FRECOM

Nord Stream 2

ASSESSMENT OF ALTERNATIVES FOR THE RUSSIAN SECTION

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Nord Stream 2
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Abbreviations

BAP	Biodiversity Action Plan
BCC	Backup Control Centre
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EU	European Union
IBA	International Bird Area
IFC	International Financial Corporation
IUCN	International Union for Conservation of Nature
LNG	Liquefied Natural Gas
MCC	Main Control Centre
MPa	Megapascal
PID	Project Information Document
PTA	Pig Trap Area
SCA	Special Conservation Area

1 Executive Summary

Nord Stream 2 AG is planning to expand the export capacity of natural gas from Russia to Western Europe through the Baltic Sea. This will be achieved through the construction and operation of a pipeline system that mirrors the characteristics of the existing export system known as Nord Stream.

The planned pipeline system, which is known as Nord Stream 2, will be routed as far as possible along the existing Nord Stream pipeline corridor. In the Russian sector, however, alternative locations for the starting point (the landfall facilities) and the offshore route had to be sought because of technical, environmental and social aspects that constrained the location of the facilities in Portovaya Bay, which is the starting point of the Nord Stream system. For this reason, Nord Stream 2 carried out feasibility studies and commissioned third parties to carry out an independent assessment of feasible alternatives.

The first stage of the Assessment of Alternatives considered the possibility to bundle the pipeline system with the existing Nord Stream development. Because of environmental, social and technical constraints, and because of the need to supply gas to strategic industrial developments in the western part of the Leningrad region, this option was not considered viable.

The most significant environmental and social constraints were:

- Crossing densely populated areas on either side of the River Neva;
- Cumulative impacts associated with the construction of a second compressor station in Portovaya Bay
- Cumulative impacts on the nearshore environment of Portovaya Bay.

Because of the impossibility to bundle the Nord Stream 2 pipeline system with Nord Stream, a subsequent constraint analysis of the southern part of the Gulf of Finland was carried out (Stage 2) and it identified two possible locations on the shoreline, where a landfall facility could be developed, on Cape Kolganpya and in Narva Bay on the Kurgalsky peninsula. The selection of a specific location for a landfall in Narva Bay was carried out with the intent to select the least environmentally sensitive location within the Kurgalsky peninsula, which has a regional and international protection status.

On the basis of these two potential locations, an outline routing and engineering design was developed for both options, addressing the need to route an onshore pipeline to supply gas to the offshore system, the need to construct a compressor station and the requirements associated with routing and constructing the offshore pipeline system.

Based on the preliminary routing and engineering design an analysis of potential environmental and social impacts associated with the two preferred options was carried out (Stage 3). **The assessment indicates that the Narva Bay option is preferable,** although residual environmental risks occur because of the protected status of the Kurgalsky peninsula and valuable ecological habitats in the coastal zone. Design optimisation will therefore be carried out during the detailed engineering phase of the project to minimise environmental and social impacts.

2 Introduction

2.1 Project History

Nord Stream 2 is a pipeline system through the Baltic Sea planned to deliver natural gas from vast reserves in Russia directly to the European Union (EU) gas market. The pipeline system will contribute to the EU's security of supply by filling the growing gas import gap and by covering demand and supply risks expected by 2020.

The twin 1,200-kilometre subsea pipelines will have the capacity to supply about 55 billion cubic metres of gas per year in an economic, environmentally safe and reliable way. The privately funded €8 billion infrastructure project will enhance the ability of the EU to acquire gas, a clean and low carbon fuel necessary to meet its ambitious environmental and decarbonisation objectives.

The route will stretch from Russia's Baltic coast near Ust-Luga, west of St Petersburg to the landfall in Germany, near Greifswald. The Nord Stream 2 routing is largely parallel to Nord Stream. Landfall facilities in both Russia and Germany will be separate from Nord Stream.

Nord Stream 2 – like Nord Stream – transports gas supplied via the new northern gas corridor in Russia from the fields on the Yamal peninsula, in particular the supergiant field of Bovanenkovo. The production capacity of the Yamal peninsula fields are in the build-up phase, while producing fields from the previously developed Urengoy area that feed into the central gas corridor have reached or passed their plateau production. The northern corridor and Nord Stream 2 are efficient, modern state-of-the-art systems, with an operating pressure of 120 bar onshore and an inlet pressure of 220 bar to the offshore system.

The Nord Stream 2 Pipeline will be designed, constructed and operated according to the internationally recognised certification DNV-OS-F101 which sets the standards for offshore pipelines. Nord Stream 2 AG has engaged DNV GL, the world's leading ship and offshore classification company, as its main verification and certification contractor. DNV GL will verify all phases of the project.

The downstream transport of gas supplied by Nord Stream 2 to the European gas hubs will be secured by upgraded capacity (NEL pipeline) and newly planned capacity (EUGAL pipeline), developed simultaneously by separate transmission system operators (TSO). Thus, the new downstream infrastructure will be delivering gas to Germany and north-western Europe as well as to central and south-eastern Europe via the gas hub in Baumgarten, Austria, complementing the southern corridor. This will strengthen the EU's gas infrastructure, hubs and markets and will complement the existing infrastructure.

The new state-of-the-art gas supply infrastructure will be privately funded. The project budget (CAPEX) is around 8 billion euros, with 30% shareholder funded and 70% from external financing sources.

The Nord Stream 2 Pipeline will be implemented based on the positive experience of construction and operation of the existing Nord Stream Pipeline. The Nord Stream Pipeline project, upon its completion, was hailed as a milestone in the long-standing energy partnership between Russia and the EU, contributing to the achievement of a common goal – a secure, reliable and sustainable reinforcement of Europe's energy security.

Nord Stream's first line was put into operation in 2011 and the second line came on stream in 2012. The entire project was completed on schedule and on budget, and received many accolades for high environmental and HSE standards, green logistics, open dialogue and public consultation.

In May 2012, at the request of its shareholders, Nord Stream AG conducted a feasibility study of two potential additional pipelines. The study included technical solutions, route alternatives, environmental impact assessments and financing options.

The feasibility study confirmed that extending Nord Stream with one or two additional lines was possible.

In its feasibility study, Nord Stream AG developed three main route corridor options to be investigated further based on reconnaissance level surveys, environmental impact assessments and stakeholder feedback, in order to come to an optimized route proposal.

In 2012, Nord Stream AG submitted requests for survey permits in the relevant countries. The aim was to further research the route corridor options and to find the optimal routing for the pipelines with minimum length and environmental impact.

In April 2013, Nord Stream AG published the Project Information Document (PID) on the extension project, a key milestone in enabling planning for future environmental impact assessments. The PID highlighted the proposed project in the context of the international notification process according to the Espoo Convention, enabling potentially affected parties to determine their role in the future environmental and social impact assessments and associated permitting processes, in accordance with their country-specific laws and regulations. In preparation for further development of an extension project, Nord Stream discussed the programme proposals for the national environmental impact studies in the five countries (Russia, Finland, Sweden, Denmark, and German) whose Exclusive Economic Zones (EEZ) or territorial waters the proposed route would cross. –Initial consultations were also conducted with the authorities and stakeholders in other Baltic Sea countries.

The permitting, survey and engineering work initiated by Nord Stream AG was taken over by a dedicated project company, Nord Stream 2 AG, which was established in July 2015.

Nord Stream 2 AG is a project company established for planning, construction and subsequent operation of the Nord Stream 2 Pipeline. The company is based in Zug, Switzerland and owned by Public Joint Stock Company (PJSC) Gazprom. PJSC Gazprom is the largest supplier of natural gas in the world, accounting for approximately 15 percent of world gas production.

2.2 Objectives of the Report

The objective of this report is to describe the process, methodology and results of the alternative assessment that was carried out to select the best route alternative for the Nord Stream 2 gas pipelines, in Russia, ensuring the safety of the facilities and minimising the scale of the environmental and social impacts.

The report contains seven chapters:

- Chapter 1. Executive Summary
- Chapter 2. Introduction: Project history, a brief description of the Project’s technical characteristics taken into account when analysing the alternative route options, the Project’s legal and regulatory framework and the main alternatives considered. The methodology used to compare alternatives is also described.
- Chapter 3. Stage 1. Bundling of Nord Stream 2 with Nord Stream pipeline system. It describes the option to lay the Nord Stream 2 route alongside the existing Nord Stream corridor and analyses the constraints that have led Nord Stream 2 AG to discard this option.
- Chapter 4. Stage 2. Selecting areas on the southern coast of the Gulf of Finland. It describes the environmental, social and technical constraints along this coastal section and shows how two possible sites for the Project to cross the shoreline were identified.

- Chapter 5. Stage 3. Comparative assessment of two alternative routes from the starting points of Cape Kolganpya and Narva Bay. It describes the findings of the detailed comparative assessment that have led to the selection of the preferred landfall and associated offshore route.
- Chapter 6. Conclusions.
- This actual report has been prepared by FRECOM and includes data and materials provided by third parties:
- • Eco-Express-Service – results of environmental surveys along Kolganpya Cape and Narva Bay route options (Chapter 4);
- • Gazprom Proektirovanie – evaluation of restrictions for pipeline route to the north of St. Petersburg (Chapter 3);
- • ERM – maps layout based on FRECOM' cartographic materials.

2.3 Technical characteristics of the proposed pipeline system

The pipeline will stretch for approximately 1,200 km from Russia's Baltic coast in the Leningrad Region to the German coast in the Bay of Greifswald (Figure 2-1).

The pipeline will be supplied with gas originating from gas fields within the Russian Federation. The methane content of the transported gas will be more than 98%.

The Nord Stream 2 gas pipeline will consist of two parallel steel pipelines with a diameter of 1,153 mm (48 inches). Each pipeline will have a capacity of 27.5 bcm per year. The maximum inlet pressure of the pipelines will be approximately 220 bar (approx. 22 MPa). The following battery limits apply to the Project (Figure 2-2):

Offshore Pipeline:	48" pipeline up to the shoreline
Dry Section:	48" pipeline from the shoreline to the pig trap (including all the 48" components, but excluding the pig-trap)
Pig Trap Area:	all piping in the pig trap area

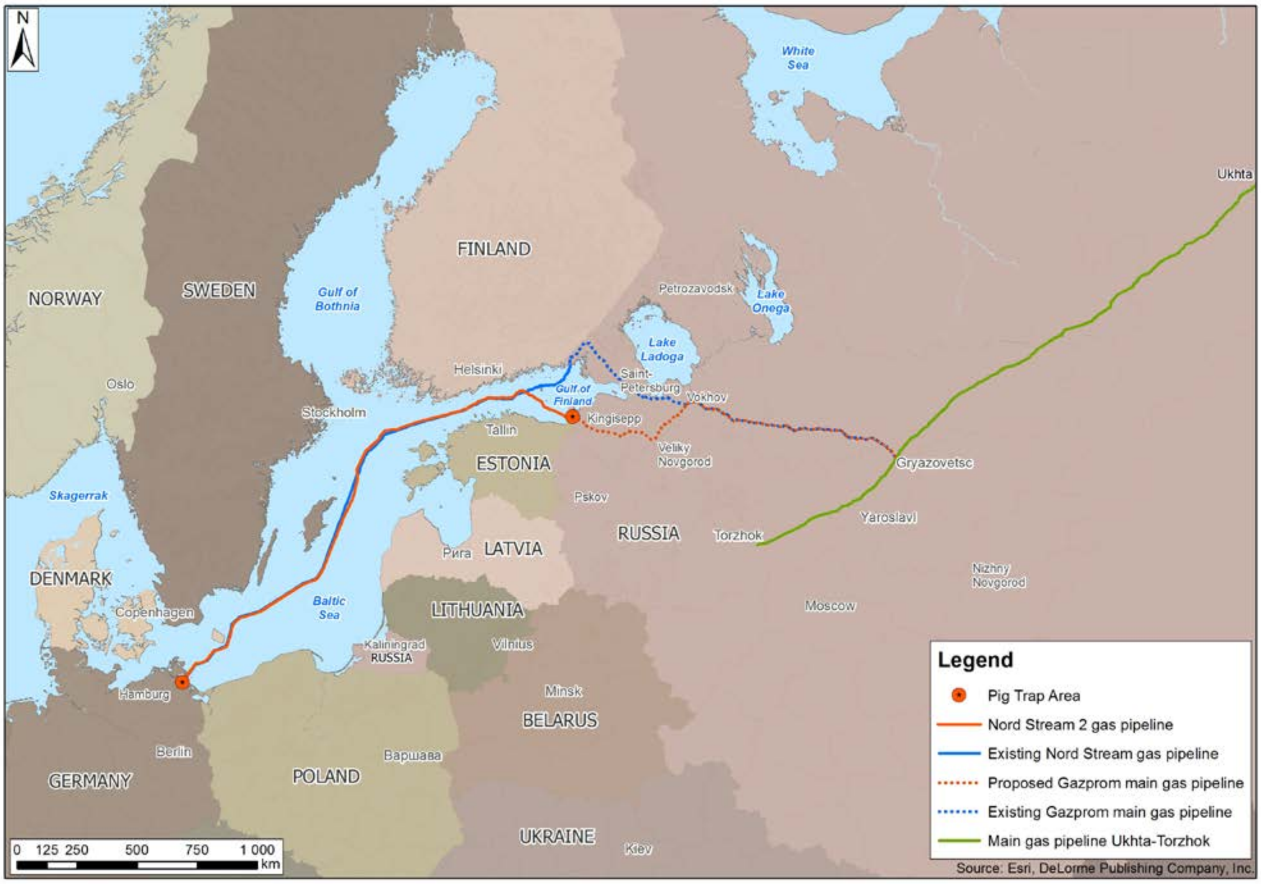

Figure 2-1 Nord Stream 2 Project Overview

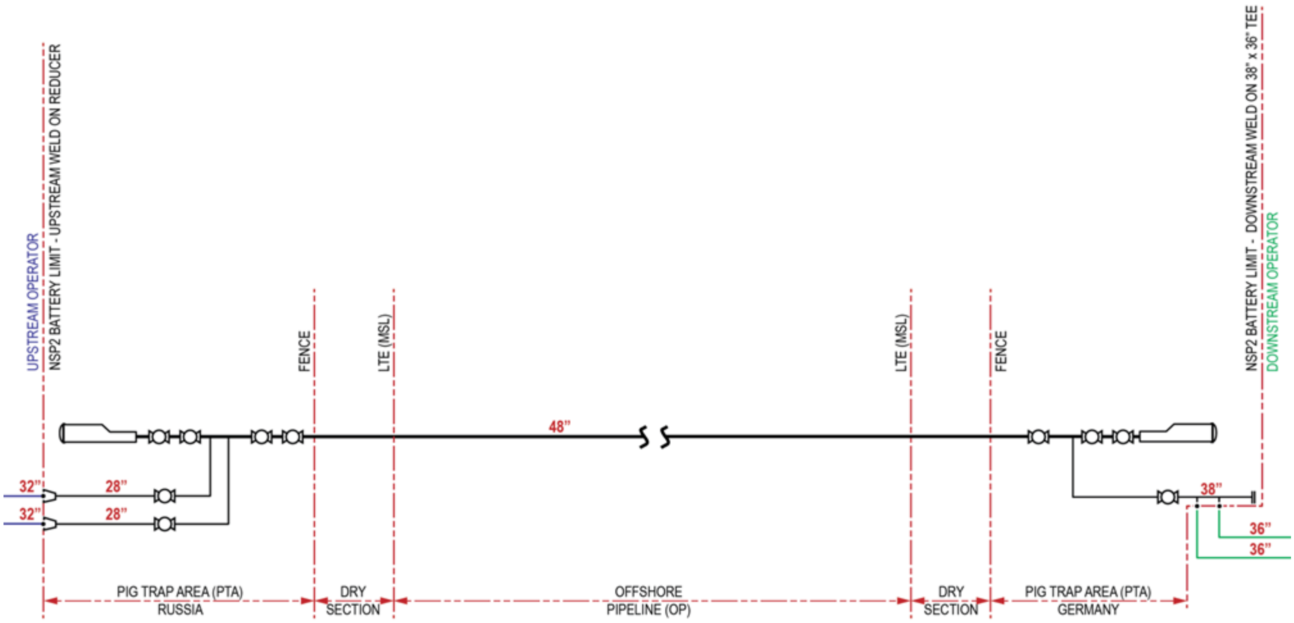

Figure 2-2 Nord Stream 2 Project Battery Limits

2.3.1 Construction

The linear section of the pipelines will be installed underground in the onshore section and within the shallow parts (< than 13m water depth) of the Gulf of Finland; in deep water it will be laid on the surface of the seabed.

A temporary construction area will be established in Russia, outside the construction corridor and extending to approximately 40 hectares to support the construction operations and to provide space for temporary buildings and facilities, parking areas, workers' camp and material and equipment warehouses.

In the offshore sector, the pipes will be laid by pipelaying vessels using the S-lay method. The planned average pipelaying rate on the seabed is 2.5 to 3.0 km per day, depending on weather conditions and sea depth. Where necessary, pre-lay works will be carried out to remove boulders or other seabed obstacles, such as steep sand banks, or to protect the pipeline from potential damage associated with maritime activities or crossings of other infrastructure.

Upon completion of the installation of the PTAs and of the pipelines, the system will be tested to verify the integrity of all components. This phase is referred to as the pre-commissioning phase. After pre-commissioning, the system is ready for operation and it is commissioned by gradually filling it with gas.

2.3.2 Operational aspects

Once in operation the Nord Stream 2 pipeline system will be monitored and managed remotely from a Main Control Centre (MCC). The MCC will be equipped with a video screen and workstations for operators and engineers; it will operate 24 hours a day, 365 days a year.

In addition to the MCC, a Backup Control Centre (BCC) will be created to replace the MCC if necessary. The BCC monitoring and control system will be constantly updated in real time together with the MCC to ensure that, if necessary, the BCC can immediately take on the MCC functions.

The MCC and the BCC will be located in Zug (Switzerland), although in different physical locations.

Local emergency shutdown systems will operate at facilities in the landfall areas in Russia and Germany. These systems will be triggered upon detection of fire or gas leaks in the gas pipelines or in pipeline process facilities.

2.3.3 Decommissioning

The Nord Stream 2 pipelines will have a service life of at least 50 years, like the existing Nord Stream pipelines.

When the pipelines reach the limit of their design service life or the limit of their economic viability, their disconnection and other related actions shall be approved by national authorities.

Nord Stream 2 AG will decommission the pipelines in accordance with industry standards, including environmental and social standards, and with national and international laws that will be applicable at that time.

2.4 Regulatory basis for the alternative assessment

The Nord Stream 2 gas pipeline will cross waters of five countries - Russia, Finland, Sweden, Denmark and Germany - and will comply with their national regulation and relevant international conventions.

The Russian sector comprises the stretch of the pipeline in the Russian territorial waters, and a short onshore part from the shore to the PTA.

The Russian sector of the Nord Stream 2 gas pipeline will be designed in accordance with applicable national legislation and international standards regarding environmental and social sustainability.

The Russian legal framework requires the developer to carry out an assessment of project implementation options to select the optimal solution, taking into account the environmental, economic and technical characteristics of the project.

This report has been prepared to document the activities carried out by Nord Stream 2 AG to comply with the alternative assessment requirements of national and international legislation when developing the project and, in particular, to determine the optimal route and technical options, taking into account all applicable criteria. The assessment methodology is described in Section 2.4. The applicable environmental and social regulations and standards, including those that address the selection of alternatives are outlined below.

- Main regulatory acts of the Russian Federation that apply to the project:

On Environmental Protection (Federal Law of 10 January 2002, No.7-FZ, as amended 29 December 2015, No. 404-FZ, article 32).

On Environmental Expert Review (Federal Law of 23 November 1995, No. 174-FZ, as amended 29 December 2015, FZ 408-FZ).

Provision on the impact assessment of planned economic and other activities on the environment in the Russian Federation (approved by order of the State Committee for Environmental Protection of the Russian Federation of 16 May 2000, No. 372).

In addition to the regulatory requirements listed above, the Project adheres to the principles listed in "Environmental impact assessment to justify the investment in the construction of enterprises, buildings and structures - SP 11-101-95" as recommended by the Russian State Committee for Environmental Protection on 19 June 1998, Russian State Committee for Construction, SE Tsentrinvestproekt, 1998).

- International conventions:

Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) adopted 25 February 1991;

Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention) governed by the Helsinki Commission (HELCOM) adopted in 1992;

Convention on Wetlands of International Importance (Ramsar Convention) adopted in 1971.

- Requirements of international financial institutions:

International Financial Corporation Performance Standards (IFC PS);

In accordance with the IFC PS[1], environmental and social impact assessments for new construction projects shall include an examination of technically and financially feasible alternatives for implementing the project, in terms of the different level, and nature, of the environmental and social impacts, and a documented rationale for the selection. The goal of the alternatives assessment is to improve decisions on project design, construction and operation based on feasible alternatives to the proposed project. The alternatives assessment should be conducted as early as possible in the project. Alternative locations, technical solutions and alternative methods for minimising negative environmental and social impacts shall be examined.

IFC Performance Standard 6 also stipulates the need for an alternatives assessment. This assessment is required, in particular, to ensure that the project does not significantly transform or degrade natural habitats unless all of the following are demonstrated:

- no other viable alternatives within the region exist for developing the project in modified habitats;
- consultation has established the views of stakeholders, including Affected Communities, with respect to the extent of transformation and degradation; and
- any transformation or degradation is mitigated according to the mitigation hierarchy.

2.5 Methodology of the Assessment of Alternatives

The methodology that has been used to assess the possible alternative locations for the landfall site and the offshore route has also taken into account the need to deliver gas to the landfall from inland Russia and the requirement to construct and operate a large compressor station. The main stages of the assessment are described below.

- <u>Stage 1. Bundling of Nord Stream 2 with the Nord Stream pipeline system:</u>

This option was based on the assumption that the landfall site would be located in the proximity of the Nord Stream landfall, within the municipality of Vyborg, and constraints were analysed with regard of the feasibility to deliver gas to the landfall location.

The assessment relied on the analysis of satellite imagery and information on the master plans of the municipalities that extend between the City of St Petersburg and Lake Ladoga, along the banks of the River Neva.

In addition, a high-level evaluation of the feasibility to lay two additional pipelines within Portovaya bay was carried out.

- <u>Stage 2. Route options on the southern coast of the Gulf of Finland:</u>

This stage consisted of an analysis of environmental and social constraints occurring along the Baltic coast from the western edge of St Petersburg harbour and the border with Estonia.

The constraints analysis was based on satellite imagery, topographic maps and published information on the environmental characteristics of the area.

[1] Guidance Notes 1 (GN) Assessment and Management of Environmental and Social Risks and Impacts, GN 23 and GN 25

The constraints analysis led to the identification of potentially feasible locations where gas could be delivered from inland Russia and where the Nord Stream 2 landfall could be located.

- Stage 3. Detailed comparative analysis of the two feasible options

Having identified two potentially feasible locations for the landfall facilities, the third stage of the assessment consisted of a comparative assessment of the two options. The assessment has been based on the results of environmental engineering surveys conducted in 2015 for both route options and on basic design assumptions with respect to nearshore and offshore dredging requirements, seabed intervention works, offshore pipe lay and shore crossing methodology.

The two options were compared based on the sensitivity of the environmental and social receptors, taking into consideration not only the Nord Stream 2 facilities but also the onshore gas supply routes required to deliver gas to the Nord Stream 2 project, and the possible locations of the compressor station.

3 Stage 1. Bundling of Nord Stream 2 with the Nord Stream pipeline system

The first option that was considered in the feasibility study phase consisted of installing the Nord Stream 2 pipeline system alongside the existing Nord Stream system, to bundle impacts at locations that had already been affected by the development and where significant knowledge on the social and environmental conditions had been acquired as part of the Nord Stream project.

The detailed analysis of the capacity of the existing inland gas transport system showed that there are limitations regarding the supply of 55 bcm of gas from the existing pipeline network to territories located to the North of Saint Petersburg and new trunk lines were deemed to be required. In addition, a new compressor station, or a 100% expansion of the existing compressor station at Portovaya would be required.

