11 Biodiversity

11.1 Delimitation of the study area

In general, the effects on biodiversity are linked to the biotopes and the influences on water
, soil and air quality and on the noise climate. The sphere of influence for this discipline is therefore determined by the largest sphere of influence for one of the above-mentioned environmental compartments, taking into account the relevant effect groups or scope.

Initially, the study area is determined by the sphere of influence of the environmental component with the widest influence (air). This broad contour is caused by the sphere of influence of acidifying and eutrophying deposits, as determined in the air modelling. This delimits an area within a radius of 20 kilometres around the project site (this is the maximum modelling area in IMPACT) or an area within the contour of 0.001 kg N/ha.y (this is the lower limit of the IMPACT model). In the present project, the maximum modelling area of IMPACT is taken, since the contour of 0.001 kg N/ha.j does not fall within this area.

This is illustrated in the figure below.

Figure 11-1: Study area for biodiversity discipline with a 20 km contour (red) around the project area (blue).

11.2 Methodology

The methodology provides an explanation of the method used to assess the environmental effects on biodiversity for the present project. It explains:

- how the reference situation is described.
- how the effects of the various sub-aspects related to biodiversity are analysed, as well as on the basis of which scientific data.
- which significance frameworks are used.

11.2.1 Description of the reference situation

The description of the reference situation is provided on two levels:

5. description of the most important natural values in the areas of interest within the study area;
6. description of the zones with natural value within the project area.

Areas of interest include zones that are highly valued in terms of nature conservation within the study area, namely:

- Natura 2000 areas: Bird and Habitat Directive areas (including Ramsar sites). This includes both current habitats and search zones[61] for the creation of habitats within the Natura 2000 areas
- areas belonging to the Flemish Ecological Network (VEN);

The areas described above also have a nature management plan. Specifically, these

are:

- Habitat Directive areas (or parts thereof):

1. Kalmthoutse heath (SBZ-H BE2100015)
2. Scheldt and Durme estuary from the Dutch border to Ghent (SBZ-H BE2300006)
3. Klein and Groot Schietveld (SBZ-H BE2100016)
4. Historic fortification belts around Antwerp as bat habitat (SBZ-H BE2100045)
5. Forest and heathland areas east of Antwerp (SBZ-H BE2100017)
6. Forests and heathlands of sandy Flanders – eastern part (BE2300005)

- Birds Directive areas (or parts thereof):

7. Kalmthoutse Heath (SBZ-V BE2100323)
8. Zeeschelde – Salt marshes and polders of the Lower Scheldt (SBZ-V BE2301336)
9. Tufted Duck (SBZ-V BE2300222) incl Blokkersdijk
10. De Maatjes, Wuustwezelheide and Groot Schietveld (SBZ-V BE2101437)

The following VEN areas (or parts thereof) are also located in the wider vicinity of the project area:

- Slikken and Schorren along the Scheldt: sub-areas Groot Buitenschoor, Galgenschoor; Schorren van Doel; Hobokense Polder
- The Tufted Duck: sub-areas Kuifeend, Grote Kreek, Opstalvallei
- Blokkersdijk
- The Kalmthoutse Heath
- De Maatjes
- The Oude Landen and Bospolder
- De Stropers
- Wase Scheldepolders
- The Clay Valley

The 'Groot Buitenschoor en Galgenschoor' is a recognised nature reserve located approximately 150 m west of the project area. This reserve area is also covered by the Ramsar Convention. The 'Kuifeend' area is designated as a nature reserve on the regional plan. The 'Opstalvalleigebied' is located on the other side of the Kanaaldok and is partly a recognised nature reserve.

Finally, the following special protection areas on Dutch territory are located in the wider vicinity of the project area:

- Habitat Directive areas:

11. Brabantse Wal (SBZ-H NL9801055)
12. Westerschelde and Saeftinghe (SBZ-H NL9803061)

[61] The search area is an area that indicates the perimeter to be protected for each European protected species and each European protected habitat with a view to optimally setting the conservation objectives for the special protection area concerned. The size of the search area is determined by the area needed to achieve the outstanding balance of the target for the European protected habitat or European protected species concerned.

13. Oosterschelde (SBZ-H NL3009016)
14. Vogelkreek (SBZ-H NL2003049)
15. Yerseke and Kapelse Moer (SBZ-H NL9802068)

- Bird Directive areas:

16. Brabantse Wal (SBZ-V NL3009003)
17. Markiezaat (SBZ-V NL3009015)
18. Zoommeer (SBZ-V NL9902010)
19. Oosterschelde (SBZ-V NL3009016)
20. Westerschelde and Saeftinghe (SBZV NL9802026)
21. Yerseke and Kapelse Moer (SBZ-V NL9802068)

- parts of the permanent ecological infrastructure demarcated within the framework of the SBP-2: the zone next to Havenlaan – N163 and the railway line (west of the project area). This area borders the project area.

For a detailed description of the Natura 2000 areas in Flanders and the Netherlands, and the VEN areas in Flanders, please also refer to the respective appropriate assessments (§ 11.9 and § 11.10) and the enhanced nature assessment (§11.8). See also Appendix 10.

11.2.2 Sources of information

The description of the natural values in the areas of interest is based on the available literature relating to these areas (including reports on the specific conservation objectives of the Bird and Habitat Directive areas, data from the waterbird counts conducted by the Research Institute for Nature and Forestry) and specific research reports on the fauna and flora of the Scheldt estuary and the project area (research reports by INBO, Natuurpunt, Ghent University). See Appendices 7.6 and 10 for the relevant conservation objectives.

For the Dutch Natura 2000 areas, please refer to Appendix 10.3.

The Biological Assessment Map - Habitat Map version 2023 (INBO) is used to verify the presence of European habitat types and regionally important biotopes and for the general biological assessment of the areas. An overview of the protection status of the areas of interest is also provided in each case.

The description of the project area in terms of its original condition[62] is based on extensive field surveys carried out by Natuurpunt (biodiversity and vegetation, 2018, 2019), Corridor (biodiversity and vegetation, 2020 and 2021) and ARCADIS (biodiversity and forest, 2019), site photographs, the Biological Assessment Map – Habitat Map version 2020 (INBO), orthophotos and the detailed vegetation mapping carried out by Natuurpunt.

An overview of the field inventories is provided in § 11.2.3.2. The results of the inventory rounds conducted by Natuurpunt (2018, 2019) are included in Appendix 7.1. During these inventory rounds, a targeted search was conducted for certain protected habitat types and species. In addition to the inventories carried out by Natuurpunt, Corridor conducted field inventories over a period of 10 days in 2020 with regard to bats using automatic detection, a breeding bird inventory, a targeted inventory of the natterjack toad, a targeted inventory of protected orchid species and a targeted inventory in the context of forest age and sea buckthorn scrub. These field inventories were repeated by Corridor in 2021 (flora, birds, amphibians, bats).

The inventory of the amount of forest and forest older than 22 years was carried out on the basis of data from 2021 (most recent aerial photographs and a site inventory in March 2021 – see Appendix 7.1).

[62] This concerns the original situation prior to the work being carried out on the basis of the first environmental permit for Project One (see also Chapter 2.4 Administrative history).

This concerns the original situation prior to the start of the work currently being carried out on the basis of the first environmental permit (see also section 2.4 Administrative history).

On 19 March 2024, a site survey was carried out to describe the current situation (in 2024) with regard to the presence of natural values on the site.

11.2.3 Impact description and impact assessment

The following impact groups will be described and investigated:

1. Direct land use (loss of biotope and ecotope)
2. Noise disturbance
3. Fragmentation and barrier effect
4. Ecotoxicological effects resulting from water and air emissions
5. Light pollution and visual disturbance
6. Impact on groundwater management
7. Acidifying and eutrophicating deposition

An appropriate assessment, a more stringent nature assessment and an assessment of the Species Decree will also be carried out. An appropriate assessment is required due to the proximity of Natura 2000 areas (Galgenschoor et al.) and the possible impacts on groundwater, air, water and acidifying and eutrophying deposition, which need to be investigated further.

The present methodology describes the impacts relative to the original situation (2021), prior to the start of the works.

The description and assessment of the effects on the natural values present is based on:

- The vulnerability of the area and its surroundings to disturbance;
- The presence of vulnerable (bird) species that are sensitive to disturbance;
- The distance from the ecologically valuable area to the project area;
- The expected noise contours during the construction and operational phases based on the project's contribution.

The expected effects in the surrounding area and in the Natura 2000 areas and VEN areas are described in the appropriate assessment and the enhanced nature assessment, respectively.

Both appropriate assessments will determine whether or not there will be a significant adverse effect on the natural characteristics of the Special Protection Areas on the one hand, and the relationship with the achievement of the conservation objectives set for the relevant habitat types and species on the other.

The enhanced nature assessment will determine whether the project will cause unavoidable and irreparable damage to the natural characteristics of VEN areas in the vicinity.

If an impact group is relevant to the Netherlands, given its sphere of influence, this is explicitly stated. In all other cases, no impacts can be expected from the impact group due to the considerable distance from the project area.

In addition, the extent to which this impact still occurs in the current situation (works in progress based on the current permit) is indicated.

11.2.3.1 Soil disturbance

Soil disturbance occurs as a result of the site preparation and layout of the site in relation to its original condition. The soil on the site is completely excavated and levelled. All vegetation is removed. The effects of this are described in full in § 11.4.1.3 and §11.4.2.3 Direct space occupation.

After completion of the project, there will be no further soil disturbance, as all vegetation will have been removed.

11.2.3.2 Direct land use (loss of biotope and ecotope)

The removal of vegetation, preparation and development of the site will result in immediate land use. The description and assessment of the impact on the habitat types present will be based on:

- Field inventories by Arcadis (2019, 2024);
- Field inventories by Corridor (2020, 2021), including bats;
- Field inventories by Natuurpunt, including bats (2018, 2019);
- Data from the Natuurpunt vzw database (2010-2021 and 2021-2024);
- Photographic material;
- GIS and aerial photo analysis;
- Determination of the number of forest areas and the age of the forest within the project area.

The project EIA describes and assesses the direct impact on the habitat types present in a quantitative manner, focusing on:

- Biological assessment;
- European protection;
- Vegetation that is prohibited from being altered (Vegetation Decree);
- Protected dune habitats;
- Existing forest and shrub vegetation covered by the Forest Decree.

The determination of the amount of forest and the age of the forest, as well as the determination of the presence of vegetation that is prohibited from being altered, is based on the analysis conducted by Corridor in 2021 and was checked and validated by the EIA biodiversity expert. This was done on the basis of intensive site inventories and aerial photo analysis. These quantities, including the compensation factor, are described in the project EIA. Where and how the forest compensation[63]will take place is described in detail in the forest compensation form, which is not part of the project EIA. This form is an integral part of the environmental permit application. Restoration measures are formulated and exemptions are requested for the loss of vegetation that is prohibited from being altered.

In addition, it is indicated to what extent this effect still occurs in the current situation (work in progress based on the current permit).

11.2.3.3 Noise disturbance

The present methodology describes the impacts in relation to the original situation (2021), prior to the start of the works. In other words, the impact assessment is carried out for the entire project, including all phases, in relation to the situation in 2021.

Within the discipline of Noise, noise modelling has been carried out to provide an indication of the expected noise pollution resulting from the activities in the various phases of the project.

Initially, the vegetation removal works will cause noise emissions (feller bunchers, chippers, excavators, lorries, etc.). Subsequently, the construction and operation of the new installations, roads, etc. will cause noise emissions.

[63] This does not constitute compensation within the meaning of Article 6(4) of the Habitats Directive.

11.2.3.4 Fragmentation and barrier effect

The effects in terms of fragmentation and barrier action are determined qualitatively, taking into account the ecological value of the project area and the value of the project area as an ecological connection. The impact assessment also takes into account (positive) effects resulting from compensatory afforestation.

11.2.3.5 Ecotoxicological effects resulting from water and air emissions

Ecotoxicological effects caused by water and air emissions are assessed on the basis of the results obtained within the Water and Air disciplines. The effects are described on the basis of literature data using 'predicted no effect concentrations' (PNEC) and 'half-life' (or DT50) of a particular substance that will be emitted into the air or water. The focus here is mainly on substances that exceed the VLAREM environmental quality standards set by the government.

The potential ecotoxicological effects of water and air emissions in Dutch Natura 2000 areas are discussed in the section on appropriate assessment in the Netherlands.

11.2.3.6 Light pollution and visual disturbance

Lighting will be present during both the construction and operational phases, partly for safety reasons. In addition, visual disturbance (movement) may also occur due to the presence of machinery or people, for example.

The impact of potential light pollution on areas of concern in the surrounding area is described and assessed in qualitative terms. Measures relating to the application of 'principles of good lighting', with instructions on the type of lighting, colour of the light, angle at which the lighting can be positioned, etc., are defined.

11.2.3.7 Impact on groundwater management

Drainage can affect groundwater-dependent vegetation. The expected decline in the groundwater level will be mapped based on groundwater modelling. A description and assessment of the effects will be made based on this contour and the location of the groundwater-dependent vegetation. The possible effect of salinisation on natural values will also be studied, based on the results within the Water discipline.

The potential impact on groundwater management will not affect Dutch Natura 2000 areas and is therefore not discussed further in the section on appropriate assessment for the Netherlands.

11.2.3.8 Acidifying and eutrophying deposition

The description and assessment of the effects of acidifying and eutrophying deposition is based on overview studies of the critical deposition values for acidification and eutrophication (Van Dobben *et al.* 2012, Hens & Neirynck 2013 and RIVM 2011) in the context of drawing up an appropriate assessment.

On the one hand, within the framework of the Nitrogen Decree (2024), a preliminary assessment based on the impact score tool will be used to assess whether the deposits at the level of habitat types in Natura 2000 areas as a result of the project during the constructionand operational phases will exceed or fall below 1% of the critical deposition values for notified and targeted habitat types in Habitat Directive areas.

The threshold value of 1% may be used for industrial sources with DeNOx implementation if the following conditions are met:

- The DeNOx installation ensures a NOx-N reduction of at least 50%.
- The impact score of the IIOA without the DeNOx installation is greater than or equal to the impact score of the IIOA with the DeNOx installation.

These conditions have been met; please refer to Appendices 7.8b and 7.8c. These appendices contain the results of the impact score tool for the scenario with and without DeNOx.

If the contribution is less than or equal to 1%, it can be stated on the basis of the provisions in the Nitrogen Decree that meaningful impacts within the declining context of fertilising deposits by 2030 as a result of the PAS measures in the Nitrogen Decree can be ruled out a priori and no appropriate assessment of the effects of nitrogen deposition via the air needs to be made.

If the contribution exceeds 1%, it is mandatory to prepare an appropriate assessment of the effects of nitrogen deposition via the air.

On the other hand, an in-depth ecological assessment is being developed on the basis of additional research and recent scientific knowledge and insights in order to investigate the impact of the fertilising (and acidifying) deposits resulting from the project on habitats and species. This is being done using the IMPACT air modelling tool (see air discipline).

The research into the impact of fertilising and acidifying deposits is based on the following modelling:

- Modelling with the **IMPACTSCORETOOL** (version 2.33.0), in accordance with the provisions of the Nitrogen Decree (2024). These results were used to assess compliance with the 1% threshold specified in the decree, see Appendix 7.8;
- Modelling with **IMPACT** (July/August 2024) using the representative meteorological year 2017;

The fertilising and acidifying deposition originating from the project is assessed in relation to the critical deposition values for the various Natura 2000 habitat types located within the zone of influence.

The results of the nitrogen modelling will also be used as a basis for the Appropriate Assessment (see below). The specific approach to the ecological assessment in the Appropriate Assessment is explained in more detail under 11.9 and 11.10.

11.2.3.9 Appropriate assessment / enhanced nature assessment / Species Decree assessment

Specifically for the aspect of biodiversity, an appropriate assessment and stricter nature assessment will be drawn up as part of the project EIA within the framework of Article 36ter and Article 26bis of the Nature Decree. An appropriate assessment has been drawn up for areas located on both Flemish and Dutch territory.

There are several Natura 2000 areas in the wider vicinity of the project area that could potentially be affected by noise, air and water emissions, light pollution or impact on the groundwater table. The aforementioned nature assessments will also examine the aspects of fragmentation and barrier effects. The appropriate assessments and enhanced nature assessments are included as separate documents in Appendix 10 to the project EIA.

The project EIA also assesses compliance with the provisions of the Species Decree and the Vegetation Decree. The Species Decree (approved by the Flemish Government on 15 May 2009) has a broad scope and covers all native wild bird species (category 2) and all species listed in Annex IV of the Habitats Directive. Category 1 lists the plant and animal species that are also protected under the Species Decree. The EIA describes and assesses the impact on these plant and animal species and their habitats. Where necessary, it indicates whether a derogation must be requested under the Species Decree. The assessment against the Vegetation Decree translates into a description and assessment of the vegetation that is prohibited from being altered and the restoration measures that are provided for within the framework of the duty of care and the standstill principle. The derogation permits were already issued in 2021 through separate procedures.

11.2.4 Significance frameworks

Table 11-1: Assessment criteria for expected effects on biodiversity

Significance level	Assessment criteria	Mitigating measures
Loss of ecotopes and biotopes		
Significant negative effect (-3)	Encroachment on European protected habitats and/or regionally important biotopes; *or* Occupation of biologically (highly) valuable biotopes; *or* Loss of (potential) habitats of animal species protected at European or Flemish level; *or* The impact is permanent; *and/or* The effect is not limited in scope.	Mitigating measures required or justification
Negative effect (-2)	Occupation of European protected habitats and/or regionally important biotopes; *or* Space occupied by biologically (highly) valuable biotopes; *or* Loss of (potential) habitats of animal species protected at European or Flemish level; *or* The effect is temporary or permanent; *and* The effect is limited in scope.	Mitigating measures desirable or justification
Limited negative effect (-1)	Land use of biologically less valuable biotopes; The effect is temporary or permanent; The effect is limited in scope.	No specific measures required in addition to existing regulations
Negligible effect (0)	No space requirements; *or* No ecotope creation.	N/A
Limited positive effect (+1)	Creation (or restoration) of ecotopes of lesser biological value; *or* Creation of (potential) habitats for animal species.	N/A
Positive effect (+2)	Creation (or restoration) of ecotopes for biologically (highly) valuable biotopes; *or* Creation of (potential) habitats for animal species.	N/A
Significant positive effect (+3)	Creation (or restoration) of European protected habitats and/or regionally important biotopes; *or* Creation of (potential) habitats for animal species protected at European or Flemish level.	Not applicable
Disturbance		
Significant negative effect (-3)	Presence of/significant potential for highly vulnerable and vulnerable species to disturbance; *or* Permanent or temporary effects during vulnerable periods (breeding season, wintering, etc.): depending on the importance of the area for species during those periods; *or* Disturbance of peace and quiet in areas that are not yet acoustically disturbed (current noise level < 45 dB(A)), even if the increase in noise as a result of the project is limited	Mitigating measures required or justification
Negative effect (-2)	Presence of/significant potential for species that are not very vulnerable to disturbance; *or* Limited permanent or temporary effects during vulnerable periods (breeding season, wintering, etc.): depending on the importance of the area for species during those periods; *or*	Mitigation measures desirable or justification

Significance level	Assessment criteria	Mitigating measures
	Disturbance of peace and quiet in areas that are already acoustically disturbed (current noise level between 45 dB(A) and 55dB(A))	
Limited negative effect (-1)	Limited presence of/limited potential for species that are not very sensitive to disturbance; *or* No permanent or temporary effects during vulnerable periods (breeding season, wintering, etc.): depending on the importance of the area for species during those periods	No specific measures required in addition to existing regulations
Negligible effect (0)	No highly vulnerable, vulnerable or slightly vulnerable species present that are susceptible to disturbance, nor any potential for these species; *or* disturbance in areas that are already acoustically disturbed (current noise level already > 55 dB(A))	N/A
Limited positive effect (1) **Positive effect (2)**	Decrease in current noise level to between 45 dB(A) and 55 dB(A) thanks to project	N/A
Significant positive effect (3)	Decrease in current noise level to between 40 dB(A) and 45 dB(A) thanks to the project	Not applicable
	Decrease in current noise level to < 40 dB(A) thanks to project	Not applicable
Network effects and barrier effects		
Significant negative effect (-3)	The project causes additional barrier effects/fragmentation in an area that has significant (potential) connectivity value; *or* Occurrence of species that are sensitive to habitat fragmentation; *or* Decrease in suitable habitat area for species; *or* Fragmentation of habitat into smaller units (more edge disturbance); *or* Increase in distance between the remaining suitable areas; *or* Increased resistance of the landscape (species are less able to reach suitable areas or can no longer reach them); *or* The creation of physical barriers that completely prevent the exchange of species between spatially separated habitats	Mitigation measures required or justification
Negative effect (-2)	The project causes additional barrier effects/fragmentation in an area that has a certain potential connection value; *or* Limited reduction in the area of suitable habitat for species; *or* Very limited fragmentation of habitat into smaller units (more edge disturbance); *or* Very limited increase in distance between the remaining suitable areas; *or* Limited increase in landscape resistance (species may find it slightly more difficult to reach suitable areas); *or* Emergence of physical barriers that make the exchange of species between spatially separated habitats less easy (but still possible)	Mitigating measures desirable or justification
Limited negative effect (-1)	The project causes additional barrier effects/fragmentation in an area that has only limited connectivity value; *or* Very limited reduction in the area of suitable habitat for species; *or*	No specific measures required in addition to existing regulations

Significance level	Assessment criteria	Mitigating measures
	Habitat does not break down into smaller units; *or* No increase in distance between the remaining suitable areas; *or* No increase in landscape resistance; *or* No physical barriers are created that could hinder the exchange of species between spatially separated habitats	
Negligible effect (0)	The project does not change anything in terms of barrier effect and fragmentation; *or* No reduction in suitable habitat area for species; *or* Habitat does not break down into smaller units; *or* No increase in distance between the remaining suitable areas; *or* No increase in landscape resistance; *or* No physical barriers are created that could hinder the exchange of species between spatially separated habitats.	N/A
Limited positive effect (1)	Existing barriers or fragmentation situations are improved, resolved or restored, with little added value from an ecological point of view; *or* Very limited increase in suitable habitat area for species	N/A
Positive effect (2)	Existing barriers or fragmentation situations are improved, resolved or restored, with moderate added value from an ecological point of view; *or* Limited increase in suitable habitat area for species; *or* Limited decrease in landscape resilience	N/A
Significant positive effect (3)	Existing barriers or fragmentation situations are improved, resolved or restored, with significant added value from an ecological point of view; *or* Increase in suitable habitat area for species; *or* Suitable habitats are grouped into larger units; *or* Distance between suitable areas is reduced; *or* Decrease in landscape resistance; *or* Removal of physical barriers, promoting the exchange of species between areas; *or* Project contributes to the realisation of nature connections	N/A
Light pollution		
Significant negative effect (-3)	Permanent and significant effect on an important habitat that is vulnerable to highly vulnerable to light disturbance; *or* Presence of species that are sensitive to very sensitive to light disturbance, such as bats	Mitigation measures required or justification
Negative effect (-2)	Permanent moderate or temporary effect on an important habitat that is vulnerable to highly vulnerable to light disturbance; *or* Presence of species that are sensitive to highly sensitive to light disturbance, such as bats	Mitigation measures desirable or justification

Significance level	Assessment criteria	Mitigation measures
Limited negative effect (-1)	Permanent or temporary effect on a less important habitat that is not very vulnerable or vulnerable to light disturbance; *or* Presence of species that are not very sensitive to light disturbance The necessary mitigating measures have been taken, so that the effect of light disturbance can be assessed as limited negative , for example, dimming of lighting, bat-friendly lighting, principles of good lighting	No specific measures required in addition to existing regulations
Negligible to no effect (0)	Permanent or temporary effect Area is not very vulnerable to disturbance; *or* Presence of species that are not very sensitive to light disturbance The necessary mitigating measures have been taken, so that the effect of light disturbance can be considered negligible , for example, dimming of lighting, bat-friendly lighting, principles of good lighting	N/A
Impact on groundwater management - desiccation		
Significant negative effect (-3)	Area is vulnerable to very vulnerable to desiccation Presence of European protected groundwater-dependent vegetation The effect is permanent The effect is not limited in scope The affected habitat is not recoverable	Mitigating measures required or justification
Negative effect (-2)	Area is vulnerable to highly vulnerable to desiccation Presence of European protected groundwater-dependent vegetation The effect is temporary The effect is (not) limited in scope The affected habitat is recoverable	Mitigation measures desirable or justification
Limited negative effect (-1)	Area is vulnerable to highly vulnerable to desiccation The effect is (not) limited in scope The effect is temporary The affected habitat is recoverable	No specific measures required in addition to existing regulations
Negligible to no effect (0)	Area is not vulnerable or only slightly vulnerable to desiccation (absence of groundwater-dependent vegetation) The effect is limited in scope The effect is temporary or permanent	N/A

11.3 Reference situation

11.3.1 General

Within the study area of Project One, there are several areas of interest, some of which enjoy international, European or Flemish protection. There are also several Natura 2000 areas on Dutch territory that may be affected by the project.

The list below shows the areas located within a 20-kilometre radius of the project area.

The overview of nature areas discussed below is based on the potential impact of deposition based on air modelling.

There are a large number of areas within the study area where no impact is expected, as they are located well outside the deposition contour of 0.001 kg N/ha.j (see impact discussion).

The impact assessment also shows which of these areas may be affected (see also Appendix 10):

The table below provides an overview of the Flemish and Dutch nature reserves in the wider area and their protection status.

Table 11-2: Overview of Flemish nature reserves

Area	SBZ-V	SBZ-H	VEN	Flemish legislation: (Flemish) Nature reserve	Regional plan nature reserve	Ramsar
Groot Buitenschoor[ab]	68 m W		3.5 km NW	3.3 km NW	3.3 km NW	150m W
Galgenschoor[ab]	155 m W		3.5 km NW	150 m W	150 m W	150m W
De Schorren in Doel[ab]	68 m W		3km NW	1.3 km W	1.3 km W	150m W
Hoboken polder[b]			13 km Z			
Opstal Valley			400m O	600 m E		
De Kuifeend, Blokkersdijk, Grote kreek	3 km SE		3km SE	3 km SE	3 km SE	
De Maatjes	12km NE		19 km NE	18 km NE	18 km NE	
Oude Landen and Bospolder			9km SW			
De Stropers			16km W			
Wase Scheldepolders			8.5 km E			
The Clay Valley			19.6 km S			
Wuustwezel Heath	12km NO				12 km NE	
Small & large shooting range	12kmNE					
Kalmthoutse Heath	9.8 km NE		9km NE	9.8 km NE	9.8 km NE	9.8km NE
Historic fortifications of Antwerp as bat habitat		3.5 km NW		3.5 km NW*		

Area	SBZ-V	SBZ-H	VEN	Flemish legislation: (Flemish) Nature reserve	Regional plan nature reserve	Ramsar
Forests and heathland of sandy Flanders – eastern part		16 km W				
Forest and heathland areas east of Antwerp		13 km SE				

*Not all forts are recognised nature reserves. **a** Part of SBZ-H Scheldt and Durme estuary **b** Part of VEN area Mudflats and salt marshes along the Scheldt

Table 11-3: Overview of Dutch nature reserves

Area	SBZ-V	SBZ-H	Ramsar
NL - Westerschelde and Saeftinghe	4 km N	4 km N	4 km N
NL - Markiezaat	14 km N		16 km N
NL - Zoommeer	16 km N		19 km N
NL - Oosterschelde	15 km N	11 km N	
NL – Brabantse Wal	4.2 km NE	4.2 km NE	
NL - Vogel Creek		20 km N	
NL – Yerseke & Kapelse Moer*	26 km N	26 km N	

For the location of the relevant ecologically valuable areas, please refer to Appendix 1, Maps 11 and 13.

The Natura 2000 areas, both on Flemish and Dutch territory, are described in detail (notified habitats and species, conservation objectives, conservation status) in the appropriate assessment in Appendix 10.

Several of the areas of concern mentioned above coincide with the estuarine environment, particularly the Zeeschelde. We will therefore begin with a general description of the estuarine environment of the Zeeschelde.

11.3.1.1 Background on nitrogen

The Appropriate Assessments and Enhanced Nature Assessment provide a detailed explanation of the nitrogen problem in Flanders and the Netherlands. See Appendix 10.

11.3.1.2 Species Decree

The Species Decree (approved by the Flemish Government on 15 May 2009) has a broad scope and covers all native wild bird species (category 2) and all species listed in Annex IV of the Habitats Directive (including all bat species). The protection of protected bird species applies to both specimens and nests. This provision is not limited to certain protected areas, but applies throughout Flanders. The protection of specimens implies that the following actions are prohibited:

- deliberate killing;
- deliberate capture;
- deliberately and significantly disturbing them, in particular during periods of reproduction, dependency of young, hibernation and migration.

For some species, altering habitats or destroying nests is also prohibited. For example, altering the habitat of the natterjack toad and destroying nests is prohibited when they are in use.

The term 'significantly disrupt' can be understood here as 'a disruption that has measurable and demonstrable consequences for the conservation status of a species' [64].

The Species Decree provides for the possibility of drawing up a species protection programme. Such a programme is drawn up in consultation with the target groups concerned and comprises a number of measures aimed at ensuring that one or more species in Flanders are in a favourable state of conservation. A species protection programme (SBP) is adopted by the minister and has a duration of five years.

The SBP for the Port of Antwerp was adopted on 26 September 2022. The SBP aims to reconcile the dynamics of the port area with the conservation of the numerous protected species that occur there, while respecting the protection provisions of the Species Decree that apply to these species.

When granting an exemption from the protection provisions for a species listed in the Species Decree, it must always be considered whether granting the exemption will jeopardise the favourable conservation status of the population of the protected species. The implementation of this SBP ensures that this favourable status for the protected species is guaranteed within the network of ecological infrastructure in the port. This allows economic activities in the port areas to be carried out smoothly while ensuring the preservation of healthy populations of the protected species in the port area.

In Flanders, there are currently 27 official species protection programmes in force, with the support of the European Commission. These are listed below and highlighted in bold if applicable to the study area:

Table 11-4: Overview of Species Protection Programmes

• Farmland birds	• Hamster	• **Pool Frog**
• **Brook lamprey, bullhead and weatherfish***	• **Port of Antwerp**	• Spotted crake
• Beaver Tree frog	• Dormouse **Moor**	• Bittern **Natterjack**
• **Marsh harrier***	• **frog** Moorland**	• **toad** Bats** Flying deer
• **Smooth snake** Hen	• **clouded yellow**	• Midwife toad
• harrier	• **butterfly* Crested**	• **Meadow birds with a focus**
• Red-backed shrike	• **newt*** Common	• **on black-tailed godwit and**
•	• spadefoot toad	• **curlew****
	Corncrake*	• Turtle dove
• Large mud loach	• **Otter**	

*nitrogen-sensitive, **nitrogen-sensitive, but subordinate to other environmental pressures

The following species are included in individual species protection programmes in the SBP 'Port of Antwerp' Umbrella species (ISBPP):

• Argus butterfly	• **Sand martin**
• **Bluethroat**	• Common tern
• Building-dwelling swallow species	• **Wild orchids***
• **Green-winged orchid**	• **Natterjack toad****
• Daubenton's bat	• Black-headed gull

[64] Within the meaning of the definition set out in the Decree on nature conservation and the natural environment (21/10/1997, Article 2 30°: significant impairment of the natural characteristics of a special protection area: impairment that has measurable and demonstrable consequences for the natural characteristics of a special protection area, to the extent that there are measurable and demonstrable consequences for the conservation status of the species or habitat(s) for which the special protection area in question has been designated, or for the conservation status of the species listed in Annex III to this Decree, insofar as they occur in the special protection area in question.

Based on the site inventory conducted by Natuurpunt vzw and Corridor, the following protected plant and animal species were identified:

Birds

Table 11-5: Overview of protected plant and animal species

Species	Protection status	Impacted population	Status in EIN port area 2022 (SBP monitoring)	Nature restoration measures
Shelduck (*Tadorna tadorna*)	Annex I cat 2	1 pair (2019), just outside project area	11 breeding pairs	Mitigating measures to prevent settlement during the works: closing rabbit burrows. Installation of nesting boxes in the Scheldt dyke to attract breeding birds.
Tree lark (*Lullula arborea*)	AppendixIcat2	1 territory (2021)	Notstreamsd	The tree lark is a species of heathland, clearings, etc. This species may migrate to heathland and poor grasslands near the harbour. Additional recovery measures are therefore not necessary.
Tree pipit (*Anthus trivialis*)	Annex I, cat. 2	9 territories 2019 5 territories 2020 7 territories 2021	Not known	The tree pipit is a species found in heathland, dunes with scrub, clearings, young plantations and copses in agricultural areas. This species can migrate to heathlands and poor grasslands in and around the harbour. Additional restoration measures are therefore not necessary.
Lesser Whitethroat (Sylvia curruca)	Annex I, cat. 2	1 territory 2021	Unknown	This species is characteristic of dense thorny scrub and may find a new habitat in the newly restored scrub.
Buzzard (*Buteo buteo*)	AppendixIcat2	1 territory 2019 3 territories 2020 2 territories 2021	Unknown	Buzzards have several nests that they use alternately. This species will move to another location in the area. No recovery measures needed.
Canada goose (Branta canadensis)	Appendix I cat 2 cat 4	3 territories 2020 3 territories 2021	Notknown	This species will move to another location in the area. Undesirable exotic species No recovery measures required.
Magpie (*Pica pica*)	Annex I cat 2 cat 3	6alreadythennot occupied nests	Not known	This species will move to another location in the harbour. No remedial measures required.

Species	Protection status	Impacted population	Status in EIN port area 2022 (SBP monitoring)	Nature restoration measures
Pheasant (*Phasianus colchicus*)	Annex I cat 2 cat 4	6 territories	Unknown	This species will migrate to another location in the harbour. No restoration measures required.
Willow Warbler (*Phylloscopus trochilus*)	Appendix I cat. 2	65 territories 2020 35 territories 2021	Notknown	The willow warbler is characteristic of dry to moist semi-open landscapes: heathland, forest and agricultural areas. This species may migrate to agricultural areas near the harbour and scrubland. Additional restoration measures are therefore not necessary.
Jay (*Garrulus glandarius*)	AppendixIcat2	Present – no breeding certainty	Notknown	This species can find new habitat in the area.
Redstart (*Phoenicurus phoenicurus*)	Appendix I cat 2	1 territory 2020	Unknown	Thisspeciescannewhabitatfind in the forest compensation areas.
Common Whitethroat (*Sylvia communis*)	AppendixIcat2	4 territories 2020 2 territories 2021	Unknown	This species is characteristic of dense thorny scrub and may find a new habitat in the newly restored scrubland.
Meadow pipit (*Anthus pratensis*)	Annex I cat. 2	2 territories 2019 3 territories 2020 3 territories 2021	19 breeding pairs (2017) 15 breeding pairs (2018)	Grassland restoration measures
Green woodpecker (Picus viridis)	AppendixIcat.2	Present-none breeding certainty 2021	Unknown	This species can find new habitat in the area.
Great spotted woodpecker (Dendrocopus major)	Appendix I cat. 2	2 territories 2020 Present – no breeding certainty 2021	Notknown	New habitat in the forest compensation areas.
Hedge sparrow (Prunella modularis)	Annex I cat. 2	16 territories 2020 7 Territories 2021	Notknown	New habitat in the forest compensation areas and restored scrubland.
Wood pigeon (*Columba palumbus*)	Annex I cat. 2 cat 4.	10 territories 2020 Present (9) – 2021 (no breeding certainty)	Unknown	New habitat in the Forest compensation areas and restored scrubland.
Jackdaw (*Corvus monedula*)	Annex I cat. 2	Present – no breeding certainty (2021)	Unknown	This species will move to another location in the harbour. No restoration measures required.

Species	Protection status	Impacted population	Status in EIN port area 2022 (SBP monitoring)	Nature restoration measures
Lapwing(*Vanellus vanellus*)	Appendix I cat 2, cat 4	1 territory 2019 12 territories 2020 7 territories 2021	Not available	This species will move to another location in the harbour. No recovery measures required.
Reed warbler (*Acrocephalus scirpaceus*)	Annex I cat. 2	1 territory 2021	Not available	This species will move to another location in the port. No restoration measures required.
Cuckoo (Cuculus canorus)	Annex I cat. 2	1 territory 2020	Unknown	New habitat in the forest compensation areas and restored scrubland.
Great tit (*Parus major*)	Annex I cat. 2	Common in the project area (2020) 4 territories 2021	Unknown	New habitat for this species in the restored scrub and forest compensation areas.
Gadwall (Anas strepera)	AppendixIcat.2	1 territory 2020 1 territory 2021	Notknown	Alternative locations in the vicinity (opposite side of Kanaaldok)
Blackbird (Turdus merula	Annex I cat. 2	6 territories 2020 1 territory 2021	Notknown	New habitat for this species in the restored scrub and forest compensation areas.
Nightingale (*Luscinia megarhynchos*)	Appendix I, cat. 2	5 territories 2020 5 territories 2021	Notknown	The nightingale is characteristic of shrub vegetation and sea buckthorn. The 3 hectares of sea buckthorn vegetation that will disappear will be replanted at another location in the harbour in combination with other shrub species as part of nature restoration. This species can then migrate there.
Blue tit (*Parus caeruleus*)	Annex I cat. 2	Common in the project area (2020) 9 territories 2021	Unknown	New habitat for this species in the Restored scrub and forest compensation areas.
Goldfinch (*Carduelis carduelis*)	Annex I cat. 2	1 territory 2021	Unknown	New habitat for this species in the restored scrub and forest compensation areas
Robin (*Erithacus rubecula*)	Annex I cat. 2	Common in the project area (2020) 12 territories 2021	Unknown	New habitat for this species in the restored scrubland and forest compensation areas.
Oystercatcher (*Haematopus ostralegus*)	Appendix I cat 2	1 territory in 2019 3 territories 2020 3 territories 2021	Three territories in EIN Port area: not available	This species breeds in the harbour Regularly on roofs and lawns between the businesses. After the work, this species can move to elsewhere or remain in place.

Species	Protection status	Impacted population	Status in EIN port area 2022 (SBP monitoring)	Nature restoration measures
Sparrowhawk (*Accipiter nisus*)	Appendix I cat 2	Present – no breeding certainty		New habitat for this species in the restored scrub and forest compensation areas.
Long-tailed tit (*Aegithalos caudatus*)	Annex I cat 2	4 territories 2020 5 territories 2021	Not available	New habitat for this species in the restored scrub.
Chiffchaff (*Phylloscopus collybita*)	Annex I cat. 2	42 territories 2020 19 territories 2021	Notknown	New habitat for this species in the restored scrubland and forest compensation areas.
Garden Warbler (*Sylviaborin*)	Annex I cat. 2	2 territories 2020 3 territories 2021	Notknown	New habitat for this species in the Restored scrubland and forest compensation areas.
Chaffinch (*Fringilla coelebs*)	AppendixIcat.2	13 territories 2020 13 territories 2021	Notknown	New habitat for this species in the restored scrub and forest compensation areas.
Wren (*Wren*)	Appendix I cat. 2	4 territories 2020 2 territories 2021	Notknown	New habitat for this species in the restored scrub and forest compensation areas.
White wagtail (*Motacilla alba*)	Annex I cat. 2	2 territories 2021	Not known	This species will move to another location in the harbour. No restoration measures required.
Song thrush (*Turdus philomenos*)	Annex I cat. 2	1 territory 2020 3 territories 2021	Unknown	New habitat for this species in the restored scrub and the forest compensation areas.
Black crow (*Corvus corone*)	Annex I cat. 2	Present – None breeding certainty	Not known	This species will move to another location in the harbour. No remedial measures required.
Black redstart (Phoenicurus ochruros)	Annex I cat. 2	4 territory 2020 3 territories 2021	Unknown	In principle, this species can remain among the farm buildings. This species often breeds on (industrial) buildings and in urban areas.
Blackcap (Sylvia atricapilla)	Annex I cat. 2	10 territories 2020 9 territories 2021	Notknown	New habitat for this species in the restored scrub and forest compensation areas.

Other species

The following discussion provides an overview of the protected species present in the reference situation for which a derogation application was required. The derogation applications from the first environmental impact report and environmental permit have already been implemented. It is therefore no longer necessary to apply for derogations.

The various protected species are listed in the table below.

Table 11-6: Overview of protected plant and animal species in the reference situation

Species	Protection status	Impacted population	Status in port area 2022 (SBP monitoring)	Nature restoration measures
Bee orchid (*Ophrys apifera*)	Annex I cat 1 Species Decree (all species of orchids: all species except those specifically mentioned by species name in this annex)	Minimum 107 specimens in 2019 Most of them were relocated as part of the construction of the quay wall by the Antwerp Port Authority. A small population (around ten specimens) is still present.	5239 specimens in 20 growth sites	Derogation requested, approved and implemented: most of the population has been relocated by the Antwerp Port Authority. A small part of the population is still present and has been relocated.
Large bee orchid (*Neottia ovata*)	Annex I cat 1 Species Decree (all species of orchids: all species except those specifically mentioned by species name in this annex)	Minimum 615 specimens	Several thousand specimens or 5 growth sites within EIN	Derogation requested, approved and implemented: nature restoration through translocation
True reindeer moss (*Cladonia rangiferina*)	Appendix I cat 1 Species Decree (Cladiona spp. subgen. Cladina)	Not observed in the field. Uncertain occurrence. However, other *Cladonia* spp. are certain to be present.	Not available	No restoration measures required. This species can develop on fallow land within the project area.
Blue-winged grasshopper (*Oedipoda caerulescens*)	Appendix I cat 1 Species Decree	A few sightings	Not available	No restoration measures required This species can continue to develop on the 36 hectares of poor grassland that will be developed in the harbour.
True centaury (*Centaurium erythraea*)	AppendixIcat1 thousands Species Decree	Order of magnitude:	Frequent and widespread in port (not further specified)	No restoration measures required
Natterjack toad (*Epidalea calamita*)	Appendix I cat 3 Species Decree	1 breeding site		Construction of a suitable breeding water and adjacent land habitat within the ecological infrastructure of the Port of Antwerp

11.3.2 General description of the estuarine environment and the Sea Scheldt in particular

This general description covers various areas protected under the Birds Directive, Habitats Directive, VEN area or nature reserve (see table above). These are Groot Buitenschoor, Galgenschoor and De Schorren in Doel. These areas are part of the SBZ-H 'BE2300006 - Scheldt and Durme estuary from the Dutch border to Ghent'.

The Scheldt estuary has a fresh-salt gradient from the mouth to the interior. The tidal influence extends as far as Ghent. The Zeeschelde has a highly dynamic system of side channels, shallow water, shoals, mud flats and salt marshes.

The Scheldt estuary is home to a wide variety of organisms, although the number of species in the brackish areas is rather low. The Scheldt estuary has a very high primary productivity.

This abundant food supply attracts high concentrations of invertebrate soil organisms, known as benthos. This rich soil fauna is a source of food for both birds and fish.

The Scheldt estuary is an attractive spawning and nursery area for marine fish species. During the winter, the estuary serves as a wintering ground for species such as herring, sprat and sea bass. In spring, the estuary forms the access route for anadromous (migratory) fish species that swim up the river to their spawning grounds. For example, a large population of river lamprey (Annex II species) migrates up the Sea Scheldt. Other migratory fish species that are now regularly observed in the Zeeschelde thanks to improved water quality include twait shad, eel and smelt.

Not only fish, but also birds make significant use of these rich food sources. Especially during the migration period and in winter, large numbers of waders and other water birds depend on these areas for their survival.

The Scheldt estuary was severely affected by human intervention during the 20th century. The estuary was increasingly reclaimed and diked. The shipping channel was dredged deeper and wider to improve access to the port of Antwerp. The main bottlenecks for the ecological functioning of the Scheldt estuary are the changes in hydromorphology, increased tidal energy, poor water quality and contamination of the waterbed. As a result of the diking and deepening of the Scheldt, the area of mudflats and salt marshes has decreased significantly over the past 150 years. In 2003, the area was only a third of what it was in 1850 (Nature Report 2007 – focus on the Sea Scheldt). The remaining intertidal areas are not very sustainable in many places because they are under high hydromorphological pressure.

However, in recent decades, there has been a shift in international and local environmental and nature policy (more specifically, the pursuit of more integrated management of the estuary) and a number of initiatives, including the revised Sigma Plan, have been launched, which may slowly turn the tide (Nature Report 2005).

11.3.3 Groot Buitenschoor

The Groot Buitenschoor is located northwest of the project area, along the Scheldt, and covers 215 hectares. The Groot Buitenschoor is part of the Birds Directive area (SBZ-V) BE2301336 'Schorren en polders van de Beneden-Schelde' (Salt marshes and polders of the Lower Scheldt) and the Habitats Directive area (SBZ-H) BE2300006 'Schelde- en Durme-estuarium van de Nederlandse grens tot Gent' (Scheldt and Durme estuary from the Dutch border to Ghent). The area is designated as a recognised nature reserve 'Groot Buitenschoor and Galgenschoor' (Natuurpunt) and Ramsar site. The shortest distance between the project area and Groot Buitenschoor is approximately 3,500 metres in a NNW direction.

11.3.3.1 Vegetation

The Groot Buitenschoor is coloured on the 2018 version of the biological value map as a biologically very valuable area with mud flats (BWK code ds), salt marshes (BWK code da), reed beds (BWK code mr) and brackish to saline marshes with Heen (BWK code mz). The higher areas along the dyke feature rough grassland (BWK code hr) and mesophilic hay meadows (BWK code hu). The European habitat types 1130 'Estuaries' and 1330 'Atlantic salt marshes (Glauco-Puccinellietalia maritimae)' occur here. On the higher parts, outside the reach of the tides, the habitat type 6510 'Shiny oat grass and tall foxtail grasslands' occurs.

Mudflats and salt marshes are 'extremely rare' in Flanders: the total area of mudflats and salt marshes in Flanders is estimated at 1,500 to 2,000 hectares. The distribution of brackish mudflats and salt marshes in Flanders is limited to the areas outside the dykes along the Zeeschelde, downstream from Antwerp. In Europe, they are now only found in the estuaries of the Elbe and the Westerschelde.

Saltwater mudflats occur in various places along the Flemish coast, including at the IJzermonding, the Zwin and the Bay of Heist.

Species-poor pioneer vegetation with glasswort species and also sea lavender occurs on sheltered mud flats that are flooded daily with strongly brackish water. Glasswort and sea lavender vegetation form the initial stage in the succession from mud flat to salt marsh. At the transition between mudflats and salt marshes, which are flooded at every tide, the vegetation is dominated by common saltmarsh grass (synonym: English saltmarsh grass). Saltmarsh grass vegetation plays an important role in the succession from mudflats to salt marshes. This perennial species forms hummocks, which accelerate the elevation of the terrain. In higher locations, which are only flooded at spring tide, the vitality of the previous habitat declines due to sedimentation and salt marshes develop. Common saltmarsh grass is the typical indicator species for low salt marshes that are flooded more often and for longer periods, while common saltwort and sea lavender are characteristic of higher locations. Sea lavender and sea plantain occur on medium-high salt marshes that flood less frequently. Grazed, high salt marshes normally develop short grassy vegetation with English grass, milkwort and salt-tolerant forms of red fescue and fescue. The typical indicator species for the brackish water salt marshes in the Scheldt estuary are Zulte, Heen and Echt spoonwort (source: EIA Nuclear Power Plant in Doel, 2010).

11.3.3.2 Fauna

The Zeeschelde (the section of the Scheldt from Ghent to the Belgian-Dutch border) is internationally important for wintering water birds. The most important species are Gadwall, Pochard and Teal, and during some winters also Pintail. At the Flemish level, the Zeeschelde is home to more than 30% of the Western European winter populations of teal, gadwall and pintail. Teals are the most numerous wintering waterbirds in the Zeeschelde. They occur along the entire gradient in the Scheldt estuary. In the 1990s, however, numbers declined sharply in the Western Scheldt, while increasing significantly in the Sea Scheldt. It is not clear whether there has been a shift in the population, but it is almost certain that the improvement in water quality in the 1990s is the reason for the increase in the Sea Scheldt. The teals in the Sea Scheldt forage on the mudflats along the waterline and almost never in the water. At low tide, they also forage on mudflats that are still wet near the water's edge, while at high tide they move to the neighbouring salt marshes. Due to the high densities of invertebrate fauna on the mudflats and sandy areas, large numbers of waders such as plovers and sandpipers often forage here. At high tide, salt marshes also provide a refuge for all kinds of wading birds that forage on the surrounding mudflats or beaches (Dumortier *et al.,* 2007; Demolder *et al.,* 2014). Seals are regularly observed in the area (source: waarnemingen.be/species/395). There are no fish species for which specific conservation objectives have been formulated for the Zeeschelde.

In recent years, a downward trend has been observed in the numbers of several wintering water birds (including teal, pochard, shelduck, pintail, dunlin, redshank, etc.). In the fresh and brackish water estuary of the Zeeschelde, changes in water quality have led to major changes in the food supply. Initially, an improvement in water quality led to a sharp increase in waterbird numbers. However, as the organic load in the estuary continued to decline, the food supply – mainly small benthic animals (Oligochaeta) – decreased sharply again and the large numbers of waterbirds disappeared (Devos & Onkelinx, 2013).

The Groot Buitenschoor is a mudflat and salt marsh area that is used as a feeding and resting place by water birds (ducks, herons, cormorants) and waders. The reed beds along the Scheldt in the Groot Buitenschoor provide habitat for typical breeding birds.

The site notification states that, based on valid observations of breeding birds during the spring of 2012 (Avimap), at least 11 species of breeding birds occur in the part of Groot Buitenschoor that lies within VEN (latest available data reported in the site notification).

Of particular interest are the breeding territories of the bluethroat (four), reed bunting (four, red list 'Near Threatened') and linnet (one territory, red list 'Vulnerable'). The impact assessment also makes additional use of more recent breeding bird data (individual observations) from Natuurpunt vzw.

The ‘Flemish risk atlas for birds and wind turbines’ (Everaert, 2015)[65] indicates that the study area is located near a route used by gulls and waders for their daily migration to and from their roosting sites (this concerns migration between the De Kuifeend complex on the one hand and the Scheldt on the other) and close to the Zeeschelde, which is itself an important migration route. In addition, the Zeeschelde also functions as a corridor for the daily movements of water birds and waders between feeding areas and resting areas. The Zeeschelde and the canal docks both serve as staging and resting areas for water birds and waders. The plots in the project area are located within the 1 km buffer zone around these staging areas.

11.3.4 Galgenschoor

Galgenschoor is located to the west of the project area. This ecologically valuable mudflat and salt marsh area is separated from the project area by a grassy verge/dyke with high-voltage pylons, Scheldelaan and railway lines on either side of Scheldelaan.

The boundary of the Birds Directive area (SBZ-V) BE2301336 'Schorren en polders van de Beneden-Schelde' (Salt marshes and polders of the Lower Scheldt) lies
within 100 m of the plot boundary of the project area (the SBZ-V also includes railway lines).

In addition, Galgenschoor is also designated as a Ramsar site, a Habitat Directive area (SBZ-H) (border approximately 150 m from the project area) and a 'Large Nature Unit' (GEN) within the Flemish Ecological Network (VEN). As sub-area 37, it belongs to the Habitat Directive area BE2300006 'Scheldt and Durme estuary from the Dutch border to Ghent' and to the VEN 'Slikken en schorren langs de Schelde' (Mudflats and salt marshes along the Scheldt).

The Galgenschoor is also a recognised nature reserve 'Groot Buitenschoor en Galgenschoor' (Natuurpunt), the
the boundary is demarcated at a minimum of approx. 150 m from the project area.

The Galgenschoor covers an area of approximately 46 hectares and is 2 km long. It is located north of Antwerp on the right bank of the Scheldt between Lillo Fort and the Euroterminal. It is designated on the Biological Value Map (2020) as a biologically very valuable brackish salt marsh area in the municipalities of Zandvliet and Lillo. The southern part of the Galgenschoor borders the Fort Lillo reserve via a narrow strip of reed vegetation in the southern part.

The current form of the Galgenschoor is already visible on Ferraris' maps (1771-1778). Until the 1950s, it was grazed by sheep and had varied salt marsh vegetation. After grazing ceased, the vegetation evolved into rather monotonous reed vegetation. Grazing has now been reintroduced in order to restore the variety of vegetation. By 'trampling' the soil and loosening the thick layer of half-decayed plant debris (mainly reeds and sea lavender), the soil becomes mobile again, erosion increases and the rejuvenation of the salt marsh continues steadily. In the southern part, the reeds are cut annually for economic reasons. The 2008 monitoring report indicates that new channels continue to form and that the brackish salt marsh vegetation with its salt-tolerant species continues to develop (Wagemans et al., 2008).

The following figures show the location of this area in relation to the project area.

[65] This risk atlas is part of the decision-support tool for the installation of wind turbines in Flanders and the possible effects on birds and bats.

Figure 11-2: Location of the Galgenschoor (part of the Scheldt and Durme estuary SPA from the Dutch border to Ghent) in relation to the project area (overview).

Figure 11-3: Location of the Galgenschoor (part of the Scheldt and Durme estuary SBZ from the Dutch border to Ghent) in relation to the project area (detail).

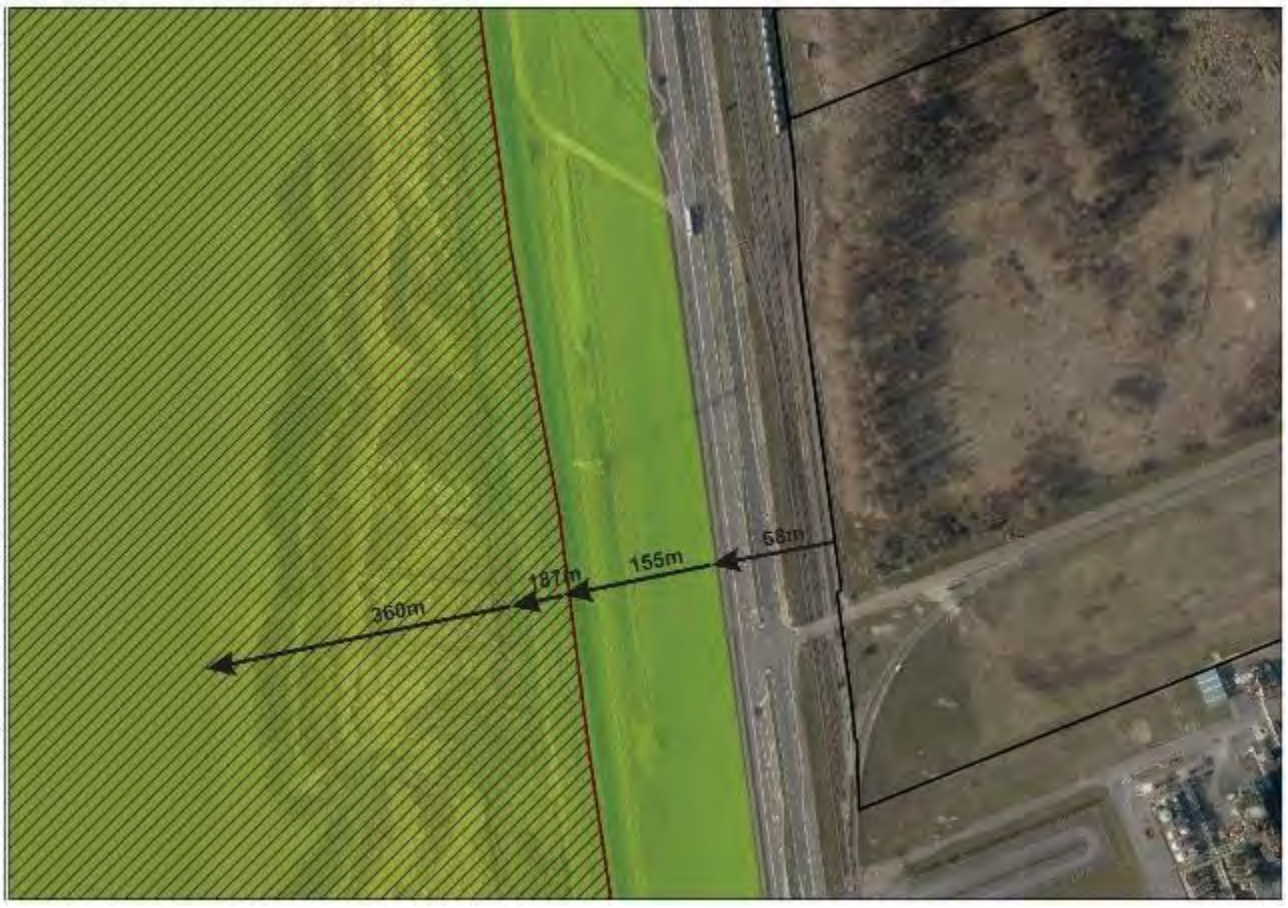

Figure 11-4: Location of the Galgenschoor (part of the Scheldt and Durme estuary SPA from the Dutch border to Ghent) in relation to the project area (detail).

11.3.4.1 Vegetation

The entire Galgenschoor is coloured in on the 2020 version of the biological value map as a biologically highly valuable area with mudflats (BWK code ds), salt marshes (BWK code da) and reed beds (BWK code mr). European habitat type 1130 'Estuaries' is present, as is habitat type 1330 'Atlantic salt marshes (Glauco-Puccinellietalia maritimae)' on the slightly higher parts, which are not flooded at every high tide, but only at spring tide. In addition, the regionally important biotope 'Reed beds and other Phragmition vegetation' is also present.

Due to its location outside the dykes, the vegetation in the Galgenschoor is characterised by relatively species-poor plant communities with a strong dominance of one species.

Species-poor pioneer vegetation with glasswort species and also sea lavender occurs on sheltered mud flats that are flooded daily with strongly brackish water. Glasswort and sea lavender vegetation form the initial stage in the succession from mud flat to salt marsh. At the transition between mudflats and salt marshes, which are flooded at every tide, the vegetation is dominated by common saltmarsh grass (synonym: English saltmarsh grass). Saltmarsh grass vegetation plays an important role in the succession from mudflats to salt marshes. This perennial species forms hummocks, which accelerate the elevation of the terrain. In higher locations, which are only flooded at spring tide, the vitality of the previous habitat type decreases due to sedimentation and salt marshes develop. Common saltmarsh grass is the typical indicator species for low salt marshes that are flooded more often and for longer periods, while common saltwort and sea lavender are characteristic of higher locations. Sea lavender and sea plantain occur on medium-high salt marshes that flood less frequently. Grazed, high salt marshes normally develop short grassy vegetation with English grass, milkwort and salt-tolerant forms of red fescue and fescue. The typical indicator species for the brackish water salt marshes in the Scheldt estuary are Zulte, Heen and Echt spoonwort (source: EIA Nuclear Power Plant in Doel, 2010).

The following figure shows the ecotope map of the mudflats and salt marshes in the study area (including Galgenschoor). Based on this map, the following can be deduced for Galgenschoor, from east to west:

- The easternmost zone is characterised by a salt marsh zone, which is wide in the south and narrows towards the north;
- The salt marsh transitions into a mudflat zone characterised by: medium-high mudflat soft substrate, low mudflat soft substrate, 3 small zones of low mudflat hard natural substrate;
- The mudflats transition into a shallow subtidal zone and a deep subtidal zone.

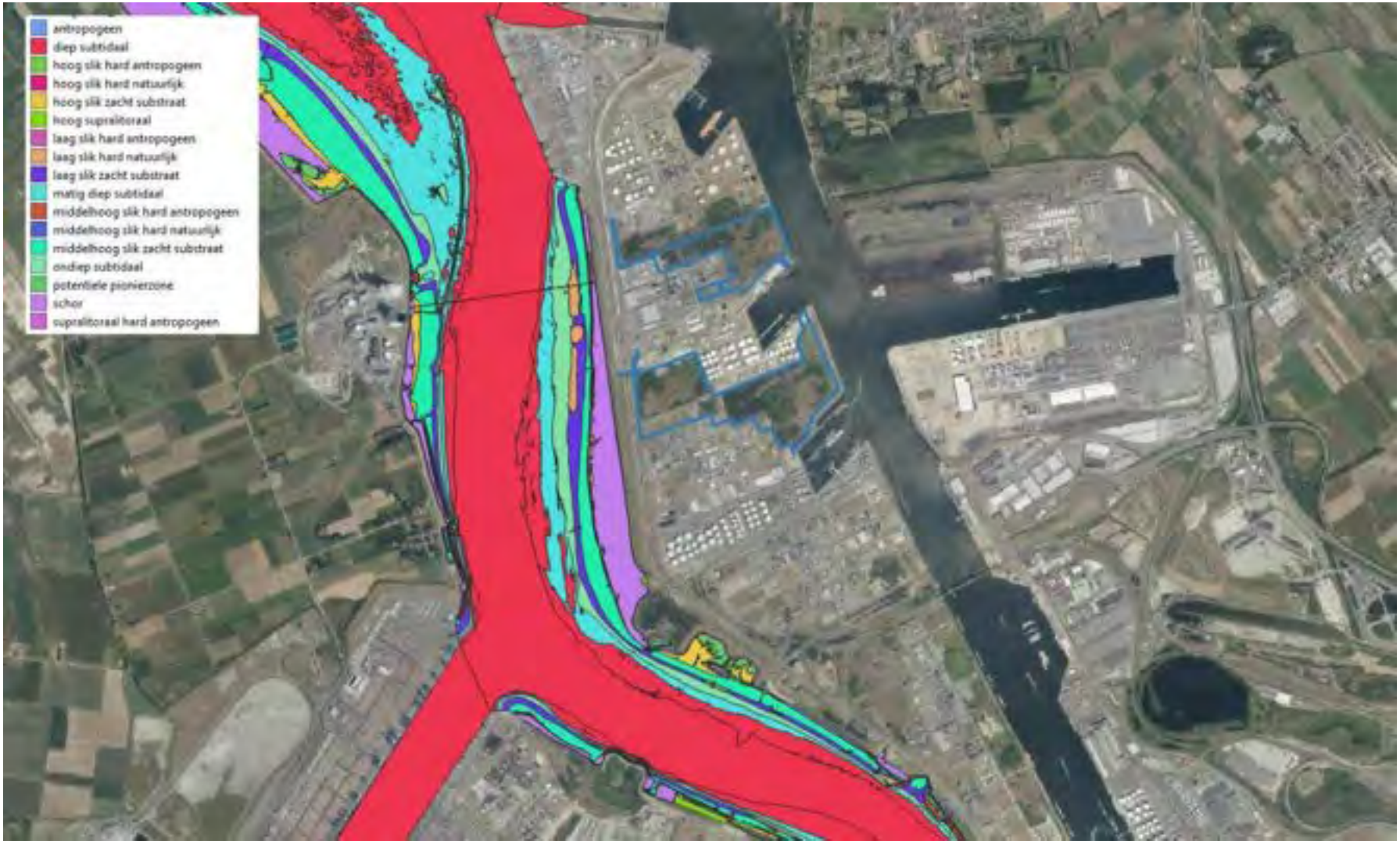

Figure 11-5: Ecotope map of the mudflats and salt marshes (including Galgenschoor) in the project area (Source: ecotope map 2015, INBO)

11.3.4.2 Fauna

The faunal value of the Galgenschoor is mainly determined by its birdlife. Tidal areas such as Galgenschoor are extremely valuable for many bird species. This is mainly due to the gradient from salt to fresh water. They also have a very clear seasonal aspect: there are breeding birds, migratory birds and winter visitors. These are briefly described here.

The Zeeschelde is internationally important for wintering water birds. The most important species are Gadwall, Pochard and Teal, and during some winters also Pintail. At the Flemish level, the Zeeschelde is home to more than 30% of the winter populations of teal, gadwall and pintail. Teal are the most numerous wintering waterbirds in the Zeeschelde. They occur along the entire gradient in the Scheldt estuary. In the 1990s, however, numbers declined sharply in the Western Scheldt, while increasing significantly in the Sea Scheldt. It is not clear whether there has been a shift in the population, but it is almost certain that the improvement in water quality in the 1990s is the reason for the increase in the Sea Scheldt. The teals in the Sea Scheldt forage on the mudflats along the waterline and almost never in the water. At low tide, they also forage on mudflats that are still wet near the water's edge, while at high tide they roost on the neighbouring salt marshes (Dumortier et al., 2007; Demolder et al., 2014).

Due to the abundant invertebrate fauna present on the mudflats and sandy areas, large numbers of waders such as plovers and sandpipers often forage here. At high tide, salt marshes also provide a refuge for all kinds of wading birds that forage on the surrounding mudflats or beaches.

Van Ryckegem *et al.* (2017) conducted an extensive study into habitat mapping and the foraging habits of wintering waterbirds on the mudflats of the Zeeschelde. During the 2014-2015 campaigns, 52,154 birds were counted. Two main groups were distinguished: ducks and waders. These figures show that ducks are mainly observed in the freshwater zones along the Zeeschelde. Relatively fewer ducks are counted in the brackish water zone, but rather redshanks, avocets and black-headed gulls. However, the large numbers of waders are limited to two areas, namely Ouden Doel and Doel-Kerncentrale. These are the areas with the largest mudflat surface area. Although Galgenschoor is also located in the brackish water zone, there are still many ducks.

