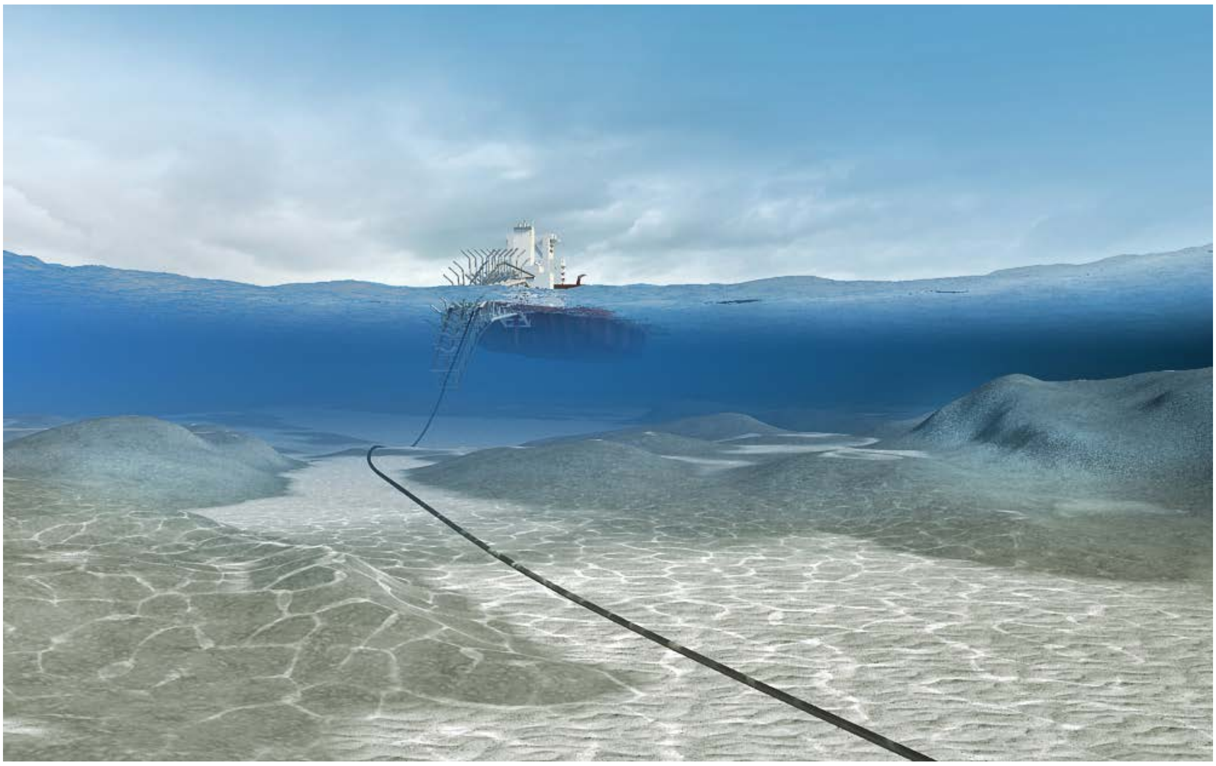

# BALTICCONNECTOR

## Natural gas pipeline between Finland and Estonia

2015

Environmental impact assessment report

Finland

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The EIA report and related material are available online at http://www.balticconnector.fi

The project's EIA report for Estonia is available in English at http://www.balticconnector.fi

# FOREWORD

Gasum Corporation (hereinafter Gasum) and the Estonian company AS EG Võrguteenus (hereinafter Võrguteenus) are jointly planning the Balticconnector natural gas pipeline to interconnect the Finnish and Estonian natural gas distribution networks.

The environmental impact assessment (EIA) procedure for the project has been conducted in both countries in compliance with national legislation. The procedure has involved the production of separate environmental impact assessment reports (EIA reports) in Finland and Estonia. The EIA reports for the project were drawn up by Pöyry Finland Oy and the EIA programs by Ramboll. Information provided in the EIA program has, as applicable, also been utilized in the EIA reports.

This report is the EIA report for Finland presenting and comparing the environmental impacts in the Gulf of Finland and Finland in particular of the alternatives presented in the Environmental Impact Assessment Program. Appended to the report (Appendix 4) is a summary of the project's key impacts in Estonia. The full EIA report for Estonia is available in Estonian and English on the Gasum website *(www.balticconnector.fi)*. Due to the international dimension of the project, the EIA procedure has also been carried out in compliance with the UNECE Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) and the bilateral Agreement between Finland and Estonia on Environmental Impact Assessment in a Transboundary Context. The EIA reports for the project were drawn up by Pöyry Finland Oy and the EIA programs by Ramboll. Information provided in the EIA program has, as applicable, also been utilized in the EIA report.

The aim of the environmental impact assessment was to examine the project's environmental impacts concerning the entire planned natural gas pipeline routing and related activities. The EIA procedure covers the natural gas pipeline route from Ingå, Finland, to Paldiski, Estonia. The examination of the pipeline route in Finland and Estonia covers the routing alternatives proposed.

The Balticconnector natural gas pipeline project aims to considerably improve regional access to and supply security of natural gas and promote the reliability of natural gas distribution in different circumstances in Finland and the Baltic states. The Balticconnector natural gas pipeline project is categorized as a priority project in the guidelines for trans-European energy networks (TEN-E) and has been granted financial assistance by the EU. The Balticconnector is also included in the EU's list of Projects for Common Interest (PCI) published in autumn 2013, and the related applications for EU support were submitted in 2014.

The Balticconnector natural gas pipeline will be connected to the existing gas network in Finland and Estonia and to the LNG terminal planned for construction in Ingå, Finland. The LNG terminal development project is also currently underway. The Balticconnector will enable a bidirectional flow of natural gas between Finland and Estonia.

The Balticconnector natural gas pipeline project was one of the mini pilot projects of the IMPERIA project co-funded by the EU (http://www.imperia.jyu.fi). The multi-criteria decision analysis (MCDA) practices and tools developed in the IMPERIA project were employed as appropriate in the assessments of environmental impacts and their significance in Finland and Estonia.

Gasum Corporation, Espoo, April 2015

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The separate reports produced during the project's EIA procedure are available on the Gasum website (http://www.balticconnector.fi).

# EIA WORKING GROUP

This environmental impact assessment report was compiled by the consultant Pöyry Finland Oy. A large group of experts from Finland and Estonia also participated in the impact assessment work. The experts of the EIA working group are presented in the table below for both the Finnish and the Estonian impact assessments.

| | Finnish EIA working group | Estonian EIA working group |
|---|---|---|
| **Project leader** | Terhi Rauhamäki, MSc (Pöyry) | |
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| **Nature** | Soile Turkulainen, MSc (Pöyry)<br>William Velmala, MSc (Pöyry) | Natalja Kolesova, BSc (Marine Systems Institute at TUT)<br>Inga Lips, PhD (Marine Systems Institute at TUT)<br>Lauri Klein, MSc (OÜ Tirts & Tigu) |
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| | Finnish EIA working group | Estonian EIA working group |
|---|---|---|
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| **Noise** | Carlo Di Napoli, MSc (Pöyry) (onshore noise)<br>Janek Laanearu, PhD and Aleksander Klauson, PhD (Department of Mechanics, Tallinn University of Technology) (underwater noise)<br>Thomas Folegot, PhD (Quiet Oceans) (underwater noise) | |
| **Air quality** | Mirja Kosonen, MSc (Pöyry), Jüri Teder (OÜ Entec Eesti) | |
| **Exceptional and accident situations** | Mirja Kosonen, MSc (Pöyry) | |
| **Traffic, traffic safety** | Anna-Katri Räihä, MSc (Pöyry)<br>Jaakko Kettunen, MSc (Pöyry) | Taavi Liblik, PhD ( Marine Systems Institute at TUT)<br>Germo Väli, PhD (Marine Systems Institute at TUT) |
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| **Land use, landscape and cultural heritage** | Saija Miettinen-Tuoma, MSc (Ramboll)<br>Mariikka Manninen, MSc (Landscape Archit) (Ramboll) | Kerttu Kõll, BA (OÜ Entec Eesti)<br>Kaur Lass, MA (OÜ Head) |
| **People and society** | Jari Laitakari, eMBA (Pöyry)<br>Ville Koskimäki, MSc (Pöyry) | Kaur Lass, MA (OÜ Head) |
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| **Decommissioning** | Terhi Rauhamäki, MSc (Pöyry) | |
| **Zero alternative** | Terhi Rauhamäki, MSc (Pöyry) | |
| **Geographic information, maps** | Jari Ruohonen, MSc (Tech) (Pöyry) | Kerttu Kõll, BA (OÜ Entec Eesti) |

# SUMMARY

In early 2014 an environmental impact assessment (EIA) procedure was launched by the Finnish Gasum Corporation and the Estonian AS EG Võrguteenus concerning the construction of a natural gas pipeline between Finland and Estonia. The Balticconnector natural gas pipeline project aims to considerably improve regional access to and supply security of natural gas and promote the reliability of natural gas distribution in different circumstances in Finland and the Baltic states.

The purpose of the EIA procedure was to assess the project's environmental impacts and increase the project's openness and stakeholder interaction. This EIA report covers the preliminary route of the offshore Balticconnector natural gas pipeline from Ingå, Finland, to Paldiski, Estonia, and the related routing alternatives in Finland. The routing alternatives for the Paldiski area are covered by the EIA report for Estonia, which is available in English on the Gasum website (*http://www.balticconnector.fi*). The most significant environmental impacts of the routing alternatives in Estonia are also described in Appendix 4 of this EIA report.

The contents of this EIA report by chapter are shown in the table below.

| EIA report chapter | Chapter contents in brief |
|---|---|
| **1. Project** | The purpose of the chapter is to present the project. A brief description of the Project Developers, their business activities and position from the project perspective as well as backgrounds and purpose of the project is provided. The chapter also presents the project schedule and the relationship of the project with other projects.<br><br>The chapter covers the previously studied routing alternatives, the selection of the current route, and the alternatives assessed in the EIA procedure. |
| **2. Environmental impact assessment procedure** | The chapter describes the EIA procedures carried out for Finland as well as Estonia taking the requirements of international consultations and the bilateral agreement between the countries into consideration.<br><br>The chapter covers the content and schedule of, parties to as well as communications and participation relating to the EIA procedure. The statements and opinions received on the EIA program are also covered in the chapter. |
| **3. Technical description of the project** | The chapter describes the phases, procedures and technical data relating to project design, construction and operation. |
| **4. Licenses, permits, plans and decisions required for the project** | The licenses, permits, plans and decisions required for the project are described in the chapter. |
| **5. Project's relationship with programs concerning the use of natural resources and environmental protection** | The chapter presents the key plans and programs concerning the use of natural resources and environmental protection, including national target programs as well as international commitments, from the project's perspective. |
| **6. Starting points of the environmental impact assessment** | The chapter describes the starting points of the EIA and covers the scoping, significance and extent of the environmental impacts in general.<br><br>In the assessment work, the multi-criteria decision analysis (MCDA) practices and tools developed in the EU LIFE+ IMPERIA project (presented in chapter 6) were employed as appropriate in the assessment of the significance of the environmental impacts. |
| **7. Current status of the environment** | The chapter describes the current status of the environment as regards the Gulf of Finland and Ingå, Finland. |
| **8. Assessment methods and the environmental impacts assessed** | The chapter presents the assessment methods employed in the assessment and the uncertainties relating to the assessments conducted.<br><br>The chapter also presents the results of the impact assessment by environmental impact, including the impacts of the zero alternative, cumulative impacts with other known projects, impacts of project decommissioning and transboundary impacts. A summary of the significance of the impacts and comparison between alternatives is also provided in conjunction with assessment results.<br><br>The chapter further describes the means and ways that can be employed by the Project Developers in subsequent project phases to prevent or mitigate any adverse impacts caused by the project and assessed in the EIA report. |
| **9. Comparison between alternatives** | The chapter describes the principles, phases and results of the comparison carried out between the alternatives. The chapter aims to also provide the reader with a clear idea of the feasibility of the alternatives and of how the comparison between the alternatives was carried out and what its results are based on. |
| **10. Environmental impact monitoring** | The chapter describes the plans made by the Project Developers for environmental impact monitoring during and after the project. |

### Application and stages of the EIA procedure

The offshore natural gas pipeline will enable the transmission of natural gas between Finland and Estonia. Due to the international dimension of the Balticconnector project, two main international procedures are applied to the project: the UNECE Convention on Environmental Impact Assessment in Transboundary Context (Espoo Convention) and the bilateral Agreement between Finland and Estonia on Environmental Impact Assessment in a Transboundary Context.

The need for the assessment of the project's environmental impacts for Finland is based on the Act on Environmental Impact Assessment Procedure. The Balticconnector project is not included in the list of projects provided in section 6 of the Finnish EIA Decree, but the EIA procedure is applied to the project in accordance with a decision made by the Ministry of the Environment.

The EIA procedure for Finland comprises two stages. Firstly, an environmental impact assessment program was prepared. This is a plan specifying which impacts will be assessed and how they will be assessed. The Project Developer submitted the EIA program to the coordinating authority, the Uusimaa Centre for Economic Development, Transport and the Environment, on January 27, 2014. The coordinating authority gave notification of the public display of the EIA program in media including local newspapers and its website. The EIA program was on display for statements and opinions between February 10 and April 7, 2014. The coordinating authority made a summary of opinions and statements provided and issued its own statement regarding the program on May 7, 2014 (Appendix 1).

The report proper concerning the project's environmental impacts – the EIA report – was produced in the second stage of the EIA procedure. The EIA report was prepared on the basis of the EIA program and the opinions and statements provided concerning the program. Investigations for this EIA report commenced in spring 2014, and the report was submitted to the coordinating authority in April 2015. The work was guided by the statements and opinions received during the program stage as well as comments provided at public consultations. The contents of the EIA report were also affected by the comments on the draft report made by the EIA monitoring group.

Citizens and various stakeholders may express their opinion about the EIA Report within the period of time specified by the coordinating authority. The EIA procedure ends when the coordinating authority provides its statement on the EIA Report. The EIA report as well as the stakeholder interaction carried out and the material acquired during the EIA procedure will provide important support to more specific planning and design concerning the project.

### Project description and alternatives assessed

In addition to the entire pipeline route, the following alternatives were examined in the environmental impact assessments conducted (Figure 0–1):

#### In Finland

- **Alternative FIN 1 (ALT FIN 1):** Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Ingå, Finland, to Paldiski, Estonia, route north of Stora Fagerö.
- **Alternative FIN 2 (ALT FIN 2):** Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Ingå, Finland, to Paldiski, Estonia, route south of Stora Fagerö.

#### In Estonia

- **Alternative EST 1 (ALT EST 1):** Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Ingå, Finland, to Paldiski, Estonia, with the point of landfall in Kersalu, Estonia.
- **Alternative EST 2 (ALT EST 2):** Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Ingå, Finland, to Paldiski, Estonia, with the point of landfall in Pakrineeme, Estonia.

In addition, two alternative points of landfall in Finland and the respective natural gas pipeline routings in Ingå were examined:

- **Landfall 1 (LF1):** Landfall of the Balticconnector natural gas pipeline north of the Fjusö Peninsula in the Bastubackaviken Bay area.
- **Landfall 2 (LF2):** Landfall of the Balticconnector natural gas pipeline on the Fjusö Peninsula.

A situation where the Balticconnector natural gas pipeline will not be constructed was assessed as the zero alternative.

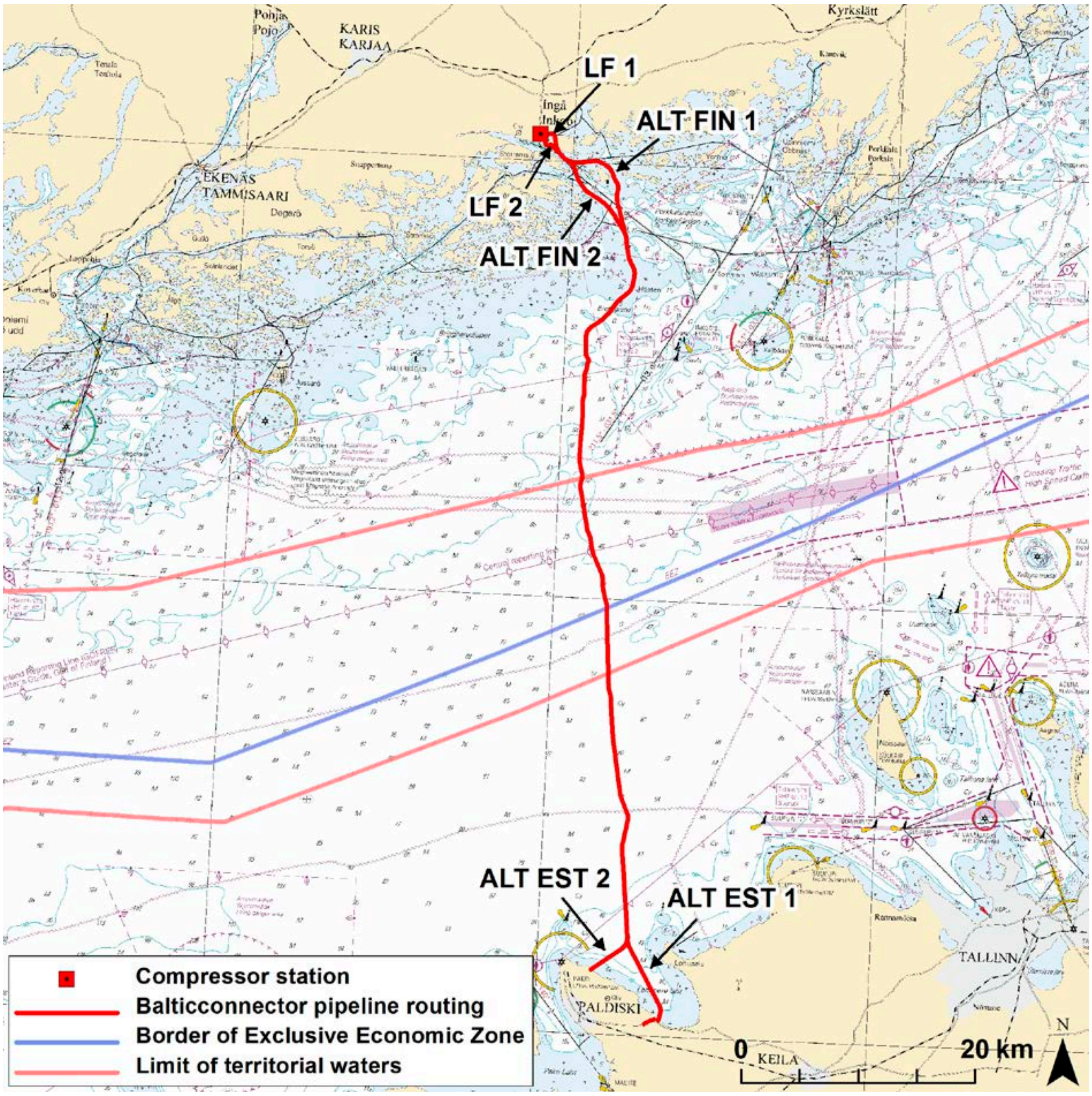



Figure 0–1. The routing alternatives of the Balticconnector natural gas pipeline.

### The most significant environmental impacts

The most significant environmental impacts of the project will arise during the construction of the natural gas pipeline. Adverse impacts during pipeline operation will be of lower significance. Impacts identified as the most significant impacts during construction are impacts on the seabed, water quality, the marine environment, flora and fauna.

According to preliminary calculations and plans, a significant amount of seabed intervention measures (dredging, ploughing or jetting, underwater blasting and subsea rock installation) will be required for pipeline protection and freespan rectification. The actual need for seabed intervention will be specified further once progress is made in technical project design, with the need for intervention for each pipeline section likely to be reduced below the level presented in this EIA report. The environmental impact assessments conducted are based on conservative assessments concerning project measures, and efforts have been made to conduct them on the basis of the worst-case scenarios.