The analysis of the requirements above identified three categories of constraints:

- Inland routing
- Identifying a suitable site for the construction and operation of the compressor station
- Engineering the nearshore pipeline system within, or adjacent to Portovaya Bay.

These constraints are discussed below.

3.1 Inland routing

During implementation of the project NSP1 found it difficult to identify a reliable and safe route for the onshore supply system, because of high-density development areas in the St. Petersburg area.

Gazprom Proektirovanie (GPP) carried out a technical assessment of the feasibility to construct additional trunk lines to Portovaya Bay for NSP2 project (report ref. W-EN-ENG-PRU-ANS-819-RSJ000RU), for the purpose of supplying gas to the Nord Stream 2 system. Research has shown that it is impossible to build two additional gas trunk lines in accordance with the norms and requirements of the Russian Federation as well as ensuring the safe operation of a hazardous facility.

The study identifies several constraints, as follows:

- Crossing of the Volkhov river is not possible because of the required safety distances from existing buildings, which are part of the villages Pomyalovo and Bratovishe. The safety distances are dictated by technical standard SP 36.13330.2012 (the new version of SNIP 2.05.06-85). To bypass this place is difficult, since the length of the pipeline will increase significantly.

- It is also not possible to route two additional pipelines through the settlements of Shum, Gorka and Voybokalo because of the safety distances that would be required from the recently approved municipality boundaries and the villages. The company «Oktyabrskaya Railway» has denied approval of crossing with the railroad in this sector due to difficult geological conditions and risks.

- Safety distance requirements also constrain the routing of two additional trunk lines between the villages of Nizhnaya Shaldika and Putilovo.

- One additional significant constraint is associated with the crossing of the Neva River. As shown in Figure 3-1, the banks of the Neva River are extensively developed with residential and industrial facilities. The safety distances dictated by the above mentioned code require a minimum safety corridor of approximately 400m on both banks of the river and such corridor does not exist. The possibility to relocate residential or industrial facilities to create a safe corridor has been discounted on the basis of the adverse social impacts that such a course of action would create.

- Additional restrictions associated with the extensively developed residential and industrial facilities throughout the region, north of the river: construction of additional two gas pipelines will significantly increase the potential hazard to the population.

Additional alternatives for circumventing some of the above constraints, like crossing Lake Ladoga, have been considered, but the initial desk research carried out by Gazprom Proektirovanie showed that the overall complexity and potential environmental and social impacts associated with these options will be far greater than the land routing options considered in their study.

3.2 Construction of a compressor station

To ensure the operation of the Nord Stream 2 pipeline system, a compressor station would need to be built with features similar to those of the existing compressor station of the Nord Stream project, including an overall permanent footprint of approximately 45 hectares. The compressor station required for the Nord Stream 2 project would have to be located in the proximity of the existing Portovaya compressor station. Construction and operation of the compressor station requires an area of approximately 60 hectares; this would have led to significant cumulative impacts associated with land acquisition, impacts on natural habitats and environmental emissions, such as atmospheric emissions, water discharges and noise emissions.

3.3 Pipeline landfall

The feasibility of constructing additional facilities at the coastal outlet near the existing Nord Stream infrastructure in Portovaya Bay was evaluated in 2013 on the basis of the construction experience made with the Nord Stream project. The seabed sediments at this location consist of glacial deposits and include large boulders. The challenging geological structure resulted in a fairly complex corridor route for the Nord Stream project and the feasibility of identifying another corridor for two additional pipelines is questionable: for the Nord Stream 2 project to be constructed along the same alignment as the Nord Stream project, a considerable amount of offshore intervention works would be required; such activities would adversely impact the nearshore area where benthic habitats have been recovering since completion of the Nord Stream pipelines in 2012.

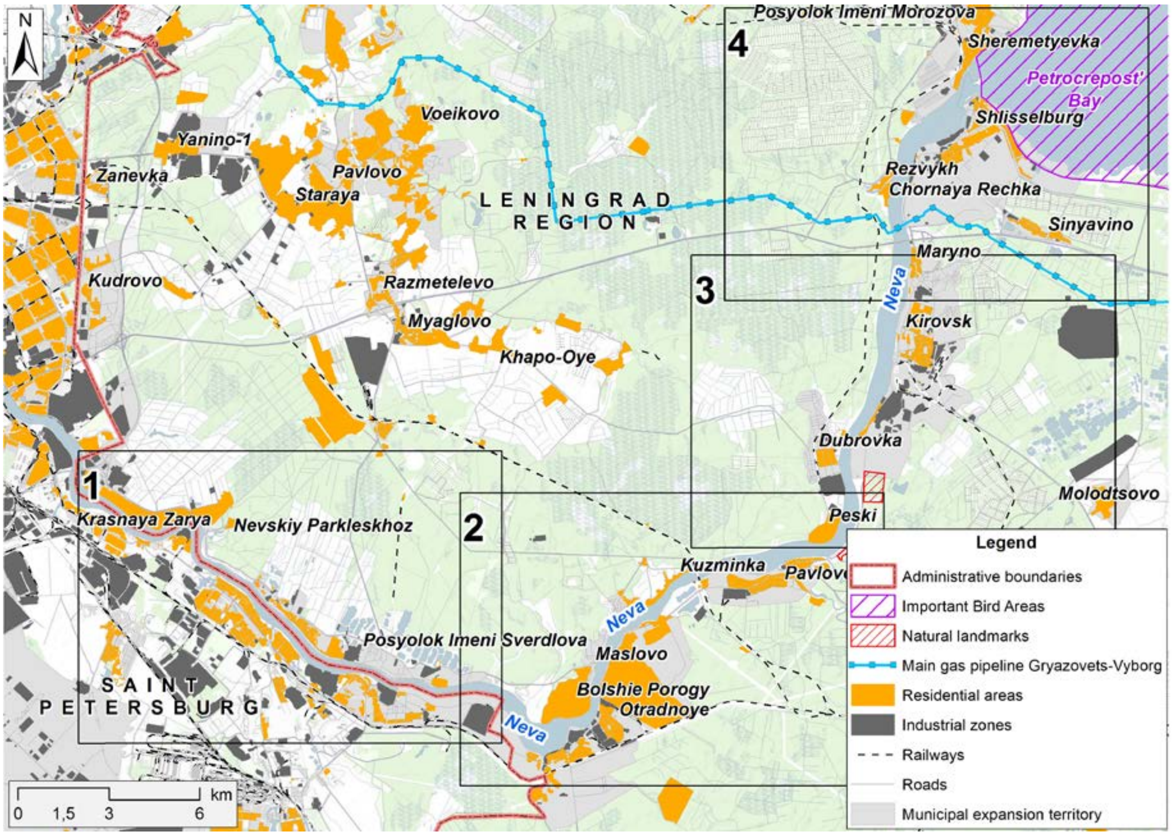

Figure 3-1 Existing facilities and infrastructure along the banks of the Neva to the north of Saint Petersburg

The constraints described in the previous sections are challenging environmental, social and technical obstacles to implementing the bundling option in the nearshore and onshore section of the Nord Stream 2 project.

Additional considerations included the commitment made by Gazprom in 2003 to the authorities of the Leningrad region to develop the gas infrastructure in the South-West Leningrad region, including the Kingisepp District, where ongoing industrial development (Ust Luga harbour, agrochemical plants and other industrial enterprises) has led to an increase in natural gas demand. Combining this strategic supply requirement with the need to supply gas for the Nord Stream 2 project seemed rational and environmentally sustainable and therefore, it was decided to reject the bundling option in the Russian sector.

Construction of two gas pipelines – one to Kingisepp District and one for gas supply to Nord Stream 2, would lead to an excessive environmental footprints, which cannot be considered as reasonable.

Combining both goals is reasonable and optimal from an environmental standpoint.

4 Stage 2. Selecting areas on the southern coast of the Gulf of Finland

The whole territory to the west of Saint Petersburg to the borders with Estonia along the southern coast of the Gulf of Finland (Figure 4-1) was considered for the purpose of selecting a potentially feasible location for the Nord Stream 2 pipeline landfall site and associated facilities: the compressor station and the inland gas supply pipeline, which will be built and operated by Gazprom.

For the purpose of evaluating the environmental and social constraints, the southern coast of the Russian section of the Gulf of Finland has been divided into three sections:

1) from Saint Petersburg to Sosnovy Bor,

2) from Sosnovy Bor to Ust-Luga,

3) from the village of Ust-Luga to the Russian-Estonian border.

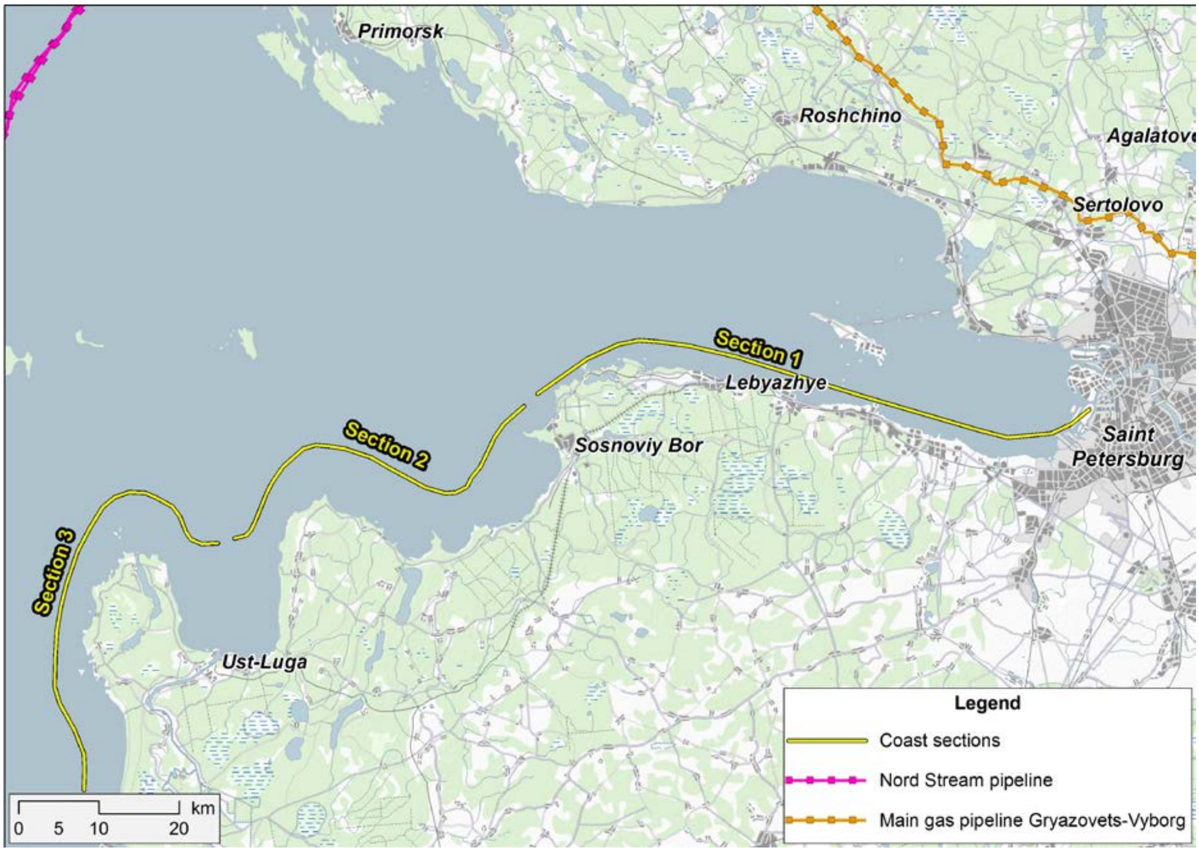

Figure 4-1 Study Area

4.1 Section 1: Saint Petersburg – Sosnovy Bor

The main constraints associated with the development of the Nord Stream 2 system in this area are as follows:

- Dense residential development along the coastline;
- The presence of a number of historical and cultural sites of global importance along the coast, from the border of Saint Petersburg to Bolshaya Izhora;
- Saint Petersburg's complex of flood defence structures;

- The presence of special conservation areas (SCA) occupying a significant part of the coast;
- Complex coastal geological conditions;
- Proximity to shipping lanes.

Each of these factors is considered in detail below.

4.1.1 Dense residential development along the coastline

The high density of existing buildings in Section 1 is illustrated in Figure 4.2 and Figure 4.3. These areas are unsuitable for construction of a high-pressure pipeline system and associated infrastructure, because of the minimum distance required between residential and commercial activities and such a high pressure pipeline and associated facilities.

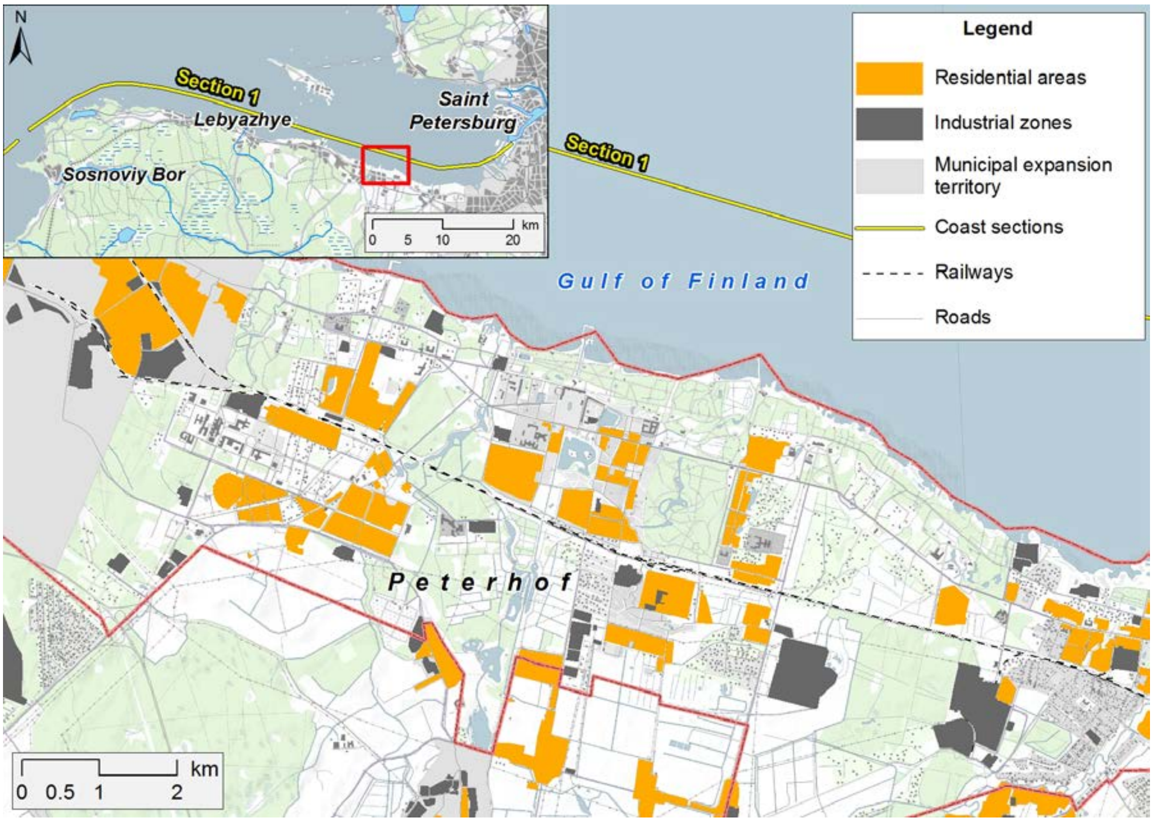

Figure 4-2 High density residential developments

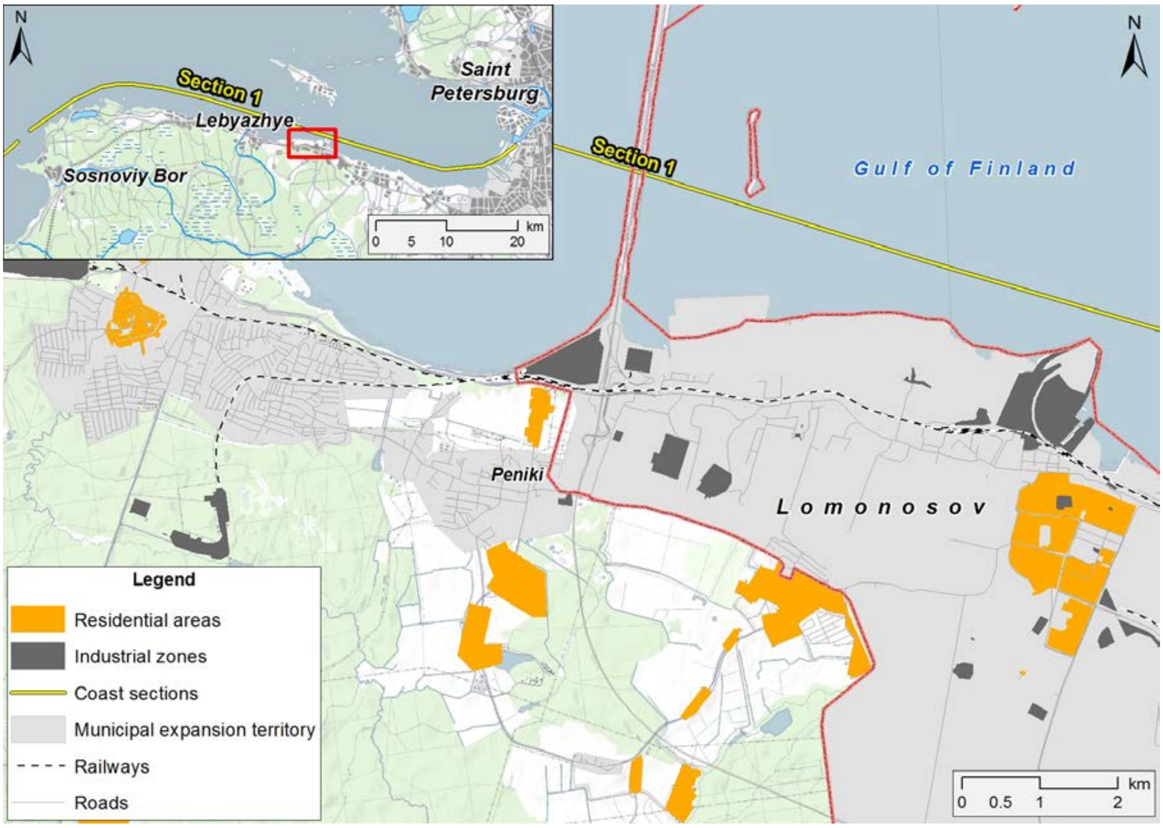

Figure 4-3 High density residential developments

4.1.2 Historical and cultural sites of global importance

There are a number of globally important historical and cultural sites on the coastal section from the border of Saint Petersburg to Bolshaya Izhora, including the towns of Petergof and Lomonosov (Oranienbaum). The location of these sites is shown in Figure 4.4.

4.1.3 Saint Petersburg flood defences

The Saint Petersburg Flood Defences consist of dams and associated (sluices and navigation openings) hydraulic facilities, stretched along the Gulf of Finland from Bronka to Sestroretsk (Gorskaya village) (Figure 4.5).

The complex consists of 11 rock and earth dams, 6 sluice complexes, 2 navigation channels, a highway with 3 intersections, 7 bridges and a road tunnel.

The body of each dam is in the form of a trapezoid. The core of the dam is sandy loam soil and moraine. The side slopes are reinforced with gravel and rock, which allows it to withstand the onslaught of water and prevents the mounds from degrading. The width of the dam in the waters reaches 80 m and the height of the embankment is 6.5 m above sea level.

It is not possible to cross the flood defence structures without breaching the integrity of the dam, which is unacceptable in terms of safe operation.

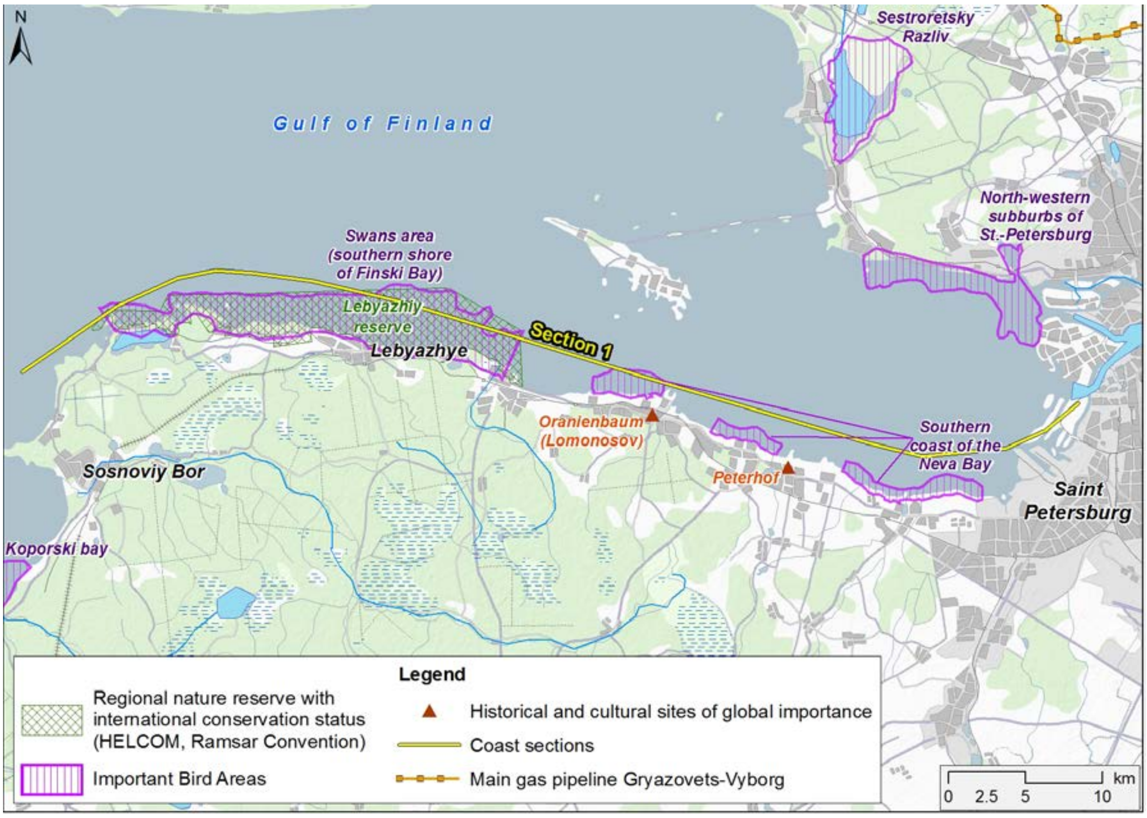

Figure 4-4 Globally important historical and cultural sites, SCAs within Section 1

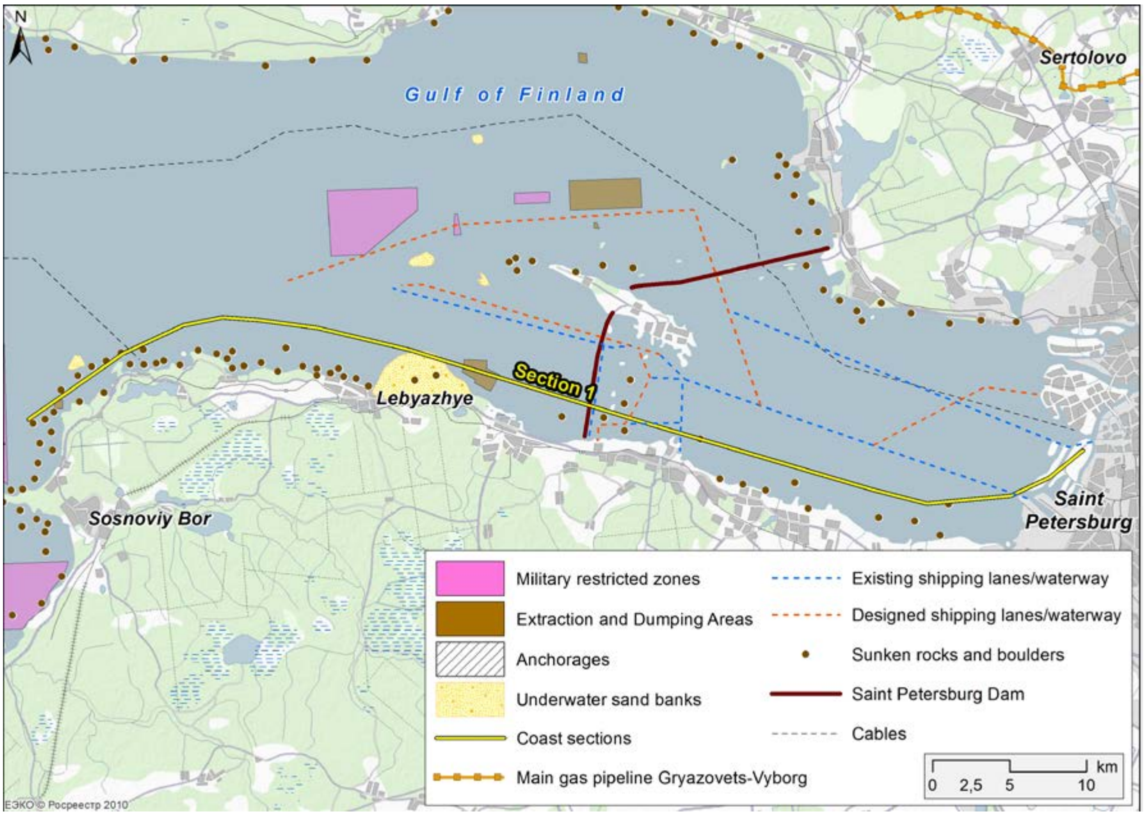

Figure 4-5 Layout of Saint Petersburg's flood defence and coastal geological conditions

4.1.4 Presence of special conservation areas

There are two special conservation areas within section 1:

- The southern coast of the Neva Bay (SP-001) important bird area (IBA);
- The Lebyazhye state nature reserve, which also includes the Swans Area IBA (RU049) that comes under the Ramsar Convention on Wetlands.