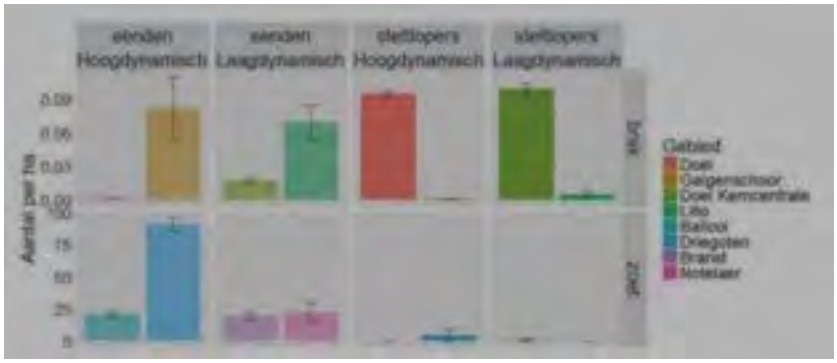

Figure 11-6: Total number of ducks and waders per hectare (± standard error) in the focus areas. (Note that the scale differs between freshwater and brackish water.)

The 'Flemish risk atlas for birds and wind turbines' (Everaert, 2015) indicates that the study area is located on a daily roost migration route for gulls and waders to and from their roosting sites (this concerns roost migration between the De Kuifeend complex on the one hand and the Scheldt on the other) and close to the Zeeschelde, which is itself also an important roost migration route. In addition, the Zeeschelde is also used for foraging migration, which refers to the daily movements of waterbirds and waders between feeding areas and resting areas. The Zeeschelde and the canal docks both serve as staging and resting areas for waterbirds and waders. The plots in the project area are located within the 1 km buffer zone around these staging areas.

The tables below show the numbers of water birds for the winters of 2018/2019 and 2020/2021 in Galgenschoor (source: scheldeschorren.be). Data for 2019/2020 were not available.

Table 11-7: Numbers of water birds in Galgenschoor 2018/2019 (source: Scheldeschorren.be)

SPECIES	October '18	November '18	December '18	January '19	February '19
Kievit	36	48	16	87	122
Greylag goose	39	8	71	21	27
Canadian goose					10
Wigeon				12	34
Oystercatcher	7	8	5	4	10
Gadwall			2	14	20
Teal	10		8	18	9
Curlew	3	6	4	6	4
Shelduck	3			1	21
Grey heron	1		1		
Cormorant			1		1
Egyptian goose		1			2
Mallard	64	4			22
Water rail					2

Table 11-8: Numbers of water birds Galgenschoor 2020/2021 (source: Scheldeschorren.be)

SPECIES	October '20	January '21	February '21
Lapwing	61		64
Greylag goose	43	44	80
Wigeon	3	2	12
Oystercatcher	57	106	104
Gadwall	44	24	44
Teal	2	35	16
Curlew	8	5	6
Shelduck			6
Egyptian goose	2		
Mallard	15		67
Ringed plover			38
Tufted duck			6
Redshank			1
Woodcock			1

Compared to other areas along the Zeeschelde, the numbers of water birds that forage or rest in winter near Galgenschoor are relatively low.

Table 11-9 shows the breeding bird species present in Galgenschoor, including all species listed in Annex I of the Birds Directive, supplemented with species of special concern. These data are the result of applying the PTT method (Gyselings et al., 2011 and Verbessem et al., 2007). The species of concern are included in the impact assessment because of the importance of the study area for these species on a Flemish scale, their presence on the Red List or because of the indicative value these species have for the condition of the important breeding bird areas and their breeding bird community. All species for which conservation objectives have been set are also included in the list.

The most important breeding birds of the Galgenschoor are typical species of salt marsh areas, such as the redshank and shelduck. The reed bunting and bluethroat find a suitable breeding habitat in the tall reed vegetation. The marsh harrier also breeds in the area (successful breeding in 2014 and again in 2020). This is in line with the designation of Galgenschoor as a breeding area for the rare breeding bird, the marsh harrier, in the 'Flemish risk atlas for birds and wind turbines' (INBO, 2011). Since 2011, there have also been indications of breeding cases of the reed warbler and the marsh warbler (courtship behaviour).

Table 11-9: Overview of the types of breeding birds and breeding birds listed in Annex I of the Birds Directive in Galgenschoor, based on Gyselings et al. (2011) and Verbessem et al. (2007).

SPECIES	Galgenschoor	Annex I species	Red List species (Devos et al., 2016)
Shelduck	X		Currently not endangered
Gadwall	X		Not currently endangered
Bluethroat	X	X	Not currently endangered
Reed Bunting	X		Near threatened
Meadow pipit	X		Threatened
Redshank	X		Vulnerable
Avocet	X	X	Vulnerable
Marsh harrier [67]	X	X	Threatened

The figures below show observations of breeding behaviour from 2020-2024 (Source: databank waarnemingen.be, Natuurpunt vzw). Data up to February 2024 are included.

([66]) The breeding bird data for Galgenschoor are the result of the PTT method (Point Transect Method). This method is a very general counting method in which all organisms, in this case birds, are counted at a series of points along a fixed route. A sample is taken from the selected area by counting at a number of fixed points and ultimately comparing for each species whether there are more or fewer the following year. In contrast to the accurate mapping method, which can determine absolute numbers (densities) of territories (breeding pairs), the PTT method provides relative numbers. By counting at a large number of fixed points, a long-term picture of the trend per species is obtained. The advantage of the PTT method is that it is less labour-intensive than the mapping method and that more areas can be counted. A disadvantage of the PTT method is that there is no certainty that the species observed actually breeds in the area. The PTT method is therefore less suitable for a number of species and the results must be interpreted with caution. More specifically, this concerns the bird species: shelduck, gadwall, avocet and redshank. That is why the table does not show numbers, but only indicates the presence of a breeding case of the species.

[67] Advice 19-210678 ANB Antwerp

[68] Observations of birds exhibiting breeding behaviour are observations made during the breeding season of, among other things, nest building, foraging flights, diversionary behaviour, nests, fledglings, etc.

Figure 11-7: Observations of breeding behaviour in the common harrier in 2020-2024 (Source: databank waarnemingen.be, Natuurpunt vzw 2021-2024). Purple dots: common harrier - observations)

Figure 11-8: Observations of breeding behaviour of shelducks, avocets, gadwalls and redshanks in 2020-2024 (Source: databank waarnemingen.be, Natuurpunt vzw 2021-2024). Blue: Shelduck, Orange: Avocet, Brown: Gadwall, Purple: Redshank).

Figure 11-9: Observations of breeding behaviour of Bluethroat, Cetti's Warbler and Reed Warbler in 2020-2024 (Source: database waarnemingen.be, Natuurpunt vzw 2021-2024). Red: Bluethroat, Orange: Cetti's warbler, Dark blue: Reed warbler, Light blue: Reed bunting).

11.3.5 Tufted Duck including Opstal Valley, Grote Kreek and Tufted Duck

The 'De Kuifeend' area is located on the right bank of the Scheldt north of Antwerp within the NMBS Antwerp North marshalling yard. The shortest distance between the project area and this nature reserve is approximately 3 kilometres in a south-easterly and easterly direction. The area is designated as a VEN area (with sub-areas Opstalvallei, Grote Kreek and Kuifeend) and is also a recognised nature reserve. The area is part of the Birds Directive area 'De Kuifeend – Blokkersdijk'.

The Opstalvallei sub-area is a newly created nature reserve named after the stream of the same name. One part consists of two excavated lakes and a widening of the watercourse through the area, with two forest plots. In the southern part, an ecological dyke has been constructed with a viewing platform. The Reigersbos connects to the Opstalvallei area. The area forms a breeding habitat for water and reed birds. The area was created to compensate for lost natural values in the harbour area.

De Kuifeend consists of ponds, wetlands, extensive reed beds and varied grasslands. De Kuifeend is an important breeding, resting and wintering area for (water) birds. It originated in the former Antwerp polder. It is a nature oasis in the middle of the port of Antwerp, surrounded by industry, container terminals, railway infrastructure, busy traffic arteries, port docks and the Hooge Maey landfill site. The land is owned by NMBS and the Antwerp Port Authority. It is managed by Natuurpunt Antwerpen Noord vzw.

11.3.6 Blokkersdijk

The Blokkersdijk sub-area is a 100-hectare nature reserve on the western edge of the city of Antwerp. The reserve is located between the N49 motorway and the Scheldt river. To the west lies the industrial zone of the Port of Antwerp, while to the east it is bordered by the Sint-Annabos. On the other side of the N49 motorway lie Het Rot and Het Vlietbos. The shortest distance between the project area and Blokkersdijk is approximately 9.5 kilometres to the south.

The reserve is located on reclaimed land and consists of a large central lake and its shore areas. Blokkersdijk is an important waterbird area that is protected at European level as a Natura 2000 area (Bird Directive area 'De Kuifeend en Blokkersdijk' (BE2300222)/ the Scheldt banks are a Habitat Directive area as part of 'Scheldt and Durme estuary from the Dutch border to Ghent' (BE2300006)). The area has been a protected nature reserve since 1999.

The Blokkersdijk used to form the boundary between the Borgerweertpolder and the Melselepolder. The lake was created when the Borgerweertpolder was raised.

11.3.7 De Maatjes, Wuustwezelheide and Groot Schietveld

This area is located approximately 12 kilometres northeast of the project area. The Habitat Directive area is designated as 'Klein en Groot Schietveld' and the Birds Directive area is designated as 'De Maatjes, Wuustwezelheide and Groot Schietveld'. The Birds Directive area does not completely overlap with the Habitats Directive area. The nature reserve 'De Maatjes' is also recognised as a Flemish nature reserve.

The Klein and Groot Schietveld military domains contain some of the best-preserved areas of wet heathland in Flanders, which are important for the survival of typical heathland species such as the silver-studded blue butterfly and the adder.

The Schietvelden are located in the north-west of the province of Antwerp. The anti-tank ditch runs along the southern edge of the Klein Schietveld. The Klein and Groot Schietveld are two exceptionally large nature reserves that form part of the green belt north of the city of Antwerp. This green belt extends into the Netherlands. The Bird Directive area 'De Maatjes, Wuustwezelheide and Groot Schietveld' is partly outside the Habitat Directive area, in the north of the municipality of Wuustwezel.

Both shooting ranges consist of considerable areas of wet and dry heathland. The fens located there are important habitats for amphibians and dragonflies. Peat habitats can also be found in mosaic with wet heathland.
Locally, there are heath grasslands where the endangered strawberry butterfly lives. The heathland and the transition zone to the forest are home to rare species such as the adder, the alcon blue butterfly, the nightjar and the tree lark. On the edge of the Marum sub-area, you will find a beautiful transition from small-scale meadow landscape to stream valley and heathland.

The Klein and Groot Schietveld are military domains. The military authorities are therefore the main users of the site. In the Groot Schietveld, there is a Pidpa groundwater extraction facility and an agricultural concession from the municipality of Brecht. The Klein Schietveld airfield is used by an aeroclub, and Natuurpunt conducts bat surveys in the Brasschaat fort.

The De Maatjes nature reserve is located in the municipality of Kalmthout. The De Maatjes marshland and nature reserve is the remnant of an old lowland peat bog and peat extraction area in which silting up has occurred in the reed marsh over the last 200 years and which currently consists of reed marsh and (wet) meadows. The area is characterised by the frequent presence of small natural features such as rows of pollarded willows, wooded edges and hedges. The reed beds have taken the place of what used to be open water pools and are part of a much larger reed bed across the border with the Netherlands. Originally, the area was covered by a large expanse of wet extensive grasslands, which have now been reduced to the area within the Flemish Nature Reserve.

The marshland is particularly important for the marsh harrier, bittern and bluethroat, but also for other typical reed species such as the reed warbler, bearded reedling, spotted flycatcher, marsh warbler, etc. Until about 10 years ago, even the spotted crake was observed here, and this species will benefit from the objectives set for the other marsh and meadow birds. The main bottlenecks are the small area (6 ha) of the reed marsh and the drying out due to excessive drainage. To conserve the bittern, a species listed in the Birds Directive, the aim is to increase the reed bed by approximately 100 ha. The bluethroat and marsh harrier will also benefit from this objective.

The current Flemish nature reserve around the Maatjes contains structurally rich, wet grasslands that are very important for wintering and migratory meadow and water birds. The available habitat for these species is highly concentrated in these nature-oriented managed grasslands. The most important (meadow) species are the Eurasian curlew, hen harrier, ruff, Mediterranean gull, redshank, curlew, black-tailed godwit, garganey, wigeon, bean goose, etc.

The grassland complex for these species must be sufficiently large and varied, with both less wet and wet grasslands present to provide sufficient foraging opportunities for the different species. In summary, this amounts to a grassland complex of 200 hectares, of which at least 100 hectares are wet to very wet.

11.3.8 Kalmthoutse Heide

The Bird and Habitat Directive area 'De Kalmthoutse Heide' is located approximately 9.8 kilometres northeast of the project area. This area is also designated as a Ramsar site and Flemish nature reserve. The Stappersven, located in the Kalmthoutse Heide, is a recognised nature reserve.

The Kalmthoutse Heide is a varied heathland landscape on sand dunes with open sand, dry and wet heathland, fens and forests. Rare species such as the woodlark and the smooth snake can be found in the transition zone from heathland to deciduous forest.

The Kalmthoutse Heide is located in the north-west of Antwerp's Noorderkempen region, near the Belgian-Dutch border. This area is of exceptional importance for nature conservation because, with its 2,000 hectares of varied heathland consisting of inland dunes, dry and wet heath, fens, forests and the various transitions between them, it is one of the last truly extensive heathland areas in Flanders. Numerous typical and rare species survive there and almost all heathland environments have developed there. The integrity of the landscape is unique in Flanders.

The Kalmthoutse Heide is part of a larger cross-border nature reserve: De Zoom – Kalmthoutse Heide border park. This area, covering almost 6,000 hectares, is a valuable remnant of what was once a vast landscape of drifting sands, heathland and peat bogs.

Almost the entire area of the Kalmthoutse Heide is designated as a 'nature reserve'. As a result, there are very few dwellings. The enclaves that are still used for agriculture in the north of the reserve area are gradually disappearing. Close to the Kalmthoutse Heide, there is a groundwater extraction site belonging to Pidpa and two belonging to the Dutch drinking water company Evides. The Agency for Nature and Forests manages more than 1,000 hectares, while the area around the Stappersven is owned and managed by Natuurpunt.

11.3.9 Antwerp's historic fortifications as bat habitats

The Habitat Directive area 'Historic fortifications of Antwerp as bat habitats' consists of 19 forts and one redoubt, built between the 16th century and the First World War. When the fortifications lost their military function, nature took over. The damp, dark and quiet fort corridors full of crevices and the old trees in the vicinity form ideal habitats for thousands of bats. The shortest distance to the project area is approximately 3.5 kilometres to the north-west.

This area is part of the historic fortification belt around Antwerp, which comprises a total of 36 forts and 12 redoubts. The inner fortification belt lies just south and east of Antwerp city centre, while the outer belt is located 12 to 18 kilometres from the city centre and partly falls within East Flanders. Most of the forts are no longer in military use but serve a nature, recreational or cultural-historical function.

Each fort usually consists of fort buildings covered with a thick layer of soil with forest, heathland and shrubs, surrounded by a moat. Bats use the forts and surrounding forests as wintering grounds, summer residences, maternity colonies and roosting places. The copses, wooded edges and moats connect to a network of small landscape elements in the surrounding area. Bats use these 'roads' to find their way to the parks, forests and nature reserves in the wider area. The moats are also the habitat of the rare weatherfish and crested newt.

Most forts are owned by public authorities. Others are privately owned. The Ministry of Defence also still owns a few forts. Fort Steendorp, Fort 7 and Schans Smoutakker are managed as nature reserves. Parts of almost all other forts are managed by Natuurpunt.

11.3.10 Forests and heathlands of sandy Flanders – eastern part

The closest part of the Habitat Directive area 'Forests and heathlands of sandy Flanders – eastern part' is Located approximately 16 kilometres west of the project area.

This area is located in the northern half of the province of East Flanders and is divided into 12 relatively distant sub-areas in the sandy region. On the one hand, it is characterised by a number of larger forests in which the heathland is slowly recovering. On the other hand, a number of valley landscapes, such as the larger Moervaart valley and the smaller Zeverenbeek valley, are also very typical.

This nature reserve is relatively flat, but in addition to extensive woodland and heathland, it also has several valley areas. The heathland always occurs in existing forests, such as in the Drongengoed or the Heide- en Stropersbos. In the valleys, such as the Moervaart and Zeverenbeek valleys, there are mainly swamp forests, marshes and wet grasslands. A characteristic feature of this area is that the sub-areas are widely scattered.

Most of the area, approximately 60%, is currently forest. Half of this is managed by the Agency for Nature and Forests, the province or the land management association. The other half is owned by private forest owners. Agriculture also plays a major role in the area: approximately 730 hectares with no fewer than 264 companies involved. Water extraction for drinking water is important in the Heidebos area. In addition, the land is also used by hunters and recreational users.

11.3.11 Woodland and heathland areas east of Antwerp

The forest and heathland areas east of Antwerp offer a mix of forests, stream valleys and heathland. They include the oldest deciduous forests in the Kempen region. The Visbeek valley is home to one of the last populations of adders in Flanders.

The forest and heathland areas east of Antwerp are spread across 14 sub-areas in 18 municipalities in the province of Antwerp. They are located across a wide strip in the centre of the province. Most of the sub-areas are located in the Kempen, in the Central Kempen river and dune district. They are located north of the Kleine Nete valley area and south of Blak, Kievitsheide and Ekstergoor.

This area is located in a region with a flat to slightly undulating relief in the Nete basin. The slight undulation is particularly evident in the inland dunes, which follow the orientation of the watercourses. There is a dense network of streams that flow into the Kleine Nete, including the Tappelbeek, the Molenbeek, the Visbeek and the Grote Caliebeek. The wide valleys contain thousands of ponds that were used as fish ponds or for peat extraction. The area offers a beautiful mix of forests, heathland and stream valleys.

The Agency for Nature and Forests owns 16% of the area and also manages a further 22%, including municipal forests and military domains. 5% of the area is managed by nature associations. In addition, 984 hectares of agricultural land are registered by 278 agricultural businesses. The Ministry of Defence is active on the military domains of Malle and Tielen. Pidpa has a groundwater extraction site in the area and three other groundwater extraction sites in the immediate vicinity. Finally, some parts of the area are very attractive to recreational users.

11.3.12 Ecological infrastructure network in the Port of Antwerp

The Flanders Spatial Structure Plan stipulated that a maximum of 5% of all seaport areas would be preserved from industrial development to serve as ecological infrastructure. In order to achieve this and thereby guarantee the survival of certain plants and animals in the Antwerp seaport area, a network of ecological infrastructure nature (EIN) was demarcated within the Regional Spatial Implementation Plan 'Demarcation of the Antwerp Seaport Area'.

Permanent habitats are being created on public land (permanent EIN). In addition, temporary areas and initiatives on industrial sites can also be incorporated into the network (temporary EIN) (Figure 11-10).

The EIN consists of a network of corridors and stepping stones that connect the core areas. The core areas are larger contiguous areas of nature and often have a higher natural value. Corridors form elongated connecting zones between areas, while stepping stones are small residual areas where species have more space to rest. The stepping stones normally offer more suitable habitat for intermediate reproduction (such as for the natterjack toad) than a corridor. In reality, the two overlap.

In order to create a functional network, numerous verges were also included in the ecological infrastructure network. Most of the verges consist of dry grasslands. In places where pipelines are present, the soil is regularly tilled, giving these verges great potential for pioneer vegetation.

There are several permanent ecological infrastructure elements and a nature reserve in the immediate vicinity of the project area. The Galgenschoor is a nature reserve and has already been discussed above. The dykes (BWK code kd) and verges with rough vegetation (BWK code ku) along Scheldelaan and the railways form part of a permanent ecological infrastructure that connects the northern part with the southern part of the port area on the right bank. These areas border the project area.

Based on the map below, it can be concluded that the project area is not part of the Ecological Infrastructure defined within the port area (RUP Port of Antwerp).

[69] The permanent EIN and the core nature areas will always be preserved. The temporary EIN and the temporary compensation areas were included in the Antwerp Port Species Protection Programme to support the core nature areas and the permanent EIN in order to achieve the Conservation Objectives (IHDs). These CSOs were drawn up for the European protected habitat types and species in all Flemish Special Protection Areas (SPAs) of the European Birds and Habitats Directive areas as part of the European Natura 2000 network. These mainly concern species listed in the Birds Directive, such as the marsh harrier, common tern and Mediterranean gull.

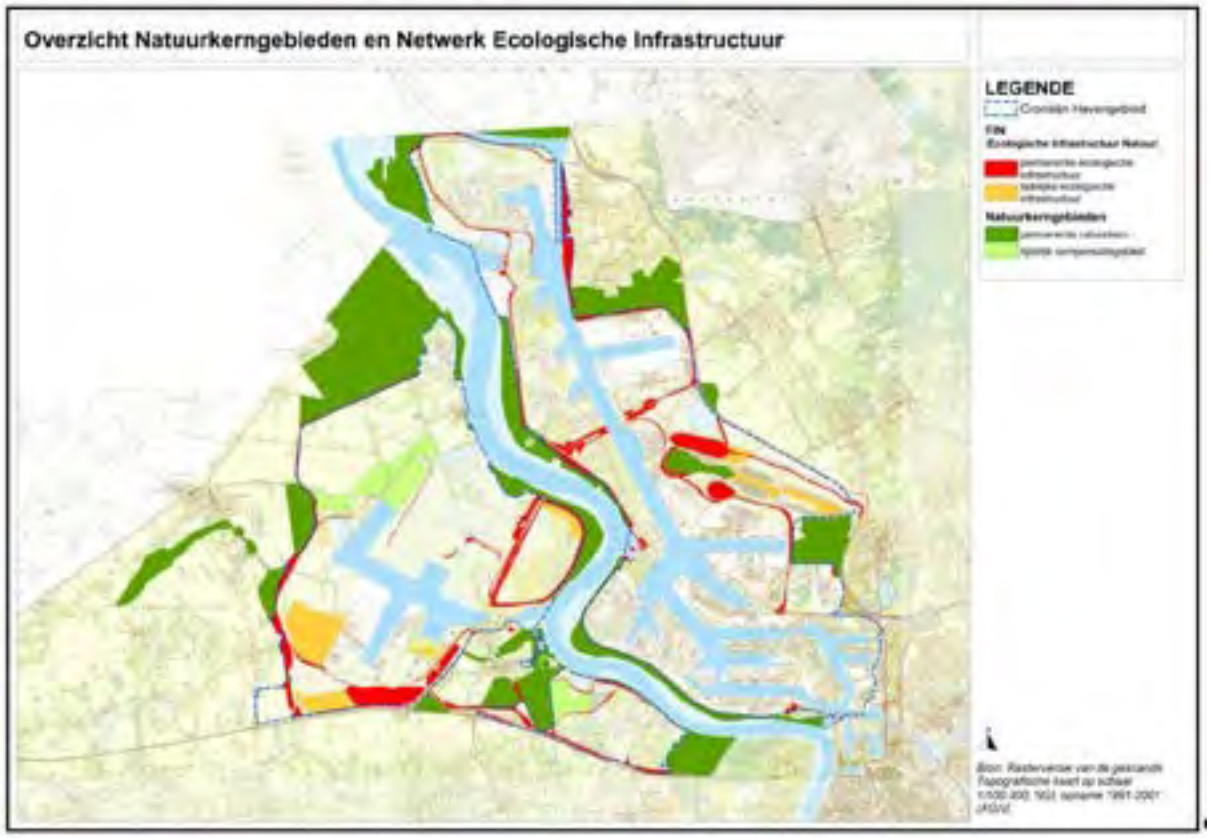

Figure 11-10: Network of ecological infrastructure in the Antwerp port area (Source: Baetens et al., 2015).

11.3.13 Value of project and study area for avifauna (macro scale)

Based on the risk atlas for birds in relation to wind turbines (2015 version), it can be concluded that the project area is not of significant value as:

- A resting and roosting area for water birds and waders (Figures 11-12)
- Roosting area;
- Breeding colony;
- Meadow bird area;
- Field bird area;
- Habitat for special breeding birds;
- Feeding migration;
- Sleep migration.

The Scheldt estuary is an important resting and breeding area for water birds and waders. The project area is crossed during seasonal migration, when birds fly from the east towards the Scheldt. As this is seasonal migration, they do not stop at the project area. Seasonal migration usually takes place over a fairly wide front.

The area is not used for migratory flight. There is a migratory flight route to the north that starts from the Kanaaldok towards the Scheldt. This route flies over the industrial installations to the north.

The area is not designated as a feeding migration zone. Various routes run around the area that are used daily by ducks, geese and gulls. Industrial areas do not form an obstacle and are flown over.

Figure 11-11: Seasonal migration (Wind Turbine Risk Atlas 2015)

Figure 11-12: Resting and roosting areas for water birds and waders (Wind Turbine Risk Atlas 2015)

Figure 11-13: Special breeding birds (Wind Turbine Risk Atlas 2015) - green overlay

11.3.14 Natural values on the plots within the project area

11.3.14.1 Site mapping

Site mapping by Natuurpunt vzw (2018-2019)

The sites in the project area were extensively surveyed by Natuurpunt vzw in the autumn of 2018 and spring of 2019. The site visits took place on the dates shown in the following table.

Table 11-10: Dates of site visits by Natuurpunt vzw

	24/10	15/11	21/03/19	04/04/19	09/04/19	06/06/19	08/07/19
Site 1		X					X
Site 2	X		X			X	
Area 3			X			X	
Area 4				X			
Area 7	X					X	

The relevant report is included in Appendix 7.1. Protected species and vegetation were mapped. The following numbering system was used for the site mapping[70]:

- Site 1: IOB
- Area 2: IOB
- Area 3: IOB
- Area 4: IOB
- Area 7: IOB

This numbering system will be used in the rest of this discussion.

[70]It should be noted that the inventories cover a larger area than the actual project area. The report also includes sites 5 and 6, but these are not part of the present project area.

Figure 11-14: Plots mapped in the project area during the inventory by Natuurpunt vzw

It should be noted that a small part of the project area, located next to site 1, has no breeding birds as there is no vegetation of interest to breeding birds.

In order to map the occurrence of bats, inventories were carried out by Natuurpunt vzw on 30 September and 18 October 2019. The report on this is included in Appendix 7.2.

Site mapping by Arcadis

Arcadis carried out a series of site visits on 22/3/2019, 28/3/2019 and 29/3/2019 to identify the main characteristics of the vegetation and forest, partly in the context of the forest inventory and age determination of the forest.

In addition, an additional site visit was carried out on 19/03/2024 to the sites for Project One to verify the current presence of nature on the site.

Site mapping Corridor

In 2020, Corridor conducted an additional inventory of breeding birds, bats and other protected species (amphibians, plants, forest ants, etc.). Site visits were also carried out in 2020 as part of an update of the area and age of the forest and sea buckthorn scrub. In 2021, a number of site visits were carried out again to update the area of forest and sea buckthorn.

The site visits took place on the following dates: 30/3/2020, 31 March 2020, 14 April 2020, 15 April 2020, 27 April 2020, 7 May 2020, 20 May 2020, 27 May 2020 and 11 June 2020. On 30-31/03/2020 and 14-15/4/2020, the entire project area was covered in two days. After that, this was done in one day (due to increased knowledge/experience of the terrain). Fixed routes were followed each time. Each day started at sunrise. On 7 May 2020, an inventory was carried out in the evening for the natterjack toad.

The automatic bat detector was placed in the area from 24/4/2020 to 7/5/2020. The reason for this timing is that the local species are present during this period and it also coincides with the spring migration period for bats. The bat detector was set up in the uninterrupted zone from the Scheldt to the Canal Dock. A detailed description of the field surveys carried out by Corridor with regard to bats is included in Appendix 7.2.

In 2021, inventories were carried out on the following days:

- breeding bird inventory on 31/03/2021, 02/04/2021, 13/04/2021, 30/04/2021 and 10/05/2021

- The automatic bat detector was installed from 30/04/21 to 10/05/2021
- The breeding location of the natterjack toad on 13/04/21, 30/04/2021 and 10/05/2021

Otherwise, the same methodology was used as in 2020.

11.3.14.2 Vegetation and protected plant species/groups

Until 2021, most of the plots in the project area were largely undeveloped. Since these areas were created (approximately 40-50 years ago), the project area had evolved through succession into a mosaic of sparse scrub vegetation and spontaneous growth of shrubs and trees.

The northern and southern parts of the project area were both designated as biologically valuable on the biological value map (2018). The area is still designated as biologically valuable on the biological value map (2023). However, this is currently an outdated situation, as the data from the BWK 2023 dates from 2004.

According to the BWK, this mainly concerns scrub or pioneer vegetation (BWK unit ku), with shrub and tree growth in some areas (BWK units sz and kub). The soil in the reference condition consisted mainly of calcareous sand with shells. The sites were fairly dry, with several wet gullies and ditches occurring locally. There were two pools, one in the southern part of the project area and one in the northern part (shaded, in forest). The depressions, gullies and pools did not hold water permanently (depending on climatic conditions).

The terrain was fairly flat over large areas. Here and there, it was heavily rugged due to soil dumping in the past. There was a small gully/pool in the southern part of the project area.

Based on the available data, an overview of the main vegetation types on the sites in the reference situation is provided here. Where possible, the calculated areas of these vegetation types were also included (site inventory Natuurpunt 2018-2019, site inventory Corridor 2020-2021).

In total, Natuurpunt vzw identified approximately 141 plant species in the project area. The main vegetation

types are discussed in the following sections.

Pioneer vegetation with characteristics of dry, poor grassland

The non-forested parts of the project area consisted largely of pioneer vegetation with characteristics of dry, poor grassland (approx. 36.25 hectares). Approximately 11.92 hectares were scattered in the north and 24.33 hectares in the south of the project area. It should be regarded as a mosaic of different vegetation types: lichen vegetation, dune reed vegetation and pioneer vegetation with herbaceous plants, combined with locally bare, sandy areas. This whole area functioned as a contiguous habitat for characteristic species such as sand bees (including the grey sand bee), butterflies (brown hairstreak, small copper, skipper, etc.), grasshoppers (including the sand grasshopper, blue-winged grasshopper, knapweed grasshopper, etc.) and beetles (including
Bastard sand beetle, etc.). The meadow pipit is a typical bird species for such areas. The value of the site lay mainly in its contiguous surface area with a mosaic of different vegetation types. This allows various organisms (e.g. bees) to find foraging areas (nectar-rich flowering plants) and breeding areas (e.g. open, sandy spots) within a short distance.

Lichen vegetation with *Cladonia* spp. was widespread in the project area. The lichen vegetation is often mixed with sparse, herbaceous vegetation. Here and there, lichens completely covered the ground (aspect-determining). Despite the pioneer nature of this type of vegetation, it can often remain present on poor soils, such as those in the project area at the time, for a long period (10-20 years) before being replaced by species from a later stage of succession (higher herbaceous vegetation, shrubs and trees).

Lichen vegetation can be characteristic of certain (priority) Natura 2000 habitat types and vegetation that is prohibited from being altered, such as:

- **Habitat type 2330** (Open grassland with Corynephoris and Agrostis species on inland dunes). Inland dunes are 'very rare' [71]in Flanders. The most extensive drifting dune formations are found in the large reserves and military domains in the Antwerp and Limburg Kempen. Well-developed examples can be found in the Kalmthoutse Heide and the Houtsberg. More stabilised inland dunes and other acidic, flat sandy soils are more widespread and occur in the Kempen and the Flemish Sand Region. In addition, this habitat type also occurs on fossil river dunes and in artificial areas such as sand extraction pits. (https://www.ecopedia.be/natura2000/)
- **priority habitat** type **2150*** (Atlantic fixed decalcified dunes – Calluno-Ulicetea). In Flanders, this habitat type is only marginally present in terms of surface area: a few small fragments have been preserved in the inner dunes of Westende (Schuddebeurze) and the inner dunes of Bredene-De Haan (d'Heye). Completely decalcified dunes occur only in a very limited number of places in the oldest dune relics along the Flemish coast. https://www.ecopedia.be/natura2000
- **Priority habitat type 2130*** (moss dunes). Moss dunes are 'extremely rare' in Flanders (see footnote below for reference). Well-developed forms can be found in various dune areas, but usually only over a small area. Well-developed dune calcareous grasslands occur on the west coast as far as Middelkerke and in the roughs of the golf courses in De Haan and Knokke. Calcareous to acidic moss dunes and dune grasslands still occur in the Cabour dunes (Adinkerke), d'Heye (Bredene), Schuddebeurze (Middelkerke) and locally in parts of the old and sub-recent dunes on the west and east coasts. (https://www.ecopedia.be/natura2000)
- **the vegetation that is prohibited from being altered - historically permanent grassland with BWK unit hd**, which stands for 'dry dune grassland in a calcareous environment'. This unit is scattered throughout the entire ecoregion of the coastal dunes. Large areas and well-developed forms can be found on both the west and east coasts. This habitat type does not occur further inland.

However, the project area does not belong to the coastal dunes and/or inland dunes, which means that these pioneer vegetation types do not belong to these Natura 2000 habitat types and are not subject to restrictions on vegetation alteration. Even when applying the BWK key, the vegetation types in the project area do not belong to a protected vegetation type.

Pioneer vegetation with herbaceous plants also occurred across large parts of the area. This vegetation consisted of a limited number of species, adapted to the poor and often dry soil (sand sedge, early marsh grass, etc.). These vegetation types often transition to poor grassland at a slightly later stage of succession. Typical species such as summer bittercress, soft cranesbill (fairly scarce), heron's bill (fairly scarce) and true centaury (locally abundant) were regularly found in the project area. These pioneer vegetation types are home to communities of all kinds of insects and other organisms.

Dune grass vegetation (*Calamagrostis epigejos*) covered a considerable area. This type of vegetation is very species-poor and often completely dominated by dune grass. This type of vegetation is less interesting for insects and other organisms because of its monotonous and dense character, the absence of flowering plants and nesting sites, etc.

[71] Rarity classes according to the Biological Assessment Map (Vriens et al. 2011).

Figure 11-15: The vegetation in the foreground is dominated by sand reed (Calamagrostis epigejos). Photo taken during site visit on 22 March 2019

Based on the site visit on 19 March 2024, it was established that there is no longer any vegetation in the southern project zone. In the northern project zone, there are currently still a limited number of annual pioneer species that have sprouted on the levelled areas, but these do not constitute biologically valuable vegetation.

Sea buckthorn scrub

Sea buckthorn thickets (Hippophae rhamnoides) were found in various places in the project area. Sea buckthorn is a species that mainly occurs along the coast in Flanders. It is likely that the growth sites in the Antwerp port, including the project area, originate from plantings that have spread further. From an ecological point of view, the monotonous sea buckthorn thickets in the port area are less desirable. There are also suspicions that the planting was done with non-native material.

The common sea buckthorn and creeping willow scrub does not belong to the European protected habitat type 2160: Dunes with Hippophae rhamnoides or 2170: Dunes with Salix repens ssp. Argentea (Salicion arenariae), as it does not occur in the coastal dunes (www.natura2000.vlaanderen.be/habitattype/duinstruweel-2160).

The total area of sea buckthorn scrub in the project area was approximately 3 hectares (see Figure 11-16). This comprises approximately 1.07 hectares of 'pure' sea buckthorn scrub and approximately 1.97 hectares in the undergrowth of forest.

The distribution of this species is shown in the report by Natuurpunt vzw (Appendix 7.1) and in the figures below.

Figures 11-16: Location of 'pure and free-standing' sea buckthorn scrub in 2021 (Corridor). Sea buckthorn just outside the project contours (quay wall) has already been removed as part of the Antwerp Port Authority's quay wall project.

Dune vegetation, which includes sea buckthorn scrub (see Annex V of the Vegetation Decree), is prohibited from being altered under Article 7, 7° of the Vegetation Decree. The removal of sea buckthorn scrub is prohibited in principle under this article and no grounds for exemption apply. This means that a derogation must be requested and obtained from this fundamental prohibition on alteration. The exemption will be requested in accordance with Article 10 of the Vegetation Decree. In accordance with Article 15, §2 of the Vegetation Decree, the following assessment elements will be taken into account:

- "§ 2. The following assessment elements shall be taken into account when making the decision:
  8. the existing state of nature, regardless of the designated use of the area;
  9. the current state of the vegetation or small landscape features;
  10. measures for the restoration and development of habitats and ecosystems;
  11. the abiotic elements.

At the same time, sea buckthorn scrub falls under woody vegetation pursuant to Article 3 of the Forestry Decree. Consequently, the forest compensation obligation applies here, insofar as the sea buckthorn scrub is older than 22 years. As mentioned above, there are 3 hectares of sea buckthorn scrub within the project area, of which 1.97 hectares are in the undergrowth of the forest and 1.07 hectares are pure and free-standing sea buckthorn scrub. The sea buckthorn scrub that is present as undergrowth in the forest is counted as part of the existing forest that is more than 22 years old and compensated for within the framework of the planned forest compensation.

An exemption application will be submitted under the Vegetation Decree for the loss of 1.07 hectares of free-standing sea buckthorn scrub, which is no more than 22 years old. Restoration measures are planned for the loss of this vegetation under the standstill principle and the duty of care (see § 11.11), namely the planting of approximately 3 hectares of mixed scrub located in VEN, in the Antwerp port area. Due to its location within VEN, a separate VEN exemption has already been requested for this. In order to increase the ecological value of this planting, mixed scrub will be planted.

Reference is made in this context to the requests for derogation.

The required remedial measures have already been implemented (2024).

Figure 11-17: Sea buckthorn vegetation near the slipway. Photo taken during site visit on 22 March 2019

Reed vegetation

The area covered by reed vegetation (*Phragmites communis*) was very limited in the project area, amounting to only 0.083 ha. Reed is dependent on moist conditions, and these were only present to a limited extent on the site. The limited reed vegetation that was present was dry reed, and was therefore less suitable for reed birds. At one location, denser reed vegetation was found in a canal. Reed vegetation is protected under the 1998 Vegetation Decree of the Flemish Government. This means that it is prohibited to destroy this vegetation without exemption and that, in accordance with the standstill principle and the duty of care, nature restoration of this vegetation should be provided for. The distribution of reed vegetation is shown in the figures below.

An exemption from the Vegetation Decree is being requested for the loss of reed vegetation. This project EIA contains the information necessary to assess this exemption, namely: type and quantity of vegetation, nature restoration planned. The restoration measure is described in § 11.11.

The figures below show the location of the reed vegetation according to the monitoring report by Natuurpunt vzw (see Appendix 7.1).

Figure 11-18: Location of reed vegetation (within yellow circle)

Figure 11-19: Location of reed vegetation (within yellow circle)

Figure 11-20: Reed vegetation in wet gully. Photo taken during site visit on 22 March 2019

Mixed forest with willows and rough birch

A significant area of the land had evolved through succession into a mixed deciduous forest dominated by willows and rough birch. Willows and birches are pioneer tree species that can spread very well via the wind and are therefore able to colonise open areas quickly. Woody species that later dominate in succession (black alder, ash, oak, lime, hornbeam, common maple, etc.) are absent from the project area. The proportion of willows/silver birches varies according to soil moisture, with more willows in wetter conditions. The following species are dominant in this vegetation type: goat willow (*Salix capraea*), white willow (*Salix alba*), *Salix x multinervis* and silver birch (*Betula pendula)*. In addition, a range of other tree species are scattered throughout the area: Scots pine (Pinus sylvestris), black pine (Pinus nigra), Canadian poplar (Populus x canadensis), black balsam poplar (*Populus trichocarpa*), olive willow spp. (*Eleagnus* spp.). The undergrowth often consists of thickets of sea buckthorn or creeping willow, or pioneer species from earlier stages of succession (lichen, dune grass).

The total area of mixed forest in 2020 and forest older than 22 years was approximately 39.31 ha and 14.245 ha, respectively.

The amount of forest and forest older than 22 years was estimated on the basis of a thorough analysis of aerial photographs and a dozen site visits. The analysis of forest age and, more specifically, the determination of the amount of forest and forest older than 22 years, carried out by Corridor, was done as follows:

- **Current forested area**: colouring in GIS based on the most recent orthophoto and terrain knowledge. All areas covered with trees, more than 10 metres wide and at least 3 rows of trees, with a canopy closure of >50% were coloured in, with a generous margin.
- **Forest area > 22 years:** colouring in GIS based on the 2002-2003 orthophoto. All tree-covered areas wider than 10 metres and with at least three rows of trees, with a canopy closure of >50%, were coloured in, with a generous margin.

The data relating to the forested area was checked and validated by the biodiversity expert.

Based on this aerial photograph analysis by Corridor and intensive site inventories for forest determination by Corridor, 39.31 hectares of forest vegetation were found to be present. This figure included the sea buckthorn scrub present in the forest undergrowth (approx. 2 hectares). Of this, 14.245 hectares were eligible for forest compensation[72] (older than 22 years).

In order to obtain an equivalent forest area, the surface area of the deforestation in m² is multiplied by a forest compensation factor. This factor depends on the ecological value of the forest, with the tree species composition being the determining factor. It varies from 1 to 3, depending on the type of forest:

- Non-native deciduous forest and/or coniferous forest: ground cover consists of at least 80% non-native deciduous wood, coniferous wood or a mixture thereof: factor 1;
- Mixed forest: ground cover of native deciduous trees between 20 and 80%: factor 1.5;
- Native deciduous forest: ground area consists of at least 80% native deciduous trees: factor 2;
- Forest with one or more European protected forest habitats: factor 3.

The forest compensation factor that applies here is factor 2 for 'Native deciduous forest: ground cover consists of at least 80% native deciduous forest'. The forest type that occurs here does not belong to a European habitat. Only forest that meets one or more of the following habitat codes is eligible for compensation and falls under compensation factor 3[73] :

- 2160: Dunes with *Hyppophae rhamnoides* 2170: Dunes with *Salix repens ssp. Argentea* (*Salicion arenariae*)
- 2180: Wooded dunes of the Atlantic, Continental and Boreal coastal regions
- 9110: Beech forests of the Luzulo-Fagetum type
- 9120: Acidophilic Atlantic beech forests with undergrowth of Ilex or sometimes Taxus (*Quercion robori-petraeae if Ilici-Fagion*)
- 9130: Beech forests of the Asperulo-Fagetum type
- 9150: Central European calcareous beech forests belonging to the Cephalanthero-Fagetum
- 9160: Sub-Atlantic and Central European oak forests or oak-hornbeam forests belonging to the Carpinion-betuli
- 9190: Old acidophilous oak forests with *Quercus robur* on sandy plains
- 91D0: Bog woodlands
- 91 E0: Alluvial forests with *Alnion glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)
- 91 F0: Mixed oak-elm-ash forests along the banks of large rivers with *Quercus robur*, *Ulmus laevis*, *Fraxinus excelsior* or *Fraxinus angustifolia* (*Ulmenion minoris*)

[72] This does not constitute compensation within the meaning of Article 6(4) of the Habitats Directive
[73]https://www.natuurenbos.be/bomenkappen/ontbossen/berekening-boscompensatie

A compensation factor of 3 is therefore not required, as the forest type does not correspond to any of the above types.

Figure 11-21: Identification of forest plots with indication of the forest vegetation present (green shading) and forest vegetation older than 22 years (yellow shading). Data 2021 (Corridor).

The required forest compensation measures have been implemented or are currently being implemented. A regularisation is being requested in connection with the administrative aspects of the forest compensation.

Along the Kanaaldok there is a row of poplars (just outside the project area), which is a small landscape element (KLE). This row of poplars has been and will be preserved.

Protected plant species and lichens listed in Appendix I of the Species Decree

During the site visits, several plant species were observed that are listed in Appendix I of the Species Decree. The Species Decree prohibits the deliberate picking and collecting, cutting, uprooting, destroying or transplanting of these species. In light of these prohibitions, an exemption was requested for these species.

The species observed are:

1. True centaury;
2. Two orchid species: Greater butterfly orchid, Bee orchid.

During the site visits by Natuurpunt in 2018-2019 (see site inventory report in Appendix 7.1), *Centaurium spp.* was found at various locations in the project area (sites 1, 2, 3 and 7). These were rosettes of non-flowering specimens, often in large numbers (hundreds of specimens). In 2020, the species was observed flowering and it appears that only *Centaurium erythraea* is present, and not *Centaurium pulchellum*. Pretty centaury is found in more humid environments than True centaury. It is a common species (Red List 'currently not threatened'), which does appear in Appendix I of the Species Decree, and is found in several places in the port area (Baetens et al., 2015).

Figure 11-22: Rosettes of Centaury (Centaurium spp.). Photo taken during site visit on 22 March 2019.

At one location (site 7), **the broad-leaved helleborine** (*Neottia ovata*) was found in damp willow forest in the project area. On 30/4/2019, the numbers of broad-leaved helleborine orchids on site 7 were counted by Natuurpunt vzw. A total of 615 specimens were counted in one forest zone. The majority of these were vegetative specimens (535, or 87% of the total). Only 80 flowering specimens were found. Given that the sites are very unclear and the forest areas where this species is found are very densely vegetated, this is an absolute minimum. In the spring of 2020, the number of broad-leaved helleborines was inventoried again. At that time, 399 were observed.

Figure 11-23: A non-flowering specimen of the broad-leaved marsh orchid (Neottia ovata). Photo taken during a site visit on 22 March 2019.

In 2019, Natuurpunt vzw discovered two locations where **bee orchids** grow. These locations were marked on the site. There were approximately 107 specimens across two sites (site 3 and site 4) (see Natuurpunt site inventory report 2018-2019). In 2020, Corridor identified only one additional specimen. The causes for this are likely drought or rabbit predation. The distribution of bee orchids is shown in the Natuurpunt vzw report (Appendix 7.1).

The majority of the bee orchid population was located between the area designated for the construction of the quay by the Antwerp Port Authority and the Project One project area. This population was relocated by the Antwerp Port Authority in 2020. The bee orchid population that occurred in the project area was relocated in accordance with the granted exemption (reference ANB/BL-FF/V21-00383). Currently (2024), the area is fully in the construction phase and this species no longer occurs there.

Large areas covered with lichens of the genus **Cladonia** were found in some areas (especially areas 1, 2 and 3). As species from this genus are often difficult to identify, samples were collected at several locations and sent to an expert in the field. This revealed the following species: false reindeer lichen (*Cladonia rangiformis*), open reindeer lichen (*Cladonia portentosa*) and red cup lichen (*Cladonia coccifera*).

Figures 11-24 and 11-25 show some photographs of this vegetation type. These are the non-protected Cladonia species. protected Cladonia species.

Figure 11-24: Pioneer vegetation consisting of cushions of Cladonia furcata and mosses. Photo taken during site visit on 22 March 2019

Figure 11-25: Lichen vegetation (Cladonia spp.). Lichens are dominant. Photo taken during site visit on 22 March 2019

For the bee orchid, greater butterfly orchid and true centaury, exemptions from the Species Decree were requested, approved and implemented in the context of the previous environmental impact assessment and environmental permit.
A new exemption application is no longer required. The necessary information regarding nature restoration is included in § 11.11 of this project EIA.

11.3.14.3 Fauna and protected animal species

Breeding birds

The avifauna present reflected the pioneering nature of the forest: a number of species were characteristic of scrubland and semi-open parkland. The living and dead trees in the pioneer forest were still predominantly small in size and therefore offered only limited breeding and nesting opportunities for cavity-nesting species.

Breeding birds and non-breeding species were inventoried during surveys by Natuurpunt vzw (2019) and site visits by ARCADIS (2019) and Corridor (2020, 2021).

The table below provides an overview of the birds (breeding birds) found in the project area in 2020. Cetti's warbler was found just outside the area. In 2020, there was one territory, just outside the project area.

The European turtle dove was observed once in 2020, but without any indication of breeding.

In addition, a number of non-breeding species were found (see Appendix 7.3). The table below shows the confirmed breeding birds from this list.

Table 11-11: Results of the breeding bird inventory Corridor (2020-2021)

Species	Number 2020	Number 2021	Explanation of number
Shelduck	79 1	32	Maximum number of adult individuals counted: 1 breeding pair
Tree pipit	5	7	Breeding pairs / Song post

Species	Number 2020	Number 2021	Explanation of number
Tree lark	0	1	Territory
Blackcap	0	1	Singing post
Buzzard	3	2	Breeding pairs
Canada goose	3	3	Breeding pairs
Magpie	0	6	Breeding pairs
Pheasant	0	6	Territories
Willow warbler	65	35	Breeding pairs / Song post
Redstart	1	0	Breeding pairs / Song post
Grasshopper Warbler	4	2	Breeding pairs / Song post
Meadow pipit	5	3	Breeding pairs / Song post
Great Spotted Woodpecker	2	1	Breeding pairs / Song post
Hedge Sparrow	16	7	Breeding pairs / Song post
Wood pigeon	10	9	Breeding pairs / Song post
Lapwing	12	6	Breeding pairs / Song post
Cuckoo	1	0	Breeding pairs / Song post
Great tit	10	4	Breeding pairs / Song post
Gadwall	1	1	Breeding pairs / Song post
Blackbird	6	1	Breeding pairs / Song post
Nightingale	5	5	Breeding pairs / Song post
Blue tit	14	9	Breeding pairs / Song post
Goldfinch	0	1	Breeding pairs/Singing post
Robin	14	12	Breeding pairs / Song post
Oystercatcher	3	3	Breeding pairs / Song post
Long-tailed tit	4	0	Breeding pairs / Song post
Chiffchaff	42	19	Breeding pairs / Song post
Garden Warbler	2	3	Breeding pairs / Song post
Chaffinch	13	13	Breeding pairs / Song post
Wren	4	2	Breeding pairs / Singing post
White wagtail	0	2	Breeding pairs / Song post

Species	Number 2020	Number in 2021	Explanation of number
Song thrush	1	3	Breeding pairs / Song post
Black crow	6	0	Breeding pairs / Song post
Black Redstart	4	3	Breeding pairs / Song post
Blackcap	10	9	Breeding pairs / Song post

Most of the species observed were fairly common to very common birds such as the chiffchaff (*Phylloscopus colybita*), Great Tit (*Parus major*), Blue Tit (*Cyanistes caerulea*), Robin (*Erithacus rubecula*), Wren (*Troglodytes troglodytes*), Blackcap (*Sylva atricapilla*), etc.

In addition to these common species, a number of less common species were also found:

- **Shelduck (*Tadorna tadorna*)**: In 2020, a pair of shelducks was found in area 5, which is outside the project area. The species was also found in 2021. This species prefers to breed in open sandy areas, where they build their nests in rabbit burrows. Red List status: currently not endangered.
- **Tree Pipit (Anthus trivialis):** In 2020, five Tree Pipit territories were identified, and in 2021, seven territories. Red List status: near threatened.
- **Tree lark (Lullula arborea):** One territory was identified in 2021. Red List status: Vulnerable.
- **Buzzard (*Buteo buteo)***: One territory was identified in 2019, three territories in 2020 and two territories in 2021. Red List status: currently not endangered.
- **Meadow pipit (*Anthus pratensis*)**. In 2019, several singing posts were identified in areas 2, 3 and 4, which were probably partly migrants. Later in the breeding season, singing posts and indications of breeding cases (alarming specimens) were identified. In 2020, five territories were identified, and in 2021, three territories. Red List status: endangered.
- **Lapwing (*Vanellus vanellus*):** In 2019, territorial behaviour of lapwings was observed in areas 3 and 4. One nest with eggs of this species was found in area 4 in 2019. A total of 12 pairs were found in 2020 and 6 pairs in 2021. Red List status: endangered.
- **Oystercatcher (*Haematopus ostralegus*):** A pair of oystercatchers was observed on site 4 in 2019. In 2020 and 2021, the species was identified as a breeding bird (3 pairs), with nests on the ground. Like the lapwing, this species prefers to breed in open areas. The Oystercatcher currently breeds in the harbour area mainly on flat roofs, so it cannot be ruled out that the pair observed here breeds elsewhere on the site and only comes to forage on the site. Red List status: currently not endangered.
- **Nightingale (*Luscinia megarhynchos)***: 5 singing posts in 2020 and 2021. Red List status: vulnerable.
- **Common Whitethroat (*Sylvia communis*)**: 4 singing posts in 2020, 3 in 2021. Red List status: currently not endangered.
- **Black Redstart (*Phoenicurus ochrurus*):** 1 singing post in 2020. Red List status: currently not endangered.
- **Willow Warbler (*Phylloscopus trochilus*)**: 65 singing posts in the area in 2020, 35 in 2021. Red List status: vulnerable.

The works commenced outside the breeding season and, given that their habitat is not protected, no deliberate prohibited actions are being carried out, meaning that it is not necessary to request an exemption from the Species Decree.

Currently, there are no longer any breeding birds in the project area, as it is no longer suitable, as determined during the site visit on 19/03/24.

Natterjack toad

No natterjack toads were observed in 2019, as potential breeding sites had dried up. In 2020 and 2021, Corridor identified a limited number of natterjack toad larvae in a water-filled ditch. The current breeding site consists of a small ditch, which floods to a limited extent during heavy rainfall, forming a temporary, very shallow pool.

The natterjack toad belongs to category 3 of Appendix I of the Species Decree. An exemption from the Species Decree was requested, approved and implemented in the context of the previous environmental impact report and environmental permit. A new exemption request is no longer required. The restoration measures necessary for this species are described in § 11.11.

Blue-winged grasshopper (Oedipoda caerulescens)

On 8 July 2019, several specimens of the blue-winged grasshopper were found on site 1. This species occurs in open areas with bare soil or pioneer vegetation. It is difficult to take measures for this species, except for providing suitable habitat. The species is already present in the ecological infrastructure (e.g. the Zouten EIN028/029), but also on industrial sites and along railway lines. It is therefore possible that the species will continue to occur on the site after development.

The blue-winged grasshopper belongs to category 1 of Appendix I of the Species Decree. An exemption from the Species Decree was requested, approved and implemented in the context of the previous environmental impact report and environmental permit. A new exemption request is no longer required. The restoration measures necessary for this species are described in § 11.11.

Bats

All bat species belong to category 3 of Appendix I of the Species Decree. A few studies do provide some insight into the occurrence and importance of the project area as a habitat for bats. In addition, targeted inventory efforts were made in 2019 (Natuurpunt) and 2020 (Corridor) to further investigate the occurrence of bats in the project area. A detailed description of Corridor's bat inventory is included in Annex 7.2.

Currently, the project area is no longer suitable as a habitat or foraging area for bats, as determined during the site visit on 19/03/24.

Existing studies and data

Based on data from the wider area (Rechterscheldeoever, Natuurpunt vzw database, www.waarnemingen.be), at least the following species occur in the wider area of the project area: Common pipistrelle, Serotine bat and Red bat. With a few sightings of the parti-coloured bat, the 'status' of the latter species is less clear. However, there are no indications that this species (particoloured bat) occurs in significant numbers in the port environment.

Based on a number of known facts and studies, it appeared that the value of the project area for bats was relatively limited for the following reasons:

- Based on monitoring reports from 2012-2014 and for 2015, drawn up within the framework of the former SBP 'Antwerp Port', the species Daubenton's bat and pond bat are mainly mentioned for the right bank of the Scheldt (Baetens et al., 2015; Baetens et al., 2016). These species are strongly dependent on water as a foraging area. The project area was not suitable as a foraging area (no suitable open water in the area).
- Due to the relatively young age of the forest (mostly < 22 years old, partly approx. 30 to 22 years old), there were no old trees in the project area that could provide the necessary tree hollows as summer roosts for bats.
- The Species Protection Plan for the Pond Bat (part of the current SBP-2 Port of Antwerp) and other bat species associated with it (Gyselings, 2014) identifies a corridor for bats in the port area (see figure below**)**. However, the project area (red dotted line) is not part of this.

Figure 11-26: Flight routes for Daubenton's bats and other bats in the port area (Baetens et al., 2016). Red shading: project area, indicative indication.

- Virtually no bat activity has been observed in the centre of the harbour (cf. near the project area). Suitable habitat types are present, albeit smaller and more fragmented (Grontmij, 2009). The somewhat larger forest entities – important for tree-dwelling species such as the red bat and Daubenton's bat – such as the Bospolder and the Reigersbos have already been selected as important areas. The project area and the immediate vicinity of the industrial installations have not been designated as important habitats for bats, partly due to the light pollution already present.

The Background Note on Nature (Nature Department, 2006) discusses in more detail the presumed use of bats in the Antwerp port area and its surroundings. It also takes into account developments in the area as a result of autonomous and policy-driven developments. This note mentions the following elements that are relevant to the Rechterschelde riverbank area (including the project area):

- Summer roosts. A number of species have their summer colonies in hollow trees. These include the common pipistrelle and Daubenton's bat and, to a lesser extent, the soprano pipistrelle and Geoffroy's bat. Possible (suboptimal) summer roosts and maternity colonies are located in the rows of poplars in the polder landscape (Grote Geule, Drijdijk, Melkader area) and the southern green zone. On the right bank, the Reigersbos and Bospolder in particular have developed into suitable summer roosts. The pond bat has its summer roosts in buildings. Opportunities are mainly seen in homes and farms in the vicinity of polder villages and not so much in industrial areas.
- Hunting grounds. The main hunting grounds for the above-mentioned species in the reference situation will be: Verrebroekse plassen, Grote Geule & Groot en Klein Weel, Drijdijck, Groot en Klein rietveld, Zoete Kreek, De Putten, de Ekerse Putten, the water features within the De Kuifeend complex and the completed parts of the Opstal area. ... These areas are not in the immediate vicinity of the project area.

Bat inventory 2019, 2020 and 2021

In addition to the existing data from the literature, additional data has been collected as part of 'Project One'. Inventories carried out for the bat group.

On 30 September 2019 and 18 October 2019, Natuurpunt conducted a manual bat survey in the project area (Appendix 7.4). In addition, automatic detectors were installed between 18 October 2019 and 21 October 2019. As part of this survey, transects were walked in the project area. Bat sounds were recorded using a bat detector and recording equipment, and flying bats were noted. In addition, potential roosting sites were investigated using a thermal imaging camera.

No bat roosts were found in any of the sub-areas of the project area. The areas were also unsuitable for this purpose due to the lack of old deciduous trees and buildings. The project area was only used to a limited extent as a hunting ground.

Based on the research with automatic detectors, the presence of two bat species was established: the common pipistrelle (*Pipistrellus pipistrellus*) and Nathusius' pipistrelle (*Pipistrellus nathusii*). A total of 97 recordings were made with both detectors. This is a very low number, but this was also due to the less than optimal monitoring period late in the season. Therefore, the research was repeated by Corridor in April/May 2020 and 2021.

The activity curves per night showed that the location was not a hotspot for bats. Most observations – especially of Nathusius' pipistrelle – appeared to concern flying (migrating) animals.

In 2020 and 2021, Corridor conducted another bat survey using an automatic ultrasound detector (24 April 2020 to 7 May 2020, and from 30 April 2021 to 10 May 2021). A total of 531 recordings were made in 2020. In 2021, 199 recordings were made (see Appendix 7.2). These are low numbers compared to other areas, from which it can be deduced that this was not an important habitat for bats.

Just over 60% of the recordings were attributable to the common pipistrelle (*Pipistrellus pipistrellus*). 30% of the recordings were from specimens of Nathusius' pipistrelle (*Pipistrellus natusii*). This pattern was similar during monitoring in 2020 and 2021. The remaining recordings also concerned *Pipistrellus* sp. which could not be identified on the basis of the recording, but in all likelihood also belong to one of these two species. An important feature of the Nathusius' pipistrelle is its seasonal migration over long distances between its northern breeding grounds and southern wintering grounds. In our regions, we therefore see a peak in sightings of this species in April and September. The specimens observed in the project area were also most likely passing through from their wintering grounds to the northern breeding grounds (northern and north-eastern Europe), often using canals as migration routes.

Finally, three sightings of the red bat were also recorded. The red bat is one of our largest bats and is a typical tree dweller, using old trees with hollows. However, these were passing specimens. The project area does not contain any old trees with hollows that are necessary for this species, so it can be concluded with certainty that there was no colony. In 2021, several sightings of the serotine bat were also recorded.

Conclusion on bats

Based on the above sources and monitoring data, the following conclusions can be drawn with regard to bats:

- The species diversity was very limited;
- The existing forestation did not play a role as a habitat for the species observed. The age of the existing forest was too young to be of significance as a habitat for tree-dwelling bat species;
- The area was of limited importance as a foraging zone for the species observed. Most of the observations of Nathusius' pipistrelle were probably of migrating animals flying overhead.
- The open space in the project area was used as a connection between the Scheldt and the Canal Dock;

- A number of observations concerned foraging bats above the Canal Dock.

Other

The area was suitable as a habitat for the fox (*Vulpes vulpes*). However, during the Corridor inventory (2020), it was found that very few traces (footprints, droppings, nesting sites, etc.) of the fox were found in the area, which is remarkable. More traces are found in similar areas.
Rabbits were present.

The project area was not a suitable habitat for wolves for the following reasons:

- There was a lack of large prey animals, such as roe deer, red deer, wild boar, etc., in the project area.

Depending on the food situation, wolves in Europe live in territories averaging 200 to 2,000 km² in size, where they travel long distances in search of prey. In vast areas, their territory can extend to thousands of km². In the cultural landscape of Europe, the lower limit is determined by food supply, with a minimum of 120 km² (www.welkomwolf.be). The project area did not meet this minimum size, as it consisted of two sub-areas **with** existing industrial installations in between.

- The project area was already severely disrupted in the reference situation due to the presence of industry and roads in the surrounding area.

An exemption from the Species Decree was obtained for the blue-winged grasshopper and the natterjack toad (ANB/BL-FF/V21-00383). The necessary information is included in § 11.3 of this project EIA. In addition, restoration measures for certain bird species are also included, as described in § 11.11.

11.3.15 Areas of concern in the Netherlands

11.3.15.1 Westerschelde and Saeftinghe

The Westerschelde and Saeftinghe Bird and Habitat Directive area is located on Dutch territory, to the north-east of the project area. This area is also designated as a Ramsar site. The shortest distance to the project area is 4 kilometres.

The Westerschelde is the southern branch of the original estuary of the River Scheldt. It is the only branch of the Delta that still has an estuary with an open connection to the sea. It is a highly dynamic area, partly due to its funnel shape, which causes a very large tidal difference at the rear. The estuary consists of deep and shallow waters, sand and mud flats that fall dry at low tide, and salt marshes.

The largest salt marsh area in the Netherlands, the Verdronken Land van Saeftinghe, is located beneath the salt marshes along the Westerschelde. Due to the large tidal difference, the Verdronken Land van Saeftinghe has very high embankments and wide channels. Offshore, the silted-up slufter of the Verdronken Zwarte Polder is still located in the area. In the estuary area, dunes are also forming at Rammekenshoek, the Kaloot and on the Hooge Platen. Inside the dykes are a number of areas with nature linked to the estuary: Rammekenshoek, Inlaag 1887, Bathse Kreek, Inlaag Hoofdplaat and Herdijkte Zwarte Polder.

11.3.15.2 Oosterschelde, Markiezaat and Zoommeer

Also on Dutch territory, approximately 12 km north of the project area, lies the Dutch Bird and Habitat Directive area 'Oosterschelde'.

Adjacent to the Oosterschelde are the Ramsar sites Markiezaatmeer and Zoommeer, located 16 and 19 kilometres north of the project area, respectively. These were created by the embankment of the Oosterschelde and are known for their large concentrations of water birds.

The Oosterschelde area is part of the former Scheldt estuary. In 1986, the Oosterschelde was closed off from the sea by a storm surge barrier, which still allows the tides to flow to some extent.

Tidal currents cause erosion and sedimentation processes that result in a varied pattern of salt marshes, mud flats and dry sandbanks (the intertidal zone), shallow water and deep tidal channels. The deepest channels are found in the mouth of the Oosterschelde, reaching depths of 45 metres in places. Between these tidal channels and in the area east of the Zeeland Bridge, there are extensive areas of shallow water with sandbanks. In the east and north of the area, there are large areas of mud flats. Inside the dykes, along the shore, a large number of cart fields, inlets and creek remnants are included in the area. These areas consist mainly of wet grasslands and open water. The water, the intertidal area and the areas located inside the dykes together form the habitat for the rich flora and fauna of the area. The wide variety of environmental types in the area is accompanied by a great diversity of animal and plant species. This variety of environmental types is determined by factors such as tide, current, water temperature, altitude, water quality and sediment composition.

The area was expanded by 190 hectares in 2005 as part of a LIFE project, which was part of the Plan Tureluur nature development project.

11.3.15.3 Brabantse Wal

Approximately 4.2 km northwest of the project area lies the Brabantse Wal Bird and Habitat Directive area.

The Brabantse Wal consists of various areas located on the border between the higher sandy landscape of Brabant and the clay landscape of the Zeeland delta. The westernmost part of the Kempen Plateau ends here in a high escarpment. Perpendicular to this escarpment are several stream valleys.

There are several areas of drifting sand on the Brabantse Wal. In addition to relatively recent drifting dunes, there are also much older river dunes, which were formed at the end of the last ice age. De Mattemburgh is an old estate on the transition from the Brabantse Wal to the young sea clay of the Oosterschelde. Due to its gradient-rich location, it has a great biological diversity. Drifting sand, coniferous forest and mixed forest can be found on the Woensdrechtse Heide. The Wouwse Plantage is an old estate with mixed forests, agricultural land, a relict of a sand drift and long beech avenues in the shape of a star. Zoomland originated from four seventeenth-century estates. The estate consists of varied mixed forests, meadows and farmland, heathland with oak scrub, drifting sand and marshland. Kortenhoef consists of natural forest and heathland on a former estate. The northern part of the Grote Meer estate consists of gently undulating sandy soils covered with plantations of mainly coniferous trees, with patches of agricultural land and a few natural fens: the Groote Meer, Kleine Meer and Zwaluwmoer. The southern half consists of pine forest, heathland and sand drifts.

11.3.15.4 Vogelkreek

The Vogelkreek is a former, slightly brackish creek surrounded by wet and salty grasslands and a few patches of forest. The Vogelkreek has a low bank zone with abundant reed vegetation.

The creek was once part of an inlet connected to the Western Scheldt. At that time, a large area of salt marshes stretched north of the current creek. From the 12th century onwards, several attempts were made to reclaim parts of this area by constructing dykes. However, until the flood disaster of 1953, large parts of the area were repeatedly flooded.