### Impacts during construction

#### *Offshore areas*

For the purpose of environmental impact assessment, the suspended solids load caused by natural gas pipeline construction work was modeled using a mathematical

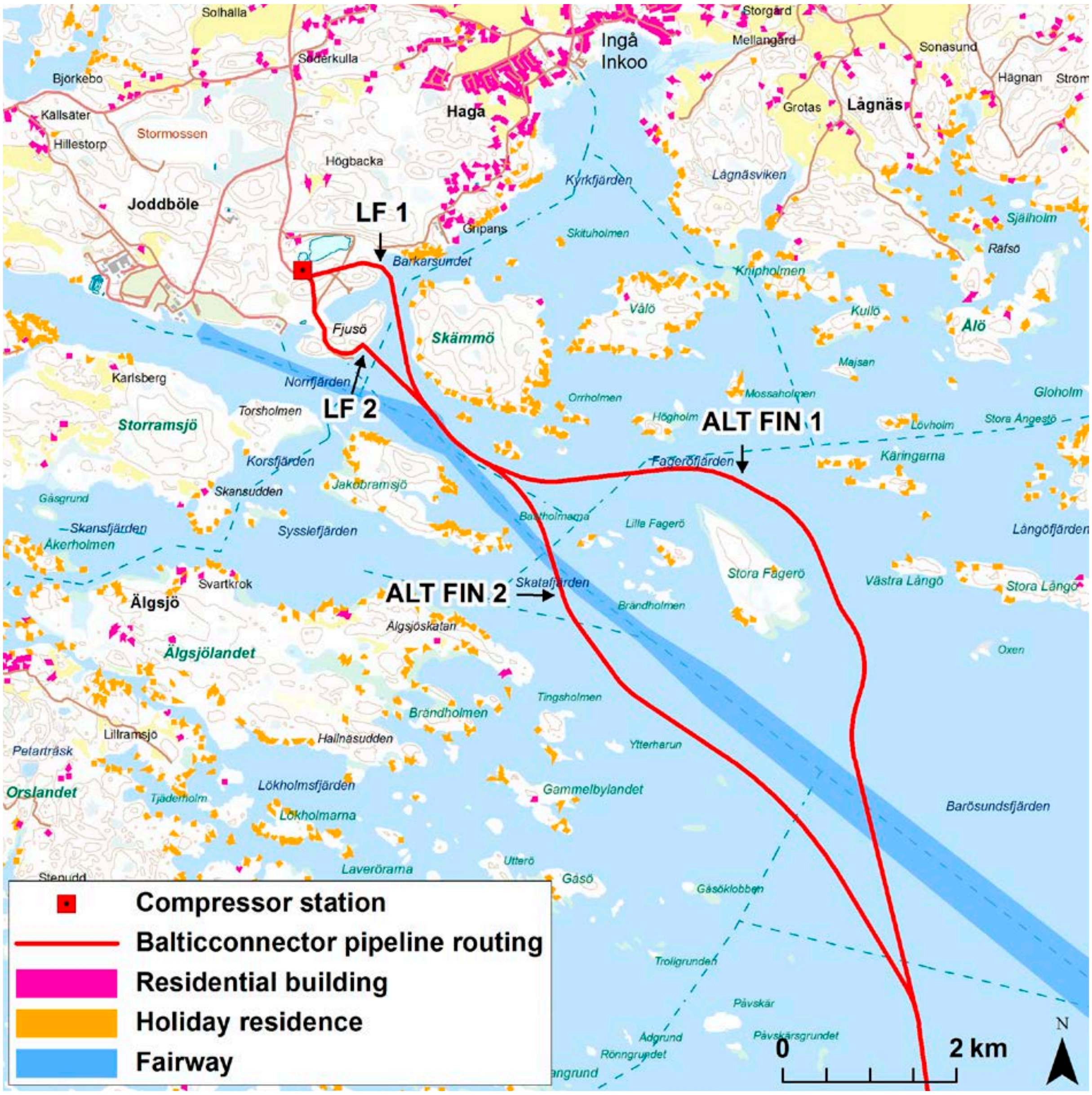



Figure 0–2. The routing alternatives of the Balticconnector natural gas pipeline in Finland.

model on water movements and the migration of substances. The amount of seabed intervention required during construction will be relatively small in the offshore areas of western Gulf of Finland, with the impacts on water quality in these areas being very low due to the large volumes of water, efficient exchange of water and lesser nature values. The affected area is estimated to extend approximately to a maximum of 1 km from the pipeline. Turbidity and accumulation areas as well as impacts on marine environment will be clearly lower than in near-shore areas. Harmful substances are likely to be dispersed with suspended matter along the flow directions but to be eventually resedimented with the solids.

Impacts on water bodies were also found to be temporary, local and low in the environmental monitoring carried out during the construction of the Nord Stream gas pipeline project. In offshore areas the duration of noise and other disturbances will also be shorter than in archipelago areas as construction work will progress faster further off the shore.

Where permitted by the ice situation, some birds, seals and occasionally also harbor porpoises are found in the open sea areas of the Gulf of Finland. No particularly important feeding areas attracting large numbers of individuals are known in the area covered by the natural gas pipeline project. Among birds, Anseriformes in particular prefer feeding in shallow areas very rarely found in open sea areas. The impacts of offshore turbidity on bird fauna are likely to be low since the impacts on fish, bivalves and other small fauna that they feed on are estimated to be very local and short-term. Deep-bottom zoobenthos will be destroyed almost all the way underneath the pipeline, but on the whole the natural gas pipeline is not estimated to pose a major risk to offshore soft-bottom benthic communities which, due to the poor oxygen situation, are quite non-diverse and have good recovery potential.

Fish populations are impacted particularly by underwater explosions, which result in behavioral changes over several kilometers and risk of injury up to hundreds of meters from the blasting site. Demersal fish are also affected by changes in the benthos, which may have either negative or positive impacts depending on the species of fish. No significant fish spawning areas can be found in the offshore zone of the project area. The impact on fisheries is reduced by the fact that the impact focus will be on mature fish.

Adverse effects on fishing in the offshore areas of the Gulf of Finland will mainly be caused by the prevention of trawling in the project area during construction. Fishing vessels operating in the area will be disturbed by increased vessel traffic, seabed intervention work, pipelaying as well as pipeline protection measures. In the Gulf of Finland however, where fairway crossings take place in the open sea, the impacts on other vessel traffic will be low as there will be plenty of space around the safety zone of the pipelaying vessel for diversionary routes, resulting in only short detours.

The risks relating to the construction of the natural gas pipeline are low. The most significant risks comprise the collision of installation vessels participating in pipelaying with other vessels as well as any munitions and barrels containing hazardous substances found in the seabed in the construction area. The prevention of safety incidents is the primary goal set for planning. Planning will take place in compliance with legislation as well as safety and occupational health and safety rules. Efforts will be made to prevent vessel collisions and groundings through traffic control. The disposal of munitions and barrels will be negotiated with the relevant national authorities.

### *Coastal areas*

According to assessments made on the basis of the results of water system modeling carried out off Ingå, turbidity caused by the various phases in the construction of the natural gas pipeline will be relatively low. The biggest impacts will be seen near the coast where flow rates are lower and exchange of water slower than in offshore areas. Ploughing is the method causing the highest levels of turbidity. Changes in wind direction will create a potential impact area around the construction site, the extent of which as well as the dispersal direction of turbidity will vary depending on the wind and flow situation. The division of the work into stages will result in repeated turbidity bursts varying in locations occurring throughout the construction period. Sediment accumulation will increase during the work but will remain small in quantity due to the short duration.

According to preliminary construction method plans, extraction through blasting will take place in several locations. An explosion generates a rapid increase in pressure, a blast, which is followed by a rapid decrease in pressure. The turbidity cloud created will move with currents. The material is mostly minerals, whereby it will settle quite quickly. Due to their very brief duration, the water quality impacts of turbidity clouds are assessed to be low in comparison with impacts including those of dredging and ploughing. The impacts of blasts are the highest on aquatic organisms.

Sediment mixing may result in the release of pollutants into seawater, and these may end up in body systems of animals and in food chains. According to the results of sediment sampling, however, the concentrations of metals and organic compounds are low and remain below the reference values determined on the basis of ecological criteria. Pollutants will be dispersed with turbidity but are likely to be eventually resedimented with the solids.

Birds nesting on islets near the pipeline routing alternatives may experience significant temporary disturbance to food sourcing if turbidity is high and occurs during their breeding season. Overall the impact is, however, assessed as low because the turbidity will be short-term and only take place in a small area at a time. As regards fish, significant impacts during construction were assessed to occur in situations where there are adverse effects on fish spawning areas, spawning or fry. In these respects the most significant impacts will be targeted at the inner archipelago (spring-spawning fish species, possibly some species seeking to spawn in rivers) as well as middle and outer archipelago (Baltic herring, *Clupea harengus membras*, and the sea-spawning European whitefish, *Coregonus lavaretus*) of Ingå. The adverse effect caused by fish being driven away will be temporary and can be addressed through compensations to commercial fishers. Any impacts on fish breeding areas will, however, result in permanent adverse effects.

Vessel traffic during the construction of the Balticconnector pipeline will contribute to the impacts of vessel traffic near the islands by the pipeline route and the areas close to the Ingå fairway. Bird populations in the archipelago of the Stora Fagerö area in particular will be subjected to the impacts of noise and other disturbances because the planned routing alternatives run close to nesting islets. The impacts of above-water noise on birds will, however, overall be low. Any damaging impact of underwater noise is likely to affect only a small number of individuals (such as birds, harbor porpoises and seals), and therefore the impacts of underwater noise are also assessed as low concerning animals in the area. In the worst cases, however, underwater noise may injure individual marine mammals. Therefore measures mitigating the impacts of pressure waves must be employed in blasting work in order to prevent injuries in marine mammals.

Vessel transport during construction involves the regular shipping risks, such as the risk of oil spill or introduction of non-indigenous species. The risk of introduction of non-indigenous species is low in conjunction with the project as transport will take place locally. Vessel traffic also causes nitrogen oxide, sulfur dioxide, particulate and carbon dioxide emissions, but their impact in the project will be low in comparison with other waterborne transport. Considering the volumes transported by the vessels, the impacts of increased vessel traffic are estimated to be low on the whole.

The impacts on people and society will focus almost entirely on the period of natural gas pipeline construction. The adverse effects caused by the construction of the natural gas pipeline will, however, be non-persistent by nature, whereby the impact will not last for a long time. Compared with the current situation, some work conducted during construction may to some extent cause annoyance. Human perception of adverse effects or their impacts on amenity and living conditions depends on the individual. The most significant impacts will be related to temporary noise disturbance in marine and land areas and increases in vessel traffic during construction. Short-term turbidity in water areas close to the offshore pipeline may cause minor adverse effects on the recreational use of the areas during construction.

### Impacts during operation

The Balticconnector natural gas pipeline will cover a strip of the seabed in the Gulf of Finland. The pipeline and the subsea rock berms protecting it will form a protrusion from the seabed in many places. In normal situations there will be no impact on water quality during the operation of the natural gas pipeline. During operation, the impacts of the pipeline on the marine environment will mainly be restricted to minor flow amendments due to morphometric changes caused by the pipeline itself and its construction (covering and protection) in areas near the pipeline, such as increased turbulence around the pipeline at faster bottom flow velocities. Changes in flow velocities and directions may affect the transport and accumulation of materials in the close vicinity of the pipeline. According to measurements carried out for the Nord Stream project, the impacts only extend up to tens of meters from the pipeline.

The overall impacts during the operation of the natural gas pipeline in the archipelago and marine area will be low. Periodic inspections and servicing and maintenance tasks may cause minor disturbances to birds and marine mammals, but these will not differ from the disturbances caused by other movement in the area. Pipeline maintenance measures will include the addition of soil around the pipeline wherever necessary. Such measures may contribute toward changes in near-bottom flows as well, whereby changes in flows may cause changes in erosion or sediment accumulation in nearby areas.

Flora in the onshore gas pipeline work area will be allowed to restore naturally following pipeline construction. An area along the line of the pipe that is approximately 5 m in width will be kept treeless and cleared of shrubbery. Impacts during operation on flora and fauna will be restricted to the cleared zone and areas near it, but changes will take place in species composition from the current situation. An increase in flora such as grasses and sedges and a decrease in herb-rich forest plants are likely to be seen in the cleared zone. The edge effect will not extend very far into the environment, and the zone that is kept clear of trees and shrubbery will not restrict the movement of animals or cause significant habitat changes for breeding birds.

The compressor station can be powered by electricity or natural gas. If powered by electricity, there will be no local flue gas emissions from the compressor station. A natural gas-fueled compressor station will generate small amounts of carbon dioxide ($CO_2$), nitrogen oxides ($NO_x$) and water vapor. The combustion of natural gas does not result in any sulfur dioxide of particulate emissions. According to calculation results, noise impacts during compressor station operation will be low and very local.

Possible damage to the gas pipeline and resulting pipeline malfunction could have consequences to human safety. The risk assessment conducted for the Balticconnector project (*Ramboll 2014b*) identified the sections where the pipeline must be protected to prevent pipeline damage Maintenance management of the natural gas pipeline will be carried out to ensure the pipeline will be kept in good working order and will not face an external risk (with the biggest risk being mechanical pipeline damage caused by an outsider).

### Transboundary impacts across the borders of Finland

The Balticconnector project is not estimated to cause significant transboundary impacts across the borders of Finland. The pipeline will extend across western Gulf of Finland to Estonia, whereby construction work in Finnish waters may result in low impacts in Estonia's territorial waters. No impacts are estimated to occur on other Baltic states.

The deterioration of water quality arising from seabed intervention relating to the construction of the natural gas pipeline will be restricted in terms of area and duration. Offshore impacts on western Gulf of Finland will be low due to the large volumes of water and, on the other hand, the smaller scale of the marine works carried out. Due to the large water depth and the stratification of the water column in this area, the impacts will not in practice reach the surface layer. According to preliminary plans, there will be low levels of construction carried out in Finland's Exclusive Economic Zone (EEZ) south of Kilometer Post (KP) 34. The marine works carried out in Finland's EEZ and turbidity arising from these will not cause any significant adverse effects in Estonian EEZ or territorial waters. The contaminant contents found in sediment samples obtained from the Balticconnector pipeline route were also low, and their distribution with solids during construction is not likely to pose a risk to the marine environment in Estonian EEZ or territorial waters. The Balticconnector project will not have significant transboundary impacts on water quality regardless of whether construction is carried out in Finnish or Estonian waters. Any low impacts taking place will be short-term and local.

Gas pipeline project activities taking place within Finnish waters during construction or operation are not estimated to have significant transboundary effects on flora, birds, marine mammals or fish in Estonian waters either. Underwater blasting causes brief and high levels of sound pressure transported over distances of tens of kilometers. Underwater blasting will take place in Finnish as well as Estonian waters. The number of blasting sites will, however, be higher on the Finnish side. The nearest blasting site is located around 3 km from the border of Estonia's EEZ. As the distance from the blasting site increases, the impacts are reduced as the intensity of the sound decreases. Underwater noise from seabed dredging and possible blasting explosions may be carried from Finnish waters to Estonian waters, whereby seals or harbor porpoises in the area may hear sounds caused by blasts. Due to the distance, however, there will not be significant noise impacts on the behavior of marine mammals. Above-water noise impacts will be low and short-term, and no significant transboundary impacts across the Finnish borders are estimated to occur during project construction or operation.

The nearest Natura 2000 site in Finland's neighboring states is Naissaare, Estonia (EE0010127, SCI), located around 30 km from the limit of Finland's territorial waters. Balticconnector project activities on the Finnish side will not result in impacts on the protection principles of the Natura site.

Seabed intervention will mainly result in momentary local impacts on other vessel traffic with a maximum duration of few days for each area. In the offshore areas between Finland and Estonia where the pipeline will cross fairways with high traffic intensity, the safety zone will result in impacts on other vessel traffic because traffic will have to be diverted to avoid the safety zone of the pipelaying vessel. This is not estimated to have a significant impact on the safety of vessel traffic considering the existing navigation and traffic control measures. Emissions from the pipelaying fleet will have an impact on air quality in the Estonian territory when the vessels are close to the Estonian territory. The impacts will be very low and remain close to the route taken by the vessels.

The transboundary impacts of the project on people and society will be low. There will be a temporary increase in technological and economic activity in Estonia and well as Finland during construction. During operation, there will be an emphasis in transboundary impacts on the territory of the two states on the role of the natural gas pipeline as an energy transport channel reducing dependency on Russian natural gas supply. The Balticconnector pipeline will not cause restrictions on bottom trawling, whereby there will be no impact on those working in fisheries.

In the possible worst-case scenario accident in Finnish waters (gas pipeline rupture), the size of the dangerous flammable gas cloud would be slightly over 700 m, whereby the impact would also extend to waters on the Estonian side.

Once all construction activities have been carried out, the final integrity of the installed pipeline will be documented by hydrostatic testing. Following this pressure test, the seawater used to flood the pipeline will be filtered and treated with oxygen scavengers and/or biocides. Flooding can also be carried out using clean water without any additives. When using oxygen scavengers or biocides, the water removed is led into a basin for the settlement of solids and any impurities in them. Following the settlement process, the water is pumped into a marine area where mixing will take place rapidly. If the flooding is carried out using filtered water, there is no need for settling and the water can be led in a controlled manner into the sea. If the flooding water is discharged on the Estonian side, any resulting environmental impacts in Estonia will be transboundary impacts, but their impact is assessed as low due to the small quantity of water and the short duration of the discharge as well on the basis of experiences gained from the Nord Stream project.

### Feasibility of alternatives and summary of comparison

As regards environmental impacts, the alternatives examined are feasible when a special focus in project design is given to the prevention and mitigation of adverse impacts of pipeline construction. No adverse environmental impacts that are unacceptable or that could not be mitigated to an acceptable level were found during the environmental impact assessments of the project alternatives. The overall significance of the implementation alternatives assessed is shown in the table below (Table 0–1).

Due to the higher levels of suspended solids resulting from construction, the impacts on water quality, marine environment, fish, fisheries, and birds will be higher in the ALT FIN 1 alternative than in ALT FIN 2. The area affected by the ALT FIN 1 routing alternative is also closer to its natural state and more susceptible to changes, and more commercial fishing is carried out in its vicinity than that of the ALT FIN 2 alternative. The ALT FIN 1 alternative is also closer to significant bird areas and a nesting ground of a species under strict protection than ALT FIN 2. Water quality impacts during construction will be higher with LF1 than LF2 due to a higher solids concentration. The adverse effects on fish and fisheries caused by LF1 will be higher than those of LF2 due to the destruction of a significant reedbed area. The magnitude of the adverse impact on commercial fishing will also be greater and the affected area larger than with LF2.

The route taken by ALT FIN 2 east of Jakobramsjö passes closer to holiday residences than ALT FIN 1, whereby ALT FIN 2 may affect the recreational conditions of a larger number of holiday residents. LF1 is closer to holiday and permanent residences than LF2, whereby temporary adverse effects may be caused at a slightly higher level on the amenity of coastal residents and swimming beach users. Human perception of adverse effects or their impacts on amenity and living conditions depends on the individual. The noise impacts of LF1 regarding the landfall site and onshore blasting would be slightly higher than those of LF2. LF1 may result in the daily guideline value of 45 dB(A) being exceeded over the short term at the nearest holiday residences. Furthermore, in the event of a possible (but highly unlikely) leak from the natural gas pipeline, there are more holiday residences in the danger zone of the LF1 alternative near Ingå than there are in the LF2 alternative. None of the adverse effects are assessed to result in a permanent change in the living conditions of local residents or holiday residents. Landfall LF1 is located on a site that is in accordance with the local detailed plan while LF2 is not. On the other hand, changes to the detailed plan are likely to be required in any case.

In addition to adverse impacts, the implementation of the project will also have positive environmental impacts. The long-term objective of the development of the Finnish energy market is to increase natural gas sourcing alternatives to ensure supply security and the functioning of the natural gas market. At the moment natural gas for Finland is only sourced from Russia. The construction of the LNG terminal and the Balticconnector natural gas pipeline would contribute to the development of the natural gas market and supply security in Finland. The positive impacts on employment and livelihoods will also not be realized if the project is not implemented. If the project is not implemented, neither the adverse nor the positive impacts of the project will be realized.

Table 0-1. Assessment scale for the assessment of the significance of impacts, and the significance of the environmental impacts of the implementation alternatives of the Balticconnector project assessed (ALT FIN 1, ALT FIN 2, LF1 and LF2) in comparison with the current situation and the non-implementation of the project (zero alternative).

| | |
|---|---|
| **Significance of impacts** | Moderate ++ |
| | Low + |
| | No impact (0) |
| | Low - |
| | Moderate -- |
| | High --- |
| | Very high ---- |

| PROJECT'S ENVIRONMENTAL IMPACTS | ALT 0 | Construction | | | | Operation | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | ALT FIN 1 | ALT FIN 2 | LF1 | LF2 | ALT FIN 1 | ALT FIN 2 | LF1 | LF2 |
| **Seabed** | 0 | - | - | - | - | - | - | - | - |
| **Water quality** | 0 | - - | - - | - - | - - | - | - | - | - |
| **Benthic fauna and aquatic flora** | 0 | - | - | - - | - | - | - | - | - |
| **Fish fauna** | 0 | - - | - - | - - - | - - | - | - | - | - |
| **Fishing** | 0 | - - | - - | - - - | - - | 0 | 0 | 0 | 0 |
| **Conservation areas** | 0 | - - | - - | - | - | 0 | 0 | 0 | 0 |
| **Flora** | 0 | - | - | - | - | - | - | - | - |
| **Bird fauna** | 0 | - - | - - | - | - | 0 | 0 | 0 | 0 |
| **Other fauna** | 0 | - | - | - | - | 0 | 0 | 0 | 0 |
| **Soil, bedrock and groundwater** | 0 | - | - | - | - | 0 | 0 | 0 | 0 |
| **Noise** | 0 | - - | - - | - - | - - | - | - | - | - |
| **Vibrations** | 0 | - | - | - | - | 0 | 0 | 0 | 0 |
| **Waterborne transport** | 0 | - | - | - | - | - | - | - | - |
| **Land transport** | 0 | - | - | - | - | - | - | - | - |
| **Air emissions** | - | - | - | - | - | - | - | - | - |
| **Land use and built environment** | 0 | - | - | - | - | - | - | - | - |
| **Landscape and cultural environment** | 0 | - | - | - | - | - | - | - | - |
| **People and society** | 0 | - | - | - | - | + | + | + | + |
| **Natural resources** | 0 | 0 | 0 | 0 | 0 | - | - | - | - |
| **Waste** | 0 | - | - | - | - | - | - | - | - |

# GLOSSARY

**AE** Asphalt enamel

**AIS** Automatic Identification System (used for vessel traffic registration on the Baltic Sea).

**Alvar** A biological environment based on a limestone plain with thin or no soil and, as a result, sparse grassland vegetation.