Neva Bay Southern Coast Important Birds Area

The Neva Bay southern coast (SP-001) important bird area (IBA) is located to the west of the border of the city of Saint Petersburg. The IBA is a strip of shallow-water and reeds along the southern coast of the Neva Bay of the Gulf of Finland, from the dam in the West to the Neva delta in the east. It consists of three sections, separated by coastal sections of urban development in the towns of Lomonosov and Peterhof (Figure 4.2, 4.3 and 4.4).

This is an important part of the White Sea-Baltic migration route, where migratory birds gather in spring (mostly), as well as in summer and autumn. The importance of this area as a place for birds to stop during spring migration grew significantly after the destruction, in the 1970s, of the shoals at the mouth of the Neva River.

Currently, more than 30,000 water birds and shorebirds stop at the IBA in spring. 50,000-60,000 land birds can be seen in the morning along the coast in spring. The IBA is home to species that are rare for this region: the bearded tit (*Panurus biarmicus*) and European penduline tit (*Remiz pendulinus*). In autumn-winter, a large number of granivorous birds are attracted by coastal sticky alders.

Lebyazhye state nature reserve

The nature reserve (Figure 4.4) includes the coastal strip of the Gulf of Finland and the shallow part of the water area. The objectives of the nature reserve are:

- to preserve the typical and unique natural complexes of the coastal zone of the Gulf of Finland;
- to protect water birds and shorebirds that rest here during spring migration and breeding (including species listed in the Red Data Book of the Russian Federation and the Red Data Book of Leningrad Region).

Within the Lebyazhye state nature reserve the following specially protected areas are identified:

- areas where swans rest near the villages of Chernaya Lakhta, Lebyazhye, Bolshaya Izhora: the total number of whooper swan (*Cygnus cygnus*), mute swan (*Cygnus olor*) and Bewick's Swan (*Cygnus bewickii*) that stop here during migration is approximately 25,000, of which 4,000 are Bewick’s Swan, which is listed in the Russian Red Data Book;
- nesting places of other waterbirds and shorebirds that are of strategic importance on the White Sea-Baltic Sea migration route:
    - 16 species of duck (mostly – *Anas platyrhynchos, A.penelope, A.acuta, A.crecca, A.querquedula, A.clypeata, Aythya fuligula, Bucephala clangula, Mergus serrator, M.merganser*) form groups of at least 100,000 individuals; there are 200,000 individuals of European herring gull (*Larus argentatus*), common gull (*Larus canus*) and black headed gull (*Larus ridibundus*).
    - geese: greater white-fronted goose (*Anser albifrons*), greylag goose (*Anser anser*), lesser white-fronted goose (*Anser erythropus*), bean goose (*Anser fabalis*), but they do not gather in large numbers. At least 20 species of waders stop in the shallow waters during migration.

  - a total of 120 species were noted during migration, including 17 species listed in the Red Data Book of the Russian Federation and three species listed in the International Red Data Book that are of particular value – lesser white-fronted goose, ferruginous duck and white-tailed eagle; nesting mallard dark, garganey and Eurasian teal, northern shoveller, tufted duck and common pochard, redshank, black-tailed godwit, coot, common moorhen, water rail, corncrake, spotted crake and other water birds have been recorded.

- coastal shallow-water areas of the Gulf of Finland: coastal shallow-water areas overgrown with pondweed more than a kilometre wide serve as a place for long-term (up to one month) spring and autumn migration rest for swans and various species of ducks.
- rare plant species: *Lotus Ruprecht*, *Juncus balticus*, sea milkwort, *Myrica gale*, (whose population here is one of the largest in terms of area in the region).
- Rare animal species: there are 5 amphibian species, 3 reptile species and more than 30 species of mammals. Five species of mammals are listed in the Red Data Book of Leningrad Region, while the Baltic subspecies of ringed seal and grey seal are listed in the Red Data Book of the Russian Federation and require special protection.

The state nature reserve also has an international status:

- The ministerial meeting of the Baltic Marine Environment Protection Commission (HELCOM), held from 18-20 May 2010 in Moscow, decided to add the Lebyazhye state nature reserve to the list of protected areas in the Baltic Sea;
- Included in the list of wetlands of international importance (Wetlands International) of the Ramsar Convention as a place of mass concentration of water birds during migration - Southern coast of the Gulf of Finland within the Lebyazhe nature reserve;
- The Swans Area IBA (RU049) was set up to protect the large numbers of water birds resting here during spring migration (including species listed in the Red Data Book). The territory includes coastal shallow-water (up to 5 m isobath) and a narrow section of land on the southern coast of the eastern part of the Gulf of Finland in the Baltic Sea from Karavalday Peninsula in the west to the base of the dam in the east.

4.1.5 Complex coastal geological conditions

A typical feature of the morphology of the offshore coastal slope of the eastern section of the Gulf of Finland is the presence of a nearshore platform bordering its north and south coasts. Most of the Gulf of Finland’s shores in the study area are abrasive-accumulative and consist of coarse grained sediments. Sandy accumulative beaches are formed in the coast’s bends (e.g., Sosnovy Bor’s town beach). A series of underwater alongshore sand banks are found on the underwater coastal slope (Figure 4.5).

In the proposed offshore sections (between the village of Lebyazhye and Cape Seraya Loshad'), the coastal zone is of a moraine subtype, where the accumulation of boulders can be observed.

The section of the southern coastal zone of the Gulf of Finland in the area of the village of Bolshaya Izhora is unique for the eastern section of the Gulf of Finland. This is the only place where complex sand spits, reminiscent in structure to the Azov type spit, were formed during the late Holocene.

One of the most dangerous natural processes threatening the preservation of the unique coastal landscape of the eastern part of the Gulf of Finland is the erosion of the coastline. The coastal zone is subject to the periodic development of intense erosion, which puts some places in a critical situation.

Long-term trends that encourage the development of erosion are determined by geological and geomorphological features of the studied coastal zone, which include weak strength properties of quaternary deposits, a lack of sediment and offshore coastal slope terrain. Hydro meteorological processes influence the extent of coastal erosion.

Active (and often dangerous) coastal erosion, as well as specific excavation and redistribution of secondary formations, mainly occurs due to the action of waves as a result of increased sea level and the absence of ice on the body of water. Periods of relative stability can last for up to 3-4 years, but under extreme hydrodynamic conditions, the rate of erosion along coast, during one storm, can significantly exceed the annual average.

The described complex geological conditions and coastal processes are not conducive to carrying out extensive seabed and coastal works such as those that would be required to install the Nord Stream 2 pipeline system, because such activities could trigger instability in an already fragile coastal system.

4.1.6 Proximity to navigation channels

A number of navigation channels are located close to the Saint Petersburg maritime canal, the Kronstadt ship waterway and the large ships waterway.

The proximity of the area to the main shipping lanes (Figure 4.6) leading to Saint Petersburg port will cause difficulties for shipping during construction, because of the constant traffic of supply vessels that would be required to assist the pipeline construction spread. In addition, the offshore route would encroach on anchorages and dredging disposal sites and this factor would be a considerable safety risk during operation of the pipeline.

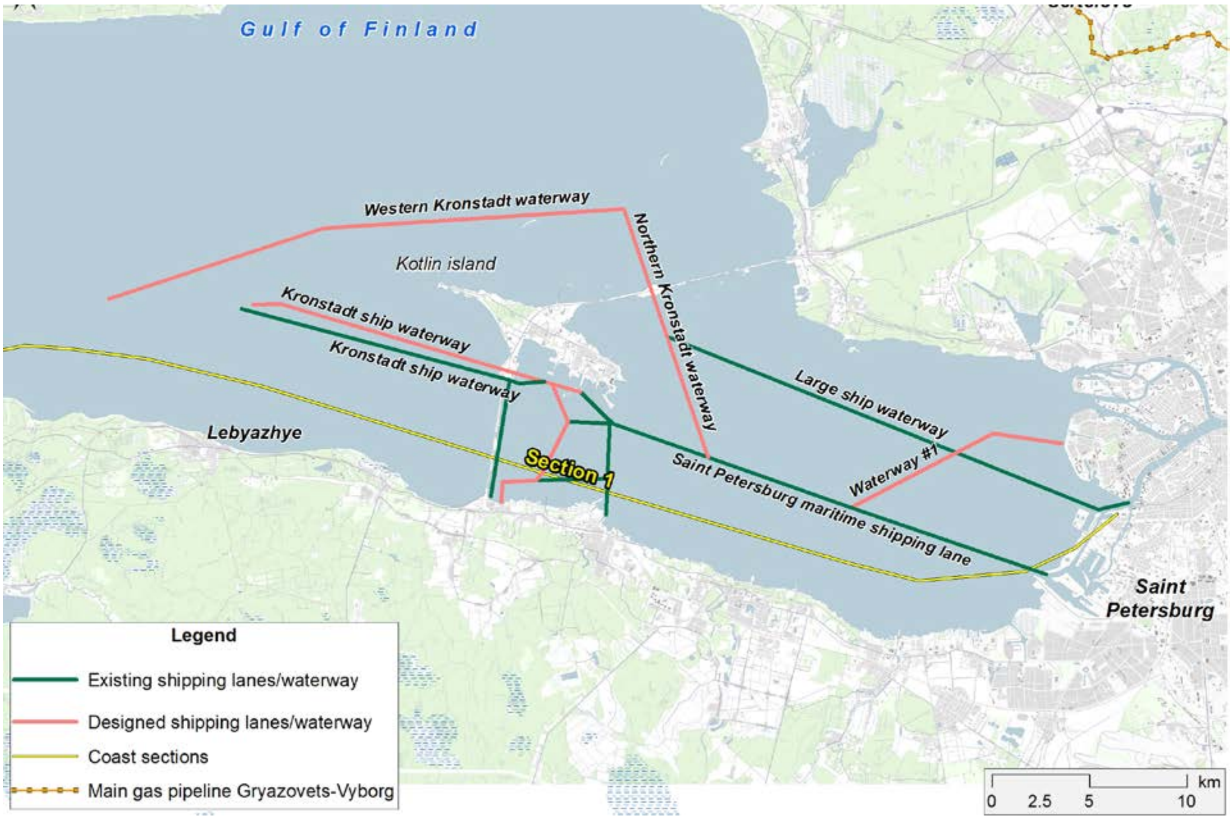

Figure 4-6 Current and planned shipping routes

4.1.7 Conclusion on the feasibility of using Section 1

Sections 4.1.1 - 4.1.6 show that each of the considered constraints significantly limits the feasibility of using this section to implement the Nord Stream 2 Project. The combination of all these factors on this territory exclude such a possibility (Figure 4.7).

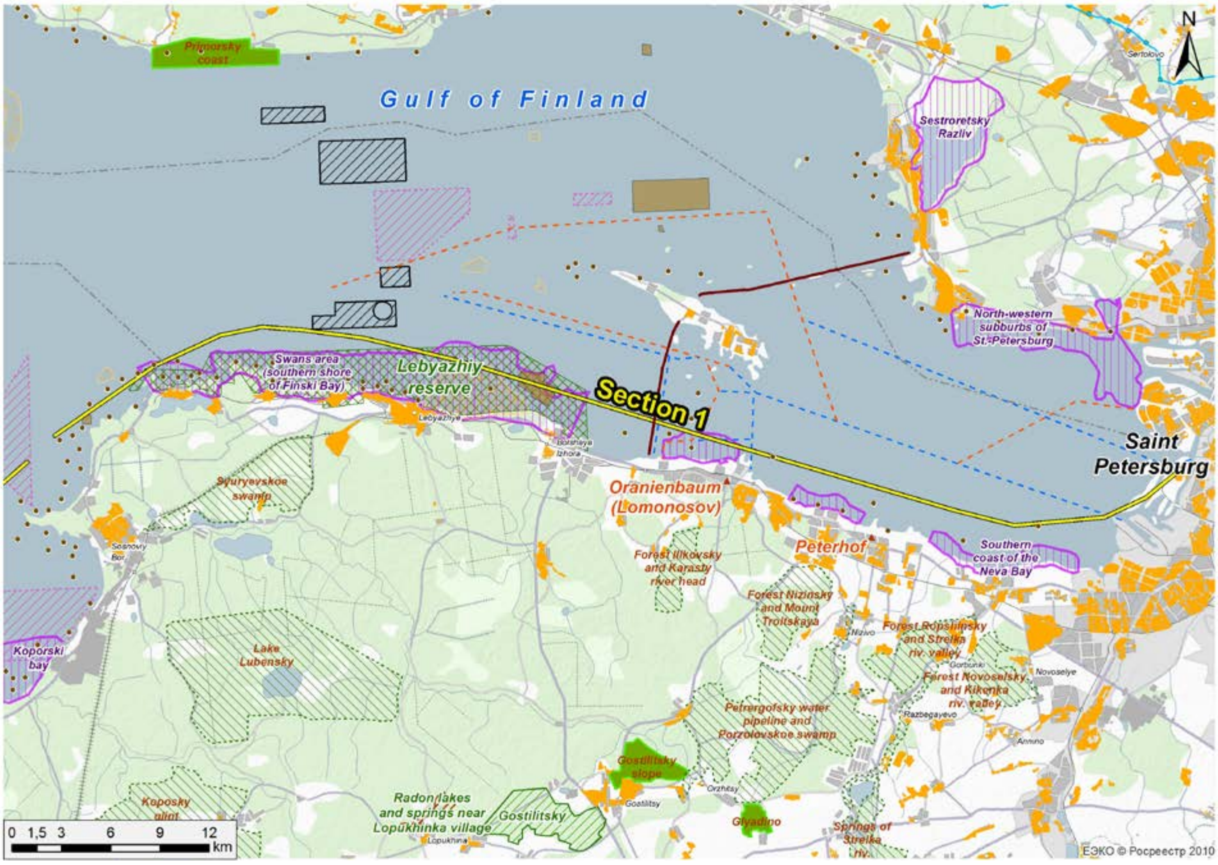

Figure 4-7 Summary of Environmental and Social Constraints

4.2 Section 2: Sosnovy Bor - Ust-Luga

A potential pipeline landfall on the section from Sosnovy Bor to Cape Kolganpya is constrained by the following factors:

- Coastal development;
- Leningrad nuclear power plant and associated complex of hazardous processes and facilities;
- Presence of Special Conservation Areas (SCA/SPNA) and Important Bird Areas (IBA);
- Presence of restricted zones offshore;
- Complex coastal geological conditions;
- Proximity to the port of Ust-Luga and its shipping routes.

Each of these factors is considered in detail below.

4.2.1 Coastal development

Residential developments in Sosnovy Bor and the presence of the Leningrad Nuclear Power Plant (LNPP) mean that the onshore gas pipeline section cannot be built in the Sosnovy Bor - Ust-Luga section (Figure 4-8).

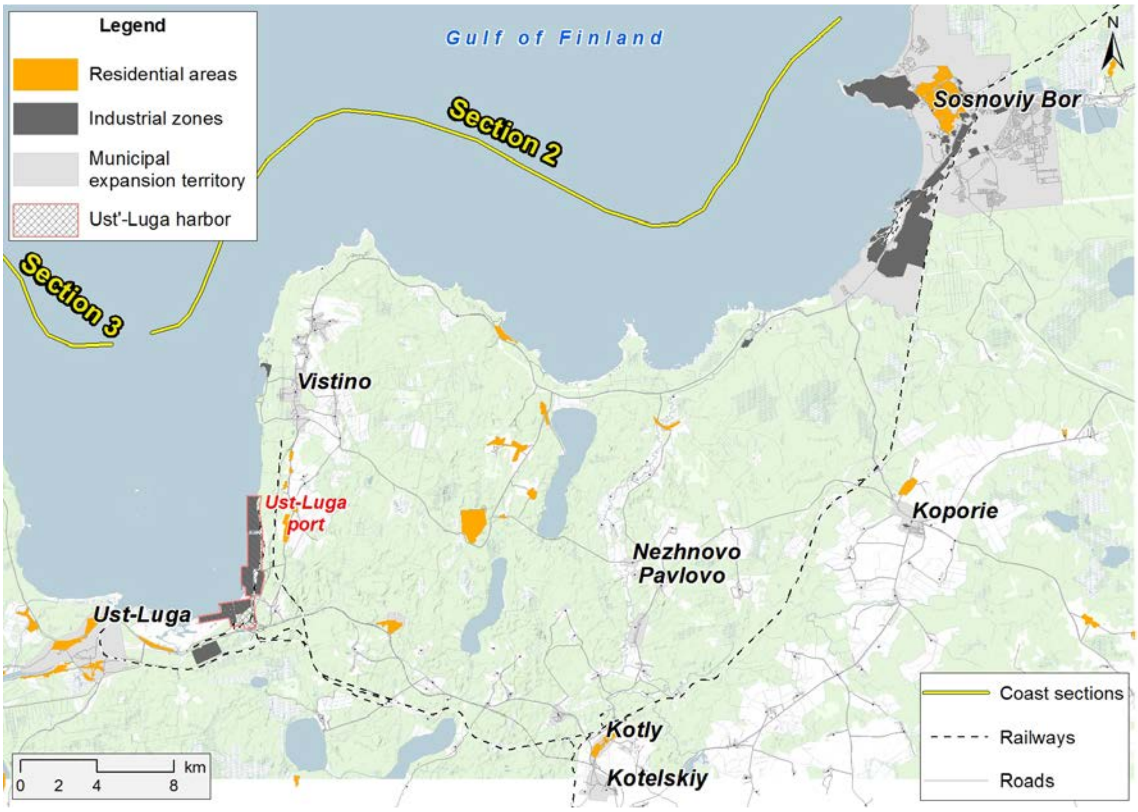

Figure 4-8 Development and infrastructure facilities within Section 2

4.2.2 The Leningrad nuclear power plant and associated complex of hazardous processes and facilities

The number of nuclear facilities in Sosnovy Bor within Section 2 is unique for the entire Baltic region.

The Leningrad Nuclear power Plant is the largest nuclear power plant in the Baltic region (4000 MW); it has four RBMK-1000 uranium-graphite reactors that use 200 m^3/sec of sea water as coolant.

In addition to the LNPP, the Sosnovy Bor nuclear cluster includes (Figure 4-9):

- radioactive waste processing complex;
- interim spent fuel storage facility;
- Leningrad NPP-2, under construction;
- Alexandrov Research Institute of Technology;
- north-western temporary storage of medium and low level solid (more than 60,000 m^3) and liquid (1,200 m^3) radioactive waste;
- the largest metallic radioactive waste re-melting plant in Europe.

In addition, a buried radioactive waste repository is planned. The storage facility will be below ground with a burial depth of 60 m. One radioactive waste repository tunnel about 1 km long and with a diameter of 14 m is designed to take 50,000 cubic metres of radioactive waste. Further storage expansion is expected. Five tunnels are currently planned.

Note: SWYD - open distributive system; TRI - Technological Research Institute; RosRAO/Ecomet-C - radioactive waste management; ISFSI - Independent spent fuel storage installation

Figure 4-9 Sosnovy Bor nuclear cluster

Location of the landfall facilities associated with the offshore pipeline system in the vicinity of Sosnovy Bor carries a significant operational risk, mainly due to the fact that a long term exclusion zone would be established in case of nuclear accident. If any Project facilities were inside the exclusion zone, their maintenance and routine operation would no longer be possible.

To minimise such risk when selecting a location for the Project facilities, any area that may be included in an exclusion zone created after an accident in the nuclear cluster must be avoided. The size of this zone can be up to 20 km (based on experience of the relatively recent nuclear power plant incident in Japan) (Figure 4-10).

4.2.3 Existing and proposed SCAs and IBAs

Section 2 includes the following environmentally sensitive areas:

- Kotelsky nature reserve;
- Koporski Bay IBA (RU045).

There are also plans to establish the Lake Lubensky regional nature reserve. The location of existing and proposed SCAs within Section 2 is shown on Figure 4-11.