11.3.15.5 Yerseke and Kapelse Moer

The Yerseke and Kapelse Moer is one of the oldest polder areas in Zeeland, which was already diked in the twelfth century. The old land of Yerseke and Kapelse Moer forms one of the last remaining pieces of authentic Zeeland polder landscape. The location of the ditches still reveals the old, small-scale parceling pattern. Until the 16th century, salt was extracted in the Yerseke Moer by digging up and burning the salty peat. The resulting pits were then filled in with excavated clay. This process of 'moerneren' resulted in a fairly regular, bumpy terrain. This relief is still recognisable today. The creek ridges also contribute to the relief. The creeks themselves have silted up with sandy soil. The Kapelse Moer consists of grassland located inside the dykes with cattle drinking troughs and hedges.

11.4 Impact description and impact assessment

11.4.1 Construction phase

11.4.1.1 Soil disturbance

During the construction phase (vegetation removal, preparatory work, building foundations, construction), soil disturbance will occur in the project area compared to the 2021 reference condition.

A new ethylene pipeline will be laid under Scheldelaan to connect to the existing ethylene pipeline in the pipeline corridor along Scheldelaan. This will require very localised earthworks in the pipeline corridor. The pipelines will then be covered again.

Given that the soil in the reference condition was characterised by raised (several metres), already disturbed terrain, and considering the already disturbed soil at the pipeline route on Scheldelaan, the impact on biodiversity for that aspect is assessed as a negligible effect (0) compared to the 2021 reference condition.

11.4.1.2 Noise disturbance

Disturbance to avifauna

The potential impact of chronic noise pollution from industrial activity and peak noise from events on birds was investigated in the study by Sierdsema *et al.* (2014) and is relevant to this case, given that the project in question is an industrial project and this is addressed in the aforementioned study.

Research into chronic noise pollution caused by industrial noise and urban sounds indicates that the effects are comparable to those of traffic on birds. There is much evidence that low-frequency bird sounds in particular are masked by chronic noise pollution (both urban and industrial noise contain many low frequencies (<2 kHz), which disrupt communication), which can have consequences for breeding success and fitness. On this basis, it is likely that species that communicate with low-frequency sounds are particularly sensitive to this type of noise pollution. Effects were observed at levels of 50-60 dB(A). Effect distances have not been determined.

In addition to chronic noise pollution, some sources cause short-term noise or peak noise pollution. Here too, a distinction can be made between a one-off bang, a passing aeroplane and a pop concert lasting a day (or part of a day).

When suddenly exposed to loud noises, some species exhibit disturbance responses, such as (temporary) flight. Other species do not exhibit these reactions. There are also indications that adaptation occurs when noise recurs regularly (Klein, 2008). An example of this is the mudflats and salt marshes in the Scheldt estuary, which are of great importance to all kinds of water birds, despite the heavy ship traffic and noise from all kinds of port activities.

In the case of chronic noise [74](24-hour average), effects on bird densities can be assumed from 50dB(A) onwards, with densities decreasing. The sensitive species are expected to be mainly those that communicate in low tones.

There are no indications that low-frequency peak noise affects bird densities.

[74] Noise sources with peaks higher than 50dB but a 24-hour average lower than 50dB are classified as peak noise. The sensitive species are expected to be mainly those that communicate in low tones.

One assumption regarding peak noise is that incidental noise does not have a significant impact on breeding bird densities. If it occurs more frequently, the impact of the noise can be better assessed as chronic noise.

The figure below shows the disturbance sensitivity of different bird species groups, both breeding and non-breeding birds (Krijgsveld *et al.* 2008). The following sensitivity classes are used:

- 1-6: not very sensitive
- 7-12: sensitive
- 12-17: highly sensitive to disturbance.

The breeding birds relevant to the project area are mainly small songbirds (bluethroat, reed bunting, reed warbler, linnet, etc.), ducks, geese and waders.

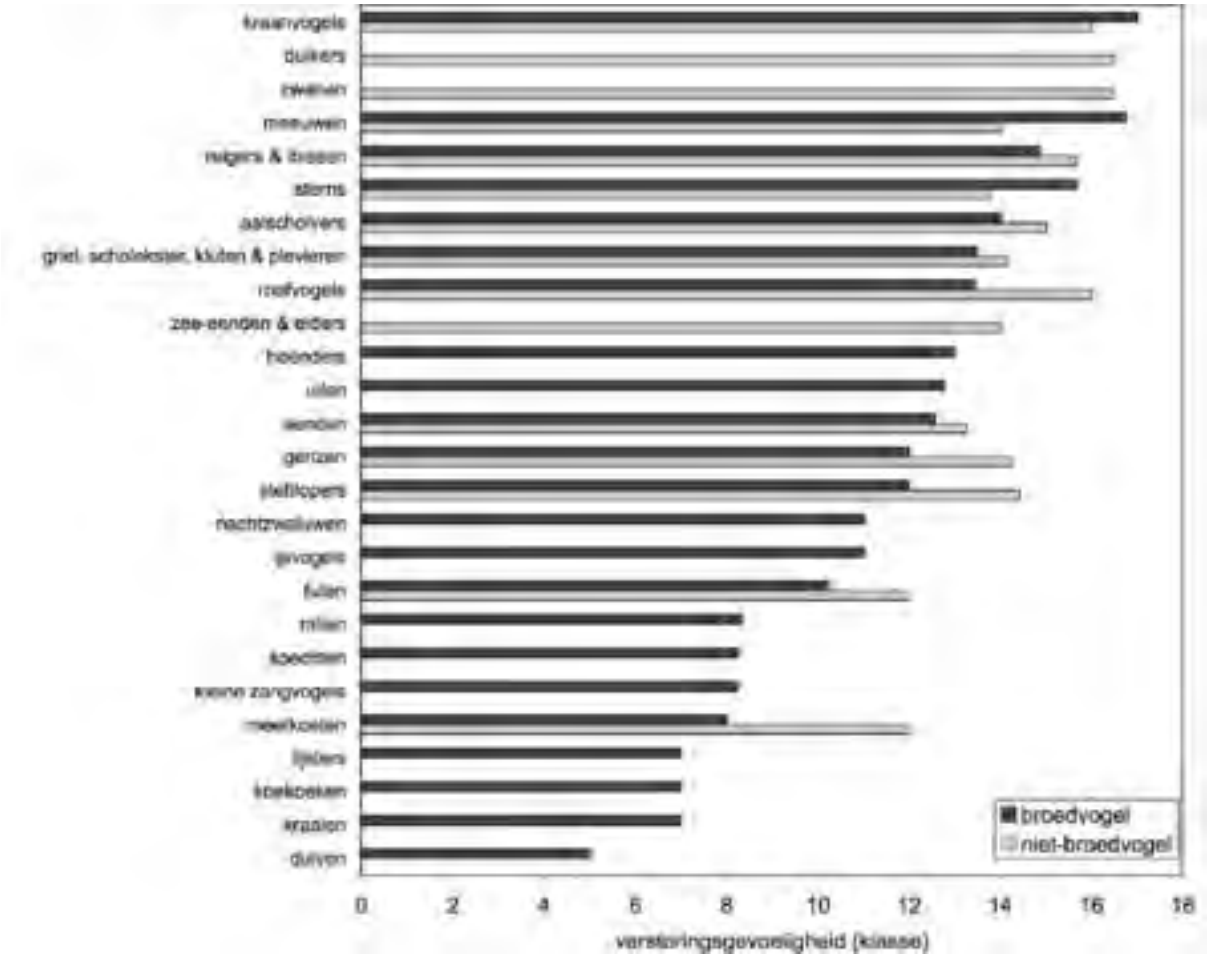

Figure 11-27: Sensitivity to disturbance of the various species groups (averages of relevant Dutch species, Krijgsveld et al. 2008)

In addition to the sensitivity of species groups to disturbance, there is also a relative sensitivity to noise disturbance for birds relevant to Flanders, according to a methodology proposed by Cuperus (in Tamis, W.L.M. & Runhaar, J. 1994, Everaert *et al.* 2015). He proposes a sensitivity assessment for each bird species based on five criteria, each of which is assigned a sensitivity score between 1 (very sensitive) and 3 (limited sensitivity). These criteria are:

- reproductive capacity/clutch size: species with a high reproductive capacity (> 10) are less sensitive than species with a low reproductive capacity (< 6);
- territory size: species with a large area requirement (> 40 ha) are more sensitive than species with a small area requirement (< 4 ha);
- migration strategy: migratory birds are more sensitive than resident birds;

- song/call: loud singers are less sensitive than quiet singers;
- ecological amplitude or dependence on open landscapes, such as grasslands: species of open areas are more sensitive.

These are five of the seven so-called Life History characteristics. Cuperus (in Tamis, W.L.M. & Runhaar, J. 1994) also distinguishes the criteria 'colony formation' and 'risk of traffic casualties', which are not relevant here.

The product of the scores for the five criteria then yields an overall sensitivity score per bird species, which is finally converted into a 5-part ordinal sensitivity scale:

- 1 insensitive
- 2
- 3 sensitive
- 4
- 5 highly sensitive.

The following table shows the sensitivity to disturbance of the most common bird species in the Galgenschoor area.

Table 11-12: Sensitivity to disturbance of birds according to Cuperus (in Tamis, W.L.M. & Runhaar, J. 1994)

Bird species	Sensitivity to disturbance
Teal	1
Pochard	1
Greylag goose	1
Avocet	5
Lapwing	3
Oystercatcher	4
Greylag goose	4
Tufted duck	2
Curlew	5
Little ringed plover	4
Ringed plover	2
Common sandpiper	4
Redshank	4
Reed Bunting	2
Linnet	1
Reed Warbler	5
Bluethroat	3

Based on the study by Krijgsveld *et al.* (2008) and Cuperus (in Tamis, W.L.M. & Runhaar, J. 1994), the sensitivity to disturbance of the relevant species groups and species (at Galgenschoor) is as follows (sensitivity score on a nominal scale of 1 to 5):

- **Waders**: highly sensitive to disturbance, which is also confirmed by Cuperus (in Tamis, W.L.M. & Runhaar, J. 1994), with the black-winged stilt, oystercatcher, little ringed plover and redshank having a sensitivity score of 4 to 5.
- D**ucks and geese**: highly sensitive to disturbance, but it should be added that, based on research by Cuperus (in Tamis, W.L.M. & Runhaar, J. 1994), the most common duck species, such as teal, pochard, shelduck and tufted duck, are insensitive to slightly sensitive. Greylag geese are sensitive to disturbance.
- **Small songbirds**: sensitive to disturbance, such as the reed warbler, which has a sensitivity score of 5. The linnet and reed bunting are less sensitive to disturbance. The bluethroat has a score of 3.

Threshold values

The study by Reijnen and Foppen (2006) identified two threshold values: 42 dB(A) for forest birds and 47 dB(A) for grassland species and meadow birds. However, these are averages across a large group of species. There is considerable variation between individual species.

In Germany, an extensive study was conducted into the relationship between birds and traffic noise (Garniel et al. 2007). The threshold values found for some 20 species range from 47 to 58 dB(A), but 85% are between 52 and 55 dB(A).

There is little experience with the logical extension of traffic studies to the effects of noise disturbance caused by industrial activities. No dose-effect studies have been conducted for industrial noise, but in practice a value of 45 dB(A) over a 24-hour period is often used (Weevers, 2013). However, given the threshold values identified in traffic research, it can be concluded on the basis of the available literature that this could be extended to 50 dB(A), which is also a value that clearly exceeds background levels (Sierdsema et al., 2014). In a rural environment, for example, this is 40 dB(A), and in an urban environment 50 dB(A).

These increased noise levels will result in reduced breeding bird densities, but it should be noted that the remaining breeding birds may become accustomed to the noise to a certain extent.

Noise modelling

For the construction of Project One, work will be carried out throughout the project area for approximately 3 years and 8 months (roughly from August 2022 to March 2026, or 44 months).

An indication is given of which months are most intensive in terms of noise emissions during the various construction phases:

- Construction stage A: site preparation (removal of vegetation, excavation of topsoil, construction of roads for contractor village, etc.)
- Construction stage B: mainly structural works on the southern part (cut and fill terrain profiling, foundation works, etc.)
- Construction stage C: mainly mechanical works on the southern part (construction of installations, etc.)

The following assumptions were used in the noise modelling for the various construction phases:

- The acoustic transmission model takes into account the Scheldt dyke in its current form (which can serve as a buffer). The relief of the ground level has been added based on the Digital Elevation Model of Flanders - Digital terrain model of the ground level in grid format with a ground resolution of 1 m from AGIV (source: open source data - Geopunt Vlaanderen).
- The modelling is based on the worst-case assumption for noise emissions per construction stage (see Noise discipline).
- The modelling results used are the Lday and Lnight values (see Noise discipline).
- The calculation is a worst-case scenario, in accordance with the ISO 9613-2 standard for the most critical wind direction, i.e. 'downwind'. i.e. for a wind direction from the source to the immission point. The calculated map shows the sound pressure level at 4 m above ground level in accordance with VLAREM II.
- In addition, a calculation was also performed for 1 m above ground level. This is more representative for breeding birds and species that forage on the ground.

- An important side note is that the most common wind in Flanders comes from the south-west, with Galgenschoor located upwind of the noise sources. With this most common wind, the noise is 'directed' away from Galgenschoor. The calculations using the transmission model, which determine the specific noise levels of the project (day, evening and night), were performed based on an approach of maximum noise transmission from the sources to the receptors for all wind directions, i.e. for locations upwind, the noise exposure is rather an overestimation of the actual situation.

The following table shows the percentage distribution of wind directions over time for Belgium (source: Basic Engineering Design Data, Ukkel weather station, long-term average). The wind direction conditions for Ukkel are comparable to those for the project area and, by extension, Flanders (source: KMI). This data was not available for closer weather stations.

Table 11-13: Percentage distribution of wind directions over time for Belgium (source: Basic Engineering Design Data, Ukkel weather station, long-term average).

	N	NNE	NE	ESE	E	OZO	SO	ZZO
% time	3.8	3.6	6.6	5.8	5.3	3.1	3.5	4.9
Average speed	3.6	4.2	3.7	3.3	2.9	2.5	4.9	3.9

	Z	ZZW	ZW	WZW	W	WNW	NW	NNW
% time	7.3	9.0	12.5	11.0	9.1	5.5	4.7	3.7
Average speed	4.4	4.8	4.9	4.0	4.0	3.8	3.4	3.4

Based on the table above, it is clear that for approximately 67% of the time, the wind comes from directions without an easterly component (including calm conditions and no wind). Within this period, the wind comes from a westerly direction for approximately 55% of the time, i.e. away from Galgenschoor. With a westerly wind, this will result in a reduction in noise levels of 1 to 4 dB at Galgenschoor compared to worst-case conditions with an easterly wind.

Construction phase A

The figure below shows the noise contours in dB(A) based on the modelled sound pressures of the activities during construction phase A (Lden) at heights of 4 m and 1 m. The critical contours of 45 and 50 dB(A) at a 24-hour level are indicated.

Figure 11-28: Noise contours based on an acoustic transmission model for the activities during Construction Stage A, daytime, at 4 m above ground level in accordance with VLAREM II, indicating the SBZ-H area 'Scheldt and Durme estuary from the Dutch border to Ghent'.

Figure 11-29: Noise contours based on an acoustic transmission model for activities during construction phase A, daytime, at 1 m above ground level, indicating the SBZ-H area 'Scheldt and Durme estuary from the Dutch border to Ghent'.

In addition to being a breeding ground, Galgenschoor is particularly important as a resting and foraging area for all kinds of waders and water birds (ducks, geese), whether they are wintering or not. These waders and water birds are mainly found near the mudflats (and less so near the salt marshes) and therefore on the western edge of the area, furthest away from the project site. The distance from the project area to these mudflats is approximately 247 metres in the north of the project area and approximately 360 metres in the south of the project area. The salt marshes are located at a distance of approximately 190 metres.

During construction phase A, most of the Galgenschoor area will experience a sound pressure level of more than 45 dB(A). In a very limited area in the southern part of the project area, this noise level will exceed 50 dB(A) during construction phase A. The area where 50 dB(A) may occur at a height of 1 metre is very limited and concerns the higher salt marsh (1.5 hectares). The mudflat habitat, which is important for wintering birds, has a lower noise level. This is shown in the following figure (illustrative, construction phase A).

Figure 11-30: Sound pressure in dB(A) at a height of 1 metre in the salt marsh habitat near Galgenschoor during construction phase A. Purple colouring: salt marsh habitat.

When evaluating the effects of noise disturbance on water birds and waders in Galgenschoor and the surrounding area, the following elements are taken into account in the assessment of the various construction stages:

- Water birds and waders are mainly found near the mudflats and therefore on the western edge of the area. The distance from the project area to these mudflat zones is approximately 440 m in the north of the project area and 360 m in the south of the project area. The salt marsh zones are located at a distance of approximately 190 m.
- Currently, there is already high noise pollution in the wider area surrounding the project site and Galgenschoor due to rail and road traffic along Scheldelaan, shipping and port activities. Despite the high noise pollution, the areas remain attractive and continue to function as wintering and foraging grounds for birds. Many of the bird species found there have already adapted to some extent to the ambient noise.
- The actual deforestation work (carried out in 2022) was short-lived (approx. 2 months). For the southern part closest to Scheldelaan, this only took a few days. The deforestation of the northern zone took place some distance from Galgenschoor (440 m). Work was carried out systematically in an easterly direction, with the sources of noise moving further and further away from Galgenschoor.

- Most of the time (67%), the wind direction will not come from an easterly direction. In such conditions, the sound pressure at Galgenschoor will decrease by 1 to 4 dB.
- The chipper is located on the eastern side of the project areas, further away from Galgenschoor. Furthermore, not all machines were operating simultaneously and at the same location.

Taking into account the project-integrated noise reduction measures (see Noise section), the impact of noise disturbance on non-breeding birds (water birds, waders) at Galgenschoor is assessed as limited negative (-1) for construction phase A.

This assessment also takes into account the fact that, despite the busy and noisy port environment, the species found in the vicinity of the project area continue to breed and use the area as a resting, foraging and wintering area. The species present are therefore already largely adapted to the high noise levels, and a limited increase in noise levels will therefore have virtually no impact on the species present.

Impact on breeding species

Since Construction Stage A will be carried out outside the breeding season, no impact on breeding species is expected (no effect (0)).

Construction phase B

Construction phase B mainly involves structural work on the southern part of the project area: cut and fill site profiling, foundation work, etc. The period with the most noise-intensive activities will be June 2024. The figure below shows the noise contours in dB(A) based on the modelled sound pressures of the activities during construction phase B. The critical contours of 45 and 50 dB(A) are indicated.

Figure 11-31: Noise contours based on an acoustic transmission model for the activities during construction phase B, at 4 m above ground level in accordance with VLAREM II, indicating the SBZ-H area 'Scheldt and Durme estuary from the Dutch border to Ghent'.

Figure 11-32: Noise contours based on an acoustic transmission model (Lday) for activities during construction phase B, at 1 m above ground level, indicating the SBZ-H area 'Scheldt and Durme estuary from the Dutch border to Ghent'.

Impact on non-breeding species (water birds and waders)

The most noise-intensive activities will take place in June 2024. During this period, non-breeding species will be present in the Galgenschoor, mainly water birds and waders. Based on similar reasoning as described for construction phase A, and taking into account the project-integrated noise reduction measures (see Noise discipline), the impact of noise disturbance on non-breeding birds (water birds, waders) at Galgenschoor is assessed as limited negative (-1) for construction phase B.

Impact on breeding species

The most noise-intensive period of construction phase B partially overlaps with the breeding season (June 2024).

When assessing the effects of noise disturbance during construction phase B on (avi)fauna in the surrounding area, the following elements are taken into account:

- Breeding birds in the Galgenschoor are located in the higher salt marsh habitat.
- A large proportion of the species (groups) found in the Galgenschoor area are sensitive to very sensitive to disturbance (according to a sensitivity score on a nominal scale of 1 to 5), such as:
  - Waders: highly sensitive to disturbance, which is also confirmed by Cuperus (in Tamis, W.L.M. & Runhaar, J. 1994), with the black-winged stilt, oystercatcher, little ringed plover and redshank having a sensitivity score of 4 to 5.
  - Ducks and geese: highly sensitive to disturbance, but it should be added that, based on research by Cuperus (in Tamis, W.L.M. & Runhaar, J. 1994), the most common duck species, such as teal, pochard, shelduck and tufted duck, are insensitive to slightly sensitive. Greylag geese are sensitive to disturbance.
  - Small songbirds: sensitive to disturbance, such as the reed warbler, which has a sensitivity score of 5. The linnet and reed bunting are less sensitive to disturbance. The bluethroat has a sensitivity score of 3.

The figure below shows recent observations of a few selected species groups in relation to the worst-case modelled noise contours during construction phase B (day) at a height of 1 metre:

- reed birds (Cetti's warbler, reed warbler, reed bunting and bluethroat),
- ducks and waders (greater white-fronted goose, gadwall, avocet and redshank),
- marsh harrier.

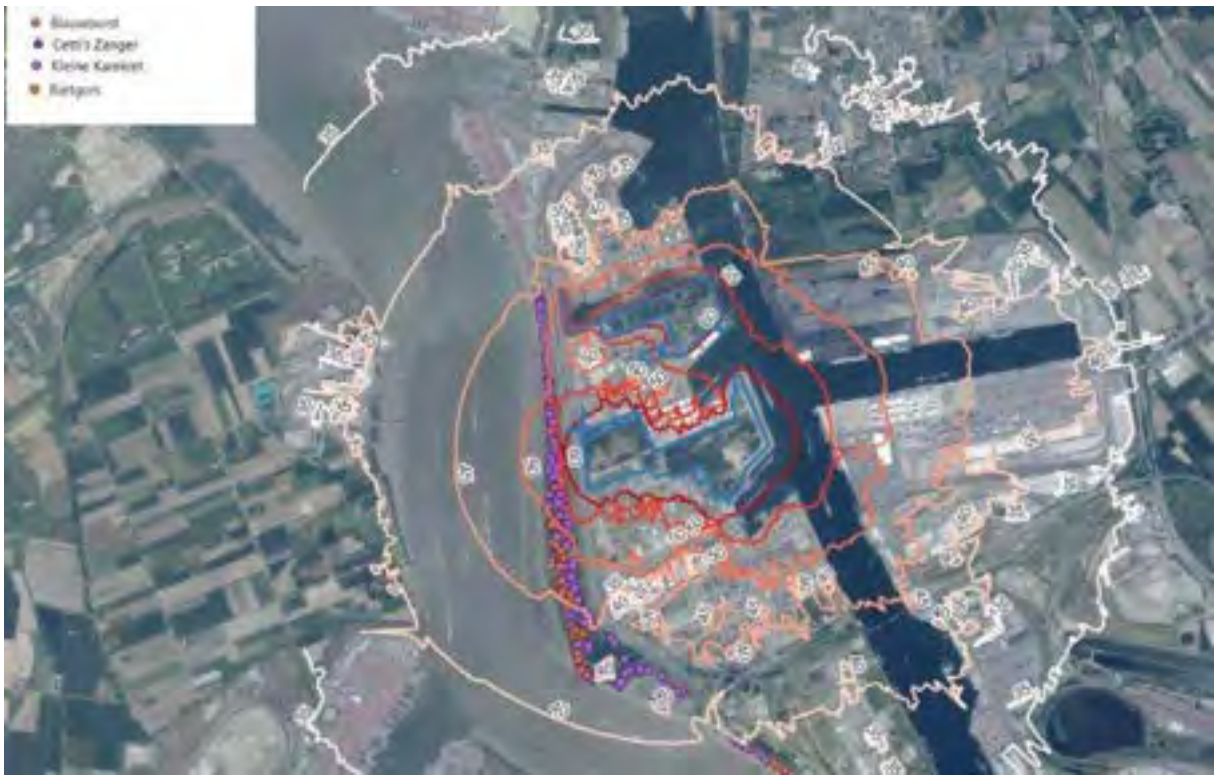

Figure 11-33: Noise contours (Lday) during construction phase B, daytime, 1 m height for breeding birds associated with reeds in the Galgenschoor (observations of breeding behaviour, data from Natuurpunt vzw).

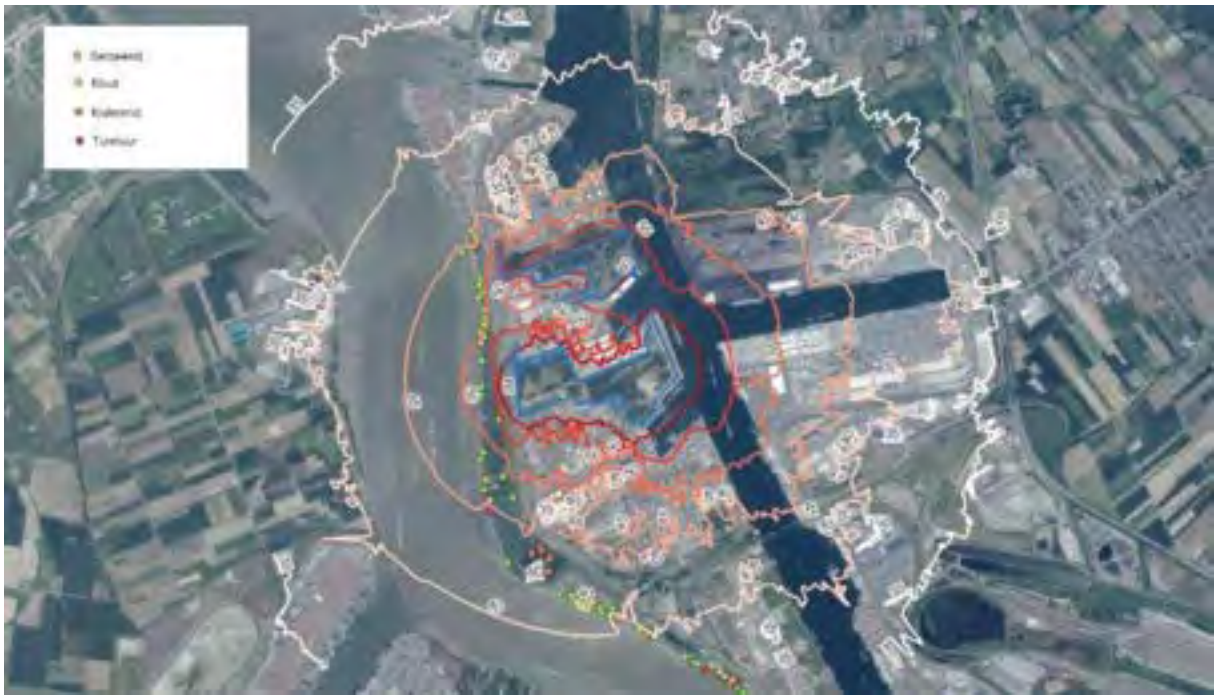

Figure 11-34: Noise contours (Lday) during construction phase B, daytime, 1 m height for selected water birds and waders in Galgenschoor (observations with breeding behaviour, data from Natuurpunt vzw).

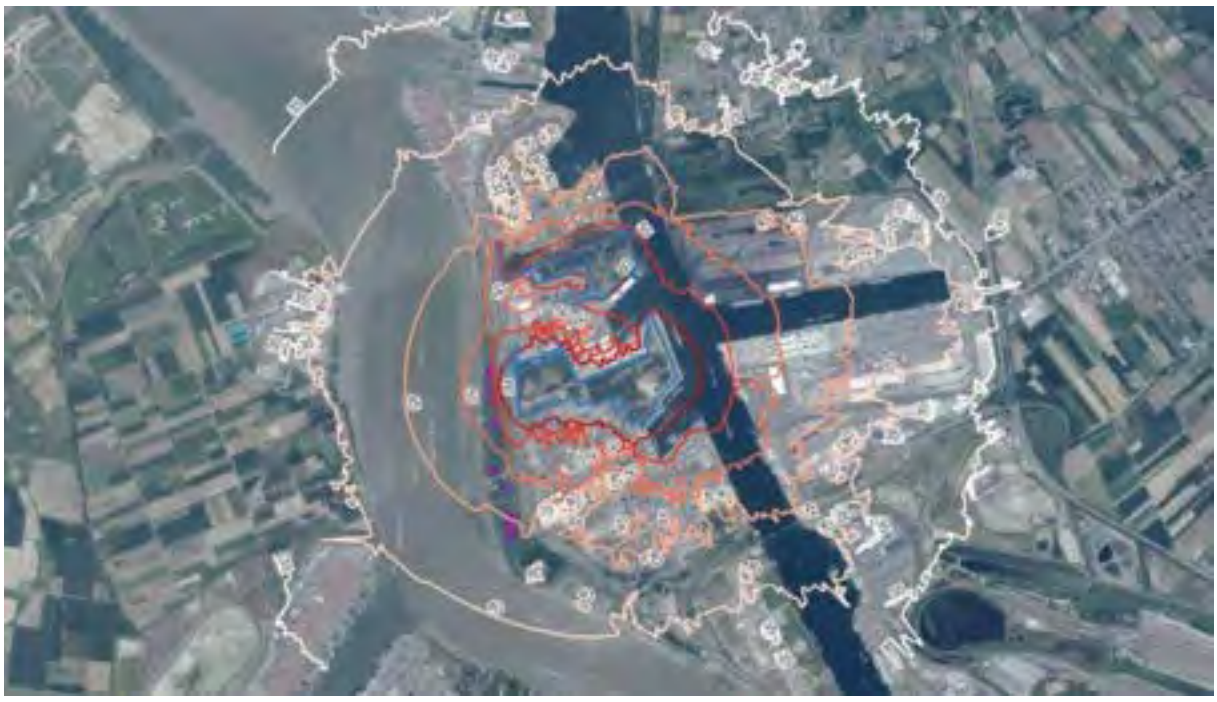

Figure 11-35: Noise contours (Lday) during construction phase B, daytime, 1 m height for marsh harriers in Galgenschoor (observations of breeding behaviour, data from Natuurpunt vzw).

During the daytime, an impact can be expected in the Galgenschoor area. Based on the model results, most of the Galgenschoor area will experience a sound pressure of more than 45 dB(A) during construction phase B. In a limited area, this sound pressure will rise to more than 50 dB(A) at a height of 1 metre. This concerns the higher salt marsh and a small area of mudflat (9.9 ha). In this limited zone, noise disturbance is possible for breeding birds (see maps above).

The impact assessment should take the following assumptions into account:

- Adaptation of breeding birds in Galgenschoor to the already high noise levels caused by rail and road traffic along Scheldelaan, shipping and the existing businesses in the port.
- Limited duration of the most noise-intensive activities during construction phase B during the breeding season.
- Predominant wind direction (67% of the time) from a direction without an eastern component (i.e. mostly away from Galgenschoor), whereby sound pressure at Galgenschoor will decrease by 1 to 4 dB.

Taking into account the project-integrated noise reduction measures (see Noise discipline) and the above assumptions, the impact of noise disturbance on breeding birds at Galgenschoor is assessed as limited negative (-1) for construction phase B.

This assessment also takes into account the fact that, despite the busy and noisy port environment, the species found in the vicinity of the project area continue to breed and use the area as a resting, foraging and wintering area. The species present are therefore already largely adapted to the high noise levels, and a limited increase in noise levels will therefore have virtually no impact on the species present.

Construction phase C

Construction phase C mainly involves mechanical works in the southern part of the project area (construction installations, etc.), with July 2025 being the most critical month. The following figure shows the noise contours in dB(A) based on the modelled sound pressures of the activities during construction phase C, in combination with the location of the Galgenschoor Habitat Directive area. The critical contours of 45 and 50 dB(A) are indicated here.

Figure 11-36: Noise contours (Lday) based on an acoustic transmission model for activities during construction phase C, daytime, at 4 m above ground level in accordance with VLAREM II, indicating the SBZ-H area 'Scheldt and Durme estuary from the Dutch border to Ghent'.

Figure 11-37: Noise contours (Lday) based on an acoustic transmission model for the activities during construction phase C, at 1 m above

ground level, indicating the SBZ-H area 'Scheldt and Durme estuary from the Dutch border to Ghent'.

During the day, an impact can be expected in the Galgenschoor area. Based on the model results, most of the Galgenschoor area will experience a sound pressure of more than 45 dB(A) during construction phase C. In a limited area, this sound pressure will rise to more than 50 dB(A) during the day. This concerns the higher salt marsh (7.4 hectares) (see maps above).

Impact on non-breeding species (water birds and waders)

The most noise-intensive activities will take place in July 2025. During this period, non-breeding species are present in the Galgenschoor, mainly water birds and waders. Based on similar reasoning as described for construction stages A and B, and taking into account the project-integrated noise reduction measures (see Noise discipline), the impact of noise disturbance on non-breeding birds (water birds, waders) in the Galgenschoor area is assessed as limited negative (-1) for construction phase C. As mentioned above, this assessment also takes into account the fact that the species present are already accustomed to the busy and noisy port environment, as their presence de facto proves.

Impact on breeding species

As mentioned earlier, the assessment must take into account the fact that the species present are already accustomed to the busy and noisy port environment.

The less noise-intensive periods of yard stage C partially overlap with the breeding season. However, no impact on breeding species is expected (negligible effect (0)).

If the most noise-intensive periods overlap entirely or partially with the breeding season, a limited impact (limited negative (-1)) can be expected on breeding species.

Impact of noise disturbance at the Potpolder van Lillo:

The Potpolder van Lillo, located south of Fort Lillo, is also of great value as a foraging and resting area for all kinds of bird species. Based on the model results for the various construction stages, it can be clearly concluded that there will be no impact on this area. The impact here can be assessed as negligible (0) for the various construction stages.

If the most noise-intensive periods overlap entirely or partially with the breeding season, this impact remains negligible (0).

Conclusion on the impact of noise disturbance during construction phases A, B and C

The table below summarises the effects during the various construction stages in Galgenschoor.

Table 11-14: Effects of noise

	Construction stage A	Construction stage B	Construction phase C
Breeding birds	No effect (0)	Limited negative (-1)	Negligible (0) If overlapping with breeding season: limited negative (-1)
Non-breeding birds	Limited negative (-1)	Limited negative (-1)	Limited negative (-1) If overlapping with breeding season: limited negative (-1)

The impact in terms of noise disturbance in the Potpolder van Lillo is assessed as negligible (0) in all stages, given the distance and location in relation to the 45 dB(A) contours.

Overall, the impact on breeding birds and non-breeding birds in the vicinity of the project area is assessed as limited negative (-1) for all construction phases combined.

This assessment also takes into account the fact that, despite the busy and noisy port environment, the species present in the vicinity of the project area are de facto present and will remain so, continuing to breed and use the area as a resting, foraging and wintering area.

The species present are therefore already largely adapted to the high noise levels, and a limited increase in noise levels will therefore have virtually no impact on the species present[75].

11.4.1.3 Direct space occupation (loss of habitat and ecotope)

The entire project area covers 90.3 hectares. In the reference situation, the project area was characterised by grasslands and scrub vegetation with forest. At the start of the project, the vegetation on the entire site was removed and levelled.

On the Biological Value Map (2020), most of the project area is designated in the reference situation as biologically valuable or biologically valuable with valuable elements.

A complete overview of the ecotopes that have been lost as a result, indicating the vegetation types that may not be altered and those that fall under the provisions of the Forestry Decree and Vegetation Decree, is provided in the table below. This table takes into account the update of the amount of forest (older than 22 years) and the amount of sea buckthorn scrub in 2021, whereby it can be clarified that there is approximately 1.07 ha of free-standing sea buckthorn scrub within the project area. The rest of the sea buckthorn scrub is located in the undergrowth of the mixed native deciduous forest.

Table 11-15: Overview of the impact on valuable vegetation resulting from the implementation of the project.

Type of vegetation	Vegetation prohibited from alteration and KLE	Falls under the provisions of the Forestry Decree	Impacted area
Project area			Completed: 90.3 ha Not completed: 90.29 ha
of which			
1) **Mixed native deciduous forest (willow-birch) (including forest with sea buckthorn in the undergrowth).**		X	39.31 ha
of which: Mixed native deciduous forest (willow-birch) older than 22 years		X	14.245 ha
2) Pioneer vegetation with characteristics of poor grassland, including dune reed vegetation, Cladonia, etc.			36.25 ha
3) **Sea buckthorn thicket (free-standing, not as undergrowth of mixed deciduous forest)**	X	X	1.07 ha
4) **Reed**	X		0.08 ha
5) **Other (unpaved roads, car park, row of trees along the canal,** biological less valuable areas cfr. BWK, **etc.)**			13.58

[75] If such a project were to be planned in a quiet area, the species present would be more affected by such limited increases in noise pressure because they are not accustomed to it.

Forest and shrub vegetation (Forest Decree)

Forests older than 22 years must be compensated for under the provisions of the Forestry Decree. It should be noted that forest compensation measures are currently being implemented or are in the process of being implemented. A regularisation is currently being requested in connection with the administrative processing of this matter.

Based on the most recent analysis of forest area by Corridor (based on aerial photography research and intensive field observations), the forest area older than 22 years in 2021 was determined to be 14.245 hectares.

In order to obtain an equivalent forest area, the surface area of the deforestation in m² is multiplied by a forest compensation factor. The applicable forest compensation factor is factor 2 for native forest whose ground area consists of at least 80% native deciduous trees. There is no European forest habitat to be protected on the site[76].

In the context of this project, forest compensation[77] of 28.489 ha is therefore legally required.

With regard to the loss of sea buckthorn scrub, which is also covered by the provisions of the Forestry Decree, recent site surveys and aerial photograph analysis carried out by Corridor show that there is no pure sea buckthorn vegetation older than 22 years. Consequently, no compensation is required for the loss of sea buckthorn scrub on the basis of the provisions of the Forestry Decree. The sea buckthorn scrub that is older than 22 years is located in the undergrowth of the forest and is included in the calculation of the amount of forest older than 22 years. This is therefore compensated for within the forest compensation scheme.

For the amount of pure and free-standing sea buckthorn scrub within the project area (1.07 ha), nature restoration will be carried out in accordance with the standstill principle and the duty of care by planting 3 ha of mixed (thorn) scrub native to the region in the Port of Antwerp (see § 11.11).

To describe the significance of this deforestation at the local level, reference can be made in part to the description of the impact on species habitats. As a result of deforestation, a large area of forest with all its associated biotic communities will be lost at the local level (right bank of the Port of Antwerp), which can be assessed as having a significant negative impact (-3). There are no other known cases of deforestation on the right bank of the Port of Antwerp in the vicinity of the project area. The most recent deforestation on the right bank was near Luithaegen (quay number 200) and was compensated for. There has been some recent deforestation on the left bank, including in the context of the Oosterweel Project, Vlakte van Zwijndrecht, etc., but on the scale of the Port of Antwerp, this constitutes a different ecological unit for land-based species and many insects due to the distance from the project area. There is therefore no cumulative effect with other deforestation in the vicinity, but there is a cumulative effect on the territory of the Province of Antwerp.

Pioneer vegetation (ku*) with characteristics of poor grassland, dune reed vegetation, moss dunes, etc.

In addition to the forest, an area of approximately 36.25 hectares of pioneer vegetation with characteristics of poor grassland will also be lost. This pioneer vegetation with characteristics of poor grassland is scattered throughout both parts of the project area, approximately 16 hectares in the north of the project area and 20 hectares in the south of the project area. It is a mosaic of different vegetation types: lichen vegetation, dune reed vegetation and pioneer vegetation with herbaceous plants, combined with locally unvegetated, sandy areas. This whole area serves as a large habitat for all kinds of rare and specialised species, such as meadow pipits, sand bees, sand beetles, blue-winged grasshoppers, etc. Bee orchids also occur here. Due to their vastness, low disturbance and variety of habitats, both parts of the project area are considered to be of high biological value.

[76] See habitat types listed at https://www.natuurenbos.be/bomenkappen/ontbossen/berekening-boscompensatie
[77] This does not constitute compensation within the meaning of Article 6(4) of the Habitats Directive

The loss of these pioneer vegetation habitats, including the biotic communities that occur therein, is assessed as a significant negative effect (-3) due to its permanent nature and the large contiguous area involved.

A mitigating measure is required and will consist of strengthening and expanding the ecological infrastructure within the Port of Antwerp, more specifically in the development and strengthening of dry, poor grassland vegetation scattered throughout the port area, in collaboration with the Antwerp Port Authority (see statement of commitment in Appendix 7.7). This will further contribute to the development of a contiguous, functional and high-quality basic network of dry, nutrient-poor grasslands within the port area. The creation of this network should also contribute to the sustainable conservation of (port-specific) species.

The required land and strips on which the loss of habitat consisting of pioneer vegetation with characteristics of poor grassland will be mitigated (in collaboration with the Antwerp Port Authority) are already available and managed by the Antwerp Port Authority, but are not yet all in optimal condition in terms of habitat quality, as necessary to function as optimal habitat. The latest count of the number of hectares of poor grassland dates from 2014 (2015 monitoring programme) and amounts to approximately 150 hectares. Thanks to the conversion management measures implemented, the area of poor grassland is steadily increasing, although this is a process that takes time. It can therefore be assumed that this figure of 150 hectares is an underestimate and that there will in any case be an increase in the amount of nutrient-poor grassland within the Port of Antwerp. By continuing this ecological management in the coming years, the area of 224 hectares will be converted into nutrient-poor grassland within the foreseeable future. In order to mitigate the impact of the loss of pioneer vegetation with characteristics of poor grassland, the Port Authority is also committed to additional mitigating measures outside the Ecological Infrastructure. This is described in more detail under mitigating measures.

The implementation of the project will result in the disappearance of the territory of certain species, such as the meadow pipit, at this location. The mitigating measures taken for the creation of nutrient-poor grassland, as described below, will contribute to the creation of habitat for the meadow pipit.

Vegetation that may not be altered

The Decree of the Flemish Government of 23 July 1998, subsequently amended by the Decree of 3 July 2009, lays down, among other things, the provisions for changing vegetation or a small landscape feature. Changes to vegetation or small landscape features are prohibited or subject to conditions.

Dune vegetation, which includes sea buckthorn scrub (see Annex V of the Vegetation Decree), is prohibited from being altered under Article 7, 7° of the Vegetation Decree. The removal of sea buckthorn scrub is prohibited in principle under this article and no exemption applies. If this vegetation needs to be removed, an exemption must be requested and obtained from this fundamental prohibition on alteration. The exemption is requested in accordance with Article 10 of the Vegetation Decree. In accordance with Article 15, §2 of the Vegetation Decree, the following assessment elements are taken into account:

- “§ 2. The following assessment elements shall be taken into account when making the decision:
  1. the existing state of nature, regardless of the designated use of the area;
  2. the current state of the vegetation or small landscape features;
  3. measures for the restoration and development of habitats and ecosystems;
  4. the abiotic elements.

At the same time, sea buckthorn scrub falls under woody vegetation pursuant to Article 3 of the Forestry Decree. Consequently, the forest compensation obligation applies here, insofar as the sea buckthorn scrub is older than 22 years. As mentioned above, there are 3 hectares of sea buckthorn scrub within the project area, of which 1.97 hectares are in the undergrowth of the forest and 1.07 hectares are pure and free-standing sea buckthorn scrub. The sea buckthorn scrub that is present as undergrowth in the forest is counted as part of the existing forest that is more than 22 years old and compensated for within the framework of the planned forest compensation.

An exemption application will be submitted under the Vegetation Decree for the loss of 1.07 hectares of free-standing sea buckthorn scrub, which is no more than 22 years old.

Restoration measures have been planned for the loss of this vegetation in accordance with the standstill principle and the duty of care (see §11.11), namely the planting of approximately 3 hectares of mixed (thorn) scrub native to the region in VEN, in the Antwerp port area. Due to its location within the VEN, a separate VEN exemption is also being requested.

As part of the project, a small area of 0.08 hectares of reed vegetation (vegetation that may not be altered, cf. Vegetation Decree) will be removed. An exemption from the prohibition on altering both types of vegetation (reeds and sea buckthorn scrub) is therefore being requested for the removal of vegetation. Nature restoration will take place as follows:

- The area of reed vegetation that is lost will be replanted on the site itself. It may be possible to preserve some areas where reeds currently grow. In that case, there will be more limited planting of reeds. This nature restoration is described in §11.11.
- The 1.07 hectares of sea buckthorn scrub that will be lost (free-standing, no undergrowth forest older than 22 years) will be replaced, in accordance with the standstill principle and the duty of care, by the planting of 3 hectares of mixed (thorn) scrub native to the region at another location in the Port of Antwerp. The decision has been made to plant thorn bushes other than sea buckthorn, because sea buckthorn is not ecologically desirable and does not belong in the port of Antwerp. The shrub vegetation that is planned (hawthorn, wild privet, dog rose, wild rose and blackthorn) has greater ecological value. Some species bear berries and can serve as a habitat (breeding site, foraging area, lookout post) for all kinds of birds, including nightingales, which are currently found within the project area. This nature restoration is described in §11.11.

Impact on bats

Based on the description in the reference situation, it can be stated that the project area does not constitute an important habitat (summer residence, hunting area and corridor) for bats. There are no old buildings or old trees with tree hollows in the project area that could serve as potential summer roosts. The map showing flight routes for pond bats and hitchhiking bats (Baetens *et al.* 2016) also shows that the project area is not part of the confirmed and/or suspected flight routes. This is confirmed by the monitoring campaigns (2019, 2020, 2021) carried out in the project area: the numbers observed are limited and comprise common bat species.

As indicated in the project description, a corridor approximately 15 metres wide will be retained in the southern section, enabling an east-west connection.

North of the project area, outside the Project One concession, a number of sites will be retained that can continue to function as an east-west connection as long as the concessionaire or the Port Authority does not realise any other project on them. The width of these sites to be retained is at least 140 metres over their entire length.

In addition, the connection at the Tijsman Tunnel is still in place, which has been designated as permanent ecological infrastructure within the Port of Antwerp.

Consequently, no significant effects are expected with regard to bats, and no mitigating measures are required for this species group.

Impact on bird flight paths

Based on the description in the reference situation, it appears that the project area does not function as an important corridor for birds. However, there are a number of migration routes in the vicinity of the project area (Everaert *et al.* 2015). Various routes run around the project area that are used daily by ducks, geese and gulls during the winter. Industrial installations and areas do not form an obstacle and are flown over.

The project area is not used for migratory bird flight paths. There is a migratory bird flight path to the north that starts from the Kanaaldok towards the Scheldt. It appears that existing industrial installations to the north are flown over. The project area is not designated as a feeding area for migratory birds.

The Scheldt estuary is an important resting and breeding area for water birds and waders. The project area is crossed during seasonal migration, when birds fly from the east towards the Scheldt. As this is seasonal migration, they do not stop in the project area.

Seasonal migration usually covers a fairly broad front and, as a result, no significant effects are expected with regard to bird flight paths, and no mitigating measures are required in relation to bird flight paths.

Impact on protected species (Species Decree)

The project area is home to a number of protected species. An overview of these is provided in the table below. The numbers are based on the site inventory conducted by Natuurpunt vzw (2018-2019) and recent site inventories conducted by Corridor in 2020 and 2021.

Given that several species listed in Appendix I of the Species Decree occur within the project area, a derogation from the Species Decree must be requested for these species if prohibited activities are carried out.

With regard to **birds,** it should be noted that the deforestation work during the construction phase was started outside the breeding season. No deliberate prohibited activities are carried out during this period, which means that it is not necessary to request a derogation from the Species Decree for birds.

Where necessary, restoration measures will be taken for the various species, as further detailed in §11.11. These restoration measures will also form part of the exemption applications.

The project area is home to a breeding site for **the natterjack toad**. No adults were observed, but in the spring of 2020 and 2021, a few larvae were caught in the water-filled ditch near a dried-up pool. The numbers were very low, and it is likely that the adult population consists of only a few specimens (satellite population).

Figure 11-38: Natterjack toad breeding site

Table 11-16: Overview of impact on populations of protected species in the project area.

Species	Protection status	Impacted population	Status in port area 2017 (SBP monitoring)	Mitigation and restoration measures
Bee orchid (*Ophrys apifera*)	Appendix I (cat 1) Species Decree,	2019: Minimum 107 specimens 2020: 1 specimen	12 growth sites, 516 specimens	Nature restoration through translocation Note: most of the population has already been translocated by the Port of Antwerp.
Large bee orchid (*Neottia ovata*)	Appendix I (cat 1) Species Decree	2019: Minimum 615 specimens 2020: 399 specimens	Not available	Nature restoration through translocation
True reindeer moss (*Cladonia rangiferina*)	Appendix I (cat 1) Species Decree	Not observed in the field. Uncertain occurrence. However, other *Cladonia* spp. have been observed with certainty.	Not available	No restoration measures required
Blue-winged grasshopper (*Oedipoda caerulescens*)	Appendix I (cat 1) Species Decree,	2019: single observation 2020: not observed	Not available	No restoration measures required
True centaury (*Centaurium erythraea*)	Annex I (cat 1) Species Decree,	2019-2020-2021: order of magnitude: 1000- and	Frequentenwidespreadin port (unspecified)	No recovery measures required
Meadow pipit (*Anthus pratensis*)	Appendix I cat. 2 Species Decree,	2 territories 2019 3 territories 2020 3 territories 2021	19 breeding pairs (2017) 15breeding pairs(2018)	Restoration measures see poor grassland
Great spotted woodpecker (*Dendrocopos major*)	Appendix I (cat. 2) Species Decree	2 breeding pairs 2020 1 breeding pair 2021	Unknown	This species will have to move to another location in the environment. No recovery measures required
Hedge sparrow (*Prunella modularis*)	Appendix I (cat. 2) Species Decree	16 territories 2020 7 territories 2021	Notknown	New habitat for this species in the restored scrub and the forest compensation areas.

Species	Protection status	Impacted population	Status in port area 2017 (SBP monitoring)	Mitigation and restoration measures
Tree pipit (*Anthus trivialis*)	Appendix I (cat. 2) Species Decree	9 territories 2019 5 territories 2020 7 territories 2021	Unknown	The tree pipit is a species that occurs in heathlands, dunes with scrub, clearings, young plantations and copses in agricultural areas. This species can migrate to heathland and poor grasslands in and around the harbour. Additional restoration measures are therefore not necessary.
Tree lark (*Lullula arborea*)	Annex I (cat. 2) Species Decree	1territory2020	Notknown	New habitat for this species in the restored scrub and the forest compensation areas.
Lesser whitethroat (Sylvia curruca)	AppendixI(cat.2) Species Decree	1 territory 2021	Unknown	This species is characteristic of dense thorny scrub and may find a new habitat in the newly restored scrubland.
Shelduck (*Tadorna tadorna*)	Appendix I (cat. 2) Species Decree	1 breeding pair in 2019 (just outside project area) pairs	80breeding	Mitigating measures to encourage settlement during the works To be countered: closing rabbit burrows. Installation of nesting boxes in the Scheldt dyke to attract breeding birds.
Buzzard (*Buteo buteo*)	Appendix I (cat. 2) Species Decree	1 territory 2019 3 territories 2020 2 territories 2021	Not available	Buzzards have several nests that they use alternately. The species may migrate to the surrounding area. No recovery measures required
Canada goose (*Branta canadensis*)	Appendix I (cat. 2, cat. 4) Species Decree	3 breeding pairs 2020 3 breeding pairs 2021	Not known	This species will have to move to another location in the harbour. Exotic No restoration measures required
Magpie (*Pica pica*)	Appendix I (cat. 2, cat. 3) Species Decree	6 occupied or unoccupied nests	Unknown	This species will have to relocate to another location in the harbour. No recovery measures required

Species	Protection status	Impacted population	Status in port area 2017 (SBP monitoring)	Mitigation and restoration measures
Greylag goose (*Anser anser*)	AppendixI(cat.2,cat.4) Species Decree	1 breeding pair 2020	Unknown	This species will have to move to another location in the harbour. No recovery measures required
Great Tit (*Parus major*)	AppendixI(cat.2) Species Decree	10 breeding pairs 2020 4 breeding pairs 2021	Notknown	New habitat for this species in the restored scrubland and the forest compensation areas.
Blackbird (*Turdus merula*)	AppendixI(cat.2) Species Decree	6 territories 2020 1 territory 2021	Unknown	This species will have to move to another location in the harbour. No recovery measures required
Blue tit (*Parus caeruleus*)	Appendix I (cat. 2) Species Decree	14 territories 2020 9 territories 2021	Notknown	New habitat for this species in the restored scrub and the forest compensation areas.
Goldfinch (Carduelis carduelis)	AppendixI(cat.2) Species Decree	1 territory2021	Notknown	New habitat for this species in the restored scrubland and the forest compensation areas.
Long-tailed tit (Aegithalos caudatus)	Appendix I (cat. 2) Species Decree	4 territories 2020 5 territories 2021	Not available	New habitat for this species in the restored scrubland and forest compensation areas.
Chiffchaff (*Phylloscopus collybita*)	Appendix I (cat. 2) Species Decree	42 territories 2020 19 territories 2021	Notknown	New habitat for this species in the restored scrub and the forest compensation areas.
Garden Warbler (*Sylvia borin*)	AppendixI(cat.2) Species Decree	2 territories 2020 3 territories 2021	Notknown	New habitat for this species in the restored scrubland and the forest compensation areas.
Robin (*Erithacus rubecula*)	Appendix I (cat. 2) Species Decree	14 territories 2020 12 territories 2021	Notknown	New habitat for this species in the restored scrubland and the forest compensation areas.
Wren (*Troglodytes troglodytes*)	Appendix I (cat. 2) Species Decree	4 territories 2020 2 territories 2021	Notknown	New habitat for this species in the restored scrub and the forest compensation areas.

Species	Protection status	Impacted population	Status in port area 2017 (SBP monitoring)	Mitigation and restoration measures
White wagtail (*Motacilla alba*)	Annex I (cat. 2) Species Decree	2territories2021	(Unknown)	This species will move to another location in the harbour. No recovery measures required.
Nightingale (*Luscinia megarhynchos*)	Appendix I (cat. 2) Species Decree	5 Territories 2019 5 territories 2020 5 territories 2021	Unknown	The nightingale is characteristic of shrub vegetation and sea buckthorn. The sea buckthorn vegetation that is disappearing will be replanted at another location in the harbour in combination with other shrub species (3 ha) as part of nature restoration. Additional restoration measures are therefore not necessary.
Willow warbler (*Phylloscopus trochilus*)	Appendix I (cat. 2) Species Decree	17 territories 2019 65 territories 2020 35 territories 2021	unknown	Fitis is characteristic of dry to moist semi-open landscapes: heathland, forest and agricultural areas. This species can move to the planted scrub and surrounding areas. Additional restoration measures are therefore not necessary.
Lapwing (*Vanellus vanellus*)	Appendix I (cat. 2, cat. 4) Species Decree	1 territory 2019 12 territories 2020 7 territories 2021	Not available	This species will move to another location in the harbour. No remedial measures are required.
Reed warbler (Acrocep	AppendixI(cat.2) Species Decree	1territory2021	Notavailable	This species will move to another location in the harbour. No recovery measures required.
Oystercatcher (*Haematopus ostralegus*)	Appendix I (cat. 2) Species Decree	1 territory 2019 3 territories 2020 3 territories 2021	Not available	This species regularly breeds in the harbour on roofs and lawns between businesses. Once the work is complete, this species may move elsewhere or remain in place.
Chaffinch (*Fringilla coelebs*)	AppendixI(cat.2) Species Decree	13 territories 2020 13 territories 2021	Notavailable	New habitat for this species in the restored scrubland and the forest compensation areas.
Gadwall (Anas strepera)	AppendixI(cat.2,cat.4) Species Decree	1 territory 2020 1 territory 2021	Notavailable	This species may migrate to areas in the vicinity (opposite side of the canal dock).

Species	Protection status	Impacted population	Status in port area 2017 (SBP monitoring)	Mitigation and restoration measures
Common whitethroat (*Sylvia communis*)	Annex I (cat. 2) Species Decree	4 territories 2020 2 territories 2021	Notavailable	This species is characteristic of dense thorny scrub and can find a new habitat in the newly restored scrub.
Wood pigeon (*Columbo palumbus*)	Appendix I (cat. 2, cat. 4) Species Decree	10territories2020	Notavailable	This species can find new habitat in the forest compensation areas.
Redstart (*Phoenicurus phoenicurus*)	Annex I (cat. 2) Species Decree	1territory2020	Notavailable	This species can find new habitat in the forest compensation areas.
Black redstart (*Phoenicurus ochrurus*)	Appendix I (cat. 2) Species Decree	4 territories 2020 3 territories 2021	Notavailable	In principle, this species can remain among the industrial buildings. This species often breeds on (industrial) buildings and in urban areas.
Blackcap (*Sylvia atricapilla*)	AppendixI(cat.2) Species Decree	10 territories 2020 9 territories 2021	Notavailable	New habitat for this species in the restored scrubland and the forest compensation areas.
Cuckoo (Cuculus canorus)	Appendix I (cat. 2) Species Decree	1 territory 2020	Not available	This species can find new habitat in the forest compensation areas and near the constructed scrub.
Song thrush (Turdus philomenos)	Appendix I (cat. 2) Species Decree	1 territory 2020 3 territories 2021	Notavailable	This species may find new habitat in the forest compensation areas and near the constructed scrub.
Natterjack toad (*Bufo calamita*)	Annex I (cat. 3) Species Decree	2019: no observations. 2020, 2021: observation of natterjack toad larvae in a pool and water-filled ditch.	698 calling males	Mitigating measures to prevent settlement during the works: avoid pool formation. Translocation if natterjack toads are discovered during the works. Construction of a breeding pool near the Muisbroekbosjes. Construction of deepened wadis near the administrative building.

Conclusion

Given that:

- it concerns an intake of approximately 90.3 ha of currently available open space (= fallow land);
- this acquisition is largely permanent;
- the biotopes with their biotic communities consist partly of pioneer vegetation with characteristics of dry, poor grassland on reclaimed land, and partly of spontaneously developed native deciduous forest dominated by willows and birch, catalogued as biologically valuable land on the BWK (2018);
- these areas form the habitat for a number of generally protected species (Appendix I of the Species Decree);
- the disruption associated with the construction phase will be detrimental to protected bird species observed in the project area;

the effects of the permanent occupation of space and the loss of habitat for species due to the project are assessed at local level as a significant negative effect (-3) on biodiversity.

Provided that a series of **mitigating, compensatory and remedial measures** are taken into account, the negative effects can be partially offset (see §11.11)).

This is mainly due to:

- Sea buckthorn vegetation will be largely replaced (3 hectares) by the planting of native, mixed scrub in the port area, as part of the mandatory compensation required by the Vegetation Decree; From an ecological point of view, sea buckthorn is not a naturally occurring habitat in the port and will be replaced by native, mixed scrub, which offers more opportunities for biodiversity from an ecological point of view.
- The limited loss of reed vegetation, which will be preserved or replanted on the site itself;
- Protected species, such as the greater butterfly orchid and the bee orchid, which will be relocated;
- Natterjack toad, for which a breeding site will be created in the EIN port of Antwerp (Muisbroek), and for which potential habitat sites will be created in the administrative zone along Scheldelaan (deepened wadis).
- Sand martins, for which one ground stock will be set up as a breeding site.
- Lapwings and oystercatchers that can settle in other locations in the harbour;
- The loss of pioneer vegetation (ku*) with characteristics of poor grassland will be mitigated by taking a number of targeted measures in the port area of Rechterscheldeoever within the existing ecological infrastructure of the port, supplemented by a few new areas as an extension of the existing ecological infrastructure. In the relatively short term, a total area of 36.25 ha will be realised by converting existing, less valuable vegetation into ecologically valuable poor vegetation. This will include an ecologically managed zone along the Scheldelaan, which is located in the immediate vicinity of the project area. This zone can contribute to the creation of a robust network for poor grassland species.
  This transformation (degradation management) is being carried out by the Port of Antwerp, in consultation with INEOS:

22. sheep grazing (+2.95 ha). Grazing by sheep opens up the vegetation and impoverishes it;
23. mowing management of pioneer vegetation (+1.3 ha). These plots are mowed once a year after 15 July. The clippings are removed;
24. management of new ecological infrastructure (+6.92 ha). These plots are mowed once or twice a year, depending on the nutrient content. The cuttings are removed;
25. Intensive mowing management of nutrient-rich grasslands (+19.75 ha). These plots are mowed three times a year to impoverish the soil. If the plot is sufficiently impoverished, one mowing after 15 July is sufficient. The clippings are removed;
26. scraping nutrient-rich topsoil (+5.33 ha). The top 15-20 cm of nutrient-rich topsoil is scraped off and removed. The thickness of the layer may vary locally.

The areas eligible for this are: Grote Kreek, Spoorzone Kuifeend, Zouten – Stocatradijk, Groot Buitenschoor, Scheldelaan, Sigmadijk.

The maps below show the locations for this restoration and expansion of nutrient-poor grassland. The management measures in the areas on the left bank of the Scheldt that are part of those 224 hectares will also continue to be managed ecologically.

Figure 11-39: Locations where poor grassland will be created in the port area on the right bank (northern part)

Figure 11-40: Locations where poor grassland will be created in the port area on the right bank (southern part)

Notwithstanding these restoration measures, based on the proposed assessment framework, the effect on ecotope and biotope loss in this region after taking the mitigating, compensatory and nature restoration measures remains significantly negative (-3). However, the following nuance should be added:

- Additional measures are being taken to mitigate the loss of pioneer vegetation with characteristics of poor grassland, on the one hand by implementing targeted management measures in the existing EI network (approx. 26 ha) and, on the other hand, by expanding the existing ecological infrastructure network with a robust zone of approx. 7 ha along the Scheldelaan, in the immediate vicinity of the project area, and managing this ecologically as well. This zone can contribute to the creation of a robust network for species of poor grassland. This transformation will be achieved through a series of targeted management measures, which will be anchored in the Antwerp Port Species Protection Programme 2, which is currently being drawn up.
- Approximately 3 hectares of mixed (thorn) scrub will be planted in the Port of Antwerp as voluntary compensation for the loss of approximately 1.07 hectares of free-standing sea buckthorn scrub.
- A series of measures are being taken to compensate for the loss of habitat for bird species, such as:
  - The planting of approximately 3 hectares of mixed (thorn) scrub will create a new suitable habitat for all kinds of songbirds, such as nightingales.
  - A single ground stock is being provided as a possible breeding location for sand martins;
- The policy decision, namely the GRUP, designates this zone as an industrial area.
- The project involves infill development within the Port of Antwerp and therefore does not involve any expansion outside the existing port area.

11.4.1.4 Fragmentation and barrier effect

In the reference situation, the northern part of the project area formed an ecological connection between the nature areas to the west along the Scheldt (Galgenschoor), the ecological connection zones along Scheldelaan and the nature areas along the eastern side of the port.

In the southern part of the project area, there is a pipeline corridor that serves as an ecological corridor. This pipeline corridor is owned and managed by the Port of Antwerp Authority. In the reference condition, the ecological connection in the southern part mainly served species from more open areas (via the open scrub vegetation in the area) and was in fact a pipeline corridor. This corridor allowed species (butterflies, other insects, mammals) from western habitats along the Scheldt (Galgenschoor, dykes, etc.) to migrate to areas east of the project area and other locations on the port grounds.

The corridor functions in the northern and southern parts of the project area were less pronounced for species of closed habitats (forest), as the forest habitats are rather isolated from other forest areas in the wider environment. It can also be expected that the characteristic reed and water birds that occur near the mudflats and salt marshes on the Galgenschoor did not use this corridor.

Figure 11-41: Sketch of the corridor function in the north of the project area for species of open habitats (scrubland).

Figure 11-42: Sketch of the corridor function in the south of the project area for species of open habitats (scrubland).

The implementation of the project has created a significant amount of open space, which in the reference situation served as an ecological connection, and has created an additional barrier between the aforementioned areas.

- Open habitats and forest habitats in the southern part have been completely taken over, causing the corridor function to largely disappear.
- Open habitats and forest habitats in the northern part of the project area have been occupied, but a significant area of the corridor has been preserved. The areas north of the project area have been preserved and consist of open habitats and forest habitats.

The effects are mitigated by a number of measures:

The strip of land located in the southern part, owned by the Port of Antwerp, will be managed ecologically so that its functions as an ecological corridor can be preserved and enhanced.

Ecological management will consist of:

- Extensive mowing management (once or twice a year) with removal of the clippings. Mowing will be carried out using a disc mower. The first mowing will take place after 15 July (85% of the area).
- The clippings will be placed in swaths or ridges and baled and removed at the earliest one day later and at the latest 10 days later. So there is no direct removal via suction of the clippings.
- Every year, approximately 15% of the area is not mowed (alternating) to provide a refuge for small fauna and a habitat for insects and birds. These rougher strips are important for butterflies and other insects, birds, etc. as a foraging area.
- In this strip, it is important to preserve smaller sandy strips (a few dozen square metres). These biotopes are suitable habitats for sand beetles and wild bees. These strips can be maintained by excavation work (checking pipes, laying pipes) or targeted excavation work (scraping the soil). This type of biotope can also be preserved along sandy roads in the strip.

This maintains open, nutrient-poor grassland vegetation and allows species characteristic of open, nutrient-poor grassland vegetation to migrate throughout the area. The target species for this corridor are mainly (flying) insects (butterflies, ground beetles, bees, grasshoppers, including the blue-winged grasshopper), spiders and small mammals. These species groups find a habitat and connecting area here. In any case, upward growth is prevented in this pipeline corridor.

The intention is not to create an ecological trap here and attract large mammals. The purpose of the corridor here is to ensure that animal species do not become trapped on one side of the project area, but that passage is possible.

Due to the presence of underground pipes, no pools or ditches can be dug. Due to the absence of wet habitats, this corridor will also not be suitable as a living and connecting area for amphibians. However, most amphibians are not very mobile. Therefore, the risk of an ecological trap for amphibians is considered limited.

