at the south will be the most exposed to the refinery activity.



Municipality	Population
Setúbal	91 000

Figure 3-101 – Air dispersion analysis on Setúbal site location

In this specific case, there is no population located on the south side of the refinery limits.

The average wind speed[42] of Setúbal varies between 9 km/h and 13 km/h. It should be noted that the highest average wind velocity enhances air circulation leading to good dispersion of potential pollutants.

3.9.6. Valongo

3.9.6.1.1. Air quality characterization

The characterisation of the air quality of the study area is made by comparing the concentration values measured at the Ermesinde-Valongo Urban Station, located at 9.4 km north-west of the implementation area, with the values of Decree-Law no. 102/2010, of 23 September, amended by Decree-Law no. No. 43/2015, of March 27, and by Decree-Law No. 47/2017, of May 10. This legal document establishes measures aimed at defining and setting targets relating to the environment's air quality to avoid, prevent or reduce harmful effects on human health and the environment.

[42] Climatological Normal of Setúbal (1971-2000). Retrieved from PDMFCI Setúbal

The data available at Ermesinde-Valongo Urban Station only covered NO_2, PM_{10}, and ozone (O_3), therefore, for the sulfur dioxide (SO_2), it was necessary to search for other air quality stations. The air quality station Paredes, a traffic station, would be the second closest to the site location, however there is also no available data for SO_2. In the absence of a feasible source of information, the SO_2 was excluded from the analysis.

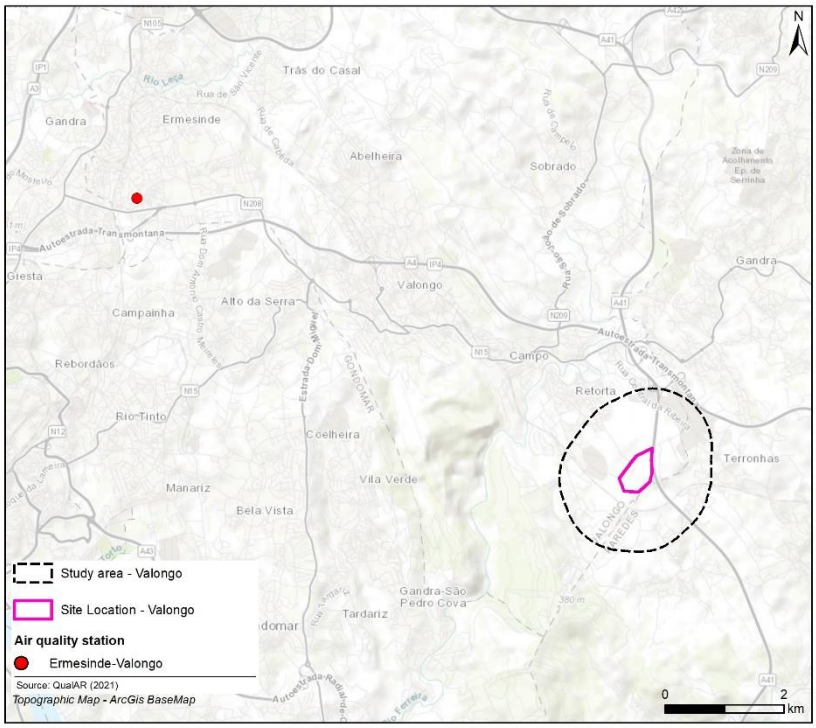


Figure 3-102 – Location of the air quality stations for Valongo site location

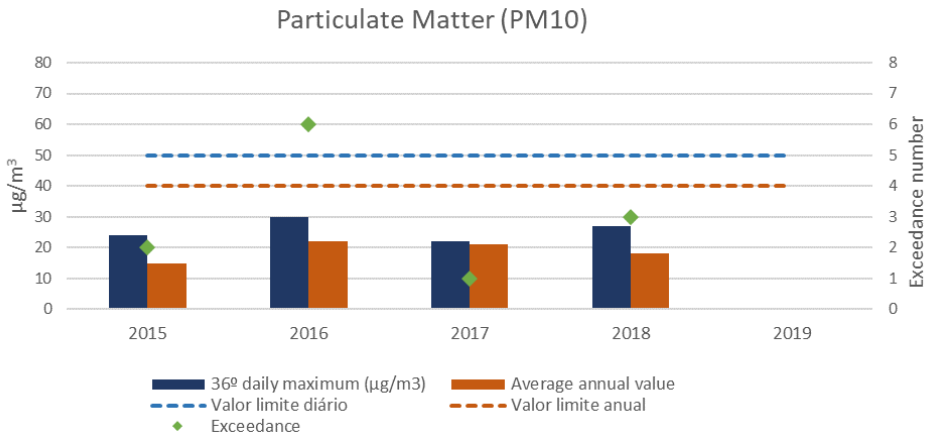


Figure 3-103 – Air quality monitoring in Ermesinde-Valongo Station for PM10 (2015-2019)

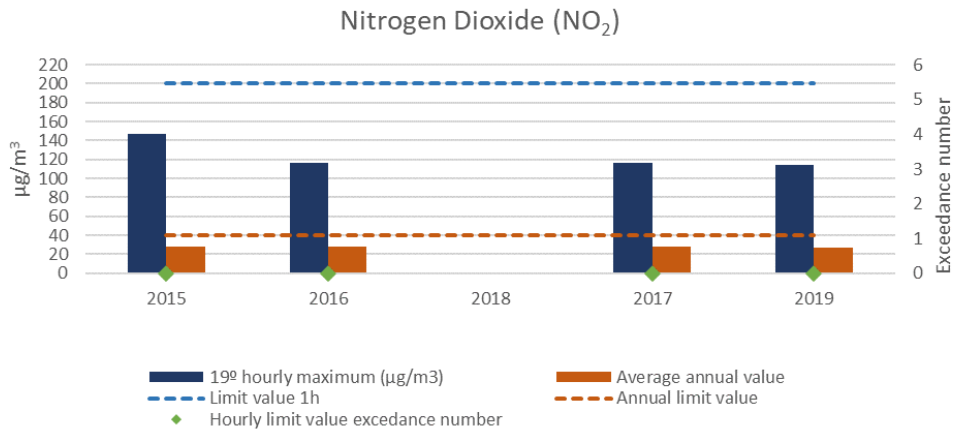


Figure 3-104 – Air quality monitoring in for NO_2 (2015-2019)

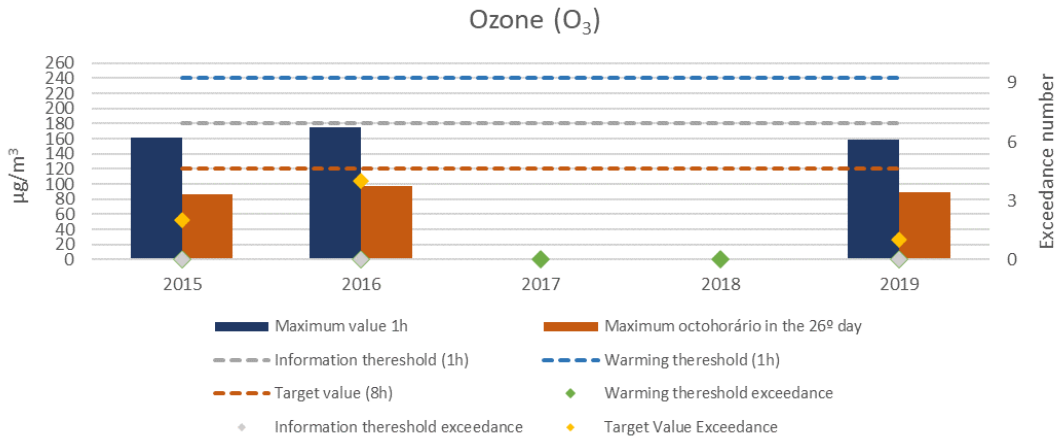


Figure 3-105 – Air quality monitoring in for O_3 (2015-2019)

The monitorization results show that:

- There are exceedances of the daily limit value of PM_{10} in 2015, 2016, 2017 and 2018. However, these exceedances occur in a number of days inferior to the one legally defined. It also should be noticed that the 36º maximum value is always inferior to 30 µg.m^{-3}. The data recorded for 2019 has a very reduced efficiency (2%), so it was chosen not to use in this analysis. The annual averages comply with the annual limit value for all the temporal scope analysed. Noteworthy that, the PM_{10} emissions result both from human activities and natural sources;
- For NO_2, the maximum hourly concentration is lower than the legally defined limit value related to the human health for all the study years. No exceedances of the hourly limit value were recorded. It should be noted that for 2018 there is no available data.
- In 2015, 2016 and 2019 the target values were exceeded. However, these exceedances of the target-value occur in a number of days inferior to the one legally defined (120 µg.m-3 on less than 25 days a year) for the analysed period. It should be noted that for 2018 there is no available data and in 2017 the data recorded has a very reduced efficiency (14%), so it was chosen not to use in this analysis. It is also important to mention that this pollutant is not directly released to the atmosphere by local sources as it is produced in atmosphere by the action of solar radiation when combined with NO2 and VOC's. These are normally from pollution sources located further from the place where the ozone is monitored.

The main atmospheric pollutants emitted by the lithium refinery are particulate matter (PM10 and PM2.5), SOx and odour compounds.

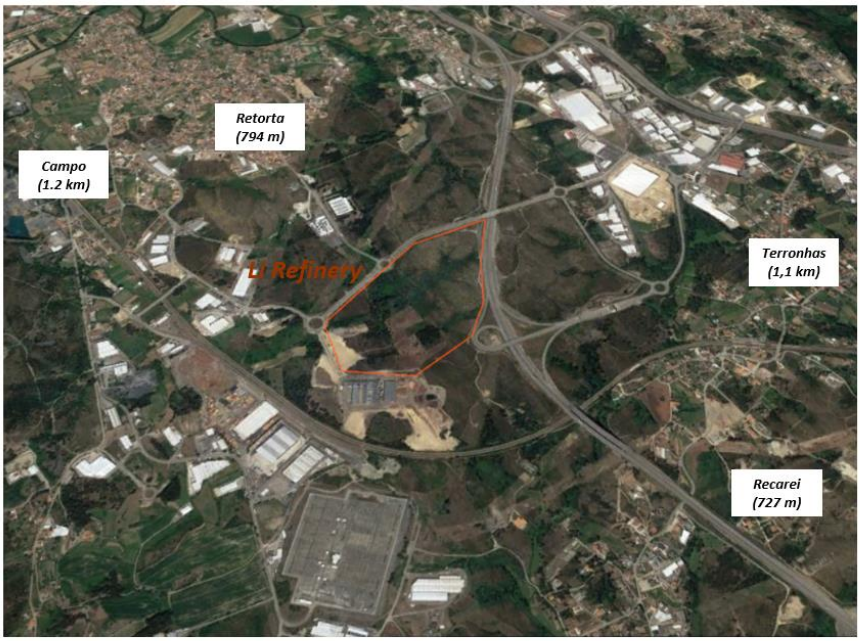
Considering that the study area is already strongly affected by high PM10 concentrations (exceeding the threshold values in the 4 years analysed), it can be assumed that the contribution of the refinery emissions to air pollution is going to be of little relevance.

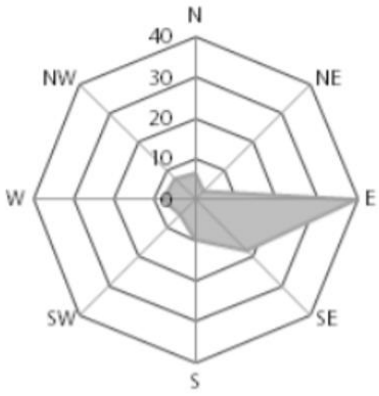
As SO_2 is not monitored in the Air Quality Stations Network of the region it is recommended a specific monitoring campaign of this pollutant is included in the baseline characterization in the next phases, namely the Environmental Impact Assessment.

The baseline air quality is unknown, however it can be assumed that considering the proximity of the refinery to the population clusters, and the inexistence of other relevant sources of odour compounds, the impact of the refinery on the odour levels is going to be significant, unless mitigation measures are implemented.

3.9.6.1.2. Air dispersion analysis

Considering that the prevailing direction of the wind in Valongo is from the east, the population cluster at the west will be the most exposed to the refinery activity.





Parish	Population
Campo e Sobrado	15 280
Recarei	4 479
Gandra	6 967

Figure 3-106 – Air dispersion analysis on Valongo site location

Considering the predominant winds, Campo, located at 1.2 km from the site location, with a parish population density of 15 280 inhabitants, will be highly exposed to the atmospheric emissions from the refinery. This applies for odour, PM10 and other atmospheric pollutants that will be emitted during the lifespan of the refinery.

The annual average wind speed of Valongo is 16.7 km/h[43].It should be noted that the highest average wind velocity enhances air circulation, leading to a good dispersion of pollutants.

[43] Retrieved from the Municipal Forest Fire Defense Plan of Trofa

3.9.7. Trofa

3.9.7.1.1. Air quality characterisation

The characterisation of the air quality of the study area is made by comparing the concentration values measured at the Burgães - Santo Tirso Urban Station, located at 5,7 km north-east of the implementation area, with the values of Decree-Law no. 102/2010, of 23 September, amended by Decree-Law no. No. 43/2015, of March 27, and by Decree-Law No. 47/2017, of May 10. This legal document establishes measures aimed at defining and setting targets relating to the environment's air quality to avoid, prevent or reduce harmful effects on human health and the environment.

The data available at Burgães - Santo Tirso Urban Station only covered NO_2, PM_{10}, and ozone (O_3), therefore, for the sulfur dioxide (SO_2), it was necessary to search for other air quality stations. The air quality station Paços de Ferreira would be the second closest to the site location, however there is also no available data for SO_2. In the absence of a feasible source of information, the SO_2 was excluded from the analysis.

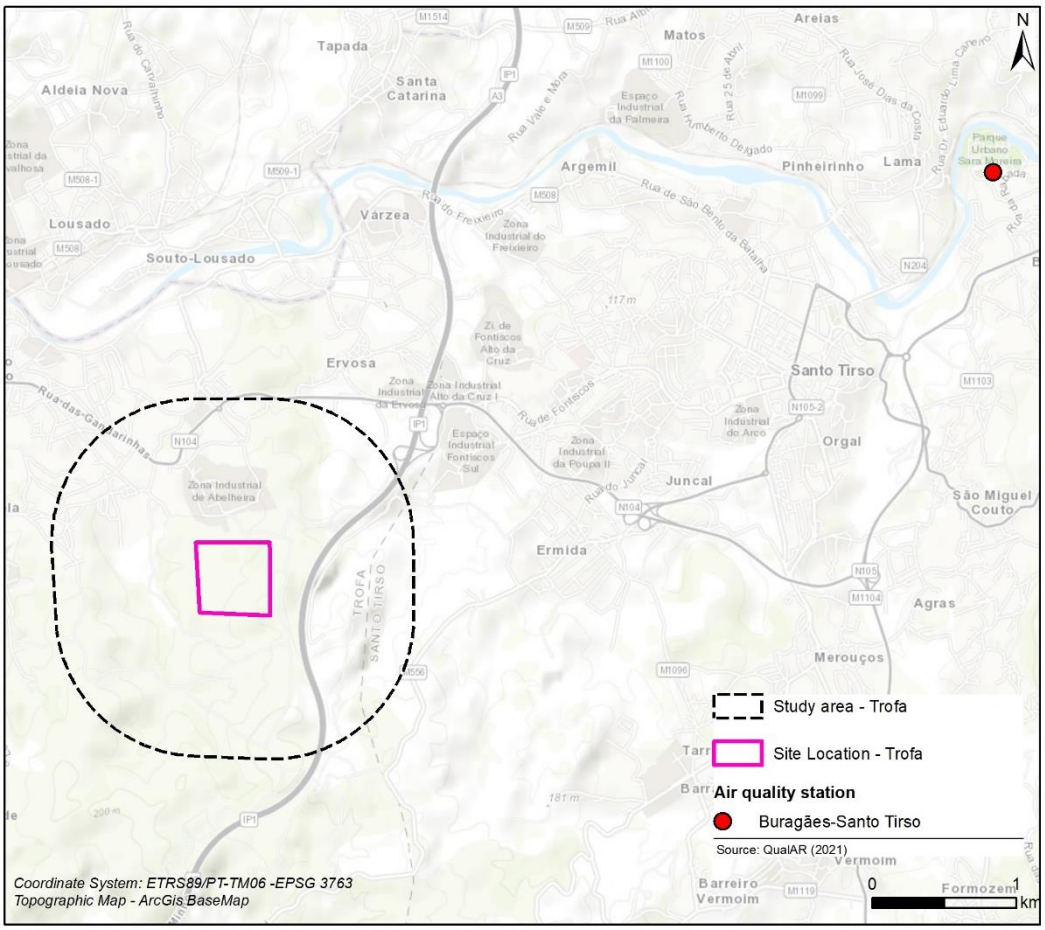


Figure 3-107 – Location of the air quality station for Trofa site location

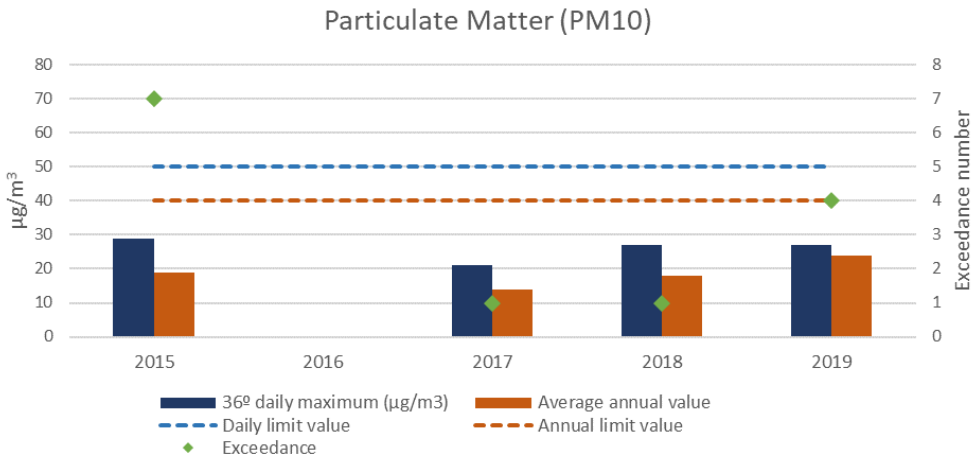


Figure 3-108 – Air quality monitoring in Burgães -Santo Tirso Station for PM_{10} (2015-2019)