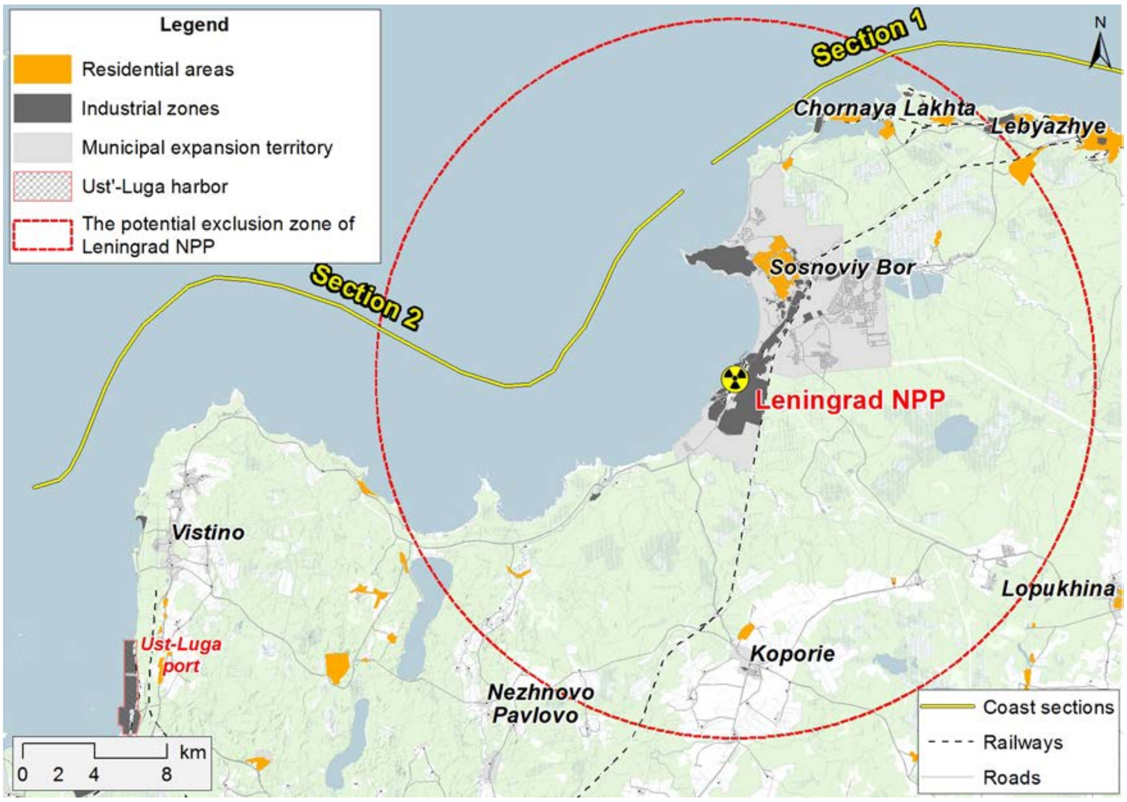

Figure 4-10 Potential exclusion zone

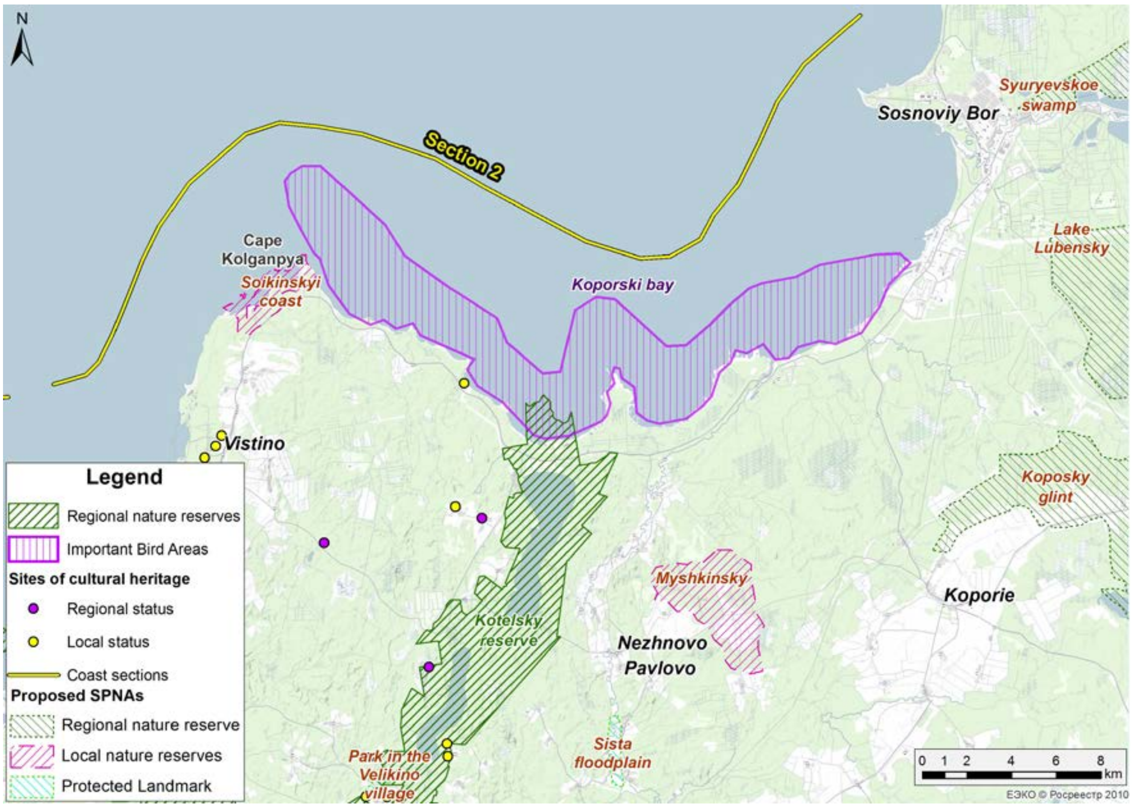

Figure 4-11 Location of existing and proposed SCAs within Section 2

Kotelsky nature reserve

The reserve covers a system of scenic lakes, including Kopanskoe, Glubokoe, Babinskoe, Khabolovo and Sudache.

The regional Kotelsky state complex nature reserve was established in 1976. The nature reserve includes the coast of the central part of Koporski Bay in the Gulf of Finland, the waters of lakes Kopanskoe, Glubokoe, Babinskoe, Khabolovo, Sudache and adjacent territories. In 2011, the Lake Leshy area was included in the nature reserve (resolution of the Government of Leningrad Region 13 May 2011 No. 134). Babinskoe, Glubokoe and Kopanskoe Lakes are a fragment of the ancient Luga river valley – a trough of glacial waters.

The nature reserve covers 16,146.3 hectares, including 3,098.3 hectares of lakes and 301.8 hectares of the Gulf of Finland.

The objectives of the nature reserve are to:

- preserve the hydrological regime of lake ecosystems;
- preserve the natural glacial terrain complexes;
- preserve broad-leaved tree forests, including oak forests close to the northern limit of their distribution, as well as pine forests with southern pine species;
- preserve old-growth forests with rare species of plants, fungi and animals;
- preserve the complex of migrating birds and birds associated with broad-leaved tree forests;
- preserve protected species of plants, fungi and animals and their habitat; support biological diversity.

201 species of birds, 38 species of mammals and 9 species of amphibians and reptiles have been recorded in the nature reserve. Of these, more than 100 species are listed in the Red Data Books of the Russian federation and/or Leningrad region.

There are species of plants growing in the lakes that are listed in the Red Data Book of the Russian Federation – *Lobelia dortmanna*, quillwort and *Caulinia tenuissima*. These plants require clean water and they are easily displaced from the ground, therefore, they only grow away from bathing and boating sites.

Large areas of the nature reserve are covered with forests and swamp. Spruce is the dominant species (sometimes mixed with oak, linden and maple) followed by pine, birch, alder and aspen trees; a small area is occupied by oak forest.

Koporski Bay IBA (RU045)

The Koporski Bay Important Bird Area is situated on the south coast of the Gulf of Finland stretching from Cape Kolganpya in the west to the mouth of the Voronka River in Lomonosov district in Leningrad region. The seaward border of the IBA runs along the 10 m isobath and its total area is 6,000 ha. Approximately 400 ha of the Koporski Bay important bird area is part of the regional Kotelsky complex nature reserve, covering a vast area of islands in the Kingisepp district of Leningrad Region.

More than 100 species of biota are listed in different Red Data Books.

Proposed Lake Lubensky regional nature reserve

The objectives of the nature reserve are: to preserve the water lake system, nesting places and mass migration sites for water birds and shorebirds; to support the ecological balance in the heavily populated area; to protect rare and threatened species of flora and fauna.

4.2.4 Restricted areas offshore

Koporski Bay contains restricted marine areas: the Sosnovy Bor buffer zone, a military practice area and an area with abundant ferro-manganese deposits that would also impede the passage of the gas pipeline (Figure 4-12).

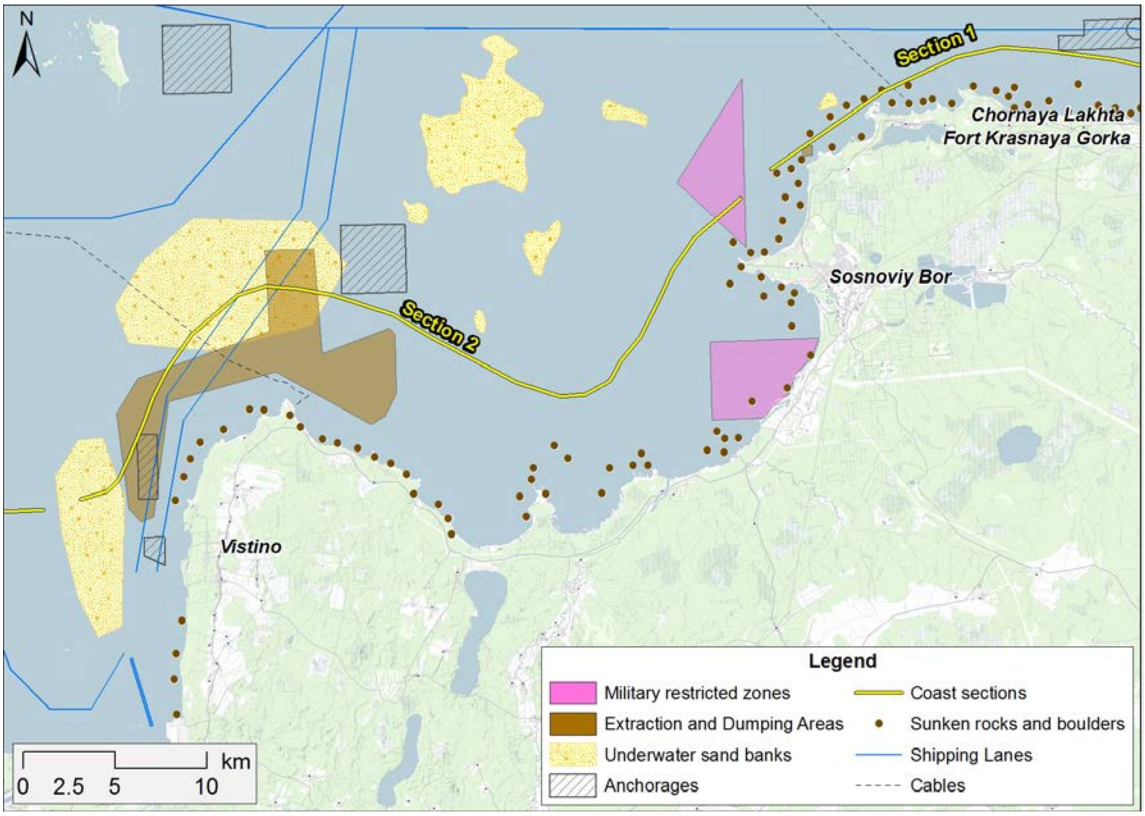

Figure 4-12 Restricted marine areas in the waters of Koporski Bay

4.2.5 Complex coastal geological conditions

The territory of Section 2 contains tectonic faults that are associated with seismic activity, such as for example, the Osmussaar earthquake that occurred on 25 October 1976 with magnitude 4.7 on the Richter scale. Geological studies that were carried out in the Sosnovy Bor district, revealed the presence of mud volcanoes and shallow gas, indicating the presence of "active" tectonic faults in the area.

In addition, boulder clusters are observed along almost the entire coast of Koporski Bay.

The extensive presence of boulders on the seabed and within the upper layers of sediment (Figure 4-12) are not conducive to carrying out extensive seabed and coastal works such as those that would be required to install the Nord Stream 2 pipeline system.

4.2.6 Proximity to the port of Ust-Luga and its shipping routes

The proximity to Ust-Luga port and its shipping routes, especially given its growing capacity, which by 2020 should reach 100 million tonnes per year, as well as the proposed construction of the Baltic LNG plant, including the port terminal, create significant restrictions on the feasibility of routing the offshore section of the gas pipeline.

4.2.7 Conclusion on the feasibility of using Section 2

Sections 4.2.1 - 4.2.6 show that each of the considered constraints limits the feasibility of using Section 2 to implement the Nord Stream 2 Project. Notwithstanding such multiple environmental and technical constraints, a small section of land between Koporski Bay and Ust-Luga (in the area of Cape Kolganpya (Figure 4-13) is a technically feasible location for the construction of the onshore section of the pipeline, the compressor station and landfall facilities is. This area has been therefore considered for further detailed engineering and environmental assessment as described in Section 5 of this report.

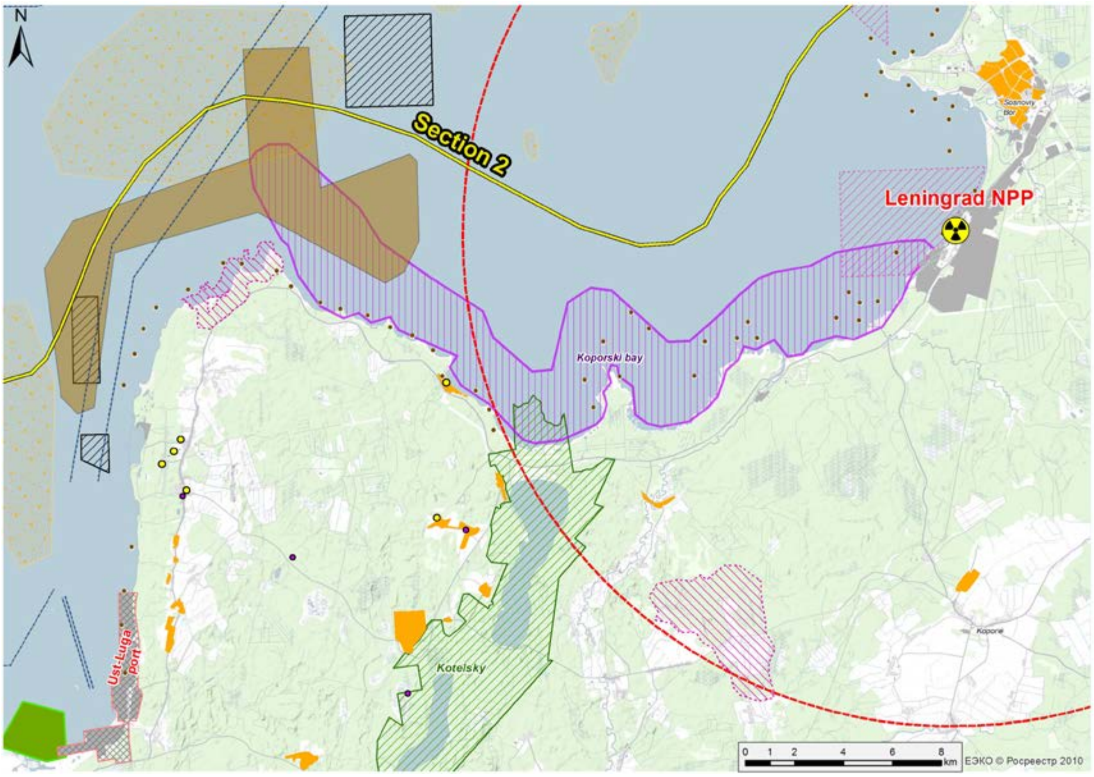

Figure 4-13 Summary of Environmental and Social Constraints

4.3 Section 3 Ust-Luga - Russian-Estonian border

Section 3 is the westernmost part of the Russian coastline in the Gulf of Finland. In this general area, there are no dense urban developments, major known sites of cultural and historical significance or potentially hazardous industrial facilities. Navigation channels are also located at a reasonable distance from the shore. Most of the limiting factors identified in Section 1 and Section 2 were not identified in Section 3 (Figure 4-14).

The most significant constraint is the presence of a Special Conservation Area: the Kurgalsky regional nature reserve and its wetlands.

4.3.1 Presence of special conservation areas

The environmental sensitivities of Section 3 are as follows:

- Kurgalsky regional nature reserve;
- Kurgalsky Peninsula IBA (LG-002) is also registered as the Kurgalsky Peninsula wetlands of the Gulf of Finland in the Baltic Sea protected by the Ramsar Convention.

Kurgalsky regional nature reserve

The territory of the nature reserve includes the mainland (Kurgalsky Peninsula) and island section (islands and waters of the Gulf of Finland, Narva Bay, Luga Bay). The nature reserve covers 60,000 ha, including 38,400 ha of the waters of the Gulf of Finland and 848 ha of lakes (Figure 4.15) and was established in 2000. It was originally set up in 1975 as a hunting reserve.

In 1994, this zone was included in the list of wetlands of international importance of the Russian Federation because of its characteristics as a habitat for water birds. In 2004, Ramsar site No. 690 was approved by the Government of Leningrad Region with the same boundaries and standards. The current legislative document on the Kurgalsky regional nature reserve was approved in 2010.

The ministerial meeting of the Baltic Marine Environment Protection Commission (HELCOM), held from 18-20 May 2010 in Moscow, decided to add the Kurgalsky nature reserve to the list of protected areas in the Baltic Sea.

The territory of the nature reserve is inhabited by 250 species of birds, 750 species of embryophytes. Fifteen critically endangered species of plants grow within the reserve as well as a number of protected birds (white tailed eagles, golden eagles, peregrine falcons, black-throated loons) and mammals (grey seals, ringed seals). The nature reserve is a place for the mass stopover and nesting of birds that migrate globally from Northern Siberia to Western Europe and Africa.

Kurgalsky Peninsula IBA (LG-002)

The Kurgalsky Peninsula IBA (LG-002) includes the marine shallow waters and the lower terraces of the southern coast of the Gulf of Finland along the perimeter of Kurgalsky Peninsula as well as Lake Beloye, which is in the centre of the peninsula (59°41' N 28°07' E). The numerous small islands and the coastal shallow waters of the Kurgalsky reef are an important place for water birds to stop during migration and for a large number of regionally rare species to nest. The forest adjacent to the coast is a nesting site for white-tailed eagles (*Haliaeetus albicilla*, 3 pairs).

The thick reeds on the small islands are nesting sites for the mute swan and greylag goose (*Anser anser*). The following marine birds nest on the reef's islands: razorbill (*Alca torda*), black guillemot (*Cepphus grylle*) and great cormorant (*Phalacrocorax carbo*). Up to 500-600,000 river ducks pass this stopping place on the coasts of the peninsula in spring, predominantly northern pintail (*Anas acuta*) and mallard (*Anas platyrhynchos*), up to 400-600 thousand diving ducks (*Aythya fuligula, Clangula hyemalis, Mergus merganser, Bucephala clangula, Melanitta nigra*) and up to 1 million gulls (*Larus sp.*). In spring, three species of branta (*Branta sp.*) pass through the coast of the peninsula – hundreds of thousands of individuals; 4 species of goose (*Anser sp.*) – hundreds of thousands of individuals; 5 species of tern (*Sterna sp.*) – congregation of up to several hundred individuals, with the most common being the river and polar terns. The Bewick's swan (*Cygnus bewickii*), whooper swan (*Cygnus cygnus*) and the mute swan migrate seasonally. The largest group of moulting river ducks (up to 3,000 individuals) gather on Reymosar Island (Narva Bay), while spring and autumn moulting groups of red-breasted merganser (*Mergus serrator*) and common merganser (up to 5,000-8,000 individuals) gather on adjacent waters. The border of the IBA is shown on Figure 4-15 below.

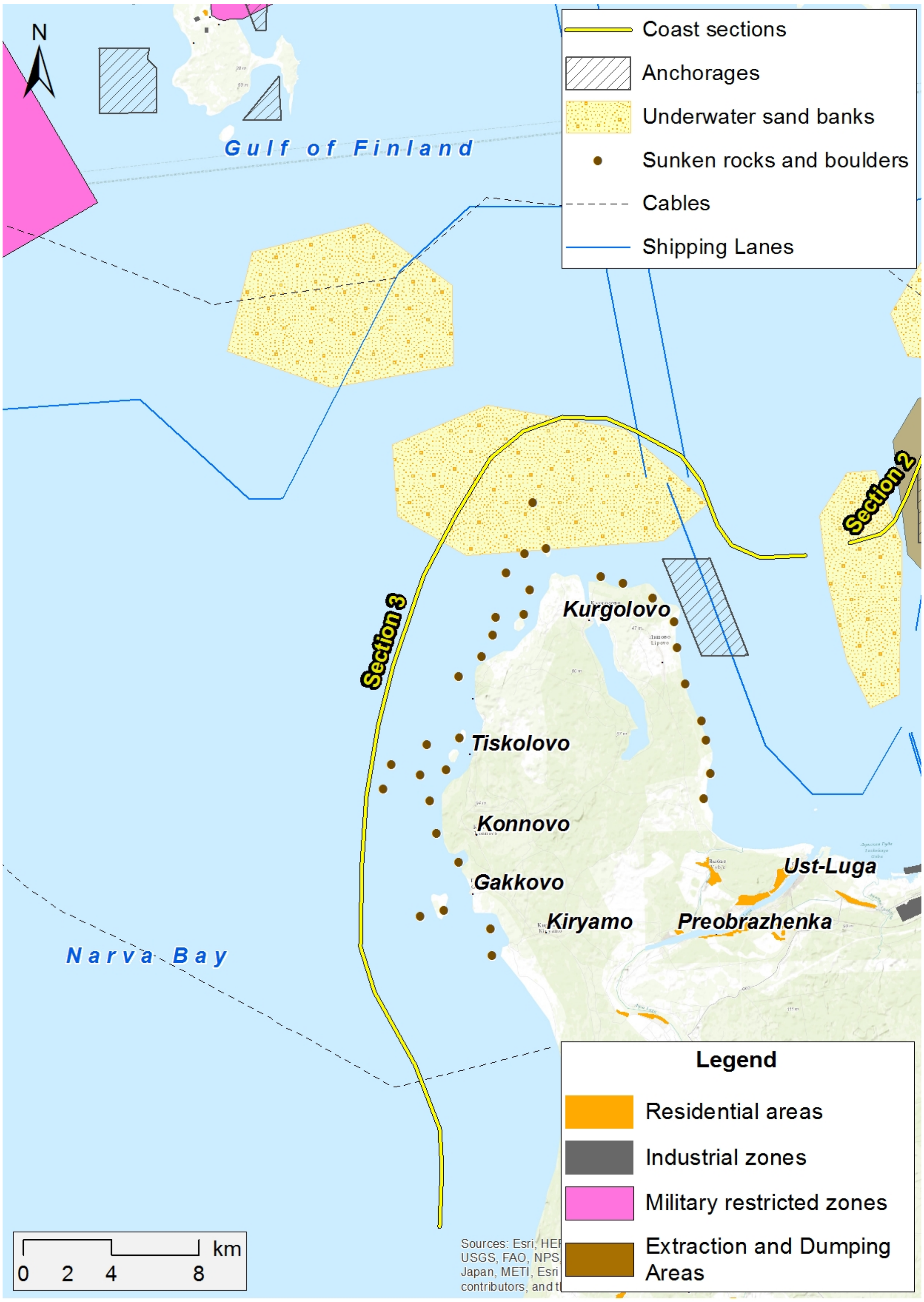

Figure 4-14 Section 3 and factors limiting the location of Project facilities (Part 1)

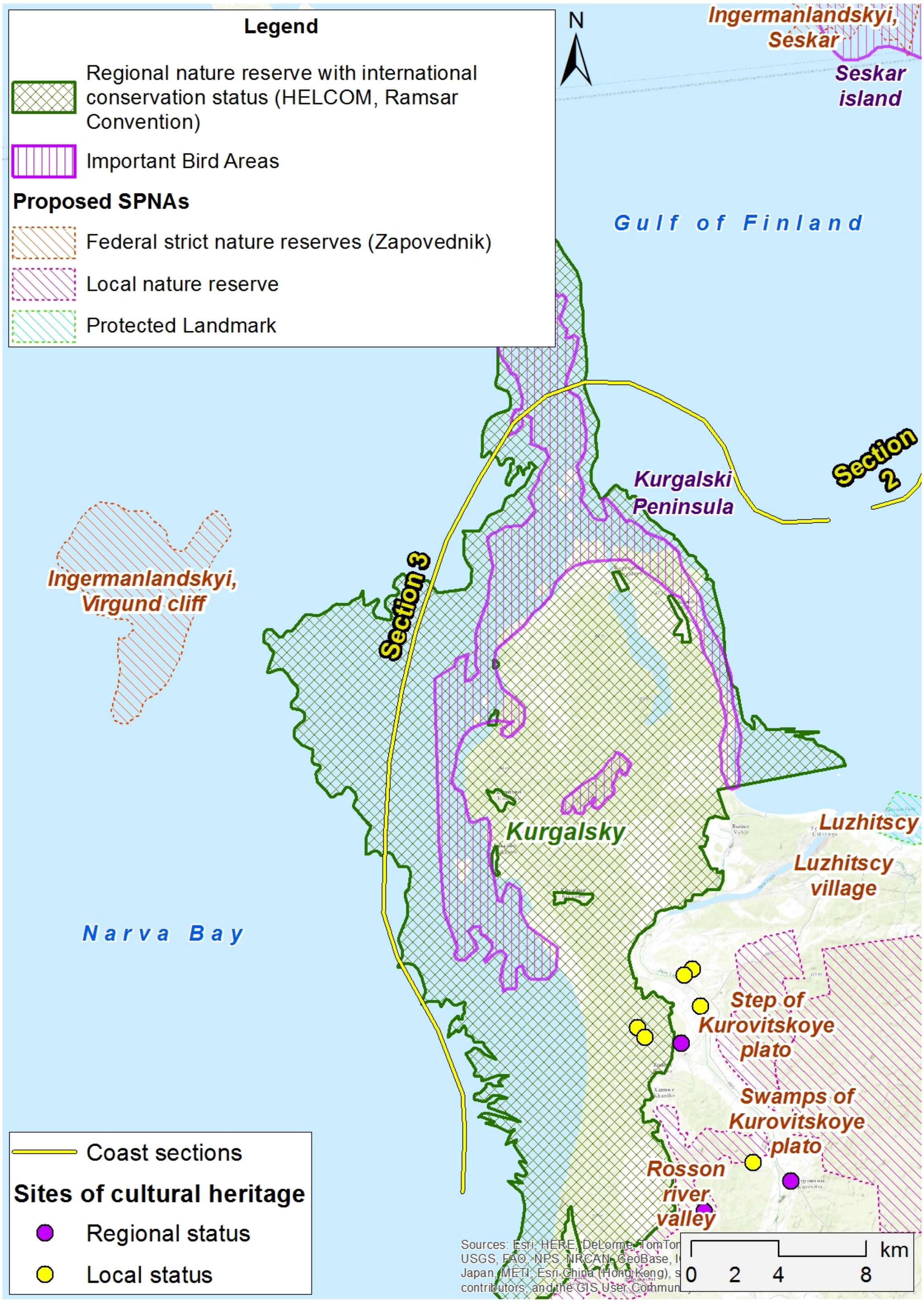

Figure 4-15 Section 3 and factors limiting the location of Project facilities (Part 2)

4.3.2 Conclusion on the feasibility of using Section 3

In the absence of many of the constraints present in Sections 1 and 2 a landfall in the southern part of Section 3, outside the IBA, is a potentially feasible alternative.