The corridor can be used permanently as a guide for bats in the area. However, bats are highly sensitive to light disturbance, which will certainly be present from existing and future installations. Therefore, the corridors will be suboptimal for guiding bats. The corridors will therefore mainly be important as a guide for insects. The Guidelines for Wildlife Facilities in Infrastructure (Rijkwaterstaat and ProRail, 2013) describe that a guidance strip for butterflies should ideally be 5 to 15 metres wide, with a gradual transition from grassland to scrub and thickets.

Given that the pipeline corridor in the south and the remaining habitats in the north of the project area are characterised by sparse vegetation, given that the pipeline corridor has an average width of approximately 15-20 metres, which is considered sufficient, and given that ecological management will be applied in the pipeline corridor and an ecological connection will therefore still be maintained from west to east and vice versa, the effect in terms of fragmentation is assessed as a limited negative effect (-1) after mitigation.

11.4.1.5 Acidifying and fertilising deposits

For a literature review and theoretical consideration of the effects of acidifying and eutrophying deposits on vegetation and the methodology used, please refer to § 11.2.4 Background eutrophying and acidifying deposits and to Appendix 10.

Project One – expected nitrogen emissions during the construction phase

During the construction phase (emissions from energy production, ships and vehicles), nitrogen emissions are released, mostly in the form of nitrogen oxides (NOx).

During the construction phase, only low-emission equipment and vehicles (Stage IV or better) will be used in the project, which will drastically reduce emissions during the construction phase. Many of the construction activities will also use mains power, reducing the need for generators.

- ➔ *The expected emissions of NOx and $_{NH3}$ during the construction phase amount to an average of approximately 18 tonnes/year of NOx and 0.08 tonnes/year $_{of\ NH3}$ over a period of 3 years and 8 months, and a maximum of 28.6 tonnes/year of NOx and 0.123 tonnes/year $_{of\ NH3}$ during the year with the highest emissions.*

Determining nitrogen emissions to nitrogen deposition in the vicinity of the project area

Based on the expected emission quantities, the deposition into the environment was modelled using the Flemish IMPACT model. The methodology used is discussed in Chapter 7 Air.

The local contribution to nitrogen deposition from Project One in the study area is shown in detail in Appendix 10.

Nitrogen deposition during the construction phase

The impact score resulting from the construction phase is 0.548% in Flanders for both eutrophication and acidification, see also Appendix 7.8a.

Figure 11-43: provides an overview of the contours of theoretical nitrogen deposition caused by activities during the construction phase in relation to habitat types within and outside Habitat Directive areas. The theoretical contours are shown in various steps up to 0.010 kg N/ha.j. The values are averages over the 12 months with the highest continuous nitrogen emissions during the construction phase. It should be noted that the Natura 2000 classification and the classification of regionally important biotopes have been used here. Natura 2000 habitat types may also be located outside Natura 2000 areas.

Figure 11-43: Contours of nitrogen deposition in kg N/ha.year during the construction phase in relation to Natura 2000 habitats inside and outside Habitats Directive areas

Taking into account:

- The wide distribution of Habitat Directive areas within the study area and the conclusion that effects on the conservation objectives of habitats and species are negligible;
- The wide distribution of VEN areas across the study area and the conclusion that effects in terms of unavoidable or irreparable damage are negligible;
- That the nearest nature area, the Opstal Valley, is part of the VEN De Kuifeend, for which an assessment was carried out and the effects of nitrogen deposition as a result of the project were assessed as negligible,
- the fact that the negligible effects outside N2000 and VEN are unavoidable;

It is stated that, by extension, no significant effects are to be expected for all other vegetation outside nature reserves (scattered throughout the study area between the Natura 2000 and VEN areas), whether or not they are sensitive to nitrogen deposition, and that the influences are negligible or absent.

In addition, there is a downward trend in nitrogen emissions and deposition (Lefebvre, W., Hooyberghs, H., Deutsch F., 2024). In order to assess whether damage has occurred, such a downward trend may also be taken into account in accordance with Article 3 of the Decree of the Flemish Government of 10 January 2024 on the assessment of damage to nature in the Flemish Ecological Network.

Even if damage were to occur, it would qualify as unavoidable damage, taking into account the fact that all practicable precautions are already being taken to limit nitrogen emissions from Project One.

Some protected species may also occur outside protected areas[78]. With regard to impacts on protected species outside the SAC and SAC areas described here, the nitrogen sensitivity of species must be taken into account (see 11.3.2.1 Species Decree).

Most protected species are not sensitive to eutrophic deposition. The impact on non-nitrogen-sensitive species as a result of temporary eutrophic deposition in the project during the construction phase is negligible. Furthermore, not all species are relevant or occur in the study area, for example the tree frog, dormouse, harrier, common spadefoot toad and stag beetle. Some species (moor frog, moorland clouded yellow butterfly) occur exclusively within VEN or SBZ areas and are described above in terms of impact.

For species found in flowing water such as brook lamprey, bullhead and weatherfish, the influence of point and diffuse sources (agriculture, discharge points, etc.) is much more decisive than the negligible influence of project deposits from the air on the water quality of the habitat. Here too, the impact on non-nitrogen-sensitive species as a result of temporary fertilising deposits in the project during the construction phase is negligible.

The marsh harrier may also occur in the study area outside SBZ or VEN areas. The marsh harrier may breed in the region in nutrient-rich marsh areas, and sometimes also in grain fields. These habitat types are not sensitive to nitrogen. Other environmental factors (disturbance, predation) are much more important determinants for this species. The impact on the marsh harrier as a result of temporary fertilising deposits in the project during the construction phase is negligible.

The most important factor determining the populations of the crested newt is the quality of its habitat. This species occurs in small-scale landscapes with a high diversity of biotope types. The breeding pools tend to be nutrient-rich. Other environmental pressures (intensification of agriculture, water quality, disappearance of breeding pools and land habitat) are also much more decisive for these populations than temporary fertilising deposits.

[78] Protected species within VEN and SBZ areas are discussed in the Enhanced Nature Assessment and Appropriate Assessment respectively.

Meadow birds such as the black-tailed godwit and curlew can also occur in agricultural areas as breeding birds. Fertilising deposition during the construction phase is not a determining factor for these species during the breeding season.

For these species too, other environmental pressures (intensification of agriculture, mowing) are much more decisive for these populations than temporary fertilising deposition.

In general, it can therefore be concluded that no impact on protected species is expected as a result of temporary fertilising deposits during the construction phase.

The impact is therefore assessed as absent or negligible (0) for both the habitats and the species that occur therein.

For the description and assessment of the impact of fertilising/acidifying deposition on the Natura 2000 areas in the vicinity, reference is made to the appropriate assessments (see Annexes 10.2 and 10.3). The impact on VEN areas is described in Annex 10.1.

For a description and assessment of the impact of fertilising/acidifying deposition during the operational phase, please refer to § 11.4.2.

11.4.1.6 Effects on groundwater management

The Water discipline describes that an impact on groundwater management is possible during the construction phase of the project due to drainage, with two possible scenarios: maximum scenario and sheet pile scenario.

At certain locations within the project area, the groundwater table is only approximately 50 cm below ground level, making temporary drainage necessary during the construction phase. For a detailed description of the technical aspects of the drainage and scenarios, please refer to the Water discipline.

Detailed groundwater modelling was carried out within the Water discipline. Based on the groundwater modelling (see Chapter 9 Water), the temporary groundwater level reductions during the construction phase were mapped out. The figure below shows the maximum groundwater levels relative to ground level in the current situation (without the project) at Galgenschoor (example). The salt marsh vegetation is also indicated (orange). This serves as the reference condition.

Figure 11-44: Groundwater levels at Galgenschoor relative to ground level (in metres) in the current situation based on groundwater modelling. Salt marsh vegetation with reeds is indicated in orange.

Effects of drainage during the construction phase

The figures below show the effects on groundwater during the construction phase for temporary drainage for the construction of installations, for the sheet piling scenario.

Figure 11-45: Maximum calculated groundwater lowering (m-mv) for the sheet piling scenario, in combination with Natura 2000 habitat types in the Galgenschoor.

The impact of the temporary drainage for the construction of the installations stops at the eastern boundary of the project area at the Kanaaldok and therefore does **not** extend under the Kanaaldok. The areas to the east of the Kanaaldok will therefore not be affected by the drainage.

In the southern part of the project area, the sphere of influence extends to Galgenschoor in the sheet piling scenario (this scenario is selected in the project). The temporary subsidence amounts to between 0.01 and 0.1 m at the level of the salt marsh with reed vegetation.

Based on current groundwater levels at the salt marsh covered with reeds, it appears that reed vegetation occurs across a range of groundwater levels from 0 cm (ground level) to 180 cm below ground level.

At Galgenschoor, the salt marsh zone has largely been desalinated due to the presence of a sharp steep edge between the salt marsh and the mudflats. As a result, the salt marsh is now only flooded during spring tides, and even then only occasionally. A slight lowering of the water table under the unsaturated salt marsh area – which, partly due to desalination, is mainly covered with reeds – will have little effect, taking into account the current range of groundwater levels. Moreover, the temporary reduction is only 1 to 10 cm, which falls within the natural fluctuations of the groundwater level. Based on the groundwater modelling, no salinisation effects are expected (see Chapter 9 Water).

Based on the above arguments, the results of the groundwater modelling and the temporary nature of the groundwater lowering, it can be concluded that the effect of the groundwater lowering during the construction phase of the project can be assessed as limited negative (-1). The groundwater table decline remains within the natural variation, but in very dry periods a limited negative impact can be expected.

11.4.1.7 Light pollution and visual disturbance

Effects on fauna according to the available literature

Light pollution can have various effects on fauna. In general, it can be said that light pollution, depending on the species, can lead to (de Molenaar, 2003):

- barrier effects and fragmentation;
- indirect loss of habitat due to restrictions on space utilisation;
- a reduction in habitat quality.

It is well known that **bats** are an important group to consider when it comes to light pollution. They are nocturnal animals, and a number of species are known to be very sensitive to light pollution (including Daubenton's bat, pond bat, common/grey long-eared bat and Brandt's bat). Three factors play a role in light pollution for bats: (1) avoidance of the illuminated area by light-shy species, (2) attraction of insects by lighting, and (3) degradation of the surrounding biotope due to light scattering.

Insects appear to be attracted to light [79] , and are more attracted to blue and white light than to yellow light (Natuurpunt Educatie & Preventie Lichthinder vzw, 2010).

The main negative effects of artificial light on insects are as follows:

- getting stuck in light fixtures;
- increased risk of predation by predators (including bats);
- Flying around artificial light = wasted time and energy, which comes at the expense of foraging or reproduction (relevant given the short lifespan of insects).

In a study investigating the effect of road lighting on **amphibians**, it was concluded that no statistical difference could be demonstrated between the number of nocturnal passages with and without lighting. Some species of toads are attracted by extremely low light intensities (De Molenaar 2003), while others are not. In general, it can be concluded that there are no major impacts on this species group.

The following issues relating to lighting and **birdlife** are known from the literature (de Molenaar, 2003; Natuurpunt Educatie & Preventie Lichthinder vzw, 2010):

- disruption of the annual cycle (reproduction and migration shift in time);
- disruption of migratory birds' orientation, circling behaviour observed in illuminated areas;
- diurnal birds also become active at night: disrupted biorhythm, lack of sleep;
- restriction of nesting site selection (decline in breeding bird populations);
- increased risk of collision resulting in death (not relevant here, especially in the case of tall illuminated buildings, large window areas and also on migration routes, e.g. apartment buildings on the coast).

[79] The attraction of insects to light is in fact caused by a kind of optical illusion related to the structure of the compound eye in insects. Insects perceive a dark hole next to a burning lamp. As they move towards it, the hole changes position because the compound eye is spherical in shape and contains thousands of lenses that can never all be illuminated by a lamp at the same time. As an insect flies, different parts of the compound eye are illuminated. This causes the imaginary black hole to change position. Insects therefore fly after a kind of mirage, resulting in a frantic flight.

Current project

Work may be carried out before sunrise or after sunset during the construction phase. Lighting of the site will be necessary at these times.

This will mainly be an issue during the winter months, which is when bats – some species of which [80]are particularly sensitive to light disturbance – hibernate. At present, the area is not an important habitat for bats, and once the vegetation has been removed, the area will be of no value to bats whatsoever.

Given that the lighting is necessary for safety reasons, as the area is characterised by an industrial environment with many light sources necessary for the safe and proper functioning of the port, and taking into account the fact that the natural values in the project area will no longer be present, and given that the project area is not an important habitat for bats, the impact in terms of light pollution during the construction phase is assessed as negligible or no effect (0). It remains important, however, that through the careful selection and placement of lighting, only the project area itself is illuminated and not the surrounding area (minimising light pollution in the construction zone). The chapter on mitigation measures and recommendations therefore provides a number of recommendations on the use of 'good lighting principles'. These recommendations apply to both the construction and operational phases.

11.4.1.8 Ecotoxicological effects resulting from water emissions

Reference is made to the Appropriate Assessment for the discussion of the effects of drainage on surface water, see Appendix 10.

11.4.2 Operational phase

11.4.2.1 Soil disturbance

As there will be no interventions in the soil during the operational phase, no effects are expected with regard to soil disturbance.

11.4.2.2 Noise disturbance

For a literature review and theoretical consideration of the effects of noise disturbance and impact assessment on avifauna, please refer to § 11.4.1.2 Noise disturbance during the construction phase.

Noise modelling results

Please refer to § 11.4.1.2 for a more detailed explanation of the methodology.

The map with the modelled contours for Lden values shows the sound pressure level of the operational phase at 4 m above ground level in accordance with VLAREM II during the day (Lday).

The figure below shows the noise contours in dB(A) based on the modelled sound pressures of the activities during the operational phase, both with and without ship movements. A total of 266 ships per year are expected. The modelling takes into account 1 large ship (VLEC) at quay 2 + 1 small ship (inland vessel) at quay 3. When the ship is at the quay, it produces noise for the loading of products on the one hand and the '[hotel]services' on the other. The modelling with two ships is a worst-case scenario. In practice, this will occur less frequently.

[80] Including Daubenton's bat and pond bat.
[81] 'Hotel services' are the 'day-to-day activities' on board – kitchen, lighting, heating, etc. (when a ship is docked).

It should be noted that the noise from the flares is not included in the noise model because they are not part of the normal production process and have a very short operating time. The flares are considered an incidental noise source. During stable production, the flares are activated on average once a year. There are three ground flares, one of which is double (one in use and one as a backup). There is one tower flare, which is only used in exceptional circumstances in an emergency. Due to the incidental nature of the tower flare's operation and the very low probability of the various flares operating simultaneously, flaring only contributes to a limited extent to the disturbance, compared to the constant noise during operation. The critical contours of 45 and 50 dB(A) at a 24-hour level (Lden) are indicated here.

Figure 11-46: Noise contours during the operational phase, with two ships (one large and one small), based on an acoustic transmission model indicating the SBZ-H area 'Scheldt and Durme estuary from the Dutch border to Ghent'. Blue contour: project area (Lden values).

Figure 11-47: Noise contours during the operational phase, without ships, based on an acoustic transmission model indicating the SBZ-H area 'Scheldt and Durme estuary from the Dutch border to Ghent'. Blue contour: project area (Lden values).

Impact of noise disturbance in the nearby Birds Directive, Habitats Directive, Ramsar and Galgenschoor nature reserve areas.

Based on the above figures*, it* can *be concluded* for the modelling of *the operational phase, including ship movements, that most of the Galgenschoor will experience a sound pressure of less than 40 dB(A). The part of the Galgenschoor that will experience a sound pressure higher than 40 dB(A) (approx. 5%) is limited to a small part of the higher salt marsh, a habitat suitable for some species of breeding birds. The entire surface area of the mudflat habitat, which is important for wintering birds, has a noise level well below 40 dB(A), up to 35 dB(A) or less.*

In the model results without ship movements*, only a tiny area of Galgenschoor will experience a contribution of 40 dB(A). The rest of Galgenschoor will not be affected at all by the increase in noise from the operation of the installations and supporting infrastructure.*

As stated above, the assumptions in the noise modelling are based on a *worst-case scenario (more specifically, downwind in all directions, including north-easterly wind; all installations operating simultaneously, two ships). In reality, for a large part of the operating time, the wind will come from the prevailing SW direction, which will reduce the effect (1 to 4 dB(A) lower at Galgenschoor).*

When assessing the effects of noise disturbance during *the operational phase (with or without ship movements) on fauna and avifauna in the area, the following elements are taken into account:*

- It can be said that, in addition to being a breeding area, Galgenschoor is particularly important as a resting and foraging area for all kinds of water birds. The mudflats that are relevant to water birds have a noise level of less than 40dB(A).
- For quite some time now, there has been high noise pollution in the wider vicinity of the project area and Galgenschoor due to rail and road traffic along Scheldelaan and the port companies. Despite the high noise pollution, the areas remain attractive and continue to function as breeding and wintering grounds for birds. Many of the bird species found there have already adapted to the ambient noise levels.

The calculated sound pressures are based on a worst-case scenario (E-NE wind) rather than the prevailing SW wind direction and the presence of two ships.

The figure below shows observations of a few selected species groups in relation to the noise contours during the operational phase (with or without ship movements): reed birds (Cetti's warbler, reed warbler, reed bunting and bluethroat), waders (little ringed plover, oystercatcher and redshank) and marsh harrier.

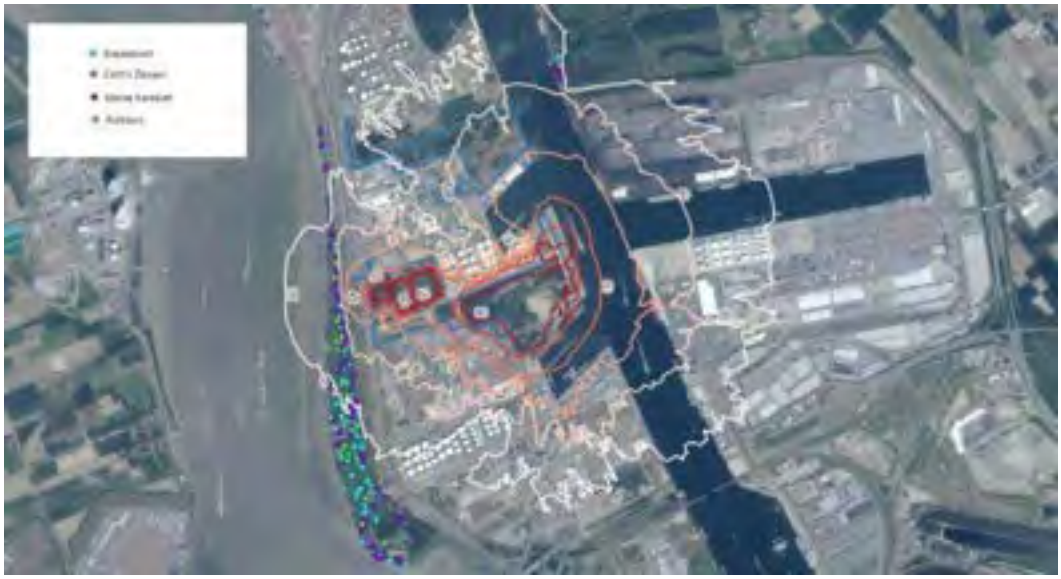

Figure 11-48: Locations with breeding behaviour for a number of reed birds in relation to the noise contours during the operational phase + ships (Lden). Source: databank waarnemingen.be (Natuurpunt vzw 2020-2024).

Figure 11-49: Locations with breeding behaviour for a number of selected waders and ducks in relation to the noise contours during the operational phase + ships (Lden). Source: waarnemingen.be database (Natuurpunt vzw 2020-2024).

Figure 11-50: Locations with breeding behaviour indicative of the marsh harrier in relation to noise contours during the operational phase + ships (Lden). Source: waarnemingen.be database (Natuurpunt vzw 2020-2024).

Based on the significance framework, it has been decided that the effect *of noise disturbance during the operational phase on bird species in the Galgenschoor is negligible (0). For wintering water birds that use the mudflat zone, there is a negligible or no effect (0). Mitigation measures are not necessary, either for breeding birds or for wintering birds, also taking into account the fact that the assessment is a worst-case assessment and that in reality the noise pollution is likely to be lower.*

Impact of noise disturbance at the Potpolder van Lillo

The *Potpolder van Lillo, located south of Fort Lillo, is also highly valuable as a foraging and resting area for all kinds of bird species. Based on the model results, and taking into account that this is a worst-case calculation, it can be concluded that there will be no effects in this zone (< 40 dB(A)). The impact can be assessed as negligible or no effect (0).*

Impact of noise disturbance at Opstalvallei

The Opstal Valley, located east of the project area, is a valuable breeding ground for many species of birds. Based on the model results, and taking into account that this is a worst-case calculation, it can be concluded that there will be no effects in this zone (< 45 dB(A)). The impact can be assessed as negligible or no effect (0).

Impact of noise disturbance in the project area

The value of the project area for breeding birds during *the operational phase will remain very limited. However, species such as oystercatchers and the like may still breed on the site. Oystercatchers are known to breed on roofs or lawns between industrial installations and are therefore fairly tolerant of industrial noise levels. Consequently, a negligible or no effect (0) on the disturbance of breeding species is to be expected.*

11.4.2.3 Direct space occupation (loss of biotope and ecotope)

During the operational phase, industrial waste water from the site will be discharged via Inovyn's existing effluent pipe at Galgenschoor after treatment. No new discharge pipe will be constructed towards the Scheldt. The existing discharge location is indicated in the figure below. The effluent pipe emerges at the bottom of the rubble dump in the mudflats.

Figure 11-51: Location of Inovyn's existing effluent pipe.

Currently, the discharge flow rate of Inovyn and IMB is approximately 155 m³/h. The proposed project will add an average of approximately 74 m³/h to this, with an exceptional discharge of up to 246 m³/h (during a maximum of 5% of the time).

This is not expected to result in a more pronounced drainage channel in the mudflats. The drainage channel is currently partially and adequately protected by riprap (visible in the photo above) up to halfway to the low-water line. At the bottom of the drainage channel with rubble, there is a weakly developed channel that only erodes at low tide (once the tide rises above the rubble, there is no more erosion). No additional erosion of the salt marsh is expected. No lasting effect on the mudflats is expected either.

The increased flow rate will therefore not lead to a loss of salt marsh or mudflat habitat (no effect (0)).

11.4.2.4 Acidifying and eutrophying deposits

For a literature review and theoretical consideration of the effects of acidifying and eutrophying deposits on vegetation and species and the methodology used, please refer to § 11.2.4 Background eutrophying and acidifying deposits and to Appendix 10.

Project One – expected nitrogen emissions during the operational phase

During the operational phase (emissions from cracking furnaces, steam boilers and shipping), nitrogen emissions are released, mostly in the form of nitrogen oxides (NOx).

➔ *The expected annual emissions of NOx and $_{NH3}$ during the operational phase are 167 tonnes of NOx and approximately 18 tonnes $_{of\ NH3}$, respectively. These emissions will be continuously monitored using validated measuring equipment on each of the chimneys.*

Determining nitrogen emissions to nitrogen deposition in the vicinity of the project area

Based on the expected emission quantities, the deposition into the environment has been modelled using the Flemish IMPACT model. The methodology used is discussed in Chapter 7 Air. Modelling is carried out for a zone of 20 kilometres around the project area and within the contour of 0.001 kg N/ha.j.

The specific figures are included in detail for each protection zone and habitat type in Appendix 10 later in this chapter.

Nitrogen deposition during the operational phase

The impact score resulting from the exploitation phase is 0.553% in Flanders for eutrophication and 0.571% for acidification, see also Appendix 7.8b.

Figure 11-52 provides an overview of the contours of theoretical nitrogen deposition caused by activities during the operational phase in relation to habitat types within and outside Habitat Directive areas. The theoretical contours are shown in various steps up to 0.010 kg N/ha.j. It should be noted that the Natura 2000 classification and the classification of regionally important biotopes have been used here. Natura 2000 habitat types may also be located outside Natura 2000 areas.

Figure 11-52: Contours of nitrogen deposition in kg N/ha.year during the operational phase in relation to Natura 2000 habitats within and outside habitat directive areas.

European habitat types occurring within Natura 2000 areas are specifically addressed in the appropriate assessment (see § 11.9 Appropriate assessment Natura 2000 and assessment against Annex IV species of the Habitats Directive (Flanders)).

Taking into account:

- The wide distribution of habitat directive areas within the study area and the conclusion that effects with regard to conservation objectives are negligible;
- The spatial distribution of VEN areas across the study area and the conclusion that effects with regard to unavoidable or irreparable damage are negligible;
- That the nearest nature area, the Opstalvallei, is part of the VEN De Kuifeend for which an assessment was made and the effects of nitrogen deposition as a result of the project were assessed as negligible;
- The fact that the negligible effects outside N2000 and VEN are unavoidable;

It is stated that, by extension, no significant effects are to be expected for all other vegetation outside nature reserves (scattered throughout the study area between the Natura 2000 and VEN areas), whether or not they are sensitive to nitrogen deposition, and that the influences are negligible or absent.

Based on these extensive assessments for Natura 2000 areas and VEN areas, it appears that the deposits at vegetation level in these areas do not cause any significant impact and/or damage to this vegetation or influence the recoverability of vegetation.

Based on this analysis, it can be concluded that, by extension, no significant impacts are to be expected for all other vegetation outside nature reserves (scattered throughout the study area between the Natura 2000 and VEN areas), whether or not they are sensitive to nitrogen deposition, and that there are no or negligible influences.

Some protected species may also occur outside protected areas. With regard to impacts resulting from eutrophicating deposits during the operational phase on protected species outside nature reserves, the nitrogen sensitivity of species must be taken into account (see 11.3.2.1 Species Decree).

Most protected species are not sensitive to fertilising deposition. There is no impact on non-nitrogen-sensitive species as a result of temporary fertilising deposition in the project during the construction phase.
Furthermore, not all species are relevant or occur in the study area, for example tree frogs, dormice, harriers, common spadefoot toads and stag beetles. Some species (moor frogs and moorland clouded butterflies) occur exclusively within VEN or SBZ areas and are described in terms of their impact in the enhanced nature assessment or appropriate assessment.

For species found in flowing water, such as brook lamprey, bullhead and weatherfish, the impact of point and diffuse sources (agriculture, discharge points, etc.) is much more decisive than the negligible impact of project deposits from the air during the operational phase on the water quality of the habitat. Here too, the impact on non-nitrogen-sensitive species from project deposits during the construction phase is negligible.

The marsh harrier may also occur in the study area outside SBZ or VEN areas. The marsh harrier may breed in the region in nutrient-rich marsh areas, and sometimes also in grain fields. These habitat types are not sensitive to nitrogen. Other environmental factors (disturbance, predation) are much more important determinants for this species. The impact on the marsh harrier as a result of temporary fertilising deposits in the project during the construction phase is negligible.

The most important factor determining the populations of the crested newt is the quality of its habitat. This species occurs in small-scale landscapes with a high diversity of biotope types. The breeding pools tend to be nutrient-rich. Other environmental pressures (intensification of agriculture, water quality, disappearance of breeding pools and land habitat) are also much more decisive for these populations than fertilising deposits during the construction phase.

Meadow birds such as the black-tailed godwit and curlew can also occur as breeding birds in agricultural areas outside nature reserves.

Fertilising deposition during the exploitation phase is not a determining factor for these species during the breeding season. For these species too, other environmental pressures (intensification of agriculture, mowing) are much more decisive for these populations than temporary fertilising deposits.

In general, it can therefore be concluded that no impacts are expected on protected species outside nature reserves as a result of fertilising deposits during the exploitation phase.

The impact is therefore assessed as absent or negligible (0) for both the habitats and the species that occur therein.

11.4.2.5 Light pollution and visual disturbance

For safety reasons, it is necessary for the project area to be illuminated during the operational phase.

During the operational phase, few to no local light-sensitive species (bats) will be present in the project area (as there is no habitat). During the migration periods (spring, autumn), migratory bats may be present in the wider area. Night-migrating birds may also be present during the migration period. Migratory bats will avoid the illuminated areas, while some night-migrating birds may be attracted to light sources. Overall, this effect will be limited negative (-1).

As with the construction phase, however, it is recommended that the 'principles of good lighting' be applied. These are described in §11.11. If these principles are taken into account, no additional light pollution is expected in the vicinity of Galgenschoor and the Scheldt.

11.4.2.6 Ecotoxicological effects as a result of water and air emissions

Water emissions

During the operational phase, wastewater will be produced which, after treatment, will be discharged into the Scheldt at Galgenschoor via the same existing pipeline used to discharge Inovyn's wastewater.

No ecotoxicological effects on the biota present are expected, as all substances comply with the Wezer tool analysis in terms of concentration and mass volume and therefore no significant impact is expected (see Water discipline §9.2.4).

The effects of water emissions are therefore considered negligible (0).

Air emissions

For a detailed discussion of the expected air emissions, please refer to the Air section.

Project One's contribution to air pollution near the company site is around 1% of the environmental quality standards for SO_2, particulate matter and benzene and less than 1% of the environmental quality standards for CO. Consequently, no significant effects are to be expected.

NOx

One possible direct effect of NOx on plant growth is premature yellowing of leaves. Research shows that sensitive species are affected during the growing season at concentrations of 10-43 µg/m³. The annual average concentration of NOx required to avoid effects on most plants is 30 µg/m³ (WHO 2000). NOx is the combination of NO and NO_2; in the atmosphere, NO is converted into NO_2. Nitrogen dioxide is therefore also monitored by the VMM. Within the port area, the NO2 concentration is 21 to 30 µg/m³. Outside the port area, values of less than 21 µg/m³ are measured (see Air discipline).

In the immediate vicinity of the project area, NOx levels can be expected to rise slightly as a result of the project. However, there will no longer be any biologically valuable or vulnerable vegetation on and around the project site, so no effects are expected.

Outside the port area, too, the increase in annual average concentrations due to the new installations will be limited and the value will not exceed 30 µg/m³. Consequently, this will not lead to significant effects on vegetation in the surrounding area. The effect is assessed as negligible (0).

It should be noted that the indirect effects of NOx on vegetation through eutrophication and acidification (e.g. through the dominance of species adapted to nutrient-rich conditions) are greater than the direct effects of NOx on plants.

Volatile Organic Compounds (VOC)

There is little data available on ecotoxicological effects on fauna and flora.
of volatile organic compounds. Limited data is available for benzene. Acute lethal concentrations in experiments on laboratory animals or plants vary from several tens of mg/m³ to several hundreds of mg/m³, depending on the species and duration of exposure. Benzene can also have effects with prolonged exposure to low concentrations. A known effect is the impact of benzene on reproduction (WHO 2010). This has been demonstrated in laboratory animals (mice, rabbits).

There are no data available in the literature regarding the effects of chronic exposure.
of (avi)fauna to benzene. However, no significant acute or chronic effects are expected for fauna in the surrounding area, given the low concentrations. The concentrations in the immediate vicinity of the project area resulting from Project One's contribution are in the order of ng or µg/m³. At these concentrations, no acute effects are to be expected. However, limited negative effects cannot be ruled out for local resident birds in the immediate vicinity of the project area due to chronic exposure, where benzene concentrations are highest, and for species that permanently reside in the area. However, given the mobility of most bird species, this is the case for very few species and numbers. Compared to the higher background concentrations, Project One only has a limited contribution. The effect is assessed as negligible (0).

11.4.2.7 Light pollution and visual disturbance

Effects on fauna according to the available literature

For an overview of the literature on the effects of light pollution and visual disturbance on fauna, please refer to § 11.4.1.7.

This project

Operational phase

For safety reasons, it is necessary for the project area to be illuminated during the operational phase.

During the operational phase, few to no local light-sensitive species (bats) will be present in the project area (as there will no longer be any habitat). During the migration periods (spring, autumn), migratory bats may be present in the wider area. Night-migrating birds may also be present during the migration period. Migratory bats will avoid the illuminated areas, while some night-migrating birds may be attracted to light sources.

The distance between the illuminated installations and Galgenschoor is sufficiently large, with the Scheldt dyke forming a buffer between them, and light pollution will not occur at Galgenschoor.

The project is located between existing industrial chemical installations in the area and fits in with these. The project does not constitute an isolated point in a dark landscape to which organisms may be attracted. In general, the light pollution effect will therefore be limited negative (-1).

As with the construction phase, however, it is recommended that the 'principles of good lighting' be applied. These are described in §11.11. If these principles are taken into account, no additional light pollution is expected in the surrounding area.

11.6 Cumulative effects

11.6.1 Quay wall

The Antwerp Port Authority has built a new quay wall along the canal dock, partly during the construction phase of this project. This is the project 'New quay wall Canal Dock B2 (K631-639) – Insteekdok (K629)'. The project zone for this project was undeveloped and bordered the Project One project area. In this project, a new quay wall was built, approximately 60 metres inland at the Insteekdok and approximately 80 metres inland at the Canal Dock B2.

Possible cumulative effects during the construction phase of the quay and Project One (in particular the removal of vegetation, possibly the rest of the construction phase) from the perspective of biodiversity are as follows:

- space occupation (loss of ecotope and biotope);
- noise disturbance;
- air emissions.

This zone consisted of biologically valuable scrub and pioneer vegetation, with a limited forest area, similar to the project area for Project One. The implementation of this project resulted in the disappearance of these ecotopes, along with the disappearance of the valuable biotopes in the Project One project area. This also eliminated the potential corridor and refuge function of this remaining zone along the Canal Dock.

In terms of **space requirements**, each project (quay and Project One) provides for its own forest compensation and nature restoration for the loss of vegetation that is prohibited from being altered. With regard to the loss of sea buckthorn scrub, nature restoration is being carried out as part of Project One in collaboration with the Port of Antwerp. The nature restoration that the Antwerp Port Authority must carry out for the loss of sea buckthorn scrub for the construction of the quay will be carried out on the same plot of land where the nature restoration for the preparatory works for Project One is being carried out (albeit with a different timetable). This will create a larger contiguous area of new scrub, which can be considered positive in terms of ecological functioning. The additional effects of the quay wall project in terms of space occupation are limited. Overall, the cumulative effects of Project One and the quay wall are considered to be significantly negative (-3), partly due to the fact that the effects of Project One in terms of space occupation are assessed as significantly negative (-3).

Particularly during the construction phase on the eastern side of the southern part of Project One, there may be a certain cumulative effect in terms of **noise disturbance**. The planned works in the north of the Project One project area will have a negligible cumulative effect, due to the distance from the quay wall project area. With regard to the possible impact on the Galgenschoor Natura 2000 area, no cumulative effects are expected with regard to the conservation objectives and natural characteristics of the SBZ-H, as the quay is located at a considerable distance from Galgenschoor and will only contribute very little to noise levels. Furthermore, this is not expected to lead to drastic increases in noise levels above 45 dBA. The noise disturbance at Galgenschoor mainly originates from the works close to Galgenschoor, on the western side of the project area.

The **emissions to air** for the construction of the quay are limited in scope. The cumulative effect is therefore also limited. The period of overlap between the works on the quay wall and the works in the present project is limited in time. No significant effects are expected with regard to the vulnerable Natura 2000 areas located in the most common wind direction, such as the Kalmthoutse heath.

11.7 Development scenarios

11.7.1 ECA

For a description of the Complex Project "Realisation of additional container handling capacity in the Antwerp Port Area" (abbreviated to ECA), please refer to section 5.5.1.

The realisation of the complex ECA project would result in additional NOx emissions due to the extra seagoing vessels, container handling, road traffic, inland shipping and rail traffic. According to the strategic EIA for ECA (dated 27/09/2019), the total expected worst-case emissions for all sub-projects of the preferred alternative are in the order of 1,407 tonnes of NOx/year. These emissions occur in a number of zones spread across the port area, on both the left and right banks of the Scheldt. If the proposed mitigation measures are implemented, emissions can be halved. The implementation of the mitigation measures mentioned in the strategic EIA for the ECA project is currently being further investigated in the elaboration phase and will be finalised when applying for permits for the sub-projects of the complex project.

Project One will result in additional NOx emissions in the order of 167 tonnes NOx/year, which is significantly lower than the additional emissions expected from the realisation of ECA (in the order of 1,407 tonnes NOx/year for the preferred alternative for the entire ECA project).

Based on the data currently available (only a strategic EIA is available), it is not useful to assess where and how these cumulative effects would occur. Such calculations are made during the permit procedures for the specific sub-projects of ECA.

11.8 Stricter nature assessment

For the stricter nature assessment, please refer to the separate document in Appendix 10.1.

11.9 Appropriate assessment Natura 2000 and assessment against Annex IV species of the Habitats Directive (Flanders)

For the Appropriate Assessment (Flanders), please refer to the separate document in Appendix 10.2.

11.10 Appropriate Assessment Natura 2000 and assessment against Annex IV species of the Habitats Directive (Netherlands)

For the Appropriate Assessment (Netherlands), please refer to the separate document in Appendix 10.3.

11.11 Mitigation measures and restoration measures

Given that the project will have a significant negative impact in terms of habitat and ecotope loss, fragmentation and barrier effects within the discipline of biodiversity, various mitigating, compensatory and restoration measures apply.

The compensatory measures relate solely to forest compensation. Compensatory measures within the framework of Article 36ter of the Nature Decree, which are linked to the impact on European protected habitats and species, are not relevant here.

Throughout the project, all mitigating measures have already been integrated into the project and will therefore be implemented by the initiator in any case. By applying these project-integrated measures, the significant negative effects can be mitigated.

Only in terms of ecotope and biotope loss does a significant effect remain, mainly at the local level, due to the fact that a contiguous area of ecological value is permanently disappearing. Below is a summary of the various measures that contribute significantly to mitigating certain aspects, such as the impact on species.

In Project One, BBT is applied in the furnace technology and boilers, as well as SCR NOx reduction on the chimneys.

11.11.1 Construction phase

11.11.1.1 Occurrence of protected species during the works

During vegetation removal, a security company checked whether birds had settled in the remaining areas where vegetation still needed to be removed, or on the already deforested areas (e.g. ground-nesting birds such as the little ringed plover).

As soon as the work commenced (actually prior to the breeding season), additional measures were taken by playing deterrent sounds (birds of prey) on the sites to prevent birds from settling and breeding, both on the sites still to be deforested and on the deforested sites. Care was taken to ensure that there was no disturbance in the direction of Galgenschoor. However, vegetation removal systematically progressed from west to east. By the main breeding season (April-May), the work was already well advanced and the deterrent sounds were located at a considerable distance from Galgenschoor. Where necessary, the volume of the noise was adjusted if it appeared to be having an effect on Galgenschoor.

In the case of temporary soil storage, care will be taken to ensure that it is unsuitable as a breeding habitat for cavity-nesting species such as the sand martin. In other words, vertical walls will be avoided.

Project One will set up a single ground stock in such a way that sand martins can breed on the site. This ground stock will be placed in a location that is not necessary for further levelling work. In this way, a temporary breeding site for sand martins will be provided. As far as possible, we will also examine whether this breeding site can be maintained in the long term.

Avoiding vertical walls is a necessary mitigation measure that has already been incorporated into the project.

11.11.1.2 Legally required forest compensation

The project resulted in the loss of approximately 39.31 hectares of forest, of which 14.245 hectares were older than 22 years. As mentioned above, taking into account a compensation factor of 2, this requires forest compensation of 28.489 hectares.

The forest compensation forms contain all the detailed information regarding the forest compensation and are attached to the permit application.

Deforestation has already been fully implemented (2022) and was licensed, including forest compensation.

➔This is a legally required compensatory measure.

11.11.1.3 Measures against colonisation Japanese knotweed

Japanese knotweed is a perennial plant with hollow, woody stems that can grow into dense clusters every spring. The dense shrubs displace native species and can grow strongly underground, damaging infrastructure. This species is therefore highly undesirable.

Japanese knotweed is not currently present in either project area.

To prevent Japanese knotweed from being introduced when soil is brought in, strict instructions will be included in the specifications for contractors that soil from land infested with Japanese knotweed must not be brought in under any circumstances.

➔This is a necessary mitigating measure, which has already been integrated into the project.

11.11.1.4 Measures for Annex I (category 2) bird species of the Species Decree

Several birds listed in Annex I, category 2, of the Species Decree have been observed within the project area. The habitat of these species is not protected under the Species Decree. The works were carried out outside the breeding season and therefore no prohibited actions were taken. To mitigate the impact on these species, a number of restoration measures are proposed.

With regard to birds, it should be noted that the works were started before the breeding season and continued without interruption. Consequently, there was no deliberate disturbance, and breeding birds will no longer be present. No exemption from the Species Decree was therefore requested for birds.

For most of these species, new habitat will be created at the location where 3 hectares of mixed (thorn) scrub will be planted (see § 11.4.1.3) and at the forest compensation areas. A number of species may remain partially in place after completion of the project (e.g. black redstart, oystercatcher). In addition, a number of species-specific restoration measures are explained in more detail below. Overall, sufficient habitat will be created to accommodate these species.

Table 11-17: Measures for Annex I (category 2) bird species of the Species Decree

Species	Protection status Species Decree	Impacted population	Status in port area 2017 (SBP monitoring)	Mitigation and restoration measures
Sand martin (*Riparia riparia*)	AppendixI(cat2),	Small population (to be determined)	1814 breeding pairs	Mitigating measures to prevent settlement during the works (site monitoring, no steep walls) Provided with one ground stock as a possible breeding location
Meadow pipit (*Anthus pratensis*)	Appendix I (cat. 2),	2 territories 2019 5 territories 2020 3 territories 2021	19 breeding pairs (2017) 15 breeding pairs (2018)	Restoration measures see poor grassland
Great spotted woodpecker (*Dendrocoposmajor*)	Annex I (cat. 2)	2 breeding pairs (2020)	Unknown	This species will move to another location. No recovery measures needed
Tree lark(*Lullula arborea*)	Appendix I (cat. 2)	1 territory (2021)	Unknown	This species will move to another location. No restoration measures required
Tree Pipit (*Anthus trivialis*)	Appendix I, (cat. 2)	9 territories 2019 5 territories 2020 7 territories 2021	Unknown	The tree pipit is a species that occurs in heathlands, dunes with scrub, clearings, young plantations and copses in agricultural areas. This species can migrate to heathlands and poor grasslands in and around the harbour. Additional restoration measures are therefore not necessary.
Common shelduck (*Tadorna tadorna*)	Annex I (cat 2)	1 pair (2019 and 2020), outside the project zone Courting pairs, no breeding certainty (2021)	80 breeding pairs	Mitigating measures to prevent settlement during the works: closing rabbit burrows. Installation of nesting boxes in the Scheldt dyke to attract breeding birds.

Species	Protection status Species Decree	Impacted population	Status in port area 2017 (SBP monitoring)	Mitigation and restoration measures
Buzzard (*Buteo buteo*)	Annex I (cat 2)	1 territory 2019 3 territories 2020 2 territories 2021	Not available	Buzzards have several nests that they use alternately. This species may move to another location in the harbour. No recovery measures needed
Lesser whitethroat (Sylvia curruca)	AppendixI(cat2)	1territory2019	Notavailable	This species can move to another location in the harbour. No recovery measures required
Canada goose (*Branta canadensis*)	AppendixI(cat2,cat4)	3 breeding pairs in 2020 3 breeding pairs 2021	Notknown	This species may move to another location in the harbour. Exotic No recovery measures required
Magpie (*Pica pica*)	Appendix I (cat 2, cat 3)	6 occupied or unoccupied nests 2021	Notknown	This species can move to another location in the port. No restoration measures required
Pheasant (Phasianus colchicus)	Annex I (cat 2, cat 4)	6 territories	Not known	This species may relocate to another location in the harbour. No recovery measures required
Greygoose(*Anser anser*)	Annex I (cat 2, cat 4)	1 breeding pair 2020	Unknown	This species can move to another location in the harbour. No restoration measures required
Great Tit (*Parus major*)	Annex I (cat. 2)	Common in the project area 4 territories 2021	Unknown	New habitat for this species in the restored scrub and the forest compensation areas.
Blackbird (*Turdus merula*)	Appendix I (cat. 2)	6 territories 2020 1 territory 2021	Notknown	This species may move to another location in the harbour. No recovery measures required
Blue tit (*Parus caeruleus*)	Appendix I (cat. 2)	Generalinthe project area	Notknown	New habitat for this species in the restored scrub and forest compensation areas.

Species	Protection status Species Decree	Impacted population	Status in port area 2017 (SBP monitoring)	Mitigation and restoration measures
		9 territories 2021		
Goldfinch (*Carduelis carduelis*)	AppendixI(cat.2)	1territory2021	Notknown	New habitat for this species in the restored scrub and forest compensation areas.
Long-tailed tit (Aegithalos caudatus)	AppendixI(cat.2)	4 territories 2020 5 territories 2021	Notknown	New habitat for this species in the restored scrub and forest compensation areas.
Chiffchaff (*Phylloscopus collybita*)	Annex I (cat. 2)	Common in the project area 42 territories 2020 19 territories 2021	(Unknown)	New habitat for this species in the restored scrubland and forest compensation areas.
Garden Warbler (*Sylvia borin*)	Annex I (cat. 2)	2territories2020 3 territories 2021	Notknown	New habitat for this species in the restored scrub and forest compensation areas.
Robin (*Erithacus rubecula*)	AppendixI(cat.2)	Common in the project area 12 territories 2021	Unknown	New habitat for this species in the restored scrubland and forest compensation areas.
Wren (*Troglodytes troglodytes*)	Appendix I (cat. 2)	Generalinthe project area	Notknown	New habitat for this species in the restored scrubland and forest compensation areas.
Nightingale (*Luscinia megarhynchos*)	AppendixI(cat.2)	5 territories 2019 5 territories 2020 5 territories 2021	Unknown	The nightingale is characteristic of shrub vegetation and sea buckthorn vegetation. The 3 hectares of sea buckthorn vegetation that will disappear will be replanted at another location in the harbour in combination with other shrub species as part of nature restoration efforts. Additional restoration measures are therefore not necessary.
Willow warbler (*Phylloscopus trochilus*)	AppendixI,cat.2	65 territories 2020 35 territories 2021	Unknown	Willow Warbler is characteristic of dry to moist semi-open landscapes: heathland, forest and agricultural areas. This species can retreat to planted scrub and surrounding areas.

Species	Protection status Species Decree	Impacted population	Status in port area 2017 (SBP monitoring)	Mitigation and restoration measures
				Additional recovery measures are therefore not necessary.
Lapwing (*Vanellus vanellus*)	Annex I cat 2, cat 4	1 territory 2019 12 territories 2020 7 territories 2021	Not available	This species will move to another location in the port. No restoration measures are necessary.
Oystercatcher (*Haematopus ostralegus*)	Annex I cat 2	1 territory 2019 3 territories 2020 3 territories 2021	Not available	This species regularly breeds in the port on roofs and lawns between the companies. Once the work has been completed, this species may move elsewhere or remain in situ.
Chaffinch (*Fringilla coelebs*)	Annex I cat 2	13territories2020 13 territories 2021	Notavailable	New habitat for this species in the restored scrubland and forest compensation areas.
Gadwall (Anas strepera)	Annex I cat 2, cat 4	1territory2020 1 territory 2021	Notavailable	This species may migrate to neighbouring areas (opposite side of the Canal Dock).
Garden Warbler (*Sylvia communis*)	AppendixIcat2	4 territories 2020 5 territories 2021	Notavailable	This species is characteristic of dense thorny scrub and can find a new habitat in the newly restored scrub.
Wood pigeon (*Columbo palumbus*)	Appendix I cat 2, cat 4	10 territories 2020	Not available	This species can find new habitat in the forest compensation areas.
Redstart (*Phoenicurus phoenicurus*)	Appendix I cat 2	1 territory 2020	Not available	This species can find new habitat in the forest compensation areas.
Cuckoo (*Cuculus canorus*)	AppendixIcat.2	1territory2020	Notavailable	This species can find new habitat in the forest compensation areas and near the constructed scrub.
Song thrush (*Turdus philomenos*)	AppendixIcat.2	1 territory 2020 3 territories 2021	Notavailable	This species can find new habitat in the forest compensation areas and near the constructed scrub.

Species	Protection status Species Decree	Impacted population	Status in port area 2017 (SBP monitoring)	Mitigation and restoration measures
Reed warbler (*Acrocephalus scirpaceus*)	Annex I cat. 2	1 territory 2020	Not available	This species may move to another location in the harbour. No recovery measures required

Lapwing

In 2020, 12 breeding pairs of lapwings were identified in the project area. Lapwings are not subject to compensation and can easily move to the surrounding area, for example to the zone near the Zandvliet-Berendrechtsluis lock or elsewhere. A number of grassland plots with a total area of 2.61 hectares are currently available at the Berendrechtsluis. These plots are extensively managed by the Antwerp Port Authority (mowed twice a year, with the first mowing at the end of June and the second in September). Oystercatchers are already breeding on these plots. The location of these plots is shown on the map below.

Figure 11-53: Example of suitable plots for lapwings. Green: Ecological Infrastructure Port of Antwerp. Blue: Grassland suitable for lapwings.

Sand martin

During the works, measures will be taken (no steep walls, sloping walls, possibly covering steep walls) to prevent sand martins from nesting on the ground piles that are necessary for the preparatory works. A ground pile will be retained as a possible nesting site.
Furthermore, there are sufficient alternative habitats for this species within the ecological infrastructure of the Port of Antwerp.

Meadow pipit

In 2019, several singing posts of this species were observed on sites 2, 3 and 4. During a follow-up visit on 6 June 2019, one singing post was again observed on site 4, which makes it clear that this is a permanent territory. Along the quay on site 3, one specimen was sounding the alarm, indicating a nest nearby. No meadow pipits were found on site 2.

On 8 July 2019, several meadow pipits were observed on site 1. At least two of these were young birds that hatched this year, which strongly suggests that there was also a breeding case here.

In 2020 and 2021, several territories were observed.

After occupying the site, the meadow pipit will seek out other areas with open spaces, e.g. the area around the tufted duck - marshalling yard. There are still sufficient alternative sites available in the wider vicinity of the project area. The measures described for pioneer vegetation with characteristics of poor grassland will also ensure the creation of new habitats for the meadow pipit. Consequently, no additional specific restoration measures for this species are included.

Buzzard

At least one pair of buzzards breeds in the northern part of the project area. In 2019, there was one territory, in 2020 three territories were identified and in 2021 two territories, with indications of two breeding pairs on the site and one just outside it. To prevent the buzzards from nesting, the trees will be removed first (manually if necessary).

Usually, there are two or three nests in a territory, which change in use over the years. Buzzards are largely loyal to nests from previous years, especially if they have been successful. The nest is then expanded further and further until, after several years of use, it becomes unsuitable due to the presence of parasites, mites, lice flies and ticks (BIJ12, 2017). An existing buzzard's nest cannot therefore continue to function as a nest forever. Buzzards appear to be capable of building their own nests if necessary, but they prefer to use the foundations of old nests of other birds, such as crows' nests and nests of the grey heron, in their territory and then rebuild them. Providing artificial nesting sites is often not an option because buzzards generally do not use them (BIJ12, 2017).

After vegetation removal, this species can find another nesting site in the area, for example in the Reigersbos. Consequently, no additional specific recovery measures for this species will be included.

11.11.1.5 Restoration measures within the framework of the Species Decree

In order to mitigate the impact on Annex I category 1 species of the Species Decree, a series of restoration measures will be implemented. To this end, a derogation will be requested under the Flemish Government's decree of 15 May 2009 on species protection and species management.

These measures are imposed as mitigating measures in the project EIA.

The various species for which a derogation is requested are listed in the table below.

Table 11-18: Recovery measures for protected plant and animal species

Species	Protection status	Impacted population	Status in port area 2017 (SBP monitoring)	Nature restoration measures
Bee orchid (*Ophrys apifera*)	Appendix I cat 1 Species Decree, (all species of orchids: all species except those specifically mentioned by species name in this appendix)	2019: Minimum 107 specimens 2020: 1 specimen (growing site has been largely relocated). 2021: a few specimens remaining	12 growth sites, 516 specimens	The majority of the population has already been relocated as part of the quay wall project. Nature restoration through translocation of the remaining specimens.
Large bee orchid (*Neottia ovata*)	Appendix I cat 1 Species Decree (all species of orchids: all species except those specifically mentioned by species name in this appendix)	Minimum 615 specimens	Notavailable	Nature restoration through translocation

Species	Protection status	Impacted population	Status in port area 2017 (SBP monitoring)	Nature restoration measures
Genuine reindeer moss (*Cladonia rangiferina*)	Appendix I cat 1 Species Decree (Cladiona spp. subgen. Cladina)	Not observed in the field. Uncertain occurrence. However, other Cladonia spp. are definitely present.	Not available	No restoration measures required
(*Oedipoda caerulescens*)	Annex I cat 1 Species Decree	A few observations		No restoration measures required. This species can continue to develop on the 36 hectares of poor grassland that will be developed in the harbour.
Truecentaury (*Centaurium erythraea*)	Appendix I cat 1 Species Decree,	Size: thousands	Frequent and widespread in harbour (not specified)	No recovery measures required
Natterjack toad (*Epidalea calamita*)	Appendix I cat 3 Species Decree	1 breeding location		Construction of a suitable breeding water and adjacent land habitat in the ecological infrastructure of the Port of Antwerp and on the site's own land in the administrative zone along Scheldelaan (deepened wadis)

Bee orchid

A population of bee orchids occurs in the project area (minimum 107 specimens in 2019, 1 specimen in 2020). Dry climatic conditions are likely to be the reason for this low number in 2020.
Rabbit damage may also be a factor. However, bee orchids can survive underground in unfavourable conditions. Most of the specimens in the population were found on the side of the Canal Dock and have already been relocated as part of the quay wall project of the Antwerp Port Authority.

The remaining specimens on site 4 (see below) will be relocated.

The translocation will be carried out by mechanically removing the entire known growing site (remaining specimens on site 4) with a large sod. As part of nature restoration, the existing bee orchid population will be translocated within the Antwerp Port Area. The translocation will take place at two locations. There are two possibilities in the immediate vicinity: translocation to a residual strip along the canal dock and translocation to an existing population along Scheldelaan.

Figure 11-54: Overview of the bee orchids found on site 3. These have already been relocated.

Figure 11-55: Overview of the bee orchids found on site 4.

The remaining population of bee orchids will be transplanted between November 2022 and February 2023 to the growing site in EIN095 along Scheldelaan (see shaded blocks in Figure 11-56). The other half will be transplanted during the same period to area 1 on the future INEOS site. This will ensure that the species is kept on the site itself as much as possible.

The excavation is carried out using a sliding tray on a crane arm, so that the orchids are transported to their new growing location at a depth of up to 40 cm, together with their soil structure, rhizomes and associated fungi (mycorrhiza).

Since bee orchids are not easy to transplant successfully, seeds will also be collected (if available) in order to spread the species to the above-mentioned areas.

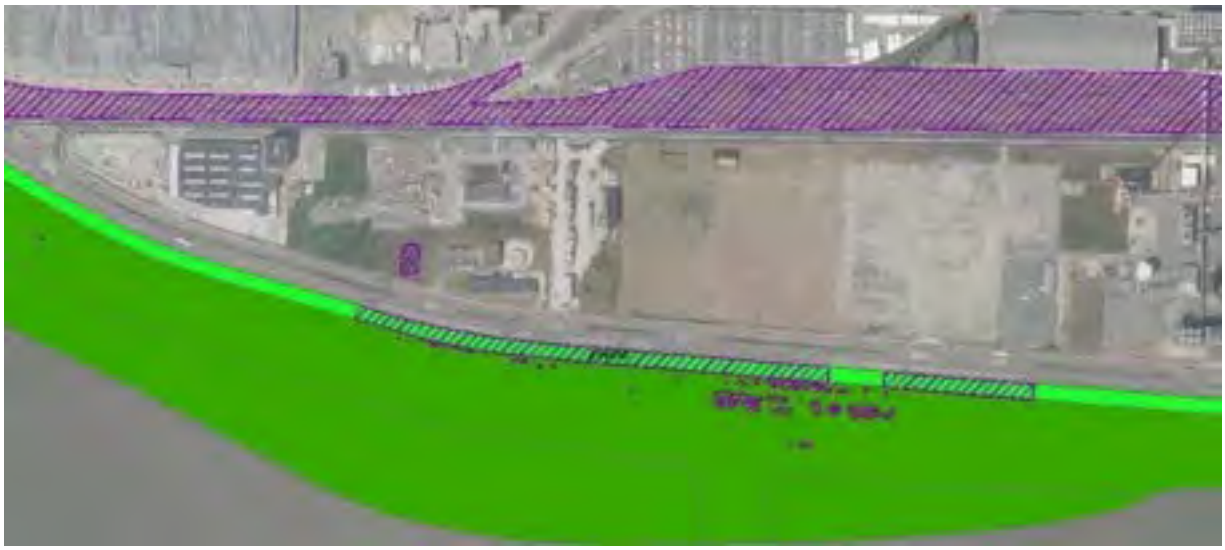

Figure 11-56: Location of translocation half location Bee orchid

Large beetle orchid

A population of Greater butterfly orchids is present in the project area (at least 615 specimens in 2019, 399 specimens in 2020). Here too, the dry climatic conditions are probably the reason for this decline. As a recovery measure, the entire area where the orchid species was observed in 2019 will be translocated. In this way, the 'dormant individuals' will also be translocated.

The translocation is planned to the locations 'Ekers moeras' and 'Wit bosvogeltje'.

The plants will be translocated to this zone. Excavation will be carried out using a sliding bucket on a crane arm, so that the orchids, together with their soil structure, rhizomes and associated fungi, can be transported to their new growing site at a depth of up to 40 cm.

Figure 11-57: Locations (green areas) for translocation of the greater butterfly orchid at the locations 'Ekers moeras' (top figure) and 'Wit bosvogeltje' (bottom figure)

Blue-winged grasshopper

Several specimens of the blue-winged grasshopper were observed in the project area. This species occurs in open areas with bare soil or pioneer vegetation. It is difficult to take measures for this species, except for providing suitable habitat. The species already occurs here and there in the ecological infrastructure (e.g. the Zouten EIN028/029), but also on industrial sites and along railway lines. Provided that the open areas on the site are managed ecologically, there is a real chance that this species will continue to occur on the site after development.

In addition, a number of targeted measures will be taken, within the existing ecological infrastructure of the port or in new areas as an extension of the ecological infrastructure, to strengthen the habitat of this species and other grassland species.

In the relatively short term, a total area of 36.25 hectares will be created by converting existing, less valuable vegetation into ecologically valuable poor vegetation. In mutual consultation between the port authority and the initiator, it was agreed that the port authority would additionally manage 7 hectares of grassland ecologically throughout the Port of Antwerp. An overview of the cadastral parcels, owners and commitment statement will be added to the environmental permit. These approximately 7 hectares concern an area along the Scheldelaan, which contributes to a robust network of poor grasslands and the communities that live there. In addition, ecological management will of course continue to be carried out on the remaining parcels on both the left and right banks.

This transformation is achieved through the following targeted management measures:

- sheep grazing (+2.95 hectares);
- mowing management of pioneer vegetation (+1.3 hectares);
- management of new ecological infrastructure (+6.92 hectares);
- intensive mowing management of nutrient-rich grasslands (+19.75 hectares);
- scraping of nutrient-rich topsoil (+5.33 hectares).

The areas eligible for this are: Grote Kreek, Kuifeend railway zone, Zouten-Stocatradijk, Groot Buitenschoor, Scheldelaan, Sigmadijk. The maps below show the locations for this restoration and expansion of nutrient-poor grassland.

Additional measures are therefore being taken to mitigate the loss of rough grassland, on the one hand by implementing targeted management measures in the existing ecological infrastructure network (approx. 30 ha) and, on the other hand, by expanding the existing ecological infrastructure network with a robust 7-hectare zone along Scheldelaan, in the immediate vicinity of the project area, which will also be managed ecologically.

Thousand-guilder herb

True centaury is found in various locations within the project area. True centaury is a locally common species (Red List status: 'currently not threatened') that is found in several locations in the port area (Baetens et al., 2015). On 8 July 2019, several specimens of the species were found in the north-east of the project area (Area 1), confirming its presence here.

In the context of nature restoration, it can be assumed that in open areas between the new installations, centaury will spontaneously return and spread.

In addition, targeted measures will be taken to strengthen the network of growth sites for this species and other grassland species by, on the one hand, implementing targeted management measures in the existing ecological infrastructure network (approx. 30 ha) and, on the other hand, by expanding the existing ecological infrastructure network with a robust 7-hectare zone along Scheldelaan, in the immediate vicinity of the project area, which will also be managed ecologically (see Blue-winged Grasshopper).

Reindeer mosses (Cladonia)

There are no Cladonia species belonging to the protected group of true reindeer moss (Annex I species decree).

Translocations of Cladonia during developments are not necessary and have little effect. In order to preserve Cladonia species, it can also be ensured that, in future developments, sufficient suitable habitat is available in the fallow zones between the installations.

It is proposed to provide development opportunities for this species on the current sites. Opportunities for Cladonia vegetation can be provided in open areas between future installations (e.g. under flares, pipeline corridors). To this end, the same substrate (calcareous, nutrient-poor sand) as currently present on the site should be provided.

It is expected that, with proper management (no trespassing, keeping vegetation open), these lichen vegetations can be preserved on the site. In addition, there are also alternative locations for this type of vegetation on the Haazop sites on the left bank, which are part of the ecological port infrastructure.

Natterjack toad

The current breeding site consists of a small canal that floods slightly during heavy rainfall, forming a temporary, very shallow pool. After a few days of dry weather, this pool dries up and only the canal remains as potential breeding water. The canal also has limited water retention, which means that the chance of larvae developing into young toads is very small. In addition, the immediate surroundings of the ditch are becoming heavily wooded, which will cause both the ditch and the temporary pool to be shaded. The current breeding water is not optimal and will disappear in the very short term due to increasing woodland growth, even if the project is not implemented. The implementation of the measures below is therefore also necessary for the survival of the local population.

As a remedial measure, adult specimens and any larvae found on the site will be relocated. To this end, the breeding water will be made inaccessible for the breeding period (before the end of March). This can be achieved by installing screens made of sturdy plastic or root cloth, 50 centimetres high and buried at least 10 centimetres into the ground. These screens will be checked regularly for gaps and overhanging vegetation. The natterjack toads present will be removed using a time-consuming process based on three methods:

- Along the outside of the screens that shield the breeding water, buckets are dug into the ground to catch animals that are heading towards the breeding water. The buckets must be emptied daily.
- In the wider area around the breeding water, trapping sessions are organised in the evening, during which torches are used to search for adult specimens.
- Amphibian boards are placed near the breeding water, under which natterjack toads can hide. This allows for targeted searches and more efficient collection of adult specimens.

The best period for this is from March to May, before the eggs are laid. The captured specimens must be moved to a suitable habitat as quickly as possible. At the end of the breeding season, the pool and water-filled ditch are checked for larvae. Any larvae found are transferred to a suitable habitat.

Natterjack toads and larvae found in the project area will be relocated to another site in the port area (Muisbroek), where the species will enjoy long-term protection. This will be done in agreement with the Antwerp Port Authority. In addition, Project One plans to create a number of potential habitat locations in the form of deepened WADIs in the administrative zone along Scheldelaan.

11.11.1.6 Restoration measures in the context of the ban on vegetation modification

Restoration measures will be taken to compensate for the loss of sea buckthorn scrub and reed vegetation. The reed vegetation will be restored on site. To compensate for the loss of 1.07 hectares of pure, free-standing sea buckthorn scrub, nature restoration will be carried out, involving the planting of 3 hectares of thorn scrub in the port of Antwerp.

Sea buckthorn scrub

As part of 'Project One', 3 ha of sea buckthorn scrub will be cleared (approx. 1.93 ha as undergrowth in forest and approx. 1.07 hectares of clean and detached land). Sea buckthorn will be cleared together with the surrounding forest.

Sea buckthorn scrub in the Port of Antwerp often forms monotonous vegetation that is of little ecological interest. Moreover, sea buckthorn is not typical of the port area and originally comes from plantations.

The restoration measure for the sea buckthorn scrub consists of replanting a diverse scrub with native species, which will form a more ecologically interesting vegetation for many species (e.g. nightingale).

Three hectares of native and mixed thorny scrub will be planted, consisting of hawthorn, wild privet, dog rose, wild rose, dune rose, creeping willow and blackthorn. The native (thorny) scrub provides much more biodiversity than the current vegetation or the planting of sea buckthorn alone. The area where the planting will take place is the cadastral parcel known as Antwerp, division 20, section A, number 1D2. This zone is part of the Flemish Ecological Network, which means that a VEN exemption is being requested for this activity.

The location of the plot is indicated, along with several photographs (Figure 11-59) of the area where planting will take place.