**Anode field** Anode fields form part of the cathodic protection system of natural gas transmission pipelines.

**Argillite** A fine-grained sedimentary rock composed predominantly of indurated clay particles.

**As** Arsenic

**Barg** Bar gauge; a unit of gauge pressure, i.e. pressure in bars above atmospheric pressure.

**Benchmark vessel** A vessel type designation illustrating the vessel's size class.

**Boil-off gas** Gas vaporized from LNG in cargo or storage tanks at the top of the tank above the liquid surface.

**BSPA** Baltic Sea Protected Area

**Bunkering vessel** A vessel used for fuel transport from LNG storage tanks to ship fuel tanks.

**Carlin tag** An individual fish identification tag attached with steel or plastic wire at the base of the dorsal fin.

**Catch quota** A quota for how much of each species can be caught based upon the total available. Quotas usually aim to control fishing mortality.

**Cathodic protection** Cathodic protection is an electrical system to protect a transmission pipeline against corrosion. Cathodic protection systems comprise anode fields, power sources and cables between the natural gas pipeline and the anode fields.

**Clastic sediments** Sediments mainly composed of broken pieces of older weathered and eroded rocks.

**Compressor station** Compressor stations are used to raise gas pressure and that way increase the natural gas transmission network capacity. Finland's compressor stations are located in Imatra, Kouvola and Mäntsälä.

**Consultation zone** A zone around a production or storage facility creating a major-accident hazard where planning and construction restrictions apply due to the installation causing a major-accident hazard. The consultation zone specifies the distance from the installation within which activities will require an expert consultation procedure to ensure safety. The extent of the consultation zone will be determined by the Finnish Safety and Chemicals Agency (Tukes). The restrictions set on consultation zones may vary depending on the characteristics of the installation and the area.

**Cryogenic** A very low temperature (below –150 °C).

**CWC**Concrete weight coating

**DN** The nominal diameter of a natural gas pipeline in millimeters.

**DP** Dynamically positioned

**Drainage basin** An area of land where surface water from rain, melting snow or ice converges to a single point.

**Espoo Convention** The Convention on Environmental Impact Assessment in a Transboundary Context.

**Exclusive Economic Zone (EEZ)** A sea zone over which a state has special rights regarding the exploration and use of marine resources.

**FINIBA** Finnish Important Bird and Biodiversity Area

**Flammable range** The proportion of fuel to air mixture that is ignitable. Expressed in terms of percentage of vapor in air by volume.

**FNU** Formazin Nephelometric Unit; a unit of measure for turbidity.

**FSRU** Floating Storage Regasification Unit

**FTU**Formazin Turbidity Unit, a unit of measure for turbidity.

**GOFREP** The Gulf of Finland Reporting System for vessel traffic.

**Halocline** A strong vertical salinity gradient within a body of water.

**HELCOM MPA** A Marine Protected Area (MPA) under the Baltic Marine Environment Protection Commission (HELCOM).

**Horizontal drilling** Also called horizontal directional drilling (HDD) or directional boring, this is a subsurface installation method for natural gas pipelines that does not require open-cut installation. A pilot hole is drilled using a drill bit with directional control, which is then enlarged to reach the sufficient diameter to accommodate the subsurface pulling of the pipeline without surface intervention.

**IBA** Important Bird and Biodiversity Area

**IBSFC** The International Baltic Sea Fishery Commission

**ICES statistical rectangle** The ICES has divided marine areas into ICES divisions and ICES sub-divisions. The Baltic Sea is located in ICES subdivisions 22–32, and the Gulf of Finland is in subdivision 32. The divisions are further divided into statistical rectangles (approximately 55 km x 55 km) with two parallel numbering systems, the one used by the ICES and the one used by the State of Finland.

**ICES** The International Council for the Exploration of the Sea

**IMO** The International Maritime Organization

**IUCN** The International Union for Conservation of Nature and Natural Resources

**LNG** Liquefied natural gas. Natural gas remains in liquid form in normal atmospheric pressure if its temperature is around –163 °C.

**LNGC** Liquefied Natural Gas Carrier

**Longline** Offshore fishing gear used to catch salmon. Net length usually around 20 km (1,000 hooks).

**Natural gas transmission capacity** Power (unit of measure: watt, W) is the amount of energy consumed per unit of time. Natural gas transmission capacity (power) denotes the amount of gas transmitted over a period of time; can also be expressed in $m^3/h$.

**Natural gas transmission volume** In natural gas sales and transmission, volume means the total combined amount of energy transmitted. This volume is obtained by multiplying transmission capacity by period of consumption. The most commonly used unit is the gigawatt hour (GWh = 0.001 TWh = 1,00 MWh = 1,000,000 kWh)

**Pelagic** Living in offshore or open water areas.

**Perched groundwater** A body of water occurring above the groundwater table that has formed on top of impermeable layers of soil or rock.

**Photic zone** A layer of a body of water that is exposed to sufficient sunlight for photosynthesis, also called 'euphotic zone'.

**Pipeline capacity** Pipeline capacity denotes the amount of natural gas expressed in units of power that can be moved through each section of the pipeline over a period of time.

**Profundal zone** The profundal zone is the deep bottom-water area where less than 1% of the surface sunlight remains. Due to this shortage of light, only zoobenthos but no aquatic plants can be found in the profundal zone.

**Ramsar site** A site designated under the Convention on Wetlands of International Importance (the Ramsar Convention).

**Right-of-way** An easement-like right to use an area in a piece of real estate owned by another party.

**ROV** Remote Operated Vehicle

**Safety distance** A zone within which only activities relating to the terminal are allowed. The safety distance is smaller than the consultation zone. The restrictions on land use set by safety zones are determined case-specifically depending on the installation's operations. The placement of production facilities and the sufficiency of safety distances between them and other activities is supervised by Tukes under the permit procedure laid down in chemicals legislation.

**SCV** Submerged Combustion Vaporizer

**Seveso establishment** An establishment (production or storage facility) referred to in the Seveso II Directive with a risk of a major accident. The major-accident hazard in these establishments is caused by the handling of hazardous substances. Establishments are classified on the basis of increases in the risk level caused by the quantity and quality of substances used into establishments that must submit a notification, establishments that must draw up a major-accident prevention policy, and establishments that must produce a safety report.

**Seveso II Directive** Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances. The Directive was brought into force in Finland by an amendment to the Decree on Industrial Chemicals in 1999.

**Side-scan sonar** A device that creates an image of the sea floor.

**S-lay method** Refers to the shape that the pipe forms as it is lowered onto the seabed.

**Sub-bottom profiler** A powerful low-frequency echo-sounder providing profiles of the upper layers of the sea bottom.

**Territorial waters** A belt of coastal waters extending at most 12 nautical miles from the baseline (usually the mean low-water mark) of a coastal state.

**Thermocline** A steep gradient of rapid temperature change in a body of water.

**Tukes** The Finnish Safety and Chemicals Agency (formerly the Safety Technology Authority).

**Turbidity** Loss of clarity in water caused by the presence of suspended silt or organic matter.

**UNCLOS** The United Nations Convention on the Law of the Sea

**Usufruct** An easement-like right to use an area in a piece of real estate owned by another party. This provides Gasum with rights including the transmission of natural gas and the maintenance of the pipeline.

# 1 PROJECT

## 1.1 Project Developers

The Project Developers in the environmental impact assessment (EIA) procedure for the Balticconnector project are the Finnish Gasum Corporation and the Estonian AS EG Võrguteenus.

The Gasum Group consists of the parent company, Gasum Corporation, and the subsidiaries Gasum Paikallisjakelu Oy, Gasum Energiapalvelut Oy, Gas Exchange Ltd, Helsingin Kaupunkikaasu Oy, Gasum Tekniikka Oy and Gasum Eesti AS. Under the natural gas network license held by Gasum, the company has been designated to have responsibility for the technical functioning and reliability of the natural gas transmission system and to perform the duties related to balance responsibility for the transmission system in a manner that is appropriate and equal in respect of the parties to the natural gas market (system responsibility). Gasum has been appointed as the Finnish Transmission System Operator (TSO).

AS EG Võrguteenus, the Estonian Transmission System Operator (TSO), was founded in December 2005 on the basis of the legal obligations issued by the Republic of Estonia and the European Union. AS EG Võrguteenus began its economic activities on January 1, 2006 as an independent natural gas transmission and distribution service company operating in Estonia. Since August 2013, AS EG Võrguteenus has been solely responsible for natural gas transmission services as the national TSO.

## 1.2 Project background and justifications

### 1.2.1 Purpose of the project

The purpose of the Balticconnector natural gas pipeline project is to interconnect the Finnish and Estonian natural gas distribution networks. The integration of the Finnish and Estonian gas infrastructures will ensure a more coherent and diverse natural gas network in the Baltic Sea region and guarantee the security of natural gas supply for the northeastern Member States of the EU. The offshore pipeline will enable gas transmission between Finland and Estonia while also providing the opportunity to utilize the underground natural gas storage facilities in Latvia. The flow of gas can take place in both directions, making it also possible to transmit natural gas from Finland to Estonia.

In Finland the Balticconnector pipeline will be connected to the Gasum natural gas network via a pipeline section to be constructed from Ingå to Siuntio. In Estonia the Balticconnector pipeline will be connected to the Estonian natural gas network via the planned compressor station and the pipeline section to be constructed in Kiili. The connection of the Balticconnector pipeline to the Ingå LNG terminal will create an integrated natural gas network for the Baltic states and Finland. The offshore natural gas pipeline project can also be justified from the supply security perspective. The planning project relating to the LNG terminal is currently underway, and its environmental impact assessment report was submitted to the coordinating authority in spring 2015. The potential cumulative impacts of the LNG terminal and the Balticconnector project are discussed in section 8.20 of this EIA report.

### 1.2.2 Project background

Finland has been importing natural gas from Russia since 1974. The length of the current Finnish gas pipeline network is more than 1,000 km. The annual consumption of gas is approximately 3.5 billion m³, corresponding to 8.5% of Finland's total energy consumption. Gasum has been the only importer of gas to Finland since 1994. The imports of gas are based on a supply contract between Gasum and OAO Gazprom valid until 2025.

Estonia imports natural gas from Russia and the Inčukalns underground gas storage facility in Latvia. Gas is transmitted to customers via pipelines, distribution stations and pressure reduction stations. The Eesti Gaas Group is the leading natural gas distributor in Estonia (with a share exceeding 90% of the retail market) via the group companies AS Eesti Gaas, AS EG Ehitus and AS Gaasivõrgud. According to the economic indicators published by Eesti Gaas for 2013, the volume of natural gas sold by the company totaled almost 582 million m³. Of this, 79% was sold to consumers (including industry) and 10% to residential customers.

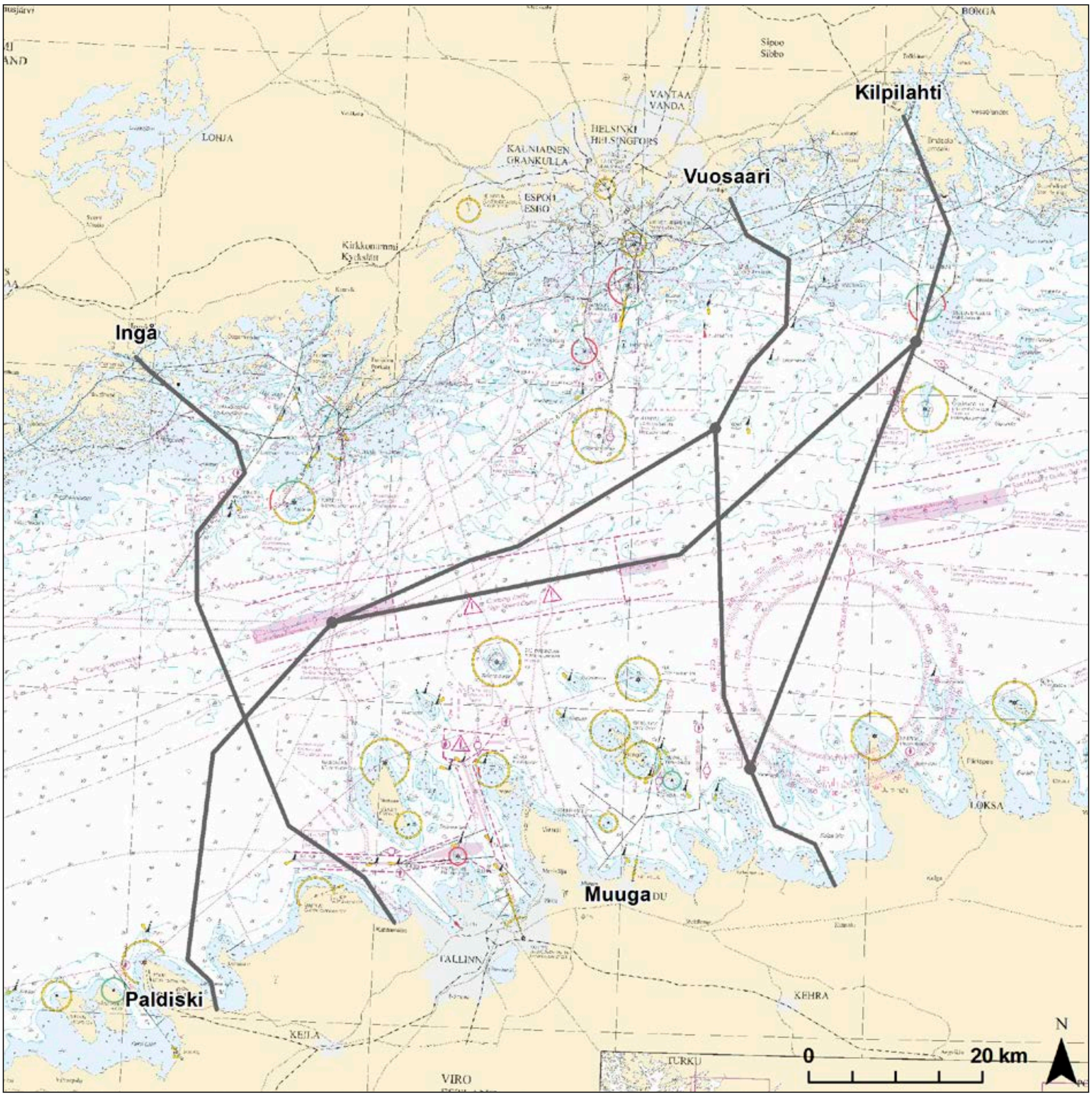



Figure 1-1. Previously studied route alternatives and the respective landfall sites.

Access to and supply security of natural gas and, consequently, the consumption of natural gas in Finland and the Baltics can be considerably improved by new alternative natural gas transport routes. The Balticconnector is classified in the guidelines for trans-European energy networks (TEN-E) as a priority project and has been granted financial assistance by the EU. Part of the funding has been used for the pipeline's preliminary technical design, geotechnical and geophysical studies and environmental surveys. The studies and surveys conducted during the project are described in section 6.3 on current environmental status.

It was found on the basis of the natural gas network capacity surveys conducted during the project that most of the capacity of the natural gas pipelines extending from Western Russia via the Baltic states to Finland is in use. Free capacity to respond to Finnish demand is only available occasionally. Correspondingly, occurrences of low capacity have also been experienced in supply to cater for Estonia's own demand for natural gas. Therefore explorations were launched into the opportunity to transmit gas via Finland to Estonia and possibly also to the other Baltic states. The opportunity of bidirectional natural gas transmission is the basic requirement for the implementation of the project.

## 1.3 Routing alternatives

### 1.3.1 Previously studied routing alternatives

Alternative routings for the Balticconnector project have been explored since the early 2000s (Figure 1–1). These studies were based on the utilization of existing data. In Finland, points of landfall examined in addition to Ingå include the Kopparnäs area in Ingå, Suomenoja in Espoo, Vuosaari in Helsinki and Kilpilahti in Porvoo. In Estonia, Muuga and Paldiski have been considered as landfall sites. First to be examined in the feasibility studies on the alternatives was the relationship of the landfall sites to the natural gas network. These examinations resulted in the shortlisting of the above-mentioned points of landfall. Further examination of the alternatives focused on any restrictions arising from land use in the areas, restrictions relating to the offshore areas, and the length of each route. The following objectives were set for the comparison and shortlisting of routes:

- minimizing the length of the pipeline;
- avoiding special areas;
- maintaining a sufficient safety distance from the built environment;
- avoiding cables, wires and wrecks;
- avoiding fishing areas, marine sand extraction areas, military areas, wind parks and anchoring areas;
- avoiding unfavorable seabed areas;
- avoiding marine transport routes.

The Estonian landfall at Muuga was rejected in the further examinations due to the intensive land use in the area. In Finland the Kopparnäs, Suomenoja and Kilpilahti landfall sites were not included in further examinations.

Kilpilahti was rejected because the pipeline would be more than 100 km in length and run through a military firing area, a nature reserve and, for more than 6 km, through inner archipelago. The pipeline would also cross several cables and run along the main fairway of the Gulf of Finland over a considerable distance. The selection of this pipeline route would have required the placement of the Estonian landfall east of Tallinn in Muuga. Muuga is not suitable as a landfall site for land use planning reasons.

Vuosaari, Helsinki, was rejected as a landfall site due to the land use in the area. Land use around the Vuosaari Harbor is intensive, and there is no suitable site available for a compressor station in the area. The Vuosaari Harbor area and sea lane also make the offshore area limited in space, whereby it would be a demanding task to install the pipeline alongside the sea lane. There are also lots of islands and rocks off Vuosaari. The offshore pipeline from Vuosaari to Paldiski would also be very long, around 126 km in total.

Suomenoja was rejected as a landfall due to the area's intensive land use plans. A new, densely built urban residential area is being planned for the Suomenoja area, which also involves land reclamation and harbor development. The Suomenoja landfall would also have required the routing of the offshore pipeline east of the Helsinki caisson lighthouse, which would extend the offshore section considerably to around 120 km.

Kopparnäs was not included in the further examinations due to the difficult construction conditions on the Finnish side and the current and planned land use in Kopparnäs and along the Kopparnäs–Siuntio natural gas pipeline. The pipeline would also have to be installed in the archipelago over a considerable distance off Kopparnäs.

Some of the restrictions and other grounds for shortlisting concerning the previously studied routing alternatives are also presented in the table (Table 1–1).

Table 1-1. Alternative routes for the Balticconnector project and their restrictions.

| Route | Offshore pipeline length, km | Onshore pipeline length, km | Restrictions and other justifications |
|---|---|---|---|
| Muuga-Kilpilahti | 107 | 1 | Not possible to coordinate with land use in Muuga area |
| Muuga-Vuosaari | 91 | 3 | Offshore section short, not possible to coordinate with land use in Muuga area |
| Muuga-Suomenoja | 86 | 0 | Offshore section short, not possible to coordinate with land use in Muuga area |
| Paldiski-Kilpilahti | 148 | 1 | Offshore section very long, located along the main fairway of the Gulf of Finland, dense archipelago off Kilpilahti. |
| Paldiski-Vuosaari | 126 | 3 | Long offshore section, dense archipelago off Vuosaari, not possible to coordinate with land use in Vuosaari. |
| Paldiski-Suomenoja | 119 | 0 | Long offshore section, very difficult to coordinate with future land use in Suomenoja. |
| Paldiski-Kopparnäs | 90 | 10 | Short offshore section, difficult marine construction conditions near the coast, difficult to coordinate in terms of land use. |
| **Paldiski-Ingå** | **81** | **30** | **The shortest offshore section, can be coordinated with land use.** |

### 1.3.2 Selection of the current route

On the basis of the examinations presented above, the Ingå-Paldiski offshore pipeline routing was selected for the EIA procedure (Table 1-1). The selection was based on the pipeline route featuring the shortest offshore section and the fact that the natural gas pipeline and the compressor station can in both countries be coordinated with land use in the area. There are no wind farms planned in the immediate vicinity of the offshore section. The project is not in conflict with the operations of the Defence Forces. Crossings of the main fairway of the Gulf of Finland have been minimized as the pipeline route runs perpendicular across the fairway.

Several factors were taken into consideration in the determination of the current route of the offshore natural gas pipeline (Ingå-Paldiski), including route length, existing natural gas network, local areas, regulations and guidelines concerning land use planning, fairways, military areas, anchoring areas, geophysical characteristics and bathymetry. The geotechnical and geophysical surveys along the offshore pipeline route were conducted by Marin Mätteknik AB in 2006 and 2013 *(MMT 2006 and 2013)*. Other studies and surveys conducted during the project are described in section 7 on current environmental status.