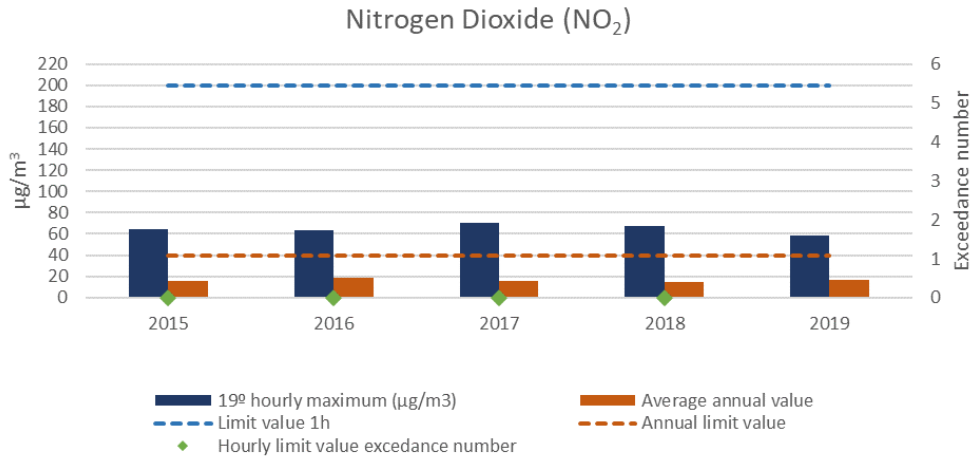


Figure 3-109 – Air quality monitoring in Burgães -Santo Tirso Station for NO_2 (2015-2019)

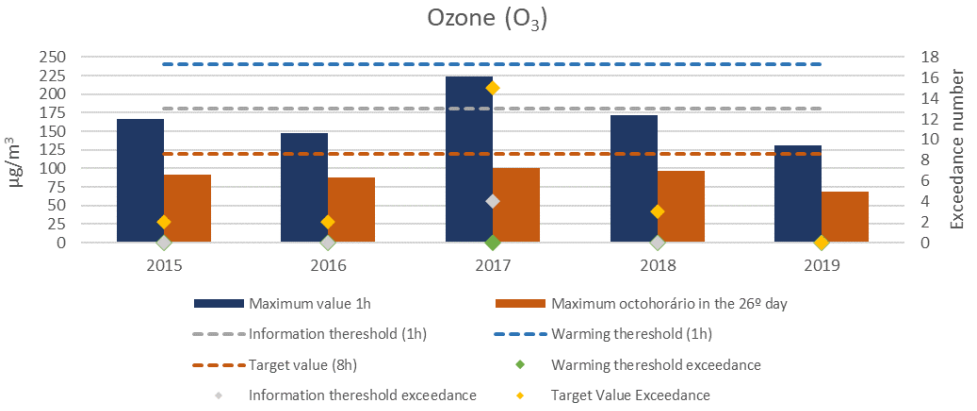


Figure 3-110 – Air quality monitoring in Burgães-Santo Tirso Station for O_3 (2015-2019)

The monitorization results show that:

- There are exceedances of the daily limit value of PM_{10} in 2019, 2018, 2017 and 2015. However, these exceedances occur in a number of days inferior than the one legally defined. It also should be noticed that, the 36º maximum value is always inferior to 30 $\mu g.m^{-3}$. The annual averages comply with the annual limit value for all the temporal scope analysed. It should be noted that for 2016 there is no available data. Noteworthy that, the PM_{10} emissions result both from human activities and natural sources;
- For NO_2, the maximum hourly concentration is lower than the legally defined limit value related to the human health for all the study years. No exceedances of the hourly limit value were recorded.
- In 2017, the maximum hourly concentration of O_3 is higher than the population information threshold (180 $\mu g.m^{-3}$), but lower than the population warning threshold (240 $\mu g.m^{-3}$). For the target-value it is possible to verify the compliance with the maximum exceedance number allowed (120 $\mu g.m^{-3}$ on less than 25 days a year) for the analysed period. For 2019 the maximum hourly concentrations of O_3 were significatively lower than the previous years. It should be noted that, this pollutant is not directly sent out to the atmosphere by local sources as it is produced in atmosphere by the action of solar radiation when combined with NO_2 and VOC's. These are normally from pollution source located further from the place where the ozone is monitored.

The main atmospheric pollutants emitted by the lithium refinery are particulate matter (PM10 and PM2.5), SOx and odour compounds.

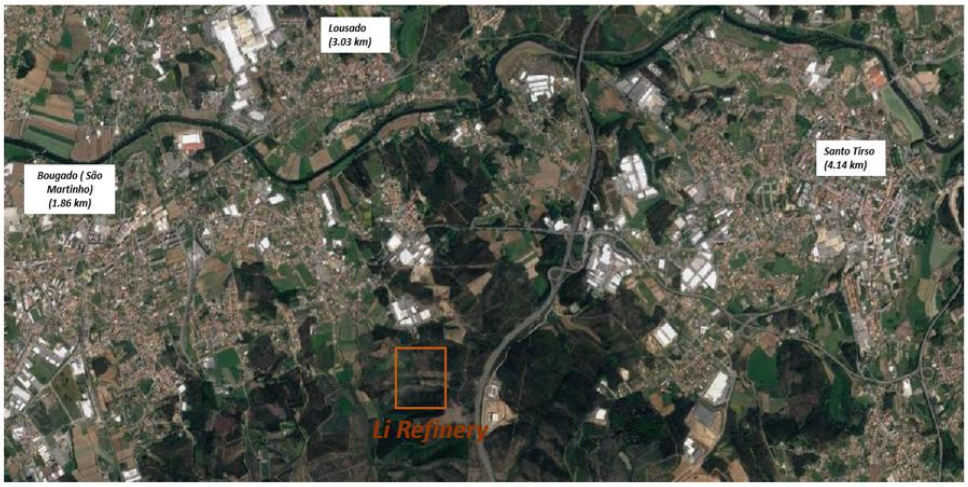
Considering that the study area is already strongly affected by high PM10 concentrations (exceeding the threshold values in 4 of the 5 years analysed), it can be assumed that the contribution of the refinery emissions to air pollution is going to be of little relevance.

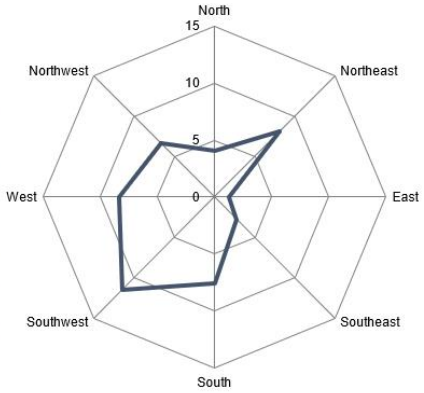
As SO_2 is not monitored in the Air Quality Stations Network of the region it is recommended that a specific monitoring campaign of this pollutant is included in the baseline characterization in the next phases, namely the Environmental Impact Assessment.

The baseline air quality is not known, however it can be assumed that considering the proximity of the refinery to the population clusters and the existence of other relevant sources of odour compounds, namely landfill, the impact of the refinery on the odour levels is going to be significant, unless mitigation measures are implemented.

3.9.7.1.2. Air dispersion analysis

Considering that the prevailing direction of the wind in Trofa is from southwest the population cluster at northeast will be the most exposed to the refinery activity. South, west and northeast have also an important representativity of the winds regime.





Parish	Population
Bougado (São Martinho)	14 627
Santo Tirso	69 630
Lousado	4 037

Figure 3-111 – Air dispersion analysis on Trofa site location

Considering the predominant winds, Santo Tirso, located at 5.78 km from the site location, with a population density of 69 630 inhabitants, will be highly exposed to the atmospheric emissions from the refinery. This applies for odour, PM10 and other atmospheric pollutant that will be emitted during the lifespan of the refinery.

The annual average wind speed of Trofa is 11 km/h[44], and annually 49.7% of the winds are calms (speed <1.0 km/h). It should be noted that highest average wind velocity enhances air circulation, leading to a good dispersion of pollutants.

3.9.8. Fafe

3.9.8.1.1. Air quality characterisation

The characterisation of the air quality of the study area is made by comparing the concentration values measured at the Paços de Fereira Urban Station, located at 21 km south-east of the implementation area, with the values of Decree-Law no. 102/2010, of 23 September, amended by Decree-Law no. No. 43/2015, of March 27, and by Decree-Law No. 47/2017, of May 10. This legal document establishes measures aimed at defining and setting targets relating to the environment's air quality to avoid, prevent or reduce harmful effects on human health and the environment.

The closest air quality station would be Cónego Traffic Station however, it is not good to use a traffic station to characterize the air quality in a region because these stations have small representativeness. In this sense, the Paços de Ferreira urban stations was considered in this analysis.

The data available at Paços de Ferreira Urban Station only covered NO_2, PM_{10}, and ozone (O_3), therefore, for the sulfur dioxide (SO_2) it was necessary to search for other air quality stations. The air quality station Burgães-Santo Tirso and Cónego would be the closest stations to the site location, however there is no available data

[44] Retrieved from the Municipal Forest Fire Defense Plan of Trofa

for SO_2 for these stations. In the absence of a feasible source of information, the SO_2 was excluded from the analysis.

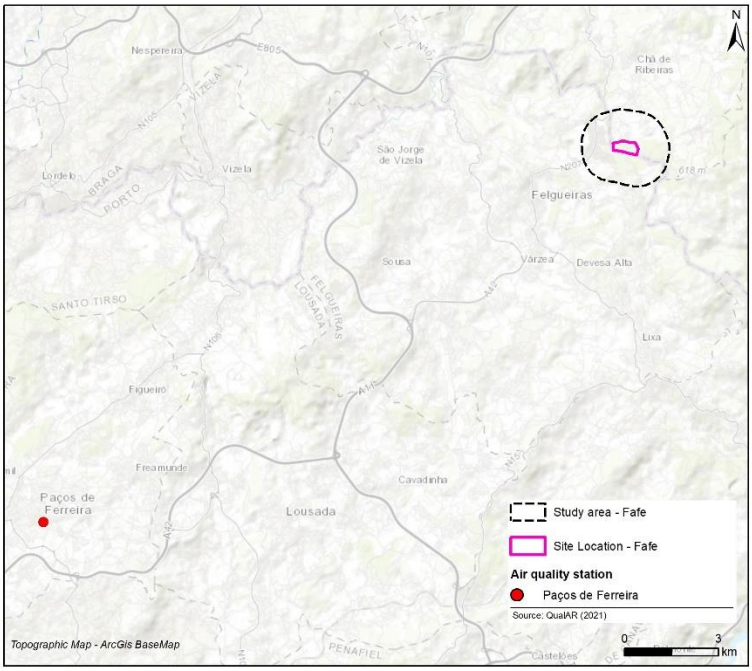


Figure 3-112 – Location of the air quality station for Fafe site location

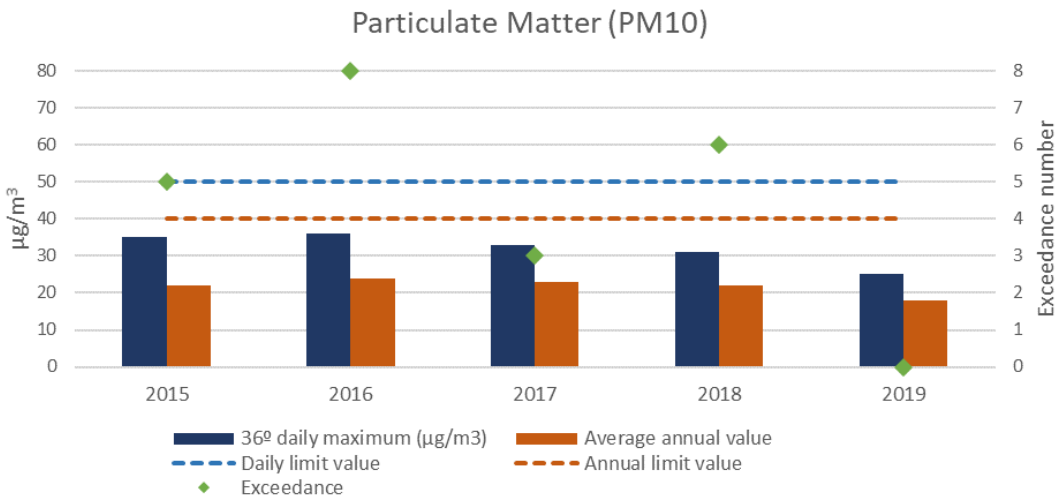


Figure 3-113 – Air quality monitoring in Paços de Ferreira Station for PM_{10} (2015-2019)

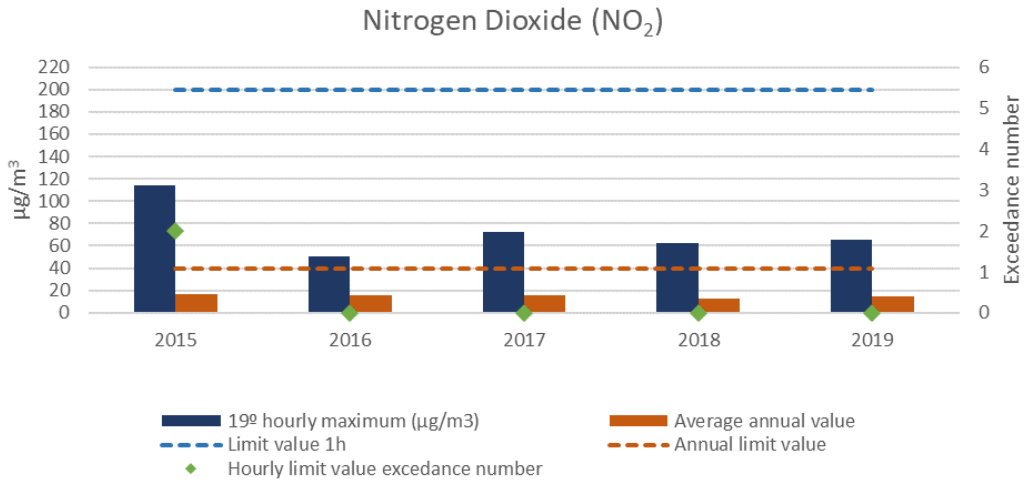


Figure 3-114 – Air quality monitoring in Paços de Ferreira Station for NO_2 (2015-2019)

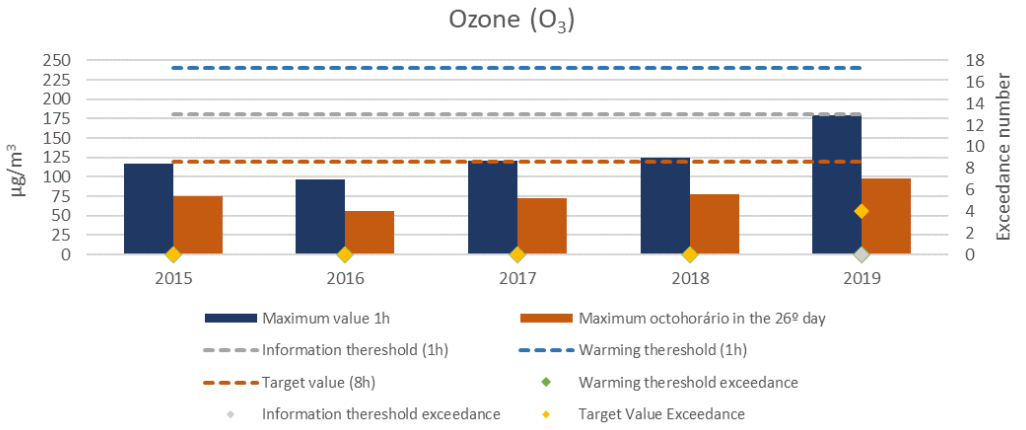


Figure 3-115 – Air quality monitoring in Paços de Ferreira Station for O_3 (2015-2019)

The monitorization results show that:

- There are exceedances of the daily limit value of PM_{10} in 2015,2016,2017 and 2018. However, these exceedances occur in a number of days inferior to the one legally defined. It also should be noticed that the 36º maximum value is always inferior to 40 µg.m^{-3}. The annual averages comply with the annual limit value for all the temporal scope analysed.
- For NO_2, the maximum hourly concentration is lower than the legally defined limit value related to human health for all the study years. 2015 is the only year that presents exceedances to the hourly limit value were recorded.
- For all the five years analysed, the concentration of O_3 is lower than the population information threshold (180 µg.m^{-3}), and the population warning threshold (240 µg.m^{-3}). For the target value, it is possible to verify the compliance with the maximum exceedance number allowed (120 µg.m^{-3} on less than 25 days a year) for the analysed period. For 2019 the maximum hourly concentrations of O_3 were significantly higher than the previous years. It should be noted that this pollutant is not directly sent out to the atmosphere by local sources as it is produced in the atmosphere by the action of solar

radiation when combined with NO_2 and VOC's. These are normally from pollution sources located further from the place where the ozone is monitored.

The main atmospheric pollutants emitted by the lithium refinery are particulate matter (PM10 and PM2.5), SOx and odour compounds.

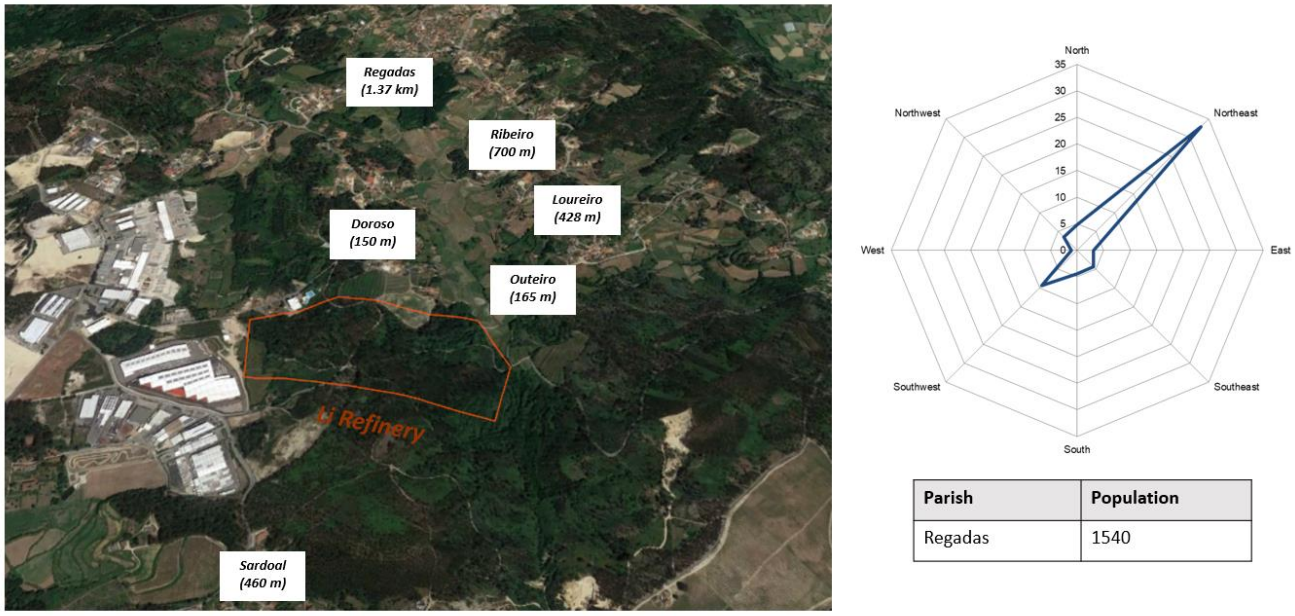
Considering that the study area is already strongly affected by high PM10 concentrations (exceeding the threshold values in 4 of the 5 years analysed), it can be assumed that the contribution of the refinery emissions to air pollution is going to be of little relevance.