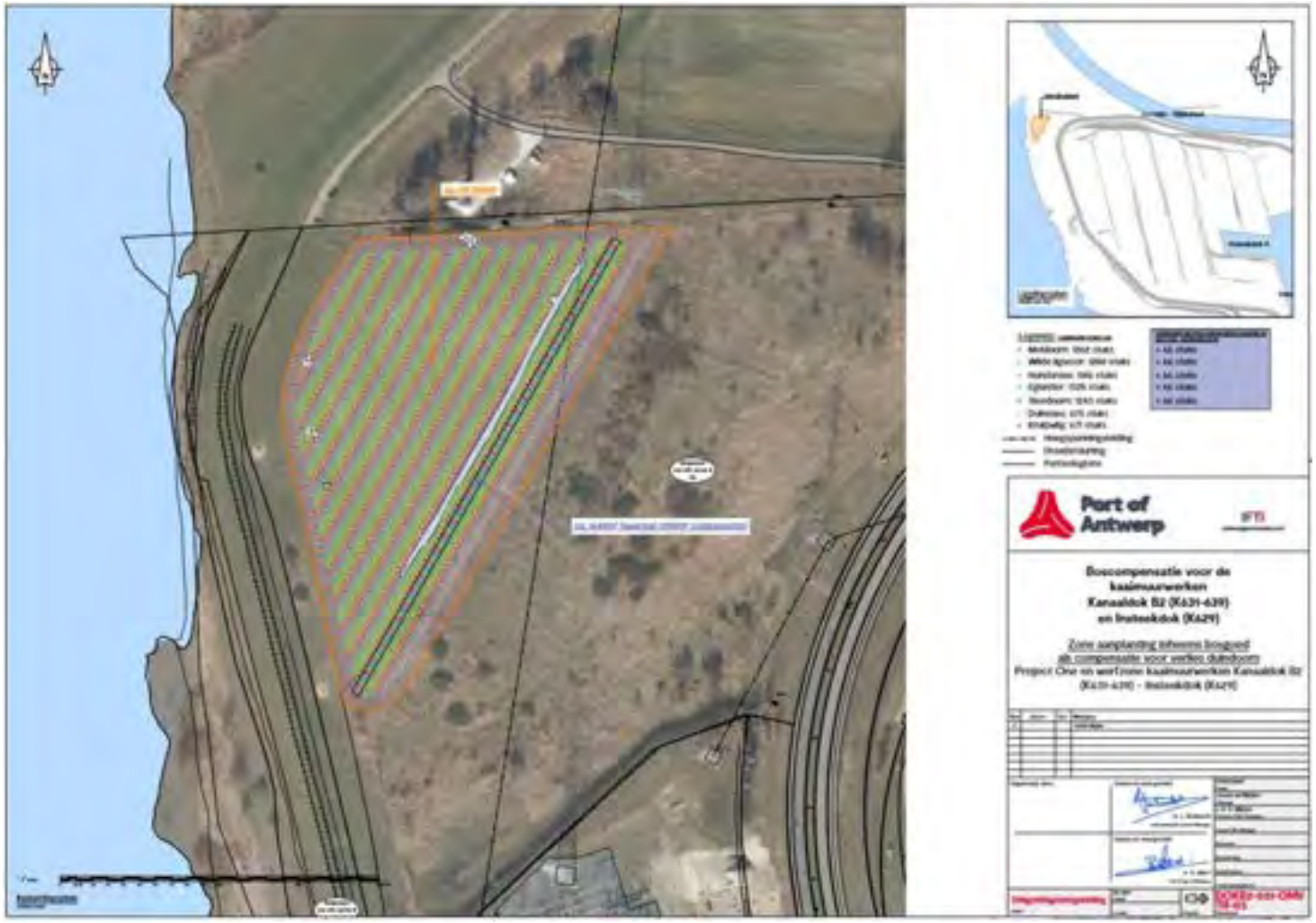

Figure 11-58: Location of the area for nature restoration Sea buckthorn thicket

A large part of the area where the scrub is being restored is currently characterised by very rough vegetation. Here, large areas of stinging nettle (*Urtica dioica*), dune reed (*Calamagrostis epigejos*), hairy willowherb (*Epilobium hirsutum*) and blackberry (*Rubus spec*.), interspersed with quite a lot of tansy (*Tanacetum vulgare*), hedge bindweed (*Convolvulus sepium*) and hemp agrimony (*Eupatorium cannabinum*). There was relatively little variation observed in this zone, which means that its value can be considered fairly low.

Along the edges (mainly the south-eastern edge, along the northern part of EIN023) of this scrubland, there was a fairly large area occupied by more open and less scrubby vegetation. However, there was also little variation here, mainly due to the high dominance of sea grass (*Elytrigia atherica*).

On the western edge of the area, there was still a fairly small zone with very sparse vegetation, adjacent to similar vegetation in the EIN. Here, mainly species of sparse sandy soil were found, such as sheep's sorrel (*Rumex acetosella*), early oatgrass (*Aira praecox*), silver oatgrass (*Aira caryophyllea*), common cat's ear (*Hypochaeris radicata*), common sandwort (*Arenaria serpyllifolia*) and broom (*Cytisus scoparius*). This zone can be considered valuable. The zone in which this vegetation (outside the EIN) was found is shown in Figure 11-60 below.

Figure 11-59: Photographs of areas for nature restoration of sea buckthorn scrub

Figure 11-60: Area to be preserved with valuable poor vegetation

This is a legally required restoration measure.

Reed vegetation

Approximately 0.083 hectares of reed vegetation will disappear as part of 'Project One'. An exemption has been requested for the loss of this vegetation.
derogation will be requested for the loss of this vegetation.

As part of nature restoration efforts, attempts will be made to preserve the reed vegetation on the site as much as possible. If this proves impossible, an area will be set aside on the site for spontaneous reed growth or planting. This is possible at two locations:

1. Along the Kanaaldok there is a strip of land that is not built on. This area could be made suitable for reed development (construction of a canal). This area covers approximately 900 m (0.09 ha). This is shown in the figure below.

Figure 11-61 Possible location for reed development (yellow)

2. Near the wadis at the administrative building. From an ecological point of view, the preference is to allowing spontaneous reed development.

Figure 11-62: Location of the wadis (blue) near the administrative building: opportunities for reed development.

11.11.1.7 Restoration measures for the loss of pioneer vegetation with characteristics of poor grassland

As part of 'Project One', approximately 36.25 hectares of pioneer vegetation (ku*) with characteristics of dry poor grassland will disappear, in combination with dune reed vegetation, open spaces, etc. This area does not form a contiguous whole, but is spread almost equally across both parts of the project area.

Since the required 224 hectares of poor grassland that must be created as part of the Antwerp Port Species Protection Programme is not yet available, a number of targeted measures will be taken within the port's existing ecological infrastructure or in new areas as an extension of the ecological infrastructure, as part of measures within the Antwerp Port SBP (Port of Antwerp). To this end, the Antwerp Port Authority has drawn up a statement of commitment, which is included in Appendix 7.7.

This will create a total area of 36.25 hectares by converting existing, less valuable vegetation into ecologically valuable poor vegetation. An overview of the cadastral parcels, owners and commitment statement will also be added to the environmental permit. In mutual consultation between the port authority and the initiator, it was agreed that the port authority would additionally manage 7 hectares of grassland ecologically throughout the port of Antwerp. These 7 hectares concern an area along the Scheldelaan, which contributes to a robust network of poor grasslands and the communities that live there. In addition, ecological management will of course continue to be carried out on the remaining plots on both the left and right banks.

This transformation will be achieved through the following targeted management measures, which will be enshrined in the Port of Antwerp's Species Protection Programme 2.0:

- sheep grazing (+2.95 hectares)
- mowing management of pioneer vegetation (+1.3 hectares)
- management of new ecological infrastructure (+6.92 hectares)
- intensive mowing management of nutrient-rich grasslands (+19.75 hectares)
- scraping of nutrient-rich topsoil (+5.33 hectares).

The areas eligible for this are: Grote Kreek, Kuifeend railway zone, Zouten – Stocatradijk, Groot Buitenschoor, Scheldelaan, Sigmadijk. The maps below show the locations for this restoration and expansion of nutrient-poor grassland.

Figure 11-63: Locations where poor grassland will be created in the port area on the right bank (yellow colour).

11.11.1.8 Ecological management of pipeline corridor

To mitigate the fragmentation and barrier effect, the strip of land located in the southern part and owned by the Port of Antwerp will be managed ecologically so that it can maintain and strengthen its function as an ecological connection.

To the north of the project area, a large area of habitats remains that can be preserved as a corridor.

A width of 20 m is sufficient to serve as a corridor for butterfly species. Given that a corridor will be preserved to the north of the project area and that a pipeline strip in the southern part of the project area will be managed as an ecological corridor, allowing an ecological connection to be maintained from west to east and vice versa, the effect in terms of fragmentation is assessed as having a minor negative impact (-1) after mitigation. The ecological management of the pipeline strip located to the south (Antwerp Port Authority) will consist of extensive management of the existing vegetation. Management will involve phased mowing once or twice a year (85% mowing and leaving a different 15% strip unmowed each time as a refuge for small fauna) with a disc mower (not a flail mower). The cuttings will be placed in swaths or ridges and baled and removed at the earliest one day later and at the latest 10 days later. So no direct removal by suction of the cuttings.

11.11.2 Measures during the construction phase

11.11.2.1 Principles of good lighting

In view of light-shy bat species that have their flight and migration routes along the Canal Dock, care must be taken when installing lighting to ensure that the Canal Dock is illuminated as little as possible.

The principles of good lighting must be applied during both the construction and operational phases:

- Respect the 20° rule;
- Completely avoid direct upward light flow by applying the principle of downward light flow;
- Limiting upward reflected light using the principle of minimum target area and the principle of minimum luminance with maximum uniformity.

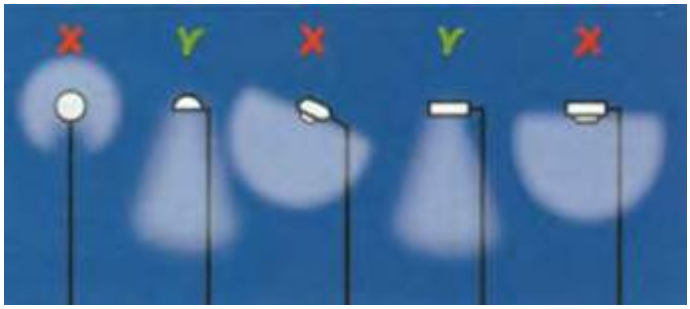

Figure 11-64 Representation of favourable and less favourable lighting for fauna.

Further information can be found in:

- de Molenaar, J.G., 2003. Light pollution. Overview of the effects on humans and animals.
- Natuurpunt Education & Prevention Light Pollution vzw, 2010. Effects of light pollution on fauna and flora. PowerPoint presentation given at the Light Pollution study day, 28 October 2010.

11.11.2.2 Noise and emissions

The following measures have already been integrated into the project (to limit NO2 emissions and noise pollution):

- The use of Stage IV or better vehicles/machines for all medium and heavy vehicles/machines (from 56 to 560 kW), which corresponds to types from 2014 or younger.
- Approximately three quarters of the vehicles/machines used fall into this category.
- For the lighter types (below 56 kW), there is little or no difference depending on the age of the machines. These are only subject to stricter emission requirements from Stage V onwards (types from 2019-2020).
- The use of less strictly regulated diesel generators of the heaviest type (> 560 kW) is excluded. Stage IV or better will be used for all types of machines, including diesel generators (< 560 kW).

Reference is also made here to other mitigating measures in the disciplines of Water, Air and Noise, which will also have a mitigating effect in nature areas/nature receptors.

11.12 Decision

The table below summarises the various effects during the construction and operational phases.

Impact group	Construction phase	Operational phase
Soil disturbance	Negligible (0)	N/A
Noise disturbance	Galgenschoor (-1) Potpolder Lillo (0) Project area (0)	Gallows beam (0) Potpolder Lillo (0) Project area (0)
Direct land use	Significant negative (-3)	N/A
Fragmentation and barrier effect	Limited negative effect (-1)	N/A
Acidification and eutrophication	Negligible (0)	Negligible (0)
Groundwater management	Negligible (0)	N/A
Air & water ecotoxicology	Negligible (0)	Water: Negligible (0) Air: SO2, particulate matter, benzene, NOx and VOCs: negligible (0)
Light pollution and visual disturbance	Negligible (0)	Limited negative (-1)

This section discusses the effects on biodiversity during the construction and operational phases of the project. See also Appendix 10.

General effects during the construction phase

- The impact on biodiversity as a result of **soil disturbance** is considered negligible (0): the existing soil is already characterised by disturbed and raised soils.
- A number of project-integrated measures will be used during the vegetation removal work (location of chipper, starting on the west side). The impact of **noise disturbance** on fauna in the Galgenschoor area is assessed as limited negative (-1). No disturbance effects are expected for fauna in the Lillo pot polder area (negligible, 0), nor in the project area itself, as there will no longer be any breeding habitat.
- During the subsequent construction phase (levelling, construction work), there will be a minor negative impact (-1) due to noise **disturbance** during the day in Galgenschoor. Mitigating measures are therefore desirable.

During the night, the impact is considered negligible (0). At the Potpolder in Lillo, the impact during the day and at night is negligible (0).

- The effects of the permanent **occupation of space** and the loss of habitat for species due to the project at the local level are assessed as a significant negative effect (-3) on biodiversity. However, a large number of restoration measures are being taken in the project. Despite the large number of restoration measures, based on the proposed assessment framework, the impact on local ecotope and biotope loss in this region remains unchanged after the mitigating, compensatory and nature restoration measures have been taken.
- The project provides for the establishment (ecological management) of one pipeline strip that will be preserved as a corridor. As a result, the impact of **fragmentation and barrier effect** can be considered a limited negative effect (-1).
- The temporary additional nitrogen deposits during the construction phase are negligible and cannot be observed as changes in the vegetation.
  Consequently, there will be negligible effects on the relevant habitat types in the wider area, with no significant damage to natural values (vegetation). Nitrogen deposition values remain well below the critical limits. Consequently, there will be no significant damage (negligible or no effect (0)).
- Based on the results of the groundwater modelling, no effects are expected as a result of **groundwater lowering** in the Galgenschoor (negligible (0)).
- During the construction phase, there will be no natural values present in the project area. The impact of **light pollution** during the construction phase is assessed as negligible or no effect (0). A few recommendations are made regarding proper lighting (applicable to the construction and operational phases).

General effects during the operational phase

- There is an increase in flow rate as a result of the **discharge of treated waste water** via an existing discharge pipe. This is not expected to lead to a loss of mudflat or salt marsh habitat, as the existing channel is adequately protected by riprap. The increased flow rate cannot therefore lead to a loss of salt marsh or mudflat habitat (no effect (0)).
- **Noise disturbance** during the operational phase will be limited. The impact on wintering bird species that mainly occur in the mudflat zone in Galgenschoor is negligible (0). The impact on breeding birds in the salt marsh zone is also negligible (0).
- The additional **fertilising and acidifying deposits** during the operational phase are so low that they cannot be measured in situ or observed as changes in vegetation. Consequently, there are only negligible effects on the relevant habitat types in the wider area, as the deposition values for nitrogen remain well below the critical limit values. Therefore, there is no significant effect (negligible or no effect (0)).
- During the operational phase, there will be few to no local light-sensitive species (bats) present in the project area (as there is no habitat). During the migration periods (spring, autumn), migratory bats may be present in the wider area. Night-migrating birds may also be present during the migration period. Migrating bats will avoid the illuminated areas, while some nocturnal migratory birds may be attracted to light sources. In general, this effect will be limited (limited negative (-1)).

With regard to specific **effects on VEN areas**:

See Chapter 6 in the enhanced nature assessment (Appendix 10.1).

With regard to specific **effects on Natura 2000 areas in Flanders**: See §12.2 in the Appropriate Assessment Flanders (Appendix 10.2).

With regard to the **relevant effects on Natura 2000 areas in the Netherlands**: See Chapter 9 in the Appropriate Assessment for the Netherlands (Appendix 10.3).

Since the areas covered by nature management plans (nature reserves) and other protections (RAMSAR) overlap with VEN and Natura 2000 areas, the impact assessment is already included in this.

12 Landscape, Architectural Heritage & Archaeology

12.1 Methodology

The following impacts will be discussed:

15. Loss of heritage values: qualitative description based on available inventories, site visits and archaeological reports;
16. Structural and relational changes: qualitative description;
17. Change in perceptual characteristics and experiential value: discussion of the impact of all planned (high) structures (including distillation towers, cracking furnaces, flares, cooling towers, etc.) on the landscape from:
    - 3.1 The residential areas;
    - 3.2 The protected town and village view of Lillo;
    - 3.3 The protected cultural-historical landscape of Groot Buitenschoor-Galgenschoor.

In this context, visualisations will be made from Galgenschoor, Lillo, Berendrecht, Zandvliet and Doel, based on 3D data of the installations.

The **impact assessment** will be carried out as follows for:

Significance level	Assessment criteria	Mitigating measures
Change in perceptual characteristics and experiential value		
Significant negative effect (-3)	Severe disruption of visual characteristics and image quality/perceived value and large-scale disruption (at supra-local level)	Mitigating measures required or justification
Negative effect (-2)	Temporary severe disruption of visual characteristics and image quality/perceived value or permanent disruption of reasonable magnitude (at local level)	Mitigating measures desirable or justification
Limited negative effect (-1)	Temporary disruption of visual characteristics and image quality/perceptual value and disruption of a rather limited scale	No specific measures required in addition to existing regulations
Negligible impact (0)	No or negligible visual disturbance and image quality	N/A
Limited positive effect (+1)	Temporary improvement in visual characteristics and image quality/perceived value or improvement of limited scope	N/A
Positiveeffect(+2)	Reasonable improvement in visual characteristics and image quality/perceived value (local level)	N/A
Significant positive effect (+3)	Permanent improvement in visual characteristics and image quality/perceived value on a large scale (supra-local)	N/A

Significance level	Assessment criteria	Mitigating measures
Loss of heritage values		
Significant negative effect (-3)	Destruction/permanent disappearance of protected landscape, architectural or archaeological heritage values	Mitigating measures required or justification
Negative impact (-2)	Destruction/permanent disappearance of unprotected landscape or architectural heritage values included in the landscape atlas or in the list of architectural heritage. Destruction of undocumented archaeological heritage.	Mitigating measures desirable or justification
Limited negative impact (-1)	Temporary alteration/limited damage to heritage elements. Damage to documented archaeological heritage	No specific measures required in addition to existing regulations
Negligible impact (0)	Negligible effects. No heritage present. No indications of and little chance of the presence of archaeological heritage	N/A
Positiveeffect(+1)	Preservation of heritage values, with possible improvement of the context.	N/A
Structural and relational changes		
Significant negative effect (-3)	Destruction/severe damage to characteristic landscape structures and coherence of supra-local importance	Mitigating measures required or justification
Negative impact (-2)	Destruction/severe damage to characteristic landscape structures and cohesion of local importance	Mitigating measures desirable or justification
Limited negative effect (-1)	Temporary alteration/limited disappearance or damage to characteristic landscape structures and coherence	No specific measures required in addition to existing regulations
Negligible effect (0)	Preservation of landscape structures and coherence.	N/A
Limited positive effect (+1)	Temporary or limited reinforcement of characteristic landscape structures and cohesion.	N/A
Positiveeffect(+2)	Clear reinforcement of characteristic landscape structures and coherence of local importance.	N/A
Significant positive effect (+3)	Clear reinforcement of characteristic landscape structures and coherence of supra-local importance.	N/A

For a description of the 7-point scale used in the above significance frameworks and the negative scores linked to the mitigating measures, please refer to § 5.3.

12.2 Reference situation

12.2.1 Delimitation of study area

The study area of Landscape, Architectural Heritage and Archaeology is broader than just the project area and is determined by the scope of the visibility of project interventions. The visibility of the project interventions will depend on their image height and the viewing distance of the observer. As the viewing distance increases, the perception of the dimensions will decrease rapidly at first and then more slowly.

The landscape of the harbour and the surrounding polders is fairly flat, with agricultural areas characterised by openness and sweeping views. In addition, there are several residential areas around the project area. These include Berendrecht and Zandvliet to the north-east, Stabroek to the east and Lillo to the south of the project area. To the west of the project area is the former residential area of Doel.

With this in mind, the landscape impact zone of the project interventions is defined as a buffer zone of 1,500 metres around the project area. Outside this impact zone, the visual impact will be virtually identical to that within the study area. The figure below shows the project area and the study area (see Chapter 3 for a description of the project area).

Figure 12-1: Indication of the study area: buffer zone of 1500 m around the project area

12.2.2 Landscape typology

The study area on a macro scale is generally described on the basis of the landscape types encountered. The classification of landscapes into 'Traditional Landscapes' according to Antrop is used to define the landscape types. According to this classification, three landscape types can be found in the study area: 'Urban areas and port areas', 'Scheldt polders' and 'Scheldt basins with tides'. The project area belongs entirely to the 'Urban areas and port areas' landscape type. The figure below shows the demarcation of the Traditional Landscapes in the vicinity of the study area.

The landscape of 'Urban areas and port areas' is mainly shaped by anthropogenic features. In this case, it is more of a port landscape than an urban area. The landscape is shaped by canals, docks and port-related infrastructure. The landscape of the Scheldt basin with tides is formed here in the study area by the Scheldt estuary with brackish water. The mudflats and salt marshes, which are created by the tidal action of the river, also belong to this landscape.

The Scheldt polders, both west and east of the Scheldt, are characterised by flat agricultural land with sweeping views in various directions. Dykes with green screens are often present as small landscape elements that define the space. There is a strong perceptual contrast with the landscape in the port area. The current vertical structures of the port and industrial landscape (cooling towers, wind turbines, chimneys, etc.) help determine the visual value of the current landscape of the Scheldt polders.

Figure 12-2: Traditional landscapes according to Antrop in the study area and surroundings

A description of the geomorphological, topographical and hydrographical characteristics of the landscape is based on the landscape characteristics map (Figure 12-3) and topographical map (Figure 12-4). The landscape in which the study area is located consists of a flat landscape that can broadly be divided into three landscape types, as indicated above: the port, the Scheldt and the polders. The project area consists of a contiguous port area formed by docks and surrounding industrial estates. In the south of the study area is the fortified centre of Lillo, which forms part of the inner fortification belt around Antwerp.

The Scheldt river lies in the western part of the study area. Along the Scheldt there are still a few salt marshes, such as Groot Buitenschoor and Galgenschoor. In the east of the study area there are various harbour docks and further away lie the remains of the Scheldt polders. As mentioned earlier, the Scheldt polders consist of open agricultural land. The main built-up areas in this region, with their typical linear road patterns, are Zandvliet, Berendrecht, Stabroek, Hoevenen and Ekeren.

To the east of the study area lies the A12 motorway, which broadly forms the boundary between the polder area and the port.

To the northeast of the study area is the anti-tank canal, a historic line of defence with forts.

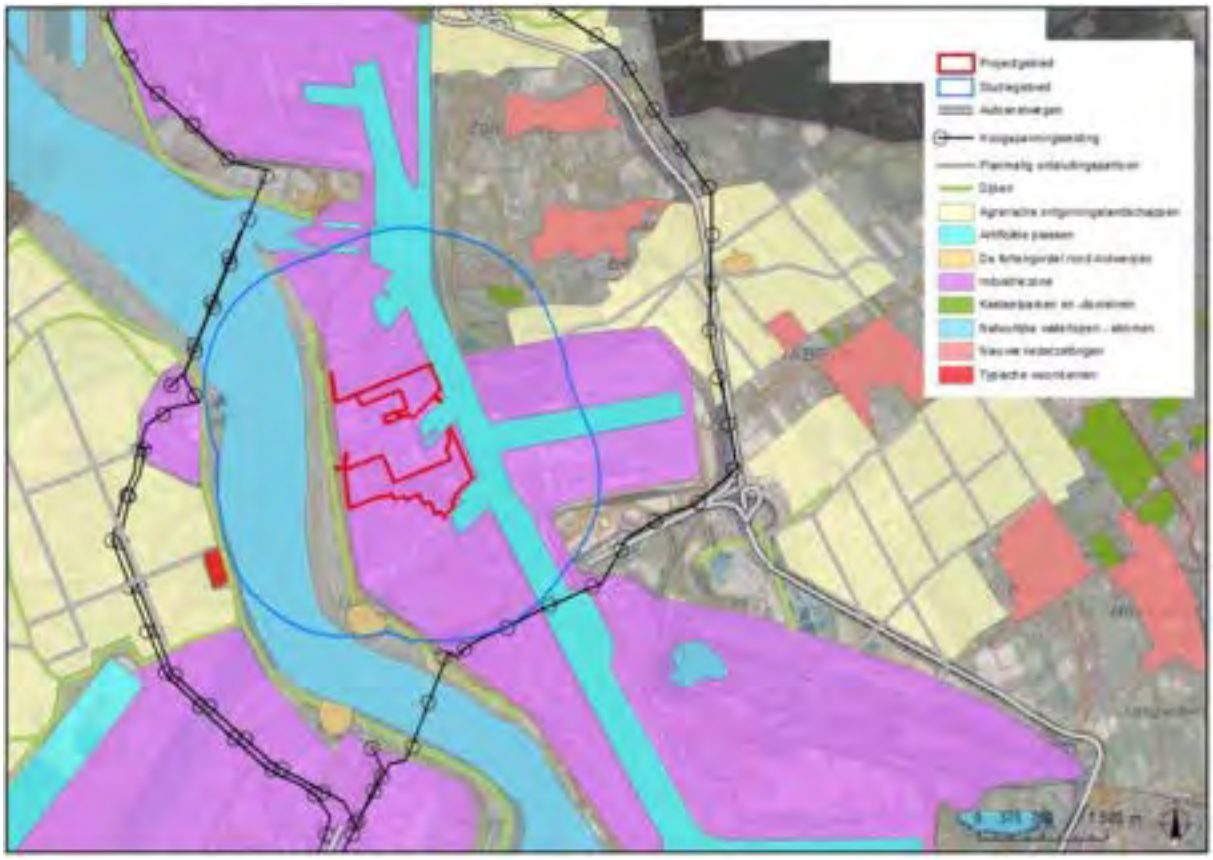

Figure 12-3: Landscape features map of the study area

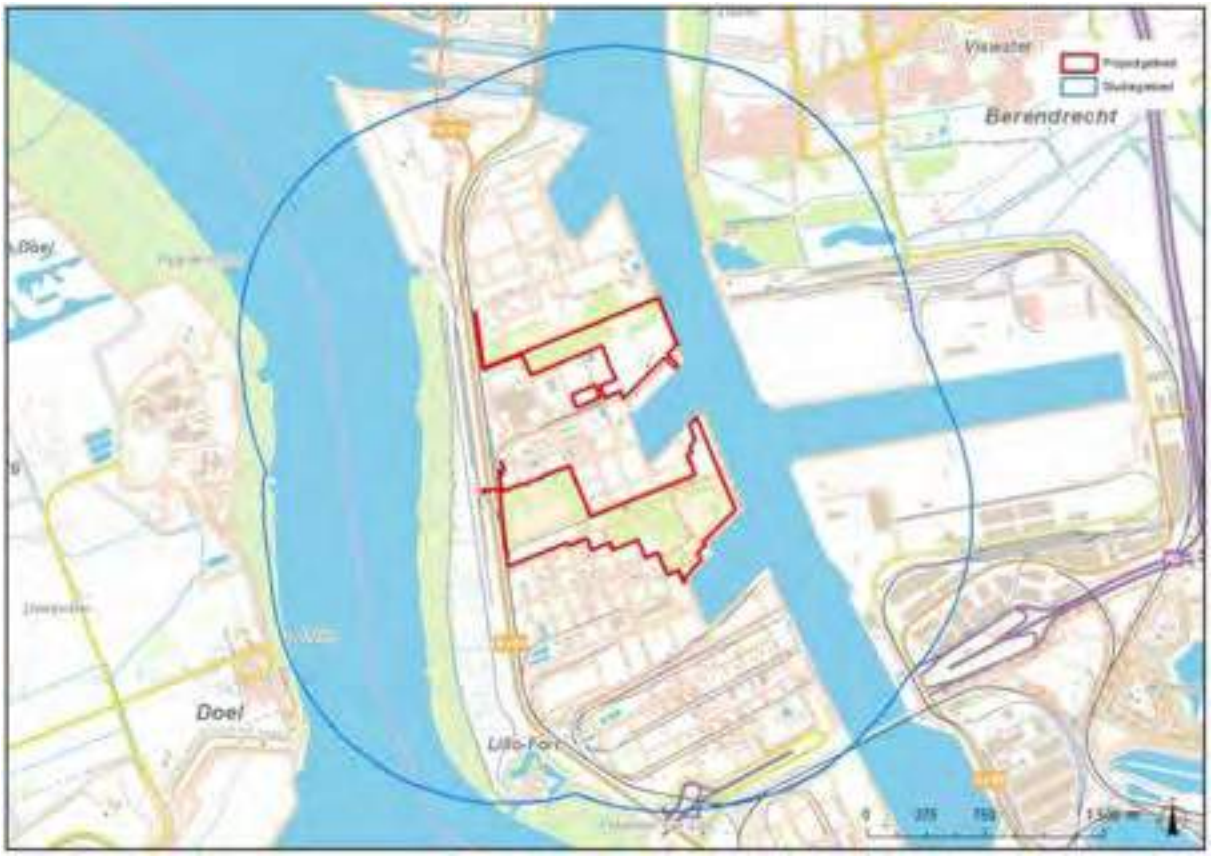

Figure 12-4: Topographic map of the study area

12.2.3 Cultural-historical context

The project area is located in the historic polder of Lillo, north of the former polder village of Oud-Lillo, which has since disappeared due to the expansion of the Port of Antwerp. The first reclamation of this area took place in the 11th and 12th centuries, and the reclaimed land was mainly used for agriculture and peat extraction. From the 14th century onwards, storm surges occurred regularly, causing dyke breaches and often flooding the polders and Lillo.

During the Eighty Years' War (1568-1648), William of Orange ordered the construction of two forts on either side of the Scheldt: Fort Liefkenshoek on the left bank and Fort Lillo on the right bank. Fort Lillo, located in the southern part of the study area, was built between 1578 and 1580. It was also during this period that strategic inundations were carried out by breaching the dykes. This made Fort Lillo an important, often besieged fortress during the Ancien Régime. During the siege of Fort Lillo in 1585, the Spanish built the Blauwgaren redoubt or fort near the project area.

Schans Blauwgaren is located approximately halfway between Fort Lillo and the site where Fort Frederik Hendrik stood in 1627, and is thought to be situated between the two parts of the project area. The redoubt remained in Spanish hands for only a few years. At the beginning of the 17th century, the original fortification was replaced by a stone redoubt with two bastions, surrounded by a 20-metre-wide moat. By the second half of the 17th century, the huts had fallen into disrepair and were used by the supervisors for the re-embankment of the area, which began in 1651. The purpose of this re-embankment was to rebuild the dykes after the strategic inundations. In 1672, the huts were completely demolished. On the 18th-century Ferraris map (Figure 12-5), Schans Blauwgaren is no longer visible; the map only shows a bulge in the dyke at the location of the presumed redoubt. The Vandermaelen map (Figure 12-6), which dates from the 19th century, mentions a fort at the same location. Based on this map, it can be established that the project area overlaps to a very limited extent with the fort indicated on the Vandermaelen map. Based on the 19th-century Atlas der Buurtwegen (Atlas of Local Roads), the fort may have occupied the far corner of the project area. For details of these and other maps and an indication of the fort zone, please refer to the archaeology report.

In the 18th and 19th centuries, Fort Lillo remained of great importance, while Fort Hendrik gradually fell into disuse and the redoubt was demolished in 1786. At the beginning of the 19th century, several dyke breaches caused flooding in the Lillo polder once again. In 1838, a collar dyke or circular dyke was therefore constructed around Fort Lillo and the village centre of Oud-Lillo. This dyke is visible on the Vandermaelen map (Figure 12-6) and runs through the project area. At the end of the 19th century, Fort Lillo lost its military character and small houses were built within the defences.

Figure 12-5: Ferraris map showing the project area and the study area

Figure 12-6: Vandermaelen map showing the project area and the study area

Antwerp remained of great strategic importance in the 20th century. During the First World War, the city was defended by two rings of forts. The outer ring consisted of modern forts, construction of which began after 1906 but which were often left unfinished. The inner ring consisted of old forts from the 1860s that were brought back into use. Around 1911, the Blauwgaren Battery was built in the project area. The Blauwgaren Battery consisted of a concrete main building, earthen fortifications and four gun platforms. Ultimately, the battery was not used at the start of the First World War. On 8 October 1914, the weapons and main building of the battery were destroyed by the Belgian army to prevent the battery from falling into German hands.

Although Antwerp was relatively spared from major destruction until its liberation in 1944, the wider region of the project area was bombed several times during the Second World War. These bombings consisted of attacks with V-bombs and took place mainly between October 1944 and March 1945. V-bombs certainly fell on the project area, but the exact location of the impacts is not known with certainty. The archaeological report therefore designates the entire project area as a risk zone for the discovery of V-bombs.

Until the 1960s, the area was a polder. With the expansion of the port of Antwerp, the site was filled in (by an average of 5 metres) in the 1960s with infrastructure spoil released during the excavation of docks. Commercial buildings were then constructed on the surrounding land around the project area, railways were laid and pavements were laid. The remaining ruins of Battery Blauwgaren were demolished in 1963 prior to the land reclamation for the port expansion. For more details on this, please refer to the archaeology report.

Following the reclamation of the harbour area, vegetation succession occurred in the project area. This succession began with bare soil, where pioneer vegetation of dune species initially sprouted. Gradually, grassland and scrub species arrived, transforming the area into grassy scrub dominated by marram grass. With the arrival of birch and willow trees, which are wind-dispersed species, this evolved into a forest of pioneer tree species. The project area was therefore mainly characterised by birch, willow, sea buckthorn scrub, open areas, dune grass vegetation, etc. For a detailed description of the habitat types present, please refer to Chapter 11 Biodiversity.

12.2.4 Protected immovable heritage

Map 9 in Appendix 1 provides an overview of the protected immovable heritage in the project area and the study area. There is no protected immovable heritage in the project area itself. However, there are a number of elements in the study area that are designated as protected immovable heritage. These are:

Protected cultural-historical landscapes:

- Groot Buitenschoor – Galgenschoor (ID: 5450) approx. 150 m west of the southern part of the project area, approx. 80 m west of the northern part of the project area;
- Slikken en schorren van Oude Doel (ID: 8437) approx. 1.3 km west of the project area;
- Antitankgracht (ID: 4344) approx. 1.6 km east of the project area.

Protected town and village views:

- Lillo Fort with ferry and tidal harbour (ID: 5095) approx. 1 km south of the project area;
- Westmolengeest windmill and surroundings (ID: 6330) approx. 2.2 km northeast of the project area (just outside the study area).

Protected monuments:

- Lillo Fort: ramparts (ID: 5094) approx. 1.2 km southwest of the project area;
- Lillo Fort: powder magazine (ID: 5090) approx. 1.4 km southwest of the project area;
- Lillo Fort: facades and roofs of officers' residences (ID: 5093) approx. 1.4 km southwest of the project area;
- Lillo Fort: casemates (ID: 5092) approx. 1.4 km southwest of the project area;
- Lillo Fort: blockhouse (ID: 5089) approx. 1.2 km southwest of the project area;

- De Eenhoorn grain windmill (ID: 7338) approx. 1.6 km southwest of the project area;
- Fort Liefkenshoek (ID: 10880) approx. 2.4 km southwest of the project area (just outside the study area);
- Target: Stone windmill (ID: 7787) approx. 1.6 km west of the project area;
- Objective: Hooghuis (ID: 7815) approx. 1.9 km west of the project area.

There are no protected archaeological sites in the wider vicinity of the study area.

12.2.5 Heritage landscapes

There are no heritage landscapes in the project area or in the study area. To the east of the study area, however, is the nearby heritage landscape *Heritage Landscape Part of Anchorage Polders of Stabroek* (ID 14896, approx. 1 km east of the study area and approx. 3 km east of the project area). This heritage landscape is shown in Figure 12-7.

Figure 12-7: Heritage landscape in the vicinity of the project area and the study area.

12.2.6 Established inventories

Designated architectural heritage:

There is no designated architectural heritage within the project area itself. The study area contains a number of elements that have been designated as **architectural heritage** (Figure 12-8 and Map 10 in Appendix 1), of which the Bevrijdingsdok[82] ((ID: 99366) approximately 400 m east of the project area) is the closest.

[1] The Bevrijdingsdok is the former Delwaidedok; in February 2019, it was decided to change the name of this dock.

The other elements are located at least 1 km from the application. These include, but are not limited to:

- Zandvliet and Berendrecht locks (ID: 73887) approx. 1.3 km north of the project area;
- Reigershof Castle (ID: 82836) approx. 1.2 km northeast of the project area;
- Frans Tijsman Tunnel (ID: 99915) approx. 1.4 km southeast of the project area;
- Lillobrug (ID: 102171) approx. 1.6 km southeast of the project area;
- Pumping station (ID: 101054) approx. 1.7 km southeast of the project area;
- Fort Liefkenshoek (ID: 70789) approx. 2.6 km southwest of the project area (just outside the study area);
- De Eenhoorn grain windmill (ID: 103486) approx. 1.6 km southwest of the project area;
- Lillo Fort (ID: 102172) approx. 1.4 km south-west of the project area;
- Parish Church of Our Lady of the Assumption (ID: 64115) approx. 1.8 km west of the project area (just outside the study area).

Identified landscape atlas relics:

There are no designated landscape atlas relics in the project area or in the study area (Map 10 in Appendix 1). The nearest landscape atlas relics are located just east of the study area, namely:

- The Stabroek Polder with transition zone to the Noorderkempen (ID: 10284) approx. 1 km east of the study area and approx. 3 km east of the project area;
- Military heritage at the transition from Scheldt polders to Kempen (ID: 10289) approx. 1.3 km east of the study area and approx. 3.3 km east of the project area.

Figure 12-8: Inventories established in the project area and the study area.

12.2.7 Central Archaeological Inventory

The Central Archaeological Inventory (CAI) includes several observations in the wider vicinity of the project area. However, no archaeological observations within the project area are mentioned in the CAI.

12.2.8 Perceptual characteristics

Due to the intensive use of space in the port, horizontal viewing distances are generally limited. The project area was an exception to this, but the backdrop to the study area is highly industrialised, supplemented by the Scheldelaan as a busy road, a busy freight railway and high-voltage power lines. Although elements of the port landscape will almost always be visible, there are some attractive views to be found in the study area. These include the view of the Scheldt, the Galgenschoor and Reigersbos-Opstalvallei nature reserves. Below, the various landscape elements that define the view in the study area are described for the different viewing directions from the project area.

The defining elements in the landscape are:

- North of the project area:
  - The Vopak production site (formerly Gunvor).
- North of the southern part of the project area:
  - The Inovyn production site;
  - The Vesta production site.
- East of the northern part of the project area:
  - The Kanaaldok B2;
  - The Reigersbos – Opstalvallei nature reserve;
  - The ABT bulk storage facility.
- To the east of the southern part of the project area:
  - Kanaaldok B2;
  - Sea-Tank's stacked containers.
- South of the northern part of the project area:
  - The IMB production site;
  - Inovyn's salt storage facility;
  - Berth 2 with loading and unloading cranes.
- South of the southern part of the project area:
  - The Bayer production site;
  - The OTSA production site;
  - The Bayer slipway with loading and unloading cranes.
- To the west of the project area:
  - The Scheldelaan;
  - The freight railway;
  - The high-voltage power line;
  - The Galgenschoor nature reserve and the Scheldt;
  - The Doel nuclear power plant is visible across the Scheldt.

The project area was very different from its surroundings and was characterised by the presence of various green landscape units and open areas. The forest located in the project area formed a rather open forest landscape with areas of open scrub vegetation, supplemented by the row of poplar trees along Scheldelaan in the southern part of the project area and the row of poplar trees along Kanaaldok B2 in the northern part of the project area, intersected by roads. However, the wooded areas within the project area formed closed units. For this reason, the boundaries with the area already developed into a seaport area to the north and south of the project area could be characterised as hard boundaries, although the forest had a screening function, making them less noticeable from the project area. In the opposite direction, the boundary was perceived as positive. The boundary with Scheldelaan in the west was less hard and direct. The reason for this is that Scheldelaan does not obstruct the horizontal viewing distance. Moreover, Scheldelaan was screened by the row of poplar trees in the southern part of the project area. This was negative for the horizontal viewing distance, but positive for the landscape experience because the row of trees completely screens the landscape with Scheldelaan, the freight railway and the high-voltage line behind this zone in summer and partially in winter. The same applies to the northern part of the project area, where the row of poplar trees screened the bulk storage area on the other side of Kanaaldok B2 from the northern part of the project area.

As described earlier, there are also several residential areas within the wider study area. To the south of the project area lies the small residential area of Fort Lillo, located in a former fort.

This residential area is almost completely surrounded by the port area of Antwerp, but there are two nature reserves to the north and south of the fort. To the north is the Galgenschoor nature reserve, and to the south is the Potpolder. You can walk and cycle on the ramparts of the fort, which offer views of both these nature reserves and the surrounding port area. The northern part of the ramparts has relatively tall vegetation, which partially filters the view of both the Galgenschoor and the industrial landscape. However, the port area remains very much present in the landscape, with many vertical elements such as cranes, high-voltage pylons, the Doel nuclear power stations and wind turbines.

Figure 12-9 shows the view from the Lillo jetty, looking north. This figure shows part of the Galgenschoor, as well as the dyke around Fort Lillo and the surrounding harbour landscape. Figure 12-10 shows the situation from the dyke around Fort Lillo. Once again, the Galgenschoor is visible here, against the backdrop of the harbour landscape. In the centre of Fort Lillo, the harbour landscape is less conspicuous. The ramparts ensure that the harbour landscape is, as it were, excluded; only the striking vertical structure of a high-voltage pylon with accompanying high-voltage cables is still visible.
present. Figures 12-11 and 12-12, showing Kazerneplein and Havenmarkt respectively, illustrate this.

Figure 12-9: Lillo – Photo taken from the jetty

Figure 12-10: Lillo – Photo taken from the ramparts

Figure 12-11: Lillo – Photo on Kazerneplein

Figure 12-12: Lillo – Photo on the Havenmarkt

The residential areas of Berendrecht and Zandvliet are located in the northern part of the study area. These are indicated on the landscape characteristics map as new settlements and have a typical linear street pattern. Both villages are located next to the canal docks. The view of these docks and the port area is partially screened by a dyke along the canal docks and by the vegetation on and next to these docks. There is also the Reigersbos, a nature reserve located along the canal docks and the dyke. This forest stretches from Derdeweg in Zandvliet to the railway line north of Bevrijdingsdok and forms a buffer between the port and the villages. From the dyke itself, you can look out over the port, as it were. The port landscape is therefore dominant here. This dyke is frequently used by walkers and cyclists.

In the villages behind the dyke, the harbour landscape is less prominent, although the tall, vertical landscape elements are still visible from certain locations. These are mainly wind turbines and high-voltage pylons, but also cranes and chimneys. Figure 12-13 was taken on the dyke near Derdeweg in Zandvliet, looking towards Berendrecht. Figure 12-14 shows the view from the dyke in Berendrecht, approximately 270 m north of the Opstalvallei viewpoint. Here too, the view is towards the south. The port landscape is once again dominant here, and the forest near the project area was also visible, partially breaking up the industrial landscape.

Figure 12-15 shows the landscape near Windmolenstraat in Zandvliet, where the wind turbine is a clearly visible element of the harbour landscape. Finally, Figure 12-16 shows the situation in the residential area of Berendrecht, located just behind the dyke, near Sint-Jan Baptiststraat. The view of the harbour from the neighbourhood is largely obscured by the dyke and by the vegetation on and along the dyke. The harbour landscape is only visible through a number of limited vistas.

Figure 12-13: Zandvliet dyke

Figure 12-14: Berendrecht dyke

Figure 12-15: Zandvliet residential area

Figure 12-16: Berendrecht residential area

Stabroek, located to the east of the study area, is also classified as a new settlement according to the landscape characteristics map. This village is surrounded by flat polder land separated from the industrial port area by the A12 motorway. Because the village is surrounded by such flat agricultural land, there are views of the port area in some locations. This means that elements of the port landscape already have an impact on the visual value of the village. In the neighbourhoods themselves, this influence remains rather limited and only tall vertical structures (wind turbines, high-voltage pylons) will be visible. At the edge of the village, the impact of the port landscape will be greater because visibility is increased.
The figures below, Figure 12-17 and Figure 12-18, provide an impression of the landscape on the outskirts of Stabroek and were taken in the northern and southern parts of Stabroek, respectively at Abtsdreef and Kleine Molenweg.

Figure 12-17: Stabroek – Abtsdreef

Figure 12-18: Stabroek – Kleine Molenweg

Finally, in the west of the study area lies the village centre of Doel. This village centre is also located behind a dyke, which partially separates the residential area and the polder area behind it from the Scheldt and the harbour landscape. This dyke also offers a panoramic view of the harbour landscape. The Doel nuclear power plants, located approximately 1.5 km north of the residential village, are a prominent feature of the landscape (Figure 12-19). The project area, located on the other side of the Scheldt, is also visible here. The forests that were present in the project area partially broke through the industrial port landscape, as shown in Figure 12-20.

Despite the impact of the port landscape, this dyke is also popular for cycling and walking. Although the dyke separates the port from the residential area, a number of industrial elements are still visible in the centre of Doel. This is partly due to the short distance between the village and the port area and the nature of the infrastructure and elements of the port landscape. Large vertical elements such as cooling towers, high-voltage pylons and cranes are visible from certain locations and have an impact on the visual experience of the village. This is shown in photos in Figure 12-21 and Figure 12-22, which were taken at Havenweg and Vissersstraat respectively.

Figure 12-19: Dijk Doel

Figure 12-20: Dijk Doel

Figure 12-21: Doel – Havenweg

Figure 12-22: Doel – Visserstraat

12.3 Impact description and impact assessment – construction phase

12.3.1 Construction phase – deforestation and vegetation removal

12.3.1.1 Loss of heritage values

Given the recent reclamation of the project area, the landscape currently has limited heritage value. It is not a historic polder landscape and the project area is completely surrounded by roads, high-voltage power lines, pipelines and existing industrial developments. The deforestation will not result in any loss of landscape, architectural or archaeological heritage values: no effect (0).

12.3.1.2 Structural and relational changes

The Project One project area is located in the middle of an industrial area on the right bank of the Scheldt in the port of Antwerp. The project area was largely wooded. Within the forest landscape, previously closed units of wooded areas alternated with areas of open scrub vegetation. This forest landscape was complemented by a row of poplar trees on Scheldelaan (southern part of the project area) and a row of poplar trees on the northern part of the project area, and was intersected by roads.

During the construction phase, approximately 39.31 hectares of land will be cleared at the Project One site. In addition, 30 cm of topsoil will be excavated across the entire surface of the project area, removing all remaining vegetation. The row of trees on the northern part of the site, along the Kanaaldok, will be preserved. The row of trees on the southern part of the project area consisted of old trees that posed a risk and were therefore removed.

This phase of the project is the first step in further developing and expanding the harbour landscape. The forest, the rough vegetation, the local elevations, and the existing rows of trees are elements that have shaped the structure of this landscape. The disappearance of these defining elements will result in a major change to the current landscape structure at this location. At the start of the works, the site will be transformed from its current forest landscape into a completely open zone. As mentioned earlier, the row of trees on the northern part of the Canal Dock will be preserved. A strip of forest will also be preserved on the Vopak site (formerly the Gunvor site). This strip of forest is located outside the project area, but was connected to the forest on the northern part of the Project One site. This mutual relationship will disappear with the deforestation. From a spatial point of view, however, it can be said that port infill is preferable to port expansion.
Taking into account industrial developments and characteristics of the environment, the overall impact of deforestation on the landscape structure is assessed as negative (-2).

The forest formed a scenic green zone that can be considered an ecological stepping stone, or in other words, a zone that is important as part of the ecological structures and ecological relationships in the landscape. With the disappearance of the forest area on the Project One site, only a limited amount of forest remains on the Vopak site. As a result, this ecological stepping stone is disrupted, reduced and broken. The change in these landscape ecological relationships is assessed as a negative effect (-2).

12.3.1.3 Change in perceptual characteristics and experiential value

Deforestation has a limited impact on the (mainly visual) perceptual characteristics of the landscape and the associated experiential qualities. The project area is located in an industrial area, which means that the landscape experience is very limited. The Fort of Lillo, which has significant perceptual and experiential value, has no direct visual connection with the project area.

The use of machinery (saws, chippers, etc.) and transport for the removal of wood during this phase of the project will cause a temporary visual and auditory disturbance to the landscape, which will be noticeable in an area of approximately 200 metres around the site. The change in the landscape and its appearance due to the temporary deforestation work can be considered a limited negative effect (-1).

During the deforestation of the project area, the landscape and the experience of it will be disrupted. This is due to the change in the general appearance of the site in relation to the surrounding area and, on the other hand, due to the works themselves. The disappearance of the forest and other vegetation from the site will have a permanent negative impact on the appearance of the area. Where there used to be a large contiguous forest in the landscape, only a small area of forest remains on the Vopak site. As a result, the landscape is largely open and the depth of view into the surrounding industrial landscape is greatly increased. However, the effect can be described as local. The change in the landscape and the perception of the landscape as a result of deforestation is considered a negative effect (-2).

12.3.1.4 Mitigation measures and recommendations

Since no significant negative effects occur during site preparation, mitigating measures are desirable but not strictly necessary. In addition, from the perspective of Landscape, Architectural Heritage and Archaeology, it is not obvious to propose mitigating measures, both for safety reasons and because of the limited space available. For these reasons, no mitigating measures are proposed from this discipline.

12.3.2 Construction phase – other site preparation and construction

12.3.2.1 Loss of heritage values

During construction, local excavation work will take place on the site. For a number of installations, pile foundations with a depth of approximately 25 metres will also be necessary. An *archaeological report* (desk study) has been drawn up in connection with this excavation work. This preliminary archaeological investigation was then supplemented with a deferred phase, to be carried out in stages. This deferred phase is reported in an *Archaeological Preliminary Investigation Report (deferred phase): 1. Report of Results* and in an *Archaeological Preliminary Investigation Report (deferred phase): 2. Programme of Measures*.

These reports will be added to the environmental permit application. For the loss of heritage values, reference is therefore made to this archaeological report. Below is a summary of both the archaeological report (regular process) and the deferred process.

Archaeological report (regular process)

The archaeological report (Aluwé et al, 2021) states that the project area is not located in a designated archaeological zone, in a protected archaeological site or in an area where no archaeological heritage is to be expected. The top 4 to 6 metres of the project area have no archaeological potential, due to the land reclamation that took place in the 1960s.

Based on the landscape, further research is being conducted on three levels of embankment:

The first layer beneath these embankments (Top van het Lid van Ekeren) may contain remains from the Middle Ages, the Modern Era and the Contemporary Era. The archaeological report concludes that the Blauwgaren redoubt or fort is not threatened by the works. No further investigation is recommended for the Blauwgaren battery either. The rest of the zone has archaeological potential, but it is very likely that this potential has been disturbed by the raising of the area. Additional archaeological research is not expected to yield any useful knowledge. No further research is therefore recommended for this level.

The second layer beneath the embankments is that of the top of the Antwerp Peat. This layer has the potential to contain Roman and Medieval remains, but the potential is rather low. It is expected that additional archaeological research will not lead to any useful gains in knowledge. No further research is recommended for this level either.

Finally, there is the top level of the Lembeke Member/Doel Member (Weichselian). This level has a high potential for the presence of Stone Age sites. Among other things, it is necessary to study the spatial distribution of the peat more closely. Additional geophysical research and landscape soil research is required. For the modalities for the implementation of this follow-up research, please refer to the second part of the archaeology memorandum, the Programme of Measures (PvM).

As mentioned earlier, remnants of wartime ammunition from World War II are still present in the soil of the project area. The archaeological report therefore designates the project area as a risk zone for the presence of V-bombs (§ 12.2.3). The desktop study conducted by BODAC on conventional and toxic explosives also indicates a high risk of V-bomb remnants throughout the project area. In specific zones, including the area around the old battery, there is a high risk of other military ammunition being present. In order to detect the war ammunition, the test drillings carried out as part of the geotechnical investigation will be equipped with equipment to detect explosives.

Deferred process

The regular process can be supplemented with a deferred preliminary archaeological investigation, which is recorded in a Report of Results (VvR) and a Programme of Measures (PvM).

The VvR discusses the results of a landscape soil investigation, CPT investigation and exploratory drilling.

These investigations were carried out to determine the local geological structure and history of formation and to assess the extent of disturbance. These investigations confirm the presence of covered archaeological (prehistoric) potential, the top of the Lembeke Member.

Appraisal drilling is also being carried out to provide more insight into the nature, extent, age and integrity of the identified distribution of finds. The indicators that were found are located at a great depth below the current ground level (> 10 m) and are associated with a clearly developed and sufficiently well-preserved, covered soil.

Based on the archaeological drilling survey, few concrete statements can be made about the exact extent and density of the find distributions. It cannot be ruled out that finds also extend beyond the drilling points. The extensive extent of this find distribution is suggested by the distribution of indicators, in variable density, across virtually the entire surveyed area.

The extent to which the site will be disturbed cannot be clearly determined. This is due to the fact that the extent of the find distribution could not be clearly mapped out because of the great depth of the site. The impact of the planned soil interventions on the informational value of the site and the associated knowledge potential are therefore also difficult to estimate.

In consultation with the Agency for Immovable Heritage (AOE), it has been decided to refrain from conducting a follow-up investigation with evaluation test areas, given the great depth, the size of the site and the nature of the soil interventions, which make this follow-up investigation technically very difficult or impossible to carry out and entail very high financial costs.

During consultations with AOE, it was agreed to carry out additional targeted mechanical drilling for the purpose of extensive scientific sampling and study. This research is described in detail in the Programme of Measures.

12.3.2.2 Structural and relational changes

Following the deforestation of the site, a temporary open area has been created for a short period of time, within which the construction work will take place. Work will commence with the levelling of the project area. The site currently has a flat topography, with a few embankments and local elevations in the landscape.
However, these local elevations in the landscape cannot be said to determine the structure.

The site facilities in the southern part of the site are temporary, while a contractor village will be set up in the northern part of the site, which will remain in permanent use after the construction phase (see Chapter 3 Project Description for more information about this contractor village). The construction roads that will be built may divide the existing open terrain into smaller sections, thereby altering the landscape structure. The construction of the various installations and the realisation of this project will cause a significant change to the existing landscape structure and landscape relationships, both within the project area and within the study area.
However, within the context of the industrial harbour landscape, this can be considered a limited negative effect (-1).

12.3.2.3 Change in perceptual characteristics and experiential value

Following the deforestation of the site, the perceptual characteristics and experiential value of the landscape and views have already changed significantly, both within the project area and within the study area. During the construction phase, roads will be built for site traffic. Site facilities will also be necessary. As mentioned earlier, the site facilities on the southern part of the site are temporary, but the contractor village on the northern part of the site will remain in permanent use after the construction phase. This contractor village will include office space, changing rooms, dining facilities, storage sheds, diesel storage and parking. These elements, which will appear on the site during the further construction phase, are larger and more prominent than the temporary site hut provided for vegetation removal. Whereas the site hut for the first part of the construction phase and the site facilities on the southern part of the site will only cause a temporary disruption to the visual characteristics of the landscape, the contractor village will have a permanent impact.

The temporary disruption to the landscape in the southern part of the site will also gradually fade away compared to the permanent change to the landscape caused by the construction of the ECR facility. Within the context of the port landscape, this can be considered a limited negative effect (-1). The total construction phase of Project One will take approximately 3 years and 8 months.

During the construction work, various machines will be present for a long period of time. For example, heavy cranes and specialised heavy vehicles will be needed to move the ECR modules, which will be delivered by ship, to the correct location on the site. Roads constructed on the site for this purpose will also need to be adapted to accommodate this heavy transport. The delivered modules will ultimately need to be assembled to construct the new installations.

The landscape within the project area will be constantly changing during the construction phase, which means that its perceptual characteristics and experiential value may also change over time. Within the context of the industrial port area and due to the fact that there are few residential areas in the vicinity, the effect on the change in perceptual characteristics and on the experiential value of the landscape during the construction phase can be considered to be limited negative (-1).

12.3.2.4 Mitigating measures and recommendations

The Landscape, Architectural Heritage and Archaeology discipline does not consider any mitigating measures to be necessary for the construction phase.

12.4 Impact description and impact assessment – operational phase

12.4.1 Loss of heritage values

As mentioned earlier, until the 1960s, the project area was a polder area that was reclaimed with the expansion of the port of Antwerp. The project area is therefore not a historic polder landscape and is also completely surrounded by roads, high-voltage power lines, pipelines and existing industrial developments and port elements. The heritage value of the project area is therefore very limited. In § 12.2.4, it was already demonstrated that there are no protected heritage elements within the project area. Nor are there any elements from the established inventories to be found in the project area (§ 12.2.6). The operational phase will therefore not result in any loss of landscape and architectural heritage values: no effect (0).

12.4.2 Structural and relational changes

General

The ECR will be located in the southern part of the project area, between the current Inovyn site and Vesta in the north and Bayer in the south. Supporting infrastructure and the administrative building will also be housed on this site (see Chapter 3 Project Description for more information). In the northern part of the site, located between the current IMB site and the Inovyn site in the south and Vopak (formerly Gunvor) in the north, a permanent contractor village with parking facilities will be provided.

The total area that will be permanently occupied by the ECR, the associated infrastructure and parking facilities is 85.0 hectares. The supporting infrastructure will be installed according to the available space.

The ECR consists of large-scale process installations with various ancillary installations (see Chapter 3 Project Description for more details). The main raw material (ethane) is stored at very low temperatures in a large cryogenic tank specially developed for this type of storage. Given its size, this tank will be one of the most striking elements on the site. In addition, there are the cooling systems with cooling towers that will be provided and the vertical elements of the ECR process that will form striking elements in the landscape. The vertical elements include chimneys, distillation towers, cracking furnaces and a tower flare. All installations will contribute to changing the landscape.

Structural and relational changes

During the operational phase of the ECR, various industrial installations will be present on the site. The operational phase of the ECR will further develop and expand the port landscape.

The port landscape dominates the study area; many of the structural elements of the study area are therefore part of this landscape. These include the existing industrial areas, the Scheldt, the canal docks and the various tall vertical structures that form landmarks in the landscape (chimneys, wind turbines, high-voltage pylons, cranes, the cooling towers of Doel, etc.).

However, the study area is also characterised by landscape elements that are not linked to the industrial nature of the port area. There are various residential areas (Berendrecht, Fort van Lillo, Doel, etc.) surrounded by agricultural polder landscapes and the protected cultural-historical landscapes *'Slikken en schorren van het Oude* Doel' (left bank of the Scheldt) and *'Groot Buitenschoor* - Galgenschoor' (right bank of the Scheldt, in the immediate vicinity of the project area).

The afforestation in the project area contributed to the presence of greenery in the port area and broke through, as it were, the heavy industrial landscape on the right bank of the Scheldt, along the canal docks, in two places. In addition, the forests provided a backdrop for the Galgenschoor. As a result, the afforestation within the study area could also be considered structure-determining. Figure 12-23 below shows the view from the dyke in Berendrecht. It looks out over the canal docks. On the right of the picture is the Vopak site (formerly Gunvor). Behind this site, the cooling towers of Doel are visible, and to the left of the cooling towers lies the northern part of the project area. The afforestation and vegetation currently located in the northern part of the project area largely screen off the harbour landscape behind it. However, a few taller structures are still visible.

Figure 12-23: View from the dyke in Berendrecht of the northern part of the project area

Figure 12-24 below shows the view from the dyke in Doel, near the protected stone windmill. On the left of the image, the Vopak site (formerly Gunvor) is visible again. To the right of this site, the vegetation in the northern part of the project area is visible. Next to it is the infrastructure of IMB and Inovyn, among others. On the far right of the figure, the afforestation in the southern part of the project site is visible. Galgenschoor is located in front of these sites, along the right bank of the Scheldt. This image also clearly shows that the vegetation and afforestation provided greenery in the port landscape and contributed to the integration of Galgenschoor into the landscape.

Figure 12-24: View from the dyke in Doel, near the protected stone windmill, of the project area

Figure 12-25. View from the dyke in Doel of the project area, current situation

After the construction of the new installations within Project One, the area between the right bank of the Scheldt and the canal docks will consist of an almost entirely industrialised area. Only in the northernmost part of the project area will a zone of forest be preserved, which will still break up the view of the heavy industrial landscape to a limited extent. The structure and relationships that were present in the landscape are therefore changing significantly. New, more industrially oriented landscape relationships are emerging and finding their place in the context of the port landscape.

Taking into account the fact that, from a spatial perspective, port expansion is preferable to port extension, it can be said that although the operational phase will cause a significant change in the structure of the landscape, this is acceptable within the port landscape. The impact of the entire operational phase of the ECR is therefore assessed as having a limited negative effect (-1).

12.4.3 Change in perceptual characteristics and experiential value

In order to map the changes in the perceptual characteristics and perceived value of the landscape in the study area, images of the view were taken at various locations. The map below (Figure 12-26) shows the locations from which the images were taken.

Figure 12-26: Locations of the visualisations

12.4.3.1 Location 1

Location 1 is situated at the dyke that separates Zandvliet from the canal docks. This dyke runs alongside the Reigerbos and is mainly used by walkers, cyclists and joggers in good weather. The first image below (Figure 12-27) shows the reference situation. The Vopak site is clearly visible across the canal docks, as are various tall vertical elements (chimneys, high-voltage pylons, etc.). In this situation, the northern part of the project area is still wooded, which is also visible in the figure. After completion of the project, a large part of the forest along the northern part of the site will disappear. The ECR will become visible in the landscape, mainly the taller structures. These will blend in with the existing vertical elements in the landscape. The effect on the visual value and perceived value of the landscape can be considered limited negative (-1) in this case.

Update 2024: The third and fourth images below show an update of the existing situation and the planned situation. In the new existing situation, the northern part of the project area is no longer forested. The industrial port landscape therefore extends across the entire horizon and is no longer interrupted by forestation. The situation after completion of the project is the same as in Figure 12-28. The ECR connects to the rest of the port area, clearly representing port expansion, further strengthening the industrial landscape relationship. Compared to the deforested situation, the effect on the visual value and perceived value of the landscape can be considered limited negative (-1) to negligible (0).

Figure 12-27: Location 1 - Reference situation

Figure 12-28: Location 1 - Visualisation of planned situation after project completion

Figure 12-29. Location 1 - Update situation 2024

Figure 12-30. Location 1 - Visualisation of planned situation after project completion, update 2024

12.4.3.2 Location 2

The images at location 2 were taken from the observation tower in the Opstal Valley (Berendrecht). This observation tower offers a view of both the nature reserve to the west of the tower (including the Reigersbos and the Dorps- and Opstalbeek) and the port area and canal docks to the east. Once again, the first image shows the reference situation and the second image shows the situation after the project has been completed. The image shows the canal dock and Insteekdok 2 (on the left of the image). The northern part of the project area is visible on the right of the image, with the Doel cooling towers behind it. Once again, it is striking that the wooded part of the project area provides greenery in the port landscape. The port industry behind is partially screened from view by the trees. Nevertheless, in addition to the canal docks, many elements of the port landscape are still present. After completion of the project, a large part of the vegetation in the northern part of the project area will be removed, but the row of trees will be retained. In combination with the forest still located on the Vopak site, this will ensure that the view in this part remains largely green. The view of the contractor village will be screened off. In the southern part of the project area, the tall structures of the ECR will become more visible in the landscape. The open tower flare is particularly striking. The impact on the visual and experiential value of the landscape at this location can therefore be considered to be slightly negative (-1).

Update **2024:** The third and fourth images show the current situation and the planned situation. In the current situation, the northern part of the project area has been deforested, the row of trees has been preserved and a section of forest is still visible near the Vopak site. As in Figure 12-32, Figure 12-34 shows the planned situation. Once again, the open tower flare is particularly striking. The view of the southern part of the project area is largely screened by the tall vegetation at the edge of the observation tower. After deforestation, the impact on the visual and experiential value of the landscape at this location can be considered limited negative (-1) to negligible (0).

Figure 12-31. Location 2 - Reference situation

Figure 12-32: Location 2 - Visualisation of planned situation after project completion

Figure 12-33: Location 2 – Update situation 2024

Figure 12-34: Location 2 - Visualisation of planned situation, after project completion, update 2024

12.4.3.3 Location 3

The images at location 3 were taken on the dyke in front of the observation tower in the Opstal Valley (Berendrecht) and therefore from ground level. The first image below shows the reference situation. Once again, the canal dock and the Solvay dock are visible (on the left of the image), as are various tall, vertical elements (chimneys, high-voltage pylons, wind turbines) and elements of the industrial port infrastructure. From this location and in this direction, mainly the southern part of the project area is visible. In the reference situation, the southern part of the project area is wooded, which is also visible in Figure 12-35. The forestation forms a green element in the industrial landscape. After the realisation of the project, it can be seen that the forested area in the southern part of the project area disappears and part of the planned infrastructure becomes visible. Both the high and low structures of the ECR become visible; these elements reinforce the port landscape and blend in with it. The impact on the visual value and perceived value of the environment at this location can therefore be considered to be slightly negative (-1).

Update 2024: The next two images below (Figure 12-37 and Figure 12-38) were also taken on the dyke in front of the observation tower in the Opstal Valley in Berendrecht. The first image shows the current situation. After the removal of vegetation, the landscape is almost entirely characterised by industrial port infrastructure. The existing row of trees will be preserved. After completion of the project, as stated earlier, both the high and low structures of the ECR will be visible. These elements clearly encroach on the port landscape. After deforestation, the impact on the visual and experiential value of the environment at this location can be considered limited negative (-1) to negligible (0).

Figure 12-35: Location 3 - Reference situation

Figure 12-36: Location 3 - Visualisation of planned situation after project completion

Figure 12-37: Location 3 – Update situation 2024

Figure 12-38: Location 3 - Visualisation of planned situation, after project completion, update 2024

12.4.3.4 Location 4

Location 4 is situated near Sint-Jan Baptiststraat in the residential area of Berendrecht, which is located just behind the dyke. This dyke and the vegetation on and along it ensure that the residential area is visually shielded from the harbour landscape behind the dyke. Only a few locations offer a view of the port. This reference situation is shown in the first image below (Figure 12-39), which shows a view that offers a very limited view of the Vopak site. After completion of the project, the view of the planned site and the rest of the port area will still be shielded by the dyke and the existing vegetation. The visual disturbance from this location and the effect of the project's completion on the perceived value of the landscape at this location is therefore negligible (0).