However, Section 3 still has a significant limitation associated with the protected status of the territory and its environmental value; therefore a potential location for the Project facilities has been identified within the southern, least valuable part of the Kurgalsky nature reserve, outside the IBA, where the majority of the vulnerable species of flora and fauna are not present and there are less social constraints.

The potential crossing point of the Kurgalsky Reserve, on which Stage 3 of the comparative assessment has been based, is located in an area of lower biodiversity value:

1. Areas that are most important for migrating birds (mute swan, whooper swan, Bewick' Swan, grey goose, black goose, common eider, velvet scoter, cormorant, black-throated diver, shag, etc.), white-tailed eagles, white and black storks, golden and greater spotted eagle as well as haulout sites of seals, nemoral forests, coastal wetlands, which are all most valuable components protected in the reserve, are located mainly in its northern part, on islands and on the so called Kurgalsky reef, and are not affected by the pipeline.
2. Within the selected pipeline corridor, due to recent extensive agricultural use, as well as wide spreading of forest fires followed by the regrowth of secondary small-leaved forest and pine artificial plantations, the habitats are significantly modified. Most part of the corridor (2.3 km of total 3.7 km) is occupied by secondary vegetation (small-leaved forests at the place of recently burnt or cut sites) and agrocoenosis, which has no high value for biodiversity conservation.
3. An extensive wetland area (Kader bog) is crossed by the pipeline in its peripheral drained part.

The only really valuable habitat consists of mature spruce forests with black alder understory along the coast of the Narva Bay.

4.4 Conclusions of Stage 2

Following consideration of the southern coast of the Gulf of Finland from Saint Petersburg to the Estonian border, two feasible options for technically feasible landfall locations were selected. Based on such landfalls, a preliminary design of potential onshore supply routes, landfall facilities (including a compressor station) and offshore routes was developed to enable a detailed comparative assessment of the environmental and social implications of each option, for final consideration (Figure 4-16).

The starting points of the considered alternative routes were identified on the basis of the least environmental and social sensitivity based on available information as described in the previous section of this report:

- coastal area on the Soikinsky Peninsula (Cape Kolganpya) – hereinafter the **Cape Kolganpya option**;
- coastal area in the southern part of the Kurgalsky Peninsula – hereinafter **Narva Bay option**.

The end points of the alternative offshore routes coincide and are on the border of Russian territorial waters and Finland's exclusive economic zone. The routes between the starting points and the end point were selected on the basis of the environmental and technical constraints, and these have been further considered for the comparative assessment of the two alternatives.

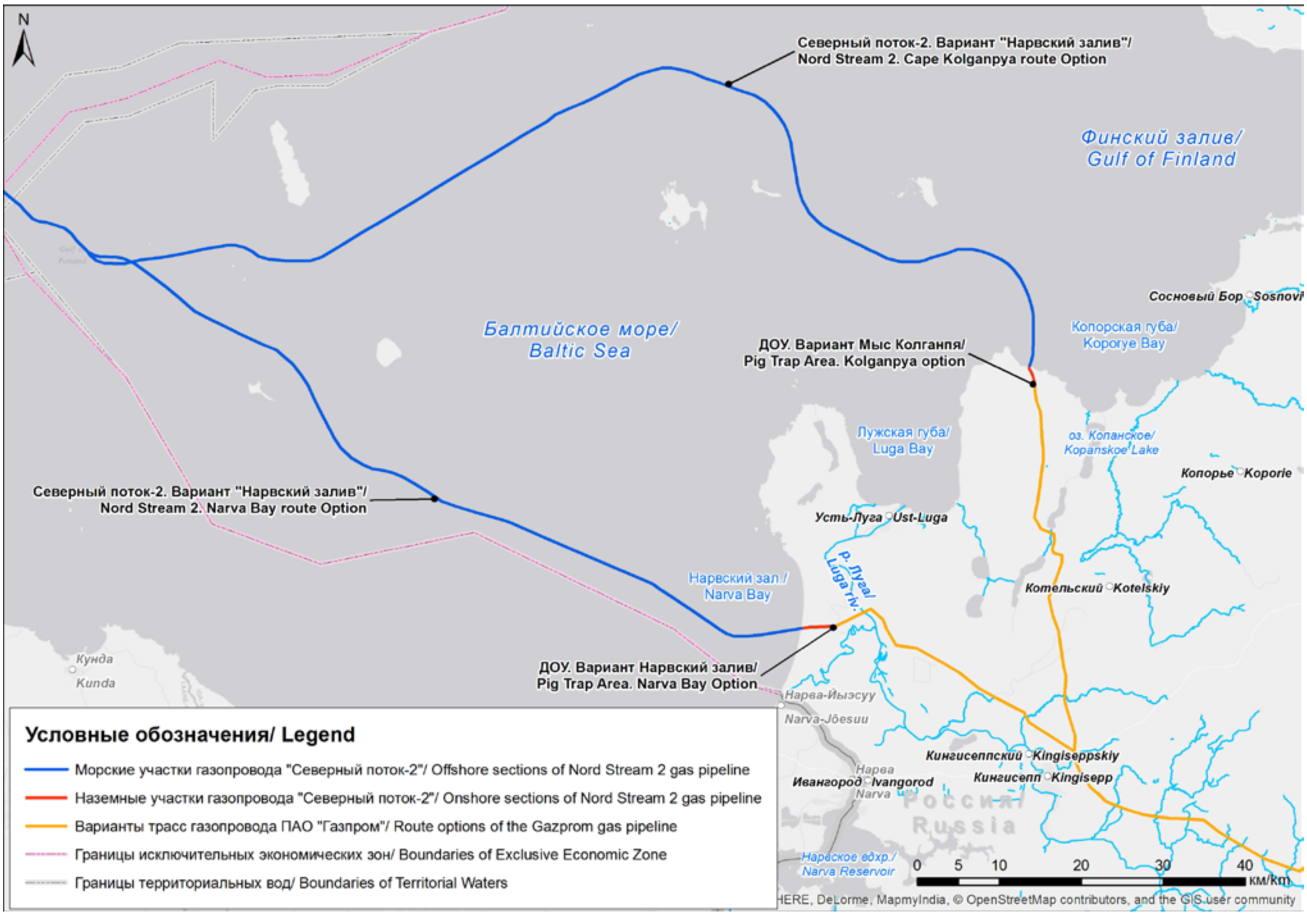

Figure 4-16 Technically feasible alternative routes for the Nord Stream 2 gas pipeline in the Russian sector

5 Stage 3. Comparative assessment of two alternative routes from the starting points of Cape Kolganpya and Narva Bay

This section provides a comparative environmental and social assessment for two route options and their associated landfalls, taking into account existing limitations and risks, as well as a preliminary assessment of the potential environmental and social impacts.

The Nord Stream 2 Russian sector starts at the Pig Trap Area (PTA). Upstream of the PTA, the system will be supplied by four feeder lines, originating from the compressor station, which, in turn, will be supplied by an onshore supply system, with an overall capacity of 80bcm[2]. The length and location of the supply system directly depend on which landfall option Nord Stream 2 AG chooses (Figure 5-1). Therefore, the main features of the upstream gas supply system are also taken into account when analysing the impact of the two alternatives.

The analysis was divided between the offshore and onshore route sections because of the significant differences in the environmental conditions and potential impacts.

Nord Stream 2 AG obtained the baseline environmental and social information used for the comparative assessment in the course of preliminary baseline studies that were carried out at both locations during the third and fourth quarters of 2015.

5.1 Basic engineering solutions: differences between the options

The technical and engineering pipeline design is the same for both route options. The difference lies in the total length of the pipelines along the border of the Russian Federation, as well as the length of the onshore and shallow-water sections (Table 5.1) and the extent of seabed intervention works that are required in the shallow water sections. These parameters determine the level of impact on the main environmental components during construction.

The starting onshore point of the compared Narva Bay and Cape Kolganpya route options is reference **point A** on the Kingisepp district border (Figure 5-1).

For the Narva Bay option, Slavyanskaya Compressor Station will be located near the village of Bolshoye Kuzemkino, while for the Kolganpya option, Izhorskaya Compressor Station will be located in the area of Cape Kolganpya.

The potential Slavyanskaya Compressor Station site is located to the south of Bolshoye Kuzemkino village at a distance of about 11 km from the shore. The route section from the compressor station site to the PTA is approximately five kilometres long and it needs to cross two watercourses: the Luga River and the smaller Mertvitsa River. The compressor station area is within a mixed forest. The terrain is even, with swampy areas.

The potential Izhorskaya CS site is located in the north of the Soikinsky Peninsula, entering the Koporski Bay near Cape Kolganpya. The distance from the compressor station site to the shoreline is approximately 1 km. The PTA would be located 200 m from the compressor station. The potential compressor station site is in a pine forest, which has an undulating and ridged terrain. The beach is a narrow sandy area with forested dunes. Most of the coastal and shallow-water surface is covered by large boulders of glacial origin. A road runs alongside the beach.

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[2] Giprogazcenter: Justification of Investments – Expansion of Unified Gas Supply System to Support Supplies of Natural Gas to Line 3 & 4 of Nord Stream Gas Pipeline. Notice (Declaration) of Intent - Leningrad Region - 4599-DN.2

Figure 5-1 Route options for the onshore sections of the Gazprom gas pipeline

Table 5-1 Length of the Nord Stream 2 gas pipeline sections and associated gas supply system

Section	**Narva Bay**	**Cape Kolganpya**
The length of the Gazprom gas pipelines from point A to the Russian border		
From point A to the compressor station (CS)	*Slavyanskaya CS in the area of Bolshoye Kuzemkino village* 66.00 km	*Izhorskaya CS in the area of Cape Kolganpya* 99.00 km;
From the CS to the pigging site:	5.00 km	0.20 km
Length of Nord Stream 2 Russian sector sections		
Onshore section	4.00 km	0.75 km
Offshore section	114.00 km	156.00 km
Total:	118.00 km	156.75 km

5.2 Comparative features of the baseline conditions of the offshore sections of the compared alternative routes

5.2.1 Engineering constraints for laying the route

This section describes and compares the baseline environmental and social conditions along the two routes. The comparative assessment of the potential environmental and social impacts is described in section 5.3.

Both route options have different engineering and environmental constraints and risks, sensitive marine and coastal habitats as well as vulnerable terrestrial habitats. The map below shows the identified constraints and risks according to project background and fieldwork data (Figure 5-2).

The Gulf of Finland is an active shipping area. During construction of the pipeline, the impact on shipping in the Gulf of Finland may occur mainly in areas where the gas pipeline crosses existing sea routes. During the operational phase, the location of pipelines near shipping lanes increases the risk of damage from dragged anchors, shipwrecks and regular shipping channel dredging.

In addition, the location of high density shipping areas and military exclusion zones, as well as crossing existing infrastructure (cables and pipelines) and fishing grounds have been considered.

These factors are constraints for the Cape Kolganpya route, which crosses, in particular, the shipping lanes to the Ust-Luga port, an exclusion zone, existing cable and is located in direct proximity of an anchorage (Figure 5-2).

For the purpose of the comparative assessment described in this document, it has been assumed that the shore crossing will be carried out, at both landfalls, with conventional open cut techniques in a dredged trench and that the pipeline will be pulled ashore through a cofferdam built with steel sheetpiles. Dredging would also be required to cross shipping lanes, military areas and to minimise the risk of damage as a result of ice scour. A comparison of the dredging volumes required for the two alternative offshore routes is shown in Table 5-2. The extent of the required dredging works has two significant environmental and social effects: the duration of the works and therefore the duration of any disturbance to marine birds and marine mammals is directly related to the dredging volumes; similarly, the deterioration of water quality is directly proportional to the dredging volumes.

Table 5-2 Estimated parameters of dredging for alternative route options

Parameter	**Narva Bay**	**Cape Kolganpya**
Nearshore dredging	525,000 m^3	365,000 m^3
Offshore dredging (shipping lanes and military areas etc.)	0	2,220,000 m^3
Total dredging volumes	525,000 m^3	2,585,000 m^3

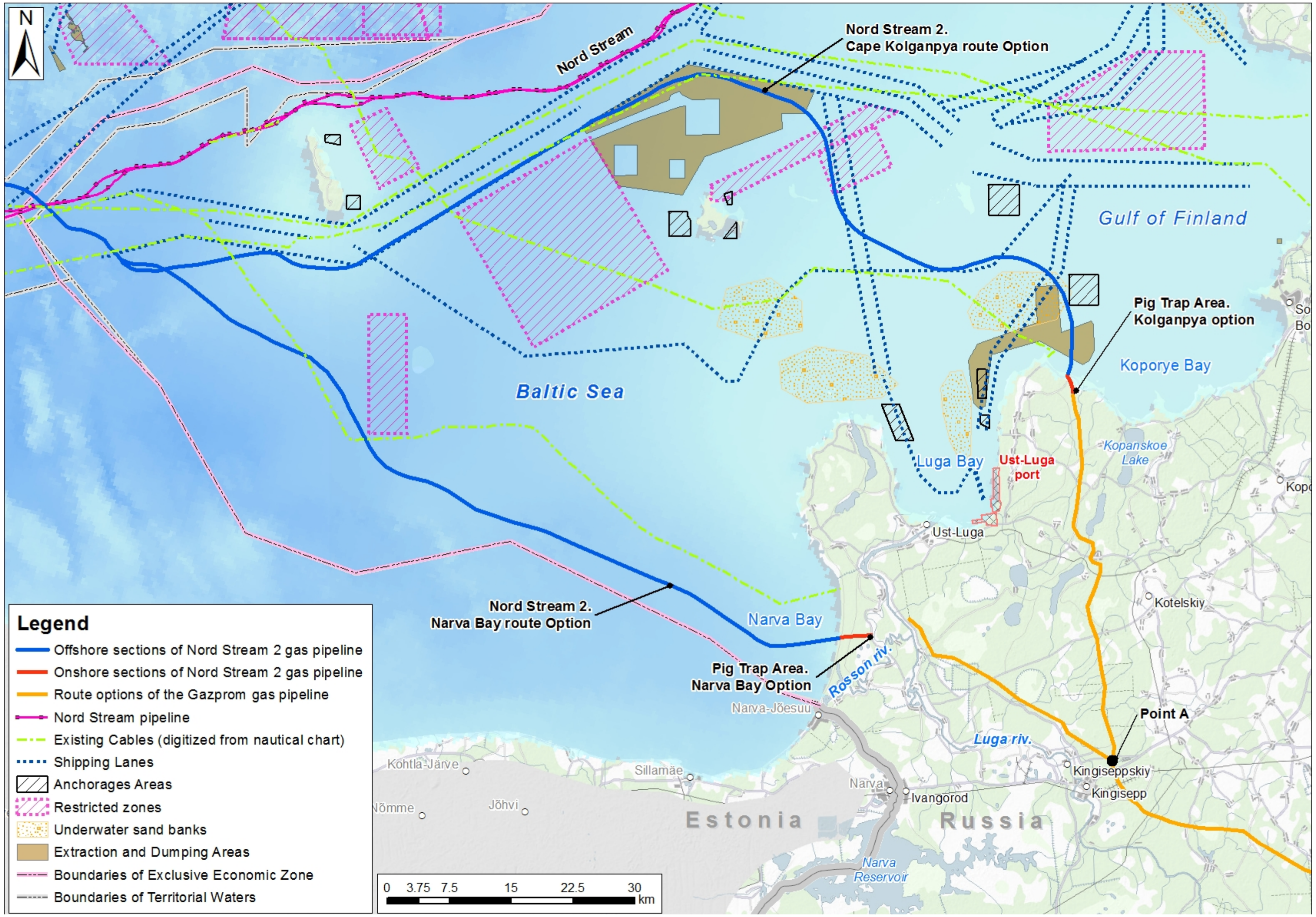

Figure 5-2 Engineering constraints and risks for the Nord Stream 2 offshore sections in Narva Bay and Kolganpya

The Narva Bay route for laying the Nord Stream 2 gas pipeline crosses an existing cable, but there are no other engineering constraints. The extent of dredging required to lay the pipeline along the Narva option is, therefore, substantially reduced.

Therefore, the Narva Bay option is preferred from the point of view of reducing interaction with third party activities and because of reduced dredging and other seabed intervention.

5.2.2 Environmental constraints and risks

Special conservation areas and other protected areas

The offshore sections of both considered route options would affect special conservation areas:

- the Cape Kolganpya route option indirectly impacts on the Kotelsky nature reserve, which would have to be crossed by the inland gas pipeline supplying gas to the compressor station;
- the Cape Kolganpya route option crosses the Koporski Bay IBA;
- the Narva Bay route option crosses the Kurgalsky nature reserve and the Kurgalsky Peninsula Ramsar site (their borders coincide), but does not affect the Kurgalsky IBA.

In addition, the Cape Kolganpya route passes close to the following sections of the planned Ingermanland nature reserve:

- Virgini - on the Virgin islands: North and South, and the surrounding waters, with an area of 248 ha;
- Maly Tyuters - on Maly Tyuters island and waters around it. Area – 2,587 ha;
- Bolshoy Tyuters – on Bolshoy Tyuters island and surrounding waters. The section covers 184 ha;
- Skala Vigrund – located in the southern part of the Gulf of Finland, near the Kurgalsky Peninsula and includes the Vigrund rock itself and its coastal waters. Area – 3,799 ha;
- Seskar– consists of Seskar Island and smaller islands: Yarki, Nogin, Kasauri, Sonin, Nizky, Kokor, Kurov, Yuzhny and surrounding waters. Total area– 6,910ha. There is an IBA on Seskar Island and adjacent waters (Seskar Island – LG-009).

All of these special conservation areas are mainly intended to protect migratory birds that fly and stop in this part of the Gulf of Finland.

Seabed sediments

A total pollution index, based on the concentration of heavy metals in the sediments, was used to characterise the current state of seabed sediments of the Gulf of Finland in the areas of the alternative routes. Figure 5.3 shows the extent of sediment pollution within the Narva Bay and Cape Kolganpya routes.

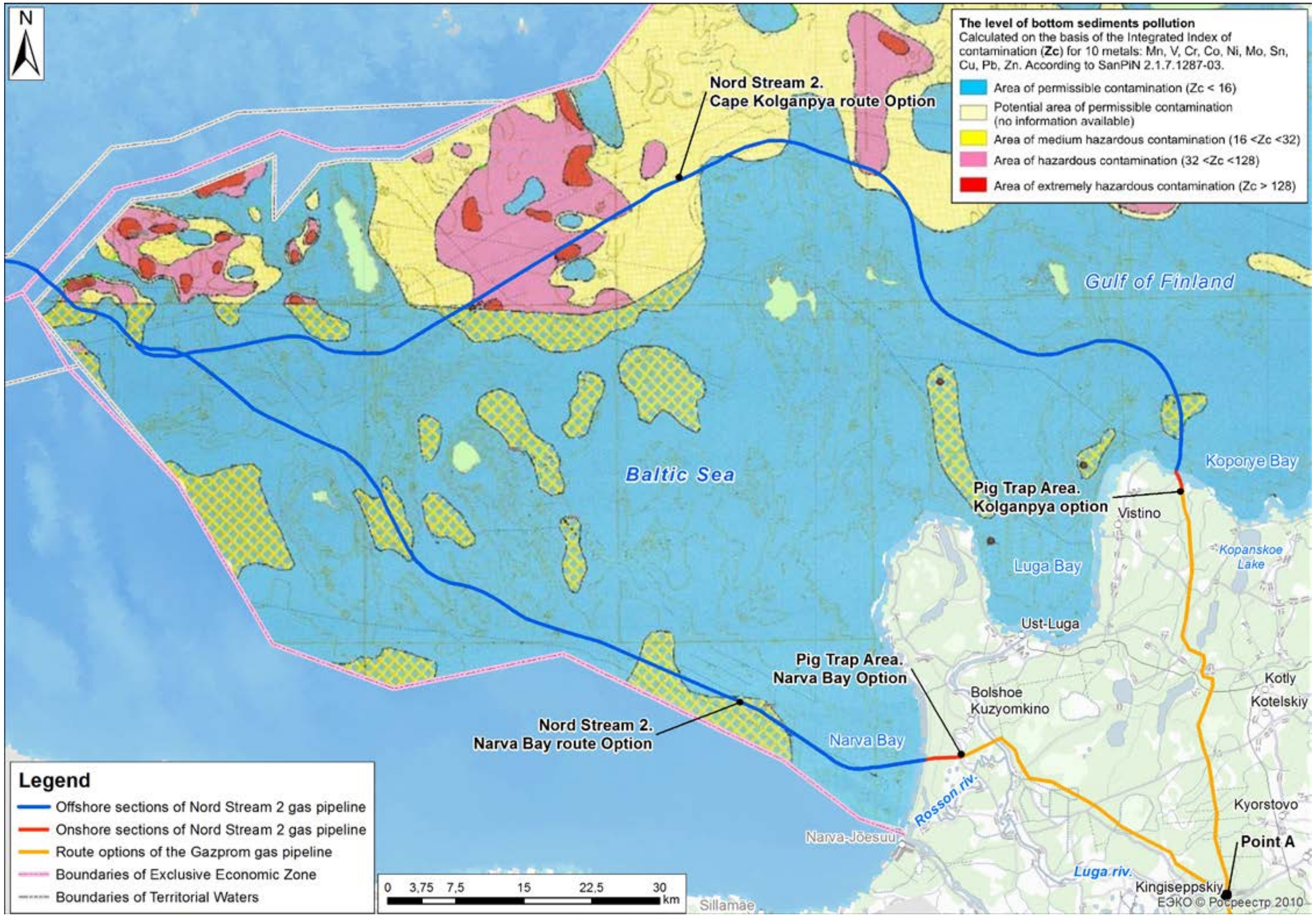

Figure 5-3 Sediment contamination (total heavy-metal contamination)

According to the atlas of the geological and ecological maps of the Baltic Sea[3], it is more likely that the Cape Kolganpya route will pass through polluted sections (including a hazardous and extremely hazardous pollution zone), while within the Narva Bay route, seabed pollution is significantly less, considering that the concentration of heavy metals in the sediment over a large area are classified within permissible pollution limits.