As SO_2 is not monitored in the Air Quality Stations Network of the region is recommended a specific monitoring campaign of this pollutant is included in the baseline characterization in the next phases, namely the Environmental Impact Assessment.

The the baseline air quality is unknown, however, it can be assumed that considering the proximity of the refinery to the population clusters, and the existence of other relevant sources of odour compounds, namely landfill, the impact of the refinery on the odour levels is going to be significant unless mitigation measures are implemented.

3.9.8.1.2. Air dispersion analysis

Considering that the prevailing direction of the wind in Fafe is from northeast the population cluster at southwest will be the most exposed to the refinery activity.



Parish	Population
Regadas	1540

Figure 3-116 – Air dispersion analysis on Fafe site location

Considering the predominant winds, Sardoal that belongs to Pinheiro parish, in Felgueiras municipality, located at 460 m from the site location, with a parish population density of 1 042 inhabitants, will be highly exposed to the atmospheric emissions from the refinery. This applies for odour, PM10 and other atmospheric pollutant that will be emitted during the lifespan of the refinery.

The annual average wind speed of Fafe is 5.9 km/h[45], and annually 36.4% of the winds are calms (speed <1,0 km/h). It should be noted that the highest average wind velocity enhances air circulation, leading to a good dispersion of pollutants.

3.10. ARCHAEOLOGICAL AND ETHNOLOGICAL HERITAGE

This section aims to identify and summarise the existing heritage features within the buffer zone of the study area.

Information for Portugal locations has been sourced via the "Patrimonio Cultural - ATLAS DO PATRIMÓNIO CLASSIFICADO E EM VIAS DE CLASSIFICAÇÃO".

Category	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
Quantitative level	2	1	1	1	1	1	1	2
	No occurrence in the project site area (direct influence) 1 occurrence in the study area (indirect influence), with no risks of being affected by the project	No occurrence in the project site area (direct influence) or study area (indirect influence)	No occurrence in the project site area (direct influence) or study area (indirect influence)	No occurrence in the project site area (direct influence) or study area (indirect influence)	No occurrence in the project site area (direct influence) or study area (indirect influence)	No occurrence in the project site area (direct influence) or study area (indirect influence)	No occurrence in the project site area (direct influence) or study area (indirect influence)	No occurrence in the project site area (direct influence) 2 occurrences in the study area (indirect influence), with no risks of being affected by the project

Table 3-65 – Characterisation of archaeological and ethnological present in the study area

3.10.1. Matosinhos

Regarding the Protection zones for cultural heritage, the 1 km buffer of study area for the Matosinhos site location intersects the Protected patrimony of Portugal - Casa de Chá da Boa Nova (IPA code IPA.00020302), determined by "Portaria nº 608/2012", 24 of October.

Casa de Chá da Boa Nova and the Leca da Palmeira Tide Pools are located within close proximity to the identified project location.

It is assumed the construction of the refinery will not have negative impact to the locations, however due to the recreational purpose of the area, it will be important to not effect access for visitors to the site.

[45] Retrieved from the Municipal Forest Fire Defense Plan of Fafe

3.10.2. Sines

It is important to note that in the study area and its immediate surroundings there are no patrimonial occurrences with official classification (National Monument, Property Interest, or in the process of classification), nor occurrences inventoried in the PDM of the municipalities of Sines.

3.10.3. Estarreja

The study area and its immediate surroundings found there are no patrimonial occurrences with official classification (National Monument, Property Interest, or in the process of classification), nor occurrences inventoried in the PDM of the municipalities of Estarreja.

3.10.4. Vigo

“Provisionally, while the regulatory development of the Galician Cultural Heritage Catalogue and the conditions of access to the information contained therein are being established, and according to the provisions of Article 30 of Law 572016, of the Cultural Heritage of Galicia, which indicates that the immovable properties that are individually listed in the instruments of urban planning and land use planning are part of the Catalogue of the Cultural Heritage of Galicia, all information relating to the listed properties can be consulted in the Catalogues of the current planning that is offered on the website of the Consellería de Medio Ambiente y Ordenación del Territorio (Regional Ministry of the Environment and Territorial Planning). “

Regarding Salvaterra de Miño and As Neves the website reference above does not have any records of cultural heritage.

3.10.5. Setúbal

An assessment of the study area and its immediate surroundings found there are no patrimonial occurrences with official classification (National Monument, Property Interest, or in the process of classification), nor occurrences inventoried in the PDM of the municipalities of Setúbal. However, in the vicinity of the study area (4 km), on the other side of the Sado’s river, it is possible to find the Immovable Heritage of Ruínas de Tróia (IPA.00003454), as it can be seen in the figure below.

The ruins of Troia are a protected heritage, which comprise a housing area, a spa, four burial zones and, a religious nucleus, in addition to several industrial nuclei.

The project will not affect the heritage in a direct way, as it is located too far away (4 km), from the heritage, or in an indirect way as all the transport to and from the refinery will be on the North side of the river.

Figure 3-117 – Patrimonial occurrence in Setúbal region

3.10.6. Valongo

An assessment of the study area and its immediate surroundings found there are no patrimonial occurrences with official classification (National Monument, Property Interest, or in the process of classification), nor occurrences inventoried in the PDM of the municipalities of Valongo.

3.10.7. Trofa

The study area and its immediate surroundings found there are no patrimonial occurrences with official classification (National Monument, Property Interest, or in the process of classification), nor occurrences inventoried in the PDM of the municipalities of Trofa.

3.10.8. Fafe

Regarding the Protection zones for cultural heritage, the 1 km buffer of study area for the Fafe site location intersects the Protected patrimony of Portugal – 3 Mamoas de Tarrio (800 m east) defined in the Fafe Municipal Master Plan, and the Povoado Edificado Senhora da Aparecida (900 meters south) defined in the Felgueiras Municipal Master plan.

It is worth noting some rural heritage is located in the surroundings of the site location and is listed in the Fafe master plan but will not have implications to the installation of the lithium refinery.

The **Figure 4.8.3 and 4.8.4 of Appendix B - Drawings** presents the archaeological and architectural heritage for Fafe municipality.

4. Overall, it is assumed the construction of the refinery will not have a negative impact due to distance, however due to the recreational purpose of the area, it will be important to not effect access for visitors to the site.

5. Social / Economical Assessment

5.1. SOCIOECONOMICS

Category	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
Demography	4	2	2	4	1	2	3	2
	The demographic loss was about 0.2 % in the municipality	The demographic loss was about 3.5% in the municipality	The demographic loss was about 2.8 % in the municipality	A demographic gain of 4.4 % in the municipality (Salvaterra de Miño)	The demographic loss was about 5 % in the municipality	The demographic loss was about 3.4 % in the municipality	The demographic loss was about 1.4 % in the municipality	The demographic loss was about 3.6 % in the municipality
Job Creation Flow on Effect – net increase to local economy, social amenity availability (schools, hospitals)	2	2	2	1	2	2	2	2
	Regional unemployment rate -5% Medium potential for positive impacts – largely brought about by the employment of local people.	Regional unemployment rate -4.4% Medium potential for positive impacts – largely brought about by the employment of local people.	Regional unemployment rate -3.5% Medium potential for positive impacts – largely brought about by the employment of local people.	Regional unemployment rate - 13% High potential for positive impacts – largely brought about by the employment of local people.	Regional unemployment rate – 7.7% Medium to High potential for positive impacts – largely brought about by the employment of local people.	Regional unemployment rate -5.0% Medium potential for positive impacts – largely brought about by the employment of local people.	Regional unemployment rate -5% Medium potential for positive impacts – largely brought about by the employment of local people.	Regional unemployment rate -4.7% Medium potential for positive impacts – largely brought about by the employment of local people.
	3	1	3	2	1	2	2	3

Category	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
Property Values & Housing Stock Availability [1] **Facilities and Services Tourism Amenity Impacts** **Net increase to local economy, social amenity availability (schools, hospitals)**	No significant negative social or economic impacts at the local or regional level. Potential for positive impacts – largely brought about by the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally. Less important than in other locations. The local tourism industry is not expected to be negatively impacted by the refinery.	Unhabitacional area - no social or economic impacts at the local or regional level. Potential for positive impacts – largely brought about by the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally. Less important than in other locations. The local tourism industry is not expected to be negatively impacted.	No significant negative social or economic impacts at the local or regional level. Potential for positive impacts – largely brought about by the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally. The local agricultural industry is not expected to be negatively impacted. However, there may be seasonality impacts	No significant negative social or economic impacts at the local or regional level. Potential for positive impacts – largely brought about by the employment of local people, the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally. More remote location so fewer services and opportunities for local business utilisation	Unhabitacional area - no social or economic impacts at the local or regional level. Potential for positive impacts – largely brought about by the employment of local people, the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally	No significant negative social or economic impacts at the local or regional level. Potential for positive impacts – largely brought about by the employment of local people, the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally. More remote location so fewer services and opportunities for local business utilisation	No significant negative social or economic impacts at the local or regional level. Potential for positive impacts – largely brought about by the employment of local people, the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally	No significant negative social or economic impacts at the local or regional level. Potential for positive impacts – largely brought about by the employment of local people, the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally. The Local tourism industry might be negatively impacted.
Total Score	9	5	7	7	4	6	7	7
Quantitative level	4	1	3	3	1	2	3	3

Table 5-1 – Characterisation of socioeconomics present in the study area

Note: 1 Sales and rental data was not reviewed as part of this assessment.

5.1.1. Overall summary and assessment

The aim of this section is to briefly identify the main sociographic key impact areas of the various areas under assessment. Information was sourced from that made publicly available by the National Institute of Statistics (INE).

Five Key Impact Areas were also considered at a broad level which are typically areas of concern for external stakeholders, or reasonably could be predicted to bring about a negative or positive impact to the socio-economic environment once the refinery becomes operational. Specific locality data was not reviewed as part of this assessment; however, it is recommended it be assessed once a final location has been chosen.

The five Key Impact Areas are:

- **Housing & Property Values:** Rental and sales prices may be raised. More pressure will be put on the bottom of the housing market. Low-income tenants may be displaced. Rates of homelessness may increase.
- **Facilities and services:** The refinery will place pressure on local facilities and services, particularly health services.
- **Residential amenity:** Residential quality of life index may be impacted. The coastal character of the area could be destroyed, coastal lifestyles will be adversely affected and the residential amenity of the area may be affected.
- **Local economic growth and employment:** The refinery will provide local employment and a boost to economic growth and development for the area; economic benefits should flow through to the local community.

5.1.2. Matosinhos

The municipality of Matosinhos falls within the level III territorial unit - Metropolitan Area of Porto (Nomenclature of Territorial Units for Statistics (NUT) II). Data made available by INE related to the years between 2011 and 2020 and show that in this period there were demographic losses at all administrative levels. The demographic loss was about 0.2 % in the municipality of Matosinhos and about 1.8% in the Metropolitan Area of Porto.

When analysing the distribution of the resident population by age groups there is a general trend towards the population ageing, with the majority of the population belonging to the age groups between 25-64 years, followed by 65 and over. Between the years 2011 and 2020, in general, there was a *decrease in the younger* population. *With regard to the senior population, over 65 years old, there was an increase of around 26.1%.*

The Statistical Yearbook of the Northern Region 2018 reported that "Wholesale and retail trade and repair of motor vehicles and motorcycles" (18%), and "Administrative and support service activities" (17%) stand out as the main economic sectors (according to the number of companies per sector) in Matosinhos. Other activities, such as "Scientific and technical consulting and similar activities" (14%) and "Human health and social support activities" (12%) also have a strong presence. In terms of employment the INE reported that in 2020 the unemployment rate registered per 100 inhabitants aged 15 or older corresponds to 5.0% in the Metropolitan Area of Porto.

The assessment findings do not demonstrate that the refinery will have any significant negative social or economic impacts at the local or regional level. There is potential for positive impacts – largely brought about by the employment of local people, the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally.

5.1.3. Sines

The municipality of Sines falls within the level III territorial unit – Alentejo Litoral (NUT II). Data made available by INE related to the years between 2011 and 2020 show that in this period there were demographic losses at all administrative levels. The demographic loss was about 3.5% in the municipality of Sines and about 5.1% in Alentejo Litoral.

When analysing the distribution of the resident population by age groups there is a general trend towards the population ageing, with the majority of the population belonging to the age groups between 25-64 years, followed by 65 and over. Between the years 2011 and 2019, in general, there was a decrease in the younger population. With regard to the senior population, over 65 years old, there was an increase of around 20% in the municipality of Sines.

The Statistical Yearbook of the Northern Region 2018 reported that "Wholesale and retail trade and repair of motor vehicles and motorcycles" (20%), and "Administrative and support service activities" (16%) stand out as the main economic sector in Sines. Also, noteworthy "Accommodation, restaurant and similar " (13%), has a strong presence in Sines reflecting the tourism sector presence in this region. In terms of employment, according to INE, in 2020 the unemployment rate registered per 100 inhabitants aged 15 or older was 4.4% in Alentejo Litoral.

The assessment findings do not demonstrate that the refinery will have any significant negative social or economic impacts at the local or regional level. There is potential for positive impacts – largely brought about by the employment of local people, the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally. As the refinery location will be within the existing Industrial area footprint, the local tourism industry is not expected to be negatively impacted.

5.1.4. Estarreja

The municipality of Estarreja falls within the level III territorial unit – Aveiro Region (NUT II). Data made available by INE related to the years between 2011 and 2020, show that in this period there were demographic losses at all administrative levels. The demographic loss was approximately 2.8 % in the municipality of Estarreja and approximately 0.6 % in the Aveiro Region.

When analysing the distribution of the resident population by age groups there is a general trend towards the population ageing, with the majority of the population belonging to the age groups between 25-64 years, followed by 65 and over. Between the years 2011 and 2020, in general, there was a decrease in the younger population. With regard to the senior population, over 65 years old, there was an increase of approximately 9% in the municipality of Estarreja.

The Statistical Yearbook of the Northern Region 2018 reported that "Wholesale and retail trade and repair of motor vehicles and motorcycles" (21%), "Agriculture - animal production, hunting, forestry and fishing" (13%) and "Administrative activities and support services" (13%) stand out as the main economic sector (according to the number of companies per sector) in Estarreja. The presence of agricultural activity in the region illustrates its rural character. Also, "Construction " (10%) has an important weight in Estarreja's economic activity. In terms of employment, according to INE, in 2020 the unemployment rate registered per 100 inhabitants aged 15 or older was 3.5% in Aveiro Region.

The assessment findings do not demonstrate that the refinery will have any significant negative social or economic impacts at the local or regional level. There is potential for positive impacts – largely brought about by the employment of local people, the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally. As the refinery location will be within the existing Industrial area footprint, the local agricultural industry is not expected to be negatively impacted. However, seasonality

impacts in relation to agriculture and demand for workers may have an impact on the refinery's potential local employment availability.

5.1.5. Vigo

The municipality of Salvaterra de Miño falls within the level III territorial unit – Pontevedra (NUT II). Data made available by INE related to the years between 2011 and 2020, show that in this period there was a demographic gain of 4.4 % in the municipality of Salvaterra de Miño and a demographic loss of approximately 1.9 % in Pontevedra.

When analysing the distribution of the resident population by age groups, there is a general trend towards population ageing, with the majority of the population belonging to the age groups between 25-64 years, followed by 65 and over. Between the years 2011 and 2020, in general, there was a decrease in the younger population. With regard to the senior population, over 65 years old, there was an increase of around 33% in Pontevedra.

The Statistical Yearbook of the Northern Region 2018 reported that "Wholesale and retail trade and repair of motor vehicles and motorcycles" (25%), "Construction" (21%) and "Administrative activities and support services" (13%) stand out as the main economic sectors (according to the number of companies per sector) in Salvaterra de Miño." Producing Industry " (10%) is also a large sector in Salvaterra de Miño.

The assessment findings do not demonstrate that the refinery will have any significant negative social or economic impacts at the local or regional level. There is potential for positive impacts – largely brought about by the employment of local people, the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally. This location is more remote than the others in that there are fewer services and opportunities for local business utilisation.

5.1.6. Setúbal

The municipality of Setúbal falls within the level III territorial unit – Metropolitan Area of Lisbon (Nomenclature of Territorial Units for Statistics (NUT) II). Data made available by INE related to the years between 2011 and 2020 show that in this period there were demographic losses in the municipality of Setúbal (5%) but a slight increase in the Metropolitan Area of Lisbon (1%).

When analysing the distribution of the resident population by age groups there is a general trend towards the population ageing, with the majority of the population belonging to the age groups between 25-64 years, followed by 65 and over. Between the years 2011 and 2020, in general, there was a *decrease in the younger* population. Concerning the senior population, over 65 years old, there was *an increase of around 19%.*

The PORDATA reported that "processing industries" (17%), "wholesale and retail trade" (15%), and "administrative and support service activities" (15%) stand out as the main economic sectors (according to the number of companies per sector) in Setúbal. Other activities such as "Construction" (10%) and "Housing and catering services" (9%) also have a strong presence. In terms of employment, the INE reported that in 2020 the unemployment rate registered per 100 inhabitants aged 15 or older corresponds to 7.7% in the Metropolitan Area of Lisbon.

The assessment findings do not demonstrate that the refinery will have any significant negative social or economic impacts at the local or regional level. There is potential for positive impacts – largely brought about by the employment of local people, the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally.

In terms of local tourism, the assessment area will not lose value in this economic sector post-integration into an industrial area.

5.1.7. Valongo

The municipality of Valongo falls within the level III territorial unit – Metropolitan Area of Porto (Nomenclature of Territorial Units for Statistics (NUT) II). Data made available by INE related to the years between 2011 and 2020 show that in this period there were demographic losses in the municipality of Valongo (3.4%) and in the Metropolitan Area of Porto (1.8%).

When analysing the distribution of the resident population by age groups there is a general trend towards the population ageing, with the majority of the population belonging to the age groups between 25-64 years (56%), followed by the age group under 24 years (25%) and lastly the age group 65 years old (19%). Between the years 2011 and 2020, in general, there was a *decrease in the younger* population. Concerning the senior population, over 65 years old, there was *an increase of around 44%.*

The Statistical Yearbook of the Northern Region 2018 reported that "Wholesale and retail trade and repair of motor vehicles and motorcycles" (21%), and "Administrative and support service activities" (17%) stand out as the main economic sectors (according to the number of companies per sector) in Valongo. Other activities, such as "Scientific and technical consulting and similar activities" (9%), "Human health and social support activities" (9%) and “Manufacturing industries” (8%) also have an important weight in Valongo’s economic activity. In terms of employment the INE reported that in 2020 the unemployment rate registered per 100 inhabitants aged 15 or older corresponds to 5.0% in the Metropolitan Area of Porto.