The technical design of the project has progressed to the preliminary technical design phase *(Ramboll 2014a)* which has involved the optimization of the pipeline route within the corridor studied (study corridor that is 275-975 m wide, *MMT 2006* and *2013*) to minimize issues including seabed intervention, pipeline length and curvature.

In Estonia the Paldiski area was selected as the point of landfall. AS Eesti Gaas has made plans to expand the current Estonian gas pipeline network west of Tallinn all the way to the City of Paldiski. The assessment of the gas pipeline route from Kiili to Paldiski running south of Tallinn was carried out in conjunction with the strategic environmental assessment (SEA) included in the statutory land use planning process. The impacts of the compressor and reception station to be constructed in Paldiski (Kersalu) were also assessed in conjunction with the SEA. According to preliminary plans, the Balticconnector natural gas pipeline will be connected to the Estonian gas pipeline network via the compressor station planned for Kersalu. The Municipality of Paldiski launched the detailed plan procedure for the compressor station on May 23, 2012 and adopted it on October 20, 2014.

In Finland, Ingå was selected as the point of landfall. In 2007 a decision was made by Gasum to invest in a new natural gas pipeline between Mäntsälä and Siuntio following the investment decision of Fortum Corporation concerning a new natural gas-fueled combined heat and power (CHP) plant in Suomenoja, Espoo. The added capacity provided by the new natural gas pipeline has primarily covered the increased gas consumption at the Suomenoja power plant but also considerably improved the supply security of natural gas in the entire Helsinki Metropolitan Area and enabled access to natural gas in new areas in western Uusimaa. This investment decision by Gasum also supports the decision to focus the development of the Balticconnector project exclusively on the Ingå-Paldiski alternative. The Balticconnector pipeline and the LNG terminal being planned at the same time will be connected to the Finnish natural gas network with the Ingå-Siuntio natural gas pipeline section planned by Gasum.

The figure (Figure 1-2) presents the existing gas pipeline connections in the Gulf of Finland region and the preliminary routing of the Balticconnector natural gas pipeline.

## 1.4 Alternatives assessed in the EIA procedure

This EIA report covers the preliminary routing of the offshore Balticconnector natural gas pipeline from Ingå, Finland, to Paldiski, Estonia, and the related routing alternatives in Finland. The routing alternatives for the Paldiski area are covered by the EIA report for Estonia, which is available in English on the Gasum website (*http://www.balticconnector.fi*). The most significant environmental impacts of the Estonian routing alternatives are also described in Appendix 4 to this EIA report. In addition to the pipeline routing as a whole, the following alternatives were examined in the environmental assessments conducted (Figure 1-3):

### In Finland

- **Alternative FIN 1 (ALT FIN 1):** Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Ingå, Finland, to Paldiski, Estonia, route north of Stora Fagerö.
- **Alternative FIN 2 (ALT FIN 2):** Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Ingå, Finland, to Paldiski, Estonia, route south of Stora Fagerö.

### In Estonia

- **Alternative EST 1 (ALT EST 1):** Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Ingå, Finland, to Paldiski, Estonia, with the point of landfall in Kersalu, Estonia.

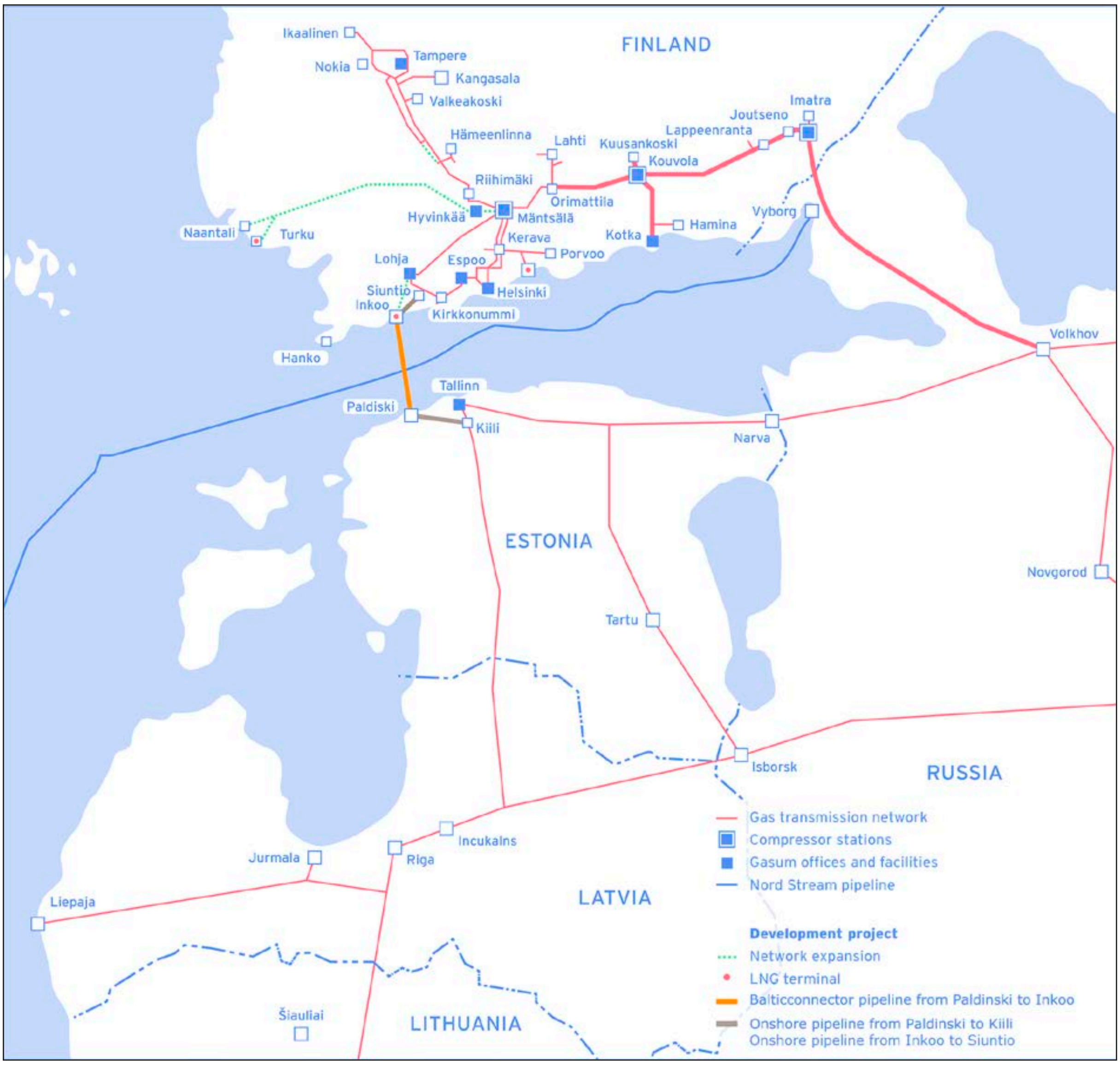



Figure 1-2. Natural gas pipeline network in the Gulf of Finland region.

- **Alternative EST 2 (ALT EST 2):** Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Ingå, Finland, to Paldiski, Estonia, with the point of landfall in Pakrineeme, Estonia.

In addition, two alternative landfall sites and the respective natural gas pipeline routings in Ingå were examined (Figure 1–4):

- **Landfall 1 (LF 1):** Landfall of the Balticconnector natural gas pipeline north of the Fjusö Peninsula in the Bastubackaviken Bay area.
- **Landfall 2 (LF 2):** Landfall of the Balticconnector natural gas pipeline on the Fjusö Peninsula.

A situation where the Balticconnector natural gas pipeline will not be constructed was assessed as the zero alternative.

### 1.4.1 Routing alternatives in Finland

Two routing alternatives were studied in the vicinity of the Port of Ingå (Figure 1–4). The ALT FIN 1 alternative passes the island of Stora Fagerö from the north and the east and crosses the fairway southeast of Stora Fagerö at a point where the fairway is wide and relatively deep. The ALT FIN 2 alternative crosses the fairway west of Stora Fagerö closer to the Port of Ingå

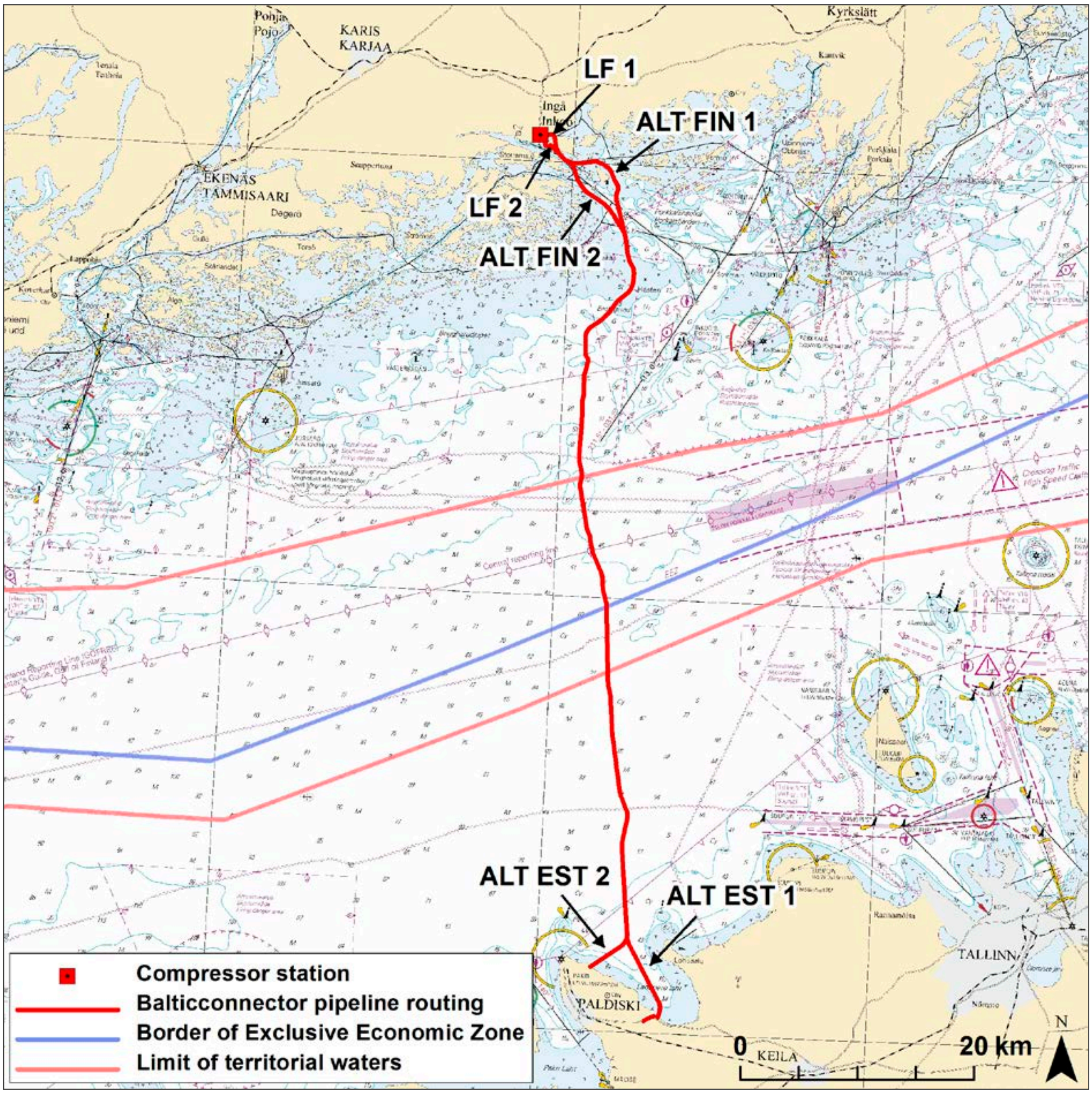



Figure 1–3. The routing alternatives of the Balticconnector natural gas pipeline.

and runs between Stora Fagerö and Älgsjö and further towards the south. After crossing the fairway, ALT FIN 2 runs parallel to the fairway for several kilometers. Water depth at the intersection of the fairway and the natural gas pipeline route alternatives (ALT FIN 1 and ALT FIN 2) is approximately 23–30 m. ALT FIN 1 is around 1.3 km longer than ALT FIN 2. The routes come together before running west of the Hästen lighthouse. From there the route runs into the deeper parts of the outer archipelago towards Estonia, passing the Enoksgrund shallow from the east.

The landfall alternatives (LF 1 and LF 2) are located in Ingå north of the Fjusö Peninsula in the Bastubackaviken Bay area and on the Fjusö Peninsula around 2 km northeast and east of the Port of Ingå, in the vicinity of the Ingå fairway (Figure 1–5). The landfalls and underground natural gas pipeline routings as well as areas directly connected with them are mostly fenced off (the site planned for the compressor station is located


Figure 1–4. The routing alternatives of the Balticconnector natural gas pipeline in Finland.

outside the fenced area by the southern section of Oljehamnsvägen road, close to the National Emergency Supply Agency gate area). The fenced area relates to the activities of the National Emergency Supply Agency, and access to the area is restricted. The area is not currently used for permanent or holiday residences, recreation or other public or private access. The area is mostly covered by forest.

### 1.4.2 Routing alternatives in Estonia

Two possible alternative points of landfall have been assessed on the Pakri Peninsula: Kersalu (ALT EST 1) and Pakrineeme (ALT EST 2) (Figure 1-6, Appendix 4). The sea area surrounding the Pakri Peninsula (excluding the waters off the Paldiski harbors) is included in the Pakri Natura 2000 site.


Figure 1–5. Landfall alternatives, including the respective natural gas pipeline routings, in Ingå.

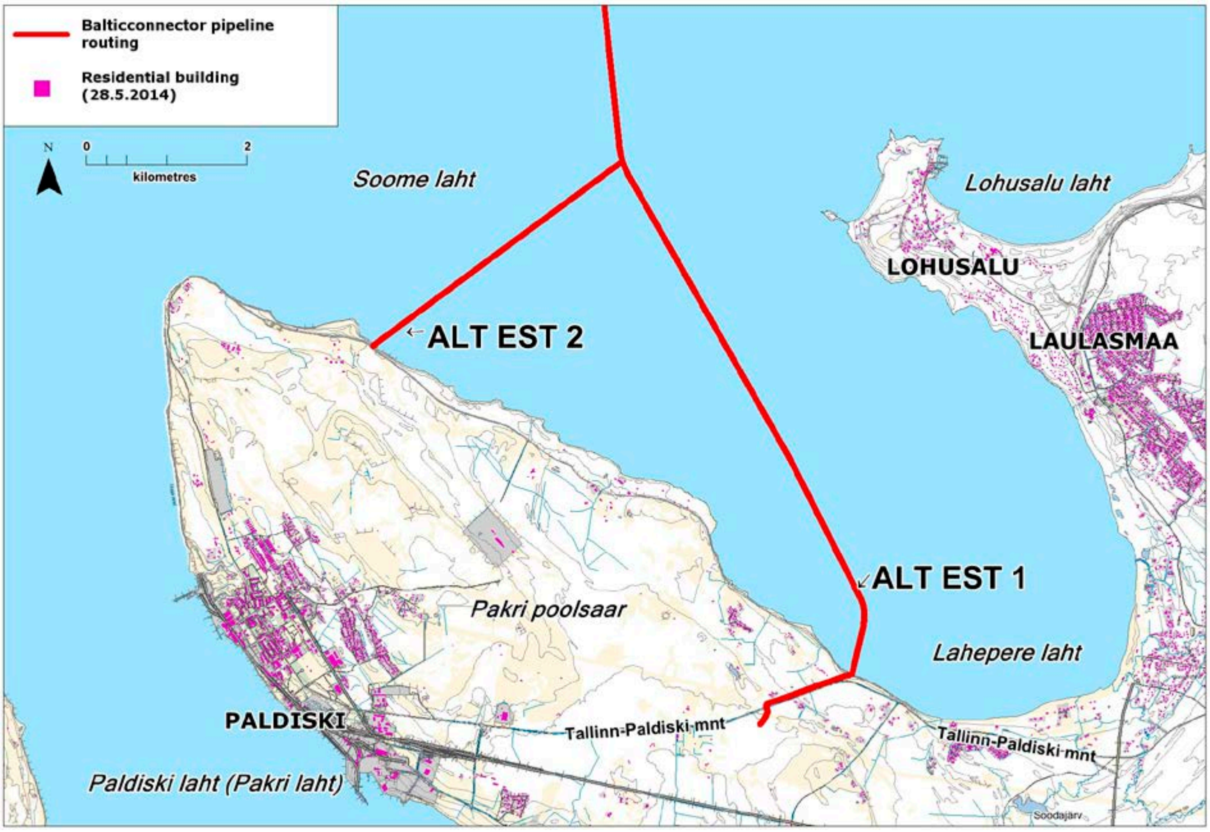



Figure 1–6. The routing alternatives of the Balticconnector natural gas pipeline in Estonia.

In the ALT EST 1 alternative the landfall is located in the shallow Lahepere Bay, Kersalu, very close to the border between the municipalities of Paldiski and Keila. The distance from the point of landfall to the center of Paldiski is around 6.5 km and to Tallinn around 50 km. The alternative also includes an onshore natural pipeline section of approximately 1.3 km from the Estonian landfall site to the compressor station planned for Kersalu. The route runs mainly through forest and meadow areas and close to the Tallinn–Paldiski road. Agriculture used to be practiced in the area, and the former fields and pastures are partly overgrown. The route mainly runs through state-owned land. There are also three private farms in the area.

The landfall in accordance with the ALT EST 1 alternative, the natural gas pipeline routing from the landfall to the compressor station, and the location of the compressor station are specified in the thematic plan included in the local master plan of the City of Paldiski entitled "Location of category D natural gas pipeline in within the City of Paldiski" approved by the local council of the City of Paldiski on December 22, 2011 *(City of Paldiski 2013a)*.

The landfall of the ALT EST 2 alternative is located in the municipality of Paldiski on the northeastern shore of the Pakri Peninsula in conjunction with the LNG terminal site planned for Paldiski. The alternative is located on the Pakri cliffs where the limestone plateau is more than 20 m high in places. The landfall site is dominated by relatively valuable meadows and deciduous-dominated forests on rocky terrain. A reception station will be constructed in the vicinity of the landfall, with the option of further constructing a connection to the Estonian natural gas network.

The seabed is more even in the Paldiski area than off the Finnish coast. Water depth already drops to around 20 m at 3.5 km from the shoreline.

### 1.4.3 Changes made to the alternatives after the EIA program phase

The Balticconnector pipeline routing and landfall alternatives presented in the EIA program were specified further in the preliminary technical design phase within the previously examined study corridor (study corridor that is 275–975 m wide, *MMT 2006* and *2014*) to minimize issues including seabed intervention.

The other point of landfall (LF 1) and related onshore pipeline routing proposed by the Uusimaa Centre for Economic Development, Transport and the Environment *(Appendix 1)*, the coordinating authority for the EIA procedure, has been included in the environmental impact assessment concerning Ingå (Figure 1–5). Both of the landfalls (LF 1 and LF 2) and the majority of the respective onshore pipeline routings to the compressor station are located in a fenced area owned by the

National Emergency Supply Agency to which there is no free access.

The Balticconnector pipeline will be connected via the compressor station to the LNG terminal being planned at the same time for Joddböle, Ingå. The location the LNG terminal was examined concerning the Inkoo Shipping area (EIA procedure ended in 2013) and the Fjusö Peninsula owned by the National Emergency Supply Agency (EIA procedure will end in summer 2015) (Figure 8-34). Accordingly, the location of the compressor station was specified further to a southern section of Oljehamnsvägen road close to the National Emergency Supply Agency gate area.

#### 1.4.4 Zero alternative

The zero alternative means a situation where the Balticconnector natural gas pipeline will not be constructed. In this alternative the LNG terminal planned for Ingå will not be constructed either, and the positive and negative environmental impacts of both projects will not be realized.

The Balticconnector natural gas pipeline and the LNG terminal would diversify and increase competition in natural gas sourcing. In the zero alternative, this objective of the projects to provide the market with less expensive, more price-stable and competitive natural gas would not be achieved and natural gas would be replaced by other fuels (coal, peat, wood, oil). On the other hand, the imports of LNG could compensate against this impact to some extent. For a more detailed description of the impacts of the zero alternative see section 8.19.

## 1.5 Project schedule

The figure below (Figure 1-7) outlines the preliminary schedule of the Balticconnector project. According to preliminary plans, the more detailed studies and the design of the project will take place in 2016–2018, construction and pipeline installation in 2018–2020 and commissioning in late 2020. The schedule of the project's EIA procedure is presented in section 2.2.2.


Figure 1-7. Outline of the preliminary project schedule.