Based on the presence of contaminants in the sediment there is a risk of secondary water pollution from resuspension of bottom sediment, during pipeline laying works along the Cape Kolganpya route, which may adversely affect marine ecological receptors.

For the Narva Bay route, there is no risk of secondary sediment pollution by heavy metals.

Marine ecosystems. Rare and commercial species

The habitats of the following endangered species of algae were recorded on the coast of the Soikinsky Peninsula in the area of the Cape Kolganpya route: *Pseudolithoderma subextensum, Scytosiphon tortilis, Ralfsia verrucosa, Fucus vesiculosus*. In the coastal waters associated with the Narva Bay option, no species of algae listed in the Red Data Book were discovered (Figure 5.4).

Figure 5.4 (source - Environmental Atlas of the Russian part of the Gulf of Finland[4]) shows the spawning migration and feeding areas of the most valuable commercial fish in the Gulf of Finland – the Atlantic (Baltic) salmon. **In Koporski Bay, where the Cape Kolganpya offshore route starts, the anticipated loss of salmon in the event of an unplanned event during construction may be significantly higher than in Narva Bay**, as the route passes through areas where young salmon feed and gather.

[3] Nord Stream Doc No: N-GE-DWG-000-CORR0001-01 (NEXT Constraints Maps; Sheet 7. Bottom sediment pollution)
[4] Environmental Atlas of the Russian part of the Gulf of Finland. Baltic Fund for Nature St. Petersburg Society of Naturalists and WWF (Sweden). St. Petersburg, 2006.

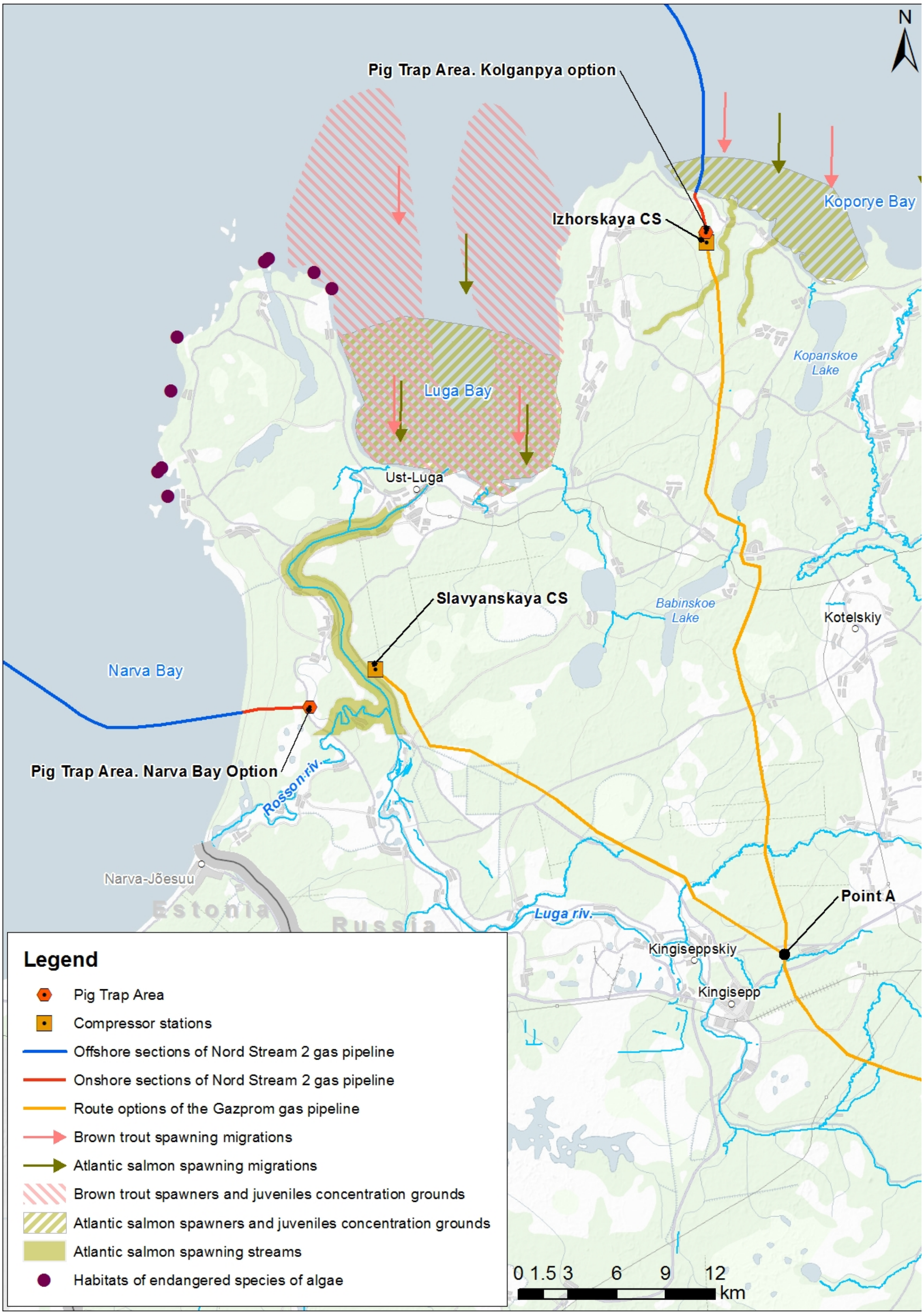

Figure 5-4 Habitats of endangered species of algae and migration and feeding routes of Atlantic salmon

Marine mammals and their habitats

Currently two species of seal are found in the Gulf of Finland in the Baltic Sea: the Baltic subspecies of the ringed seal (*Pusa hispida botnica,* Gmelin 1788) and the Baltic subspecies of the grey seal (*Halichoerus grupus macrorhynchus*, Hornschuch et Schilling 1850).

In the Gulf of Finland, seals generally congregate for calving and moulting during the winter months on the northern shores, while in spring they return to the southern shores. However, in mid-summer they leave the coast for deep water areas.

The migration of ringed seal in autumn and in spring crosses the offshore section of the Cape Kolganpya route, while the Narva Bay route lies away from the ringed seal seasonal dispersion (Figure 5.5). The same can be noted for grey seal dispersion.

Seasonal gatherings of seals are noted close to the routes of both options, but they do not cross the routes. Well-known haul-out sites are found close to the Cape Kolganpya route.

The vulnerability of marine mammals is much higher along the Cape Kolganpya option then along the Narva Bay option.

Birds. Rare species, migration

The section of the Gulf of Finland under consideration (for both options) is of high ornithological value as an area of mass nesting, migration and moult gatherings of water birds (Figure 5.6).

When comparing the proposed routes for laying the gas pipeline in the waters of the Gulf of Finland, it should be noted that both alternative Nord Stream 2 routes pass close to particularly valuable ornithological water areas:

- The Cape Kolganpya route passes the banks of Vestgrund, Seskar Island, Maly and Moshny islands, Virgina archipelago and Rodsher island. Seskar Island is the most important nesting place for gulls and water birds, as well as a traditional stopping place during migration for Bewick's swan, Steller's eider (Polysticta stelleri), river and diving ducks and waders (up to 100,000 individuals in some years).
- The Narva Bay route option would pass close to the Western coast of Kurgalsky Peninsula, Vigrund banks, Bolshoe and Maly Tyuters islands, Virgina archipelago and Rodsher island.
- Gogland Island and the northern part of the Kurgalsky reef are very rich in bird life and a significant distance from both route options.

A larger number of seabirds nest on the sections along the Kolganpya gas pipeline route option (approximately 11,800 nests compared to approximately 8,200 nests for the Narva Bay route) with a very similar species diversity. The total maximum population of migration stops for all seasons of the year is almost the same (approximately 80,000 individuals[5]) with identical species composition. The population of moult gatherings is slightly less on the sections along the Cape Kolganpya option (approximately 8,700 compared to approximately 9,200 individuals) with identical species composition.

[5]W-PE-EBS-PRU-REP-809-Q41504RU-01. Eco-Express-Service. Engineering and Evironmental survey. Russian section of the offshore pipeline Nord Stream 2 AG. Book 4

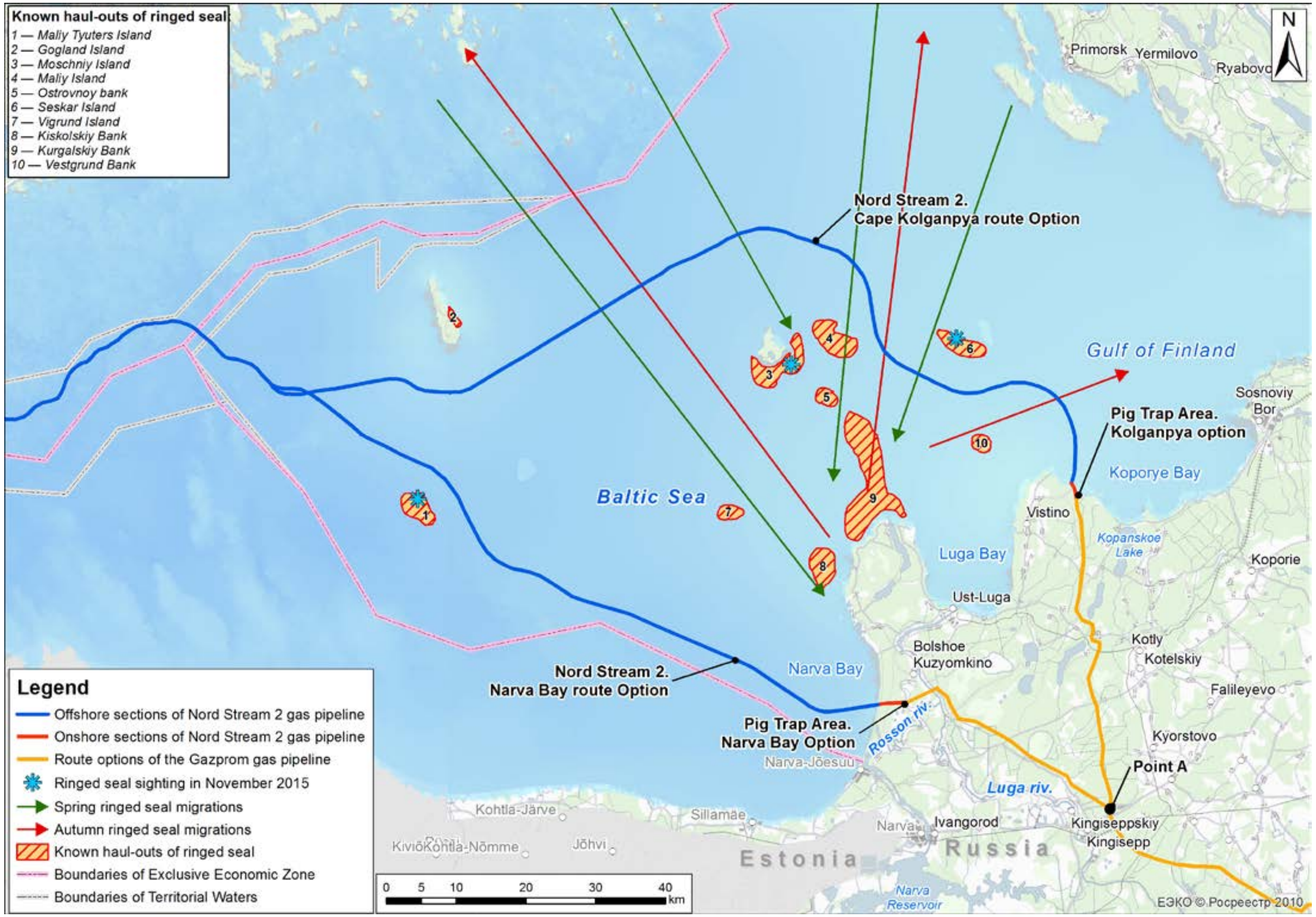

Figure 5-5 Seasonal migration and haul-out sites of ringed seals in the Gulf of Finland

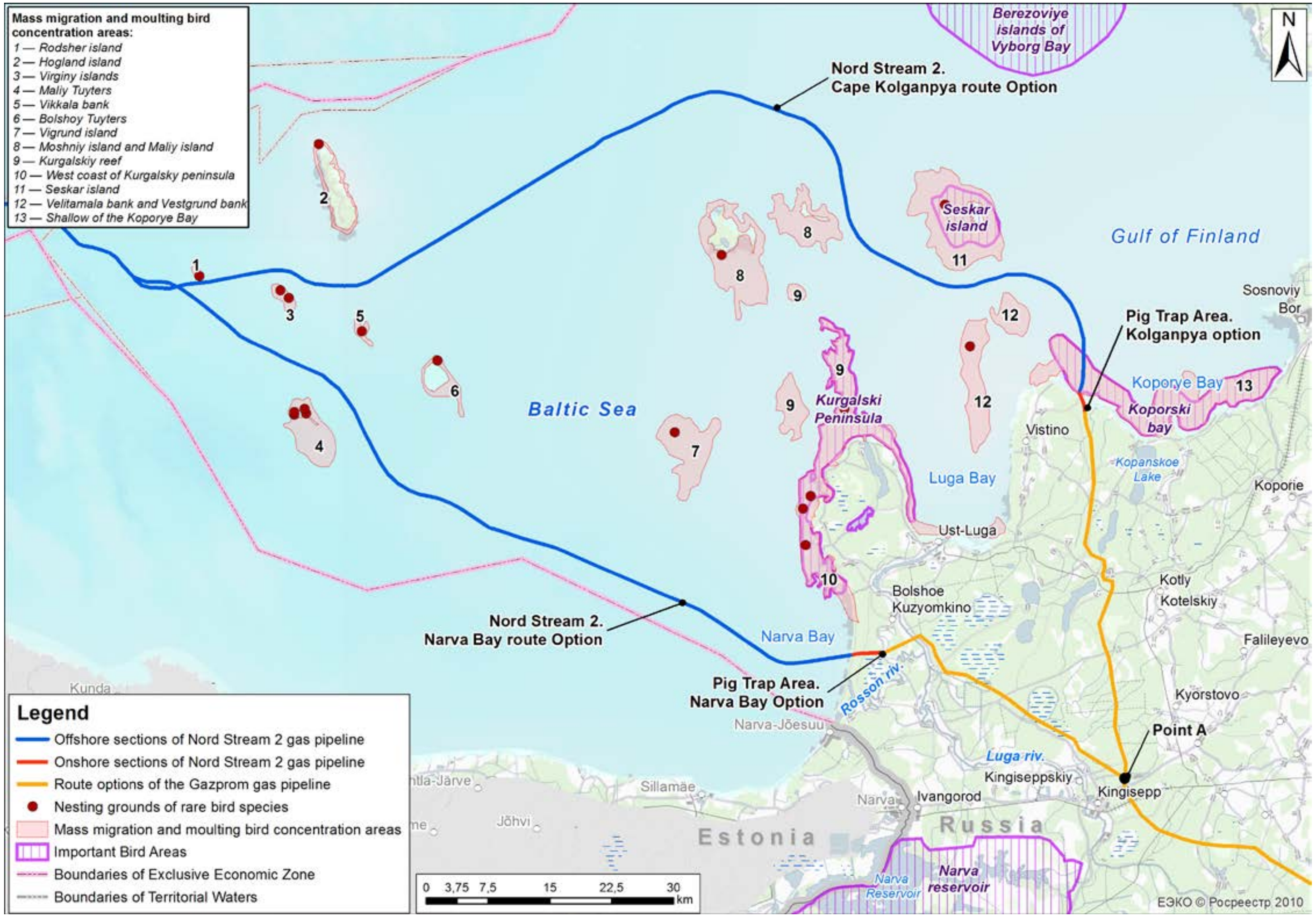

Figure 5-6 Valuable areas for water birds

The number of rare species is almost identical for both route sections. There are 59 species on the southern section (Narva Bay) and 60 species on the northern section (Cape Kolganpya). The Cape Kolganpya option crosses a long section along the coast of the Soikinsky Peninsula, which is designated as the Koporski Bay Important Bird Area (Figure 5.6).

The ornithological value of Koporski Bay and the northern part of the Kurgalsky peninsula (which is not affected by the Narva Bay option), is determined by its location on the southern branch of the White Sea-Baltic route. Large numbers of migrating birds gather (primarily water birds and shorebirds) on the vast rocky-sandy shallows, in reed beds and coastal lagoons, reaching 60-100 thousand individuals. Together with other sections of the coast of the Gulf of Finland (Luga and Narva bays, Vyborg Bay), Koporski Bay is one of the most important transit points for many migrant species: lesser white-fronted goose (up to 30 individuals), Bewick's swan (up to 500 individuals), whooper swan (up to 2,000 individuals), greater scaup (up to 10,000 individuals), common scoter (up to 50,000 individuals), common goldeneye (up to 2,000 individuals), osprey (up to 20 individuals), white-tailed eagle (up to 15 individuals), little tern (up to 150 individuals), little gull (up to 600 individuals), redshank (up to 500 individuals), green sandpiper (up to 3,000 individuals), wood sandpiper (up to 3,500 individuals), lesser black-backed gull (up to 1,000 individuals), Eurasian reed warbler (up to 500 individuals), as well as the Caspian tern, brant, smew, spotted redshank, whimbrel, black-throated loon, barnacle goose, little stint, greater white-fronted goose, velvet scoter and long-tailed duck.

The maps below show the spring and autumn migration of diving ducks, coots and river ducks (Figure 5.7).

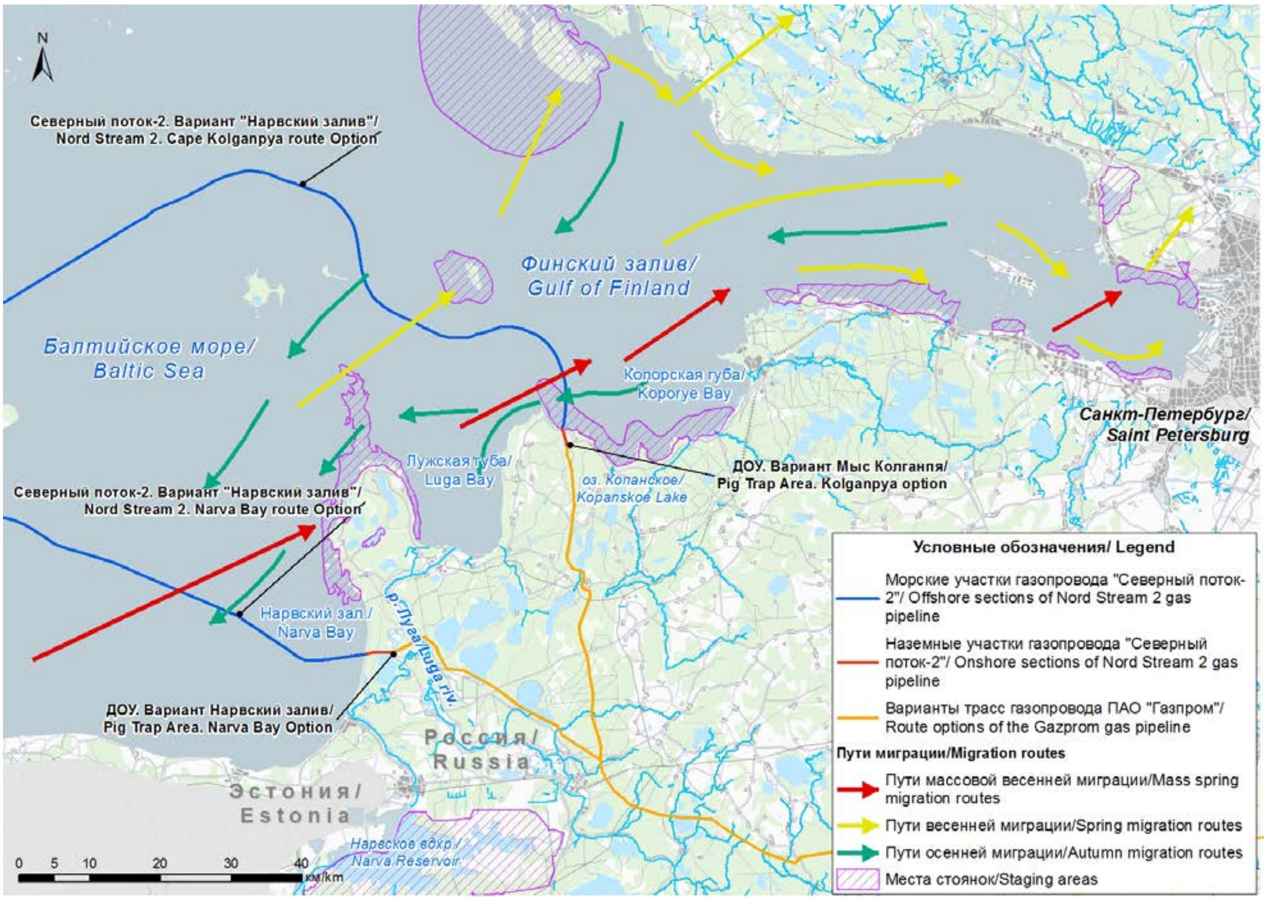

Figure 5-7 Spring and autumn migration of diving ducks, coots and river ducks

In terms of vulnerability of marine birds, the Narva Bay option is marginally preferable to the Cape Kolganpya option, primarily because of the location of the landfall and onshore section outside the most critical bird habitat that occurs within the Kurgalsky peninsula.

5.3 Comparative assessment of the expected environmental and social impacts during construction of the offshore section of the Nord Stream 2 pipeline

5.3.1 Marine waters and seabed sediments

The main impact on seawater quality during pipeline construction will come from construction works and consists of temporary local changes to the physical and chemical properties of water due to the dispersion of fine sediments (particles smaller than 0.05 mm) in the water environment, which would occur as a result of dredging activities.

To compare the volumes of dredging for the two options, the following were taken into account:

- dredging for pre-trenching on the offshore section, including the coastal zone;
- work on construction of a cofferdam in the coastal zone to support ground equipment during pre-trenching;
- backfilling of trenches on the offshore section, including the coastal zone;
- free spans corrections;
- crossings of existing pipelines or cables.

Given the greater length of the offshore section for the Cape Kolganpya option and the requirements to trench the pipeline when crossing shipping lanes and military areas, the calculated volume of dredging is twice greater than for the Narva Bay option (see Table 5.2). In addition, the sediment along the Cape Kolganpya is more contaminated than along the Narva Bay route, which will potentially lead to contamination of the water column during dredging.

5.3.2 Air quality

The main type of impact on the air quality during construction of the offshore section of the gas pipeline is air pollution from emissions of polluting substances from pipe laying vessels, supply vessels, bunkering vessels, etc. Emissions will include carbon oxides, nitrogen oxides, sulphur dioxides and particulate.

Comparison of the alternatives shows that about the same number of construction vessels will be required for both options. However, the Cape Kolganpya route is 1.4 times longer than the Narva Bay route and has a more complex seabed morphology. Therefore, work on the Cape Kolganpya route would require more time and this would lead to a greater volume of atmospheric emissions.

5.3.3 Acoustic impacts

The main sources of noise impact during work on the offshore sections are the vessels and, more specifically, their power generation equipment and the underwater propellers and thrusters. In the eventuality that underwater munition is detected, their detonation would also be a source of acoustic impacts.