The assessment findings do not demonstrate that the refinery will have any significant negative social or economic impacts at the local or regional level. There is potential for positive impacts – largely brought about by the employment of local people, the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally.

5.1.8. Trofa

The municipality of Trofa falls within the level III territorial unit – Metropolitan Area of Porto (Nomenclature of Territorial Units for Statistics (NUT) II). Data made available by INE related to the years between 2011 and 2020 show that in this period there were demographic losses in the municipality of Trofa (1.4%) and the Metropolitan Area of Porto (1.8%).

When analysing the distribution of the resident population by age groups there is a general trend towards the population ageing, with the majority of the population belonging to the age groups between 25-64 years (57%), followed by the age group under 24 years (24%) and lastly the age group 65 years old (19%). Between the years 2011 and 2020, in general, there was a *decrease in the younger* population. Concerning the senior population, over 65 years old, there was *an increase of around 41%.*

The Statistical Yearbook of the Northern Region 2018 reported that "Wholesale and retail trade and repair of motor vehicles and motorcycles" (26%), and “Manufacturing industries” (14%) stand out as the main economic sectors (according to the number of companies per sector) in Trofa. Other activities, such as "Administrative and support service activities" (10%) and "Scientific and technical consulting and similar activities" (9%) also have an important weight in Trofa’s economic activity. In terms of employment, the INE reported that in 2020 the unemployment rate registered per 100 inhabitants aged 15 or older corresponds to 5.0% in the Metropolitan Area of Porto.

The assessment findings do not demonstrate that the refinery will have any significant negative social or economic impacts at the local or regional level. There is potential for positive impacts – largely brought about by the employment of local people, the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally.

5.1.9. Fafe

The municipality of Fafe falls within the level III territorial unit – Ave (Nomenclature of Territorial Units for Statistics (NUT) II). Data made available by INE related to the years between 2011 and 2020 show that in this period there were demographic losses in the municipality of Fafe (3.6%) and Ave (5.6%).

When analysing the distribution of the resident population by age groups there is a general trend towards the population ageing, with the majority of the population belonging to the age groups between 25-64 years (56%), followed by the age group under 24 years (23%) and lastly the age group 65 years old (21%). Between the years 2011 and 2020, in general, there was a *decrease in the younger* population. Concerning the senior population, over 65 years old, there was *an increase of around 25%.*

The Statistical Yearbook of the Northern Region 2018 reported that "Wholesale and retail trade and repair of motor vehicles and motorcycles" (21%), and “Manufacturing industries” (16%) stand out as the main economic sectors (according to the number of companies per sector) in Fafe, "Construction" (11%) is also a large sector in Fafe. In terms of employment, the INE reported that in 2020 the unemployment rate registered per 100 inhabitants aged 15 or older corresponds to 4.7% in the Ave.

The assessment findings do not demonstrate that the refinery will have any significant negative social or economic impacts at the local or regional level. There is potential for positive impacts – largely brought about by the employment of local people, the in-migration of new residents and the purchasing power of the proponent to procure goods and services locally.

5.2. HUMAN HEALTH

Category	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
Overview	• High risk location in terms of population vulnerability, with a high capacity for medical assistance. • However, considered at highest risk in terms of air pollutants concentration. Good in terms of noise exposure	• High risk location in terms of population vulnerability, with lower capacity for medical assistance. • However, considered the best location in term of air pollutants concentration. High risk in terms of noise exposure.	• Low risk location in terms of population vulnerability, with good capacity for medical assistance. • However, considered high risk in terms of air pollutants concentration. High risk option in terms of noise exposure.	• High risk location in terms of population vulnerability, with the least capacity for medical assistance. • However, low risk in terms of air pollutants concentration and low risk in terms of noise exposure.	• Low risk location in terms of population vulnerability, with good capacity for medical assistance. • However, considered high risk in terms of air pollutants concentration and low risk in terms of noise exposure.	• Low risk location in terms of population vulnerability, with good capacity for medical assistance • Considered moderate risk in terms of air pollutants concentration. Low risk in terms of noise exposure	• Low risk location in terms of population vulnerability, with good capacity for medical assistance. • Considered moderate risk in terms of air pollutants concentration. moderate risk option in terms of noise exposure.	• Low risk location in terms of population vulnerability, with good capacity for medical assistance. • However, considered moderate risk in terms of air pollutants concentration. And low risk in terms of noise exposure.
Population vulnerability (potentially with higher sensitivity to the project impacts)	3	3	1	2	3	1	1	1
	• At least 35% of the population is considered vulnerable	• At least 36% of the population is considered vulnerable	• At least 34% of the population is considered vulnerable	• 23% of the population at Pontevedra has 65 or more years, being more vulnerable to health issues	• At least 36% of the population is considered vulnerable	• At least 33% the population is considered vulnerable	• At least 32% of the population is considered vulnerable	• At least 33% of the population is considered vulnerable
Medical response	1	4	3	4	2	3	3	3
	• 9.5 doctors per 1 000 inhabitants	• 2.9 doctors per 1 000 inhabitants	• 3.4 doctors per 1 000 inhabitants	• 0.9 general doctors for 1 000 inhabitants	• 5.3 general doctors for 1 000 inhabitants	• 3.6 doctors per 1 000 inhabitants	• 3.7 general doctors for 1 000 inhabitants	• 3.6 general doctors for 1 000 inhabitants
Air Quality Exposure*	4	1	3	2	1	3	2	3
	• PM10 and ozone with concentrations higher than the	• PM10 and ozone with concentrations	• PM10 and ozone with concentrations higher than the	• Ozone with concentrations higher than the	• PM10 and ozone and ozone with	• PM10 and ozone with concentrations	• PM10 and ozone with concentrations	• PM10 and ozone with concentrations

	WHO limit values which can lead to damage on the respiratory system, nausea, cough and eye/nose irritations. • Two important populations clusters, Amorosa and Leça da Palmeira, located within the study area, with high potential to be considerably affected by the atmospheric emissions from the refinery.	higher than the WHO limit values which can lead to damage on the respiratory system, nausea, cough and eyes/nose irritations. • Small residential area (Outeirinho) located within the study area, with high potential to be considerably affected by the atmospheric emissions from the refinery.	WHO limit values which can lead to damage on the respiratory system, nausea, cough and eyes/nose irritations. • One important population cluster, Póvoa de Cima, located within the study area, with high potential to be considerably affected by the atmospheric emissions from the refinery. • Canedo is very close to the site limits, with a high probability of being affected by the refinery emissions.	WHO limit values in some periods through the year. PM10 not measured, however similar results to the north of Portugal are expected, which can lead to damage on the respiratory system, nausea, cough and eye/nose irritations. • One important population cluster, Covelo, is located within the study area with a high potential to be considerably affected by the atmospheric emissions from the refinery.	concentrations higher than the WHO limit values which can lead to damage on the respiratory system, nausea, cough and eyes/nose irritations. • The closest population clusters are located on the north side and the wind direction is from north to south	higher than the WHO limit values which can lead to damage on the respiratory system, nausea, cough and eyes/nose irritations • One important population cluster, Campo, is located within the study area with a high potential to be considerably affected by the atmospheric emissions from the refinery.	higher than the WHO limit values which can lead to damage on the respiratory system, nausea, cough and eyes/nose irritations. • One important population cluster, Abelheira, is located within the study area with a high potential to be considerably affected by the atmospheric emissions from the refinery.	higher than the WHO limit values which can lead to damage on the respiratory system, nausea, cough and eyes/nose irritations. • Sardoal and Estrada are very close to the site limits and are located on the south side and the wind direction is from northeast to southwest
Noise Exposure	2	1	4	1	3	2	2	2
	• According to the noise maps the refinery location is exposed to noise level of 40<Ln<=45 which means that No Adverse health effects are observed among sensitive receptors,	• According to the noise maps the refinery location is exposed to noise level of 45<Ln<=50 and the closest receptors will be affected by lower values, which means that no Adverse health effects are	• According to the noise maps the closest receptors from the refinery are mainly exposed to noise level of 55<Ln<=60 which means that strong Adverse health effects are observed the sensitive receptors,	• Vigo refinery location has low population density and not many sources of noise pollution	• According to the noise maps the refinery location the closest sensitive receptors are mainly exposed to noise level of 45<Ln<=55 which means that Adverse health effects	• According to the noise maps the refinery location is exposed to noise level of 0<Ln<=45 which means that no Adverse health effects are observed in the sensitive receptors, with	• According to the noise maps the closest populations mainly is exposed to noise level of 0<Ln<=45 which means that no Adverse health effects are observed in the	• According to the noise maps the refinery location, and the closest sensitive receptors are in a non-conflict zone which implies the compliance with threshold limits

	with high population density	observed among the sensitive receptors, with low population density	with moderate population density		are observed the sensitive receptors, with low population density	considerable population density	sensitive receptors, with low population density	for noise exposure
Total Score	10	9	11	9	9	9	8	9
Quantitative level	3	2	4	2	2	2	1	2

Table 5-2 – Characterisation of human health in the study area

*Note: **(**Considering that the **vulnerable/elderly population is similar** for the 7 sites and that the **exposure time is the same**, with the refinery operating continuously, **the prevailing difference is the concentration of air pollutants and the location of the receptor, see section 3.11)**

5.2.1. Impact of Air Quality on Human Health

Exposure to air pollution is largely determined by the **air pollutants concentration** in the environment, as well as by the amount of **time people are exposed to those concentration values**. Globally, the exposure to air pollution mainly occurs indoors (homes, offices, and service buildings), as most people spend more time inside buildings (indoor air) than outside (ambient air). The assessment of "total exposure" should consider the contribution of pollutant concentrations in indoor air and ambient air, accounting for the time spent in the different environments (WHO, 2005). The main consequences of the high concentration of atmospheric pollutants on human health are related to the respiratory and cardiovascular system. The impact varies with the **exposure time**, **concentration**, and **vulnerability of the individual** (age, health, gender). It should be noted that respiratory diseases are a significant cause of death in the older population (over 65 years of age).

The following table summarizes some of the health effects of atmospheric pollutants that may be related to the development of the project, particularly during its construction.

Pollutant	Consequence on human health
Particulate Matter	Acute Exposure: • Nose and eyes irritation • Headaches • Tiredness • Nausea • Failure of the respiratory functions Continuous exposure: • Cough • Increase in secretions • Decrease of the respiratory functions
Carbon Monoxide	The increase of its concentration at ground level leads to the extension of the seasons and may result in more pollen production with aggravation of respiratory diseases. Its increased concentration in seawater makes the ocean water more acidic and contributes to adverse changes in the ecosystem, with implications for fisheries and food in certain regions of the world.
Nitrogen Oxides (Dioxide and Monoxide)	Bronchitis symptoms in asthmatic children increase when associated with long-term exposure
Sulfur Dioxide	Irritating to the mucous membranes of the eyes, nose, and throat. Long-term exposure can affect the respiratory system, cause changes in the defence mechanisms of the lungs and aggravate diseases such as asthma and chronic bronchitis and existing cardiovascular diseases.
Ozone	High concentrations induce damage to the respiratory mucosa and consequent inflammatory responses in the upper and lower airways. Prolonged exposure increases the risk of asthma exacerbation, particularly in children, decreased respiratory function, increased hospitalizations for respiratory diseases and increased premature mortality.

Table 5-3 – Health consequences of Exposure to air pollutants[46]

The impacts of air quality related to each study area is provided in Section 3.9.

[46] Source: Adapted from https://www.dgs.pt/paginas-de-sistema/saude-de-a-a-z/qualidade-do-ar-ambiente/efeitos-dos-poluentes-na-saude.aspx

5.2.2. Impact of noise pollution in Human Health

Noise consists of sounds that cause discomfort to the receivers and can affect the physical, mental, and social well-being of the population. Excessive noise seriously damages human health and interferes with people's daily activities at school, work, home, and leisure. It can disturb sleep, cause cardiovascular and psychophysiological problems, reduce performance, and cause behavioral changes (WHO [47]).

In Portugal, as indicated in Section 3.10, the General Noise Regulation (RGR), which is legislated by Decree-Law no. 9/2007, of 17th January, establishes noise exposure limits (ELVs) that seek to safeguard the well-being of populations, with direct effects on human health. These ELVs are, however, higher than the values recommended by the World Health Organization (WHO), to guarantee the health of the population exposed to noise.

A study by the WHO (Hurtley,2009) identified the adverse effects that the average annual exposure of the population to different noise levels at night can have on the health of the affected population.

- Thus, the following health effects of noise exposure of the population in the night period (Ln) are considered: Up to 30 dB- "It appears that up to this level no substantial biological effects are observed."

- 30 to 40 dB- "A number of effects on sleep are observed from this range: body movements, awakening, self-reported sleep disturbance, arousals. The intensity of the effect depends on the nature of the source and the number of events. Vulnerable groups (for example children, the chronically ill and the elderly) are more susceptible".

- 40 to 55dB – "Adverse health effects are observed among the exposed population. Many people must adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected."

- Above 55 dB – "The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence that the risk of cardiovascular disease increases"

The WHO Guideline Development Group for Environmental Noise Guidelines for the European Region (2018) agreed not to develop specific recommendations for occupational and industrial noise. Industrial noise can affect both people working at an industrial site and those living in its vicinity. The guidelines do not consider workers' exposure to noise in industrial environments as these are regulated by workplace standards and may, in some cases, require the wearing of protective equipment or application of other preventive and protective measures. Further, the guidelines do not explicitly consider industrial noise as an environmental noise source affecting people living in the vicinities of industrial sites. This is mainly due to the large heterogeneity and specific features of industrial noise, and the fact that exposure to industrial noise has a very localized character in the urban population. Therefore, the recommendation values to be considered are the general above mentioned (WHO,2018).

Further discussion on the impacts of noise related to each study area is provided in Section3.8.

The following subchapters summarise the current situation of the territories in terms of Human Health with a brief background of the affected region based on the Local Health Profile developed by the National Health System under the "Health Profiles" project and for Vigo, are based on data obtained at Instituto Galego de Estatística.

[47] http://www.euro.who.int/en/health-topics/environment-and-health/noise/noise

5.2.3. Matosinhos

The project area is part of the Matosinhos Health Centers Cluster (ULS Matosinhos) which is part of the Regional Health Administration of North (ARS Norte). Table 5-4 shows the characteristics of the cluster.

	Inhabitant Population	Aging Index	Elderly dependency ratio	Youth dependency ratio	Average life expectancy
Mainland	9 792 797	158.3	33.9	21.4	81.5
ARS Norte	3 569 608	153.1	29.9	19.5	81.8
ULS Matosinhos	173 753	152.0	30.7	20.2	81.7

Table 5-4 – Characteristics of ULS Matosinhos (2018)[48]

According to the Health Profile of Portugal (2017), written by the European Commission, and based on OECD health statistics for the year 2016, at least one third of the country's global disease burden is related to the following risk factors:

- Smoking
- Alcohol consumption
- Dietary habits; and
- Physical inactivity.

Through the study conducted on the age structure of the population living in the municipality of Matosinhos, *it was found that at least 35% of the population is considered vulnerable, since they are under 14 and over 65 years old.*

With regard to the response capacity of the counties in the study area in medical terms, the below indicators are evaluated:

- Health equipment (health centers and hospitals)
- Number of health professionals (doctors and nurses) per 1,000 inhabitants;

According to statistical data from INE available for the year 2020, the municipality that covers the study area has 9.5 doctors per 1 000 inhabitants. In the case of nurses in Matosinhos there are an average of 6.7 nurses per 1000 inhabitants (Table 5-5).

HEALTHCARE PERSONNEL	MAINLAND	NORTH REGION	METROPOLITAN AREA OF PORTO	MATOSINHOS
Doctors per 1,000 inhabitants (n. º)	5.6	5.6	7.5	9.5
Nurses per 1,000 inhabitants (n. º)	7.5	7.6	8.6	6.7

Table 5-5 – Number of health professionals available to the study area population (2020)[49]

The local health unit of Matosinhos provides primary, differentiated, and continuous health care and includes Pedro Hispano Hospital and the following units of Health Centers:

- Health Center Matosinhos
- Health Center São Mamede
- Health Center Senhora da Hora

[48]Source:http://www.arsnorte.min-saude.pt/wp-content/uploads/sites/3/2019/12/PeLS2018_A20_Matosinhos.pdf
[49] Source: INE, Health StatisticsEstatísticas do pessoal de saúde

- Health Center Leça da Palmeira
- Diagnostic Center for Pulmonology
- Public Health Unit
- SASU Matosinhos

5.2.4. Sines

The project area is part of the Litoral Alentejo Health Centers Cluster (ALS Litoral Alentejo) which covers the municipalities of Alcácer do Sal, Grândola, Santiago do Cacém, Sines, and Odemira and is part of Regional Health Administration of Alentejo (ARS Alentejo). Table 5-6 shows the characteristics of the cluster.

	Inhabitant Population	Aging Index	Elderly dependency ratio	Youth dependency ratio	Average life expectancy
Mainland	9 792 797	158.3	33.9	21.4	81.5
ARS Alentejo	473 235	209.6	42.0	20.0	80.3
ALS Litoral Alentejo	93 774	212.5	42.1	19.8	80.5

Table 5-6 – Characteristics of ALS Litoral Alentejo (2019)[50]

According to the Health Profile of Portugal (2017), written by the European Commission, and based on OECD health statistics for the year 2016, at least one third of the country's global disease burden is related to the following risk factors:

- Smoking
- Alcohol consumption
- Dietary habits; and
- Physical inactivity.

Through the study conducted on the age structure of the population living in the municipality of Sines, it was found that at least 36% of the population is considered vulnerable considering they are under 14 and over 65 years old.

With regard to the response capacity of the counties in the study area in medical terms, the below indicators are evaluated:

- Health equipment (health centers and hospitals); and
- Number of health professionals (doctors and nurses) per 1,000 inhabitants.

According to statistical data from INE available for the year 2020, the municipality that covers the study area has 2.9 doctors per 1 000 inhabitants. In the case of nurses in Matosinhos there was an average of 2.3 nurses per 1000 inhabitants (Table 5-7).

HEALTHCARE PERSONNEL	MAINLAND	ALENTEJO	ALENTEJO LITORAL	SINES
Doctors per 1,000 inhabitants (n. º)	5.6	3.2	2.1	2.9
Nurses per 1,000 inhabitants (n. º)	7.5	6.6	4.8	2.3

[50] Source:http://www.arsalentejo.min-saude.pt/utentes/saudepublica/ObservatorioRegionalSaude/Documents/PeLS2019_A49_ULS%20Litoral%20Alentejano.pdf

Table 5-7 – Number of health professionals available to the study area population (2020).[51]

The local health unit of Alentejo Litoral provides primary, differentiated, and continuous health care and includes Hospital Litoral Alentejano, and the following units of Health Centers:

- Health Center Alcácer do Sal
- Health Center Grândola
- Health Center Odemira
- Health Center Santiago do Cacém
- Health Center Sines

5.2.5. Estarreja

The project area is part of the Baixo Vouga Health Centers Cluster (ACeS Baixo Vouga) which covers the municipalities of Ovar, Murtosa, Estarreja, Server do Vouga, Albergaria-A-Velha, Server do Vouga, Aveiro, Ílhavo, Águeda, Vagos Oliveira do Bairro, Anadia and is part of the Regional Health Administration of Center (ARS Centro). Table 5-8 shows the characteristics of the cluster.