## 1.6 Connection of the project with the Project Developers' other projects

#### 1.6.1 LNG import terminal in Ingå

The project covers an onshore terminal for LNG imports (Figure 8-34). The terminal is planned for the same area in Joddböle, Ingå, as the Balticconnector landfall and compressor station. The locations examined as potential terminal sites are the Inkoo Shipping area (EIA procedure ended in 2013) and the Fjusö Peninsula owned by the National Emergency Supply Agency (EIA procedure will end in summer 2015). The onshore terminal has been examined on the basis of various capacities in conjunction with the EIA procedure. An alternative to the onshore terminal is a floating terminal, with the Fjusö Peninsula and a seafront site of the Fortum power plant having been studied as possible locations in Joddböle.

The LNG terminal will consist of LNG offloading equipment, storage tank(s), vaporization facility and measuring station connected to the gas network. LNG will be shipped in using special-purpose LNG carriers with a maximum capacity of around 150,000 m³. The annual number of carrier visits is estimated to total 18–30 depending on the terminal's storage capacity. The total annual production volume of the terminal at maximum capacity will be around 2 billion m³.

#### 1.6.2 Ingå-Siuntio natural gas pipeline

Ingå is not currently connected to the natural gas network. The Ingå transmission pipeline is planned to connect to the current transmission network in Siuntio (Figure 8-34). The pre-design of the transmission pipeline is already completed, and its environmental impacts have been assessed in the EIA procedure of the LNG terminal. The Balticconnector pipeline will be connected to the Ingå-Siuntio transmission pipeline at the compressor station. Gas transmission can take place in both directions. The LNG terminal can also be connected to the Ingå-Siuntio transmission pipeline.

#### 1.6.3 Paldiski-Kiili natural gas pipeline

In Estonia the Balticconnector natural gas pipeline will be connected to the natural gas network via a compressor station. From the compressor station a new natural gas pipeline connection will be constructed to Kiili, connecting the Balticconnector to the Estonian natural gas network. The preliminary length of the connecting pipeline is around 50 km (Appendix 4).

# 2 EIA PROCEDURE, COMMUNICATIONS AND PARTICIPATION

## 2.1 International EIA procedure

The offshore gas pipeline will enable the transmission of natural gas between Finland and Estonia. Due to the international dimension of the Balticconnector project, two primary international procedures are applied to the project:

- the UNECE Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention);
- the bilateral Agreement between Finland and Estonia on Environmental Impact Assessment in a Transboundary Context.

The need for the assessment of the project's environmental impacts for Finland is based on the Act on Environmental Impact Assessment Procedure (468/1994). In Estonia the need for the assessment is based on the Environmental Impact Assessment and Environmental Management System Act (RT[4] I 2005, 15, 87).

### 2.1.1 Espoo Convention

The United Nations Economic Commission for Europe (UNECE) Convention on Environmental Impact Assessment in a Trans-boundary Context (Espoo Convention) was ratified by Finland in 1995, and the Convention (67/1997) entered into force in 1997. The Convention has also been ratified by Estonia.

The Parties to the Convention have the right to participate in an environmental impact assessment procedure in another country if the adverse environmental impacts of the undertaking assessed may affect the country. The Balticconnector project falls under projects listed in Article 8, Appendix I of the Espoo Convention (large-diameter oil and gas pipelines) for which an international consultation must be organized.

The environmental authority of the Party of Origin notifies the environmental authorities of the affected countries about the establishment of an EIA procedure and inquires whether they intend to participate in the EIA procedure if the project is regarded as likely to cause impacts on the country in question. If an Affected Party decides to participate in the procedure, it places the EIA program and report on public display for any statements and opinions. The environmental authority of the Affected Party collects the opinions and submits them to the Party of Origin. Finland, Estonia and Russia have participated in the procedure of the Balticconnector project.

The competent Finnish and Estonian authorities in the international consultation in compliance with the Espoo Convention are the Ministries of the Environment. The environmental authority submits the opinions received from the Affected Parties to the national coordinating authority responsible for the EIA procedure, which takes the opinions provided into consideration in its statement.

### 2.1.2 Bilateral agreement between Estonia and Finland

In addition to the Espoo Convention, Finland and Estonia have entered into a bilateral agreement on Environmental Impact Assessment in a Transboundary Context. Signed on February 21, 2002, the agreement aims to increase the efficiency of bilateral cooperation in EIA processes. The agreement (Finnish Treaty Series 51/2002) between the Finnish and Estonian Governments entered into force on June 6, 2002.

The obligations set regarding the environmental impact assessment of projects in the bilateral EIA agreement between Finland and Estonia correspond largely to the Espoo Convention. The establishment of a Joint Advisory Commission on EIA was also agreed upon under the agreement. Both parties have appointed six Commission members. The Commission is chaired on the Finnish and Estonian sides by representatives of the countries' Ministries of the Environment, while members comprise representatives of regional environmental authorities. The Commission meets at least once a year. The commission has an advisory role and operates primarily for the purpose of information exchange.

Under Article 14, the competent authorities of the Parties are entitled to agree to carry out a joint EIA within the framework of their national legislation. The detailed EIA procedure perspectives and cooperation between the countries are agreed upon by the Finnish-Estonian EIA Commission, and these must be discussed at the Ministry of the Environment of both countries.

In the Balticconnector project, a decision was made between the Project Developers and the authorities of both countries to produce separate EIA reports for Finland and Estonia. The assessment work took place simultaneously and in cooperation between EIA experts from both countries. The EIA reports will be on display at the same time in Finland and Estonia. In the Balticconnector project both Finland and Estonia are a Party of Origin and an Affected Party. Consequently, both must notify other countries of the EIA procedure conducted in compliance with national EIA requirements. General cooperation between the authorities based on the bilateral agreement is shown in the figure (Figure 2-1).

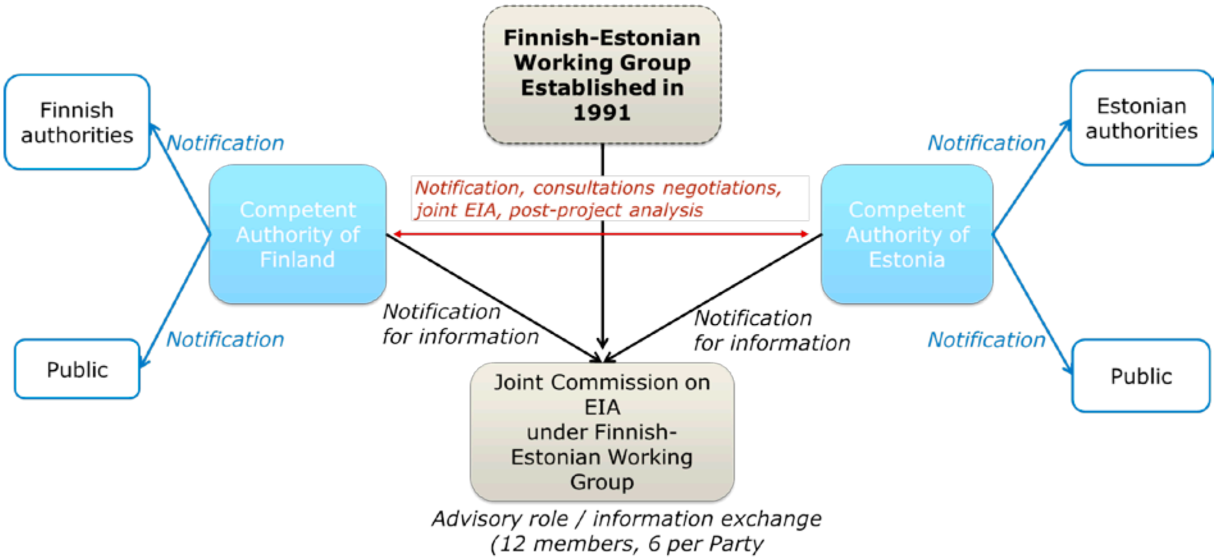



Figure 2-1. Cooperation between the authorities under the EIA agreement. *(Ramboll 2013a)*

## 2.2 EIA procedure in Finland

### 2.2.1 Need for and objectives of the EIA procedure

Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment was enforced in Finland pursuant to Annex 20 to the Agreement creating the European Economic Area under the Act on the Environmental Impact Assessment Procedure (468/1994) and the Decree on the Environmental Impact Assessment Procedure (713/2006). The EIA Act is in force in the Finnish Exclusive Economic Zone referred to in section 1 of the Act on the Finnish Exclusive Economic Zone (1058/2004).

The Balticconnector project is not included in the list of projects given in section 6 of the EIA Decree under subsection 8 b of which the EIA procedure is applied to gas pipelines with a diameter of more than DN 800 mm and a length of more than 40 km. Under section 4(2) of the EIA Act, the assessment procedure is also applied in individual cases to a project other than one referred to in the list of projects that will probably have significant adverse environmental impact comparable in type and extent to that of the projects included in the list.

Pursuant to decision YM1/5521/2006 issued on February 17, 2006 by the Ministry of the Environment, the environmental impact assessment procedure is applied to the Balticconnector natural gas pipeline project. The Balticconnector natural gas pipeline will have a diameter of approximately DN 500 mm and total approximately 80 km in length, which may be assumed to be likely to have similar environmental impacts as gas pipelines included in the list of projects provided in section 6 of the EIA Decree (diameter DN 800 mm, length 40 km). The project is also covered by section 8 of the list of projects provided in Appendix 1 to the bilateral agreement on EIA between Finland and Estonia (large-diameter oil and gas pipelines, underwater pipelines in the Baltic Sea).

The EIA procedure aims to promote the assessment and consistent consideration of environmental impacts in planning and decision-making. Another aim is to increase citizens' access to information and opportunities to participate in and influence project planning.

### 2.2.2 Stages and schedule of the EIA procedure

The EIA procedure consists of the program and report stages. The environmental impact assessment program (EIA program) is a plan for arranging an environmental impact assessment procedure and the required investigations. The environmental impact assessment report (EIA report) describes the project and its technical solutions and presents a consistent assessment of the environmental impacts based on the EIA procedure.

#### EIA program

The first stage of the EIA procedure involved the formulation of the EIA program. The EIA program includes a survey of the current status of the project area as well as a plan (working program) on the environmental impacts to be assessed and the implementation methods of the assessment. The EIA program also presents basic data on the project and the alternatives being examined as well as a communications plan for the project period and an estimate of the project schedule.

The Project Developers submitted the EIA program to the coordinating authority, the Uusimaa Centre for Economic Development, Transport and the Environment, on January 27, 2014. The coordinating authority announced the public display of the EIA program through media including local newspapers and its website. The EIA program was on display for statements and opinions between February 10 and April 7, 2014. The Uusimaa Centre for Economic Development, Transport and the Environment made a summary of the opinions and statements provided and issued its own statement regarding the program on May 7, 2014 (Appendix 1).

#### EIA report

This EIA report for Finland is a summary of the results of the assessment work based on the EIA program and the statements and opinions issued on it. The report covers the following issues:

- a description of the current status of the environment;
- the alternatives assessed;
- the environmental impacts of the project alternatives and the zero alternative as well as their significance;
- a comparison of the project alternatives;
- measures to prevent and mitigate adverse impacts;
- a proposal for an environmental impact assessment monitoring program;
- a description of interaction and participation during the EIA procedure;
- a description of how the coordinating authority's statement on the EIA program has been taken into account in the compilation of the EIA report.

The completion of the EIA report will be published in local newspapers and other publications selected by the authority, and the report will be placed on public display. During the period of public display, statements will be requested from authorities, and residents and other stakeholders will have the opportunity to submit their opinions to the coordinating authority, the Uusimaa Centre for Economic Development, Transport and the Environment. The coordinating authority will produce a summary of the statements and opinions provided on the report and, on the basis of these, issue its statement within two months of the termination of the display period. The EIA procedure ends when the coordinating authority submits its statement on the EIA report to the Project Developers.

The key stages and planned schedule of the EIA procedure are shown in the figure below. (Figure 2–2).

### 2.2.3 Parties to the EIA procedure

The Project Developers are Gasum Corporation and AS EG Võrguteenus. The coordinating authority of the project in Finland is the Uusimaa Centre for Economic Development, Transport and the Environment. The international consultation procedure is coordinated in Finland by the Ministry of the Environment.

This environmental impact assessment report for Finland was compiled by the consultant Pöyry Finland Oy. Also participating in the Finnish EIA in addition to experts from Pöyry Finland Oy were experts from Ramboll Finland Oy, Fish and Water Research Ltd, YVA Oy, Monivesi Oy, Geological Survey of Finland (GTK) as well as from the Finnish Environment Institute (SYKE) (IMPERIA). The experts taking part in the project's assessment, including their respective areas of responsibility, for Finland and Estonia are presented under the section on the EIA working group of the EIA report. A large group of experts (see section 6.3) also participated in the investigations and studies conducted during the EIA procedure.

The company responsible for the preparation of the EIA program and technical project design is Ramboll.

Key roles in the EIA procedure were also played by citizens and authorities representing a variety of sectors that have influenced the EIA procedure through contributions including submitting their statements and opinions. The parties participating in the EIA procedure of the project are illustrated in the figure (Figure 2–3).

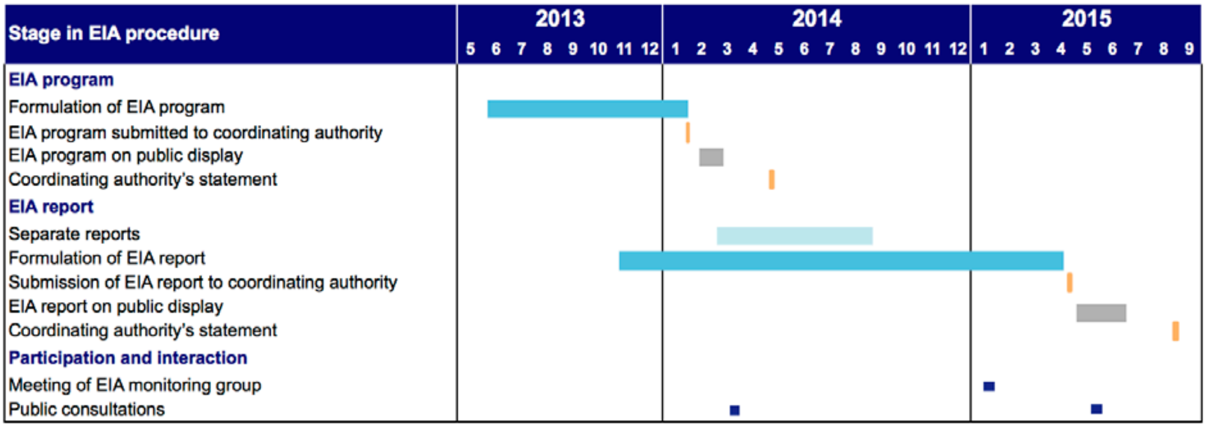



Figure 2-2. Planned schedule of the EIA procedure

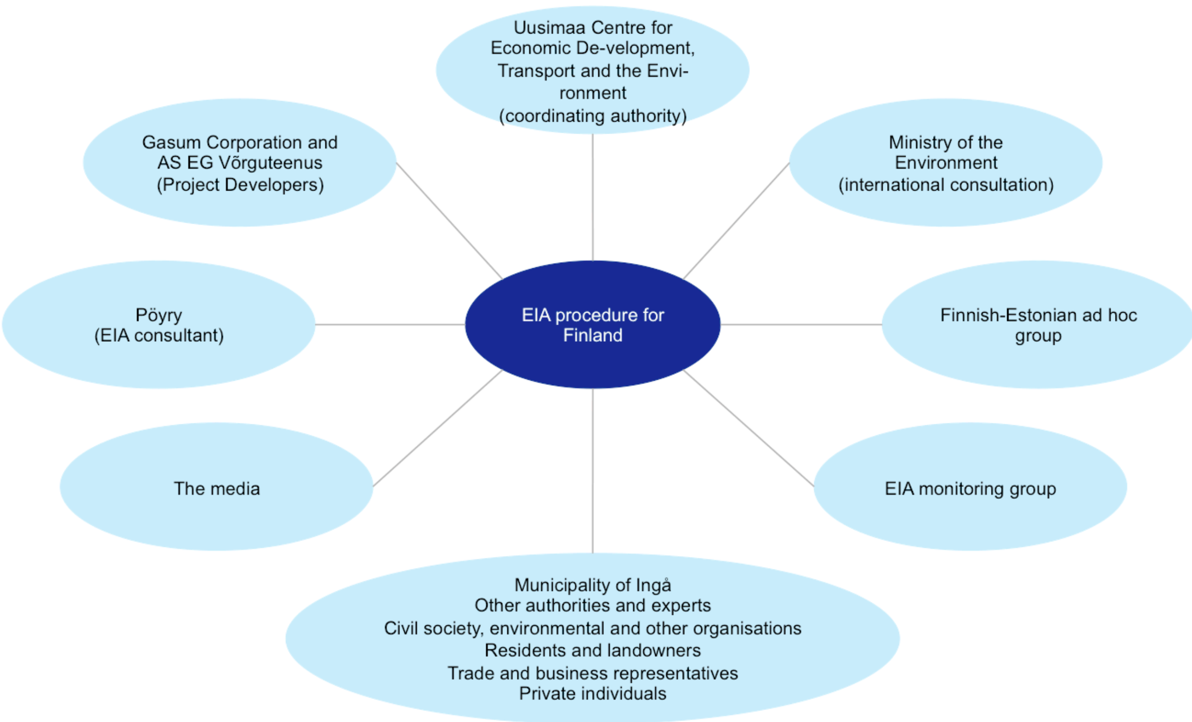



Figure 2-3. Parties participating in the EIA procedure for Finland.

### 2.2.4 Communications and participation

The EIA procedure is an open process in which residents and other interest groups can participate. Citizens have been able to participate in the project by presenting their opinions and views to the coordinating authority, the Uusimaa Centre for Economic Development, Transport and the Environment, and also to the Project Developers, i.e. Gasum and AS EG Võrguteenus, or to the EIA consultant. One of the main aims of this dialog has been to collect and utilize the views of the various parties during the EIA procedure.

#### Public information and discussion events

On March 25, 2014 a public event open to all was organized in Ingå on the EIA program. The project and the EIA program were presented at the event. The public had the opportunity to express their views and ask questions about the project, the alternatives considered and the EIA procedure. Around 20 people participated in the event. Themes raised particularly at the event included the opportunities of local residents to influence project planning and design, issues relating to compensation to landowners, environmental impacts of any blasting, and cumulative impacts with the LNG terminal planned for Ingå.

A corresponding public event will be organized following the completion of the EIA report in Ingå in May 2015. The results of the environmental impact assessment and the EIA report will be presented at the event. More detailed information about the event will be provided in local newspapers and other publications selected by the authority.

#### Monitoring group

A monitoring group was established for the EIA procedure to facilitate the flow and exchange of information with the Project Developer, authorities and other stakeholders. The monitoring group followed the progress made in the environmental impact assessment and provided opinions about the drawing up of the environmental impact assessment report and the supporting reports. In addition to the Project Developers and the consultant, representatives of the following were invited to the monitoring group:

- The Regional State Administrative Agency for Southern Finland;
- Bärösund Village Council;
- The Energy Authority;
- Environmental Health Care of Hanko, Ingo and Raseborg;
- The National Emergency Supply Agency;
- Inkoo Shipping Oy;
- Inkoon-Siuntion Ympäristöyhdistys ry/Ingå – Sjundeå Miljöförening rf environmental association;
- Ingå Fishing Region;
- Municipality of Ingå;
- The Finnish Transport Agency;
- The Provincial Museum of Western Uusimaa;
- The Association for Water and Environment of Western Uusimaa (LUVY);
- Navy Command Finland;
- Metsähallitus (the state enterprise administering state-owned land and waters;
- The National Board of Antiquities;
- Nylands fiskarförbund r.f. fishing association;
- Pro Ingå – Inkoo;
- The Finnish Game and Fisheries Research Institute (RKTL);
- The Finnish Association for Nature Conservation (FANC), Uusimaa Regional Chapter;
- The Finnish Environment Institute (SYKE);
- The Finnish Ministry of Employment and the Economy;
- The Finnish Safety and Chemicals Agency (Tukes);
- The Uusimaa Centre for Economic Development, Transport and the Environment;
- Uusimaa Regional Council;
- Ingå Marina.

The monitoring group had a meeting on January 1, 2015 to discuss the draft EIA report. The group discussed impacts of project construction on individual people as well as impacts on sensitive receptors such as fish spawning areas and bird islets in particular. Also brought up among project impacts during construction were the potential adverse impacts and restrictions on swimming beaches and safety-related impacts during construction and operation. The ways in which river basin management and marine strategy objectives as well as underwater cultural heritage items (shipwrecks) should be taken into account in the EIA report were also discussed. The monitoring group's comments have been taken into account in the EIA report.

#### Other communications

Information about the project and its environmental impact assessment has also been provided in conjunction with general communications, such as press releases, press articles and the Project Developers' websites.

In the interaction carried out during the EIA procedure, the views of local stakeholders regarding the sufficiency of access to information was monitored.

#### Interaction between planning and EIA

The EIA report as well as the stakeholder interaction carried out and the material acquired during the EIA procedure will provide important support to more specific planning and design concerning the project. One of the objectives of the EIA procedure is to support the project planning process by producing information about the project's environmental impacts. The aim is to produce information at the earliest possible planning and design stage so that environmental impacts are taken into consideration throughout the planning and design process from the very beginning. The EIA report and the coordinating authority's statement on it will be appended to any permit and license applications relating to the project, and the permitting authorities will use them as basic data in their decision-making.