Update 2024: Figure 12-40 shows an update of Figure 12-39. The situation at this location has remained unchanged. The visual disturbance from this location and the effect of the project's realisation on the perceived value of the landscape at this location is still negligible (0).

Figure 12-39: Location 4 - Reference situation and planned situation after project completion

Figure 12-40. Location 4 - Update situation 2024 and planned situation, after completion of project

12.4.3.5 Location 5

Location 5 is situated just outside the study area, near Abtsdreef in the municipality of Stabroek. As mentioned earlier, Stabroek is a typical residential area for this landscape, with a linear street pattern and surrounded by agricultural polder landscape. The edge of the residential area is less densely built-up, allowing the houses to overlook the agricultural landscape. Because visibility is greater here, the impact of the port landscape will also be greater. Location 5 is also located on the edge of the residential area. Figure 12-41 shows the reference situation from this location. Because the agricultural landscape is so flat and there are few to no large vegetation structures, the port landscape is already prominent in the current situation. Large vertical structures such as high-voltage pylons, cranes and wind turbines catch the eye and dominate the horizon. The cooling towers of Doel are also visible. After completion of the project, the ECR will also be partially visible from this location. This mainly concerns the taller structures; lower structures of the ECR will be largely screened by infrastructure closer to the viewing point, such as the blue cranes. The effect on the visual value and the experiential value can be considered negligible (0).

Update 2024: Figure 12-43 and Figure 12-44 show an update of the current situation and the planned situation, respectively. Apart from the relocation of dynamic port elements such as the cranes, the current situation has not changed compared to the situation shown in Figure 12-41. After completion of the project, as stated earlier, the ECR will be limitedly visible from this location. Even in relation to this updated reference situation, the effect on the visual value and the experiential value can be considered negligible (0).

Figure 12-41: Location 5 - Reference situation

Figure 12-42: Location 5 - Visualisation of planned situation after project completion

Figure 12-43. Location 5 - Update situation 2024

Figure 12-44: Location 5 - Visualisation of planned situation after project completion, update 2024

12.4.3.6 Location 6

The images at Location 6 were taken from the jetty in Lillo, looking north. The first image below (Figure 12-45) shows the reference situation. From this jetty, a large part of the port landscape with its characteristic elements is visible. The Doel nuclear power plant is the most striking element on the horizon, but high-voltage pylons and cranes are also present. In contrast to the port landscape, this location also offers a view of the Galgenschoor and the dyke surrounding the Fort of Lillo. Only a few elements of Project One will be visible from the jetty. The landscape will therefore only be changed to a limited extent by the realisation of the project. This effect can therefore be considered negligible (0).

Update 2024: An update of the current situation and the planned situation are shown in Figure 12-47 and Figure 12-48, respectively. The difference between the reference situation in Figure 12-45 and the current situation in Figure 12-47 is limited and purely due to seasonal differences or the relocation of dynamic elements from the port industry, such as cranes. Once again, only a few elements of Project One will be visible from this location. The effect can still be considered negligible (0).

Figure 12-45: Location 6 - Reference situation

Figure 12-46: Location 6 - Visualisation of planned situation after project completion

Figure 12-47: Location 6 - Update situation 2024

Figure 12-48: Location 6 - Visualisation of planned situation after project completion, update 2024

12.4.3.7 Location 7

The first image below (Figure 12-49) was taken from the dyke surrounding Fort Lillo and shows the reference situation. The dyke is overgrown with tall shrubs and trees, but there are large openings at various locations that offer views of Galgenschoor and the landscape beyond. Once again, several port elements are already conspicuous in the landscape in the reference situation. These include high-voltage pylons, cranes and the Doel nuclear power plant. The realisation of the project will hardly change the landscape; this is shown in Figure 12-50. The ECR will only be visible to a very limited extent (see red circle in Figure 12-50). This is partly due to the distance between the viewing location and the project area and to the vegetation that buffers the view, as it were. The impact of the project on the perceived image and experience value of the landscape at this location can therefore be considered negligible (0).

Update 2024: The third and fourth images below show an update of the situation in Figure 12-49 and the planned situation in Figure 12-50. As at location 6, no significant changes from the current situation are visible here. The differences are mainly due to a difference in season and the growth of vegetation. The situation after the completion of Project One also remains the same as in the above assessment. The impact of the project on the perceived image and experience value of the landscape at this location can still be considered negligible (0).

Figure 12-49: Location 7 - Reference situation

Figure 12-50: Location 7 - Visualisation of planned situation after project completion

Figure 12-51: Location 7 - Update situation 2024

Figure 12-52: Location 7 - Visualisation of planned situation, after project completion, update 2024

12.4.3.8 Location 8

Finally, location 8 was chosen near the residential area of Doel. This residential area is located behind a dyke, which largely shields the view of the harbour landscape from the centre. The images below were taken from this dyke. The dyke is used by walkers, cyclists and joggers, especially in good weather. The protected heritage site Stenen windmolen (ID: 7787) is also located along this dyke. Figure 12-53 shows the reference situation. This figure clearly shows the vegetation located in the project area. This vegetation breaks through the heavy port infrastructure on the right bank of the Scheldt, as it were. Figure 12-54 shows the situation after the completion of the project. After completion of the project, the existing vegetation will disappear, except at the Vopak site (formerly the Gunvor site), where part of the forest will remain. The infrastructure of the ECR will be clearly visible at this location, enhancing the port landscape. The impact of the project on the perceived value and visual appeal of the landscape can be assessed here as limited negative (-1)/negligible (0).

Update 2024: Figures 12-55 and 12-56 below show the current situation and the planned situation, respectively. In the existing situation, the effect of deforestation is clear; no vegetation is visible in the project area. The landscape on the horizon is completely dominated by the port infrastructure. As shown in Figure 12-54, the planned situation will make the ECR infrastructure clearly visible at this location. This port expansion will enhance the port landscape. The impact of the project on the perceived and visual value of the landscape after deforestation can be considered negligible (0) in this case.

Figure 12-53: Location 8 - Reference situation

Figure 12-54: Location 8 - Visualisation of planned situation after project completion

Figure 12-55: Location 8 - Update situation 2024

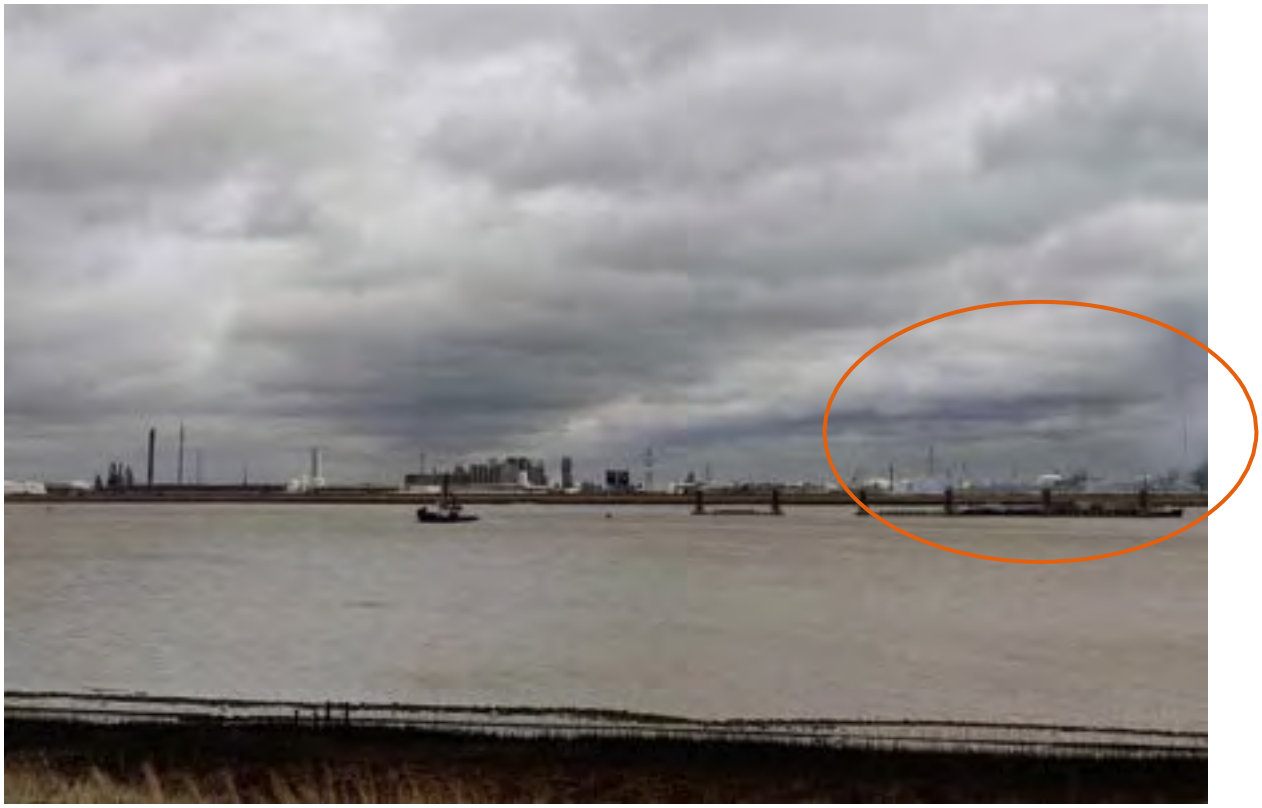

Figure 12-56: Location 8 - Visualisation of planned situation after project completion, update 2024

12.4.4 Mitigating measures and recommendations

Only at location 1, location 2, location 3 and, to a limited extent, at location 8 are the effects of this project assessed as having a limited negative impact. At all other locations, the effects are negligible. Based on the situation with deforestation (update situation 2024), the effects at location 8 can also be considered negligible. Landscape mitigation measures are not obvious in this case, partly due to safety considerations, limited available space and the size of the installations. Moreover, the context of the port makes mitigation measures less necessary. For these reasons, no mitigation measures are proposed from the perspective of Landscape, Architectural Heritage and Archaeology.

12.5 Cumulative effects

12.5.1 Retaining wall

The new quay wall is located along the Project One project area. Construction of the quay wall began in 2021 and will be fully completed in the course of 2024. The construction phase of the quay wall therefore runs partly parallel to the construction phase of Project One. As mentioned earlier, the surroundings of both projects are characterised by the Port of Antwerp, associated port activities (docks, shipping, industry, etc.) and anthropogenic structures. The construction of the quay wall will have no impact on the current landscape structure and will only be visible to a limited extent from the study area. The cumulative impact of the construction of the quay wall and the operational phase of Project One will therefore also be very limited. At most, the construction of the quay wall will further reinforce the port elements present in this landscape, thereby integrating the present project even better into the existing port landscape.

12.6 Mitigating measures

For mitigating measures in the field of archaeology, please refer to the additional studies described in the archaeology memorandum and the accompanying Programme of Measures that was drawn up.

The planned infrastructure will be built within the existing port landscape and at a relatively large distance from the existing residential areas. The effects on the perceived value of the surrounding landscape are largely limited negative (-1) or negligible (0). Given the size of the infrastructure, safety considerations and the limited space available for mitigating measures, it is not easy to provide for mitigating measures. Moreover, the context of the port landscape means that mitigating measures are less necessary in this case. For these reasons, no mitigating measures are proposed from the perspective of Landscape, Architectural Heritage and Archaeology.

12.7 Conclusion

The effects on the landscape, architectural heritage and archaeology were outlined in this chapter. Both the effects of the construction phase and the operational phase were discussed.

Construction phase

During the site preparation, given that the site was reclaimed in the 1960s, there will be no loss of landscape, architectural or archaeological heritage values. However, the landscape structure at this location has changed: the existing forest structure and scrub vegetation have been removed. This has significantly altered the landscape structure and disrupted the landscape ecological relationships. This can be considered a negative effect (-2). Deforestation also has an impact on the perceptual characteristics and the associated experiential value. However, as the project area is located in an industrial area, the landscape experience is already very limited in the current situation. The removal of the forest does have a permanent impact on the view of the area. The view of the surrounding industrial landscape is enhanced.
These effects are mainly local and the impact varies from limited negative (-1) to negative (-2).

After the vegetation was cleared, preparatory work began, which will involve further excavations. The archaeological report (desk study) revealed that the project area has significant archaeological potential for deeply buried remains from the Stone Age. It was argued that a follow-up to the preliminary archaeological investigation was only necessary in the southern part of the project area, where 25-metre-deep pile foundations are planned. The first phase of the postponed investigation (landscape soil investigation) showed that the subsoil in the southern project area is characterised by sufficiently good preservation, which led to archaeological drilling being carried out. Various phased drillings provided clear indicators of the presence of (clustered) prehistoric finds. The phased archaeological research carried out points to a new archaeological site from prehistory that is worthy of preservation.
This could contribute significantly to the still limited knowledge of prehistory in Flanders. The planned soil interventions are therefore seen as a direct threat to the identified archaeological remains. This is mainly due to the deep pile foundations that perforate the find layer. The extent to which the site will be disturbed cannot be clearly determined. The impact of the planned groundworks on the informational value of the site and the associated knowledge potential are therefore also difficult to estimate. For conclusions regarding possible loss of heritage values and the necessary additional investigations, please refer to the notes from the regular and postponed archaeological process. Construction will take place in a temporary open zone that was created after the preparatory works. The construction of the various installations, the temporary site zones, the roads and office spaces will cause a major change in the landscape structure and landscape relationships during construction. However, this is acceptable within the context of the industrial port landscape. During the construction phase, various anthropogenic elements will be present on the site. These include the contractor village, which will also be retained during the operational phase, with associated elements and temporary roads. Furthermore, various machines will be required for construction, and modules of the installation will be delivered by ship and moved around the site. The landscape within the project area will therefore be in a state of constant change during the construction phase. This will cause a temporary disruption to the perceptual characteristics of the landscape, and the experiential value of the site will also change. However, within the context of the industrial landscape, these effects can be considered to be limited negative (-1).

Operational phase

The project area is located in the port landscape of Antwerp, which is characterised by industry, canals, docks and port-related infrastructure. The heritage value of the project area itself is very limited. Therefore, no loss of landscape and architectural heritage value will occur during the operational phase.

During the operational phase, the site will feature a number of striking elements. These include the cryogenic storage tank and the vertical elements of the process installations (chimneys, distillation columns, cracking furnaces, tower flare, cooling towers). As mentioned earlier, the project area is located entirely within the port landscape, and the study area is also characterised by structural elements from this port landscape (industrial areas, canal docks, cranes, high-voltage pylons, etc.). However, within the study area there are also a large number of elements that are not linked to the industrial character of the port. These include various residential areas and the surrounding agricultural polder landscape. The existing woodland in the project area broke up the heavy industrial landscape; in the exploitation phase, the zone between the right bank of the Scheldt and the canal docks will consist of an almost entirely industrialised area.
Only a small part of the previously contiguous forest remains near the Vopak site. In general, the landscape relationships and structure will change significantly. However, this concerns port expansion, whereby more industrial landscape relationships will find their place in the context of the port. The impact of the entire operational phase on the structural changes can therefore be assessed as only slightly negative (-1).

In order to analyse the impact of the operational phase on the perceptual characteristics of the landscape, visualisations were created at various locations using the 3D model of the installations. The selected locations include residential areas, the dyke along the canal docks and the vicinity of the culturally and historically protected salt marshes. The indirect effect of this project on the landscape in the study area varies from negligible (0) to limited negative (-1). In the residential areas, which are often located behind dykes and where there are often many landscape elements that block the view of the port, the impact is largely negligible (0). The agricultural polder landscape around the residential areas is very flat, with little to no large vegetation structures. The current harbour landscape is often already prominent in these locations. This automatically mitigates the additional effect of this project on the visual and experiential value.

In general, the impact of the operational phase on the perceptual characteristics and experiential value of the landscape can be considered to be slightly negative (-1). As mentioned earlier (§ 12.6), mitigating measures are desirable in some locations, but not obvious. For this reason, no mitigating measures are proposed from the perspective of Landscape, Protected Heritage and Archaeology.

As described above, the cumulative impact of Project One was considered in relation to the construction of a new quay wall. Overall, it can be said that this cumulative impact is rather limited for the discipline of Landscape, Immovable Heritage and Archaeology.

13 People – Health

13.1 Delimitation of the study area

The EIA discipline 'People', sub-domain Health, can be described as: the part of the environmental impact assessment that deals with collecting, processing and interpreting information about changes in the living environment in order to assess the short- and long-term consequences for public health.

The World Health Organisation (WHO) defines health as: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". This broad definition implies that environmental impact assessments must take into account not only the direct impact of stressors, but also the existing situation, the longer-term effects, the social context, the indirect psychosomatic effects and public perception.

This discipline is a receiving discipline. This means that it receives the necessary data from abiotic disciplines such as Air and Noise. The demarcation of the study area is therefore a function of the space within which a significant change in the environment is expected. The study area may contain different zones that are influenced by different agents (e.g. a specific pollutant, noise, etc.). The study area of the sub-discipline Health must cover all these areas of influence. The study area therefore corresponds to the largest of these areas of influence. For the discipline Air, the expert has proposed a study area of 20 km. The area of influence appears to be greatest for the parameter NO_2. The study area selected was the contiguous area of statistical sectors and neighbourhoods where the impact of NO_2 is considered to be non-negligible and where there is residential occupation. This study area also covers the area of influence of all other agents and is therefore retained as the study area in the Health sub-discipline.

13.2 Methodology

The changes in the living environment studied here include physical, chemical and biological agents: emissions of harmful substances, noise pollution, disease-causing organisms and radiation. Attention is also paid to recommendations and measures to prevent, mitigate or remediate harmful effects.

The aim is not only to discuss the possible effects, but also to identify population groups that are at (increased) risk. The discipline of Human Health also covers the aspect of 'psychosomatic' effects. 'Psychosomatic' effects refer to possible physical complaints that have a psychological cause. In the case of 'psychosomatic' effects, the direct cause is not always clear. There is always a combination of factors at play. Psychological problems are often understandable human reactions to specific situations and are not simply a biomedical, genetic, neurological reaction or a brain disease. However, a number of risk factors can play a decisive role, such as genetic history, personality factors, traumatic events, age, the duration of certain symptoms, (over)sensitivity to stimuli, etc. An overview of these symptoms is mainly indicative here.

The assessment of potential health effects is based on toxicological and epidemiological research. The first step in estimating health risks involves determining the dose or concentration to which residents of the study area are exposed. Exposure is also largely determined by exposure routes, human behaviour and age. The absorbed dose is compared with the applicable guideline values. It must then be determined which health effects are caused by this dose.

The dose-effect relationship is the result of toxicological and epidemiological research on both humans and laboratory animals[83]. The method used to assess health risks, based on exposure and dose determination, is known as health risk analysis.

Use is made of the available dose-effect relationships and studies carried out by VITO, the Flemish Institute for Technological Research. As stated, toxicological and epidemiological research complement each other:

- Toxicological research attempts to predict the effects based on the dose to which organisms are exposed. Environmental toxicology focuses in particular on studying the effects of pollutants in the environment on organisms. Transport through the environment is also taken into account.
- Epidemiology studies a population and describes the effects that occur. This combined research makes it possible to consider only the relevant health effects. Based on this data, the health risk in the study area can be estimated. It is then possible to identify risk groups in the study area that require increased attention. Once the expected health effects have been described, an evaluation will be carried out and mitigating measures can be proposed.

In concrete terms, this means that we study the possible effects on health when the immission contributions are considered significant in the abiotic disciplines or when complaints or perception problems require this. After interpreting the significant immission values, the exposed population groups are described, as well as the possible consequences. Depending on the number and nature of those exposed, these significant changes in the environment are considered a significant effect within the discipline of Health, and mitigating measures are proposed by the expert. The assessment takes into account the change in immission or exposure resulting from the project.

The EIA guidelines system for humans, subdomain Health, determines which aspects should be included in the assessment of health effects on humans. It consists of five complementary steps (see Figure 13-1) that are carried out in three consecutive phases.

[83] In epidemiological studies, the term 'exposure-response relationship' is more commonly used.

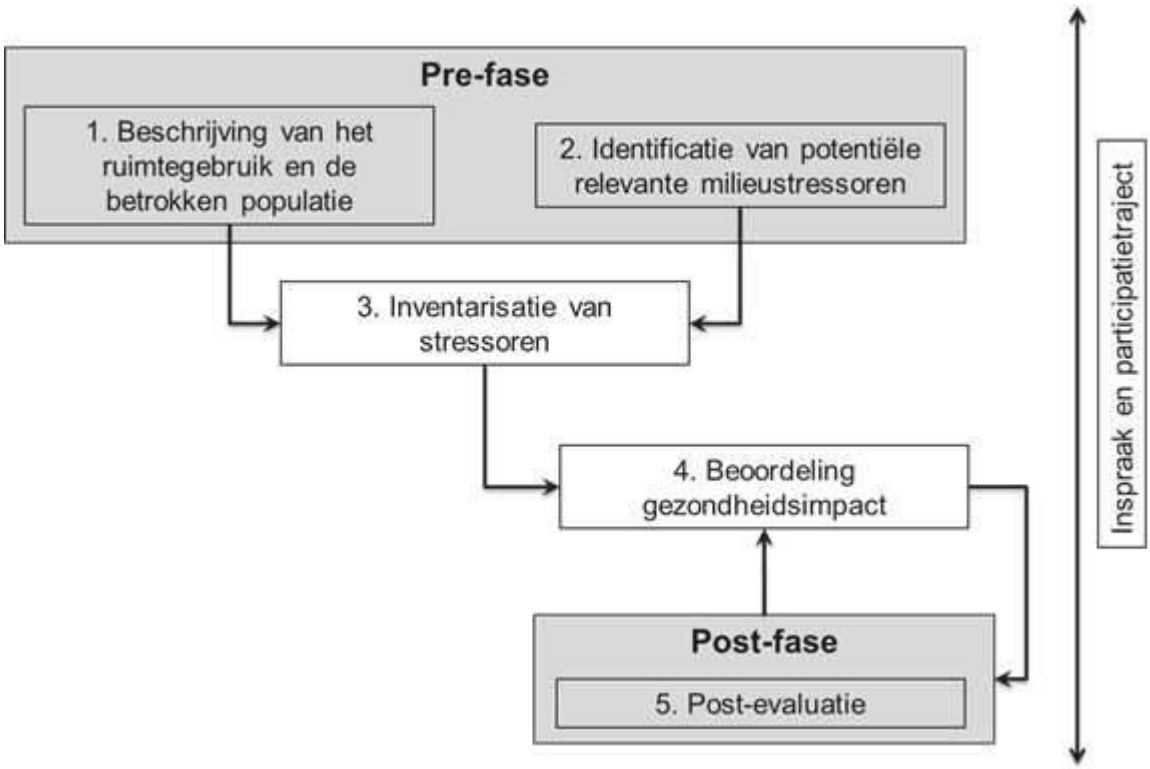

Figure 13-1: Consecutive phases of the methodology for evaluating health effects in EIA studies.

The selection criteria for further characterisation of exposures to physical, chemical and biological agents are based on the EIA guideline system, scientific literature and expert experience.
Important parameters are the exceedance of background emissions, the contribution of the activity under consideration, or pre-existing complaints or existing concerns among the population.

13.2.1 Reference values for assessing severity

13.2.1.1 Chemical stressors

The Health sub-discipline aims to identify and, where possible, assess the potential impact on human health. This assessment is based on existing health-related advisory values (hereinafter referred to as GAW) for chemical stressors resulting from the planned facility or activity. The assessment against limit values/legal standards/guideline values is carried out in the separate technical disciplines (Noise and Air). This assessment is therefore not repeated in the Health chapter. The legal standards are only mentioned here for comparison purposes.

Unlike legal standards, which also take into account technical feasibility and economic aspects, health-based advisory values are established solely from the perspective of protecting public health. Health-based advisory values are therefore usually more conservative than legal standards. They are based on established dose-response relationships or findings. However, these advisory values have no legal force. They are often established by international organisations.

International literature contains a wide range of reference values from various authorities (e.g. WHO, ATSDR, US EPA, CalEPA, ECHA, etc.). The choice of a health assessment value from this range is often a sticking point in risk analyses. That is why the Department of Care (formerly the Agency for Care and Health) had a protocol developed to select the most relevant reference value(s) (VITO, 2020). The protocol uses a systematic and standardised method to select the health advisory value to be used in a uniform and transparent manner. The sources to be consulted are divided into primary, secondary and tertiary sources:

- Primary sources originate from international agencies, undergo a rigorous peer review process, and employ transparent and well-documented methodologies (e.g. WHO, US EPA, EFSA, ATSDR).
- secondary sources: generally also well documented and transparent, but the peer review process is more limited or they originate from national agencies (e.g. OEHHA, ANSES, Health Canada, PPRTV of US EPA);
- Tertiary sources may be consulted if the primary and secondary sources do not lead to a suitable GAW. These tertiary sources often also have a more specific or limited scope of application (e.g. RIVM).

The reference values from primary sources are preferred over the reference values from secondary sources. Nevertheless, the protocol gives the most weight to the most recent derivations of the reference value.

The selection protocol should only be applied by the EIA expert if no health advisory value has yet been selected by the Department of Health. In 2017, the Department of Health took the initiative to select the HVA for inhalation exposure for use in the EIA section on human health for 20 chemical stressors that frequently occur in environmental impact assessments. When conducting an EIA, there is a need for uniformity in mapping and assessing the short- and long-term effects on public health. In 2021, the WHO published an update to the Air Quality Guidelines, tightening the WHO guideline values for six parameters. Following this WHO update, VITO carried out in-depth analyses of the available toxicological information for, among other things, particulate matter (PM_{10} and $PM_{2.5}$) and nitrogen dioxide in 2022 on behalf of the Department of Health. The list of GAWs to be used in EIA studies, based on in-depth analyses of the available toxicological information, can be found on the Department of Health's webpage [84] (https://www.zorg-en-gezondheid.be/aandachtsgebieden-en-humane-biomonitoring).

A distinction is made between health effects that occur above a certain exposure threshold and health effects without a threshold. For non-threshold effects, health-based guidance values can be derived, whereby no adverse health effects occur as long as these health-based assessment values ('thresholds') are not exceeded. The duration of exposure determines the assessment value to be used.

Other effects have no threshold value. These are mainly carcinogenic effects. For genotoxic carcinogenic effects, there is a linear relationship between exposure and risk. Every exposure carries a certain risk, albeit sometimes very small. For these effects, the health advisory value is set at the concentration that, with lifelong exposure, corresponds to an additional cancer risk of $^{1}/_{106}$, which is internationally accepted as a 'zero effect' (from a public health perspective, the risk is negligible)[85].

For non-carcinogenic effects without a threshold value, a 'pseudo' health advisory value is used (e.g. premature mortality due to $PM_{2.5}$). These advisory values are often formulated by the WHO. They are designed to protect the majority of the population from adverse health effects.

The sections below explain the reference values that are relevant to this project EIA.

13.2.1.1.1 NO_2

Nitrogen dioxide has adverse health effects due to its impact on the respiratory system.

European Directive 2008/50/EC defines limit values and an alert threshold for NO_2, implemented in Flemish legislation via VLAREM II. These are:

[84] The webpage with the guidelines for Health in EIA studies and the Department of Care were last consulted on 29/04/2024
[85] More information on the origin of the acceptability criteria is included in Appendix 2 of the report 'Carcinogenic risks in public health risk assessments' (Care and Health Agency, 18/12/2015).

- limit values:
  - 40 µg/m³ as an annual average;
  - 200 µg/m³ as a 1-hour average, may be exceeded 18 times per year;
- alarm threshold;
  - 400 µg/m³ for three consecutive hours.

These standards apply to outdoor air. For indoor air (applicable in homes and publicly accessible buildings), the Decree of the Flemish Government on measures to combat health risks caused by indoor environmental pollution of 11 June 2004, amended by the Decree of the Flemish Government of 13 July 2018, known as the Indoor Environment Decree, applies:

- 20 µg/m³ as a guideline value;
- 40 µg/m³ as an intervention value.

The above values for indoor air apply to chronic exposure.

As mentioned above, in addition to health, other aspects are also taken into consideration when setting limit values. Health-based advisory values are only set for the protection of public health. As with other pollutants, there are various sources of health-based advisory values available for NO_2.

VITO conducted an initial in-depth analysis for NO_2 in December 2017, at the request of the Department of Health. This was revised in 2022. In this revised analysis, the WHO guideline value (2021) of 10 $\mu g/m^3$ is selected as the health-based guideline value for NO_2.

This advisory value is based purely on health considerations, does not include a feasibility analysis, and does not specify what the (policy) consequences should be if this value is exceeded. The WHO is well aware that achieving this low value is not feasible in the short term for many countries and areas, and therefore proposes interim target values (which are not based on health considerations) that can be used by policymakers to take 'steps towards' the recommended values, which are the ultimate goal. There are no deadlines attached to these interim targets; they are only intended as a tool for policymakers. Specifically, the WHO proposes the following interim targets: Interim target 1: 40 µg/m³; Interim target 2: 30 µg/m³; Interim target 3: 20 µg/m³.

This EIA assesses the annual average GAW selected by VITO for use in EIA studies (hereinafter referred to as GAW), namely 10 $\mu g/m^3$.

13.2.1.1.2 PM_{10} and $PM_{2.5}$

Particulate matter (PM_{10} and $PM_{2.5}$) is an atypical component because it has a physical rather than a chemical definition: all solid and liquid particles in the air with an aerodynamic diameter smaller than 10 µm or 2.5 µm, respectively. These particles are inhalable and can therefore cause health effects.

Fine particulate matter causes health effects after inhalation, both in the short and long term. The effects depend on the size and composition of the particles. Both short-term exposure to elevated concentrations and an elevated background concentration lead to health effects. Vulnerable groups include the elderly and people with heart, vascular or lung conditions. Several studies link acute exposure to PM_{10} and $PM_{2.5}$ fine particulate matter with premature death, mainly among elderly people with heart and lung problems. In children, fine particulate matter reduces lung function at TSP (total particulate matter) concentrations above 180 µg/m³ or when there are more than 110 µg/m³ of respirable particles (PM_{10}).

Following the WHO update in 2021, VITO conducted another in-depth analysis in 2022 to derive a GAW for PM_{10} and $PM_{2.5}$ for use in EIA studies.

PM_{10} or $PM_{2.5}$ are not classified as carcinogenic substances as such. However, due to the presence of carcinogenic substances, PM_{10} and $PM_{2.5}$ can have carcinogenic properties. For example, diesel soot and fine particulate matter in outdoor air pollution are classified as carcinogenic (group 1) by the WHO.

However, since this carcinogenicity is not directly linked to the physical property (inhalable particle), VITO did not take carcinogenic properties into account when deriving the GAW[86].

The WHO guideline value (2021) for $PM_{2.5}$ (5 µg/m³; annual average) is proposed as the GAW for $PM_{2.5}$ in outdoor air. The value is based on a thorough, systematic meta-analysis of the most recent studies.
with regard to the health effects of $PM_{2.5}$ exposure. This value is the lowest published assessment value for $PM_{2.5}$ to date, but cannot be considered an absolute lower limit below which effects can be ruled out.

For PM_{10}, the WHO guideline value (2021) of 15 µg/m^3 (annual average) is proposed as the GAW for long-term exposure.

Since it is often not feasible to comply with these guideline values (especially in polluted areas), the WHO has also set interim target values for $PM_{2.5}$ (1: 35 µg/m³; 2: 25 µg/m³; 3: 15 µg/m³; 4: 10 µg/m³) and PM_{10} (1: 70 µg/m³; 2: 50 µg/m³; 3: 30 µg/m³; 4: 20 µg/m³). As with NO_2, these are only tools for policymakers in their efforts to achieve the guideline values; they are not based on health considerations and there are no deadlines attached to them.

This EIA assesses the annual average GAW selected by VITO for use in EIA studies, namely 5 µg/m^3 and 15 µg/m^3 for $PM_{2.5}$ and PM_{10} respectively.

13.2.1.1.3 Benzene

Benzene has a toxic effect on the blood and blood-forming tissues. Benzene is also carcinogenic. Benzene causes acute myeloid leukaemia (acute non-lymphocytic leukaemia) and there is limited evidence that benzene also causes acute and chronic lymphocytic leukaemia, non-Hodgkin's lymphoma and multiple myeloma. Benzene is toxic to the foetus in mice and rabbits after inhalation exposure of the mother: it causes reduced birth weight. However, it has not been found to be teratogenic in animal studies, even at doses that are toxic to the mother (source: WHO, 2010).

99% of all exposure occurs through inhalation.

Sensitive groups include children, adolescents, pregnant women, people with compromised immune systems and the elderly.

In December 2017, VITO conducted an in-depth analysis of benzene at the request of the Department of Health (VITO, 2017). The following sources were used:

Primary sources:

- WHO (2000; 2009);
- US EPA (2000; 2003);
- ATSDR MRL (2007, non-carcinogenic effects only);

Secondary sources:

- California OEHHA (2008, 2014);
- ANSES Valeurs Toxicologiques de Référence;

Tertiary sources:

- RIVM (2001).

The following section focuses on carcinogenic effects, as these form the basis for VITO's reference value.

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[86] VITO (2017) Selection of health advisory value for parameter PM_{10} for use in EIA. Commissioned by the Care and Health Agency. 8 December 2017.

According to the World Health Organisation (WHO), no safe level of benzene exposure can be established. The WHO expresses the harmfulness of benzene as the number of additional cancer cases resulting from lifelong exposure to a certain concentration. Lifelong exposure to a benzene concentration of 17 $\mu g/m3$ would result in one additional cancer case per 10,000 inhabitants, at a concentration of 1.7 $\mu g/m3$ one per 100,000 inhabitants and at 0.17 $\mu g/m3$ one per 1,000,000. The calculated unit risk is $6.0.10^{-6}$ per µg/m³ and is based on the so-called Pliofilm cohort (sometimes also referred to as the 'Plioform' cohort). To date, this is the most studied cohort with regard to benzene exposure. It concerns a cohort of more than 1,000 workers in a rubber film production company, followed up in the period 1936-1976 (and updates until 1987).
Various studies concerning the Pliofilm cohort form the basis for the unit risk derived by WHO (2000). The geometric mean of the range of unit risks in these studies was used by WHO (2000) as the unit risk for benzene.

The US EPA (2000) prefers to give a range of unit risks rather than a point estimate, due to the uncertainties involved in the exposure estimates made in the Pliofilm cohort and because different models were used by different authors, leading to different unit risks. The US EPA therefore gives a range of 2.2×10^{-6} – 7.8×10^{-6} per µg/m³.

California OEHHA's (2009) choice of an additional cancer risk of 2.9×10^{-5} per µg/m³ is based on a reference to a document from 1988. The original source documents could not be found by VITO.

The French Agence Nationale de Sécurité de l'Alimentation, de l'Environnement et du Travail (ANSES) uses Richardson's 2008 recalculations based on the Pliofilm cohort to derive the unit risk. These calculations specifically identified where the workers were employed, their age groups and the duration of their exposure. The analysis shows that older workers (>45 years) in particular showed an increased incidence of leukaemia in the first 10 years after exposure, while young people showed virtually no increased incidence. The calculated unit risk is $2.6.10^{-5}$ per µg/m³.

The RIVM (2001) follows the unit risk derived by the WHO.

VITO does not take into account the unit risk calculated by OEHHA, as the background is insufficiently known. VITO does not accept the risk calculated by ANSES, as this takes into account the most sensitive population group. VITO extrapolates this unit risk to the concentration with an additional cancer risk of 1 in 1,000,000, based on a linear dose-response relationship. However, there is data that points to a non-linear relationship. Although there are indications that a linear model probably does not fully describe the actual form of the benzene dose-response relationship, there are currently no better models, and VITO therefore uses the linear dose-response model for reasons of caution.

It has been calculated that an additional cancer risk of 1.10^{-6} corresponds to lifelong exposure to an average concentration of 0.038 µg/m³.

This EIA assesses the reference value of 0.038 µg/m³ (annual average), which according to ANSES corresponds to an additional risk of 1 in 10^{6}. This value is considerably lower than the European annual average standard, which has been 5 µg/m³ since 2010, in accordance with European Directive 2008/50/EC of the European Parliament and of the Council of 20 May 2008 on ambient air quality and cleaner air for Europe. This creates a discrepancy between, on the one hand, the EIA assessment under the Air discipline, which is based on the standards set out in European Directive 2008/50/EC, and, on the other hand, the EIA assessment under the Human Health discipline, which is based on scientific advisory values. The two EIA assessments are complementary.

13.2.1.1.4 Butadiene

Exposure to high concentrations of butadiene may cause irritation or effects on the central nervous system. However, carcinogenicity is the critical effect for the derivation of advisory values. A cohort study of workers employed in the production of 1,3-butadiene (monomers) or polymers based on 1,3-butadiene shows an increase in leukaemia. The haematological system is considered to be the target organ of butadiene. There is currently insufficient data to draw conclusions regarding the type of leukaemia.

VITO has not yet carried out an in-depth analysis for butadiene. In that case, according to the Human Health Guideline System, the standard evaluation scheme in the selection protocol must be implemented.

The standard evaluation scheme for the selection of GAW is applicable to both carcinogenic and non-carcinogenic effects.

If only one reference value is found from a primary source, and this is more than 10 years old, it must be used in accordance with the selection protocol, unless there is a more recent secondary source based on a new key study.

Only one primary source was found, namely US EPA, derived in 2002 (> 10 years). There are no more recent secondary sources based on a new key study.

The unit risk derived by the US EPA is based on a cohort study by Delzell et al. (1995) involving more than 15,000 workers in a styrene-butadiene rubber production facility and the analyses by Health Canada (1998). The unit risk of death from leukaemia is 0.03 per ppm (or 0.013 per mg/m³), based on an LEC_{01} (lower 95% confidence limit of an exposure concentration associated with a 1% increase in risk) of 0.375 ppm (0.8 mg/m³). However, since the aim is to estimate cancer incidence rather than mortality, an additional calculation was performed. This results in a LEC_{01} of 0.254 ppm (approx. 0.56 mg/m^3). A correction factor of 2 was then applied due to the possible underestimation of the risk for the entire population, by extrapolating from a cohort study involving only men. Studies in both rats and mice show that 1,3-butadiene not only causes leukaemia but also cancers in other organs. It is possible that the epidemiological study did not have sufficient discriminatory power to detect the risk of cancer in other organs (e.g. lung cancer). Furthermore, studies in rats and mice show that female animals are more sensitive to the carcinogenic effect of 1,3-butadiene than males. This results in a unit risk of 0.08 per ppm (0.04 *2) (or 0.03 per mg/m³). Linear extrapolation shows that an additional cancer risk of $1.^{10-6}$ corresponds to lifelong exposure to an average concentration of 0.033 µg/m³.

For butadiene, a reference value was derived for two effects (see Appendix 3.1):

Carcinogenic effects (leukaemia) (based on epidemiological (cohort) study, exposure under occupational conditions): 0.033 µg/m³;
Ovarian atrophy (based on a 2-year inhalation study in mice): 2 µg/m³.

For butadiene, the effects will be assessed for the most sensitive effect, in this case the carcinogenic effect.

13.2.1.1.5 NH_3

Ammonia can have adverse health effects by affecting the respiratory system. Chronic exposure to ammonia can lead to an increased incidence of respiratory symptoms, reduced lung function and asthma (symptoms). No GAW has yet been determined in the Guideline System, nor by VITO. A literature review shows that in 2016, the EPA conducted an evaluation of the non-carcinogenic health effects of ammonia exposure through inhalation. This evaluation identified 500 $µg/m^3$ as the RfC (Reference Concentration for Inhalation Exposure). Consequently, the present EIA assesses 500 $µg/m^3$ as the GAW.

13.2.1.2 Physical stressors

Noise

Above certain noise levels, depending on the characteristics of the noise and other non-acoustic factors, the following effects may occur:

- sleep disturbance, resulting in sleepiness and reduced cognitive functioning in the short term, and possibly cardiovascular disease, depression, type 2 diabetes, increased medication use and accelerated ageing in the long term. The WHO recommends a guideline value of 45 dB(A) for sleep disturbance.

At night, as LAeq over 8 hours, measured outside, with the window slightly open (WHO, 1999). Indoors, in the case of continuous noise, the noise level should not exceed 30 dB(A) in order to prevent sleep disturbance.
For the average noise level over a year (Lnight,outside), the WHO recommends a value of 30 dB(A));

- direct effects on the autonomic nervous system and the hormonal system (increased blood pressure, ischaemic heart disease), from an Lnight,outside of 50 dB(A);
- cognitive effects (effects on reading comprehension, problem solving, etc.);
- mental effects (certain studies indicate increased aggression and reduced helpful behaviour, reduced ability to process social non-verbal communication). Helpful behaviour decreases at a level of 80 dB(A) (WHO, 1999); for mental disorders, a threshold value of Lnight,outside of 60 dB(A) applies);
- (self-reported) annoyance. The WHO recommends a value of 50 dB(A) (LAeq,16h) for moderate annoyance. and 55 dB(A) (LAeq, 16h) for serious nuisance during the day and evening (outdoor living space values) (WHO, 1999);
- hearing loss from peak noises of 140 dB(A) for adults and 120 dB(A) for children (WHO, 1999) from 70 dB(A) as LAeq,24h (ISO standard 1999). For LAeq,1h, the WHO recommends a guideline value of 85 dB(A) for public spaces (indoor and outdoor) and a value of 110 dB(A) for LAmax.

For industrial noise, there is very little specific information about the extent to which this noise source can cause nuisance or health effects. This is largely due to the great heterogeneity and specific characteristics of industrial noise, and the fact that the population's exposure to industrial noise is very localised[87].

For noise, assessments will therefore be made against the VLAREM II environmental quality standards (in the case of L_{A95}) or the WHO advisory values of 1999 (in the case of L_{Aeq}). For information purposes, the calculated Lden and Lnight values (related to Project One) are also given and compared with the standard values for industrial sites from the Dutch Environment Act (Supplementary Decree on Noise[88]), namely an L_{den} of 50 dB(A) and an L_{night} of 40 dB(A) at the level of noise-sensitive buildings. These are also the values that, according to the EIA - Human Health guideline system, define the study area for the noise aspect. However, the calculated L_{den} and Lnight values cannot be directly compared to the standard values because:

L_{den} and $L_{night,}$ as defined in the Environmental Noise Directive, are based on the A-weighted average noise level measured over a period of one year. However, for assessment against VLAREM II, the noise levels at each location are always calculated as worst case, i.e. with a tailwind, in the Noise discipline.
The calculation model does not allow for an annual average for industrial noise. The L_{den} and L_{night} values derived from this are therefore overestimates, especially at locations that are upstream of the prevailing wind direction in relation to the project.
The Dutch standard values refer to the cumulative noise pollution from all facilities on the site, while the calculated L_{den} and Lnight values only concern the contribution of Project One.

Light

Light pollution is the nuisance caused by artificial light. This includes not only glare or disturbance caused by the light source itself, but also the reduction of night-time darkness.

The population may experience nuisance from glare and stray light. Stray light on the bedroom window can also cause sleep disturbances. Artificial light can also disrupt the sleep-wake cycle.

Exposure-response relationships between indoor light intensity and physiological effects (such as eye movements, EEG activity, self-reported sleepiness, melatonin production) have been fairly well established. However, this does not apply to the relationship between these effects and outdoor light intensity. There is no scientific consensus on what level of artificial light intensity is acceptable at night.

[87] Environmental Noise Guidelines, WHO, 2018
[88] Decree amending the Living Environment Activities Decree, the Living Environment Structures Decree, the Living Environment Quality Decree, the Environment Decree, the Environment Act Implementation Decree and several other decrees with a view to controlling noise from roads, railways and industrial sites, 14 October 2019.

13.2.1.3 Biological stressors (Legionella)

Legionella pneumophila is widespread in water. It grows in biofilms on the surface of lakes, rivers and streams. Low quantities can grow into high concentrations if growth-promoting factors (iron pipes, rubber seals) are present. Conditions that promote the growth of Legionella bacteria are:

Stagnant water;
Water temperature between 20°C and 50°C, with the optimum temperature being 35°C - 46°C; Acidity between 5 and 8.5;
Sediment that causes the formation of a biofilm;
Presence of microorganisms, such as algae, flavobacteria, Pseudomonas, amoebae.

Contamination with Legionella bacteria occurs via the lungs, and it is assumed that the infection is transmitted by inhaling the bacteria in very small droplets of water dispersed in the air (mist).

Most people do not become ill when they inhale Legionella bacteria. If symptoms do occur, they usually appear within two to ten days after inhaling the bacteria. Some people experience mild, flu-like symptoms. These symptoms disappear on their own after a few days. In very rare cases, Legionella bacteria can cause severe pneumonia. This is also known as Legionnaires' disease or Legionella pneumonia. This pneumonia can be so severe that it can be fatal. Infection with Legionella bacteria can be treated with antibiotics.

People who are more likely to develop severe pneumonia are the elderly, people in poor health or with weakened immune systems, and smokers. Legionella pneumonia almost never occurs in people younger than 40 years of age. Legionella is not transmissible from person to person.

The infectious dose required to cause symptoms remains unclear. No dose-response relationship has been demonstrated between the concentration of Legionella bacteria in a water source and the likelihood of becoming ill after exposure.

13.2.2 Inventory

As an integrating discipline, the discipline 'People', sub-domain Health, derives the necessary data from the more technical disciplines such as 'water', 'soil', 'air', 'noise/vibrations' and others, insofar as these are relevant for determining exposure and assessing human health risks.

This section takes stock of space utilisation, the at-risk population and environmental pressure for the subsequent assessment of the impact on humans. Since this discipline examines the consequences of environmental changes on human health, the emphasis is on locations where people are present for long periods of time.

Step 1: Description of land use and population involved

This phase includes a description of land use and the population involved in the study area.

The population groups residing within the boundaries of the study area are described according to population density and demographic structure. Vulnerable locations are also identified. These are locations where sensitive groups reside, such as children in schools and nurseries, elderly people in care homes, and patients in hospitals.

The use of space is also important for the duration of exposure of the population. Depending on the location, people may be present for shorter or longer periods of time. In the context of the Human Health discipline, the focus is therefore mainly on residential areas and other areas where people may be present for long periods of time.

Step 2: Identification of potentially relevant environmental stressors

Next, the potential relevant environmental stressors are identified. The expert lists all potential (relevant) stressors arising from the activities.

Potential chemical stressors that are relevant and discussed in the EIA are included in a sector-specific list (version 6/02/2017, available at https://www.milieuinfo.be/confluence/pages/viewpage.action?pageId=65212794). A list is available for each NACE sector. This EIA reviews the stressors from the 'Chemicals' sector (NACE 20110-20590; 21100-21209). It should be emphasised that this is a list of potentially relevant stressors. Of course, the chemical sector comprises a multitude of types of companies and associated emissions, and therefore not all emissions are relevant to the present project. In addition, additional chemical stressors can be defined by the abiotic EIA disciplines. This overview only includes chemical stressors from the list that are potentially emitted into the air. Exposure to chemical stressors through the discharge of waste water is not relevant for the following reasons:

Domestic wastewater and industrial wastewater are discharged into the Lower Sea Scheldt after treatment in the company's own wastewater treatment plant.
the Water discipline shows that the impact on the Scheldt in terms of achieving good chemical and/or ecological status and the risk of deterioration of the status of the water body is negligible for all parameters;
Direct exposure to the water of the Lower Sea Scheldt can only occur occasionally. The Scheldt is not designated as swimming or recreational water. Swimming is prohibited; water sports (e.g. water skiing) are only permitted outside the navigation channel and are not recommended.
indirect exposure is also not an issue, as the surface water body is not used for drinking water extraction.

Discharge into or onto the soil is also not taken into consideration, as this can only occur as a result of incidents or disasters, and the measures imposed in the Soil Decree and its implementing decrees make dispersion outside the site virtually impossible.

Below is a summary table listing potentially relevant environmental stressors.

Table 13-1: Identification of potential environmental stressors

Stressors	Specific description of stressor and/or source, health impact	Evaluation of relevance
Chemical stressors		
Stressors from the sector-specific list		
SOx	Uncontrolled emissions from machinery/engines during deconstruction phase	Not relevant due to the use of low-sulphur fuels.
	Non-controlled emissions from road traffic during the construction and operational phases	
	Non-conducted emissions from shipping during the operational phase	Was evaluated in the Air discipline. The effects appear to be very localised and are limited to the company site and the Canal Dock (see § 7.6.2.3). No further evaluation is required as there is no relevant exposure of local residents.
	Conducted emissions during the operational phase	
NOx	**Non-conducted emissions from machinery/engines during the construction phase**	**Under evaluation**.
	Non-controlled emissions from road traffic during the construction and operational phases	Given the location of the site in an industrial area and its good access to the higher road network (not via residential areas), exposure to air pollution from traffic is not considered relevant.
	Uncontrolled emissions from shipping during the Construction and operational phase	**Beingevaluated**.
	Controlled emissions during the operational phase	
O_3 a	Emissions of NOx, which play role in O_3 formation	Project One's contribution to O_3 cannot be meaningfully determined (see Air discipline). The NO2 immission contribution will be determined.
Fluorine compounds	No known emissions of fluorine compounds	Not relevant
Chlorine compounds	No emissions of chlorine are known.	Not relevant
NH_3	Indirect emissions as a result from the addition of NH_3 in the SCR De-NOx.	**Under evaluation.**
N2O	Part of NOx.	Not a health-related parameter.
CH_4	Part of VOC emissions.	Not a health-related parameter.
Benzene	Fugitive emissions (to Air); possible at the installations	**Under evaluation**.
1,2-dichloroethane	No emissions of dichloroethane known.	Not relevant

Stressors	Specific description of stressor and/or source, health impact	Evaluation of relevance
Dichloromethane	No emissions of dichloromethane known.	Not relevant
Phenol	No emissions of phenol are known.	Not relevant
Formaldehyde	No emissions of formaldehyde are known.	Not relevant
Styrene	No known emissions of styrene.	Not relevant
Toluene	No known emissions of toluene.	Not relevant
Xylenes	No known emissions of xylene.	Not relevant
Trichloromethane	No known emissions of trichloromethane.	Not relevant
HalogenatedNMVOS	No known emissions of halogenated NMVOCs.	Not relevant
Aromatic NMVOCs	Fugitive and uncontrolled emissions	No assessment possible for a mixture of substances. Separate evaluation for **benzene** and **butadiene**
Total NMVOC	Direct emissions Fugitive emissions and storage and transhipment emissions Flaring emissions Uncontrolled emissions from tanks and water treatment plants	No assessment possible for a mixture of substances. Separate evaluation for benzene and possibly others (if emissions can be estimated and are considered relevant).
Total ozone-depleting substances	Noneemissionsknownfrom ozone-depleting substances.	Not relevant
PAHs	No emissions known from PAHs.	Not relevant Not relevant
Metals	No known emissions of metals.	relevant
Dust (total)	Dust blown up during construction phase (excavation and construction works, soil storage)	Given the measures imposed by VLAREM II Chapter 6.12 (Control of dust emissions during construction, demolition and infrastructure works) and the distance to residential areas (approx. 1.5 km measured between the southern part of the project area and the nearest dwelling in Lillo), exposure to dust is not considered to be a problem. is not considered relevant. A temporary storage site for excavated soil (TOP) will be provided. Given the relatively low susceptibility to drift (sand) and distance from residential areas or other sensitive human receptors, dust nuisance is not considered relevant here either. A dust report will be drawn up.

Stressors	Specific description of stressor and/or source, health impact	Evaluation of relevance
PFAS on fabric	PFAS on airborne dust during the construction phase	Part of the project site falls within 3M's PFAS demarcation zone, which means that residents living within this demarcation zone must take into account the no-regret measures that apply. Different measures apply depending on the distance between the residential area and the 3M site. In addition, numerous measures are being taken on the site to prevent the formation and spread of airborne dust (see dust report). Taking these measures and the distance to residential areas or other sensitive human receptors into account, the stressor is not considered relevant in this EIA.
PM2.5 & PM10	Emissions from road traffic during construction and operation phases (site traffic, employees, goods)	Given the site's location in an industrial area and its good access to the main road network (not via a residential area), exposure to air pollution from traffic is not considered relevant here. **To be evaluated**.
	Direct emissions of PM10 and PM2.5. Indirect formation of PM2.5 through emissions of precursors (NOx, NH3, SO2 and VOCs)	See Air Discipline (section 7.6.2.7.4)
Dioxins	No emissions of dioxins are known.	Not relevant
Other stressors (not from sector-specific list)		
Butadiene	Fugitive emissions, emissions from heat recovery boiler and cracking furnaces	**This is** currently **being evaluated**.
Odour	The main chemicals used in Project One's processes are odourless or virtually odourless. Odorous substances may be produced at the water treatment plant.	At the water treatment plant, provisions are made to capture and treat emissions from the wastewater before they are emitted. These measures ensure that all potentially relevant odour emissions are treated. It is expected that the residual emissions will not cause any odour nuisance outside the site.

Stressors	Specific description of stressor and/or source, health impact	Evaluation of relevance
Physical stressors		
Noise	**Vegetation removal, excavation and construction work during the construction phase**	**To be evaluated.**
	Freight and passenger transport during the construction phase	Given the site's location in an industrial area and its good access to the main road network (not via a residential area), exposure to traffic noise is not considered relevant.
	Production units, cooling towers, water treatment plant, transformers, loading and unloading of ships, flares, etc. during the operational phase	**To be evaluated.**
	Goods and passenger transport during the operational phase	Given the site's location in an industrial area and its good access to the main road network (not via residential areas), exposure to traffic noise is not considered relevant.
Vibrations	Construction phase: laying foundations	No vibration nuisance is expected in the vicinity of the project area during the construction phase.
	No sources of vibration during the operational phase.	Not relevant
Wind	No impact on wind outside the project area.	Not relevant
Light, shade	Work may be carried out before sunrise or after sunset during the construction phase. At these times, lighting of the site is necessary (especially in winter). For safety reasons, it is necessary for the site to be illuminated during the operational phase.	**Under evaluation.**
Heat	The project area (currently wooded) has a cooling and insulating effect at the local level, which will disappear due to the change to industrial land use.	The impact of deforestation and vegetation removal on the increase in heat stress in the project area and its immediate surroundings is considered to be limited (see Climate discipline). The immediate surroundings mainly consist of industrial functions. The effect is therefore of lesser importance to humans.
EM radiation	No effects of EM radiation outside the site boundaries are expected.	Not relevant

Stressors	Specific description of stressor and/or source, health impact	Relevance assessment
Ionising radiation	Radon-222 is naturally present in the raw material.	Radon is present in the raw material (approx. 40 Bq), but the concentrations are of the same order of magnitude as the natural background concentrations (average 33 Bq in Antwerp). The final decay products are not emitted and the residual materials are processed in accordance with the applicable regulations.
Biological stressors		
Risk of infection (viruses, bacteria or other pathogens) or transmission risks (transmission by pests)	**Legionella from (open) cooling towers**	**To be evaluated.**
Acute risk of poisoning (e.g. botulinum from Clostridium botulinum, cyanotoxins from blue-green algae, etc.)	There are no relevant sources of biological toxins associated with the construction or operational phase.	Not relevant
Chronic toxicity (e.g. DNA damage caused by pathogenic bacteria)	There are no relevant sources of chronic toxicity of biological origin associated with the construction or operational phase.	Not relevant
Allergens (e.g. animal hair in intensive livestock farming)	Allergens are not relevant to the activities.	Not relevant Not relevant
Pest nuisance (rats, flies, cockroaches, mosquitoes, etc.)	Pests are not relevant to the activities.	
Proximity to green spaces	The vegetation present has been removed (first step of the construction phase).	Due to the distance from residential areas and the inaccessible nature of the area (industrial area with Seveso establishments), the direct effect of the loss of this green space is not considered relevant to public health. Ecosystem services are discussed in the Climate and Biodiversity sections.

13.2.3 Selection and inventory of relevant environmental stressors

In step 2, the potential environmental stressors were listed in Table 13-1. In step 3, the data from the technical disciplines are inventoried.

This is only done for stressors that are relevant. Relevance is assessed against the selection criteria for further health-based exposure assessment (which differs per stressor).

Relevance is assessed against the criteria listed in Table 13-2. Exposure (via air) should be investigated further if:

- the existing background emission exceeds 80% of the recommended value;
- the contribution from the activity in question exceeds 1% of the legal standard, the recommended health value or the current situation;
- there is local concern or there are already existing complaints.

If one of the criteria applies, the exposure must be further characterised.

Table 13-2: Selection criteria for exposures to physical, chemical and biological agents that require further characterisation (where possible, mainly for exposure via air)

Criterion	Further investigate exposure if:	Legal standard	Health-based guidance value	Current situation
1	Background emission	80	80	/
2	Contribution from the activity under consideration	1	1	1
3	Existing (health) complaints			
4	Pre-existing unrest among the population			

In the case of chemical, physical and biological agents for which advisory values are not always available, the stressor is considered significant if nuisance, disruption in behaviour/activity or health effects are to be expected and/or if there are existing well-founded and structural complaints.

In the case of noise as an environmental stressor, further investigation is considered necessary if the ambient noise increases by 3 dB or more and/or if there are complaints in the area.

In the case of existing complaints, however, further investigation is only considered necessary if the environmental noise resulting from the project in residential areas or other areas where people are present for long periods of time would increase by more than 1 dB. Information regarding criteria 1, 3 and 4 is included in § 13.3.2.

Aspects to be inventoried per stressor are:

- Description of the sources (current quality, nature, occurrence in environmental compartments);
- Intensity of the stressor: size, intensity and decrease according to distance and profile (if information available);
- Complaints or concerns present.

13.2.4 Assessment framework

Health risk analysis is the study of physical, chemical and biological agents in the living environment that may have a (relevant) impact on health. In order to evaluate the impact of an activity/facility on the health of the population concerned in the study area in the EIA, the following factors are taken into account:

- The severity of the change in the environment – if relevant – assessed against the extent to which advisory values have been exceeded;
- The extent and nature of the existing environmental pressure and the size of the population concerned.

Due to the potential complexity of emissions, the various exposure routes, and the complex interactions that are possible between different stressors, it is impossible to apply a 'one-size-fits-all' approach. The various environmental factors have different health endpoints, such as the risk of health damage or cancer from exposure to chemical agents and the number of people (severely) affected by exposure to noise. The large differences in health endpoints make it strictly impossible to compare health risks in absolute terms. A semi-quantitative approach will be followed as prescribed in the Human Health Guideline System.

Environmental health quality is described on the basis of the relevant stressors originating from the project (e.g. air pollution, noise, etc., see step 3). For each environmental stressor, an assessment is made against **health-based guidance values (GAW), where available.** In addition, a qualitative description is provided of which sensitive groups are exposed, what the land use is and the nature of the various possible health effects (where this information is available).

13.2.4.1 Chemical stressors

13.2.4.1.1 Chemical stressors with threshold effects

Assessing the health impact of chemical stressors is complex due to the varying nature of chemicals and the environment. To address this complexity, a methodology was developed which, after an initial screening of the project's contribution, also uses a multi-criteria analysis to assess how far to go in taking mitigating measures. A multi-criteria assessment is an evaluation method that uses multiple criteria to analyse complex decisions or options. This assessment aims to weigh up relevant factors in order to make a thorough and balanced assessment of the mitigating measures to be taken. The multi-criteria assessment provides a framework to support experts in making informed choices. By defining a set of criteria, the multi-criteria assessment aims to ensure a systematic and transparent evaluation by the expert[89].

The assessment of threshold effects is therefore no longer based on a fixed assessment framework, but on a scheme in which the need for mitigating measures must be examined. The assessment of the need for mitigating measures is carried out in a number of steps (see also the diagram below):

- Firstly, it must be determined whether the project will result in an increase or decrease. If the project leads to a decrease, no mitigating measures are necessary.
- If the project results in an increase, the immission contribution is determined as a percentage of the health advisory value. Depending on the immission contribution, mitigating measures must be investigated/proposed:
    - Less than 1% of the GAW: no mitigating measures necessary
    - More than 10% of the GAW: need to investigate/propose mitigating measures in accordance with the ALARP principle
    - If the immission contribution is between 1% and 10% of the GAW, the following outcomes are possible:
        - Immission concentration (including project contribution) is less than 80% of the GAW: no mitigating measures necessary.
        - Immission concentration (including project contribution) is more than 80% of the GAW: Further evaluation (multicriteria) of mitigating measures.

[89] Web page with guidelines for health in EIA studies: (Human Health Guidelines System - EIA Knowledge and Information System - Wiki of the Environment Department of the Flemish Government (milieuinfo.be) (dated 25/04/2024)

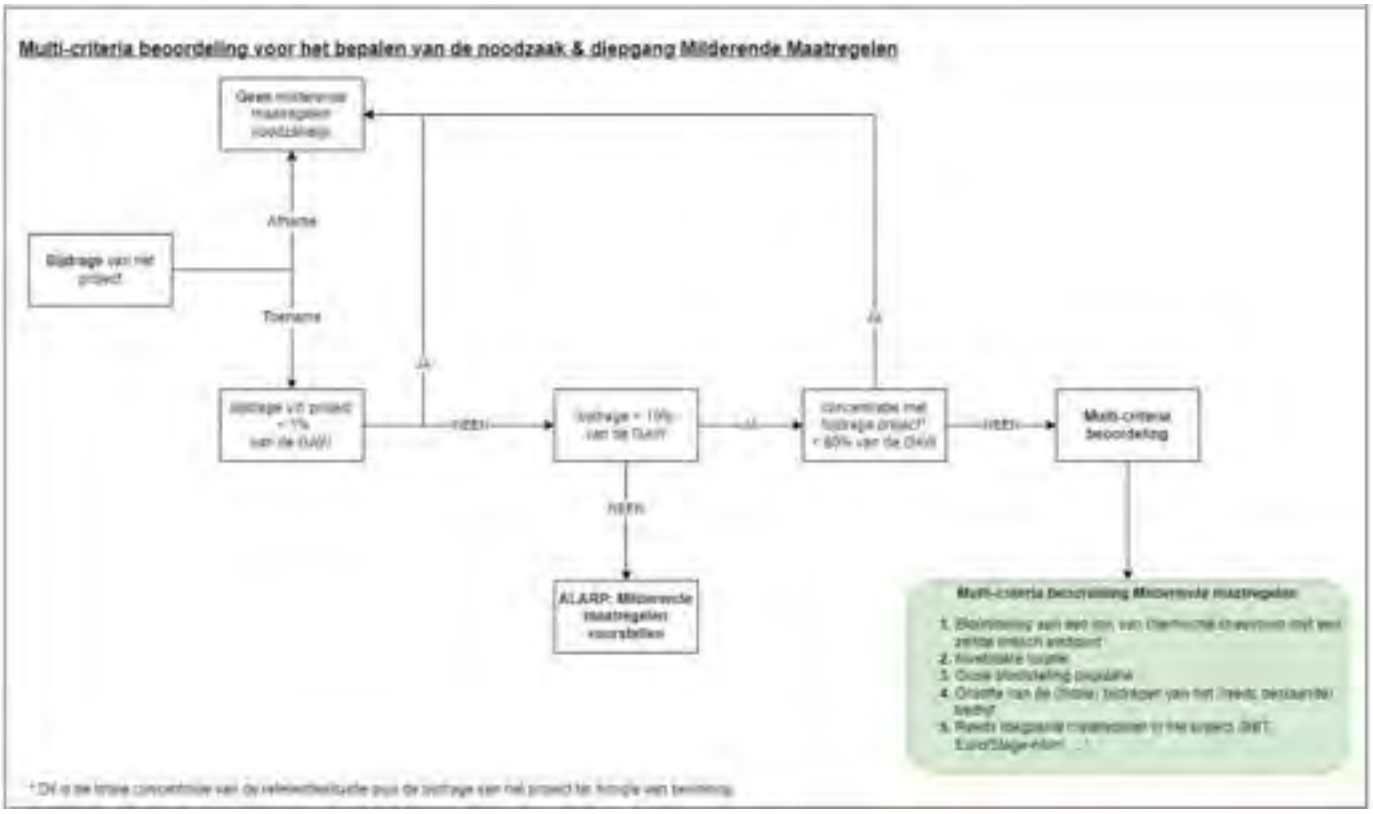

Figure 13-2: Multi-criteria assessment for determining the necessity & depth of mitigating measures for threshold effects.

When determining mitigating measures for chemical stressors, the ALARP principle must be taken into account, which stands for "As Low As Reasonably Practicable". Although similar to ALARA in its objectives, ALARP emphasises the practical feasibility of risk reduction measures.

Taking 'reasonable measures' within the framework of the ALARA or ALARP principle involves carefully weighing up various factors in order to minimise exposure to risks. This includes implementing advanced technologies and techniques that effectively reduce risks. In the context of risk management, 'reasonably practicable' means that the measures taken to reduce exposure to risks must be proportionate to their feasibility and cost.

Based on the project contribution and the multi-criteria assessment, an expert opinion will be derived for the impact assessment.

13.2.4.1.2 Chemical stressors with non-threshold effects

For non-threshold effects (there is no safe concentration below which health effects can be completely ruled out), the situation is less clear-cut. The aim is to achieve the lowest possible immission:

For cancer effects, an immission contribution corresponding to an additional cancer risk of 10^{-6} for lifelong exposure is equated with a 'zero effect'. An additional cancer risk of 10^{-4} or more is considered unacceptable. Between these two values, the aim should be to achieve ALARA, As Low As Reasonably Achievable.
For non-threshold effects other than cancer (e.g. reduced life expectancy due to $PM_{2.5}$), the ALARA principle can also be applied, but for the application of the assessment method in the EIA, a pseudo-GAW has been established in the Human Health Guideline System.

As mentioned in § 13.2.1.1, it is customary internationally to apply an additional risk of (death from) cancer at lifetime exposure that is less than or equal to 1 in a million ($\leq 1/106$) should be considered a 'zero effect'.