	Inhabitant Population	Aging Index	Elderly dependency ratio	Youth dependency ratio	Average life expectancy
Mainland	9 792 797	158.3	33.9	21.4	81.5
ARS Centro	1 663 772	201.6	38.4	19.1	81.7
ACeS Baixo Vouga	363 095	160.8	31.9	19.8	81.5

Table 5-8 – Characteristics of ACeS Baixo Vouga (2018)[52]

According to the Health Profile of Portugal (2017), written by the European Commission, and based on OECD health statistics for the year 2016 at least one third of the country's global disease burden is related to the following risk factors:

- Smoking
- Alcohol consumption
- Dietary habits; and
- Physical inactivity.

Through the study conducted on the age structure of the population living in the municipality of Estarreja, it was found that at least 34% of the population is considered vulnerable considering they are under 14 and over 65 years old.

With regard to the response capacity of the counties in the study area in medical terms, the below indicators are evaluated:

- Health equipment (health centers and hospitals); and
- Number of health professionals (doctors and nurses) per 1,000 inhabitants.

[51] Source: INE, Health Statistics
[52] Source:https://bicsp.min-saude.pt/pt/biufs/2/20019/QUEM%20SERVIMOS/PLS2016_A23_BV.pdf

According to statistical data from INE, available for the year 2020, the municipality that covers the study area has 3.4 doctors per 1 000 inhabitants. In the case of nurses in Matosinhos there was an average of 2.3 nurses per 1000 inhabitants (Table 5-9).

HEALTHCARE PERSONNEL	MAINLAND	CENTRO	REGIÃO AVEIRO	ESTARREJA
Doctors per 1,000 inhabitants (n. º)	5.6	5.3	3.8	2.3
Nurses per 1,000 inhabitants (n. º)	7.5	7.7	5.1	3.4

Table 5-9 – Number of health professionals available to the study area population (2020)[53].

The local health unit of Baixo Vouga provides primary health care and includes the following units of Health Centers:

- Health Center Águeda
- Health Center Albergaria-a-Velha
- Health Center Anadia
- Health Center Aveiro
- Health Center Estarreja
- Health Center Ílhavo
- Health Center Murtosa
- Health Center Oliveira do Bairro
- Health Center Ovar
- Health Center Sever do Vouga
- Health Center Vagos

5.2.6. Vigo

Table 5-10 presents the characteristics of the cluster according to Instituto Galego de Estatística (2019).

	Inhabitant Population	Average life expectancy
Spain	46,773,957	83.4
Galicia	2 701743	83.82
Pontevedra	954 877	83.97

Table 5-10 – Characteristics of Pontevedra (2019)

According to the Health Profile of Spain (2017), written by the European Commission, and based on OECD health statistics for the year 2016, at least one third of the country's global disease burden is related to the following risk factors:

- Smoking
- Alcohol Consumption; and
- Obesity.

Table 5-11 illustrates the distribution of the number of health facilities, health centres and the number of general doctors in Galicia, Pontevedra and Salvaterra de Miño. In Galicia there is about 2 629 doctors available, in Pontevedra 874 and in Salvaterra de Miño 5. For Pontevedra, considering the inhabitant population, there is about 0.9 general doctors for 1000 inhabitants.

[53] Source: INE, Health Statistics

HEALTHCARE	GALICIA	PONTEVEDRA	SALVATERRA DE MIÑO
Hospitals (n º)	35	13	0
Health facilities (n º)	398	92	1
General Doctor (n º)	2 629	874	5

Table 5-11 – Number of health professionals available to the study area population, health facilities and hospitals (2019)[54]

Salvaterra de Miño only has a health facility (Centro Salud Salvaterra), which includes the services of General Practitioner, Paediatrics and Nursing.

According to the statistical data, 23% of the population at Pontevedra has 65 or more years, therefore being more vulnerable to health issues. The population with less than 20 years represents 17.2%, however not all this population can be considered vulnerable, only children, especially under 5 years.

5.2.7. Valongo

The project area is part of the Maia/ Valongo Health Centers Cluster (ACeS Maia/ Valongo) which covers the municipalities of Maia and Valongo and is part of the Regional Health Administration of North (ARS Norte). Table 5-12 shows the characteristics of the cluster.

	Inhabitant Population	Ageing Index	Elderly dependency ratio	Youth dependency ratio	Average life expectancy
Mainland	9 792 797	158.3	33.9	21.4	81.5
ARS Lisboa e Vale do Tejo	3 569 608	153.1	29.9	19.5	81.8
AceS Arrábida	232 677	116.2	25.2	21.7	82.0

Table 5-12 – Characteristics of ACeS Maia/ Valongo (2018)55

According to the Health Profile of Portugal (2017), written by the European Commission, and based on OECD health statistics for the year 2016 at least one third of the country's global disease burden is related to the following risk factors:

- Smoking
- Alcohol consumption
- Dietary habits; and
- Physical inactivity.

Through the study conducted on the age structure of the population living in the municipality of Valongo, it was found that at least 33% of the population is considered vulnerable considering they are under 14 and over 65 years old.

With regard to the response capacity of the counties in the study area in medical terms, the below indicators are evaluated:

- Health equipment (health centres and hospitals); and
- Number of health professionals (doctors and nurses) per 1,000 inhabitants.

[54] Source: https://www.ige.eu/web/mostrar_seccion.jsp?idioma=gl&codigo=0202

[55] Source: http://www.arsnorte.min-saude.pt/wp-content/uploads/sites/3/2019/12/PeLS2018_A14_MaiaValongo.pdf

According to statistical data from INE, available for the year 2020, the municipality that covers the study area has 3.6 doctors per 1 000 inhabitants. In the case of nurses in Valongo there was an average of 4.3 nurses per 1000 inhabitants (Table 5-13).

HEALTHCARE PERSONNEL	MAINLAND	METROPOLITAN AREA OF LISBON	SETÚBAL
Doctors per 1,000 inhabitants (n. º)	5.6	5.6	7.5
Nurses per 1,000 inhabitants (n. º)	7.5	7.6	8.6

Table 5-13 – Number of health professionals available to the study area population (2020)[56]

The local health unit of Maia/ Valongo provides primary health care and includes the following units of Health Centres:

- UCC Águas Santas
- UCC Castelo da Maia
- UCC Ermesinde
- UCC Maia
- UCC Vallis Longus
- UCSP Ermesinde I
- UCSP Maia
- UCSP Valongo I (Campo)
- URAP Maia e Valongo
- USF Alfena
- USF Alto da Maia
- USF Bela Saúde
- USF Emilio Peres
- USF Ermesinde
- USF Íris
- USF Lidador
- USF Odisseia
- USF Pedras Rubras
- USF Pirâmides
- USF Santa Justa
- USF São João de Sobrado
- USF Saúde em Familia
- USF Terras da Maia
- USF Viver Mais
- USP Maia e Valongo

5.2.8. Setúbal

The project area is part of the Setúbal Health Centres Cluster (ACeS Arrábida) which is part of the Regional Health Administration of Lisbon e Vale do Tejo (ARS Lisboa e Vale do Tejo). Table 5-4 shows the characteristics of the cluster.

[56] Source: INE, Health Statistics

	Inhabitant Population	Ageing Index	Elderly dependency ratio	Youth dependency ratio	Average life expectancy
Mainland	9 839 140	149.6	32.4	21.6	81.3
ARS Lisboa e Vale do Tejo	3 631 935	138.7	33.6	24.2	81.2
AceS Arrábida	232 624	118.6	29.6	25.1	80.2

Table 5-14 – Characteristics of ACES Arrábida (2016)[57]

According to the Health Profile of Portugal (2017), written by the European Commission, and based on OECD health statistics for the year 2016, at least one-third of the country's global disease burden is related to the following risk factors:

- Smoking
- Alcohol consumption
- Dietary habits; and
- Physical inactivity.

Through the study conducted on the age structure of the population living in the municipality of Setúbal, *it was found that at least 36% of the population is considered vulnerable since they are under 14 and over 65 years old.*

With regard to the response capacity of the counties in the study area in medical terms, the below indicators are evaluated:

- Health equipment (health centres and hospitals)
- The number of health professionals (doctors and nurses) per 1,000 inhabitants.

According to statistical data from INE available for the year 2020, the municipality that covers the study area has 5.3 doctors per 1 000 inhabitants. In the case of nurses in Setúbal, there is an average of 10.1 nurses per 1000 inhabitants (Table 5-15).

HEALTHCARE PERSONNEL	MAINLAND	METROPOLITAN AREA OF LISBON	SETÚBAL
Doctors per 1,000 inhabitants (n. º)	5.6	6.8	5.3
Nurses per 1,000 inhabitants (n. º)	7.5	7.5	10.1

Table 5-15 – Number of health professionals available to the study area population (2020)[58]

The local health unit of Setúbal provides primary, differentiated, and continuous health care and includes S.Bernardo Hospital and Luz Hospital and the following units of Health Centres:

- UCSP São Sebastião
- UCSP São Nicolau
- UCC Península Azul
- USF São Filipe
- USF Luísa Todi
- UCSP Azeitão

[57] Source: https://bicsp.min-saude.pt/pt/biufs/3/30034/Pages/default.aspx
[58] Source: INE, Health Statistics

- UCSP Sado
- UCSP Praça da República

5.2.9. Trofa

The project area is part of the Santo Tirso/Trofa Health Centres Cluster (ACeS Santo Tirso/Trofa) which covers the municipalities of Santo Tirso and Trofa and is part of the Regional Health Administration of North (ARS Norte). Table 5-16 shows the characteristics of the cluster.

	Inhabitant Population	Aging Index	Elderly dependency ratio	Youth dependency ratio	Average life expectancy
Mainland	9 792 797	158.3	33.9	21.4	81.5
ARS Norte	3 569 608	153.1	29.9	19.5	81.8
ACeS Santo Tirso/ Trofa	106 781	168.7	29.4	17.5	81.6

Table 5-16 – Characteristics of ACeS Santo Tirso/Trofa (2018)[59]

According to the Health Profile of Portugal (2017), written by the European Commission, and based on OECD health statistics for the year 2016 at least one third of the country's global disease burden is related to the following risk factors:

- Smoking
- Alcohol consumption
- Dietary habits; and
- Physical inactivity.

Through the study conducted on the age structure of the population living in the municipality of Trofa, it was found that at least 32% of the population is considered vulnerable considering they are under 14 and over 65 years old.

With regard to the response capacity of the counties in the study area in medical terms, the below indicators are evaluated:

- Health equipment (health centres and hospitals); and
- Number of health professionals (doctors and nurses) per 1,000 inhabitants.

According to statistical data from INE, available for the year 2020, the municipality that covers the study area has 3.7 doctors per 1 000 inhabitants. In the case of nurses in Trofa there was an average of 4.0 nurses per 1000 inhabitants (Table 5-17).

HEALTHCARE PERSONNEL	MAINLAND	NORTE	METROPOLITAN AREA OF PORTO	TROFA
Doctors per 1,000 inhabitants (n. º)	5.6	5.6	7.5	3.7
Nurses per 1,000 inhabitants (n. º)	7.5	7.6	8.6	4.0

[59] Source: http://www.arsnorte.min-saude.pt/wp-content/uploads/sites/3/2019/12/PeLS2018_A12_SantoTirsoTrofa.pdf

Table 5-17 – Number of health professionals available to the study area population (2020)[60].

The local health unit of Santo Tirso and Trofa provides primary health care and includes the following units of Health Centres:

- UCC Provida
- UCC Santo Tirso
- UCC Trofa
- UCSP Alvarelhos
- UCSP Trofa
- URAP Santo Tirso e Trofa
- USF ao Encontro da Saúde
- USF Aves Saúde
- USF Caldas da Saúde
- USF Nova Saúde
- USF Ponte Velha
- USF São Tomé
- USF Uma Ponte para a Saúde
- USF Veiga do Leça
- USF Vil'Alva
- USP Santo Tirso e Trofa

5.2.10. Fafe

The project area is part of the Alto Ave Health Centres Cluster (ACeS Alto Ave) which covers the municipalities of Cabeceiras de Basto, Fafe, Guimarães, Mondim de Basto and Vizela is part of the Regional Health Administration of North (ARS Norte). Table 5-18 shows the characteristics of the cluster.

	Inhabitant Population	Aging Index	Elderly dependency ratio	Youth dependency ratio	Average life expectancy
Mainland	9 792 797	158.3	33.9	21.4	81.5
ARS Norte	3 569 608	153.1	29.9	19.5	81.8
ACeS Santo Alto Ave	248 463	133.9	25.1	18.7	82.2

Table 5-18 – Characteristics of ACeS Alto Ave (2018)[61]

According to the Health Profile of Portugal (2017), written by the European Commission, and based on OECD health statistics for the year 2016 at least one third of the country's global disease burden is related to the following risk factors:

- Smoking
- Alcohol consumption
- Dietary habits; and
- Physical inactivity.

[60] Source: INE, Health Statistics
[61] Source: http://www.arsnorte.min-saude.pt/wp-content/uploads/sites/3/2019/12/PeLS2018_A4_AltoAve.pdf

Through the study conducted on the age structure of the population living in the municipality of Fafe, it was found that at least 33% of the population is considered vulnerable considering they are under 14 and over 65 years old.

With regard to the response capacity of the counties in the study area in medical terms, the below indicators are evaluated:

- Health equipment (health centres and hospitals); and
- Number of health professionals (doctors and nurses) per 1,000 inhabitants.

According to statistical data from INE, available for the year 2020, the municipality that covers the study area has 3.6 doctors per 1 000 inhabitants. In the case of nurses in Fafe there was an average of 5.7 nurses per 1000 inhabitants (Table 5-9).

HEALTHCARE PERSONNEL	MAINLAND	NORTE	AVE	FAFE
Doctors per 1,000 inhabitants (n. º)	5.6	5.6	3.6	3.6
Nurses per 1,000 inhabitants (n. º)	7.5	7.6	5.6	5.7

Table 5-19 – Number of health professionals available to the study area population (2020)[62].

The local health unit of Alto Ave provides primary health care and includes the following units of Health Centres:

- UCC Cabeceiras de Basto
- UCC FafeSaúde
- UCC Novo Amanhecer
- UCC Sol Invictus
- UCC Vizela
- UCSP Amorosa
- URAP Alto Ave
- USF Afonso Henriques
- USF Amorosa XXI
- USF Ara de Trajano
- USF arco de Baúlhe/ Cavez
- USF Arões
- USF Duovida
- USF Fafe Sentinela
- USF Montelongo
- USF Moreira de Cónegos
- USF Nós e Vós Saúde
- USF Novo Cuidar
- USF Novos Rumos
- USF o Basto
- USF Pevidém
- USF Physis
- USF Ponte
- USF Ronfe
- USF São Nicolau

[62] Source: INE, Health Statistics

- USF São Torcato
- USF Senhora da Graça
- USF Serzedelo
- USF Vimaranes
- USP Alto Ave

6. Risk Analysis

Category	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
	• Low risk in terms of the occurrence of flood, droughts, heat waves, strong winds and earthquakes • Considerable level of risk in terms of infrastructure /transportation accidents • Low fire danger index	• Low risk in terms of the occurrence of flood, droughts, heat waves, strong winds and earthquakes • Low level of risk in terms of infrastructure /transportation accidents • Low fire danger index	• Highest risk in terms of the occurrence of flood, droughts, heat waves, strong winds and earthquakes • Highest of risk in terms of infrastructure /transportation accidents • Low fire danger index	• Considerable risk in terms of the occurrence of flood, droughts, heat waves, strong winds and earthquakes • Lowest risk in terms of infrastructure /transportation accidents • Highest fire danger index	• Considerable risk in terms of the occurrence of flood, droughts, heat waves, strong winds and earthquakes • Low level of risk in terms of infrastructure /transportation accidents • Unclassified fire danger index	• Low risk in terms of the occurrence of flood, droughts, heat waves, strong winds and earthquakes • Low level of risk in terms of infrastructure /transportation accidents • Low fire danger index	• Low risk in terms of the occurrence of flood, droughts, heat waves, strong winds and earthquakes • Low level of risk in terms of infrastructure /transportation accidents • Low fire danger index	• Low risk in terms of the occurrence of flood, droughts, heat waves, strong winds and earthquakes • Low level of risk in terms of infrastructure /transportation accidents • Low fire danger index
Natural Risks	1	2	4	3	4	3	3	2
	Analysed in climate change and geological components (Section 3.2 and 3.4)	Analysed in climate change and geological components (Section 3.2 and 3.4)	Analysed in climate change and geological components (Section 3.2 and 3.4)	Analysed in climate change and geological components (Section 3.2 and 3.4)	Analysed in climate change and geological components (Section 3.2 and 3.4)	Analysed in climate change and geological components (Section 3.2 and 3.4)	Analysed in climate change and geological components (Section 3.2 and 3.4)	Analysed in climate change and geological components (Section 3.2 and 3.4)
Technological risks	3	2	4	1	4	1	1	1
	• 2 SEVESO industries within 2km proximity – manufacturing, storage • 5 SEVESO industries within 2km to 5km proximity) – oil terminal, ports	• 1 SEVESO Industry within the site location • 7 SEVESO industries are located between 2 km and 8km from the project area • Port of Sines is located at more	• 3 SEVESO industry, with High level activity within the study area (within 2km) • 2 SEVESO industry, with low level activity within the study area (within 2km)	• No SEVESO industries in the study area. • A quarry (Áridos do Mendo) within the study area. • Rupture of existing infrastructure, such as water pipelines, will be	• 5 SEVESO industry, with High level activity within the study area (within 2km) • 1 SEVESO industry, with low level activity within the study area (within 2km)	• No SEVESO industries within the study area • Roads in the vicinity of refinery, which are main roads and highways and a railway	• No SEVESO industries within the study area • Roads in the vicinity of refinery, which are mainly for local traffic. • Rupture of existing infrastructure, such as water	• No SEVESO industries within the study area • Rupture of existing infrastructure, such as water pipelines, will be minor for the lithium refinery

Category	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
	• Sá Carneiro Airport located at 3 km from the site location limits • Roads in the vicinity of refinery, which are mainly for local traffic. • Rupture of existing infrastructure, such as water pipelines, will be minor for the lithium refinery operation conditions	than 3 km from the refinery limit – fuel storage (coal and oil) • Quarry Monte Chãos approximately 3 km from the refinery limits (explosives) • Roads in the vicinity of refinery, are used as an important hub for national and transnational freight. • Rupture of existing infrastructure, such as water pipelines, will be minor for the lithium refinery operation conditions	• The closest roads are used for transport of hazardous substances to and from the Eco Park • Rupture of existing infrastructure, such as water pipelines, will be minor for the lithium refinery operation conditions	minor for the lithium refinery operation conditions	• The closest roads are used for transport of hazardous substances to and from the Sapec Bay	• Rupture of existing infrastructure, such as water pipelines, will be minor for the lithium refinery operation conditions	pipelines, will be minor for the lithium refinery operation conditions	operation conditions
	1	1	2	4	2	4	4	2

Category	Matosinhos	Sines	Estarreja	Vigo	Setúbal	Valongo	Trofa	Fafe
Mixed risks (forest fires)	• Fire danger index mainly moderate in the study area. • No forestation in site location	• Fire danger index is low to medium in the project site area • Minimal vegetation, coastal shrubland	• Fire danger index is low to medium in the project site area • Within the project area, the fire danger index is very low. • Surrounded by forest, bushland	• High frequency of forest fire. • Included in an artificialized area. Surrounded by forest and bushland intercalated with population clusters. • Surrounded by forest, bushland	• Fire danger index is unclassified in the project site area • The study area is also mainly unclassified with very low to very high spots on the north side. • No forestation in site location	• Fire danger index mainly unclassified for the study area with very high and high spots in the northern limit. • Fire danger index unclassified for the project area • Historically affected by wildfires (most recent ones in 2016 and 2017) • Surrounded by bushes and forest, with occasional presence of industry. Traffic roads in the terrain boundaries.	• Fire danger index is mainly unclassified for the study area, with very low to very high spots on the north side. • Within the site location, the fire danger index is unclassified. • Surrounded by industry and small population clusters LOW Risk	• Fire danger index mainly unclassified for the study area with very high and high spots in the northern limit. • Fire danger index unclassified for the project area • Historically affected by wildfires (most recent ones in 2016 and 2017) • Surrounded by bushes and forest, with occasional presence of industry. Traffic roads in the terrain boundaries. HIGH RISK
Total Score	5	5	10	8	10	8	8	5
Quantitative level	**1**	**1**	**4**	**3**	**4**	**3**	**3**	**1**

Table 6-1 – Characterisation of risk analysis in the study area

6.1. OVERALL CONSIDERATIONS

The amendments introduced by Decree-Law No. 152-B/2017 of December 11 in the RJAIA, have enforced the need to assess not only the risks of the Project to the environment, but also the risks of the environment on the Project, assessing its vulnerability and resilience in situations of risk or serious accidents and disasters and the resulting effects. Thus, this chapter presents this risk analysis, which will consider the recommendations of the Manual for Environmental Impact Assessment in the civil protection aspect, for energy transport infrastructure (ANPC, 2008).