### 2.2.5 Coordinating authority's statement on the EIA program

The Uusimaa Centre for Economic Development, Transport and the Environment issued its statement regarding the project's EIA program on May 7, 2014. According to the statement, the EIA program meets the content requirements set for it in EIA legislation and its processing is in compliance with EIA legislation.

The table below (Table 2–1) presents the issues to which attention should be paid during the impact assessment work and in the drawing up of the EIA report according to the coordinating authority's statement. The right-hand column of the table presents how the coordinating authority's statement was taken into consideration in the assessment work.

The requirements set for the assessment work by the Estonian coordinating authority (Ministry of the Environment) in its approval decision of July 15, 214 were taken into consideration in the formulation of the EIA report for Estonia (summary provided in Appendix 4). Issues raised by the Estonian coordinating authority as those that are the most significant for consideration in Estonia include the project's impacts on water quality and Natura sites in the Gulf of Finland and on the coast of Estonia.

Table 2–1. Report on how the requirements set in the coordinating authority's statement were taken into account in the assessment work.

| Coordinating authority's statement | How the statement was taken into account/comments |
|---|---|
| **Project description** | |
| To conduct a specific assessment, data on the project and current environmental status must in part be supplemented and made more specific.<br><br>Sufficiently detailed map data is necessary for the assessment of the suitability of the proposed routing alternatives and any need for further studies. In addition, the project's land use needs and the need for seabed intervention, as well as the construction phases and methods, including munitions clearance, pipelaying, pipelaying fleet and equipment, subsea rock installation and crossing structures, must be presented and assessed clearly and in detail. The report must also present the type of rock material to be used and the source and transport method of the rock material. The environmental impacts of the pressure test conducted during the pre-commissioning phase must be studied and assessed more specifically. | The data as well as the descriptions of the project and current environmental status presented in the EIA program were updated and supplemented for the EIA report. The assessments presented in the EIA report were illustrated with maps.<br><br>The project's land use needs are presented in section 8.11. Preliminary assessments of the seabed intervention measures and quantities required as well as the construction phases and methods are described in chapter 3. The preliminary assessments are conservative and issues such as the quantity of rock to be installed on the seabed and the need for seabed intervention are like to be reduced considerably once progress is made in the technical design of the project (route optimization). The crossing cables and other structures have been described on the basis of preliminary scanning data. Underwater studies will be specified further and all structures relevant to the project will be studied in great detail in further stages of the project.<br><br>It is not yet known during the project's EIA procedure from which quarry the rock material to be installed on the seabed and on top of the pipeline will be sourced; the specific type cannot be assessed yet. However, project's logistics will be designed with a view to minimizing rock transport distances for the land and offshore sections.<br><br>The environmental impacts of the pressure test conducted during pre-commissioning have been assessed at a general level. The assessment can be specified further once the technical design data relating to the pressure test have been specified further. |

| Coordinating authority's statement | How the statement was taken into account/comments |
|---|---|
| **Examination of alternatives** | |
| Several routing alternatives must be presented in the EIA report. The precautionary principle must be followed in project design and implementation, and the best alternative from the environmental perspective must be proposed for the gas pipeline in the EIA report. Any need to supplement Natura 2000 sites must also be taken into consideration in the route selection.<br><br>Furthermore, the coordinating authority finds that the previously examined routing alternatives of the project must be presented in greater detail, and their exclusion from the shortlist and the inclusion of the current alternatives must be justified.<br><br>The EIA program only presents one natural gas pipeline landfall site, and this site is not in compliance with the local detailed plan currently in effect. More landfall alternatives must be presented and the inclusion of the alternatives must be justified in the EIA report. | The EIA report contains a description of the routing alternatives examined earlier as well as a justification of their exclusion. The current routing was eventually adopted on the basis of these routing alternatives examined before (for more details see section 1.3.1). Route optimization will continue once progress is made in technical design. A route within the examined study corridor that is 275–975 m wide will be sought for the pipeline with a view to ensuring issues such as minimizing seabed intervention.<br><br>In addition to the entire pipeline route, the Finnish EIA report also includes examinations and comparisons of the environmental impacts of two different routing alternatives (ALT FIN 1 and ALT FIN 2) and two different landfall sites (LF1 and LF2).<br><br>The Ingå archipelago is not included in current habitat type supplementation schemes. There is also no data concerning the area about the occurrence of underwater habitat types on the basis of which the area could be examined as an area for inclusion in Natura 2000 sites. |
| **Strategies, programs and plans concerning the project and project area** | |
| All acts, decrees, environmental agreements, programs and policies as well as the EU maritime spatial planning directive currently under preparation relevant to the project or project area must be presented and taken into consideration in the EIA report.<br><br>The EIA report must also contain a description of how the strategic objectives and measures of the Finnish marine strategy will be taken into account in project design, implementation and operation. | The licenses, permits, plans and decisions required for the project are presented in chapter 3. The project's relationship with programs concerning the use of natural resources and environmental protection is described in section 4.2. Impacts on river basin management and marine strategy status objectives are taken into account in section 8.18 All legislation relevant to the project is also presented and taken into account in the assessments specific to each receptor. |
| **Investigation of impacts and assessment of significance** | |
| The methods used to assess the project's impacts are presented insufficiently and must be presented in greater detail in the report. Route investigations and optimization must be carried out with a view to minimizing seabed intervention. The aim of route optimization for sections outside near-shore shallows must be to avoid blasting, dredging or other heavy seabed intervention methods.<br><br>Efforts must be made to minimize the length of the pipeline section for which protection measures are found necessary. In coastal shallows where the pipeline must be protected for reasons including safety aspects, it must be determined whether burying the pipeline into the seabed or covering it with rock is the preferred option from the environmental perspective. The impacts of the alternative methods must be assessed and the adverse impacts of measures must be minimized.<br><br>The scopings of the various affected areas must be presented and justified in the EIA report. | The project's impact assessment methods are presented in the EIA report specifically to each receptor. Route optimization will continue once progress is made in technical design. A route within the examined study corridor that is 275–975 m wide will be sought for the pipeline with a view to ensuring issues such as minimizing seabed intervention and pipeline protection needs. Route optimization will be essentially affected by the results of the assessment work and recommendations presented in this EIA report.<br><br>In the Balticconnector project, a dynamically positioned pipelaying vessel will be used in offshore areas and, wherever possible in areas where it is not possible to use a dynamically positioned pipelaying vessel (coastal areas), pipelaying and anchor-handling vessels that are as small as possible will be used to minimize environmental impacts. The use of an anchored pipelaying vessel requires the detailed preparation of construction measures where the anchoring methods employed are determined precisely.<br><br>The environmental impact assessments were conducted on the basis of preliminary, conservative data and in accordance with the worst-case scenarios, whereby the project's environmental impacts are not likely to increase from the assessed levels once more specific construction methods are available.<br><br>The EIA report presents the scopings of the various affected areas by impact element as well as in general in chapter 8. |

| Coordinating authority's statement | How the statement was taken into account/comments |
|---|---|
| **Impacts on the Gulf of Finland** | |
| A diverse description of the status of the Gulf of Finland is provided, but the description must be supplemented in the EIA report using existing data, such as monitoring results, as well as data obtained from further studies. The figures provided for issues such as the oxygen situation of the Gulf of Finland illustrate the oxygen situation in the deep sections of the Gulf of Finland but do not illustrate the situation in areas off Ingå or in coastal areas in general.<br><br>The nature of impacts on water bodies is identified well in the EIA program, with the principles of impact assessment and the need for studies presented clearly on the basis of this. However, the description of existing data and planned studies is very non-specific, which makes it difficult to assess their sufficiency. Impacts must be assessed in all respects with such a level of detail that the differences between the alternatives can be assessed reliably. Impacts on all of the long-term stations monitoring the status of the marine environment in the project area must also be assessed.<br><br>Work methods and measures including those on the seabed are presented at a very general level, and more specific data must be obtained for the impact assessment on issues such as excavation, dredging and subsea rock installation as regards both quantities of materials and the location of measures.<br><br>The Project Developer must assess the project's impacts on the achievement of the objectives set for the status of waters and, as regards river basin management, concerning coastal water bodies, and, as regards marine strategy, concerning marine waters in the entire territory of Finland. | The description of the current status of the project area was supplemented for the EIA report, and the results of the water system modeling conducted for the project, results of monitoring carried out during the construction of the Nord Stream gas pipeline as well as monitoring results and conclusions concerning other marine works projects, such as fairway and harbor dredging operations, were utilized in the impact assessments.<br><br>More specific data is provided in the EIA report particularly on coastal areas near the pipeline routing, and a description of the area off the coast of Ingå concerning issues such as the oxygen situation and other water quality is provided in section 7.2.<br><br>The ecological status of the landfall area and marine areas of the project area as well as the project's potential impacts on it were taken into account in the impact assessments conducted.<br><br>Environmental impacts were assessed concerning offshore as well as coastal areas. The alternatives were compared and their feasibility assessed. There are stations for the long-term monitoring of the status of the marine environment maintained by the Finnish Environment Institute and the Uusimaa Centre for Economic Development, Transport and the Environment in the area affected by the natural gas pipeline. The locations of the stations are shown on a map in section 7.2. The short-term turbidity caused by pipeline construction is not assessed to have a decisive impact on the water quality and zoobenthos monitoring carried out at local stations.<br><br>Construction methods and seabed intervention measures are described on the basis of preliminary technical design data in chapter 3. The estimates are conservative; the quantities are likely to be reduced once more specific technical designs are available.<br><br>The project's impacts were assessed for coastal water bodies as well as marine waters in the entire territory of Finland. |

| Coordinating authority's statement | How the statement was taken into account/comments |
|---|---|
| **Impacts on the natural environment** | |
| Nature surveys produced previously for the area must be taken into account in the preparation of the report. Moor frog and breeding bird surveys must also be conducted concerning the Fjusö area. Up-to-date information must be provided about the number of seals in the area affected by the project.<br><br>Impacts during natural gas pipeline construction and operation on the Kallbädan Natura 2000 site, which is significant for the protection of the gray seal, and on other areas where seals occur must be studied. Pipeline construction must be implemented and scheduled in a manner minimizing adverse impacts on seals.<br><br>The motivation for the establishment of the Ingå archipelago Natura 2000 site is primarily based on the bird values of the area. There are two significant resting sites of Long-tailed Duck, a globally Vulnerable (VU) species, in the marine area close to the gas pipeline routing. To establish the more specific area and significance of the resting sites, a survey of migrating birds resting in the Ingå archipelago Natura 2000 site must conducted.<br><br>It is proposed in the EIA program that the screening to establish the need for a Natura 2000 assessment be conducted during the EIA procedure. The coordinating authority states that there is a need to supplement the Natura 2000 network for underwater habitat types, mainly reefs and sandbanks. These habitat types may be found in the area affected by the planned gas pipeline, whereby the assessment must cover the impacts of the alternatives on any areas to be included in Natura 2000 sites. | Previously conducted nature surveys were taken into account in the assessments conducted. The nature surveys taken into account are described in sections 6.3, 7.7 and 8.10. A comprehensive nature survey was carried out in the Fjusö area, also covering moor frogs and breeding birds. A bird survey was conducted in the Ingå archipelago area, covering breeding birds and birds resting during migration in the Natura site, and this was taken into account in the assessments conducted.<br><br>As regards seals, a study based on monitoring data from the Finnish Game and Fisheries Institute (RKTL) was also conducted, with the results described in section 7.7. The results of the study and the impacts on the Kallbådan seal conservation area are described in section 8.10.<br><br>According to the Natura 2000 assessment screening conducted during the EIA procedure, the project may have impacts on the species listed in the Birds Directive due to which the Natura site was established as well as on birds resting regularly in the area, but these impacts are assessed to be low and temporary.<br><br>The Ingå archipelago is not included in current habitat type supplementation schemes. There is also no data concerning the area about the occurrence of underwater habitat types on the basis of which the area could be examined as an area for inclusion in Natura 2000 sites. The Natura 2000 assessment screening report can be found in Appendix 2. |
| **Impacts on fish and fisheries** | |
| The description of the fisheries impacts assessment methods is non-specific. The EIA program does not provide a sufficient amount information about existing research data that can be utilized, new studies to be conducted or methods to be employed in them. The program does not specify the areas in which studies will be conducted either.<br><br>The description of the fisheries impacts assessment methods must also be specified further by describing the potential impacts on fisheries during construction and operation. As regards impacts during construction, the report must also specify which existing research data has been utilized, which new studies have been conducted and which methods have been employed in the sourcing of research data.<br><br>The EIA report must present the current fishing areas in areas around the pipeline routing on a map to facilitate the assessment of the pipeline and pipelaying measures on fishing. | The descriptions of current status and the impact assessment relating to fish and fisheries are based on existing research data as well as surveys and studies conducted during the project, which are presented, with methodological descriptions included, in section 8.5.<br><br>The fishing areas around the pipeline routing are presented on maps in section 7.3. The project's impacts on fishing areas are assessed concerning construction and operation. |

| Coordinating authority's statement | How the statement was taken into account/comments |
|---|---|
| **Noise impacts** | |
| Assessments of noise during construction and operation must be conducted in compliance with the following decisions and limit values: Commission decision on criteria and methodological standards on good environmental status of marine waters (2010/477/EU) and Government resolution on Finland's marine strategy (first part).<br><br>The EIA report must present as well as possible the various noise-generating activities or processes as regards durations, locations and the incidence of any recurring noise events as well as the propagation of noise generated by these into the environment. If an activity may cause temporary high-noise events, these and the noise generated must be described separately, with the calculations presenting the equivalent continuous sound level during such activity as well as maximum sound level caused by the activity in the surrounding area. The EIA report must also provide a clear presentation of the noise abatement measures or best available technologies that will be used to mitigate noise propagation in the environment.<br><br>As regards noise relating to construction, the report must present how adverse impacts caused by activities generating high noise and pressure levels, such as blasting and other excavation, on organisms in the area can be reduced. In addition, the potential impacts of these activities on humans and any restrictions on use of areas during the construction phase (such as duration and location of activities) must be presented. | Underwater noise calculations for the construction period were carried throughout the pipeline route and for the different project alternatives. The sensitive areas (protected areas) located in the vicinity of the pipeline route and the impact of noise on them were taken into particular consideration in the noise calculations.<br><br>In the conservative assessment given in the EIA report (see section 8.6) it is assumed that only blasting will be employed for excavation (the level of noise arising from dredging is lower than that from blasts). Blasting may cause adverse impacts on marine organisms in the area. The EIA report presents the safe distances for unconfined and confined charges as regards marine mammals (Table 8-7). Underwater noise levels during pipelaying and excavation are also presented for noise level points at the perimeters of nature reserves and the Natura site (Figure 8-29). The safe distances given designate the near-field shock pressure wave effect. These safe distances must be complied with during blasting, and mitigation measures must be implemented to prevent injuries in marine organisms, particularly mammals, caused by blasting operations.<br><br>Onshore environmental noise arising from the construction and normal operation of the natural gas pipeline was assessed on the basis of noise modeling for each alternative (see section 8.6.2.1).<br><br>The impacts on noise generated by the project on humans are described in section 8.13. The restrictions on vessel traffic during project construction are described in section 8.8, on fishing in section 8.5 and on land use in section 8.11. |
| **Impacts on land use** | |
| The EIA report must present the up-to-date statutory land use planning situation and the clearest land use plan maps. The plan notations given in plans concerning the area must also be elaborated in the report.<br><br>The Helsinki-Uusimaa regional land use plan and first-phase Helsinki-Uusimaa regional land use plan are in effect for the area. The onshore section of the planned natural gas pipeline in Joddböle runs through an area designated as an industrial area with rock resources in the regional land use plan. The reconciliation of the project and the use of the area's rock resources as well as the cumulative impacts with known projects must be examined in the EIA report. In the marine area the pipeline alternatives run through an area designated as a Natura site in the regional land use plan.<br><br>Any need for amendments to the local detailed plan of Joddböle must be examined. | Up-to-date land use planning situation and related land use plan maps can be found in section 7.8. Plan notations relating to the project area are elaborated in the text.<br><br>The cumulative impacts of known projects and the Balticconnector project are assessed in section 8.20. The relationship of the project with land reservations and other plan notations in plans, including regional land use plans, is also described in the report.<br><br>The project is likely to require an amendment to the Joddböle local detailed plan if LF2 is selected. |

| Coordinating authority's statement | How the statement was taken into account/comments |
|---|---|
| **Impacts on archaeological cultural heritage, cultural environment and landscape** | |
| Regionally valuable cultural environments must be updated to the report in accordance with the latest data. These can be found appended to the second-phase Helsinki-Uusimaa regional land use plan and are based on a study conducted on the topic (Uusimaa Regional Council 2012).<br><br>A clear map must be provided on the known ancient monuments in and close to the project area. The map of shipwreck sites must be supplemented. If any ancient monuments are detected, the mitigation of adverse impacts and the procedure under the Antiquities Act must be agreed upon with the National Board of Antiquities. It is important to determine reliably in conjunction with the preparation and design of the Balticconnector project whether there are any underwater cultural heritage and ancient monument sites in the area covered by the marine works relating to the project. This must be examined through an underwater archaeological inventory carried out by an expert, with an inventory report also produced. The Antiquities Act does not apply to the Exclusive Economic Zone (EEZ), but it must also be ensured for the EEZ as well that an inventory is conducted on the pipeline routing to detect any cultural heritage sites and it must be ensured in project design that cultural heritage items and sites are not destroyed or damaged in conjunction with the project. | The regionally valuable cultural environments in accordance with the material appended to the second-phase Helsinki-Uusimaa regional land use plan are presented in the EIA report.<br><br>The on-shore ancient monuments were identified on the basis of data from the Registry of Ancient Monuments of the National Board of Antiquities (2014) and an ancient monuments inventory carried out in summer 2014 (*Mikroliitti Oy 2014*) and presented on a map in section 8.12.<br><br>The underwater cultural heritage found on Finnish territory was surveyed in conjunction with the Balticconnector project on the basis of previous inventory data (incl. *National Board of Antiquities 2014*) and the first stage of the underwater archaeological inventory based on side-scan sonar data (*SubZone Oy 2014*). The underwater cultural heritage sites, previously known and any potential new ones alike, covered by the survey are shown on a map in section 8.12.<br><br>Once progress is made in project design, more detailed studies concerning known or any new fixed ancient underwater monuments located in the immediate vicinity of the pipeline routing will be carried out throughout the pipeline routing. The studies will be programmed in cooperation with the National Board of Antiquities. |
| **Traffic impacts** | |
| The Project Developer must contact the Finnish Transport Agency and agree on the studies required for detailed design. Vessels used for exploration and installation work must maintain continuous contact with Finnish and Estonian traffic control centers and comply with instructions provided by the centers as well as International Regulations for Preventing Collisions at Sea (COLREGs) as well as national rules of the road at sea.<br><br>The Project Developer must submit the coordinates of the pipeline to be implemented in good time to the Finnish Transport Agency for inclusion on nautical charts to inform other seafarers. Guidelines provided by the Finnish Transport Agency must be followed in pipeline installation and signposting. As regards impact on road traffic, the scale, routes and sufficiency of the local road network for these must be studied in particular. In addition, any traffic safety risks relating to land transport must be investigated. | The rate of road transport in the Balticconnector project will be low compared with the waterborne traffic volumes. The project's impacts on waterborne and road traffic are covered in section 8.8.<br><br>Road traffic will be generated by the construction of the onshore pipeline section from the landfall site to the compressor station (transport of soil, rock, pipes and machinery as well as employee traffic necessary). The routes to be used are yet to be planned at this stage; the sufficiency of the local road network will be studied once more detailed design data is available. Traffic safety risks were assessed concerning waterborne and road traffic.<br><br>Waterborne traffic will be generated by seabed intervention, subsea rock installation and pipelaying work.<br><br>Road and waterborne traffic will be generated during pipeline operation due to various inspection and maintenance measures. Traffic volumes during operation will be low.<br><br>The project's impacts on traffic safety are discussed in section 8.16. |

| Coordinating authority's statement | How the statement was taken into account/comments |
|---|---|
| **Cumulative impacts with other projects and activities** | |
| Other projects, including relevant rights, located in or planned for the area affected by the project must be taken into account in all activities and the precautionary principle must be followed in the project. The routing, construction and operation of the natural gas pipeline must be planned and implemented in a manner not preventing current or future scientific research or commercial exploitation projects in the EEZ and ensuring that the adverse impacts caused by the project on such project will be as low as possible.<br><br>The information provided in the EIA program concerning other projects is insufficient (e.g. the expanding operations of Rudus and the Ingå power plant ash deposition site were not mentioned and the location given for the planned LNG terminal is incorrect). According to feedback received, the planned gas pipeline will also intersect with onshore items (oil pipeline, water and sewage pipe, planned road to the fishing harbor). The coordinating authority finds that the appropriate assessment of the cumulative impacts will require updates to the information provided in the EIA report. | The routings of the onshore sections of the Balticconnector pipeline have changed since the EIA program phase. The location of the LNG terminal has also changed. Information about projects with potential cumulative impacts were reviewed for the EIA report, and projects that may have cumulative impacts with the Balticconnector project were taken into account in the assessments. The projects are shown on maps and their potential cumulative impacts are described in section 8.20. |
| **Impacts on safety and people's living conditions** | |
| Risks posed by accidents and incidents to local residents and environment must be presented clearly in the EIA report. Furthermore, the procedures to prevent and control damage must be described.<br><br>Any impacts on the utilization of fish for human consumption must be taken into account in the impact assessment.<br><br>The impacts of turbidity will need to be assessed also as regards impacts on bathing water in the area affected by the project. | Risks posed by accidents and incidents to local residents and environment are assessed in the EIA report. A map is also provided to illustrate the risks (section 8.16). The procedure to prevent and control damage is also described in the same section.<br><br>Turbidity during construction can be regarded as only causing minor adverse impacts on fishing. Local turbidity, changes in seabed topography, any blasting and dredging impacts during construction will be short-term and local. The project's impacts on fish and fisheries are presented in section 8.5 and those on people in section 8.13. |
| **Monitoring** | |
| A proposal for a monitoring program concerning the project's impacts must be presented in the EIA report. Monitoring must take place before and during construction as well as during operation. The aim of monitoring is to obtain information about the project's impacts on the environment and the success of the mitigation measures and to identify any unexpected impacts caused by the project. | Monitoring recommendations for each impact element are provided in chapter 10 of the EIA report. |
| **Other points** | |
| | The points mentioned have been corrected for the EIA report. |

## 2.3 EIA procedure in Estonia

In Estonia the objective of environmental impact assessment (EIA) under the Environmental Impact Assessment and Environmental Management System Act is:

1. to make a proposal regarding the choice of the most feasible solution for the proposed activities based on the results of the EIA. This makes it possible to prevent or reduce damage to the state of environment and to promote sustainable development;
2. to provide information to the permitting authority on the environmental impacts of the proposed activity and feasible alternatives, and the possibilities to prevent or minimize negative environmental impacts;
3. to allow the results of the EIA to be taken into account in the proceedings for issuing a development consent.