The level of noise from vessels engaged in construction is typical for these types of vessels and the expected environmental impact is not considered to be significant.

In terms of acoustic impacts, the options do not differ significantly although impacts associated with the Cape Kolganpya option would last longer. Any detonation of unexploded ordnance would also be more likely to have adverse effects on marine mammals, due to the proximity of the Kolganpya option to know haul out sites.

5.3.4 Aquatic biota: plankton, benthos and ichthyofauna

During the construction phase, impacts on the marine environment are a result of sediment disturbance and dispersion, which in turn affects the normal conditions of existence and reproduction of aquatic animals, including fish.

Elevated levels of suspended solids in water reduce the intensity of photosynthesis, damage filtering organs, worsen feeding and reproduction conditions and lead to physiological stress and the loss of aquatic organisms. Significant sediment displacement adversely affects the whole biota of the water area: zoobenthos, which is the main food supply for bottom-feeding fish, would be particularly affected.

There will be no significant impacts on aquatic biota during the operational stage.

More damage would be caused during pipeline construction for the Cape Kolganpya option than for Narva Bay because of the greater volumes of dredging and other works.

5.3.5 Marine mammals

The impact on marine mammals from construction of the pipeline offshore section would mainly consist of a reduced area for their potential habitat as a result of:

- habitat loss;
- temporary modification of the biotic components of the habitat;
- temporary disturbance caused by physical fields (acoustic, thermal, and electromagnetic).

Both considered routes pass at a sufficient distance from habitats with high concentrations of ringed seal and grey seal. However, the Cape Kolganpya option crosses the seasonal migration paths of marine mammals and is closer to known haul-out sites. In addition, the longer construction period for laying the gas pipeline from Cape Kolganpya would increase the duration of the negative impact on these animals including during periods of seasonal migration.

Marine mammals will not suffer any impacts during the operational phase.

5.3.6 Birds

The main impacts on seabirds are also associated with the construction phase.

The principal sources of impacts include:

- disturbance from ships and machinery;
- modification of the biotic components of the habitat.

As in the case of marine mammals, the impact on seabirds will be mainly expressed in the temporary reduction of their habitat as a result of birds avoiding the area with high noise levels and a depleted food base.

Both Nord Stream 2 alternative routes pass close to water areas that are heavily used by birds. The vulnerability of the sites alongside both pipeline route options is virtually the same.

Despite the fact that the Cape Kolganpya route option passes closer to an important bird area (7.8 km, while the Narva Bay option passes at a distance of 16.7km), the impact on birds is not expected to be significantly greater. However, offshore construction work along the Cape Kolganpya route will take longer and could result in a longer impact on birds and their habitats.

Birds will not suffer any impacts during the operation phase.

5.3.7 Conclusions regarding the offshore part

Data provided in sections 4.2 - 4.3 allow to conclude that **the Narva Bay route is preferable** regarding existing environmental constrains and risks.

5.4 Comparative features of the background conditions of the onshore part of the compared route options

5.4.1 General conditions for the two options

Climatic conditions

The climate features are the same for both route options: the area has an Atlantic continental temperate climate. The key climate forming factors are atmospheric circulation conditions: the impact of sea (Atlantic) and continental air masses, Arctic ingressions and intense cyclone activity. The regional climate is defined as close to maritime; it is moderately warm in winter and cool in summer.

A typical feature of the region is its high humidity (annual average of 79%), as well as the great variability in weather conditions caused by frequent changes in air masses with strengthening of cyclone activity.

Geological and geomorphological conditions

Both route options are located within the Pre-klint lowland, which is characterised by marine terraces of different ages, in places interrupted by undulating moraine ridges and marginal facies of the Luga stage of the Valdai glacier.

The pre-Quaternary geology for both route options is similar and is represented by lower Cambrian layers (mainly clays, sands and sandstone). Both route options cross Baltic klint; the pre-Quaternary rocks here are Ordovician limestone and dolomite.

Soil cover

Both route options are dominated by podzolic (typical soils of conifer forests) and podzolic-swamp soils together with swamp soil. The soils are slightly acidic and have a low humus content.

5.4.2 Engineering constraints for laying the route

Both options rely on an inland gas pipeline supplying gas to the compressor station. From a common starting point (reference point A in Figure 5.1), the difference between the two options is the length of the gas pipeline to the compressor station and the distance from the compressor station to the PTA. Table 5-3 shows the basic parameters for the onshore section of the Gazprom routes to compare the options.

Table 5-3 Basic parameters for the onshore gas pipeline routes, from Point A (Figure 5.1) to the compressor station

Characteristics	**Unit**	**Cape Kolganpya**	**Narva Bay**
Route length, including:	km	99	71
a) bogs (peat thickness):			
type 1 (0.5 – 1 m)	km	11	9.5
type 2 (>1 m)	km	8	12
b) flooded floodplains 10% layer(including the channel section)	km	2.23	2.325
c) flooded sections	km	2	1.5
Open-cut submerged crossings with water surface width:			
a) up to 10 m	qty. km	62 0.132	51 0.113
b) 10 to 30 m	qty. km	4 0.04	1 0.01
c) 75 to 300 m	qty. km	-	1 0.152
Road crossings:			
a) railways	qty.	3	2
b) cat. I and II roads	qty.	1	1
c) cat. III - IV roads	qty.	6	4
d) cat. V roads	qty.	4	5

Characteristics	**Unit**	**Cape Kolganpya**	**Narva Bay**
Utilities Crossings			
a) OHL 500 kV and above	qty.	-	-
b) OHL 330–500 kV	qty.	1	1
c) pipelines	qty.	-	-
d) cables	qty.	16	12
Clearing forest from the route	km	65	42
Forest clearing (based on ROW width of 57m)	km^2	3.705	2.394
Total volume of earthworks	thousand m^3	2,566	1,840

The entire territory is swampy and heavily waterlogged, including the forested areas. Land drainage features, such as ditches, are widespread throughout the general area.

The Narva Bay inland route option crosses the Luga River valley, with two main water bodies: the Luga River and the smaller Mertvitza river.

The Cape Kolganpya inland route option does not cross any large river valleys. However, it will cross eight small rivers flowing into the Luga River and the Gulf of Finland.

5.4.3 Environmental constraints and risks

Crossing special conservation areas and other areas with restricted use of natural resources (onshore supply pipeline system)

The land sections of both alternative routes affect (directly or indirectly) a number of special conservation areas and other protected areas.

The onshore section of the onshore supply route along the Cape Kolganpya option crosses the regional Kotelsky state nature reserve. The reserve has been zoned to allow non-conservation activities in parts of the reserve.

The proposed inland gas pipeline route would pass through a zone of intense natural resource use, where there are minimum restrictions on economic activities. Regardless of the administrative status of the reserve, construction of the inland gas pipeline would result in an increased level of habitat loss and fragmentation (Figure 5.8).

The alternative Narva Bay route crosses the southern section of the regional Kurgalsky state complex nature reserve (Figure 5.9), which is generally considered to be the least valuable part of the Kurgalsky reserve.

The planned crossing point within the Kurgalsky nature reserve was chosen for the following reasons:

1. To avoid affecting critical biological components of the protected nature reserve. Bird migration areas, ringed seal and grey seal haul-outs, the habitats of ungulates, fragments of broad-leaved forests and marine marsh complexes are found in the northern part of the Kurgalsky Peninsula, on nearby islands and on the so-called Kurgalsky reef. These valuable conservation areas would not be affected by the proposed gas pipeline route (Figure 5.5 - Figure 5.7, Figure 5.10). In addition, the Narva Bay route does not cross the Kurgalsky IBA located within the boundaries of the Kurgalsky nature reserve; the IBA borders pass north of the route (Figure 5.9).
2. To lay the gas pipeline as much as possible on modified habitats. Intense agricultural activities (field clearance and reclamation) have been previously conducted on the section selected for laying the pipeline. A significant area of the chosen site is occupied by secondary communities that emerged after forest fires and include small-leaved species and pines. Approximately 2.3 km of the Narva Bay route covers mostly modified habitats (small forest on burned areas, unbroken salvage logging and fallow lands or artificially created plant communities) that are not of high value in terms of biodiversity conservation (Figure 5.11). 1.7 km of primary forest of ecological value are affected by the Narva Bay route.
3. To avoid impacts on large swamps. The route only affects the northern, most marginal part of Kader swamp.

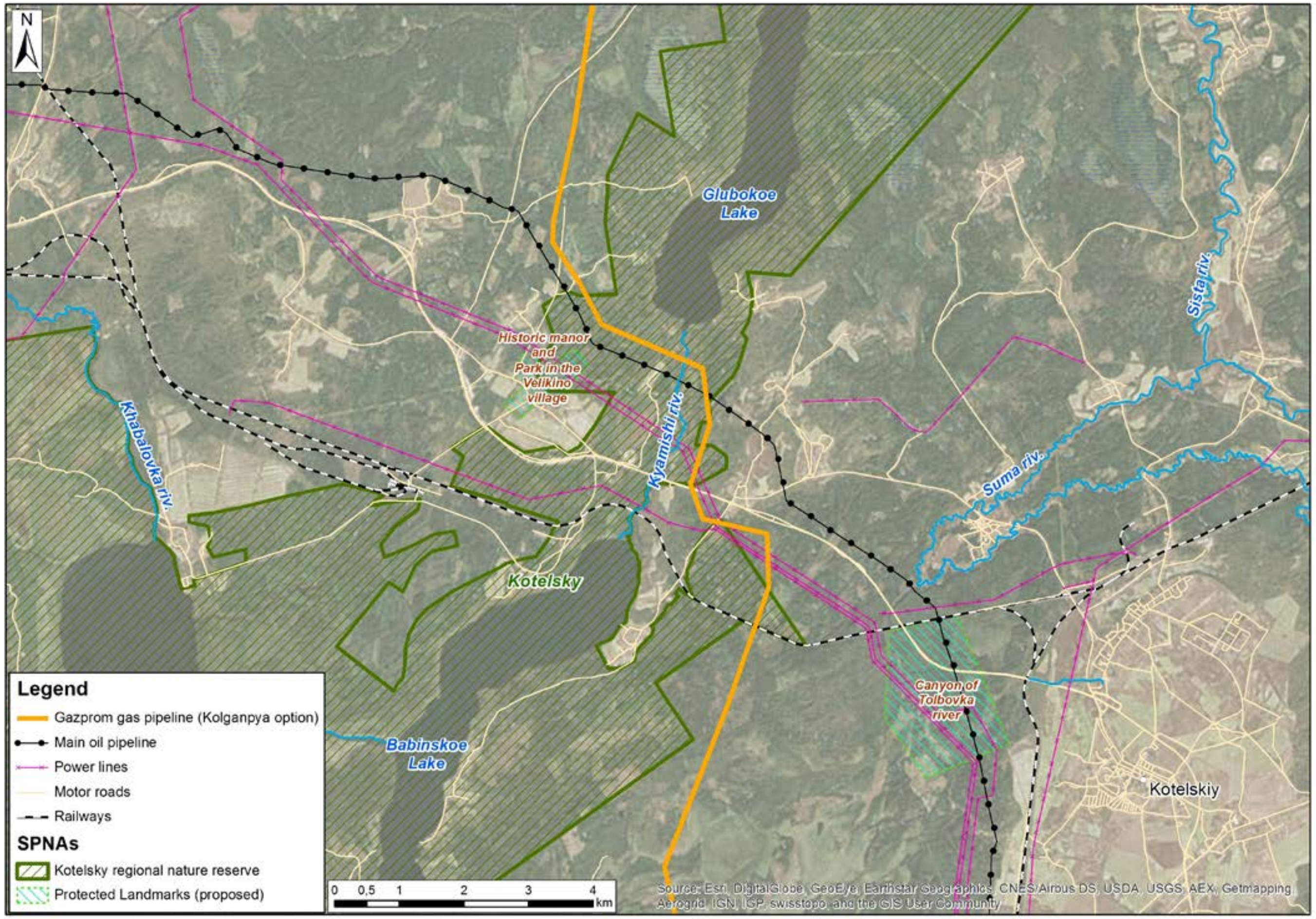

Figure 5-8 Cape Kolganpya pipeline crossing the Kotelsky nature reserve

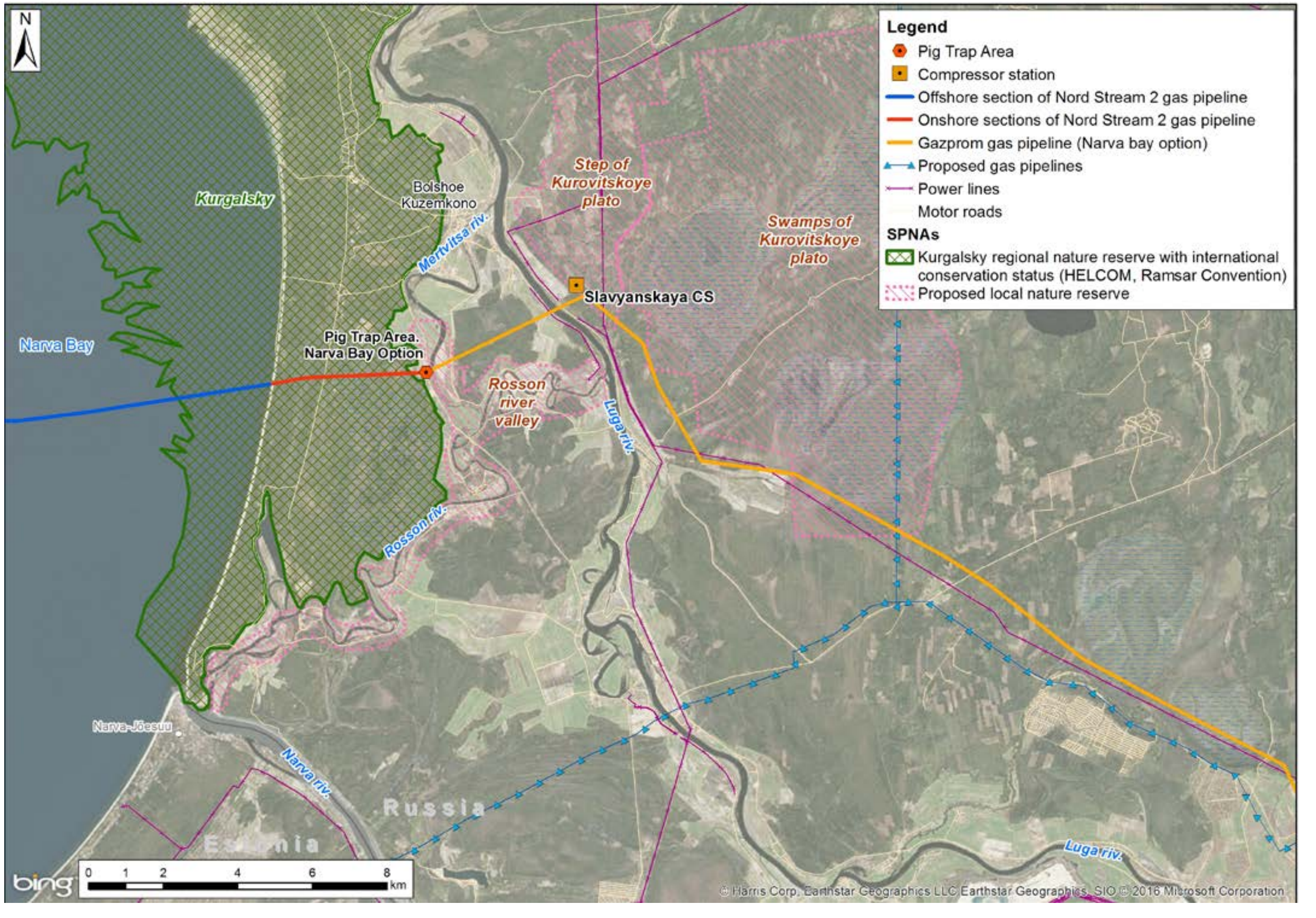

Figure 5-9 Pipeline crossing the Kurgalsky nature reserve

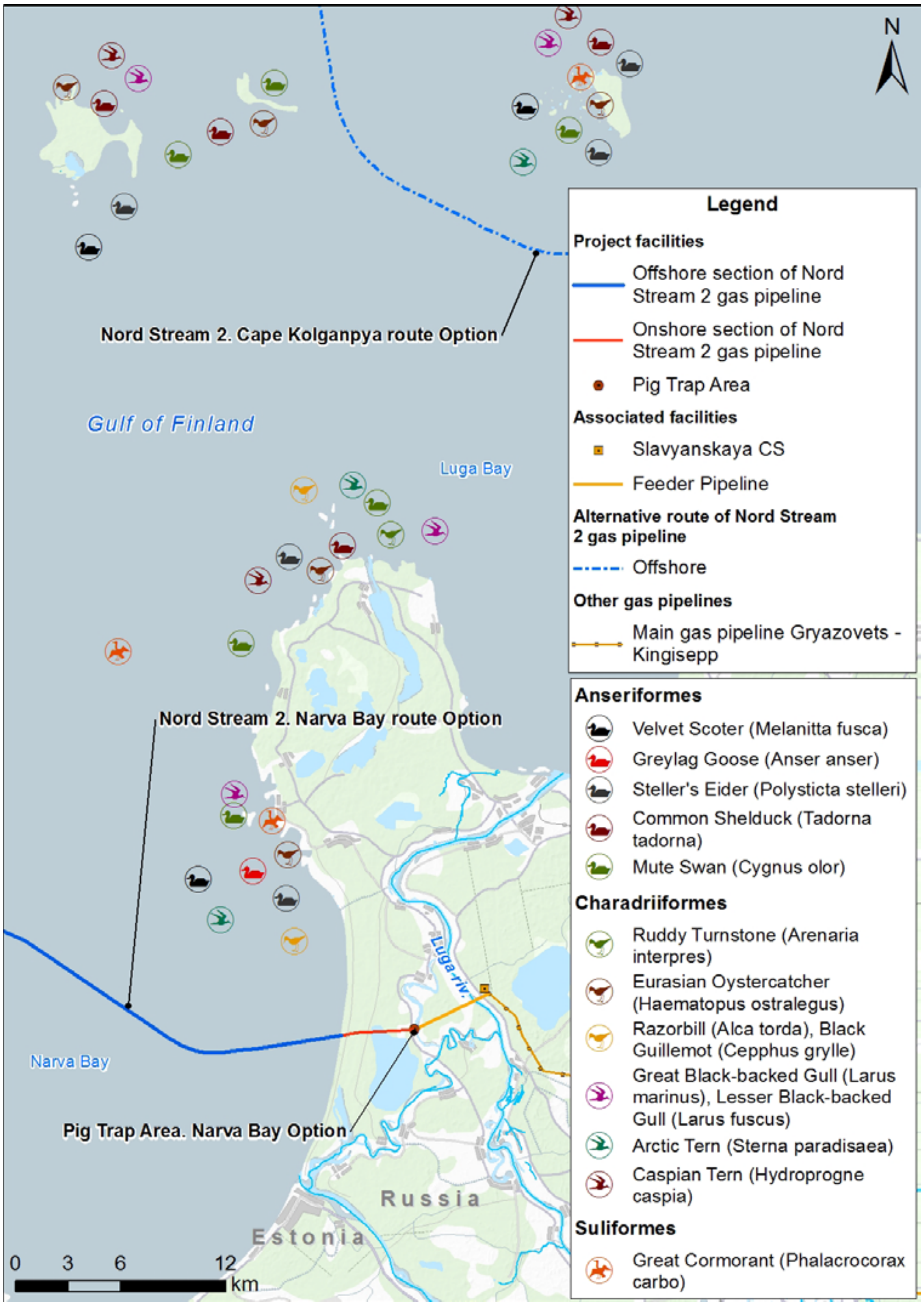

Figure 5-10 Location of the pipeline route relative to gatherings and important habitats of birds in Kurgalsky nature reserve

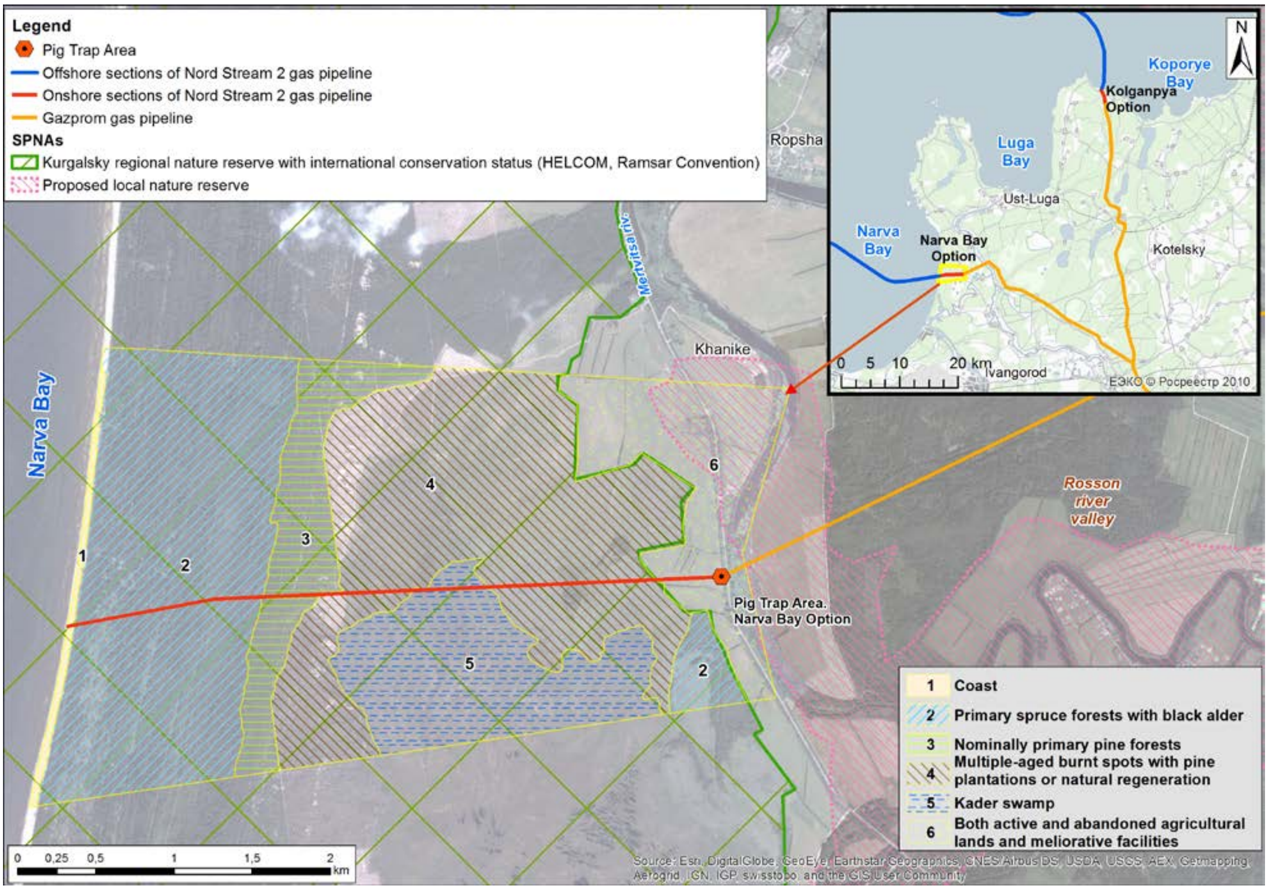

Figure 5-11 Landscapes crossed by the Narva Bay option pipeline route within the Kurgalsky nature reserve

Geohazards

The Cape Kolganpya alternative route on the Soikinsky Peninsula crosses a more rugged, dissected terrain characterised by peri-glacial formations. Fluvio-glacial fields are found in these areas: these are undulating and steeply-sloping terrain, characterised by heterogeneous occurrence of loam, boulder clays and pebble-sized material.

As a result of the undulating topography, gully erosion is a typical occurrence along the potential route.

In the section on Soikinsky Peninsula[6], which contains undulating and steeply-sloping moraine plains, the boulder clays are more widespread and hazardous natural processes, such as gully erosion, are common.