The risk can be defined as the product of the probability of occurrence of an event (accident scenario) and the potential negative consequence of the event on the natural, human and socio-economic environment (UNE 150008:2008). The concept of risk can also be translated into the following calculation formula (Houdijk, 2012):

$$Risk = \underbrace{probability * effect}_{Danger} * \overbrace{exposition * susteptibility}^{Environment\ vulnerability}$$

Impact

Considering the project typology in question (Lithium Refinery), its location and surroundings, as well as the analysis prior to the various environmental components, it is necessary to evaluate risks external to the Project and risks intrinsic to the Project which come from its construction and operation.

Also consulted was the document of National Risk Assessment (2019), adopted by the National Commission of Civil Protection in 2014 and with first amendment in 2019, which performs the identification and characterisation of the dangers of natural, technological or mixed genesis likely to affect the national territory having considered for analysis the risks applicable to the Project under study.

For external risks and as presented in the National Risk Assessment document, the following are considered:

- Natural Risks – related to adverse weather phenomena (heat waves and strong winds), extreme hydrological conditions (floods and droughts) and geodynamic phenomena (earthquakes);
- Technological risks – related to transport and infrastructure accidents (e.g. road accidents, airplane accidents, collapse of tunnels, bridges and infrastructure and dam rupture);
- Mixed risks - related to the atmosphere, such as forest fires.

Based on the previous analysis of the various environmental factors, it is considered that in the Project area and surrounding there are natural risks - arising from adverse weather and earthquakes - and mixed risks, arising from the risk of fires in adverse weather conditions. The mixed risks are covered within previous sections (Section 3.2.2).

6.2. EXTERNAL RISKS ANALYSIS – NATURAL RISKS

In terms of natural risks, the impacts identified and related to the occurrence of extreme meteorological phenomena are evaluated within the climate change risks (Section 3.3) and the geodynamic phenomena is analysed in relation to Geology and Geomorphology (Section 3.5).

6.3. EXTERNAL RISKS ANALYSIS – TECHNOLOGICAL RISKS

The Decree Law nº 150/2015, August 5 "*establishes a system for the prevention of major accidents involving dangerous substances and the limitation of their consequences for human health and the environment,*

transposing Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances". The referred law differentiates the level of the industry based on the quantity of hazardous substances.

6.3.1. Matosinhos

Technological risks in proximity of industrial installations covered by the SEVESO Directive (Figure 2.1) are:

- Gasin Manufacturing Unit for Industrial gas and chemical products with a lower level, about 1.2 km northeast from the refinery implementation area
- The Pergás Gas Storage Unit about 0.5 km northeast from the refinery site location, with higher level.
- Cepsa, about 3.4 km southeast east, with higher level.
- Leixões Port Oil Terminal, about 3.6 km south, with higher level.
- Repsol, about 3.8 km south, with higher level
- Luís Simoes, about 4.5 km, with higher level.
- Fater Portugal, about 4.6 km southeast, with higher level.

Potential serious accidents involving hazardous substances in Avenida da Liberdade, located on the western side of the refinery, are considered not to be a source of danger, considering that this road was excluded from the main distribution network according to the municipal mobility and transportation plan.

The risk to the project in this location of occurrence of accidents due to SEVESO facilities is very high.

There are other potential technological risks to be considered in this site location. The proximity to an airport (Sá Carneiro Airport is located at 3 km from the site location limits), increases the risks of an accident, with critical consequences to the refinery, and all the surrounding area. However, the probability of an accident occur during the landing and take-off are very reduced. Accidents occurred within airport limits will not affect the refinery, considering the distance between them.

The main source of danger of Port of Leixões, located at 2 km from the site refinery, is the SEVESO activity, previously identified. The other possible accidents, involving the maritime transport, will have minor consequences for the Refinery activity.

In terms of roadway accidents, they assume more importance when involve hazardous substances. The closest roads from the site refinery are Avenida da Liberdade, Rua Belchior Robbles and Rua Dom Marcos da Cruz. Any accidents occurring in these roads, will potentially affect all the infrastructures in the vicinity.

The consequences of the rupture of infrastructures, like water pipelines, will be minor for the lithium refinery operation conditions.

6.3.2. Sines

Technological risks in proximity of industrial installations covered by the SEVESO Directive (Figure 2.2) are:

- Sines Refinery (in the vicinity);
- Indorama Ventures Portugal Chemical company, about 2.3 km northwest, with a lower level
- EuroResinas Chemical Industry Unit, about 2.8 km northwest, with a higher level
- Ecoslops Portugal Oil Refining Unit, about 7.3 km west, with a lower level
- Repsol, about 3.8 km northwest, with higher level,
- Repsol Polymers, about 3.5 km, with a higher level
- LNG terminal, about 4.6 km southwest, with a higher level
- Sines Bulk Liquid Terminal, about 7,4 km southwest, with a higher level

In case of accidents occurring in these facilities the risk to the project is high.

In respect to the oil&gas company, located close to the future lithium refinery, one common hazard is the one of fire or explosion, resulting from the presence of flammable liquids and gases. Toxic chemicals or gases encountered during these processes may present an additional risk of burns, asphyxiation, cancer, or system corrosion.

The refining process results in several different hazardous materials being released into the atmosphere. As well as the risk of industrial exposure to chemicals, or accidents such as explosions or fire, health and hygiene hazards must also be considered. These are caused by air contaminants which could either be part of the routine refining process. or that could unexpectedly escape into an oil refinery.

Crude oil itself contains thousands of hydrocarbons and other chemicals, exposure to many of which can result in short- and long-term health problems, corrosive burns or asphyxiation.

In order to reduce these risks to life, property, or the wider environment, gas and oil companies are required to follow strict, mandatory safety practices, which lead to a lower and reasonable risk. In fact, lithium refineries operating in other countries are often close to oil&gas companies, without major risks associated, or registry of other problems.

In regards to potential serious accidents involving hazardous substances in IP8/A26, located on the north and the west side of the refinery, which functions as a hub for national and transnational freight, connecting the Port of Sines to Spain, which can increase the risk of potential hazardous accidents.

There are other potential technological risks to be considered in this site location, like the Port of Sines, and the quarry Monte Chãos, located at about 3,5 km and 3 km from the site refinery.

The main source of danger of Port of Sines, is the fuels storage (coal and oil, mainly), and the existing fuel station. Any accidents involving these substances will not affect the refinery, considering the distances between them.

From the quarry, the main danger is related to the potential use of explosives for dismantling. The distance of 3 km between the project area and the quarry boundaries, shows a low risk for the project.

About potential major accidents involving hazardous substances in IP8/A26, located on the north and the west side of the refinery, it is known that these main roads function as a hub for national and transnational national and transnational freight, connecting the Port of Sines to Spain, which can increase the risk of potential hazardous accidents.

The consequences of the rupture of infrastructures, like water pipelines, will be minor for the lithium refinery operation conditions.

6.3.3. Estarreja

Technological risks in proximity of industrial installations covered by the SEVESO Directive (Figure 2.3) are:

- Dow Portugal Chemical Products Unit, about 0.74 km northeast, with a higher level
- Air Liquide Portugal Gas Production Unit, about 1 km northeast, with a lower level;
- NCD Natural Detergents Company, about 1.2 km to northeast, with a lower-level activity
- Bondalti Chemical Industry Unit, about 1.32 km northeast, with a higher-level.
- Cires Synthetic Resins Unit, about 1.4 km northeast, with a higher-level.

The risk to the project in this location of the occurrence of accidents from these facilities is very high.

Besides SEVESO industries the other technological risk identified in the surroundings of the study area is the traffic road.

In terms of roadway accidents, they assume more importance when involving hazardous substances. The closest roads from the site refinery are the internal roads in the Eco Park and the EN224 and EM558. Any accidents occurring in these roads will potentially affect all the infrastructure in the vicinity.

Rupture of infrastructures, like water pipelines, will be minor for the lithium refinery operation conditions.

6.3.4. Vigo

In the vicinity of the project area, there are no SEVESO industries. However, a quarry of relevant dimension is operating within the study area (Áridos do Mendo).

Considering that the project stays downwind from the quarry, and at a distance of about 600 meters, there are potential risks from its activity, like the blast noise, the dust emission and vibrations (assuming the use of explosives for dismantling). The risk to the project operation from the quarry activity is low.

In terms of roadway accidents, they assume more importance when involving hazardous substances. The closest roads from the site refinery are the internal roads in the PLISAN area. Any accidents occurring on these roads will potentially affect all the infrastructures in the vicinity.

Rupture of infrastructures, like water pipelines, will be minor for the lithium refinery operation conditions.

6.3.5. Setúbal

The SAPEC Bay is an area with a high level of industrial use. Due to their size and characteristics, these industries have technological risks that need to be considered.

Technological risks in the proximity of industrial installations covered by the SEVESO Directive are:

- SAPEC Quimica
- Adubos Deiba
- ASCENZA AGRO
- Navigator Pulp and paper
- Tanquisado
- Sopac - Sociedade Produtora de Adubos Compostos

The risk to the project in this location of the occurrence of accidents from these facilities is very high, including the risks related to industrial fires.

Besides the industrial risk, the Mitrena Peninsula is an area with frequent heavy goods and hazardous materials transportation, including crude oil, which increases the risk of hazardous accidents. Crude oil itself contains t hydrocarbons and other chemicals, exposure to many of which can result in short- and long-term health problems, corrosive burns or asphyxiation.

To reduce these risks to life, property, or the wider environment, gas and oil companies are required to follow strict mandatory safety practices which lead to a lower and reasonable risk. Lithium refineries operating in other countries are often located close to oil and gas companies without major risks associated or registry of other problems.

The closest roads from the site refinery are the internal roads in the SAPEC Bay and the EN 10-4 and EN 10-8. the Project's use of these roads may increase the risk of potentially hazardous accidents.

The consequences of the rupture of infrastructures like water pipelines will be minor for the lithium refinery operation conditions.

6.3.6. Valongo

In the vicinity of the project area, there are no SEVESO industries.

In terms of roadway accidents, they assume more importance when involving hazardous substances. The closest roads from the site refinery are highways A41/IC24. Any accidents occurring on these roads will potentially affect all the infrastructures in the vicinity.

Rupture of infrastructures, like water pipelines, will be minor for the lithium refinery operation conditions.

6.3.7. Trofa

In the vicinity of the project area, there are no SEVESO industries. However, an ongoing landfill is operating in the surroundings of the study area (Resinorte).

The impacts of the landfill will be common to all the infrastructures and population in the surroundings due to the fact that the soil and the water resources are the receiving environments.

In terms of roadway accidents, they assume more importance when involving hazardous substances. The closest roads from the site refinery highway A3 and EN104. Any accidents occurring on these roads will potentially affect all the infrastructures in the vicinity.

Rupture of infrastructures, like water pipelines, will be minor for the lithium refinery operation conditions.

6.3.8. Fafe

In the vicinity of the project area, there are no SEVESO industries. However, an ongoing landfill is operating in the surroundings of the study area (EMAFEL).

The impacts of the landfill will be common to all the infrastructures and population in the surroundings due to the fact that the soil and the water resources are the receiving environments.

Considering the high density of businesses and industries in the area, industrial and urban fires might constitute a risk to the refinery.

In terms of roadway accidents, they assume more importance when involving hazardous substances. The closest roads from the site refinery EN207 and the municipal path CM 1687. Any accidents occurring on these roads will potentially affect all the infrastructures in the vicinity.

Rupture of infrastructures, like water pipelines, will be minor for the lithium refinery operation conditions.

7. Considerations for the implementation project

The impacts of the project operation were analysed in the previous chapters. However, the project impacts are also related to the construction phase. In this chapter is presented some considerations for the project implementation, as a complementary input to the decision-making process. The comparative analysis excluded this assessment.

	MATOSINHOS	SINES	ESTARREJA	VIGO	SETÚBAL	VALONGO	TROFA	FAFE
Artificialization	1	4	3	2	3	4	4	4
	Industrial area already occupied. Might be necessary to remove or adapt some existing structures	Predominantly forest area	Site location framed in industrial area but never been occupied	Site location framed in industrial area but never occupied for another industry. Intervened area	Site location framed in industrial area but never occupied for another industry. Intervened area	Predominantly forest area	Predominantly forest area	Predominantly forest area
Topography	1	2	2	1	1	2	4	3
	Artificial topography	Gently sloping towards the sea	Gentle slope	Artificial topography	Artificial topography	Steeper slopes in the northern sector of the site; remaining area of gentle slope	Significant slopes	Some sloping
Visual display	1	2	1	2	2	3	3	4
	Coastal surroundings with leisure, recreation, and sports facilities, but still, an artificialized landscape with a variety of situation including the high density of urban settlements, agricultural land and industry, namely the refinery in decommission	Coastal surroundings landscape with a high identity, but still artificialized landscape mixing agricultural temporary use with industrial developments, namely Sine's refinery and other industries. The urban settlements appear when moving towards	Coastal surroundings, but still artificialized landscape mixing forests with industrial and under construction areas. Small urban settlements in the surroundings of the site location. The N224 road traffic will be	Inland surrounding, but still artificialized landscape due to earth movements in the past. Small agricultural settlements in the surroundings of the site location. The AG51 road traffic will be visually impacted by the refinery	Coastal surroundings landscape with a high identity due to the Sado estuary and the industrial area. Artificialized landscape with industrial and harbour areas. Small fishing districts in the surroundings. The N10-4 road traffic will visually be impacted by the refinery	Heavily disturbed Landscape by uncontrolled urbanisation close to a large metropolitan city. Artificialized landscape mixing extensive forest area, agricultural land with industry placements. At less than 1 km from the site location there is an equestrian	Heavily disturbed Landscape by uncontrolled urbanisation close to a large metropolitan city. Artificialized landscape and agricultural land with industry placements. The A3 road traffic will be visually impacted by the refinery	Landscape with an average identity as result of the banalisation of dispersed construction without landscape integration. On the north site it is possible to find an outdoor public pool (Aquaplay) and two touristic developments that will be visually

	MATOSINHOS	SINES	ESTARREJA	VIGO	SETÚBAL	VALONGO	TROFA	FAFE
	phase. Relevant heritage in the nearby area, Natural Pools and casa de Chá da Boa Nova	the coastal line (fishing districts). The IP8 road traffic be will visually impacted by the refinery	visually impacted by the refinery		Proximity to the sandbank of Tróia (heritage)	centre to be considered. The A41 road traffic will be visually impacted by the refinery		impacted by the refinery
Land Use & Characteristics	1	2	2	1	1	2	2	2
	Area already built and paved (impermeable)	Unpaved, permeable area of pine forest and agricultural areas.	Unpaved and permeable area, composed of eucalyptus forests.	Unpaved, permeable area; existing earth movements in the past	Unpaved and permeable area; existing earth movements in the past	Unpaved and permeable area, composed of shrubs and eucalyptus forest	Unpaved and permeable area, composed of eucalyptus forest and dry and irrigated crops	Unpaved and permeable area, composed of eucalyptus forest and dry and irrigated crops
Loss of carbon sinks	1	3	4	1	1	3	4	4
	No deforestation needed	Deforestation of some pinus pinaster and pinus pinea forest that might imply compensatory measures	Deforestation of eucalyptus forest that implies compensatory measures	No deforestation needed	No deforestation needed	Deforestation of some eucalyptus forest that might imply compensatory measures	Deforestation of eucalyptus forest that implies compensatory measures	Deforestation of different forest types that implies compensatory measures
Earthmoving to regularise topography	1	2	2	1	2	2	4	3
	No need	Limited earthmoving	Limited earthmoving	No need	Limited earthmoving	Limited earthmoving	Important land movements probably needed	Some Important land movements probably needed
Total Score	6	15	14	8	10	16	19	20
Quantitative level	1	3	3	2	2	3	4	4

Table 7-1 – Comparison based on the construction work need

8. ENVIRONMENTAL PERMITTING ROADMAP ASSESSMENT

Throughout this assessment, it should be noted that the responsible entity timings are by the duration defined in the law and are subject to change, which means that variances from the effective time can occur. From experience, in Portugal, the legal timings tend to be extended for various number of reasons.

It should also be noted that the necessary studies for each EIA vary based on the project nature, location and scope. In this sense, if locations change, the refinery might need further studies covering soil and water contamination, air quality, noise, etc., which may influence the cost of the study.