Environmental impacts must be assessed: 1) upon application for or application for amendment of a development consent if the proposed activity on which is the basis for application for or amendment of the development consent is based potentially results in significant environmental impact; 2) if activities are proposed which either alone, or in conjunction with other activities, may have the potential to significantly affect a Natura 2000 site.

Environmental impact is significant if it may potentially exceed the environmental capacity of a site, as irreversible changes to the environment endanger human health and well-being, the environment, cultural heritage or property.

An EIA is mandatory for the construction of pipelines for the transport of natural gas, or main pipelines for the transport of petroleum or chemical products or other liquids, with a diameter of more than 800 mm and a length of more than 40 km.

Under the EIA Act, the EIA must be carried out by an expert holding an EIA license (issued by the Ministry of the Environment). *(Ramboll 2013a)*

### 2.3.1 Initiation of the EIA procedure

In order to initiate the EIA procedure for Estonia, the Estonian Project Developer submitted an application (superficies license) to the permitting authority, which made the decision to initiate the EIA procedure. The permitting authority in Estonia is the Ministry of Economic Affairs and Communication (MEAC). The Estonian Ministry of the Environment (MoE) acts as the EIA supervisor for the Balticconnector project (transboundary EIA).

Following consultations with the MoE and the MEAC (March 2013), it was agreed that the Project Developers will submit the application for a superficies license to the MEAC. On the basis of a proposal by the MEAC, the Estonian Government made the decision to initiate the superficies license proceedings, and the EIA procedure was initiated. Following the initiation of the EIA procedure, the license application proceedings will be suspended until the approval of the EIA report.

The purpose of the EIA is to provide information about the potential impacts to all of the permitting authorities that will make decisions on permits and licenses relating to the Balticconnector project (including superficies license, permit for the special use of water, building permit) and consider the need for the EIA procedure in conjunction with permit processing. *(Ramboll 2013a)*

The initiation of the EIA is followed by the EIA procedure, which comprises two stages (Figure 2-4). The EIA program stage and the EIA report stage are described in greater detail in the following subsections.

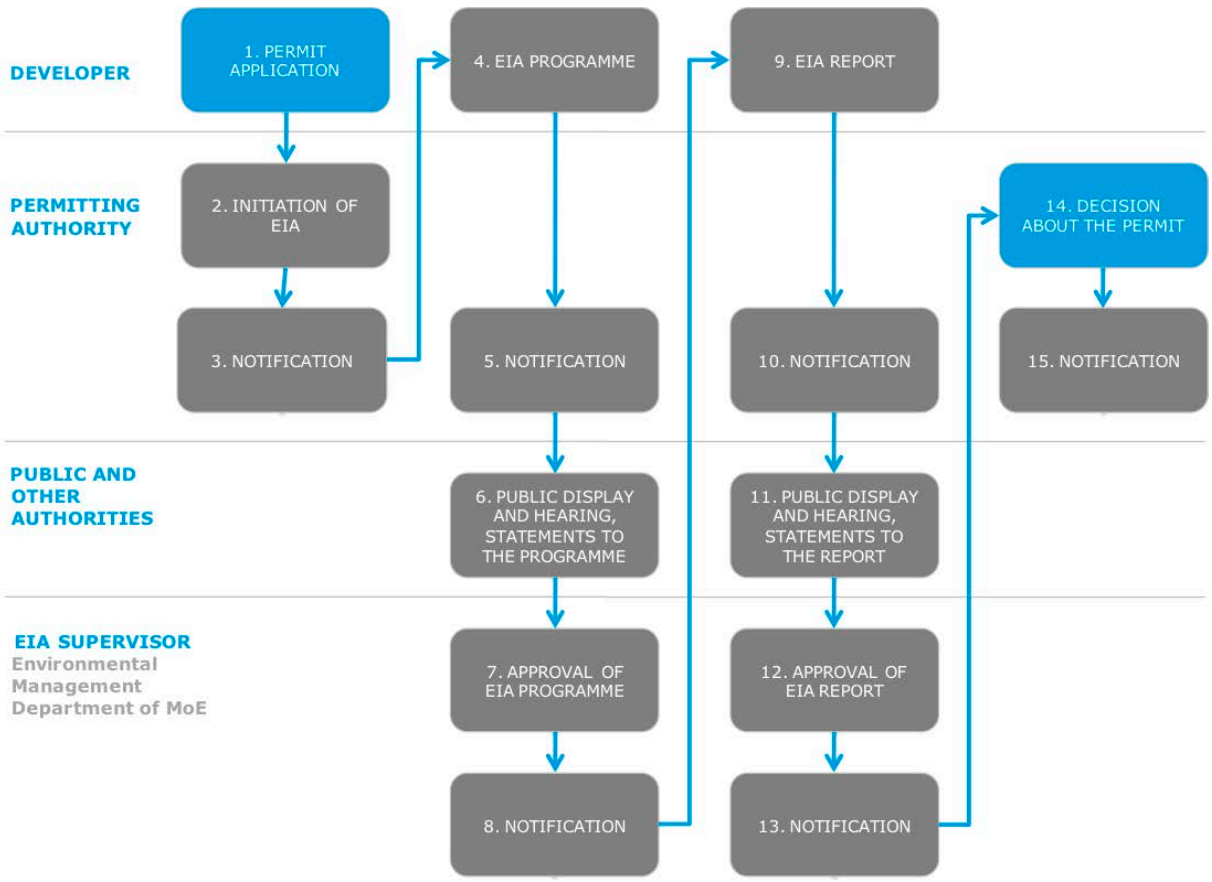



Figure 2-4. EIA procedure in Estonia. *(Ramboll 2013a)*

### 2.3.2 EIA program phase

The EIA program was compiled by a licensed EIA expert, the EIA working group and the Project Developer. The Project Developer submitted the EIA program to the permitting authority, which organized the public display of the program. The permitting authority identified the interested parties (persons, authorities and organizations) who had to be provided with the public notification.

The permitting authority notified of the publication (public display, public consultation) within 14 days after the receipt of the program. The permitting authority placed the program on public display for approximately two months (February 10 to April 7, 2014). The duration of the public display was decided in cooperation with the coordinating authorities in Estonia and Finland. The public display commenced at the same time in Estonia and Finland. The public consultation event was organized by the Project Developer.

During the public display, everyone had the right to make proposals and issue statements as well as ask questions about the EIA program. The proposals were submitted to the permitting authority.

Following the public consultation, the party responsible for the project compiled and sent its responses to those who had given proposals, statements and questions concerning the EIA program. The EIA program was reviewed on the basis of the feedback received after its publication, and the publication material (public notifications, memorandum on the public consultation, letters received and responses to them) were added to the program before it was submitted for approval. *(Ramboll 2013a)*

The Project Developer submitted the reviewed EIA program to the Estonian MoE on May 23, 2014. Due to certain incompletions found in the EIA program, the supplementation of the program was requested by the supervisor by a letter dated June 20, 2014. The supplemented and revised EIA program was re-submitted for approval on June 30, 2014. The MoE issued its decision on the approval of the EIA program by letter no 11-2/14/1093-9 of July 15, 2014. The MoE notified interested parties of its decision through official notifications and by letter within 14 days of the date of the decision.

### 2.3.3 EIA report phase

The EIA report was produced by the licensed EIA expert and the EIA working group. The publication of the EIA report is notified by the permitting authority in the same was as that of the EIA program. The requirements set for the publication and review of the EIA report are similar to those set for the EIA program.

Following the review of the EIA report, the Project Developer will submit it to the Ministry of the Environment (MoE) for approval and for the determination of environmental requirements. The MoE will make a decision on the approval of the EIA report within 30 days after receipt of the report and related material and inform the Project Developer and the permitting authority about its decision. A copy of the EIA report will be submitted by the MoE to the permitting authority.

The MoE will inform interested parties about the approval of the EIA report and the determination of environmental requirements through official notifications and by letter within 14 days of the date of decision. The EIA procedure concludes with the approval of the EIA report by the MoE/EIA supervisor. *(Ramboll 2013a)*

### 2.3.4 Permitting phase

The permit application process will continue after the approval of the EIA report. The permitting authority must take into consideration the results of the EIA procedure and the environmental requirements determined by the EIA supervisor.

If the results of the EIA procedure and the environmental requirements are not taken into account, the permitting authority must provide an argumented justification for the decision to issue or refuse issue of the permit. A permit may not be issued if the Project Developer is unable to comply with the determined environmental requirements. *(Ramboll 2013a)*

# 3 TECHNICAL DESCRIPTION OF THE PROJECT

## 3.1 Project design stages

In the EIA procedure phase of the Balticconnector project, technical design has progressed to the preliminary technical design phase, on which the project's design and technical data described in this chapter are based *(Ramboll 2014a)*.

The field and environmental studies conducted during the project are described in section 6.3. The overall schedule of the Balticconnector project is shown in the figure (Figure 1-7).

Preliminary assessments of the need for seabed intervention were carried out in the stage preceding the Front End Engineering Design (FEED) stage. Off the Finnish coast in particular, the seabed is very uneven and the need for intervention high. In the FEED stage pipeline route optimization will continue, which is likely to reduce the need for seabed intervention from the levels presented in this EIA report.

A pipeline Kilometer Post (KP) system has been established for the entire Balticconnector pipeline. For the offshore pipeline, KP 0.000 was set at the tie-in weld between the offshore and onshore pipeline at the landfall in Ingå, Finland. The KP numbering increases towards south (Figure 3-1).

## 3.2 Properties of natural gas

Natural gas is a fossil fuel which, due to its low carbon and high hydrogen content, produces less carbon dioxide ($CO_2$) emissions than other fossil fuels when combusted. The specific emission of carbon dioxide from gas combustion is 55 g/MJ, while the figures for coal and peat are 95 g/MJ and 106 g/MJ, respectively. Natural gas is also practically sulfur-free, does not cause particulate emissions and its nitrogen oxide emissions are clearly below those of other fossil fuels.

Natural gas is odorless (but odorized in the distribution network), colorless and non-toxic and does not cause corrosion. Natural gas has a narrow flammability range with air and a high ignition temperature. If there is a leak, natural gas vaporizes immediately and evaporates into the air, and it does not mix with seawater. The typical natural gas composition in the Finnish natural gas pipeline network is shown in the table below (Table 3-1). This is a typical composition, but there may be some variation depending on whether gas will come from the LNG terminal or the gas network.

Table 3-1. The typical natural gas composition in the Finnish natural gas pipeline network in Finland.

| Component | Mole (%) |
|---|---|
| Methane ($CH_4$) | 90.33 |
| Ethane, $C_2H_6$ | 5.00 |
| Propane, $C_3H_8$ | 2.50 |
| i-butane, i-$C_4H_{10}$ | 0.68 |
| n-butane, n-C4H10 | 0.67 |
| i-pentane, i-$C_5H_{12}$ | 0.15 |
| n-pentane, n-$C_5H_{12}$ | 0.15 |
| $C_6$+ | 0.17 |
| Carbon dioxide, $CO_2$ | 0.20 |
| Nitrogen, N | 0.15 |

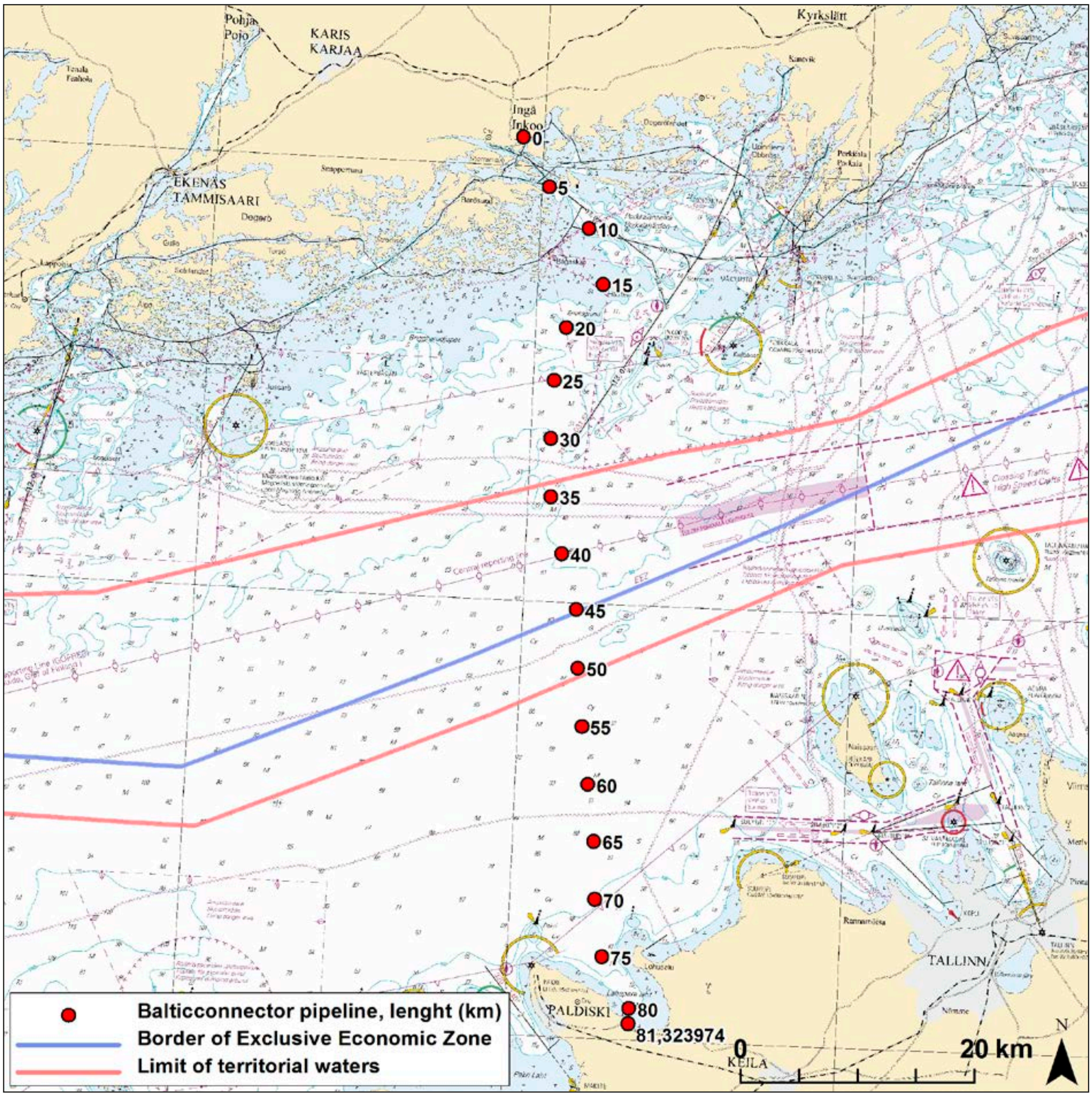



Figure 3-1. Kilometer Posts (KP) along the Balticconnector pipeline route.

## 3.3 Technical characteristics of the natural gas pipeline

The Balticconnector pipeline's length will be approximately 81 km and diameter 508 mm. Its capacity will be around 7.2 million m³/day, i.e. around 300,000 Nm³/h. The design pressure for the pipeline is 80 barg. The pipeline's operational life is expected to be 50 years.

The pipeline will be constructed from carbon steel line pipes, each 12.2 m in length, which will be welded together. The thickness of the steel line pipes is based on the maximum allowable operating pressure, prevention of external collapse and resistance to external impact. According to preliminary calculations, the wall thickness for the Balticconnector line pipes will be 12.7 mm, which is sufficient to protect the pipeline against collapse during construction, whereby separate support structures will not be needed.

### 3.3.1 Pipeline coating

#### Anti-corrosion coating

To reduce friction and improve flow conditions, the line pipes will be internally coated at the pipe manufacturing site with an epoxy-based material covering the entire pipeline length.

Figure 3-2. Line pipe with a (black) polyethylene coating inside a concrete coating. (*Ramboll 2013aa*)

An external coating will also be applied at the pipe manufacturing site using a three-layer polyethylene coating or, alternatively, an asphalt enamel coating. The pipeline will be coated over its entire length, except for the welded joints at the end of the pipes (Figure 3-2). The manufacturing site of the line pipes is not yet known at this point in project design.

### Concrete weight coating

The line pipes will be coated over their entire length, excluding their ends (the joints welded together on the pipelaying vessel), at a concrete coating facility to provide them with stability against hydrodynamic loading caused by waves and currents during construction and usage. The concrete coating will also protect the pipeline against damage caused by fishing gear, such as trawls. The concrete will comprise a mix of cement suitable for marine use, water and aggregate such as crushed rock or gravel as well as iron ore aggregate added to the mixture. The concrete coating will also be reinforced with steel cages. According to preliminary plans, the line pipes for the Balticconnector project will be coated at an existing northern-European concrete-coating facility.

The line pipes will be welded together on the pipe-laying vessel. After welding, the field joints will be insulated with a (polyethene) heat-shrink sleeve and polyurethane foam, which will protect the field joints against damage such as fishing trawl impact. The total consumption of pipeline coating system and insulation materials is shown in the table below (Table 3-2).

### 3.3.2 Protection against corrosion

In addition to the (passive) anti-corrosion systems, the pipeline will also be provided with an active protection system consisting of galvanic aluminum anodes. The anodes will be attached to the pipeline during the concrete coating process at the maximum interval of 24 line pipes (maximum distance 292.8 m). The aim in the Balticconnector project is to use zinc- and indium-activated aluminum bracelet anodes (Figure 3-3) electrically linked to the pipeline with copper cables. The cables will be protected against mechanical strain with a bitumen coating. According to preliminary assessments, there will be 278 anodes, each with a thickness of 50 mm.

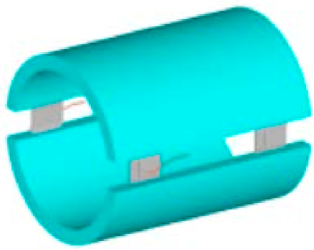


Figure 3-3. Example of an aluminum bracelet anode. (*Ramboll 2014a*)

The total consumption of material required for the offshore section of the Balticconnector pipeline is shown in the table below (Table 3-2).

Table 3-2. Total consumption of material used for the offshore pipeline section.

| Part of pipeline | Material | Estimated volume (m³) | Weight (t) |
|---|---|---|---|
| Line pipes | carbon steel | 1 631 | 12 803 |
| Internal anti-corrosion coating | epoxy paint | 7 | 11 |
| External anti-corrosion coating | asphalt enamel or three-layer polyethylene | 665<br>or<br>398 | 865<br>or<br>398 |
| Concrete coating | concrete | 9 544 | 32 450 |
| Pipe field joint insulation | polyethene | 10 | 10 |
| Field joint infill insulation | polyurethane foam | 471 | 942 |
| Anodes | AlZnIn mixture | 8 | 22 |

## 3.4 Construction

### 3.4.1 Seabed intervention

Seabed intervention will be required to protect the pipeline and to rectify the pipeline free-spans. The types of seabed intervention that are likely to be applied in the Balticconnector project are:
- dredging;
- ploughing or jetting depending on soil conditions;
- blasting to remove bedrock;
- subsea rock installation under and/or on top of the pipeline.