The Narva Bay route, after crossing the Luga River, crosses marine terrace plains, composed mostly of sand, clay and pebbles. Close to Narva Bay, a system of dunes (marine sand from the second half of the Holocene) runs parallel to the coast. The dunes are 300m to 1500 m wide, up to 32 m high and the length of the system in the Narva Bay area reaches 16 km.

[6] Map of current dynamics of the North Eurasian relief (Russia and bordering countries) /Карта современной динамики рельефа Северной Евразии (в пределах России и сопредельных стран). Scale 1 : 5 000 000.- Moscow, 2003

There are virtually no geohazards within the area of the Narva Bay alternative, with the Luga River and the Mertvitza River crossings being the only potential challenges to the stability of the pipeline installation.

Plant cover, forest

The plant cover in the Cape Kolganpya option contains primary and pseudo-primary plant communities (coastal halophilic meadows of the Soikinsky Peninsula), and, to a lesser extent secondary botanical communities and cultivated plant communities (farmland).

In addition, the route along the Cape Kolganpya option crosses the Kotelsky nature reserve, which contains specially protected areas:

- forests with broad-leaved trees, including oak forests,
- pine forests with rare southern pine species and
- old-growth forests.

Valuable plant communities include nemoral grassy plants and spruce-aspen-alder forests, which are potential habitats for rare species of plants (Figure 5.12).

This route alternative passes through the following categories of protected forests:

- forests located in water protection zones;
- forests that protect natural and other objects (protective forest strips along roads);
- valuable forests (prohibited forest strips along water objects, forest spawning strips).

Approximately one third of the forest-covered area consists of protected forests, while approximately two thirds are commercial forests.

Plant cover in the Narva Bay option is typical for boreal coastal forests and include mostly conifer trees, limited broad-leaved species of trees and a forest understory that varies depending on the water saturation of the ground (dry grass, green moss, lingonberry and heather, wood sorrel, blueberry, etc). (Figure 5.12).

One of the conservation objectives of the Kurgalsky nature reserve, which the Narva Bay option crosses, is the preservation of the natural and old second-growth forests of the middle taiga, south taiga and sub-taiga (taiga is a boreal forest or snow forest).

Within the area of the Project's potential impact[7], there are six rare protected plant species and one lichen species, most of which (*Carex arenaria, Dianthus arenarius, Epipactis atrorubens, Tripleurospermum maritimum, Hottonia palustris, Bryoria subcana*) are listed in the Red Data Book of Leningrad Region, while one species (*Pulsatilla pratensis*) is listed in the Red Data Book of the Russian Federation.

[7] W-PE-EBS-PRU-REP-809-Q41504RU-01. Eco-Express-Service. Engineering and Environmental survey. Russian section of the offshore pipeline Nord Stream 2 AG. Book 4

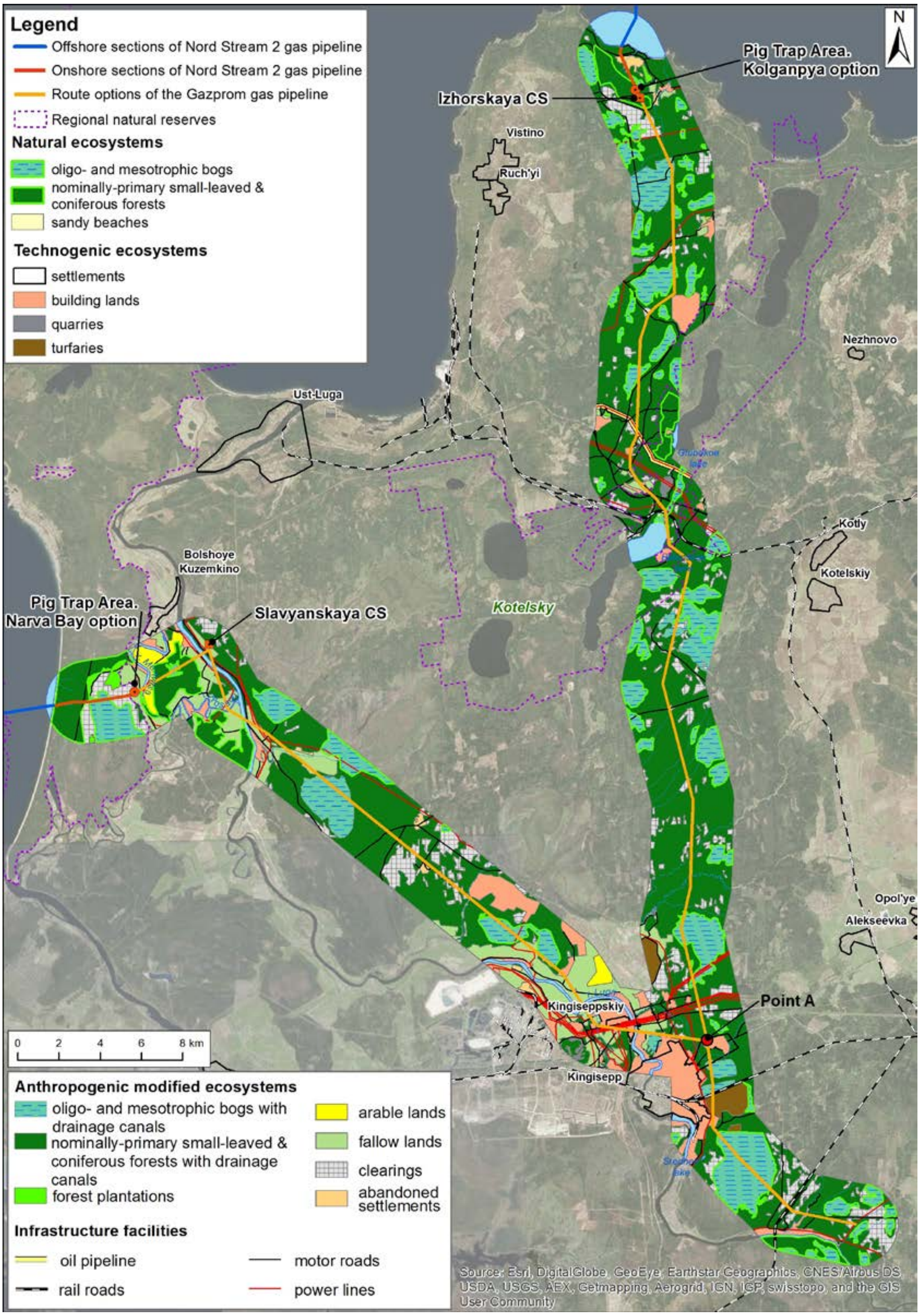

Figure 5-12 Landscape map and the degree of transformation of natural ecosystems

Approximately three quarters of the considered onshore supply pipeline route (Narva Bay option) passes through the following categories of protective forests:

- forests located in water protection zones;
- forests that protect natural and other objects (protective forest strips along roads);
- valuable forests (prohibited forest strips along water objects, forest spawning strips).

Approximately one quarter of the route passes through commercial forest.

Within the Kurgalsky nature reserve a significant area consists of modified habitats, which include agricultural land and disturbed areas (logging, burning) overgrown with small-leaved species.

Valuable habitats for terrestrial and aquatic biota, migration routes

Salmon

The Cape Kolganpya pipeline route alternative enters and then crosses the sea in an area where Atlantic salmon breeding adults and juveniles gather, occupying a section around the Soikinsky Peninsula[8]. Salmon come to spawn in the small Lovkolovsky and Gorkolovsky rivers, which are also crossed by the Cape Kolganpya route.

The Narva Bay route alternative crosses the Luga River, which is also a spawning area for Baltic salmon.

Small rivers and bodies of water

The Kolganpya route alternative crosses more small rivers and bodies of water than the Narva Bay alternative. The faunal assemblages of small rivers and swamps are quite rich and distinct in terms of species composition. Here can be found animals closely associated with the water: shrew, beaver, mink, otter, bats and woodcock.

The common crane can be found in the bogs, where young pine and capercaillie leks are widespread. In addition, birds such as the black grouse, capercaillie and ptarmigan, and mammals such as hares, bears and, occasionally, moose feed and rest in autumn and winter in the bogs.

5.5 Comparative assessment of the expected environmental impact during construction of the onshore section of the pipeline

5.5.1 Surface Waters

The impact on surface water bodies is determined by the following factors:

- transformation of various landscape elements within the watershed (small rivers are more sensitive to such transformations)
- water abstraction for domestic and industrial needs
- discharge of wastewater
- changes to the hydrological regime as a result of trenching and backfilling activities and drainage of roads and other features.

As the Cape Kolganpya pipeline route crosses a greater number of streams that are all small, the impact from this route alternative on surface water and stream biota will be more significant.

Impacts on groundwater may include:

[8] Conservation Atlas of the Russian section of the Gulf of Finland (Saint Petersburg, 2006)

- changes to the recharge, flow and discharge of groundwater as a result of disturbing the natural hydrogeological conditions;
- contamination of groundwater as a result of spillage of fuels or lubricants;
- indirect impact on recharging groundwater from cutting down forests and shrubs during the preparatory period (increased evaporation rates and reduced groundwater recharge).

Neither of the selected route alternatives are expected to have a significant impact on groundwater.

5.5.2 Geological environment and landscapes

Landscapes will undergo significant changes during project implementation. Landscapes within the construction site will be fully transformed; not only will the soil and plant cover be reduced but the original terrain will be changed and a new surface will be created. The lithogenous part and moisture conditions in secondary anthropogenic landscapes created in this way will be modified and secondary vegetative ground cover will be formed.

Preparatory and construction work will have an indirect impact on landscapes surrounding the construction site, as a result of short-term and local increases in the emission of pollutants and dust and the potential introduction of alien species of flora and fauna. In addition, changes to the topography may trigger exogenous processes in the surrounding natural landscapes.

As the onshore section of the Cape Kolganpya route alternative will be longer, it will have a greater impact on the geological environment and landscape.

5.5.3 Air quality

During the preparatory and construction activities, emissions of air borne contaminants are expected from construction machinery and this will lead to a localised increase of the concentrations of harmful substances in the atmosphere.

The following pollutants will enter the atmosphere during the construction work.

Activity	**Pollutants contained in the emissions**
Welding work at mobile stations	Hydrogen fluoride (HF), welding spray, which contains iron oxide (Fe_2O_3), manganese (Mn) and its compounds, in organic dust containing SiO2 70-20 %, fluoride (F^-)
Construction machinery and vehicles	carbon monoxide (CO), sulphur dioxide (SO_2), benzo(a)pyrene ($C_{10}H_{12}$), soot (C), volatile low and high molecular weight hydrocarbons
Grading works	dust, carbon dioxide (CO) and nitrogen oxides (NO_x)

Construction of the longer Cape Kolganpya alternative (99 km) with more rugged terrain conditions and a greater number of water crossings will take longer. Therefore, the Cape Kolganpya alternative will release a greater volume of pollutants into the atmosphere.

During the operational period, atmospheric emissions will be negligible and will be comparable for both alternatives.

5.5.4 Acoustic impacts

During construction, the main sources of noise impact will be construction machinery. There will be no difference in terms of the acoustic field generated around the construction site between the considered alternatives. However, the longer length of the pipeline for the Cape Kolganpya alternative will mean that the noise emissions will last longer and will affect a broader range of habitats.

5.5.5 Soils

The impact on the soil cover during construction will include:

- disturbed terrain and soil movement;
- full or partial destruction of the soil and plant cover;
- local pollution of the soil cover, which will impact on its biological activity;
- potential minor damage to the soil cover from moving equipment outside the site area.

After construction is completed, technical and biological reclamation of the areas will be performed; it is expected that the sections will become overgrown with natural grassy and arboreal shrubby plant cover.

The longer pipeline for the Cape Kolganpya alternative means that the soil impact will be more intensive than for the Narva Bay alternative, as result of a greater area of damaged soil and plant cover.

5.5.6 Flora

The main impact on plant cover when preparing the construction site is associated with site preparation, which involves cutting the vegetation and removing the topsoil.

Despite the planned reclamation activities, the following adverse impacts may occur:

- change to floristic diversity;
- reduction in the number of main (prevailing) species;
- loss of zonal features of flora and plant life;
- introduction of alien plant species from neighbouring regions.

As the onshore section of the Cape Kolganpya alternative route is longer, this will lead to a greater area of deforestation than for the Narva Bay alternative. The number of crossings of water protection zones and protective forests along the Cape Kolganpya route is also greater compared to the Narva Bay alternative.

5.5.7 Wildlife

Pipeline construction is expected to have the following main impacts on wildlife:

- disturbance caused by machinery noise and vibration;
- transformation of indigenous biotopes at selected sites through changes to plant associations, which could lead to changes in species and qualitative composition of animals;
- the death of animals (especially small ones) from collisions with moving machinery and other construction work;
- restricted movement of animals as a result of temporary and permanent habitat fragmentation.

The most intense impact on wildlife will occur during construction work, as this will involve a large number of people, machinery and equipment in a limited area and there will be an active impact on the soil and plant cover.

After constructions, the permanent fragmentation of forest habitats will lead to permanent impacts on the ability to fauna (especially small animals) to roam within the habitats.

A significant part of the Cape Kolganpya route alternative affects valuable animal and bird habitats. The greater length of the Cape Kolganpya route alternative may create a more significant impact on the terrestrial and aquatic biota than the Narva Bay alternative.

5.5.8 Impact on special protected areas and rare species

As shown in previous sections, both pipeline route alternatives cross a Special Conservation Area:

- The Cape Kolganpya alternative crosses the Koporski Bay IBA;
- The Narva Bay alternative crosses the Kurgalsky Peninsula Ramsar wetland.

Both alternative routes will affect special conservation areas. The impact of the Cape Kolganpya alternative on special protected area will, however, be more significant for the following reasons:

- the pipeline route crosses the central part of the Kotelsky nature reserve, which will involve further fragmentation of the land;
- the route crosses a large forest within the nature reserve.

Impact on special protected areas from the Narva Bay alternative will be less for the following reasons:

- the planned pipeline route will cross the nature reserve through its least valuable section: the most valuable bird and marine mammal habitats, broad-leaved forests and lakes are found in the north of the Kurgalsky Peninsula at a great distance from the pipeline route;
- more than 50% of the landscape for the pipeline corridor within the protected area is farmland or modified habitat.

5.5.9 Conclusions regarding the onshore section

Data presented in sections 5.4 - 5.5 allow to conclude that the Narva Bay route in general is characterized by relatively smaller environmental risks and has less environmental constrains.

5.6 Comparative assessment of the expected environmental impact on vulnerable population groups and sites of cultural heritage in the Project area

Both route alternatives are located within the Kingisepp District of the Leningrad Region. A preliminary assessment of the baseline social and economic conditions identified the following features that should be taken into account during Project implementation (Figure 5.13):

- Indigenous minorities living in the territory of Vitinskoe and Kuzemkinskoe rural settlements;
- Sites of historical and cultural heritage.

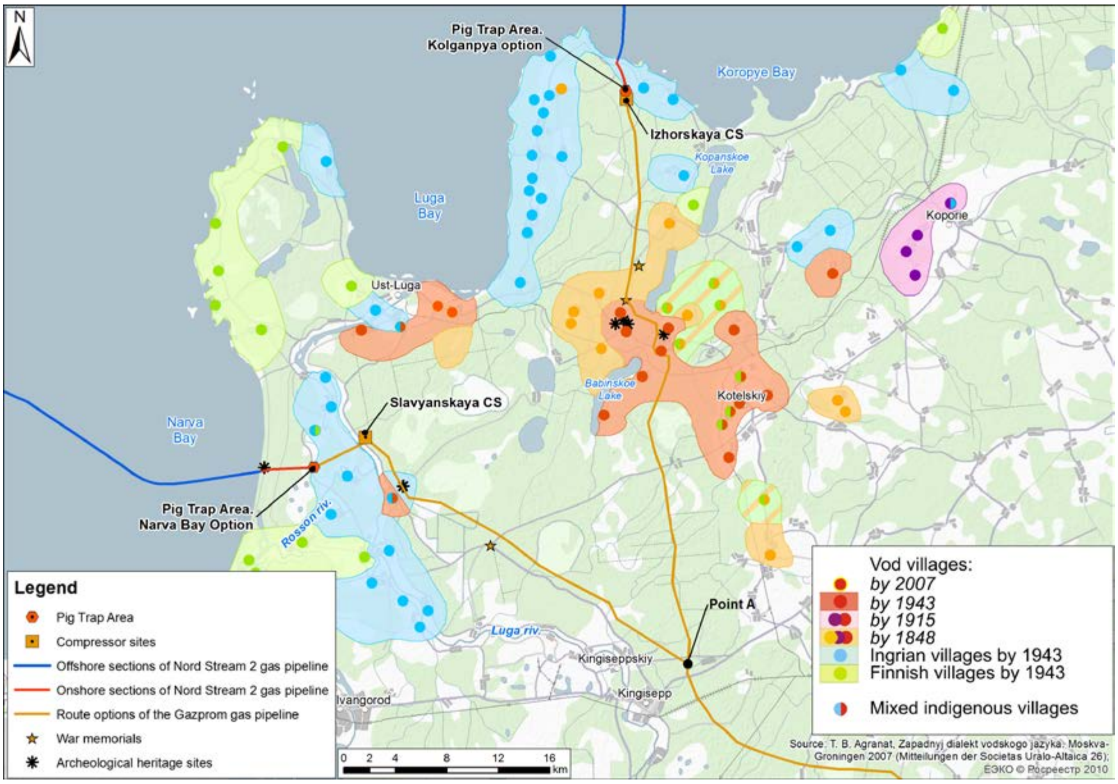

Figure 5.13 Location of indigenous people settlements and objects of social and cultural heritage within the area of alternative pipeline routes

5.6.1 Indigenous minorities

Indigenous minorities currently living in Kingisepp district consist of Izhorian and Vote nationalities. According to the Russian Federation national census of 14-25 October 2010, the total population of Votes was 11 in the Ust-Luga rural settlement (Ust-Luga and Luzhitsy villages), which is not affected by either of the Project's onshore pipeline laying route alternatives.

The characteristics of the Izhorian population, based on the above mentioned census, are shown in the Table 5-4.

Table 5-4 Settlement of the Izhorians in Kingisepp district, Leningrad Region according to the census of 14.10.2010

Rural Settlements	Population	Izhorians	Percentage of Izhorians, %
Kuzemkinskoe	**1327**	**7**	**0.5**
Vanakulya (Ilkino)	22	2	9.1
Ropsha	106	5	4.7
Vistinskoe	**1748**	**106**	**6.1**
Vistino	821	35	4.3
Valyanitsy	87	4	4.6
Glinki	48	9	18.8
Koskolovo	32	4	12.5
Krasnaya Gorka	5	4	80.0
Logi	70	5	7.1
Mishino	42	4	9.5
Novoe Garkolovo	7	4	57.1
Pakhomovka	43	10	23.3
Ruchyi	337	11	3.3
Slobodka	35	7	20.0
Smenkovo	7	5	71.4
Yugantovo	56	4	7.1
Ust-Luga**	**2835**	**5**	**0.2**
Ust-Luga	2365	5	0.2

Rural Settlements	Population	Izhorians	Percentage of Izhorians, %
TOTAL	**5910**	**119**	**2.0**

The main traditional business of the Soikinsky *Izhorians* in the 20th century is fishing: at sea during the summer months and from the shores or in inland waters during the colder seasons.

In 2005, the Community of Izhorian Minorities SHOYKULA was founded in Soikinsky rural settlement. The community is not only a form of self-government for the Izhorians, but also for people who do not belong to a national minority but have permanent residence in places where the Izhorians traditionally live and work that are united by territorial and neighbouring features. The community operates in Soikinsky administrative district, Kingisepp district, Leningrad Region and includes approximately 100 people. According to the Charter adopted in 2005, the main objectives of the Community are to protect the habitats and ecosystems of the Soikinsky Peninsula: preserve, revive and develop fishing, and to process and sell products of traditional industries (fishing). The Community also seeks to preserve Izhorian history, culture, language, traditions, ethnography and folklore and contributes to the study of Izhorian heritage.

It should be noted that even today, the older generation clearly identify themselves as Izhorians, despite 20th century assimilation processes, and most of them speak Izhorian. Young people, with rare exceptions, only speak Russian. Nevertheless, the local population upholds the tradition of the Soikinsky Peninsula as an ancient Izhorian area.

Most Izhorian communities are located along the Kolganpya alternative route which is therefore more vulnerable in terms of potential impact on the traditional Izhorian lifestyle.

5.6.2 Historical and cultural heritage

The Cape Kolganpya pipeline route alternative passing through the Soikinsky Peninsula is also more vulnerable in terms of the potential impact on historical and cultural heritage. The considered route crosses a large number of territories previously densely inhabited by the Vote people. In addition, historical and cultural heritage sites have already been recorded in this area (near the village of Mattia). Therefore, additional discoveries can be expected during construction of the pipeline.

The Narva Bay alternative is shorter and crosses a small area previously densely inhabited by Izhorians in the area of the Luga and Rosson rivers where a number of stone age sites have been discovered.

5.7 Conclusions

As a result of the comparative assessment of the two preferred alternatives, it has been determined that the Narva Bay pipeline route has the least environmental restrictions and risks. Specifically:

- The vulnerability of ecosystems as well as individual components of biodiversity and aquatic biological resources in the area of the Narva Bay route is lower than for the Cape Kolganpya option;
- The expected level and scale of impacts on all environmental and social components in the Narva Bay is predicted to be significantly lower than for the Cape Kolganpya option;

- The Narva Bay option would provide significantly less risk for pipeline construction and operation and therefore a much lower probability of accidental events.
- The following aspects are the most important environmental benefits in the offshore section that derive from selecting the Narva Bay option over the Cape Kolganpya option:
- The total volume, and therefore duration, of required dredging and seabed intervention works for the Narva Bay option is significantly less than for the Cape Kolganpya option.
- The impact on the marine environment for the Narva Bay option will be significantly less than for the Cape Kolganpya option: the extent of sediment dispersion for the Narva Bay option is much lower than for the Cape Kolganpya option; known contamination of the seabed sediments is lower and the duration of the activities that would lead to turbidity is also much shorter.
- The impact on valuable biological sites for the Narva Bay option is lower than for the Cape Kolganpya option, in particular:
    - the average distance from the route to important bird areas and ringed seal haul-outs is double; the distance to grey seal haul-outs is one and a half times greater;
    - the zone of air pollution impact on important bird areas in the waters, on grey seal haul-outs and ringed seal haul-outs is smaller;
    - the zone of hydroacoustic impact on marine mammals when laying the pipeline in the sea is much reduced;
    - the area of ringed seal and grey seal haul-outs within the strong and moderate hydroacoustic impact zone is reduced.

The environmental and social impacts associated with the onshore pipeline system that is required to supply the compressor station would also be greater along the Cape Kolganpya option because of its encroachment of the Kotelsky state complex nature reserve.

In the Narva Bay option, the route crosses the southern section of the regional Kurgalsky state complex nature reserve. The nature reserve is a wetland of international importance, included in the list of Baltic Sea territories protected under HELCOM. However, the proposed Nord Stream 2 system crosses the least valuable part of the nature reserve/wetland: all biological components protected by the nature reserve are located in the northern part of Kurgalsky Peninsula, on nearby islands and on the so-called Kurgalsky reef, and are not affected by the route.

A large part of the corridor (2.3 km) occurs within modified habitats that are not of high value in terms of the territory’s biodiversity conservation.

The large swampland (Kader swamp) is only slightly affected by the route in its northern, most marginal section.

The most valuable natural habitat that occurs along the Narva Bay onshore route is a waterlogged coastal spruce forest, which the pipeline system encroaches on, over a distance of less than 2km.

The analysis of all potential Nord Stream 2 gas pipeline routes shows that only the Narva Bay option is technically feasible and preferable regarding potential impacts on the environment, local communities and social conditions.