Assuming that the EIA in the Vigo location is submitted together with the AAI (9 months), as it should be, and that all the steps of the AIA in Portugal are followed, such as PDA, and that the LUA regime integrates all the legal regimes (approximately 12 months), it is possible to conclude, that in general, the process in Spain is faster.

Country	Phase	Estimated Time		Estimated Cost	
		Assessment - Report	**Duration of the legal process**[63]	**Assessment - Report**	**Duration of the legal process**
Portugal	PDA	**1-2 months**	According to the Art 12.º of the Decree Law n. º 152-B/2017, at least **80 days**	150 000 € - 200 000 €[1]	According to the article 3º, paragraph 1 of the Decree Law nº368/2015, for the chemical industry the fee of this procedure is **10 000€, plus 3 000 €** (article 3º, paragraph 2, subparagraph B)
	EIA	**3-4 months**	According to the article 19º, paragraph 2 and subparagraph b), of the Decree Law 151-B/2013: for projects related to industrial activities, the environmental decision issued in **90 days**, counting from receiving the EIA data, under penalty of tacit approval. It should be noted that, according to the artº24, paragraph 5, APA may request additional elements necessary for the analysis therefore suspending the deadline. This may **add up 45 days** to the original 90 days, leading to an estimated time of more or less **135 days**		
	LUA	--------	According to the Annex of the Decree Law nº 75/2015 of May 11th, at least **110 days**.[2]	------	
	LA	--------	According to the article 36.º, paragraph 3 and article 40.º,	-----	

[63] All the legal timings are presented in calendar days

Country	Phase	Estimated Time		Estimated Cost	
		Assessment - Report	Duration of the legal process[63]	Assessment - Report	Duration of the legal process
			paragraph 4, of the Decree Law 127/2013: "3- the LA procedure could take place simultaneously with the AIA if it's issued in the **detail design phase**". "4 - When the LA procedure is carried out simultaneously with the AIA, the decision on the LA request is pronounced within **10 days after the issuing of the DIA**." According to the article 36.º, paragraph 1 and article 40.º, paragraph 2, of the Decree Law 127/2013: "1 - The installation subject to EIA, the LA request is delivered after: b) The issue of the DCAPE, when the AIA is in the **preliminary study or draft phase**;" "2 - For installations in **preliminary study phase**, APA issues the decision in **50 days**."		
	RECAPE[3]	**2-4 months**[4]	According to the article 21º, paragraph 7, of the Decree Law 151-B/2013, of October 31st: The decision on the environmental conformity of the implementation project shall be issued within **50 days**, counting from the date of receipt by APA, under penalty of tacit approval.	75 000 € - 100 000 €	According to the article 4º, paragraph 1 of the Decree Law nº368/2015, for the chemical industry the fee of this procedure is **5 000€**
Spain	AAI	**3-4 months**	**9 months**	150 000 € - 200 000 €[1]	**846,27 €** [64]

[64] Tarifas vigentes de tasas - Axencia Tributaria de Galicia (atriga.gal)

Country	Phase	Estimated Time		Estimated Cost	
		Assessment - Report	Duration of the legal process[63]	Assessment - Report	Duration of the legal process
	EIA	**3-4 months**	According to the articles 8º, 9º, 10º and 11º, of the Decree Law 133/2008 of June 12th: The licensing is issued in more or less **105 days.** It should be noted that some of the deadlines may be extended by a **further 15 days** and that in a few cases the municipality may suspend the duration of the maximum period for deliberating purposes. This suspension period **may not exceed 3 months** in any case (Art 5º, subparagraph c), Law 30/1992, November 26th.	75 000 € - 100 000 €	**A specific fee does not exist for this process**

Table 8-1 – Environmental Roadmap assessment

Notes:
1 - Base value for EIA study including essential monitoring procedures like air quality, noise, archaeological and biodiversity, but excluding detailed characterisation of soil and water contamination or other additional detailed studies
2 – Assuming that all the regimes and procedures identified are applied to the lithium refinery
3 - In case the EIA has concerns regarding the pre-study phase of the project
4 -The time and cost of the reports do not include the complementary studies that the responsible entity might ask for during the process (unpredictable at this stage)

8.1. ENVIRONMENTAL PERMITTING OF LITHIUM REFINERY PROJECT – PORTUGUESE SITE LOCATION

According to the Portuguese legislation in force, to be able to operate, industrial projects must have an environmental permit that is obtained through the **LUA – Licenciamento Único Ambiental** (unique environmental permit). As a result of LUA process, a **TUA – Título Único Ambiental** (single environmental title) will be issued by the Portuguese Environmental Authority: *APA- Agência Portuguesa de Ambiente, I.P*. The TUA is a document that brings together all the requirements for the construction, operation, monitoring and deactivation/closure of a specific project, in regards to the environment, as well as all the administrative authorizations required by all environmental regimes to which the project is subject.

The TUA of a project is issued with the first environmental approval of the project.

The achievement of a TUA may involve different and complementary stages of approval as globally established in LUA regime on Decree-Law n. 75/2015, of May 11th which defines the proceedings for getting the TUA, considering all legal regimes applicable.

LUA regime integrates, among others, the obligations under the following regimes:

- Legal Regime of Environmental Impact Assessment (RJAIA)
- Legal Regime for Industrial Emissions (REI) applicable to the Integrated Prevention and Pollution Control (IPPC)
- Legal Regime for the Prevention of Major Accidents involving Hazardous Substances (RPAG)
- European Union Emissions Trading Scheme (CELE)
- General Solid Waste Management regime (SWM)
- Legal Regime for the Use of Water Resources (RJURH)

It should be noted that not all these regimes may be applied to the lithium refinery, which should be assessed with detailed information about the project through the comparison of project activity data with the limits and requirements established for each regime.

Regarding **Environmental Impact Assessments**, the Portuguese legal framework relies on the ***RJAIA – Regime Jurídico de Avaliação de Impacte Ambiental*** - established by the Decree-Law n. 151-B/2013, of October 31st altered and republished in the Decree-Law n. 152-B/2017, of December 11th.

Lithium refinery Project, under RJAIA must be subject to an Environmental Impact Assessment due to Article 1st, n. 3 paragraph a), because it can be framed into n.4 of Annex I subparagraph b), as follows:

- Annex I, n.º 4 "Installations for the production of non-ferrous raw metals (lithium) from ores, concentrates or secondary raw materials metallurgical, chemical or electrolytic processes."

Regarding the Lithium Refinery project, the first stage of an EIA proceeding should be the creation of the ***PDA – Proposta de Definição de Âmbito*** (Scope Definition Proposal). This document is not mandatory, however, it is recommended to be performed for large projects with high publicity. This document defines the scope proposed for the Environmental Impact Study, establishes the importance of each environmental factor determining which of them are more relevant for the project assessment in terms of the environment; and establishes how in-depth each environmental component will be developed.

The approval of the PDA guarantees the commitment of the Authorities to the scope of the EIA and the degree of analysis to be considered in the EIA for each environmental factor.

The AIA assessment procedure may occur with the project in the preliminary study or draft project phase or in the detailed design phase.

In this sense, the two possible ways for the AIA process will involve:

1.Detailed design phase: EIA => **DIA**-> LA => **TUA**

- In the submission of the EIA at the project execution stage, the EIA procedure consists of a single moment, which culminates with the issuing of the DIA that determines the environmental viability of the project.

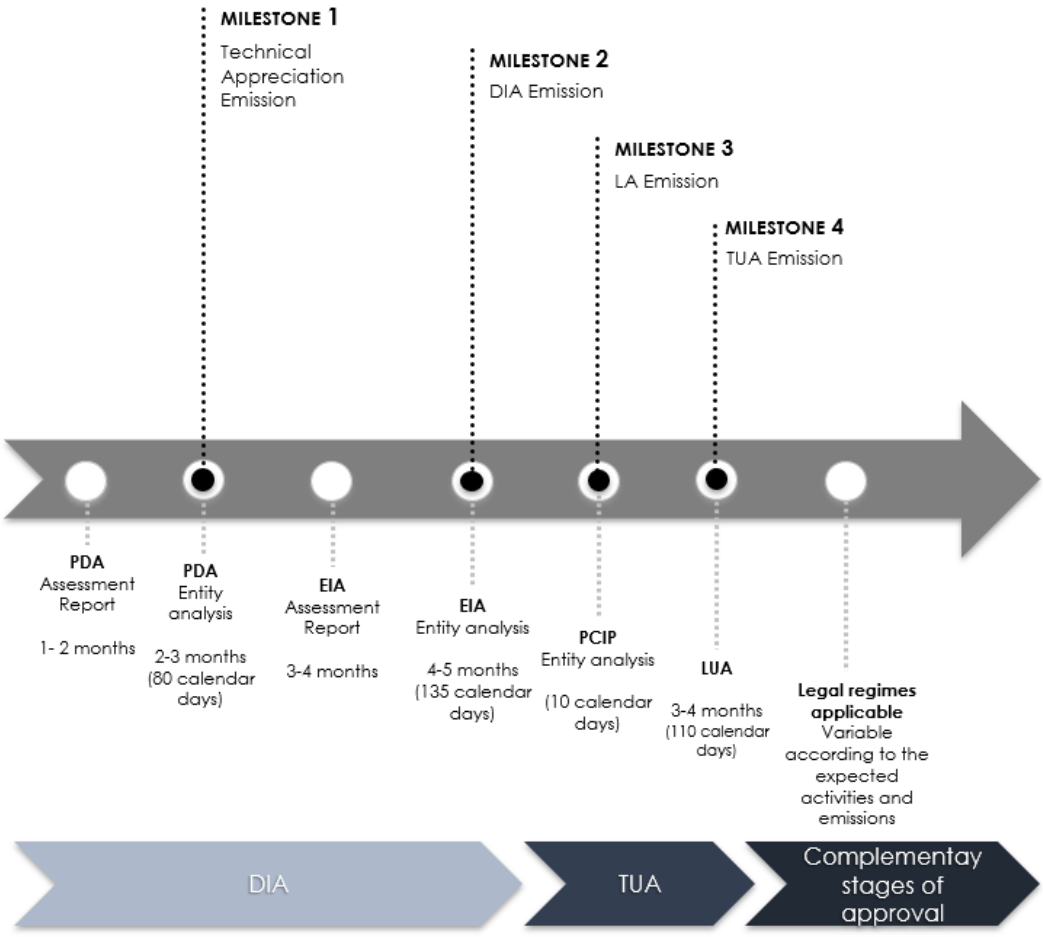


Figure 8-1 – Timeline of the AIA process in the detailed design phase

2.Preliminary study phase: EIA => **DIA ->** RECAPE => **DCAPE** -> LA => **TUA**

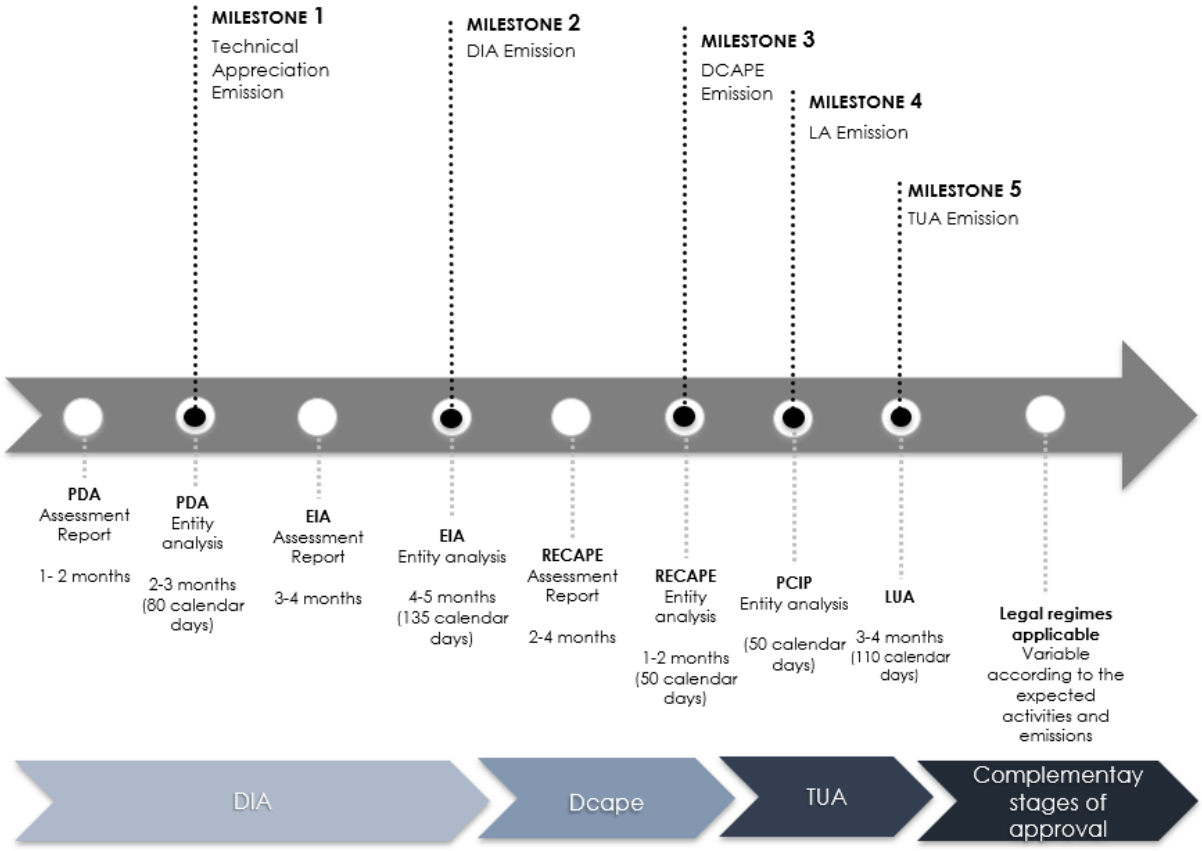


Figure 8-2 – Timeline of the AIA process in the preliminary study phase

- In the submission of the EIA at the preliminary study or draft stage, the EIA procedure comprises **two complementary moments**:
    - The assessment of the project itself - issuing of the decision on environmental viability (DIA)
    - Verification of the environmental conformity of the implementation project – compliance of the preliminary study project with the conditions of the designated DIA, and which ends with the issuing of a decision on that conformity (DCAPE).

Each phase of the AIA is described below:

- **EIA - Estudo de Impacte Ambienta**l (Environmental Impact Study) that will assess the Project.
    - The ***DIA – Declaração de Impacte Ambiental*** (EIA approval statement) approves the location of the project and its main characteristics and establishes some constraints to be considered in the Detail Design Project but requires a second moment of environmental impact assessment, after design detail project development -> RECAPE.
- **RECAPE –** ***Relatório de Conformidade Ambiental do Projeto de Execução*** (Environmental Conformity of the Detail Design Project).
    - The **DCAPE -** ***Declaração de Conformidade Ambiental do Projeto de Execução*** (RECAPE approval statement) **allows the construction of the project** in the location evaluated and approved in the EIA; DCAPE may establish some constraints to construction and/or operation phases as well as a monitoring plan. However, another process is required before operation -> LA.

- ***LA – Licença Ambiental*** (Environmental License) – needed for projects under REI – Regime de Emissões Industriais (regime of integrated prevention and pollution control of industrial emissions), established in Decree-Law n. 127/2013, of August 30th. As a result of **REI** application, the Proponent must fill in several fields in the **SILiAmb** platform (the electronic platform of APA for environmental issues) to request an environmental license for the project. The information required to fill the platform fields is identified in Ordinance[65] n. 399/2015 of November 5th. When the process is approved by APA, an Environmental Permit is issued, and its constraints are registered into the Project's **TUA**. In this case, the **LA** cannot be issued without a previous **DCAPE/DIA**.

Additionally, the public consultation regulated under the terms of the legal regime for AIA (RJAIA), aims to collect opinions, suggestions, and other contributions related to the public interest of each project subject to AIA. It is the responsibility of the AIA Authority to promote the public consultation of the project.

The RJAIA foresees Public Consultation in the following phases:

- Assessment process - 30 days (Article 15 of the RJAIA) and a further period of 10 days in the event of modification of the project (by decision of the EIA authority, as provided for in Article 16, paragraph 5, RJAIA)
- Verification of the Environmental Compliance of the Execution Project (DCAPE) - 15 days (Article 20, paragraph 6, RJAIA)

All constraints and obligations associated with the environmental permit of the Lithium Refinery project will be registered in its own ***TUA – Título Único Ambiental*** (single environmental title), to be issued by the Portuguese Environmental Authority: *APA- Agência Portuguesa de Ambiente, I.P.*

In regards to the **Legal Regime for Industrial Emissions**, the Portuguese legal framework relies on the Decree-Law n. 127/2013 of August 30th. The lithium refinery is most likely to be subject to this regime due to Article 1st, paragraph a), because it can be framed into n.4.2 of Annex I, as follows:

- Annex I, n.4.2 "Chemical industry installations - Manufacture of inorganic chemicals;"

Concerning the **Legal Regime for the Prevention of Major Accidents involving Hazardous Substances**, the Portuguese legal framework relies on the Directive 2012/18/EU related to hazardous substances and transposed to the internal legal order by the Decree n.150/2015 of August 5th. The lithium refinery might be subject to this regime depending on the amount of hazardous substances stored and transported.

The **European Union Emissions Trading Scheme** is a mechanism for regulating greenhouse gas (GHG) emissions in activities that are responsible for about 45% of GHG emissions in the European Union, such as fuel combustion, mineral oil refining, metallurgy, the production of clinker, lime and glass, ceramics, pulp and paper, **chemicals,** and aviation. In regards to this regime, the Portuguese legal framework relies on the Decree-Law n. 12/2020, April 6th by transposing the Directive 2018/410, which modifies the Directive 2003/87/CE. The lithium refinery might be subject to this regime considering the chemical nature of the project.

The **General Solid Waste Management regime** legally framed by the Decree-Law n. º 178/2006 of September 5th and revoked by Decree-Law n. º 102-D/2020, of December 10th, is most likely not applicable to the lithium refinery considering that it addresses the waste management operations.

[65] Ordinance n. 399/2015 of November 5th – establishes the elements that must be presented for each environmental request to the authorities, for projects that include industrial or similar activities and indicates which are the parts of the SILiAmb platform (the electronic platform of APA for environmental issues) that must be filled in to get each one of the environmental titles/authorizations.

The **Legal Regime for the Use of Water Resources** is the Portuguese legal framework that relies on the Decree-Law n. 226-A/2007 of May 31st. If the lithium refinery location affects the public hydric domain, it is necessary to request licensing (TURH) to the ARH (responsible entity) to analyze the impact and the most suitable license.