Practical experience and the international literature consulted also show that, fairly universally, an additional risk of 1 in 10,000 ($^{1/104}$) for lifetime exposure is considered to be the 'limit of acceptability/maximum permissible by policy' (e.g. a maximum permissible risk (MTR) for humans of 1 in 10,000 per lifetime in Dutch policy documents). This has become increasingly common internationally over the past half century. It is still approximately 3,000 times smaller than the background risk of dying from cancer in Flanders.

If the risk is between $^{10-6}$ and $^{10-4,}$ this is considered an 'intermediate zone' from a public health perspective. The risk is not negligible but not yet very high. In addition to the magnitude of the risk (closer to $^{10-6}$ or closer to $^{10-4}$), other factors are also important in determining whether or not to work towards lower exposure, as shown in the table below, drawn up by the former Flemish Agency for Care and Health (*'Carcinogenic risks in public health risk assessments'*, 18/12/2015):

INSCHATTING VAN HET EXTRA KANKERRISICO BIJ LEVENSLANGE BLOOTSTELLING	
[illegible]	Risico >10^{-4} : vanuit volksgezondheidskundig standpunt onaanvaardbaar **
[illegible]	10^{-6} < risico < 10^{-4} : vanuit volksgezondheidskundig standpunt niet verwaarloosbaar risico (groter dan "nul" effect). Er moet gestreefd worden naar een daling van het risico, volgens het ALARA*-principe. In de afweging houdt men rekening met o.a.: - de grootte van het risico (dichter bij 10^{-6} is de noodzaak tot risicoreductie minder groot dan dichter bij 10^{-4}) - de ernst van het (mogelijke) gevolg - de mogelijke onzekerheden op de inschatting, met o.a. IARC groep I, IIA of IIB - mogelijkheden en kostenefficientie van risico-reductie (ALARA) - het aantal blootgestelde personen en ongelijke verdeling over lage SES - de duur van de blootstelling - de afweging van de maatschappelijke voor- en nadelen van de activiteit - (de risicoperceptie)
Risico ≤ 10^{-6}	Risico ≤ 10^{-6} : vanuit volksgezondheidskundig standpunt verwaarloosbaar (= "nul" effect)
*ALARA : As low as reasonably achievable = zo laag als redelijkerwijze haalbaar is **indien toch overschrijding is expliciete rechtvaardiging noodzakelijk (bv. technische onmogelijkheid om het risico te reduceren)	

Figure 13-3: Estimation of the additional cancer risk from lifelong exposure (from: Carcinogenic risks in public health risk assessments, AZG, 2015)

To illustrate and contextualise the magnitude of the risks, we provide some figures here (AZG, 2015) (figures for Flanders):

Risk $^{10-4}$ and $^{10-6}$ contextualised within the general mortality risk and age:

- All persons combined, from young to old, have an average risk of dying during a year of approximately 1/100. The risk varies greatly between age groups. The 12-16 age group has the lowest risk of dying of all age groups, namely 1/10,000.
- The limit of 1/1,000,000 per year of additional risk (~1/10,000 lifetime) often used in literature and practice as the maximum permissible risk is, in other words, 100 times smaller than the already low risk of death that this group of 12-16 year olds has.

Magnitude of other risks:

- The additional risk of death in traffic accidents in 2012 was 5.9 × 10^{-5} per year (approx. 5.9 × 10^{-3} lifetime);
- The additional risk of dying from Legionnaires' disease is estimated at approximately 1.10-6 per year (approx. 1.10-4 lifetime) (based on figures from 2000-2012);
- The additional risk of dying from active smoking (all tobacco-related diseases) was 1.3 per 1,000 or 0.13% (13.10-4) in 2012 (or 13% over a lifetime).

The assessment framework for carcinogenic effects is presented in Table 13-3.

The assessment is carried out in two steps:

The significance of the effect depends on the evolution of the environmental concentration before and after implementation of the project. This is shown on the X-axis of the table below. Calculating the difference in additional cancer risk gives an interim score.

- This intermediate score may be adjusted if the cancer risk in the reference situation exceeds $^{1/106}$.
- In addition, an increase that results in an additional cancer risk of less than $^{1/107}$ is considered negligible, even if the immission after completion of the project exceeds the health advisory value.

Table 13-3: Assessment framework for carcinogenic effects for substances without a threshold value

	Risk from lifelong exposure (project contribution)	Interim score based on contribution	Adjustment if the cancer risk in the reference situation is >10^{-6}
Increase due to the project	> 10^{-4}	-3	-3
	10^{-4} – 10^{-5}	-	-3
	10^{-5} – 10^{-6}	-2	-2
	10^{-6} – 10^{-7}	0	-1
	<10-7	0	0

13.2.4.2 Physical stressors

Noise

An expert opinion will be derived. This will take into account: the increase in ambient noise;
the extent to which the reference values are exceeded (see § 13.2.1.2)
the size of the area in which this increase occurs and the presence of habitation; in the case of a non-continuous increase in noise: the frequency.

Light

An expert opinion will be derived. The emphasis will be on preventive measures.

13.2.4.3 Biological stressors (Legionella)

An expert opinion will be derived. The emphasis will be on preventive measures.

13.2.4.4 Synthesis and mitigating measures

After the assessment per stressor, an overall assessment of the impact of the various stressors (based on the above assessment framework(s)) will be carried out. An overall synthesis will show the possible effects that can be expected from the various stressors, how these can be mitigated and whether there are any specific points for attention.

The intention is by no means to assign a 'final sum' of the scores awarded to all relevant stressors in order to arrive at a final verdict on the (un)acceptability of the project in terms of public health. This is not possible due to the large differences in the nature of the health endpoints and is therefore meaningless. The intention is rather to obtain an overview of which stressors would change in terms of exposure to such an extent that mitigating measures for that stressor are appropriate.

Together with the qualitative final evaluation, mitigating or accompanying measures are formulated if the health score of the stressor is -3. Mitigating or accompanying measures are measures that can potentially be taken to reduce the stressors or reduce the likelihood of exposure. For scores of -2 and -1, recommendations, i.e. possible measures to reduce the impact, are desirable. In the case of a score of -1, the project causes only a negligible or limited effect. If the impact of the project is assessed as a score of -2, research must already be carried out into measures that could potentially be taken to reduce the effect or impact.

For a description of the 7-point scale used in the impact assessment and the negative scores linked to the mitigating measures, please refer to § 5.3.

13.3 Reference situation

13.3.1 Description of land use and the population concerned

A description of the spatial location of the project area is included in § 2.1. The Project One facilities are centrally located in an industrial area within the port of Antwerp. The immediate surroundings consist mainly of other companies, port infrastructure and nature reserves. The companies bordering the northern part of the site are Vopak to the north, IMB to the west and Inovyn to the south. The companies bordering the southern part of the project area are Inovyn to the north, Vesta (to the north, between the northern and southern parts of the project area) and Bayer and ASA to the south. The OVR calculated that within the $^{10\text{-}8}$ isorisco contour (up to approx. 1,200 metres from the boundary of the southern part of the project area), approx. 3,000 people are present at the same time in the surrounding companies (on working days during the day).

Outside the industrial area, there are several residential areas, agricultural areas and nature reserves. The residential areas include the city of Antwerp, suburban municipalities (including Zwijndrecht and Ekeren), polder villages along the left and right banks of the Scheldt (including Doel, Lillo, Berendrecht, Kallo, Stabroek), the villages of Putte, Ossendrecht, Hoogerheide and Huijbergen in the Netherlands, foothills and isolated residential areas. Agricultural areas are mainly located to the west and east. The nature reserves in the study area are scattered around the Antwerp Port Area (including polders) and along the Scheldt. These are Habitat and Bird Directive areas and VEN areas. The green areas closest to Project One are the banks of the Scheldt and the Galgenschoor to the west and the Kuifeend to the northeast. A more detailed overview of land use within the study area is provided in Table 13-4.

Table 13-4: Space utilisation in the study area (15/03/2024)

Zone	Unit	Number [90] or % of the area (distances from site boundary)				
		0-1 km	1-2 km	2-5	5-10	Total
Daycare centres [91]	Number	0	0	8	8	16
Primary schools [92]	Number	0	1	6	3	10
Secondary schools [93]	number	0	0	2	0	2
Playgrounds, holiday homes [94]	number	0	0	8	0	8
Sports grounds [95] **, scout grounds** [96] **, play forest** [97] **, …**	number	0	1	18	10	29
Hospitals [98]	number	0	0	0	0	0
Retirement homes, residential care centres, assisted living facilities [99]	number	0	0	9	1	10
Residential area [100]	%ofthe study area	0	0.3	2	10	3
	hectares	1	62	393	226	683
Agricultural activity[101]	%ofthe study area	0	0.3	7	13	19.6
	hectares	0	709	1,429	2,391	1,793
Green zone/nature[102]	%ofthe study area	0.4	0.3	2	16	18.7
	hectares	75	70	426	3,123	3,694
Industrial area[103]	%ofthe study area	3	2	8	7	20
	hectares	609	412	1,569	1,360	3,952

[90] Land use: number of unique addresses (e.g. nursery and primary school at one address counts as one location)
[91] VL: childcare facilities recognised by Kind en Gezin (both after-school care and care for babies and toddlers, both family care and group care); NL: nurseries (> 10 persons)
[92] VL: regular and special nursery and primary education (nursery and primary school at one location counts as one school), NL: schools ll. < 12 years, > 10 persons.
[93] VL: full-time and part-time secondary education, special secondary education, part-time training and apprenticeships (excluding part-time art education and secondary adult education); NL: schools ll. > 12 years
[94] VL: This figure only includes holiday accommodation (B&Bs, camper sites, campsites, hostels, hotels, youth hostels, lodgings, holiday parks and holiday homes). No data is available on the number of playgrounds. NL: hotels, bungalow parks, campsites and public playgrounds
[95] Outdoor sports fields, water sports centres, sports halls, athletics tracks, sports centres, riding schools, tennis halls, etc.
[96] VL: Sports grounds are counted individually in the analysis. No data is available on the number of scout grounds in VL. Youth hostels are included in the count. NL: Sports grounds and scout grounds.
[97] VL: freely accessible areas and play areas in forests and nature reserves; NL: no play forests in the study area.
[98] No hospitals in the study area.
[99] VL: Facilities for the elderly: convalescent homes, short-stay facilities, day care centres, assisted living facilities and residential care homes; different types of elderly care facilities at a single address are counted as one location (e.g. short-stay facility and residential care home); NL: nursing homes, homes (business/complexes) for non-self-sufficient residents, retirement homes/care homes (> 10 persons), closed institutions (youth institutions, addicts)
[100] VL: residential area according to regional plan; NL: centre and residential area according to zoning plan
[101] VL: agricultural area according to regional plan; NL: agricultural and agricultural with values according to zoning plan
[102] VL: forest area, park area, green area and nature area according to regional plan; NL: forest, green, nature and other (i.e. protected dyke) according to zoning plan

Table 13-5 provides an overview of the population in the residential areas within the study area. The distance specified in the third column indicates the shortest distance to the project area (from the boundary of Project One to the edge of the nearest sector/neighbourhood of the residential area).

Table 13-5: Residential areas and population in the study area

Residential area[104]	Province	Distance from edge to nearest boundary of project area	Number of inhabitants	Number of children ≤ 5 years[105]	Number of children aged 6 – 18 years old
Berendrecht – core	Antwerp	approx. 0.9 km to the northeast	2,923	189	475
Lillo	Antwerp	approx. 1.1 km to the south	39[a]	0	0
Destination	East Flanders	approx. 1.6 km to the south-west	107[b]	6	14
Berendrecht (other)	Antwerp	approx. 1.6 km to the northeast	3 197[c]	172	502
Stabroek	Antwerp	approx. 1.7 km to the east	9 546[f]	508	1,294
Zandvliet – centre / Stables corner	Antwerp	approx. 2.1 km to the north	3,470 [d]	188	470
Kallo	East Flanders	approx. 2.3 to the SW	85[g]	5	11
Kieldrecht	East Flanders	approx. 2.8 km to the west	12 [h]	1	2
Zandvliet (other)	Antwerp	approx. 3.2 km to the east	369 [e]	0	0
Putte (NL)	North Brabant	approx. 4.1 km to the northeast	3,855[l]	127	509
Ossendrecht (NL)	North Brabant	approx. 5.0 km to the northeast	4,850[m]	160	640
Kapellen	Antwerp	approx. 7.1 km to the east	2,943 [i]	161	385
Huijbergen (NL)	North Brabant	approx. 10.1 km to the northeast	130[o]	4	17
TOTAL			**31,526**	**1,521**	**4,319**

Source VL: open data statistical sectors: Statbel, population figures 2023; NL: CBS, key figures for districts and neighbourhoods 2022

[a] Lillo-Fort
[b] Grote Doelpolder and Doel-Kern
[c] Steenhovenstraat, Viswater, Kraaienberg
[d] Zandvliet-Kern, Stalshoek
[e] Grote Ruigeheide, Noordlaanpolder
[f] Polders, Ettenhovense Polder, Stabroek-Centrum-Oost, Stabroek-Centrum-West, Fort, Lassenhof – Hoogeind, Ravenhof, Hazepad, Putte-Driehoek, Plantijn
[g] Kallo industrial estate
[h] Prosperpolder – Nieuw Arenbergpolder
[i] Putte-East, Putte-Centre
[l] Scattered houses Putte, Putte
[m] Ossendrecht, Scattered houses west of Ossendrecht, Scattered houses east of Ossendrecht
[o] Scattered houses south of Huijbergen

[104] (Part of) municipality in VL, (part of) district in NL. See table below for included statistical sectors (VL) or neighbourhoods (NL).
([105])VL: Here, an approximate number is given based on the percentages of 0-5 and 6-18 year olds in Beveren (Melsele, Kieldrecht, Kallo, Verrebroek), Stabroek and Kapellen. The numbers for the residential areas in the city of Antwerp (Berendrecht, Zandvliet, Lillo, Ekeren) are the exact numbers for this sector. NL: This provides an approximate number based on the percentages of 0-4 years and 12-18 years within Woensdrecht according to CBS.

13.3.2 Description of the current situation with regard to potentially relevant environmental stressors

Table 13-1 lists the potentially relevant environmental stressors.

The relevance of these stressors will be assessed in the EIA (step 3) against the criteria listed in Table 13-2. The following criteria can already be assessed:

background emissions in relation to the legal standard or the scientific health advisory value;
existing (health) complaints as a result of exposure to this stressor; existing unrest among the population.

13.3.2.1 Background emissions

The relevance of the **chemical stressors** is assessed against the criteria listed in Table 13-7. The assessment values are given in Table 13-6 below. The data for the current situation were taken from the Air discipline.

Table 13-6: Assessment value for chemical stressors (µg/m³)

Parameter	Type of standard	Legal standard (or indicative limit value)	GAW	Current situation within port area	Current situation outside port area
NO2	Annual average	40	10	21-30	<21
Benzene	annual average	5	0.038	≤ 2.52 (R822, Polderdijkweg)	0.68 (AT33, Berendrecht)
Butadiene	annual average	/	0.033	0.3 (Goal, 50R830,sum1-butene and 1,3-butadiene)[106]	no data
PM10	annual average	40	15	21-25	<26
PM2.5	annual average	20	5	10.6-15	<12.6
NH3	annual average	/	500	1-16	1-8

If the scientific health advisory values or scientific reference values are stricter than the legal standards, these are taken as the assessment value for background emissions. The lowest value of the current situation in the study area is taken as the background emission.

[106] Data for 2013 (most recent data available)

Table 13-7: Assessment of chemical stressors against selection criteria for further characterisation

NO2	<210%	10			
Benzene	± 1,789 %	0.038	See Table 13-17 and Table 13-18	No specific data known about existing health complaints per pollutant in the study area. See also § 13.3.2.2.	General concern about air quality in Flanders, but no specific data per pollutant. See also § 13.3.2.2.
Butadiene	909 %	0.033			
PM10	<173	15			
PM2.5	<252 %	5			
NH3	0.2	500			

Physical stressors

The selection criteria in Table 13-2 also apply in principle to physical agents. If assessment is not possible, the stressor is considered significant if nuisance, disruption to behaviour/activity or health effects are to be expected and/or if there are existing justified and structural complaints.

In the case of noise as an environmental stressor, further investigation is considered necessary if the ambient noise increases by 3 dB or more and/or if there are complaints in the area.

Noise

The Noise discipline has provided results from continuous immission measurements taken between June 2019 and February 2021 and December 2023 and January 2024 with regard to the acoustic quality of life at the nearest homes:

measuring point 3: homes in Lillo (Kazerneplein), located to the south and south-west of the future sites. Located in a residential area less than 500 metres from an industrial area. The critical wind directions for this measuring point are north and north-east.

[107] Health advisory value or current immission quality, whichever yields the strictest assessment

Measuring point 4: homes in Berendrecht (Dorpsbeekstraat 129), located to the north and north-east of the future sites. Located in a residential area less than 500 metres from an industrial area. The critical wind directions for this measuring point are south and south-west.

By definition, noise measurements measure ambient noise (all sources). The results cannot therefore be tested against L_{den} or L_{night} advisory values, as these are drawn up for specific noise sources (e.g. road traffic, WHO Environmental Noise Guidelines for Europe 2018) and for a full year.

However, it is possible to check against the WHO (1999) guideline values, which relate to a period of 8 hours (night) or 16 hours (day and evening), as well as against the environmental quality standards set by VLAREM for the government.
II. However, assessment against the environmental quality standard for night-time periods is indicative, as the results for the four quietest hours are reported here.

The tables below show the results per wind direction. Whether or not there are significant noise sources located upwind determines the measured values.

Table 13-8: Results of continuous immission measurements at measuring point 3 vs. assessment values – June 2019

Parameter	Period	WHO 1999	MKN area type 2°	N	N	E	SE	S	SW	W	NW
LAeq	Day	55 (severe nuisance), 50 (moderate nuisance)	-	48.6	49.1	49.3	49.9	49.3	48.7	51.2	50.6
	Evening		-	49.2	47.2	47.4	47.9	47.7	48.1	47.7	48.5
	Night [108]	45 (sleep disturbance)	-	48.5	47.0	45.3	45.0	46.5	44.9	45.2	47.7
LA95	Day	-	50	44.0	44.3	44.8	44.3	41.8	42.6	43.4	44.4
	Evening	-	45	44.2	43.5	43.6	43.8	43.6	42.9	42.7	44.4
	Night [109]	-	45	46.0	45.1	43.1	43.0	43.9	42.5	43.1	45.5

Table 13-9: Results of continuous immission measurements at measuring point 3 vs. assessment values – February 2021

Parameter	Period	WHO 1999	MKN area type 2°	N	N	E	SE	S	SW	W	NW
LAeq	Day	55 (severe nuisance), 50 (moderate nuisance)	-	50.1	48.9	48.7	49.6	50.0	49.8	49.1	49.8
	Evening		-	48.9	49.5	46.7	47.7	49.2	47.3	-	47.3
	Night [110]	45 (sleep disturbance)	-	45.7	46.5	47.7	47.1	46.9	48.2	-	45.1
LA95	Day	-	50	45.7	44.9	44.9	45.4	45.6	43.2	46.1	45.8

[108] The value given is the average of the 4 lowest measured values
[109] The value given is the average of the 4 lowest measured values
[110] The value given is the average of the 4 lowest measured values

Parameter	Period	WHO 1999	MKN area type 2°	N	N	E	SE	S	SW	W	NW
	Evening	-	45	45.5	47.6	44.5	45.7	46.4	45.3	-	44.3
	Night [111]	-	45	43.3	44.4	45.9	45.4	45.0	46.1	-	41.9

Table 13-10: Results of continuous immission measurements at measuring point 3 vs. assessment values – December 2023 – January 2024

Parameter	Period	WHO 1999	MKN area type 2°	N	N	E	SE	S	SW	W	NW
LAeq	Day	55 (severe nuisance), 50 (moderate nuisance)	-	49.4	49.6	47.8	49.5	47.9	48.3	48.9	49.4
	Evening		-	47.7	47.6	46.6	47.5	47.6	45.9	47.1	46.1
	Night [112]	45 (sleep disturbance)	-	45.7	46.1	43.6	45.1	46.1	45.8	46.5	45.9
LA95	Day	-	50	45.7	47.0	46.3	47.0	45.1	45.1	45.0	43.6
	Evening	-	45	45.7	45.9	44.2	45.7	44.4	43.5	45.1	44.1
	Night [113]	-	45	43.7	44.3	41.0	43.4	44.1	43.7	43.9	43.6

Table 13-11: Results of continuous immission measurements at measuring point 4 vs. assessment values – June 2019

Parameter	Period	WHO 1999	MKN area type 2°	N	N	E	SE	S	SW	W	NW
LAeq	Day	55 (severe nuisance), 50 (moderate nuisance)	-	54.0	53.7	54.3	54.9	54.3	55.3	55.4	55.8
	Evening		-	51.5	51.2	51.4	52.7	54.3	54.1	53.2	52.9
	Night [114]	45 (sleep disturbance)	-	48.7	45.6	49.1	51.2	51.6	51.9	53.3	48.6
LA95	Day	-	50	44.2	42.3	43.7	45.0	47.1	49.2	48.5	47.3
	Evening	-	45	43.4	40.2	41.8	43.5	48.1	49.1	48.2	45.1
	Night [115]	-	45	43.4	40.2	43.8	47.0	49.0	49.3	48.7	45.1

[111] The value given is the average of the 4 lowest measured values.
[112] The value given is the average of the 4 lowest measured values
[113] The value given is the average of the four lowest measured values
[114] The value given is the average of the four lowest measured values
[115] The value given is the average of the four lowest measured values

Table 13-12: Results of continuous immission measurements at measuring point 4 vs. assessment values – February 2021

Parameter	Period	WHO 1999	MKN area type 2°	N	N	O	SUN	Z	SW	W	NW
L_{Aeq}	Day	55 (severe nuisance), 50 (moderate nuisance)	-	53.9	51.8	53.2	54.2	54.7	54.0	53.5	54.3
	Evening		-	-	-	50.2	50.7	51.9	50.7	-	48.3
	Night [116]	45 (sleep disturbance)	-	43.7	48.7	48.8	50.8	49.8	52.1	-	47.2
LA95	Day	-	50	45.0	41.6	42.3	46.5	47.1	45.0	46.7	45.8
	Evening	-	45	-	-	45.9	46.1	48.5	48.1	-	43.6
	Night [117]	-	45	41.3	46.9	45.9	47.3	47.9	48.9	-	41.5

Table 13-13: Results of continuous immission measurements at measuring point 4 vs. assessment values – December 2023 – January 2024

Parameter	Period	WHO 1999	MKN area type 2°	N	N	E	SE	S	SW	W	NW
L_{Aeq}	Day	55 (serious nuisance), 50 (moderate nuisance)	-	52.7	52.1	-	53.8	52.9	54.1	55.3	52.5
	Evening		-	50.8	49.0	53.5	50.9	50.9	50.9	52.3	50.4
	Night [118]	45 (sleep disturbance)	-	45.6	43.1	47.3	49.0	48.3	49.1	52.4	47.9
LA95	Day	-	50	44.2	42.5	-	47.2	47.3	48.3	48.4	43.7
	Evening	-	45	43.6	41.3	45.5	45.8	46.1	46.7	47.7	44.8
	Night [119]	-	45	42.1	39.9	45.7	46.6	45.9	46.8	49.6	43.0

The results show that:

at **measuring point 3** (Lillo, south of the project area):

- The average $_{LA95.}$1h level at critical wind directions varies slightly from 46 dB(A) during the day and evening to 44 dB(A) during the night, based on immission measurements in 2023-2024. However, the average $_{LA95.}$1h level over the day-evening-night period is in the same order of magnitude as in 2019 and 2021 and amounts to 45 dB(A). The most recent immission measurements in 2023–2024 show that the environmental quality standard is exceeded by a maximum of 1 dB(A) during the evening period, but is respected on average over the day-evening-night period. The ambient noise in tailwind or headwind conditions varies hardly at all during the most critical night-time period.
- the WHO guideline value for moderate nuisance is generally respected;
- the WHO guideline value for severe nuisance is respected;
- the WHO guideline value for sleep disturbance at night is not respected; at **measuring point 4** (Berendrecht, northeast of the project area):
- The average $_{LA95.}$1h level at critical wind directions varies slightly between 48 dB(A) during the day and 46 dB(A) during the evening and night, based on immission measurements taken in December 2023 – January 2024. The average $_{LA95.1h}$ level at critical wind directions over the day-evening-night period

[116] The value given is the average of the 4 lowest measured values
[117] The value given is the average of the 4 lowest measured values
[118] The value given is the average of the 4 lowest measured values
[119] The value given is the average of the four lowest measured values

is 47 dB(A), which is slightly lower than the average $L_{A95,1h}$ level of 48 dB(A) according to measurements taken in 2021 and 49 dB(A) according to measurements taken in 2019. This indicates a decrease in ambient noise, possibly due to the reduced activities of Gunvor since mid-2020. The environmental quality standard is respected during the day and exceeded by a maximum of 1 dB(A) in the evening and at night. Furthermore, measurements in 2023–2024 show that ambient noise varies by 7 to 9 dB(A) during the most critical night-time period, depending on whether the wind is blowing in the same direction or against the facility.

- the WHO guideline value for moderate nuisance is not being respected;
- the WHO guideline value for severe nuisance is respected;
- the WHO guideline value for sleep disturbance at night is not respected.

An overview of the prevailing noise levels (reference year 2016) within the industrial areas of Antwerp is given in Figure 13-4. The residential areas closest to the project area (Lillo and Berendrecht) fall outside the L_{den} contour of 55 dB.

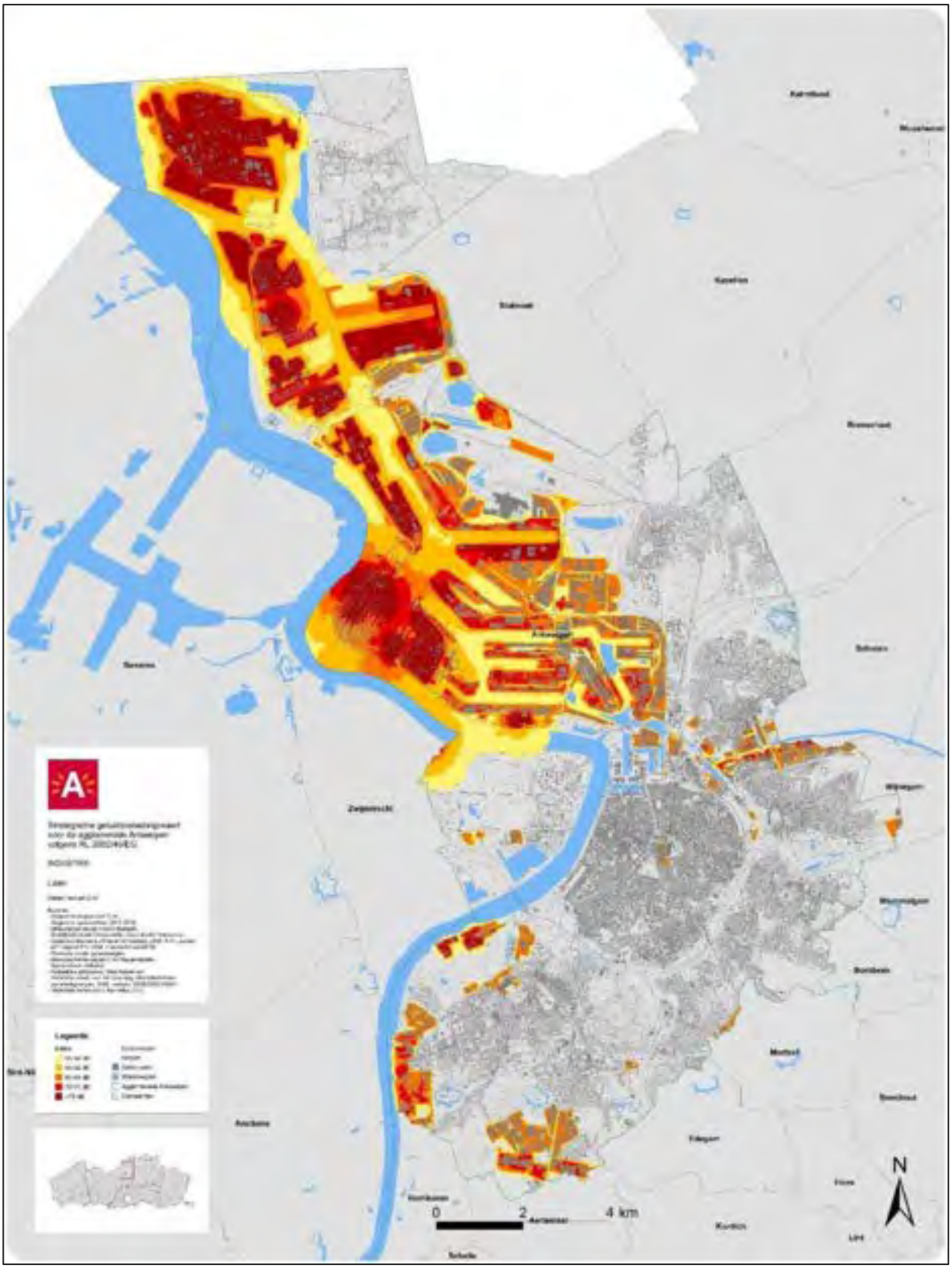

Figure 13-4: Strategic noise maps for the Antwerp agglomeration – Industry – L_{den} (reference year 2016)

As part of the environmental impact assessment, we're checking if there's any info available on noise-related health complaints in the study area. In particular, we're looking into whether industrial activities in the port area are causing noise complaints in the closest residential areas (Lillo and Berendrecht).

Light

Light spreads fairly evenly through the air and can thus lead to light pollution. Glare and stray light are more localised problems. Sky glow, on the other hand, affects a wider area.

Sky glow can be determined in various ways. Artificial sky luminance can be calculated on the basis of satellite measurements. This also involves making an assumption about natural sky luminance.

The figure below clearly illustrates the relationship between population density and light pollution in Europe. Flanders, most of the Netherlands and the Ruhr area are at a similar level (> 300%). Brussels and Antwerp have the highest levels of sky glow. Brussels probably due to its high population density and Antwerp possibly due to the industrial area in the port area.

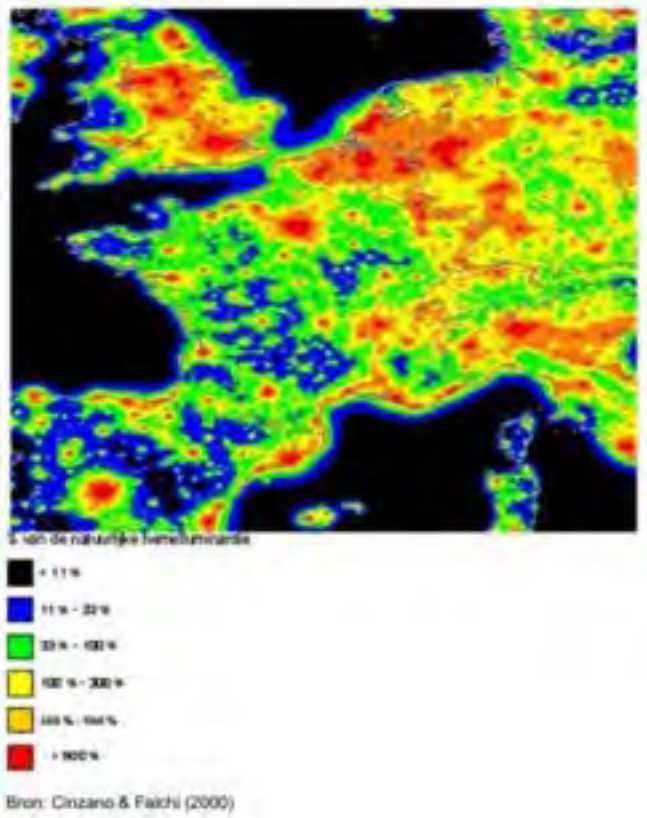

Figure 13-5: Artificial sky luminance as a percentage of natural sky luminance (Europe, 1998)

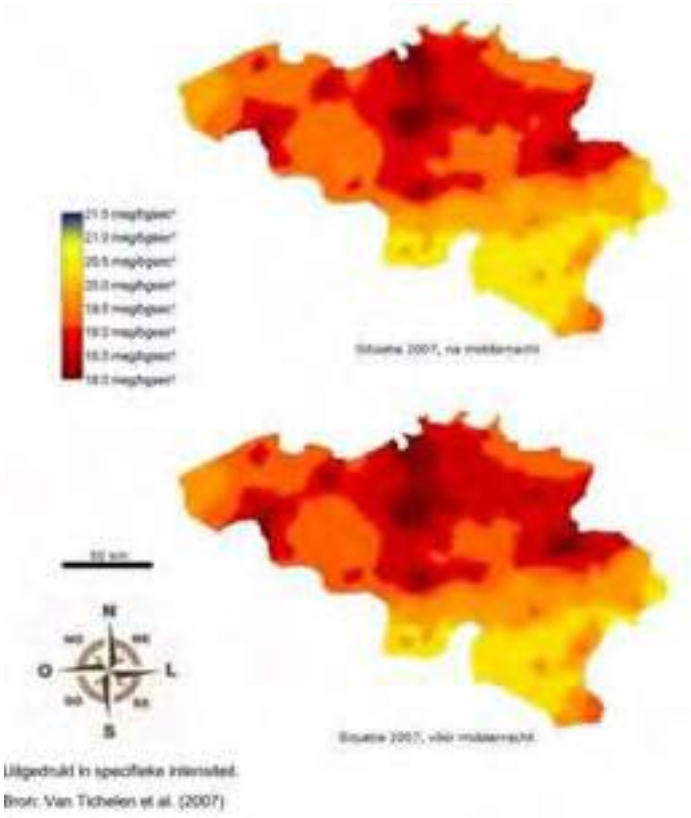

Figure 13-6: Sky luminance calculated on the basis of satellite images (Belgium, 2007)

It is not known which types of lighting are the main cause of sky glow. According to recent research (Kyba et al., 2020), street lighting is responsible for approximately 20% of the total amount of light at night. Other potentially significant sources include advertising lighting and light from buildings.

The latest Written Living Environment Survey (SLO-4) also shows that a maximum of 2% of respondents are seriously to extremely bothered by a specific light source; this concerns nuisance caused by light from traffic and transport. Furthermore, 1% indicate that they experience serious to extreme nuisance from light originating from commerce, services, recreation and tourism. For the other specific light sources, namely businesses and industry, agriculture and neighbours, less than 1% indicate that they experience serious to extreme nuisance from these sources.
Overall, 7% of respondents were moderately to extremely bothered by light in and around their homes in the past year. Eight out of ten respondents (80%) experienced no light nuisance, while 13% experienced a little light nuisance.

Biological stressors

For agents for which no advisory values are available, the stressor is considered significant if nuisance, disruption to behaviour/activity or health effects are to be expected and/or if there are existing well-founded and structural complaints.

Given that Legionella is a potentially relevant stressor, this aspect will be further investigated in the EIA.

13.3.2.2 Existing complaints and/or concerns

13.3.2.2.1 Survey of municipalities in the context of this EIA

As part of this EIA, information was requested from the environmental services of the city of Antwerp and the municipality of Beveren, specifically regarding the extent to which, given the future location of Project One, industry-related complaints occur in Lillo, Berendrecht and Zandvliet (district of 'Bezali') and Kieldrecht, Kallo, etc.

A written response was received from the City of Antwerp (Coordinator for Social Safety and Environmental Intervention, dated 11/06/2020 and 2/07/2021). The information received can be summarised as follows.

The industry-related complaints in the Bezali district mainly concern odour nuisance. The odour is described as an oily, gassy or similar smell and can often be traced to the nearby industrial area where there is a lot of chemical activity and where Project One will also be located.

Since 2019, reports of odour nuisance have been centralised via the fire brigade control centre.

Table 13-14: Odour nuisance complaints registered with Bezali (including complaints from outside the district) in 2019 and 2020

	2019	2020
Total number of odour complaints [120]	50	90
Number of complaints related to the industrial zone in which Project One is located is located (right bank)	10	15
Traced to specific company and followed up by the Environmental Inspectorate		5 2

The complaints in Lillo are related to the industrial zone in Beveren, where manure processing often causes odour nuisance. These complaints are therefore directed to the Beveren zone.

This has indeed been confirmed by the Environmental Department of the municipality of Beveren, in a telephone conversation on 2 June 2020. There have been complaints about manure processing companies for about five years now. The complaints seem to be more frequent than in 2019. Many companies are also among the complainants. An estimated 95% of odour complaints are related to manure processing companies. Other complaints may arise in connection with problems with the operation of an industrial water treatment plant.

A few complaints about noise (including at night) were also recorded in Kieldrecht. The municipality of Beveren is currently investigating the source of the noise pollution by taking measurements. The cause may be the degassing of Ro-Ro ships using fans. Shore power does not provide a solution in this case, as it only prevents the diesel engines from running.

In February 2024, the municipality of Beveren, the city of Antwerp and the East Flanders Environmental Inspectorate were asked to provide an overview of complaints received in the period 2021-2023. However, for various reasons, it proved impossible to provide this information.

At the same time, Port of Antwerp-Bruges (PoAB) was also asked to provide an overview of complaints in the Bezali district for the period 2021-2023. On 11 April 2024, a written response was received in the form of a list of industry-related noise and odour nuisance in the vicinity of Bezali. The following table provides an overview of the number of industry-related complaints registered by PoAB. The odour complaints are mainly linked to chemical and manure processing activities.

Table 13-15: Industry-related complaints in the vicinity of Bezali in 2021-2023

	2021	2022	2023
Total number Odour complaints [121]	2	6	2
Total number noise complaints	1	1	0

[120] An odour episode can consist of several calls that are reduced to a single report.
[121] An odour episode may consist of several calls that are reduced to a single report.

Recently, an investigation was also launched via the Environmental Inspectorate with VITO to map out the odour issue in the port.

This, together with the ongoing odour complaints, suggests that there is a certain amount of nuisance, especially with regard to odour.

13.3.2.2.2 Human biomonitoring programme

In response to increased public concern about the environment and health in Flanders at the end of the 1990s, including the dioxin crisis and several local pollution cases, environmental health policy in Flanders was thoroughly tightened. The establishment of the Environment and Health Support Centre and the Flemish Human Biomonitoring Programme in 2002 has its origins in this period.

The **first human biomonitoring programme (2002-2006)** examined eight areas with varying environmental pressures (urban environment, fruit-growing region, rural area and four industrial regions) and three age groups (newborns, young people aged 14-15 and adults aged 50-65).

The **second human biomonitoring programme (2007-2011)** was conceived differently. The first part aimed to determine Flemish reference values, or in other words, values for 'the average Flemish person'. These values could then be used as a benchmark for comparison with (international) guidelines, with similar campaigns in specific areas or abroad, and for monitoring trends over time. In addition, this campaign measured a much broader spectrum of pollutants and health effects than the first human biomonitoring programme. In a second phase, two areas of concern or 'hotspots' were systematically investigated using biomonitoring, namely Genk-Zuid and the Menen region.

In the **third human biomonitoring programme (2012-2015)**, Flemish reference values were again determined in different age groups, both for historical pollutants and for newer pollutants.
In addition, a third hotspot study was conducted among young people in the Ghent canal zone.

The **fourth human biomonitoring programme (2016-2020)** focused on three central themes:
indoor environment, use of space and ecological nutrition. The campaign was carried out among 610 young people.

As this reflects the most recent results, the focus is on this campaign. Partial results (435 young people, campaign school year 2017-2018) are available.

The study measured an exposure marker relevant to the present EIA, namely the metabolite t,t'-muconic acid in urine, which is a metabolite of benzene. The t,t'-muconic acid concentration in urine provides an indication of exposure to benzene during the hours to days prior to sampling (acute exposure).

The geometric mean, adjusted for urine dilution, was found to be no different in boys and girls and is not influenced by the degree of urbanisation. Young people from families with a lower level of education have higher average measurements, adjusted for urine dilution.

An increase has been observed for this substance compared to the previous measurement campaign, whereas a decrease had been observed for this substance in earlier measurement campaigns. This downward trend is therefore not continuing. The downward trend was previously linked to the reduction in benzene content in petrol, the introduction of three-way catalytic converters in vehicles and the guidelines for vapour recovery at petrol stations. Indoor benzene concentrations are usually higher than outdoor concentrations. Indoor measures such as the introduction of a smoking ban in public buildings may also have contributed to lower exposure to benzene.

The significant increase in internal exposure to benzene among young people in Flanders could be the result of higher ambient air concentrations, but it could also indicate greater exposure through indoor air exposure in cars (e.g. more time spent in the car) or in the home (e.g. smoking, passive smoking). Further research will provide more clarity on this issue. The average measurements in Flanders are comparable to values in other countries.

For the exposure markers measured in the current programme, the geometric mean and the ^{95th} percentile are compared with available health assessment values (GTW).

However, there is no international biomonitoring guideline value for internal exposure to t,t'-muconic acid. Benzene is a carcinogenic substance for which the following applies: the lower the exposure, the better.

The Flemish human biomonitoring studies FLEHS I, II and III found significant links between exposure to benzene and DNA damage in young people, short-term memory and immunological markers.

In addition to exposure to environmental pollutants, biological effects and health parameters were also measured in the population. Taking into account the selected pollutants (NO_2, particulate matter, benzene, butadiene), attention is paid to the following health parameters: DNA damage and repair, oxidative stress, cardiovascular risk factors and asthma.

Results of the comet test, related to DNA damage, show a correlation with the degree of urbanisation. No link has (yet) been established between, for example, DNA damage and oxidative stress and internal exposure to, for example, benzene, nor has a comparison been made with foreign campaigns. Therefore, the results will not be discussed further here. After all, these biomarkers do not (yet) represent health effects (in the sense of 'disease') and cannot be compared with reference values.

The average blood pressure [122]in the study was 108/65 mm Hg, which is normal for 14- to 15-year-olds. The ^{90th} percentile (122/75) and the ^{95th} percentile (126/79) are also below the elevated risk threshold of 130/80. Ten per cent of young people have cholesterol levels above the target value of 190 mg/dL.

The different forms of asthma were surveyed in a standardised manner (ISAAC questionnaire). In the total group, 18.2% of young people reported that they had 'ever' had asthma; 14.1% had asthma in the past 12 months and 7.4% had asthma, which was confirmed by a doctor. Asthma is reported at roughly the same rate as in previous campaigns.

The **fifth human biomonitoring programme (2022-2027)** will build on the strengths and experiences gained in the previous four cycles and will focus on emerging scientific and societal challenges such as health and well-being in relation to urbanisation, climate change, biodiversity loss and noise exposure. In addition, FLEHS 5 also aims to integrate new forms of collaboration between science, society and policy into its research.

13.3.2.2.3 Written Living Environment Survey (SLO-4) (2018)

In 2018, the Environment Department conducted a written living environment survey that gauged the nuisance experienced by Flemish people from noise, odour and light pollution. It was the fifth survey in a series of identical surveys that have been conducted since 2001. The questions are virtually identical in each survey, making it possible to compare the nuisance experienced with previous surveys and identify any trends.

The survey shows that noise is the main source of nuisance: 29% of Flemish people said they felt bothered by noise, 15% by odour and 7% by light. Although overall satisfaction with quality of life is increasing, it is striking that noise pollution from road traffic is increasing for the first time after many years of decline. Compared to the first survey in 2001, fewer and fewer Flemish people are bothered by odours from all kinds of activities. An important exception to this is smoke from chimneys, which is perceived as a nuisance by an increasing number of Flemish people. With regard to light pollution, the results show an increase in nuisance from lighting on municipal and regional roads, while lighting on motorways, on the other hand, is increasingly less likely to be mentioned as a source of light pollution.

[122] High blood pressure is not a direct health effect either, but it is a risk factor for cardiovascular disease.

13.4 Selection of relevant environmental stressors

In § 13.2.2, the potentially relevant environmental stressors were listed and identified (see Table 13-1). In summary, the following stressors may be relevant per phase:

Table 13-16: Identified potentially relevant environmental stressors for the construction and operational phases

	Construction phase	Operational phase
NO2	x	x
Benzene		x
Butadiene		x
PM10, PM2.5		x
NH3		x
Noise	x	x
Light	x	x
Legionella		x

NO_2, noise and light may be relevant during the **construction phase**.

Since it was established in §13.3.2.1 that the existing background emission for NO_2 exceeds the GAW, NO_2 is retained for further characterisation of the exposure.

With regard to noise, there are existing complaints (see § 13.3.2.2), and noise measurements in Lillo and Berendrecht show that the environmental quality standards set by the government and the scientific WHO advisory values are not always respected (see § 13.3.2.1). This stressor is therefore also retained for both the construction phase and the operational phase, notwithstanding the fact that the Noise discipline shows that the increase during the construction phase will be less than 3 dB(A).

Table 13-17: Assessment of chemical stressors against selection criteria for further characterisation (construction phase)

NO2	<210%	10as annual average	approx. 0.2 µg/m³ at Berendrecht in the construction phase	approx. 2 % at Berendrecht es	y

[123] Health advisory value or current immission quality, whichever is the most stringent test

Light is retained due to possible concerns in the surrounding area.

Benzene, butadiene, $PM_{10/PM2.5}$ and Legionella may also be relevant for the **operational phase**.

For NO_2, benzene, butadiene and particulate matter (PM_{10} and $PM_{2.5}$), the health advisory value is exceeded in the current situation. They are therefore retained for further characterisation. For NH_3, the health advisory value is not exceeded in the current situation and the contribution relative to the assessment value is negligible. NH_3 will therefore not be further characterised.

Table 13-18: Assessment of chemical stressors against selection criteria for further characterisation (operational phase)

NO2	<210%	10 as annual average	approx. 0.3 µg/m³ at Berendrecht (annual average)	approx. 3% near Berendrecht	y es
Benzene	1,789%	0.038 as annual average	0.009 µg/m³ near Berendrecht (annual average)	24% near Lillo	yes
Butadiene	909%	0.033 as annual average	up to 0.008 µg/m³ near Berendrecht (annual average)	24% near Berendrecht	y es
PM10 and PM2.5	<173	15 as annual average for PM10	0.09 µg/m³ at Berendrecht (annual average)	0.60% at Berendrecht	Ye s
NH3	0.02	500 as annual average	0.055 µg/m³at Berendrecht (annual average)	0.01% in respect of Berendrecht	no

Legionella is retained due to potential concerns. Legionella is invisible and, in some cases, can lead to potentially fatal pneumonia if contracted.

13.5 Effect description and effect assessment

The average concentration contribution and assessment per sector within the study area is included in Appendix 3.2.

[124] Health advisory value or current immission quality, whichever is the most stringent assessment

13.5.1 Construction phase

13.5.1.1 NO2

We are discussing the maximum situation during the construction phase, namely a period of maximum emissions lasting approximately 1.5 years. During the rest of the construction phase, the impact will be lower.

Nowhere in the study area is the background value lower than the GAW (10 µg/m3), but the WHO's IT 3 (20 µg/m3) is met in most of the study area.

In this case, the project's contribution is more than 1% of the GAW (1% of 10 µg/m³ or 0.10 µg/m³) up to approximately 4.3 km from the site (depending on wind direction, yellow in Figure 13-8). The zone with a contribution of more than 1% of the GAW includes parts of Berendrecht, Lillo and Doel (2,835 addresses or approx. 6,521 residents). In more distant residential areas, the contribution is less than 1% (0.1 µg/m³) (green in Figure 13-8). Figure 13-7 zooms in on these zones where the contribution of the project exceeds 1% of the GAW. Due to the current concentration exceeding 80% of the GAW, a multi-criteria assessment must be carried out to determine the possibility and necessity of mitigating measures.

As shown in Figure 13-8, there are six sensitive locations in this impact zone.

Figure 13-7: Homes in zone NO_2 contribution 0.1 – 2 µg/m³ during the construction phase (maximum situation)

[125] Calculated using the Flemish average of 2.3 residents/household

Outside Berendrecht, Doel and Lillo, the contribution is less than 0.1 µg/m3. Consequently, no additional multi-criteria assessment is required.

In the Netherlands, the contribution is less than 0.1 µg/m³. Here too, no additional multi-criteria assessment is necessary.

The average concentration contribution and assessment per sector within the study area is included in Appendix 3.2.

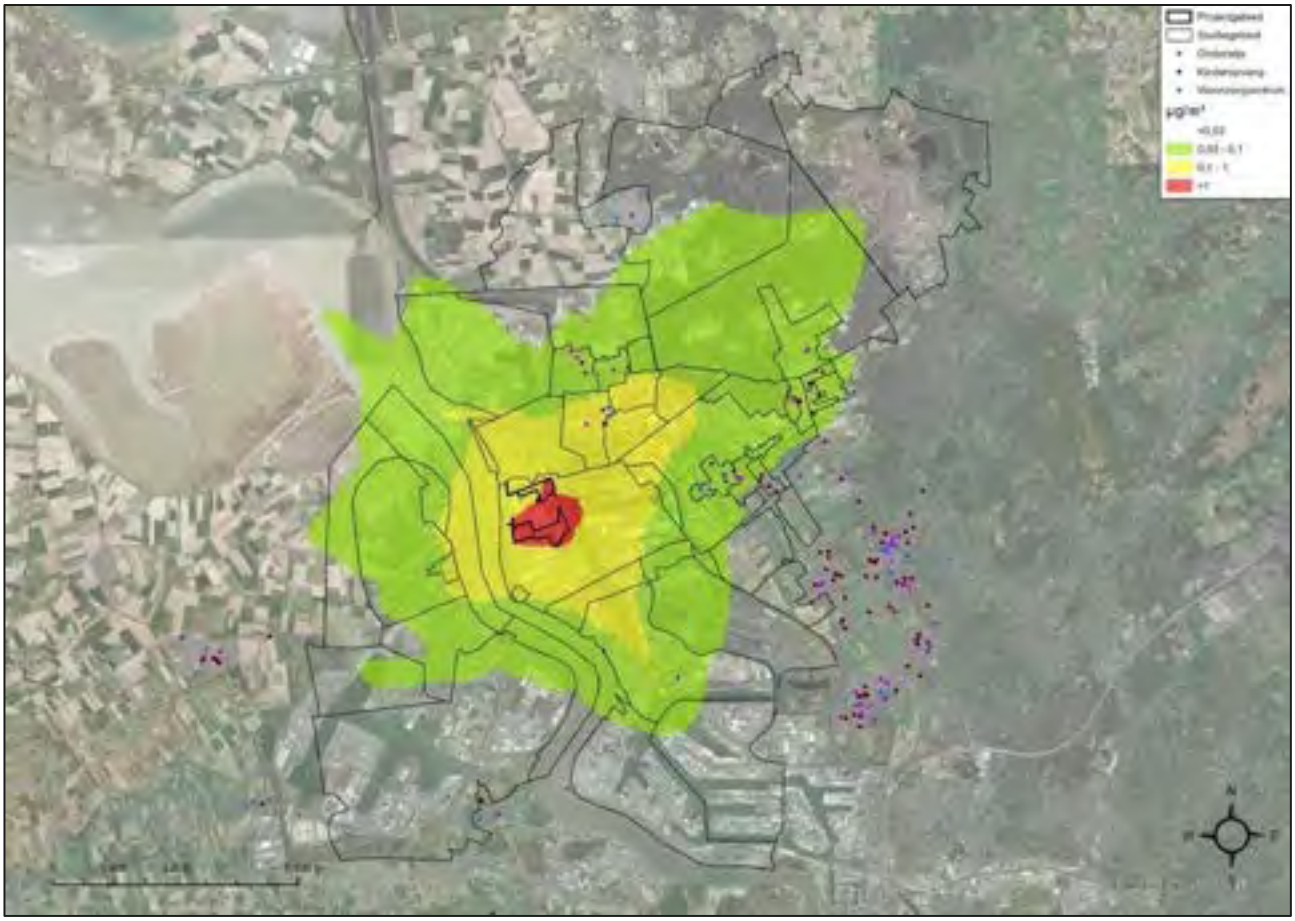

Figure 13-8: Annual average immission contribution of NO_2 during the construction phase – maximum emission situation (µg/m³)

Multi-criteria assessment

Given the contribution of the project and the total concentration in the planned situation, the criteria set out in the Directive system are examined to assess how far mitigating measures should go:

1. Exposure to a mixture of chemical stressors with the same critical endpoint.

This criterion refers to possible synergy when exposed to a mixture of substances, whereby the final effect is greater than the mere sum of the effects of the substances individually (synergistic versus additive effect). Synergistic effects have already been demonstrated in laboratory studies, but this issue has only been explicitly investigated to a limited extent in epidemiological studies. Additional research is needed to determine the relative importance of certain pollutants when exposed to mixtures. This criterion is therefore difficult to assess.

2. Vulnerable locations

There are six vulnerable locations in the 0.1-1.0 µg/m³ zone.

3. Size of the exposed population

The zone with a contribution of more than 1% of the GAW comprises parts of Berendrecht, Lillo and Doel. In total, this concerns 2,835 addresses or 6,521 inhabitants.

4. Size of the (total) contribution of the (existing) company

As there is no activity from Project One in the reference situation, only the contribution of the project is included in the assessment.

The average NOx emissions from the construction phase over four years amount to 18.2 tonnes/year. Given the annual emissions of approximately 18 ktonnes in the port of Antwerp and the temporary nature of the project, this is negligible.

The contribution to the immission concentration in Berendrecht is approximately 0.2 µg/m³, or 2% of the GAW (10 µg/m³).

5. Measures already implemented in the project (BAT, Euro/stage standard, etc.)

The following measures are already being implemented:
The use of Stage IV or better vehicles/machines for all medium and heavy vehicles/machines (from 56 to 560 kW), which corresponds to types from 2014 or younger.

- Approximately three quarters of the vehicles/machines used fall into this category.
- For lighter types (below 56 kW), there is little or no difference depending on the 'Stage' of the machines. These are only subject to stricter emission requirements from Stage V onwards (types from 2019-2020).
- The use of less strictly regulated diesel generators of the heaviest type (> 560 kW) is excluded. Stage IV machines or better will be used for all types of machines, including diesel generators (< 560 kW).

Where possible, transport is planned using ships rather than lorries. This is the case for most land transport and for the delivery of the largest parts (modules) and equipment.

Conclusion: Given the temporary nature of the emissions and the measures already in place, no additional measures are proposed.

Based on the modelled contribution and the above multi-criteria assessment, the effect in parts of Berendrecht, Lillo and Doel where the contribution exceeds 1% of the GAW is assessed as limited negative (-1). In the other parts of the study area and in the Netherlands, the effect is negligible (0).

13.5.1.2 Noise

During the construction phase, three site stages are distinguished in the Noise discipline:

- Construction phase A (approx. 9 months): removal of vegetation, excavation of topsoil, levelling of terrain, construction of an access road, etc.);
- Construction phase B (approx. 15 months): mainly structural works (cut and fill terrain profiling, foundation works, etc.);
- Construction phase C (approx. 20 months): mainly mechanical works on the southern part of the project area (construction of the installations, etc.).

Construction machinery used during the day includes bulldozers, road rollers, tractors, cranes, foundation machines, wheel loaders, dumpers, excavators, concrete mixers, asphalting machines, compressors, etc.

The table below shows the ambient noise and the respective increase for the two immission points in residential areas (Kazerneplein Lillo and Dorpsbeekstraat Berendrecht):

Table 13-19: Ambient noise during the day during the construction phase (in dB(A))

Reference point	Current ambient noise (L_{Aeq})	Ambient noise during construction phase (L_{Aeq})			Increase in environmental noise		
		Construction phase A	Construction phase B	Construction phase C	Construction phase A	Construction stage B	Construction stage C
Immission point 3 (Barracks Square, Lillo)	50	50.6	50.8	50.6	0.6	0.8	0.6
Immission point 4 (Dorpsbeekstraat t 129. Berendrecht)	54	54.6	54.2	54.3	0.6	0.2	0.2

Table 13-20: Environmental noise during the evening and night-time period during the construction phase (in dB(A))

Reference point	Current environmental noise (L_{Aeq})	Ambient noise during construction phase (L_{Aeq})			Increase in environmental noise		
		Construction stage A	Construction phase B	Construction phase C	Construction phase A	Construction stage B	Construction stage C
Immission point 3 (Barracks Square, Lillo)	46	46.0	46.3	46.1	0.0	0.3	0.1
Immission point 4 (Dorpsbeekstraat 129, Berendrecht)	49	49.0	49.1	49.0	0.0	0.1	0.0

When interpreting the calculated specific noise, it should be noted that the calculations were performed for the most critical wind direction, i.e. 'downwind', meaning for a wind direction from the source to the immission point, and should therefore be considered a worst-case scenario.

For residential areas, the above emission points can also be considered worst case scenarios, as they concern (almost) the closest homes, namely in the north-east (IP3 at 890 m from the project area) and south (IP4 at 1,400 m from the project area). Homes in other directions are further away (1.6 km to the west in Doel and 3.3 km to the east in Stabroek).

For the daytime period, it can be concluded that the increase in ambient noise will be (well) less than 3 dB(A). A difference of 3 dB(A) is just audible to the human ear. The increase is highest during construction phase B, namely 0.8 dB(A) at IP3. A significant contribution during construction phase B comes from the foundation machines. These are mainly used during the daytime period of construction phase B.

The WHO guideline value for severe annoyance ($L_{Aeq,16h}$ 55 dB) is not exceeded during the day or in the evening, neither in Berendrecht nor in Lillo. The WHO guideline value for moderate noise pollution ($L_{Aeq,16h}$ 50 dB) is moderately exceeded in Berendrecht during the day. This is also already the case in the reference situation. The contribution of the project is negligible here (≤ 1 dB(A)).

The figures below show the indicative Lden and Lnight contours for construction phase B. As already discussed in § 13.2.4, these are not annual average L_{den} or L_{night} values, but calculations based on wind in the direction of the receiver ('tailwind'). For homes in Lillo, which is located southwest of the project area, the annual average Lden value may be 1 to 4 dB lower than the calculated value with tailwind.

This reasoning does not apply to the homes in Berendrecht, as these are located northeast of the project area and the tailwind situation for this area closely matches the most common wind direction in Belgium (southwest).

Figure 13-9: Indicative Lden noise contours during construction phase B of the construction phase

Figure 13-10: Indicative Lnight noise contours during construction phase B of the construction phase

The contribution of Project One does not exceed the standard value of L_{den} 50 dB(A) or L_{night} 40 dB(A) at the level of residential areas. We would like to note that these values may be exceeded as a result of cumulative industrial noise. However, as shown by the impact expressed in L_{Aeq}, Project One's contribution to the total ambient noise is limited (maximum 0.8 dB(A) during the day and 0.3 dB(A) at night).

The increase in ambient noise is assessed as negligible (0) (maximum 1 dB(A)), both at the height of the homes in Lillo and Berendrecht, during the day, evening and night-time periods.

Project One plans to transport soil and installations during the construction phase using modules, i.e. pre-assembled installation parts, by sea and inland waterway vessels. The expected change in the number of inland vessels/push convoys compared to the current traffic flow on canal dock B1/B2 is approximately 1% compared to the current traffic flow, and approximately 7% for the number of seagoing vessels, which means that the change in noise emissions from the waterway will be <1 dB and the effect on the noise climate will be negligible (0).

13.5.1.3 Light

Work may be carried out before sunrise or after sunset during the construction phase. At these times, lighting of the site will be necessary. The locations where the industrial installations are situated, and where work will therefore be carried out for the longest and most intensive periods, are approximately 1.9 km from the residential area of Berendrecht and approximately 1.3 km from Lillo. Due to the dykes, the residential areas have only a very limited view of the industrial area (see Chapter 12 Landscape). Given that the area is characterised by an industrial environment with many light sources necessary for the safe and proper functioning of the port, and given the relatively large distance between the taller, illuminated installations and residential areas and the visual screening of the residential area from the industrial area, the impact in terms of light pollution during the construction phase is considered negligible.
(0) assessed. It remains important, however, that the lighting is chosen and positioned in such a way that only the project area itself is illuminated and not the surrounding area (minimising light pollution in the construction site area). The chapter on mitigating measures and recommendations therefore provides a number of recommendations on 'good lighting'. These recommendations apply to both the construction and operational phases.

13.5.2 Operational phase

13.5.2.1 NO2

The annual average background concentration of NO_2 in the study area is largely between 16 and 20 µg/m³. Consequently, nowhere in the study area is the background value lower than the GAW (10 µg/m³).

As with the air discipline, we evaluate the effect of NOx emissions for two scenarios:

A. NOx emissions in accordance with the emission levels associated with BAT (BAT-GENs), through the application of upstream reduction techniques such as low-NOx burners;
B. NOx emissions exceeding the emission levels associated with BAT (BAT-GENs), through the use of upstream reduction techniques such as low-NOx burners combined with downstream SCR-DeNOx gas purification; the combination of these techniques achieves a lower emission level than for each BAT technique individually.

The aim is to clarify the difference between the two scenarios. Project One has decided to implement Scenario B, specifically the application of a combination of techniques that will achieve lower emission levels than each BAT technique individually.

13.5.2.1.1 Operational phase - Scenario A: Without additional SCR-DeNOx gas purification

We provide a brief evaluation for Scenario A based on the modelled annual average contribution. Any need for a multi-criteria assessment will therefore not be elaborated here.

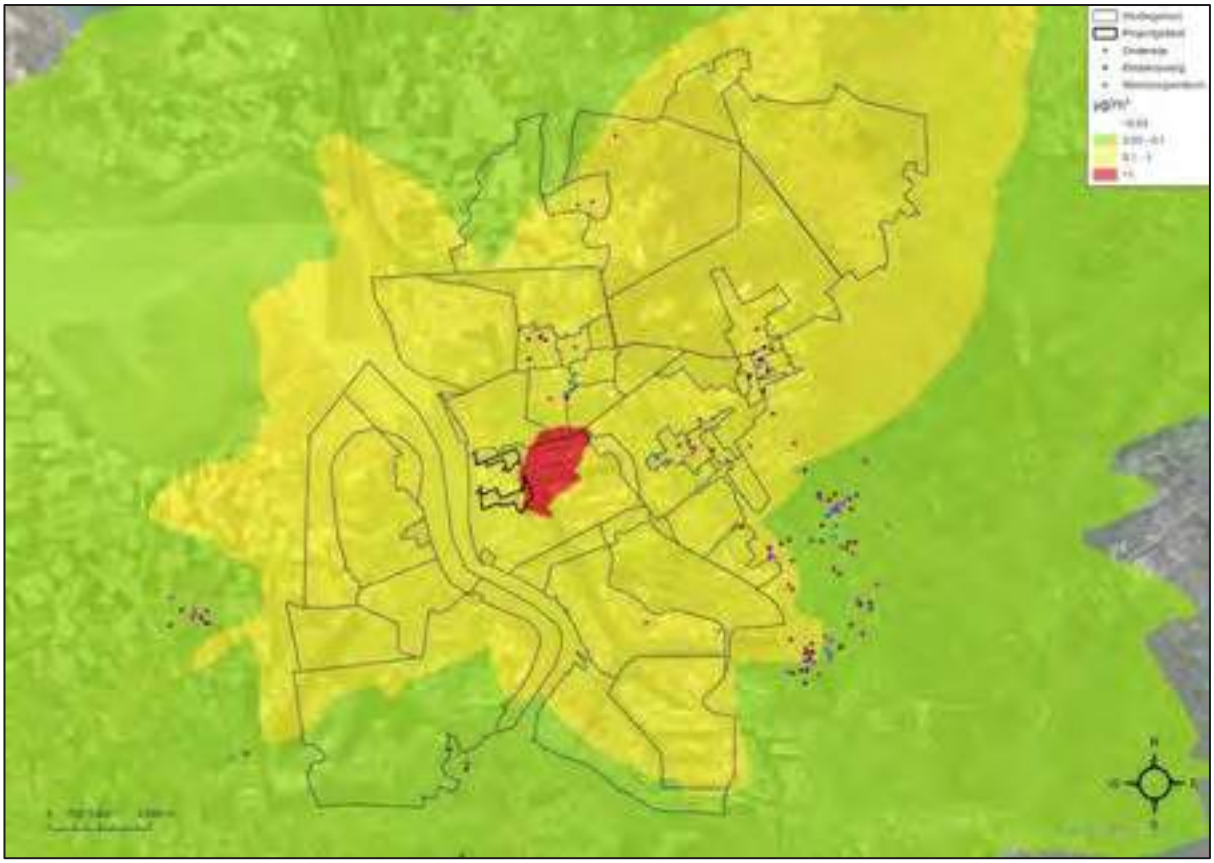

Figure 13-11: Annual average NO2 immission contribution during the operational phase (scenario A) (µg/m³)

The contribution of this project without SCR-DeNOx gas purification is more than 1% of the GAW (10 µg/m3) up to approximately 18 km from the site (depending on wind direction, yellow in Figure 13-11). Virtually the entire study area (approx. 31,526 inhabitants) and even parts outside the study area are located in this zone. In residential areas, the contribution does not exceed 10% (1.0 µg/m³) anywhere (red in Figure 13-11 and Figure 13-12).

13.5.2.1.2 Operational phase – Scenario B: With additional SCR-DeNOx gas purification

As explained in the Air discipline, opting for additional SCR-DeNOx gas purification on the eight main chimneys will achieve a reduction in NOx emissions of 591 tonnes of NOx/year (Scenario A, without SCR-DeNOx) to 167 tonnes/year (Scenario B, with SCR-DeNOx). This reduces Project One's emissions by 72% (§7.4.2.7).

This results in the reduced effects shown below.

The contribution of the project in this scenario is more than 1% of the GAW (10 µg/m³) up to approximately 8.9 km from the site (depending on wind direction, yellow in Figure 13-12). This includes the residential areas of Berendrecht, Zandvliet, Lillo, Doel and parts of Stabroek (6,245 addresses or approx. 14,364 residents) (see Figure 13-13).