Finally, it should be noted that a ***PSS - Plano de Segurança e Saúde*** (Security, Health and Safety Plan) must be completed and must follow the Portuguese legislation in force regarding this typology of plans, namely:

- Law n. º 102/2009, September 10th, altered by Law n. º 3/2014 - Legal regime for the promotion of safety and health at work.
- Ordinance n. º 53/71, of February 3rd - Approves the General Regulation on Occupational Safety and Hygiene in Industrial Establishments

8.2. ENVIRONMENTAL PERMITTING OF LITHIUM REFINERY PROJECT – SPANISH SITE LOCATION

According to the Galicia legislation in force, to be able to operate, industrial projects must have an environmental permit that is obtained through the **AAI – Autorización Ambiental Integrada** (integrated environmental authorization). The grant of the AAI process will be issued by the Consellería de Medio Ambiente del Gobierno de Galicia. The AAI is a document that includes emission limit values for pollutants, prescriptions for the minimization of long-distance and transboundary pollution and systems for treating and controlling emissions and waste and all the requirements for the construction and operation phases of a project.

The AAI is an environmental intervention mechanism created for the protection of the environment as a whole and that replaces the environmental authorizations existing up to now. For this, it articulates a complex administrative procedure that integrates all existing environmental authorizations related to:

- Production and waste management, including incineration.
- Discharge to continental waters and from land to sea.
- Emissions to the atmosphere including those referred to Volatile Organic Compounds according to Directive 1999/13/CE.
- Other environmental requirements are contained in the sectorial legislation.

In regard to the Integrated Environmental Authorization, the Spanish legal framework relies on the Legal framework for environmental permits - Law n. 16/2002 of July 1st.

Lithium refinery Project's, under the Legal framework for environmental permits, must be subject to Integrated Environmental Authorization due to Article 9th, because it can be framed into n.4.2 of Annex I), as follows:

- Annex I, n.º 4.2 "Chemical plants for the production of basic inorganic chemicals;".

In regards to the Lithium Refinery project, the first stage of AAI proceeding is the Evaluación de incidencia ambiental (Environment Incidence Study), based on the Decree 133/2008 of June 12th. Its purpose is to issue the environmental incidence decision as a prior procedure for the granting of the corresponding activity license.

The next steps of the AIA proceeding will involve:

- **Evaluación de incidencia ambiental** (Environment Incidence Study) will assess the Project at early stages (like pre-feasibility study, feasibility study or base project).
    - **Processing by the municipality** - The technical services of the city council will issue a report on the compatibility of the activity with urban planning instruments and municipal ordinances.
    - **Referral of the file to the environmental body** - the file shall be sent to the competent regional ministry for the environment, together with the allegations presented, the

compatibility reports issued and a reasoned report from the local council on the environmental impact of the activity on the local area and on the result of the public information carried out.

- **Environment incidence decision** - the competent regional ministry for the environment shall issue an Environment incidence decision.

- ***Licencia de actividaad*** (Activity License) – According to the Decree n. 133/2008 of June 12 th, the scope of the environmental impact assessment procedure and the environmental impact opinion will be mandatory and prior to the granting of the activity license.

All constraints and obligations associated with the environmental permit of the Lithium Refinery project will be issued by Consellería de Medio Ambiente del Gobierno de Galicia.

Similarly, some legal regime frameworks need to be considered in the environmental permitting study.

In regard to the **Legal Regime for Industrial Emissions**, the Spanish legal framework relies on the Decree n. 815/2013 of October 18th. The lithium refinery is most likely to be subject to this regime due to Article 1st, paragraph a) because it can be framed into n.4.2 of Annex I, as follows:

- Annex I, n.º 4.2 “Chemical industry facilities - Manufacture of inorganic chemicals;"

  Concerning the **Legal Regime for the Prevention of Major Accidents involving Hazardous Substances**, the Spanish legal framework relies on the Directive 2012/18/EU related to hazardous substances and transposed to the internal legal order by the Decree 840/2015, September 21st. The lithium refinery might be subject to this regime depending on the amount of hazardous substances stored and transported.

  The **European Union Emissions Trading Scheme** is a mechanism for regulating greenhouse gas (GHG) emissions in activities that are responsible for about 45% of GHG emissions in the European Union, such as fuel combustion, mineral oil refining, metallurgy, the production of clinker, lime and glass, ceramics, pulp and paper, **chemicals,** and aviation. Regarding this regime, the Spanish legal framework relies on the Law n. 1/2005, March 6th by transposing the Directive 2018/410, which modifies the Directive 2003/87/CE. The lithium refinery might be subject to this regime considering the chemical nature of the project.

  The **General Solid Waste Management regime** legally framed by the Law n. º 22/2011 of July 28th, is most likely not applicable to the lithium refinery considering that it addresses the waste management operations.

  Regarding the **Legal Regime for the Use of Water Resources** the Spanish legal framework relies on the Decree n. 1/2001 of July 20th, approving the revised text of the Water Law (TRLA) and Title II of the Decree n. 849/1986 of April 11th, approving the Regulations on the Public Hydraulic Domain (RDPH). If the lithium refinery location affects the public hydric domain, it is necessary to request a concession to the Galicia Government.

Finally, a Security and Safety Plan (**Plan-SST**) must be completed, and for that should follow the Spanish legislation in force regarding this typology of plans, namely:

- Law n.31/1995, November 8th – Law for prevention of occupational risks.

9. COMPARATIVE ANALYSIS

Each site location was analysed for different environmental factors, resulting in a classification of the environmental/social **quantitative level**, in a ranking from 1 – lower impact to 4 – higher impact. In socioeconomic analysis, as the impact is potential positive, it was considered 1 – higher impact and 4 – lower impact, in order uniformize the scoring system.

The site selection procedure included not only the impact level score, but also two other variables: the **knowledge level**, which is related to the available information for the site characterisation and can vary between 1 (when the knowledge is fit for purpose, considering the desktop analysis procedure) and 1,5 (when exists significant lack of information), and the **importance level**, which is related to the degree of importance defined in the study criteria and can vary between 1 (low importance), 2 (medium importance) and 3 (higher importance).

With these two variables, it is intended that the final score be increased in case it is a very relevant environmental factor or in case there are important information gaps.

The impact level is obtained by the multiplication of the 3 variables and can vary between 1 and 18. The global score for each site location results in the sum of the final score obtained for each environmental factor.

As presented in the next table Sines has the lowest score, with 66, followed by Setúbal, with 68 and Trofa with 70. These 3 places are very similar in terms of environmental and social impacts.

Considering the construction phase, it should be noted that, from the 3 places the one which presents better conditions is Setúbal, which is located in industrial areas, with low intervention for the project implementation.

Considering this ranking it can be concluded that Sines has the least potential environmental impact, assuming the combination of the 3 variables: quantitative level, knowledge level and importance level, and therefore, are the selected locations for the project implementation.

SITE LOCATION	ENVIRONMENTAL FACTOR	IMPORTANCE LEVEL	KNOWLEDGE LEVEL	QUANITATIVE LEVEL	IMPACT LEVEL
Matosinhos	Land Planning constraints	2	1	1	2
	Climate Change Risk	3	1	1	3
	Biodiversity	2	1	3	6
	Geology and Geomorphology	2	1	1	2
	Water stress, resources and quality	3	1	3	9
	Contamination of Soil/Water	3	1	4	12
	Waste treatment/management	1	1	4	4
	Noise	2	1	4	8
	Air quality	3	1	4	12
	Archaeological and ethnological heritage	1	1	2	2
	Socioeconomics	2	1	4	8
	Human Health	3	1	3	9
	Technological risks	2	1	1	2
				Total Score	**79**
Sines	Land Planning constraints	2	1	3	6
	Climate Change	3	1	3	9

SITE LOCATION	ENVIRONMENTAL FACTOR	IMPORTANCE LEVEL	KNOWLEDGE LEVEL	QUANITATIVE LEVEL	IMPACT LEVEL
	Biodiversity	2	1	1	2
	Geology and Geomorphology	2	1	4	8
	Water stress, resources and quality	3	1	4	12
	Contamination of Soil/Water	3	1	3	9
	Waste treatment management	1	1	2	2
	Noise	2	1	2	4
	Air quality	3	1	1	3
	Archaeological and ethnological heritage	1	1	1	1
	Socioeconomics	2	1	1	2
	Human Health	3	1	2	6
	Technological risks	2	1	1	2
				Total Score	**66**
Estarreja	Land Planning constraints	2	1	2	4
	Climate Change	3	1	4	12
	Biodiversity	2	1	3	6
	Geology and Geomorphology	2	1	2	4
	Water stress, resources and quality	3	1	2	6
	Contamination of Soil/Water	3	1	3	9
	Waste treatment management	1	1	3	3
	Noise	2	1	3	6
	Air quality	3	1	3	9
	Archaeological and ethnological heritage	1	1	1	1
	Socioeconomics	2	1	3	6
	Human Health	3	1	4	12
	Technological risks	2	1	2	4
				Total Score	**82**
Vigo	Land Planning constraints	2	1	2	4
	Climate Change	3	1	4	12
	Biodiversity	2	1	2	4
	Geology and Geomorphology	2	1	2	4
	Water stress, resources and quality	3	1	2	6
	Contamination of Soil/Water	3	1.5	1	4.5
	Waste treatment management	1	1	1	1
	Noise	2	1.5	1	3
	Air quality	3	1.5	2	9
	Archaeological and ethnological heritage	1	1	1	1
	Socioeconomics	2	1	3	6
	Human Health	3	1.5	2	9
	Technological risks	2	1	4	8

SITE LOCATION	ENVIRONMENTAL FACTOR	IMPORTANCE LEVEL	KNOWLEDGE LEVEL	QUANITATIVE LEVEL	IMPACT LEVEL
	Total Score				**71.5**
Setúbal	Land Planning constraints	2	1	2	4
	Climate Change	3	1	4	12
	Biodiversity	2	1	3	6
	Geology and Geomorphology	2	1	3	6
	Water stress, resources and quality	3	1	2	6
	Contamination of Soil/Water	3	1	4	12
	Waste treatment management	1	1	2	2
	Noise	2	1	2	4
	Air quality	3	1	1	3
	Archaeological and ethnological heritage	1	1	1	1
	Socioeconomics	2	1	1	2
	Human Health	3	1	2	6
	Technological risks	2	1	2	4
	Total Score				**68**
Valongo	Land Planning constraints	2	1	3	6
	Climate Change	3	1	3	9
	Biodiversity	2	1	4	8
	Geology and Geomorphology	2	1	2	4
	Water stress, resources and quality	3	1	1	3
	Contamination of Soil/Water	3	1,5	2	9
	Waste treatment management	1	1	3	3
	Noise	2	1	3	6
	Air quality	3	1	3	9
	Archaeological and ethnological heritage	1	1	1	1
	Socioeconomics	2	1	2	4
	Human Health	3	1	2	6
	Technological risks	2	1	4	8
	Total Score				**76**
Trofa	Land Planning constraints	2	1	2	4
	Climate Change	3	1	4	12
	Biodiversity	2	1	1	2
	Geology and Geomorphology	2	1	3	6
	Water stress, resources and quality	3	1	1	3
	Contamination of Soil/Water	3	1,5	2	9
	Waste treatment management	1	1	4	4
	Noise	2	1	3	6
	Air quality	3	1	2	6
	Archaeological and ethnological heritage	1	1	1	1

SITE LOCATION	ENVIRONMENTAL FACTOR	IMPORTANCE LEVEL	KNOWLEDGE LEVEL	QUANITATIVE LEVEL	IMPACT LEVEL
	Socioeconomics	2	1	3	6
	Human Health	3	1	1	3
	Technological risks	2	1	4	8
				Total Score	**70**
Fafe	Land Planning constraints	2	1	2	4
	Climate Change	3	1	2	6
	Biodiversity	2	1	3	6
	Geology and Geomorphology	2	1	3	6
	Water stress, resources and quality	3	1	1	3
	Contamination of Soil/Water	3	1,5	2	9
	Waste treatment management	1	1	4	4
	Noise	2	1	3	6
	Air quality	3	1	3	9
	Archaeological and ethnological heritage	1	1	2	2
	Socioeconomics	2	1	**3**	6
	Human Health	3	1	**2**	6
	Technological risks	2	1	**2**	4
				Total Score	**71**

Table 9-1 – Comparative analysis

10. Conclusions and Recommendations

This report aims to make a desktop analysis of the eight proposed site locations of the lithium refinery at a macro level This analysis includes an environmental and social economics assessment for each site location.

Regarding land planning, the Valongo and Sines sites are the most demanding considering the necessity to modify the municipal land planning tools, such as urbanization plans and municipal master plans. The modification request process is parallel to the EIA process, preferably should be undertaken before. If dis does not happen, will be an issue during the EIA process, and a constraint on DIA (minimum). Usually, this is undertaken by lawyers (law department), with technical involvement for specific technical questions.

Still related to land planning, for Setúbal, Fafe and Trofa sites, the plant design should only consider the classes of spaces destined for economic activities, which in these cases will reduce the current site location area. Adjusting the plant design is also a possibility.

Concerning the water domain, Setúbal, Valongo, Trofa, Fafe, Sines and Vigo sites intersect water lines which means that any use or construction in the watercourses implies the ARH permitting, for national territory or Autonomous Community of Galicia permitting, for the Spanish territory. To get this permission it is necessary to show in the EIA process that the project will not change the natural flow of the waterline and that the initial conditions of the stream are secured. There are basic studies that need to be done, namely the hydrological study and hydraulic design (culverts characterization).

Sines and Valongo site locations are crossed by one electrical powerline each, which constitutes a significant constraint to land planning. The refinery design needs to respect the easements associated with the electrical power lines.

Regarding the National Ecological Reserve, Fafe and Estarreja are the site locations that intersect REN. The plant design should avoid the use of these areas. In case that is not possible, CCDR Norte or CCDR Centro, respectively, should be prior notified.

Concerning the National Agricultural Reserve, Fafe is the site location that intersects RAN. The plant design should avoid the use of these areas. In case that is not possible, DRAP Norte should be notified.

For the road network, Vigo, Fafe, Valongo, Estarreja and Sines site locations are conditioned by the easements of the roads both within the site location and the periphery.

The sites located in Estarreja Industrial Eco-Park and Setúbal SAPEC BAY have the highest vulnerability to sea-level rise and flooding due to the proximity to Ria de Aveiro and Sado Estuary, respectively.

Vigo site location has the highest vulnerability to wildfires based on the historical frequency data and considering the fact of being surrounded by forest. Trofa and Valongo also have historical occurrences of forest fires, however the vicinity is composed mainly by industry and receptors.

Overall, Estarreja, Vigo, Trofa and Setúbal are the most vulnerable sites in terms of climate change risks and Matosinhos has the lowest vulnerability.

Matosinhos site location is the worst case in terms of impacts on human health and air pollutants exposure due to the high density of urban settlements in the surroundings.

Setúbal and Sines's sites have the lowest impact in terms of air pollutant exposure. Setúbal and Fafe have the lowest impact in terms of human health.

According to the **risk analysis**, that includes natural, technological and mixed risks, **Matosinhos**, **Sines** and **Fafe** are the site location with **higher level** of potential risks and **Estarreja** and **Setúbal** with the **lowest level** of potential risks.

For the permitting roadmap assessment, it is possible to conclude that the in general the environmental licensing process in Spain, for the Vigo site location, will be faster than the Portuguese environment licensing process.

The overall highlights, positive and negative, for each site location are listed below. It was selected only the most relevant information obtained during the desktop analysis, considering also the team's experience and sensitivity, that is important to be aware of during the decision-making process for the site selection.

Site location	Highlights	
	Positive	**Negative**
Matosinhos	• Brownfield – intervened area, low impacts on soil occupancy • No need for the construction of additional roads and accesses, and possible usage of some infrastructures and facilities • Low vulnerability to climate change impacts • Compliance with land planning • No water lines – no need of additional permitting processes • Closer to Mina do Barroso – optimized routes	• Agglomerations, densely populated, potentially exposed to the air and noise direct emissions • Brownfield, decontamination works needed • Historical social media pressure in this area due to the previous refinery – saturation of public entities and population
Sines	• Framed in an industrial area • Low risk of sensitive receptors potentially exposed to air and noise emissions • Apparently, no need the construction of additional roads and accesses • Flexibility to expand or to adjust layout if necessary	• The need to change the urbanization plan for the ZILS, once is located at a logistics area • Intersects water lines which implies ARH permitting • Electrical powerline intersection which implies E-redes/EDP approval
Estarreja	• Framed in an industrial area • No need construction of additional roads and accesses • No water lines – no need of additional permitting processes • Closer to Mina do Barroso – optimized routes	• Agglomerations, densely populated, potentially exposed to the air and noise direct emissions • Close to floodable areas • Intersects REN which implies CCDR-Centro approval • The project acceptation in the Ecoparque, from the administration, is dependent on approval of the existing industries.
Vigo	• Framed in an industrial area, prepared to the project implementation • No Seveso industries – low technological risk • Apparently, no need the construction of main additional roads and accesses • Closer to Mina do Barroso – optimized routes	• Intersects water lines which implies national authorities permitting • Agglomerations, moderately populated, potentially exposed to the air and noise direct emissions • Vulnerability to wildfires

Site location	Highlights	
	Positive	Negative
		• Low information available, which increases the uncertainty of the analysis
Setúbal	• Framed in an industrial area, in compliance with the soil classification • Low risk of sensitive receptors potentially exposed to air and noise emissions • High socioeconomic positive impacts – loss of population, high level of unemployment • Apparently, no need construction of main additional roads and accesses	• Site preparation needed; • Is located on the upstream of waterlines that drainage to to de Sado Estuary • Close to sea level rise areas • Proximity to the Sado estuary natural reserve (RNES) may raise some concerns among the population and non-governmental organizations
Valongo	• No Seveso industries – low technological risk • High socioeconomic positive impacts – loss of population, high level of unemployment • Apparently, no need the construction of main additional roads and accesses Closer to Mina do Barroso – optimized routes	• Agglomerations, moderately populated, potentially exposed to the air and noise direct emissions • The need to change the urbanization plan for Campo Industrial Zone and the municipal master plan • Intersects water lines which implies ARH permitting • Electrical powerline intersection which implies E-redes/EDP approval
Trofa	• No Seveso industries – low technological risk • Apparently, no need the construction of main additional roads and accesses • Closer to Mina do Barroso – optimized routes • Agglomerations, low populated, potentially exposed to the air and noise direct emissions	• Intersects water lines which implies ARH permitting • High risk of fire (Historically affected by fires - 2017 and 2015 and surrounded by forest, with occasional presence of industry (north and east).
Fafe	• No Seveso industries – low technological risk • Apparently, no need the construction of main additional roads and accesses • Closer to Mina do Barroso – optimized routes	• Agglomerations, moderately populated, and public spaces, potentially exposed to the air and noise direct emissions • Intersects water lines which implies ARH permitting • Intersects REN which implies CCDR-Norte prior notification • Intersects RAN which implies prior communication DRAP – Norte • Away from ports, which implies higher distances to transport materials

According to the environmental assessment findings the conclusions are that Sines has the best environmental performance, with the lowest impact level (66) followed by Setúbal (68) and Trofa (70). Considering the construction phase, it should be noted that, from the 3 places the one which presents better conditions is Setúbal, which is located in an industrial area, with low intervention for the project implementation.

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APPENDIX A Site study areas

APPENDIX B Drawings