[126] Calculated using the Flemish average of 2.3 persons/household.

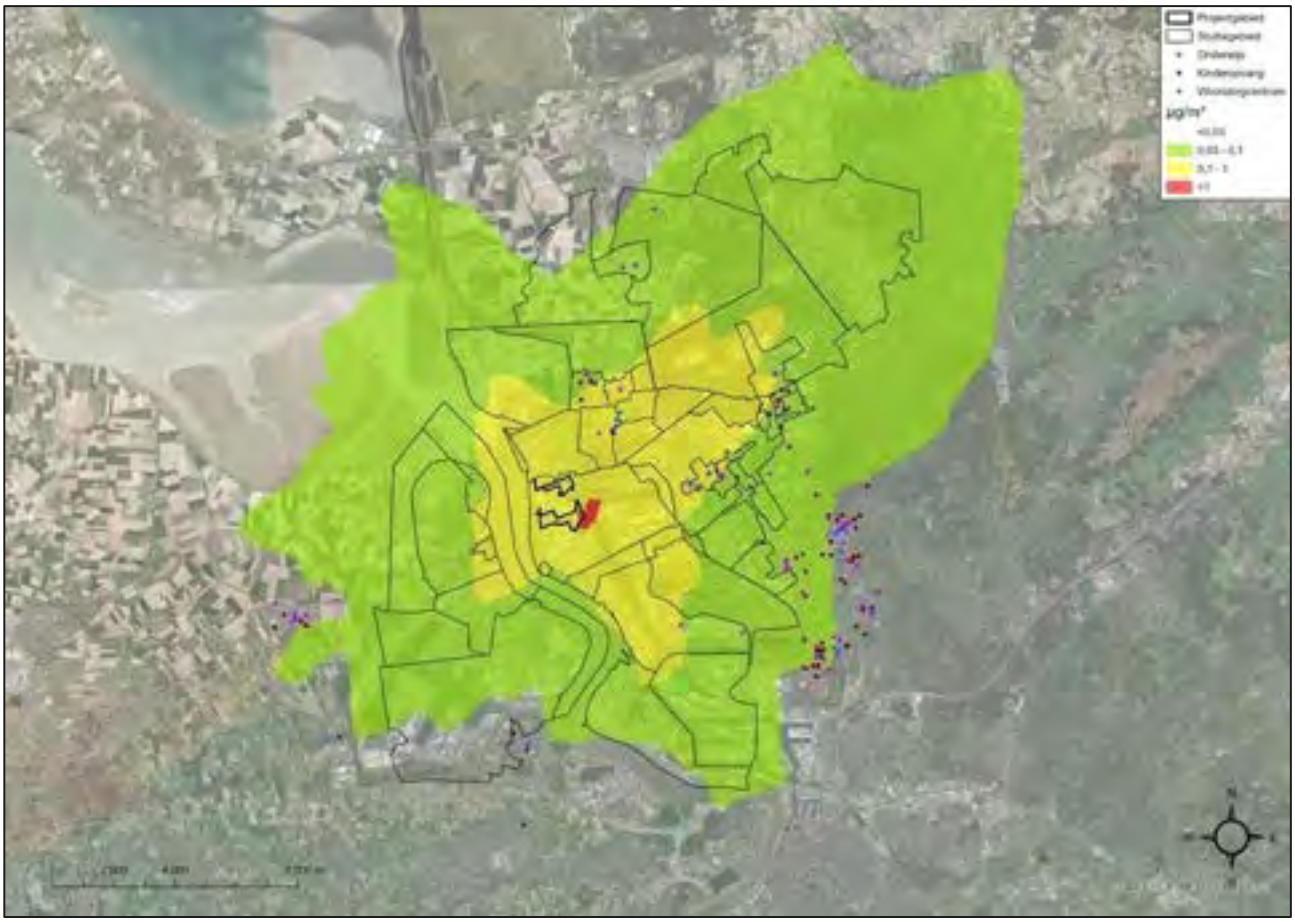

Figure 13-12: Annual average NO_2 immission contribution during the operational phase (µg/m³)

The distribution of sensitive locations is also shown in Figure 13-13. There are four schools, seven elderly care facilities and five childcare locations in the 0.1-1.0 µg/m³ zone. Due to the current concentration, which is higher than 80% of the GAW everywhere, a multi-criteria assessment for mitigating measures is necessary. In the other parts of the study area, the contribution is less than 1% and no multi-criteria assessment is required. In residential areas, the contribution does not exceed 10% (1.0 µg/m³) anywhere (red in Figure 13-12).

Figure 13-13; Homes and vulnerable locations in zone NO_2 contribution 0.2 – 0.6 µg/m³ in the operational phase

For residential areas, the contribution is highest in Berendrecht, where it amounts to a maximum of 0.38 µg/m³ (3.8% of the GAW). In Zandvliet, Doel and Lillo, the contribution varies between 0.1 and 0.2 µg/m³ (1 to 2% of the GAW). In Stabroek, the contribution is between 0.1 and 0.3 µg/m³ (1 to 3% of the GAW).

In the Netherlands, the contribution is around 0.1 µg/m³ at the level of the scattered homes in Ossendrecht and Putte. In the centres of these residential areas, the contribution is consistently lower than 0.1 µg/m³.

Multi-criteria assessment

In view of the contribution of the project and the total concentration in the planned situation, the criteria set out in the Guidelines are being examined to assess how far mitigating measures should go:

1. Exposure to a mix of chemical stressors with the same critical endpoint.

This criterion refers to possible synergy when exposed to a mixture of substances, whereby the final effect is greater than the mere sum of the effects of the substances individually (synergistic versus additive effect). Synergistic effects have already been demonstrated in laboratory studies, but this issue has only been explicitly investigated to a limited extent in epidemiological studies. Additional research is needed to determine the relative importance of certain pollutants when exposed to mixtures. This criterion is therefore difficult to assess.

2. Vulnerable locations

As mentioned in the impact assessment above, there are four schools, seven elderly care facilities and five childcare locations in the 0.1-1.0 µg/m³ zone.

3. Size of the exposed population

In the residential areas of Berendrecht, Zandvliet, Lillo, Doel and parts of Stabroek, the NO_2 contribution exceeds 0.1 µg/m³. A total of approximately 14,364 residents are exposed to this concentration.

4. Size of the (total) contribution of the (existing) company

As there is no activity from Project One in the reference situation, only the contribution of the project is included in the assessment.

Section 7.4.2.8 stipulates that the additional NOx emissions from Project One (167 tonnes/year) will account for approximately 0.2% of the NEC ceilings for 2030. NOx emissions in the port of Antwerp amount to approximately 18 ktonnes/year[127]. Consequently, the future NOx contribution of Project One will account for approximately 0.9% of total NOx emissions in the port of Antwerp.

The contribution to the immission concentration in Berendrecht is approximately 0.3 µg/m³, or 3% of the GAW (10 µg/m³).

5. Measures already implemented in the project (BAT, Euro/stage standard, etc.)

Emissions reduction measures for NO_2 have been integrated into the project. These are described in Chapter 7 Air. SCR De-NOx gas purification is provided on eight chimneys to reduce NOx emissions. As a result of the use of SCR DeNOx gas purification (technology that goes far beyond BAT), emissions will be much lower than the emission levels associated with BAT.

Conclusion: Despite the limited contribution of Project One, additional measures are desirable, given the size of the population (14,364 inhabitants) for which additional measures are recommended.

[127] VMM (2023) Air quality in the Port of Antwerp 2022

It should be noted, however, that this is mainly due to the fact that 80% of the GAW in Berendrecht is already exceeded as a result of other sources (industry, traffic, etc.).

The possibilities for further reducing emissions were examined in Chapter 7 Air (see § 7.9.2). It was investigated (see Appendix 6.4) whether NOx emissions could be further reduced by expanding the SCR catalyst beds and/or replacing them more regularly. However, the target concentration (guideline value of 25 mg/Nm³ with SCR) is close to the technical limits of the SCR, so there are no guarantees that even lower emissions can be achieved. In addition, it appears that the additional investment and operating costs (increased pressure drop across the SCR catalyst; replacement of the catalyst, production shutdown, etc.) for more far-reaching measures are very high compared to the unit reduction cost of 8.6 EUR/kg NOx removed.

Given that the expected emission concentrations amply comply with the emission limit values associated with BAT, and based on the assessment in the Air discipline (Appendix 6.4), it has been decided that no additional measures have been found in accordance with the ALARP principle.

Based on the modelled contribution and the above multi-criteria assessment, the effect in the residential areas of Berendrecht, Zandvliet, Lillo, Doel and parts of Stabroek is assessed as negative (-2) to limited negative (-1). In the other parts of the study area and in the Netherlands, the effect is negligible (0).

The average concentration contribution and assessment per sector within the study area is included in Appendix 3.2.

13.5.2.2 Benzene

The contribution of the project in the operational phase is nowhere higher than a corresponding additional cancer risk of 10^{-4}. The additional cancer risk resulting from the project's benzene contribution is higher than 10^{-5} in a limited zone near the project area, and higher than 10^{-6} in a zone of approximately 1 by 2 km, but still entirely within the industrial area (yellow in Figure 13-14). Near residential areas, the contribution is consistently less than 10^{-6}. The zone in which the additional risk is between 10^{-6} and 10^{-7} is marked in green in Figure 13-14.

The contribution resulting from Project One varies between 0.0020 and 0.010 µg/m³ in Berendrecht (6,120 inhabitants) and around 0.0070 µg/m³ in Lillo (39 inhabitants).

In the Netherlands, the contribution is at most around 0.0015 µg/m³ near the scattered dwellings in Ossendrecht and Putte.

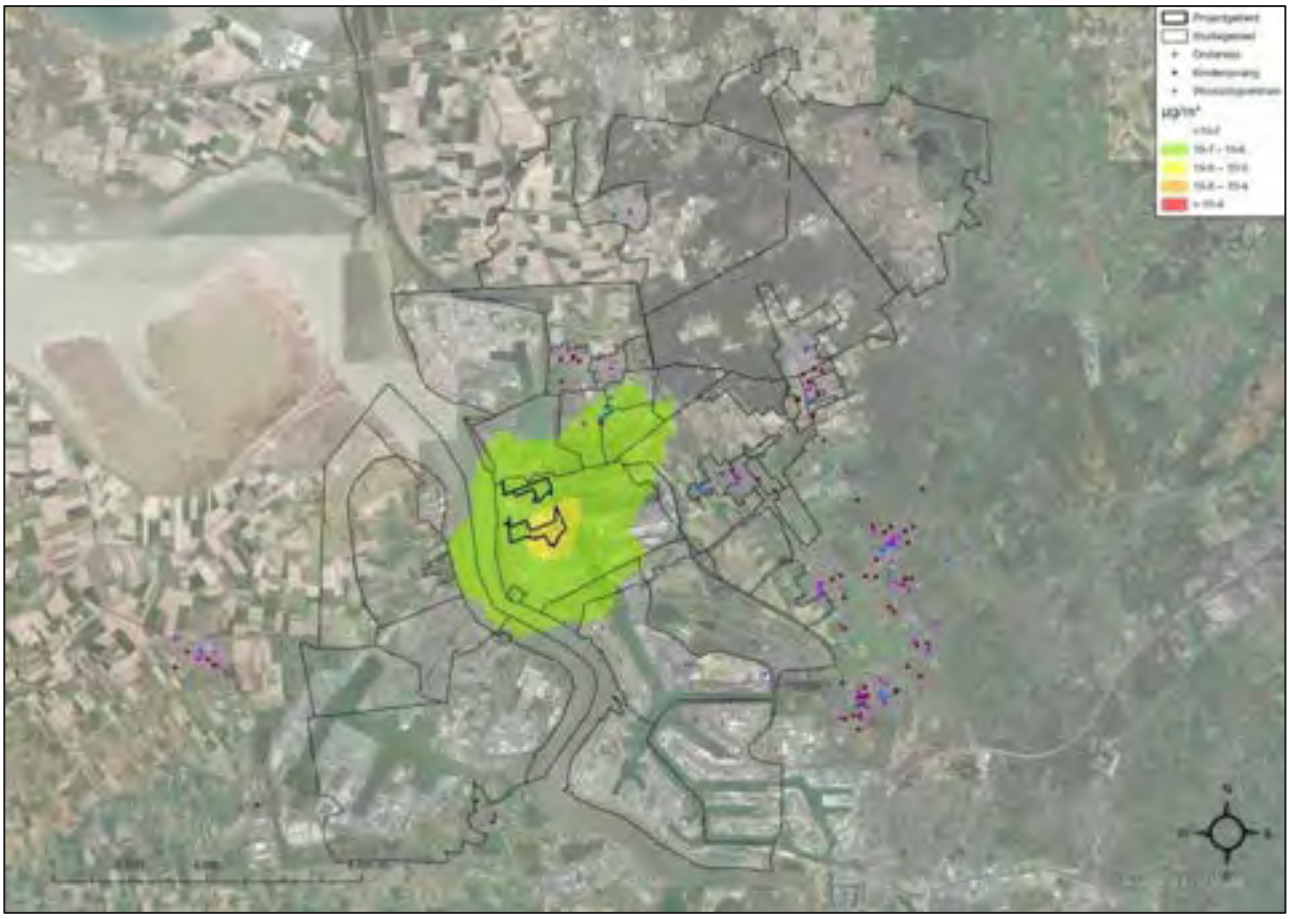

Figure 13-14: Risk contours for the impact contribution of benzene (additional cancer risk) during the operational phase

As a result of the project, the benzene concentration in residential areas will increase by a maximum of 0.010 µg/m³ (Berendrecht). This means that the additional cancer risk as a result of exposure to benzene would increase by less than 1 in 4 million (< 10^{-6}) (intermediate score 0).

Currently, exposure to benzene in the study area, outside the port area, is a maximum of 0.68 µg/m³ (Berendrecht). With lifelong exposure, this corresponds to an additional cancer risk of approximately 18 in 1 million (1.79E-05 in Figure 13-15). The risk is therefore between 1.$^{10-4}$ and 1.$^{10-6}$, the range in which, according to the assessment framework of the Department of Health, a reduction in risk should be sought in accordance with the ALARA principle.

The total additional cancer risk as a result of exposure to benzene therefore increases in the worst case scenario (with an increase from 0.68 to 0.69 µg/m³) from a probability of 1 in 55,882 to a probability of 1 in 55,072. This can be represented visually as follows:

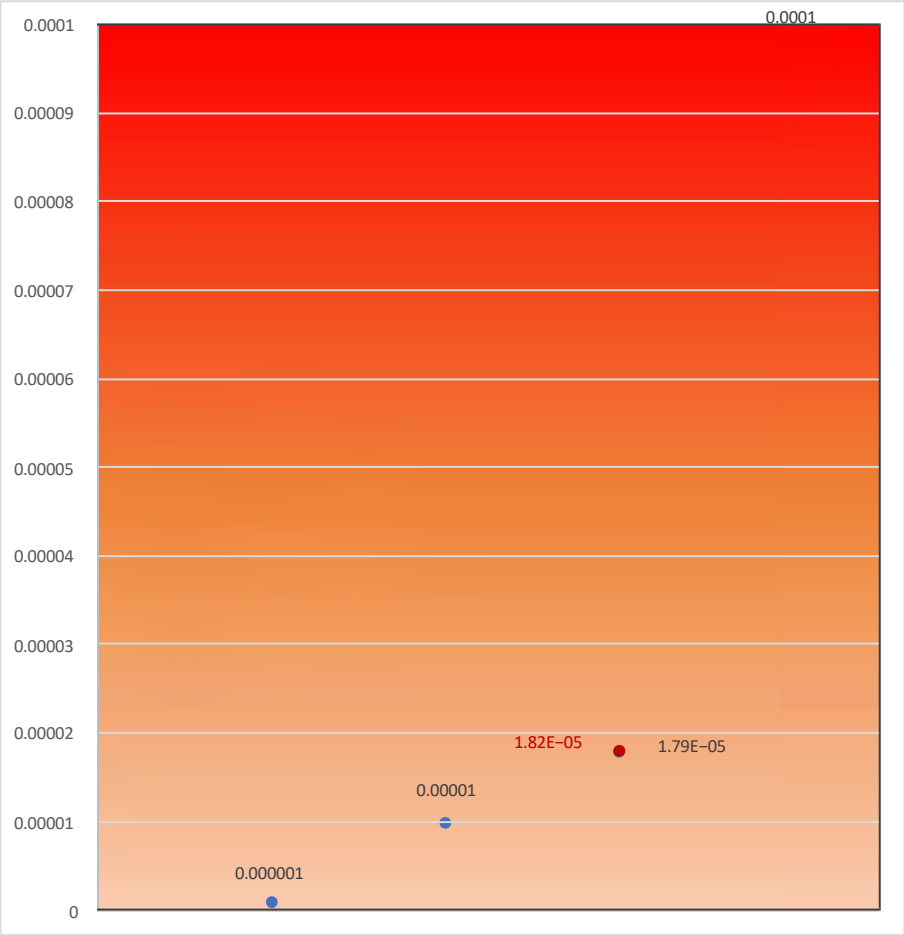

Figure 13-15: Additional cancer risk due to benzene concentration in Berendrecht (worst case) before (1.79 E-05) and after (1.82 E-05, red) implementation of the project compared to a probability of 1.10^{-6} , 1.10^{-5} and 1.10^{-4}

The figure clearly shows that the additional cancer risk is still much closer to $1.^{10-6}$ than to $1.^{10-4}$. The total risk is hardly affected by the additional risk posed by the project.

The current annual average background concentration in the port area is a maximum of 2.52 µg/m³, outside the port area it is approximately 0.68 µg/m³. Outside the port area, the reference value corresponding to a $^{10-6}$ risk for lifelong exposure (0.038 µg/m³) is already exceeded by a factor of 18. The current background concentrations in Flanders are mainly determined by road traffic.

Due to the fact that the additional cancer risk resulting from current environmental concentrations of benzene is greater than $^{10-6}$ (i.e. between $^{10-5}$ and $^{10-4}$), and the additional cancer risk resulting from the contribution of the project in Berendrecht, Lillo and a limited part of Doel is greater than $^{10-7}$, the interim score (0) is tightened and the project contribution is assessed as limited negative (-1). In the other residential areas, the contribution is negligible. (0). The average concentration contribution and assessment per sector within the study area is included in Appendix 3.2.

13.5.2.3 Butadiene

The most recent known annual average background concentration in the port area dates from 2013 and amounts to 0.3 µg/m³. No data are available for outside the port area. At that time, the reference value (0.033 µg/m³) was exceeded by a factor of 10 in the port area.

The contribution of the project in the operational phase is nowhere higher than a corresponding additional cancer risk of $^{10-4}$.

The additional cancer risk resulting from the butadiene contribution of the project is higher than 10^{-5} in a limited zone near the project area, and higher than 10^{-6} in a zone of approximately 1 by 2 km, but still entirely within the industrial area (yellow in Figure 13-14). In residential areas, the contribution is consistently less than 10^{-6}. The zone in which the additional risk is between 10^{-6} and 10^{-7} is indicated in green in Figure 13-17.

The contribution resulting from Project One varies between 0.0016 and 0.0081 µg/m³ in Berendrecht (6,120 inhabitants) and between 0.0050 and 0.0060 µg/m³ in Lillo (39 inhabitants).

In the Netherlands, the contribution of Project One is approximately 0.0015 µg/m³ at the scattered dwellings of Ossendrecht and Putte (additional risk lower than 10^{-7}, final score 0).

Figure 13-16: Risk contours for the impact contribution of butadiene (additional cancer risk) during the operational phase

As a result of the project, the butadiene concentration in residential areas will increase by a maximum of 0.0081 µg/m³ (Berendrecht). This means that the additional cancer risk due to exposure to butadiene would increase by less than 1 in 4 million (intermediate score 0).

The concentration of butadiene in the port area is currently estimated to be in the order of 0.3 µg/m³ (based on a single measurement taken 11 years ago). No data is available on the concentration of butadiene outside the port area. It is assumed here that the ratio is comparable to that of benzene. In the case of benzene, the concentration in the port area is 1.3 to 6 times higher than outside it. In the worst case, the butadiene concentration outside the port area would then be 0.230 µg/m³.

The total additional cancer risk as a result of exposure to butadiene therefore increases in the worst case scenario (with an increase from 0.230 to 0.2381 µg/m³) from a probability of 1 in 143,478 to a probability of 1 in 138,597.

For lifelong exposure, this corresponds to an additional cancer risk of approximately 7 in 1,000,000 (7.22E-06 in Figure 13-17), of which approximately 1 in 4,000,000 is due to the contribution of the project. Visually, this can be represented as follows:

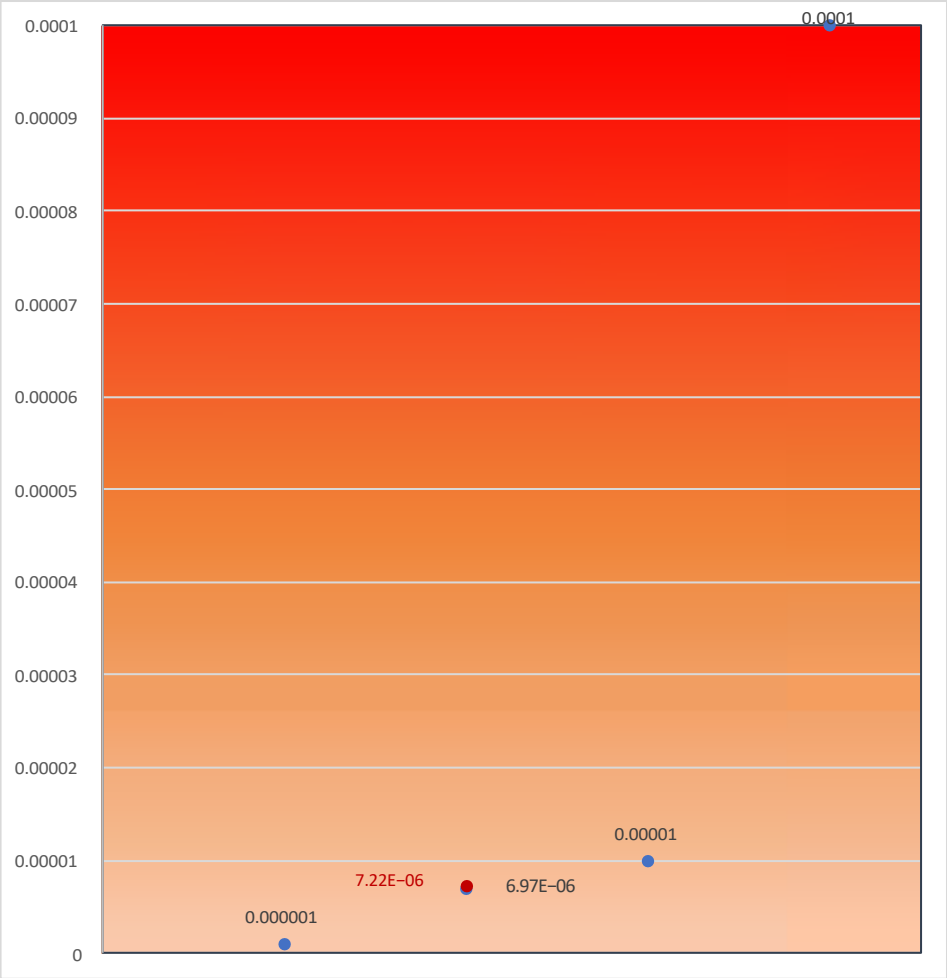

Figure 13-17: Additional cancer risk due to butadiene concentration in Berendrecht (worst case) before (6.97E-06) and after (7.22 E-06, red) implementation of the project compared to a probability of 1.10^{-6} , 1.10^{-5} and 1.10^{-4}

The figure clearly shows that the additional cancer risk is still much closer to $1.^{10\text{-}6}$ than to $1.^{10\text{-}4}$. The total risk is hardly affected by the additional risk of the project.

Due to the fact that the additional cancer risk resulting from the current environmental concentrations of butadiene in Berendrecht and Lillo is greater than $^{10\text{-}6}$ (i.e. between $^{10\text{-}5}$ and $^{10\text{-}4}$), the intermediate score (0) is tightened and the project contribution is assessed as slightly negative (-1). In the other residential areas, the contribution is negligible (0).
The average concentration contribution and assessment per sector within the study area is included in Appendix 3.2.

13.5.2.4 Accumulation of benzene and butadiene

Both benzene and butadiene affect the haematological system and can cause leukaemia.

The total risk of leukaemia as a result of lifelong exposure to the current background concentrations of benzene and butadiene in the study area (residential area) is estimated at $2.49.^{10\text{-}5}$, or a probability of 1 in 40.
218. As a result of emissions from Project One (operational phase), this risk will increase to 2.54×10^{-5} or 1 in 39,412 in the most heavily polluted residential area (Berendrecht).

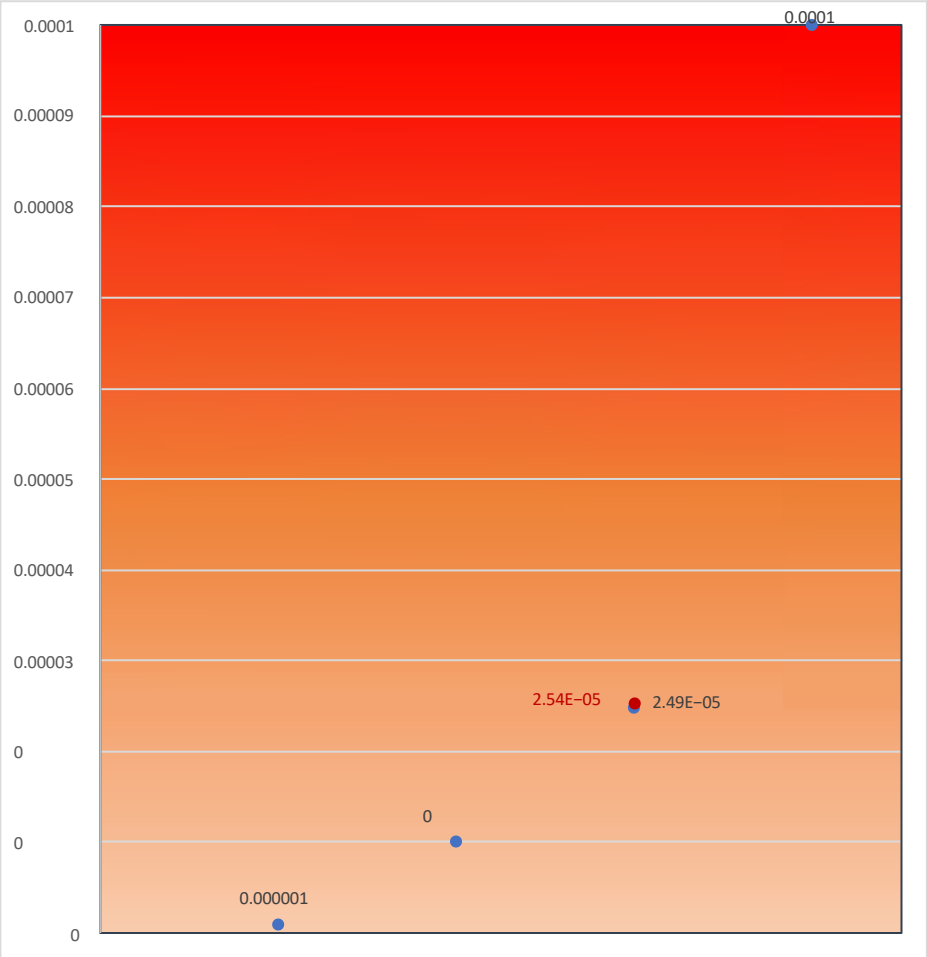

Figure 13-18: Additional cancer risk due to butadiene and benzene concentrations in Berendrecht (worst case) before (2.49E-05) and after (2.54 E-05, red) implementation of the project compared to a probability of 1.10^{-6}, 1.10^{-5} and 1.10^{-4}

The additional cancer risk resulting from total exposure to benzene and butadiene (background concentration including contribution from Project One) is still much closer to $1.^{10-6}$ than to $1.^{10-4}$. The total risk is hardly affected by the contribution of the project.

13.5.2.5 PM10 and PM2.5

13.5.2.5.1 Contribution of the project and measurement results in the surrounding area: PM10

The background concentrations in the project area mainly have an annual average concentration of 21-25 µg/m³.

Compared to the WHO guidelines of 2021, which set four interim targets (IT, interim target 1, 2, 3, 4) of (70, 50, 30 and 20 µg/m³), it can be said that the background concentration complies with the WHO's IT 3 (WHO Air Quality Guidelines, 2021).

IT 4 and the GAW of 15 µg/m³ are not met.

The maximum annual average PM10 immission contribution of the project during the operational phase is 0.185 µg/m³. This plume maximum occurs at the industrial area. Given the nature of the assessment point and the land use, no health effects are to be expected there.

In residential areas, the contribution is still a maximum of 0.09 µg/m³ (in Berendrecht), which is less than 1% of the health advisory value (15 µg/m³) (see Figure 13-19). The distribution of sensitive locations is also shown in Figure 13-19.

There are no sensitive locations in the zone where the contribution exceeds 1% of the GAW. Due to the fact that the contribution is less than 1% of the GAW, no additional multi-criteria assessment is necessary. The effect is assessed as negligible (0) here.

On Dutch territory, the contribution amounts to a maximum of 0.02 µg/m³ at the scattered dwellings of Ossendrecht and Putte. The impact can therefore also be assessed as negligible (0).

The average concentration contribution and assessment per sector within the study area is included in Appendix 3.2.

Figure 13-19: Annual average PM10 immission contribution during the operational phase (µg/m³)

13.5.2.5.2 Contribution of the project and measurement results in the surrounding area: PM2.5

The background concentrations in the project area have an annual average concentration of 12.6-15 µg/m³.

Compared to the WHO guidelines of 2021, which set four interim targets (IT, interim target 1, 2, 3, 4) of 35, 25, 15 and 10 µg/m³ respectively, it can be said that the background concentration complies with the WHO's IT 3.

IT 4 and the GAW of 5 µg/m³ are not met.

No calculations were performed for PM2.5 in the Air discipline, as the proportion of PM2.5 in total dust emissions is unknown. In the worst case, the dust emission contribution can be equated entirely to PM10. In that case, the contribution in the residential area during the operational phase is a maximum of 0.09 µg/m³ (at Berendrecht; 2,006 addresses or 4,614 inhabitants), which is more than 1% of the health advisory value (5 µg/m³). Due to the fact that the ambient concentration in the current situation already exceeds 80% of the health advisory value, a multi-criteria assessment for mitigating measures is necessary.

The other parts of the study area have an immission concentration of less than 1% of the GAW, so no multi-criteria assessment is needed for these.

In the Netherlands, the maximum contribution in residential areas is 0.02 µg/m³.

Multi-criteria assessment

Given the contribution of the project and the total concentration in the planned situation, the criteria set out in the Directive system are examined to assess how far mitigating measures should go:

1. Exposure to a mixture of chemical stressors with the same critical endpoint.

This criterion refers to possible synergy when exposed to a mixture of substances, whereby the final effect is greater than the mere sum of the effects of the substances individually (synergistic versus additive effect). Synergistic effects have already been demonstrated in laboratory studies, but this issue has only been explicitly investigated to a limited extent in epidemiological studies. Additional research is needed to determine the relative importance of certain pollutants when exposed to mixtures. This criterion is therefore difficult to assess.

2. Vulnerable locations

There are 8 vulnerable locations in the 0.05 - 0.5 µg/m³ zone.

3. Size of the exposed population

In the residential area of Berendrecht, the $PM_{2.5}$ contribution exceeds 0.05 $\mu g/m^3$. In total, approximately 4,614 residents are exposed to this concentration.

4. Size of the (total) contribution of the (existing) company

Section 7.4.2.8 stipulates that the additional $PM_{2.5}$ emissions from Project One (29 tonnes/year, worst-case estimate based on the estimated PM10 emissions, of which $PM_{2.5}$ is a part) will account for approximately 0.2% of the NEC ceilings for 2030. In 2022, the total share of $PM_{2.5}$ emissions from industrial activities in Flanders amounted to 1,969 tonnes[128]. Consequently, Project One's future $PM_{2.5}$ contribution will account for approximately 1.5% of total industrial $PM_{2.5}$ emissions in Flanders. We would like to reiterate here that, in the worst-case scenario, Project One's $PM_{2.5}$ contribution was equated entirely with the PM10 contribution.

The contribution to the immission concentration in Berendrecht is approximately 0.09 µg/m³, or 1.8% of the GAW (5 µg/m³).

5. Measures already implemented in the project (BAT, Euro/stage standard, etc.)

Emissions reduction measures have been integrated into the project for particulate matter. The decoking emissions from the ECR are limited by dust removal using cyclones (see also Chapter 7 Air).

Conclusion: Given the limited contribution of Project One and the measures already taken, no additional measures are proposed.

Based on the modelled contribution and the above multi-criteria assessment, the effect in the residential areas of Berendrecht is assessed as negative (-2) to slightly negative (-1). In the other parts of the study area and in the Netherlands, the effect is negligible (0).

The average concentration contribution and assessment per sector within the study area is included in Appendix 3.2.

[128] VMM (2024) Particulate matter emissions (PM_2,y)

Effects of particulate matter ($_{PM2.5}$)

Since particulate matter is one of the most significant pollutants in terms of health impact, a discussion has been added on the latest expectations regarding the health effects of exposure to particulate matter in Europe.

In November 2023, the European Environment Agency (hereinafter referred to as EEA) published a report on the health impact of air pollution in Europe[129] . This report, which is part of the "Air quality in Europe 2023" report, discusses, among other things, the latest expectations regarding the health effects of exposure to particulate matter and assesses the progress made in reducing the mortality rate due to air pollution.

As part of the European Green Deal's zero pollution action plan, the European Commission has set itself the target of reducing the number of premature deaths caused by $_{PM2.5}$ by at least 55% by 2030 compared to 2005.

Looking at past trends, we see that between 2005 and 2021, the number of premature deaths in the EU due to exposure to $_{PM2.5}$ above the WHO guideline value has fallen by 41% (see Figure 13-20). If air quality continues to improve at this rate and the number of premature deaths continues to decline at a similar rate in the future, the target would be achieved by 2026. However, this estimate is based solely on the assumption that the observed trend will continue. It is not a projection, as it does not take into account recent policy developments or additional efforts made since 2021 to improve air quality.

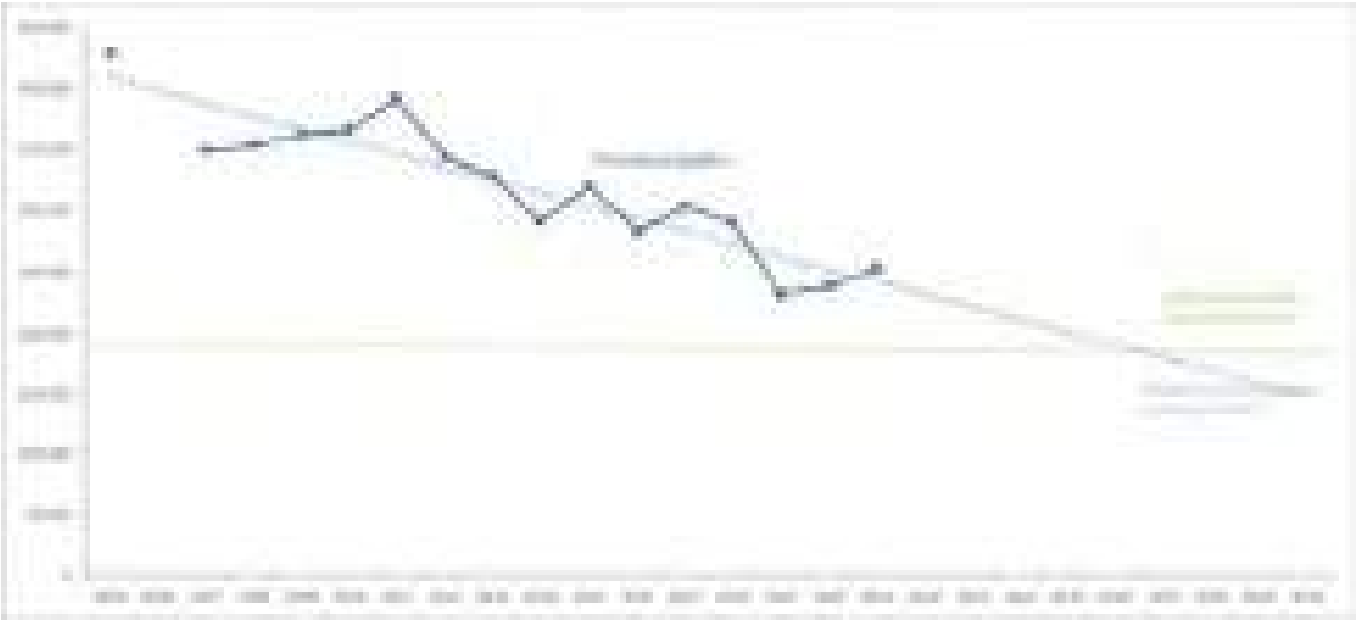

Figure 13-20: Premature deaths in the EU-27 due to PM2.5 concentrations above the WHO guideline value (2021), 2005-2021.

In 2021, there will be 253,000 (95% CI 193,440–282,490) premature deaths in the EU-27 attributable to exposure to $_{PM2.5}$ concentrations above the WHO guideline value of 5 $\mu g/m^3$. For Belgium alone, this number is 5,106 (95% CI: 3,896 - 5,705). It is important to note that the figures presented here only concern premature deaths attributable to exposure to $_{PM2.5}$ concentrations above the 2021 WHO guideline values. The scientific evidence is less certain for exposure to concentrations below the WHO guideline values than for health effects above them. However, there is no evidence that there is a threshold below which air pollution has no impact on health.

[129] Harm to human health from air pollution in Europe: burden of disease 2023 (EN HTML: TH-AM-23-026-EN-Q – ISBN: 978-92-9480-614-7 – ISSN: 2467-3196 – doi: 10.2800/721439), https://www.eea.europa.eu/publications/harm-to-human-health-from-air-pollution

The map below shows the years of life lost per 100,000 inhabitants for each country. It shows that the highest relative numbers were observed in South-Eastern Europe. The highest $PM_{2.5}$ concentrations were also observed in this region (see Figure 13-22).

Figure 13-21: Map showing years of life lost (YLL) per 100,000 inhabitants as a result of exposure to $PM_{2.5}$ above the WHO guideline value of 5 µg/m3 in 2021.

Figure 13-22: Map showing $_{PM2.5}$ concentrations in 2021[130] relative to the EU annual limit value and the WHO annual guideline level

As explained in the Air discipline (see section 7.6.2.7.4), particulate matter in the ambient air is partly the result of various dust emissions (primary particulate matter), but also partly of the conversion of gaseous pollutants (precursors: NOx, NH3, SO2, VOCs) into fine dust particles (secondary particulate matter). This involves a very widespread and therefore very low effect of each emission source on air quality. The formation of secondary particulate matter has been taken into account in the EEA study mentioned above. To clarify the contribution of Project One to these effects, we provide the following explanation:

- Due to the highly dispersed effect, calculating the contribution of a single project to the formation of secondary particulate matter is not useful for evaluating effects when granting permits. It is important, however, that emissions of precursors are limited as much as possible, not only to limit the primary effect of the precursors on air quality within the study area, but also because of their contribution to secondary effects that are widely dispersed but also occur at greater distances (see section 7.6.2.7.4).
- Due to the long-range effects, which are often transboundary, a European approach has been developed to limit emissions of precursors, thereby also reducing their secondary effects. This European approach has led to emission ceilings per country. For an explanation and evaluation of this, please refer to section 7.4.2.8.
- Specifically for Project One, with mainly NOx emissions and low precursor emissions, the formation of secondary particulate matter would take place over a period of hours to days and therefore largely occur at great distances (e.g. more than 50 km) from the location. The precise details are highly dependent on various variables (see section 7.6.2.7.4). At such distances, emissions from the site will be greatly diluted in the atmosphere and indistinguishable from other background pollution, including particulate matter.

[130] The "Air quality in Europe 2023" report shows concentrations for 2021 and 2022. The data for 2022 are provisional. It has therefore been decided to show the validated data for 2021.

13.5.2.6 Noise

During the operational phase, the following noise sources are significant:

Installations with continuous noise emissions: ECR and supporting infrastructure and ship traffic; Flares.

When calculating the specific noise from continuous sources, a distinction is made between the following variants (situations):

Specific noise from the ECR unit and supporting infrastructure;

Specific noise from the ECR unit and supporting infrastructure, including 2 small vessels (inland vessels);

Specific noise from the ECR unit and supporting infrastructure, including 1 large vessel (seagoing vessel) and 1 small vessel (inland vessel).

The tables below show the ambient noise and the respective increase due to continuous sources for the two immission points in residential areas (Kazerneplein Lillo and Dorpsbeekstraat Berendrecht):

Table 13-21: Ambient noise during the operational phase – continuous sources (in dB(A))

Reference point	Current ambient noise (L_{A95})	Lsp			Lna-Lbefore Δ $L_{A95,1h}$		
		Excluding ships	Including 2 small ships	Including 1 large and 1 small ship	Excluding ships	Including 2 small ships	Including 1 large and 1 small vessel
Emission point 3 (Barracks Square, Lillo)	44	30.6	31.0	31.1	0.2	0.2	0.2
Immission point 4 (Dorpsbeekstraat 129, Berendrecht)	46	26.0	28.2	33.0	0.0	0.1	0.2

The increase in noise (expressed in $L_{A95,1h,}$ which is the most appropriate parameter given its continuous nature) is negligible (maximum 0.2 dB(A)) at the two nearest measuring points in all three situations. This will therefore not lead to additional nuisance or health effects.

The figure below shows the indicative Lden contours for the operational phase, including the noise from one inland vessel and one seagoing vessel. As already discussed in § 13.2.4, this is not an annual average L_{den}, but a calculation based on wind in the direction of the receiver ('tailwind'). For homes in Lillo, which is located southwest of the project area, the annual average Lden value may be 1 to 4 dB lower than the calculated value with tailwind. This reasoning does not apply to the homes in Berendrecht, as these are located northeast of the project area and the tailwind situation for this area closely corresponds to the most common wind direction in Belgium (southwest).

The contribution of Project One does not exceed the standard value of L_{den} 50 dB(A) at the level of residential areas. We would like to note, however, that this value may be exceeded as a result of cumulative industrial noise. However, as shown by the impact expressed in L_{A95}, Project One's contribution to the total ambient noise is negligible (maximum 0.2 dB(A)).

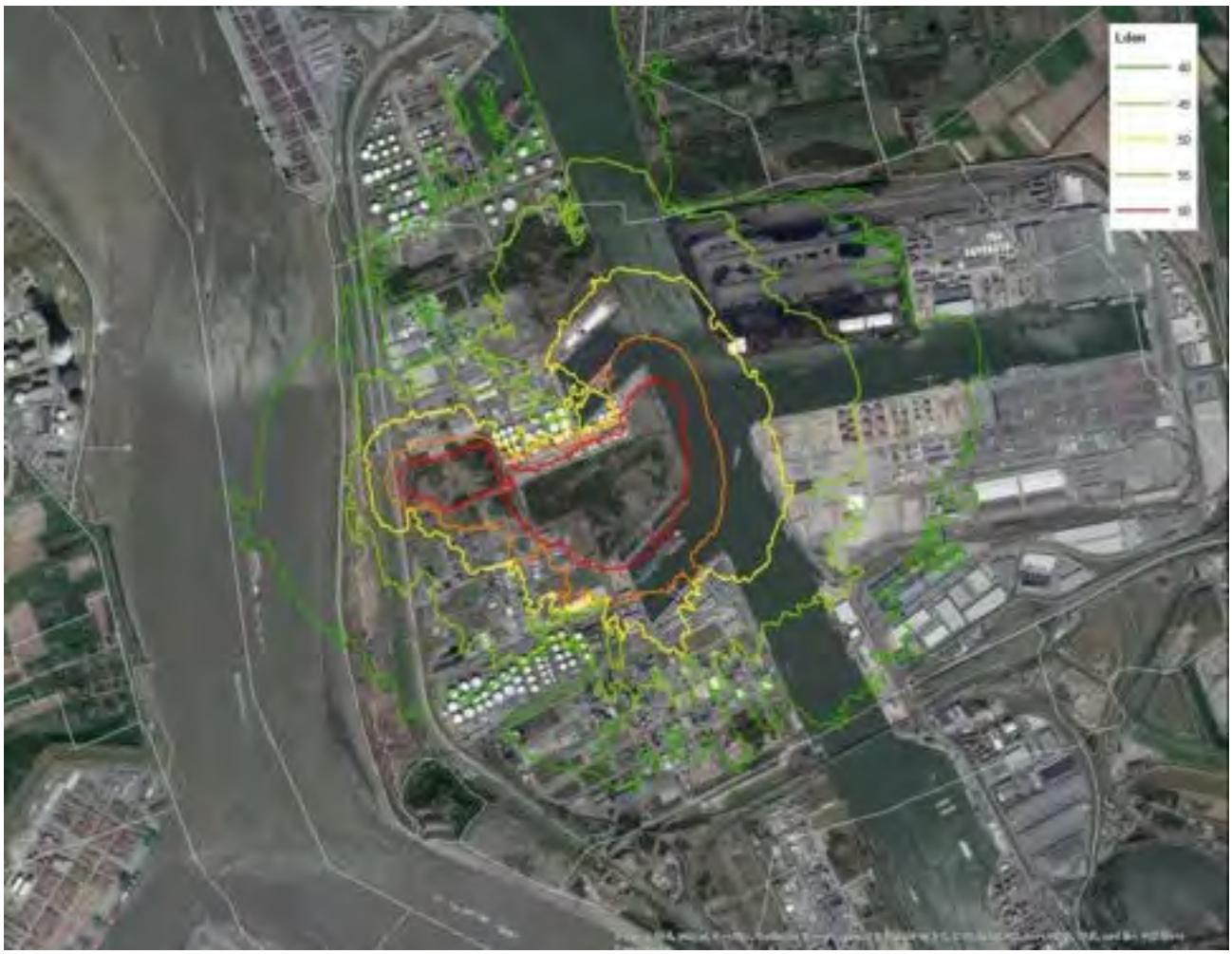

Figure 13-23: Indicative Lden noise contours during the operational phase, including 1 inland vessel and 1 seagoing vessel

Project One provides for 4 flares spread across the project area. These consist of 1 tower flare and 2 ground flares (one of which is double).

The ground flares can be used during the start-up or shutdown of the ECR; the tower flare can only be used in the event of an unexpected emergency, to ensure safety on site. They are therefore not part of the 'normal' production process of Project One.

The tables below show the ambient noise and the respective increase in noise as a result of the flares for the two immission points in residential areas (Kazerneplein Lillo and Dorpsbeekstraat Berendrecht).

Table 13-22: Environmental noise during operational phase – continuous sources ECR and supporting infrastructure + ECR ground flare (in dB(A) (during ECR start-up phase)

Reference point	Current environmental noise ($_{LA95}$)	Lsp	Lna-Lbefore Δ LA95,1h
Immission point 3 (Kazerneplein, Lillo)	44	32.1	0.3
Immission point 4 (Dorpsbeekstraat 129, Berendrecht)	46	27.5	0.1

Table 13-23: Environmental noise during operational phase – ECR tower flare (in dB(A) (during emergency)

Reference point	Current environmental noise (L_{A95})	Lsp	Lna-Lbefore Δ LA95,1h
Immission point 3 (Kazerneplein, Lillo)	44	51.6	8.3
Immission point 4 (Dorpsbeekstraat 129, Berendrecht)	46	44.0	2.1

During the start-up phase of operation with an ECR ground flare in operation, the increase in ambient noise is negligible (< 1 dB(A)).

The above shows that, during exceptional operation of the ECR tower flare, a change in ambient noise of approximately 8 dB(A) can be expected at the height of the homes in Lillo. This can be particularly disruptive during the evening and night-time hours, but, as stated earlier, only occurs in exceptional cases. For the homes in Berendrecht, the change in noise levels will be limited to less than 3 dB(A).

Project One anticipates that the ECR tower flare will only be used for emergencies after the start-up phase. The ECR ground flares are intended to prevent flaring via the tower flare during a planned start-up or shutdown of the ECR. This is discussed in § 3.4.11.

Due to the fact that the tower flare will only operate in exceptional circumstances, the impact on residential areas is assessed as limited negative (-1).

The project also provides for a maximum of four ship movements per 24 hours with an inland vessel or a maximum of two with an inland vessel and one with a seagoing vessel. This represents an increase of approximately 2% in the number of movements of inland vessels and approximately 3.5% in the number of seagoing vessels, which means that the change in noise level will be well below 1 dB and therefore negligible (0).

With regard to noise impact, the study area was limited to 2 km around the project area, and therefore only covers territory in Flanders. Consequently, no effects are expected in the Netherlands.

13.5.2.7 Light

Both the site and the installations themselves will be illuminated for safety reasons. The ECR (i.e. the tallest installation, not including chimneys and flares) is located approximately 2 km from the residential area of Berendrecht and approximately 1.5 km from Lillo. Due to the dykes, the residential areas have only very limited visibility of the industrial area (see Chapter 12 Landscape). Given that the area is characterised by an industrial environment with many light sources necessary for the safe and proper functioning of the port, and given the relatively large distance between the taller, illuminated installations and residential areas and the visual screening of the residential area from the industrial area, the impact in terms of light pollution during the construction phase is considered negligible (0). It remains important, however, that the lighting is chosen and positioned in such a way that only the site itself is illuminated and not the surrounding area. The chapter on mitigating measures and recommendations therefore provides a number of recommendations on 'good lighting'. These recommendations apply to both the construction and operational phases.

During the operational phase, ground flares may be used for planned start-up and shutdown operations. This will not be visible from the surrounding residential areas. When the tower flare is in operation, it may be clearly visible in the surrounding residential areas. However, the tower flare is only used in emergency situations and is therefore very rare. The impact of light pollution resulting from the use of flares is also assessed as negligible (0).

13.5.2.8 Legionella

The Project One site will be equipped with cooling systems for the ECR and the steam boilers. Each cooling system is a forced cooling system (multi-cell cooling towers equipped with fans, in which the water is cooled by contact with ambient air).

Due to the presence of open cooling systems, the Legionella Decree (Decree of the Flemish Government of 9 February 2007) applies. This decree stipulates measures against *Legionella pneumophila* to prevent Legionnaires' disease.

According to the above-mentioned decision, Project One must draw up a management plan that includes a description of the installation, a risk analysis and preventive measures. This management plan must be evaluated and, if necessary, adjusted whenever changes are made to the installation that could affect the risk of Legionella developing, and at least every five years.

The cooling towers will be sampled and analysed for the presence of Legionella in accordance with the management plan. If, in exceptional circumstances, the limit value specified in the decision is exceeded, the necessary measures will be taken (cleaning, adding or increasing the amount ofbiocide) and further checks will be carried out. These measures and control actions are included in the Legionella management plan.

It can therefore be concluded that, provided the management plan is implemented, the risk of Legionella contamination from the cooling systems is negligible (0).

13.6 Cumulative effects

13.6.1 Quay wall

The Antwerp Port Authority is planning to construct a new quay wall. Construction of this quay wall, located on the south-eastern side of the project area, began in 2021 and will be completed in the course of 2024 (most of this work had therefore already been carried out when this EIA was drawn up).

The construction phase of the quay wall at canal dock B2, between docks 1 and 2, overlaps with the construction phase of Project One.

During the construction phase of both projects, cumulative effects in terms of noise and air emissions may occur.

Once the quay wall has been (partially) completed, it can be put into use for the further construction work on Project One. The quay wall will provide additional berths and facilitate the supply of materials by ship. The EIA for the quay wall estimated that the new quay wall will increase the number of ships by approximately 1% compared to the total number of ships handled annually in the port.

Given the nature of the environment (port area, low population density) and the project proposal, no relevant change in emissions from health-affecting emitters in vulnerable areas (e.g. residential areas) is expected.

The specific sound pressure level resulting from the construction of the new quay wall will be approximately 10 dB(A) lower than the current ambient noise level at Berendrecht and Lillo. No relevant cumulative noise effects are therefore expected during the period when both construction sites would be operational simultaneously.

[131] The use of NaOCl as a cooling water biocide is no longer permitted. Alternatives will be investigated for this purpose. used to make significant use of organic/biodegradable additives (‘green’ anti-scalants).

13.7 Development scenarios

13.7.1 ECA

For a description of the Complex Project 'Realisation of additional container handling capacity in the Antwerp Port Area' (abbreviated to ECA), please refer to section §5.5.1.

According to the EIA at the planning level, the realisation of the complex ECA project will result in additional NOx emissions, mainly linked to seagoing vessels. These emissions will occur in a number of areas spread across the port area, on both the left and right banks of the Scheldt. The effect on air quality of the specific ECA sub-projects will be assessed for each sub-project.

The implementation of both projects (Project One and ECA) may result in a significant increase in NOx emissions in the port area. This will be further evaluated within ECA during the specific permit procedures.

Given the relatively local impact of seagoing vessels, the cumulative effect will mainly occur in residential areas in the immediate vicinity of the port area (Berendrecht, Lillo). However, this would not lead to a different analysis of Project One for the Human Health aspect, as the existing exceedance of the health advisory value is already taken into account here. Consequently, a multi-criteria assessment has already been carried out.

13.8 Mitigating measures

13.8.1 Construction phase

The following measure has already been integrated into the project:

The use of Stage IV or better vehicles/machines for all medium-duty and heavy-duty vehicles/machines (from 56 to 560 kW), which corresponds to types from 2014 or younger.

- Approximately three quarters of the vehicles/machines used fall into this category.
- For lighter types (below 56 kW), there is little or no difference depending on the 'Stage' of the machines. These are only subject to stricter emission requirements from Stage V onwards (types from 2019-2020).
- The use of less strictly regulated diesel generators of the heaviest type (> 560 kW) is excluded. Stage IV machines or better will be used for all types of machines, including diesel generators (< 560 kW).

Where possible, transport is planned using ships rather than lorries. This is the case for most land transport and for the delivery of the largest parts (modules) and equipment.

Based on the multi-criteria assessment, no additional mitigating measures were proposed. For recommendations

regarding light pollution, please refer to § 13.8.2.

13.8.2 Operational phase

Based on the impact assessment (negative (-2) to limited negative (-1) for NO_2 and $PM_{2.5}$, limited negative (-1) for benzene and butadiene), (additional) mitigating measures are desirable for these parameters.

In view of the contribution of the project and the overall concentration in the planned situation, the criteria set out in the Directive system are examined in order to assess how far mitigating measures should go. For the evaluation of the size of the population and the presence of vulnerable locations, we refer to the above-mentioned sections 13.5.2.1.2 (NO2), 13.5.2.2 (benzene), 13.5.2.3 (butadiene) and 13.5.2.5 (PM2.5) above. The Guideline System also mentions possible exposure to a mixture of chemical stressors with the same critical endpoint. This criterion refers to possible synergy when exposed to a mixture of substances, whereby the ultimate effect is greater than the mere sum of the effects of the substances individually (synergistic versus additive effect). Synergistic effects have already been demonstrated in laboratory studies, but this issue has only been explicitly investigated to a limited extent in epidemiological studies.

Further research is needed to determine the relative importance of certain pollutants when exposed to mixtures. This criterion is therefore difficult to assess.

Given the size of the population concerned and the presence of several sensitive locations in the area of influence, an assessment is being made of the measures already implemented in the project and any additional measures that may be reasonable.

When distinguishing between reasonable and unreasonable measures with regard to chemical stressors, the ALARP principle, which stands for 'As Low As Reasonably Practicable', must be taken into account according to the Human Guidelines System, subdomain Health. Although similar to ALARA in its objectives, ALARP emphasises the practical feasibility of risk reduction measures.

Emissions reduction measures were indeed integrated into the project for **NO_2**. These are described in Chapter 7 Air. SCR De-NOx gas purification is provided on eight chimneys to reduce NOx emissions. As a result of the use of SCR DeNOx gas purification (technology that goes far beyond BAT), emissions will be much lower than the emission levels associated with BAT. The contribution of Project One alone is therefore limited, but since 80% of the GAW in Berendrecht is already exceeded as a result of other sources (industry, traffic, etc.), a multi-criteria assessment for (additional) mitigating measures was necessary. The possibilities for further reducing emissions were investigated in Chapter 7 Air (see § 7.9.2). It was investigated (see Appendix 6.4) whether NOx emissions could be further reduced by expanding the SCR catalyst beds and/or replacing them more regularly. However, the target concentration (guideline value 25 mg/Nm³ with SCR) approaches the technical limits of the SCR, so there are no guarantees that even lower emissions will be achieved.
In addition, it appears that the additional investment costs and operational costs (increased pressure drop across the SCR catalyst; replacement of the catalyst, production shutdown, etc.) for more far-reaching measures are very high compared to the unit reduction cost of EUR 8.6/kg NOx removed.

The negative assessment for NO_2 is determined, among other things, by the fact that even without implementation of the project, the health advisory value of 10 µg/m³ will be exceeded. If the health advisory value is exceeded, health effects may occur, but this will not always be the case. This also depends on the specific characteristics of the population concerned and other environmental factors (including environmental factors).

For **benzene and butadiene**, the contributions can be considered limited negative (-1). This is due to the fact that, under current conditions, the negligible risk level is already exceeded. However, the contribution of Project One is limited in residential areas to an additional cancer risk of less than $1.^{10\text{-}6}$ for both benzene and butadiene.

Mitigating measures are desirable in view of the assessment. The aim should be to achieve the lowest possible emissions in accordance with the ALARA or ALARP principle. Measures to limit emissions of volatile organic compounds have already been integrated into the project: to prevent and limit fugitive emissions, action is being taken in the areas of design, construction, commissioning, maintenance and monitoring. This means that technically sealed installation components are used in all parts of the installation where gaseous or volatile liquid product flows occur. During construction, specialised, trained personnel are deployed to install flanges, valves, etc. correctly. Before the installations are commissioned, leak tests are carried out and any leaks are repaired before the installations are actually put into service. In terms of monitoring, a combination of measurements at installation components (sniffing method) and the use of advanced infrared cameras (OGI = Optical Gas Imaging) is provided in collaboration with the specialised contractor. This approach applies all aspects of BAT.

For **$PM_{2.5}$**, the effects are negative (-2) to moderately negative (-1) at Berendrecht. The negative assessment for $PM_{2.5}$ is determined, among other things, by the fact that even without implementation of the project, the health advisory value of 5 µg/m³ is exceeded. Mitigating measures are desirable.

The dust emissions mainly originate from the decoking processes, as only gaseous fuel is used. Measures are being integrated into the project to limit these emissions (see § 7.8.1). For example, the decoking emissions from the ECR are limited by dust removal using cyclones.

The operation of the ECR tower flare may cause **noise pollution**, especially in Lillo. However, as the flare will only be used in emergency situations, the impact on residential areas is assessed as limited negative (-1). As a (project-integrated) measure, ECR ground flares are also planned to capture residual gas flows during planned start-up and shutdown. As a result, the tower flare will only need to be used in exceptional circumstances and only in emergency situations.

In addition, IOB will actively communicate with local residents about planned activities (e.g. major maintenance activities, etc.) that could cause nuisance (time, duration, nature of the nuisance and reason) and, where appropriate, after incidents, about the cause, any consequences and the measures taken. To this end, IOB will join existing initiatives (Antwerp Port Advisory Council). IOB will also set up an informative website for local residents with a form for submitting questions and up-to-date information.

For both the construction and operational phases, it is recommended to limit the **lighting** of tall structures where possible and to apply the principles of good lighting:

- Respect the 20° rule;
- Completely avoid direct upward light flow by applying the principle of downward light flow;
- Limit reflected upward light via the principle of minimum target area and the principle of minimum luminance with maximum uniformity.

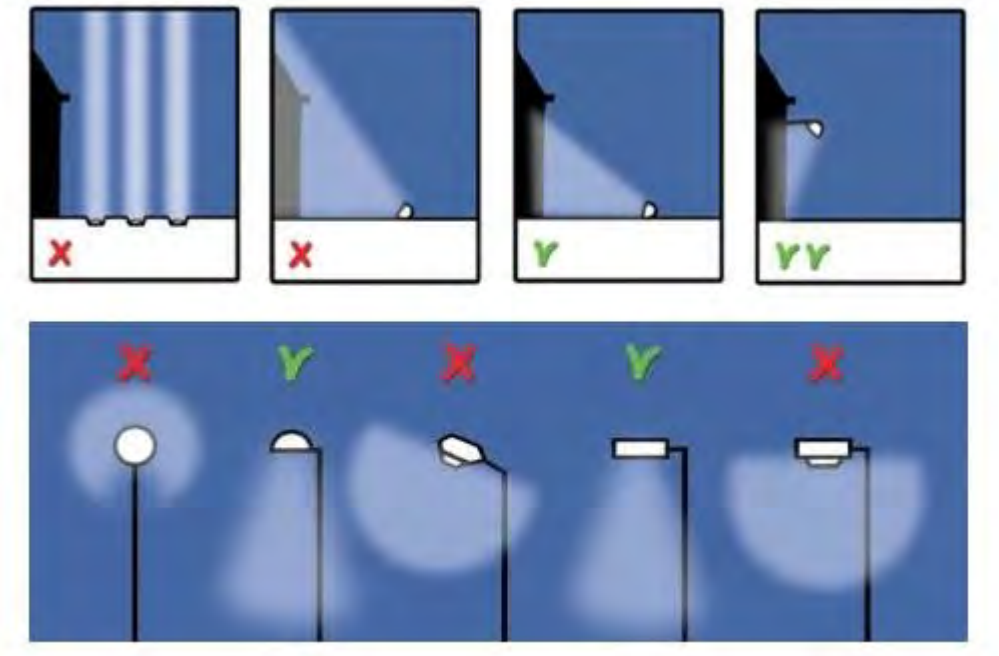

Figure 13-24 Tips for reducing light pollution

13.9 Conclusion

In this discipline, the impact of NO_2, particulate matter (PM_{10} and $PM_{2.5}$), benzene, butadiene, light, noise and Legionella was selected as potentially relevant stressors during the operational phase. During the construction phase, only NO_2, light and noise are potentially relevant.

The noise impact during the **construction phase** at the nearest homes in Lillo and Berendrecht is assessed as negligible (0).

The increase in noise from continuous sources during the **operational phase** at the nearest residential area is negligible (0). This will therefore not cause any nuisance or health effects. However, the operation of the tower flare may cause nuisance, especially in Lillo.

However, given that the flare will only be used in emergency situations and therefore exceptionally, the impact on residential areas is assessed as limited negative (-1). The noise impact of the ground flares near residential areas is negligible (0). The impact of the additional ship traffic (an average of 4 per 24 hours) is also negligible (0).

The current NO2 concentration in the residential areas surrounding the port of Antwerp is higher than the recommended health guideline value everywhere. The increase in exposure as a result of Project One during the **construction phase** is limited for Berendrecht, Lillo and Doel. Taking into account the existing background values, the impact of NO_2 during the construction phase is assessed as limited negative (-1). Elsewhere, the impact is negligible (0).

As mentioned above, the health advisory value for NO_2 in the residential areas surrounding the port of Antwerp is currently exceeded everywhere. Taking into account the background values present, the impact of NO_2 during the **operational phase** in the residential areas of Berendrecht, Zandvliet, Lillo, Doel and parts of Stabroek is assessed as negative (-2) to limited negative (-1). In other parts of the study area, the effect is assessed as negligible (0). In the Netherlands, the impact is also negligible (0).

Far-reaching emission reduction measures were integrated into the project for NO_2. These are described in Chapter 7 Air. This chapter also evaluates the possibilities for further reducing emissions. It concludes that the possibilities for further reducing NOx emissions are limited by technical constraints, whereby the high costs involved would only result in a limited reduction in NOx emissions. These measures are therefore not considered to be BAT.

The current background concentrations of benzene and butadiene throughout the study area are associated with an additional cancer risk that is not negligible from a health perspective. For these substances, the contributions of Project One during the **operational phase** are in themselves virtually negligible. Taking into account the existing background values, the effect can be considered limited negative (-1) in Lillo and Berendrecht, as well as in part of Doel for the parameter benzene. For these carcinogenic substances, the aim should be to achieve the lowest possible immission (as low as reasonably achievable). Fugitive emissions were estimated on the basis of the lower limit of existing emission factors for the sector in Europe. The latest technology and techniques will therefore be used to limit fugitive emissions, which will result in lower emissions than existing installations. Emissions will be monitored by an LDAR[132] system in accordance with VLAREM regulations. This will allow leaks to be detected and repaired in a timely manner.

For PM_{10}, the impact is negligible (0). In the worst case scenario, the $PM_{2.5}$ contribution is the same as that of PM_{10}. In that case, the impact in Berendrecht can be assessed as negative (-2) to slightly negative (-1). The negative assessment is partly due to the fact that 80% of the health advisory value for $PM_{2.5}$ is exceeded. Outside Berendrecht, the contribution for $PM_{2.5}$ is negligible (0). With regard to the formation of secondary $PM_{2.5}$, calculating the share of a single project is not useful for the granting of a permit due to the highly dispersed effect. It is important, however, to limit the emissions of the precursors as much as possible. These measures are described in detail in Chapter 7 Air.

Cooling systems will be installed at the Project One site where there is a risk of Legionella bacteria being released. IOB will draw up a management plan that includes a description of the installation, a risk analysis and preventive measures. It may be decided that, provided the management plan is implemented, the risk of contamination with Legionella bacteria from the cooling systems is negligible (0).

The effects of light pollution during the construction and operational phases are considered negligible (0). However, it is recommended that the principles of good lighting be applied.

[132] Leak Detection And Repair