#### Protection requirements

The pipeline will typically be installed on the seabed, but in some areas the pipeline will have to be protected by trenching and/or covering it with seabed sediment or rock cover (Figure 3-4). The main reasons for the pipeline protection requirements are maritime transport (dropped and dragged anchors), and ice gouging in coastal areas. The results of the Quantitative Risk Assessment report (*Ramboll 2014b*) show that protection will be required for 85% of the Balticconnector pipeline length.

The pipeline will normally be trenched or covered with a layer of rock near the landfalls to ensure pipeline stability and, for sections close to the coast or shallows, to prevent ice scouring. According to preliminary plans, the pipeline section constructed in Ingå will be protected between KP 0 and KP 23. Rock cover will also be used at locations where existing pipelines and cables are crossed.

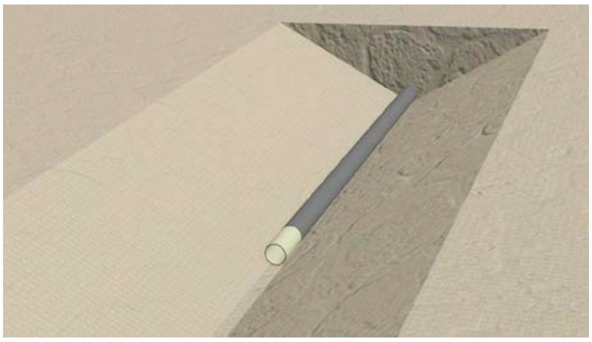


Figure 3-4. Cross-section of a trenched pipeline section. *(Ramboll 2013a)*

#### Trenching

If trenched to a sufficient depth, the pipeline can obtain protection against anchor damage, grounding and sinking ships as well as ice scouring. The depth at which the pipeline should be trenched depends on the size of the vessels crossing the pipeline. Large vessels have anchors with large fluke lengths which can penetrate deep into the seabed. Trenching can be used where the surrounding seabed does not consist of soft mud. If the pipeline needs protection on locations where the seabed consists of soft mud, the mud should be replaced with more stable material (sand or crushed aggregate) or local route optimization (re-routing) should be considered, if possible.

On fairways the pipeline must be laid at a depth of 1–2 m, and outside fairways at a depth of 1 m. (Figure 3-5).

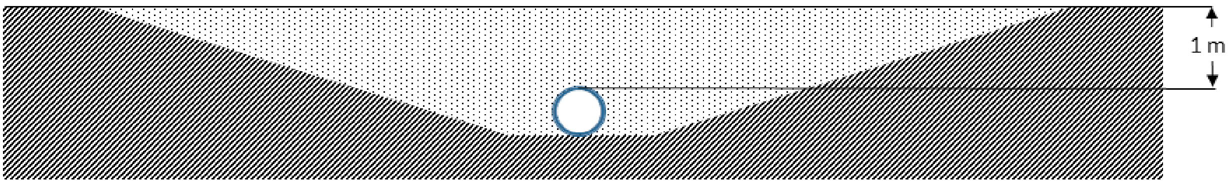



Figure 3-5. Pipeline trenching outside fairways. *(Ramboll 2014a)*

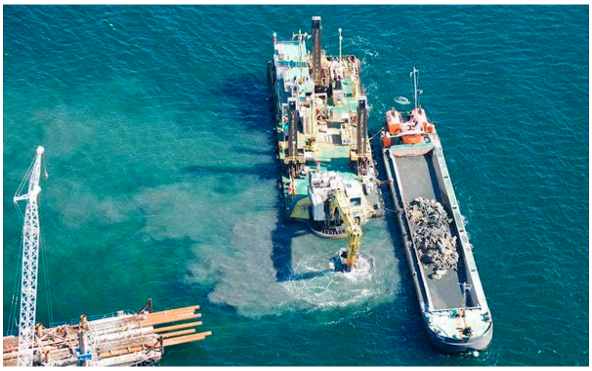


Figure 3-6. Dredging techniques. Shown above is a remotely operated "spider" and below a dredging barge and loading vessel *(Ramboll 2014a).*

Trenching can be operated with a "spider" (remotely operated dredging vehicle) or, in shallow water areas, with a surface-based dredging arm (Figure 3-6).

### Rock cover

In this context, rock dumping means that the pipeline remains on top of the seabed but is covered with a layer of rock. The rocks can then protect the pipeline against anchor damage and sinking ships. However, it is unlikely that the pipeline will be protected against ice scouring if only rock dumped (Figure 3-7), which is why the pipeline must be buried.

Installation of subsea rock will take place by using a rock dumping vessel and suspended fall pipe. The rock installation vessel (Figure 3-8) has a loading capacity of 24,000 tonnes. The vessel has a maximum rock installation speed of 2,000 tonnes per hour. However, a typical average rock installation speed which takes into consideration issues including transit times to and from quarry and between subsea structures is 150 tonnes per hour. Typical rock size used for pipeline protection is 22–125 mm. Larger rocks may for stability reasons be specifically required in shallow water.

### Increased steel wall thickness or concrete coating

By increasing the wall thickness, the force at which the pipeline can withstand pressure is increased. Similarly, additional concrete coating can absorb larger impact forces.

The table below presents a summary of the protection measures required for the pipeline (Table 3-3). The rock volumes provided are conservative estimates and will be specified further once progress is made in the technical design of the project.

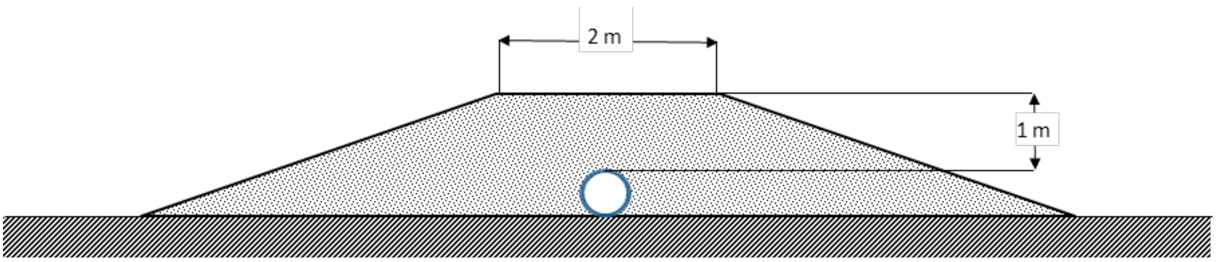



Figure 3-7. Pipeline with rock cover. *(Ramboll 2014a)*

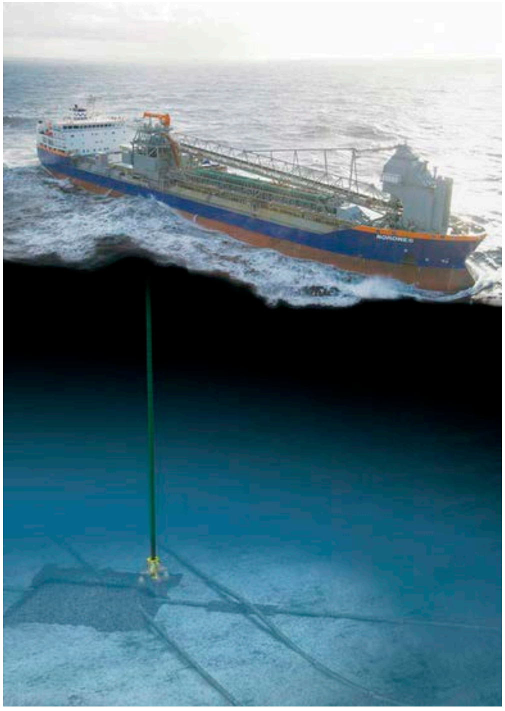


Figure 3-8. Subsea rock installation – accurate positioning by fall pipe. *(Ramboll 2013)*

Table 3-3. A summary of the protection requirements.

| KP | Hazards | Type of protection | Trenching length (m) | Estimated rock volume ($m^3$) |
|---|---|---|---|---|
| 0-23.0 | Ice gouging | Trenching + 1.0 m rock cover | 25 000 | 208 717 |
| 23.0-31.0 | No significant hazards | - | 0 | 1 313 |
| 31.0-37.0 | Dragged anchor | 1.0 m rock cover | 0 | 54 448 |
| 37.0-39.0 | Dragged/dropped anchor | Trenching + 2.0 m rock cover | 2 000 | 45 445 |
| 39.0-44.0 | Dragged anchor | 1.0 m rock cover | 0 | 45 373 |
| 44.0-46.0 | Dragged/dropped anchor | Trenching + 2.0 m rock cover | 2 000 | 45 445 |
| 46.0-59.0 | Dragged anchor | 1.0 m rock cover | 0 | 117 971 |
| 59.0-62.0 | No significant hazards | - | 0 | 75 |
| 62.0-70.0 | Dragged anchor | 1.0 m rock cover | 0 | 72 597 |
| 70.0-76.0 | No significant hazards | - | 0 | 0 |
| 76.0-81.4 | Pack ice | Trenching + 1.0 m rock cover | 5 400 | 49 003 |
| **Total** | | | **34 400** | **640 387** |

### Freespan rectification

To ensure the pipeline will remain fully functional throughout its entire design life, it will be necessary to reduce the span length of the pipeline to prevent a local buckling failure of the pipeline. The following methods can be employed in pre-lay preparation of the seabed:

- rock-dumping span gap heights to ensure mid-span touchdown points (pre-lay and post-lay);
- dredging to create flat lay corridors (pre-lay);
- blasting of bedrock peaks (pre-lay).

According to preliminary calculations and plans, a significant amount of pre-lay preparation of the seabed will be required. The locations where pre-lay preparation is required to reduce span length are shown in the table below (Table 3–4). The actual need for seabed intervention, including freespan rectification required, will be specified further once progress is made in the technical design of the project. It is, however, likely that the need for pre-lay preparation will be lower than presented here.

### Installation of subsea rock

Installation of subsea rock is the traditional method of rectifying free spans using a rock dumping vessel and suspended fall pipe (Figure 3–8).

According to preliminary estimates, around 180,000 m³ of rock will be required before pipeline installation can occur. This amount is based on the following assumptions:

- All free spans requiring rectification are conservatively filled in their entirety along the entire length (whereas detailed design is likely to conclude that only intermediary berms are required).
- Span fills are 20 m wide (lateral to the pipeline axis) to allow for +/- 10 m lay tolerance.
- Spans where both excavations and rock fill are required are conservatively calculated by halving the volume calculated by filling the gap beneath the span as calculated by the current bottom roughness analysis.

Table 3–4. Total volumes of subsea rock installation for freespan rectification based on preliminary calculations.

| KP | Estimated rock volume (m³), pre-lay | Estimated rock volume (m³), post-lay |
|---|---|---|
| 0-23.0 | 111 554 | 125 857 |
| 23.0-31.0 | 32 109 | 0 |
| 31.0-37.0 | 3 205 | 5 517 |
| 37.0-39.0 | 3 647 | 3 372 |
| 39.0-44.0 | 251 | 1 247 |
| 44.0-46.0 | 324 | 1 294 |
| 46.0-59.0 | 23 762 | 22 398.7 |
| 59.0-62.0 | 0 | 0 |
| 62.0-70.0 | 3 026 | 6 996 |
| 70.0-76.0 | 0 | 0 |
| 76.0-81.4 | 164 | 822 |
| **Total** | **178 041** | **167 504** |

### Excavation

Excavation can be performed either by dredging or blasting, depending on the soil conditions and the environment. For areas of bedrock, blasting will be necessary as conventional dredging may be slow and expensive. The removal of soil using jetting or clay cutters is known as dredging in this context (Figure 3–9).

Where dredging is not possible due to seabed condition, removal of bedrock peaks could be performed by using a traditional boring and blasting method, with special restrictions applied with regard to water-borne shockwaves and vibrations (Figure 3–10). Once the explosion has been triggered, loose rock will be moved alongside the pipeline.

Figure 3–9. Excavation techniques using hydraulic subsea equipment: T-series digger to the left, clay cutter to the right. *(Ramboll 2014a)*

Figure 3–10. Controlled subsea rock blasting. *(Ramboll 2013a)*

According to preliminary estimates, a total of 52 peaks will need to be excavated. The table below (Table 3-5) presents the preliminary volumes of seabed to be excavated by Kilometer Post (KP). The volumes of seabed to be excavated will be specified further once progress is made with the project. The current estimates are conservative; the actual volumes are likely to be smaller than those presented here.

Table 3-5. Preliminary seabed intervention measures and volumes of seabed to be excavated to level the seabed during the construction of the Balticconnector pipeline.

| KP | Intervention | Volume of material to be removed ($m^3$) |
|---|---|---|
| 0-2.0 | Blasting | 85 000 |
| 3.5-5.0 | | |
| 12.0-13.5 | | |
| 14.0-15.3 | | |
| 17.5-20.0 | | |
| 20.1-23.6 | | |
| 25.3-26.9 | | |
| 45.4-48.3 | Dredging/ploughing | 47 000 |
| 48.8-51.5 | | |
| 52.0-53.0 | | |
| 55.3-57.1 | | |
| 64.3-65.4 | | |
| 79.4-81.4 | Dredging | 39 000 |

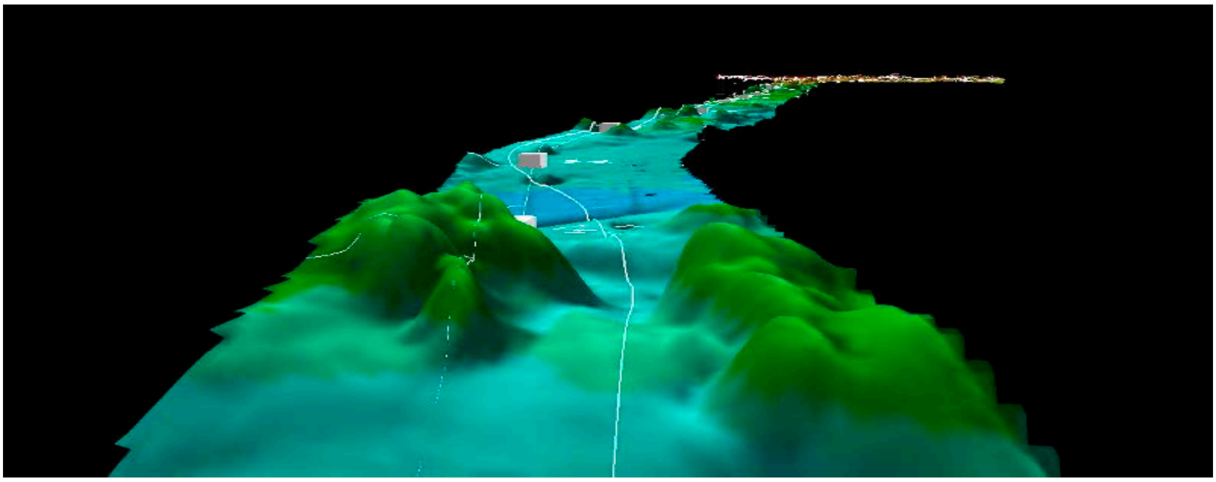


Figure 3-11. Gas pipeline route optimization on the seabed. *(MMT 2006)*

The results of the EIA procedure and the detailed studies conducted after the procedure will be used to optimize the route of the Balticconnector pipeline in order to minimize the need for seabed intervention (Figure 3-11).

### 3.4.2 Infrastructure crossings

The pipeline will have to cross a number of subsea cables and the two Nord Stream pipelines. The crossing objects identified in marine surveys executed in 2006 and 2014 *(MMT 2006* and *2013)* are presented in the figure (Figure 8-33). Unknown objects identified in the survey reports will be examined in the more detailed design phase of the project. The majority of existing service lines are telecommunications cables or wires.

In addition to the Nord Stream gas pipelines, agreements will be entered into with the owners of any other cables and structures, in which the obligations and procedures for crossings will be determined. The owners of abandoned cables or relevant authorities will also be notified of the procedures relating to such cables.

Crossed cables will be buried in the seabed, but more detailed surveys in the detailed design phase of the project will determine the exact burial depth. A pre-lay rock berm may be placed to ensure a minimum 0.5 m vertical separation between the existing cable and the Balticconnector pipeline. The vertical separation should take into account the penetration of the pipeline into the rock berm and the settlement of the rock berm. Post-lay rock will also be installed after the laying of the Balticconnector pipeline to ensure the pipeline is protected from trawl hooking and pull-over, which may displace the pipeline from the pre-lay rock berm.

Abandoned cables are typically not removed. At crossing locations of abandoned cables there is also the option to cut the cable if approval is obtained from the cable owner. In most cases, however, it is simple, more cost-effective and less environmentally disruptive to lay the pipeline over the cable with the adequate vertical separation ensured.

The Nord Stream pipelines (Figure 8–33), separated from each other by approximately 900 m at the point of crossing, will require two separate crossing designs. The pipelines were installed exposed, so a height of approximately 2 m of pre-lay rock will be required to ensure a vertical separation of 0.5 m is maintained between the Balticconnector pipeline and the Nord Stream pipelines.

### 3.4.3 Munitions clearance

Munitions (unexploded ordnance, UXO) can be divided into conventional and chemical munitions. Munitions were dumped in the Baltic Sea during the First and Second World War and all the way until the 1970s. Unidentified items such as munitions and their remnants detected in the study corridor of the Balticconnector project will be examined and removed before laying the natural gas pipeline onto the seabed. Of the total of 48 man-made objects (including munitions, metal waste, barrels) detected in the study corridor, eight have been classified as probable munitions. Six of these are on the Estonian side and two on the Finnish side *(MMT 2006* and *2014)*.

In order to clear the munitions or their remnants, an ordinance clearance plan will be developed in cooperation with relevant national authorities. Gasum has conducted preliminary negotiations with the Finnish and Estonian Defence Forces, and it has been agreed that they will take part in the clearance work. The clearance plan will include clear risk assessment procedures for the technical performance of the work together with the mitigation measures to be taken to minimize impacts on marine flora and fauna. The clearance methods used will be safe, proven and similar to those previously employed to dispose of munitions in the Baltic Sea.

The disposal of unexploded ordnance (mines) will be performed in several steps, starting with an as-found survey, implementation of mitigation measures to minimize impact on marine life, placement of the demolition charge, demolition and an as-left survey.

Throughout the activities, the authorities will be kept informed of the status, and any marine traffic in the area will be warned to avoid the location.

### 3.4.4 Offshore pipelaying

The offshore pipeline will be installed using either an anchored or dynamically positioned (DP) pipelaying vessel. Dynamic positioning is best suited for large water depths where the suspended pipe string is sufficiently flexible to absorb minor displacements at the surface without buckling. Dynamic positioning is also the best method in cases where there may be munitions outside the studied installation corridor, such as in the Gulf of Finland.

Depending on its type, the pipelaying vessel will be assisted by anchor tugboats, pipe supply vessels and various survey/monitoring vessels (Figure 3–12). For each anchor-positioned pipelaying vessel, 2–6 anchor-handling vessels will typically be required. These are typically quite large (total length around 100 m). Their stern and bow anchors will be dropped 1,000–2,000 m from the pipelaying vessel, while lateral anchors can be placed closer to the pipelaying vessel. Each individual anchor weighs around 25 tonnes. Whenever possible in the Balticconnector project, pipelaying and anchor-handling vessels that are as small as possible to minimize environmental impacts will be used in areas where it is not possible to use a dynamically positioned pipelaying vessel (coastal areas). The use of an anchored pipelaying vessel requires the detailed preparation of construction measures where the anchoring methods employed are determined precisely.

One service vessel will also be required for each pipelaying vessel. Dynamically positioned multi-purpose vessels will be used for anchor-handling and maintenance functions (Figure 3–12).

The coated line pipes will be transported by a supply vessel to the pipelaying vessel where they will be welded to form a pipe string and lowered onto the seabed. This process involves the following continuously repeated stages on board the pipelaying vessel:

- pipe welding;
- nondestructive testing (NDT) of welds;
- preparation of field joints;
- lowering the pipe onto the seabed.

Some major pipelaying vessels have double jointing facilities, whereby two 12.2 m line pipes can be welded together, usually by automatic submerged arc welding, before they are transferred to the end of the pipe string (the firing line) and welded onto the pipeline. To save time, the welding on the firing line will be carried out at a number of stations and, as the weld is completed, the pipeline goes into the tensioners. The field joint coating will be carried out just before the stinger. After welding, the field joints will be inspected using nondestructive testing (NDT) to detect any damage or material defects. NDT will take place using automated ultrasound testing that enables the detection, measurement and recording of any defects. Before construction begins, the accepted range for welding results will be determined by the designated inspection authorities. After welding and testing, the field joints will be protected against corrosion (see section 3.3.1).

Once a weld is completed, the vessel will move forward a distance corresponding to the length of one or two individual line pipes. Following this move, another line pipe will be added to the pipeline as described above. As the pipelaying vessel moves forward, the pipe string is be supported by a stinger extending 40–140 m behind the vessel as it leaves the vessel off the stern. The purpose of the stinger is to support and control the pipe string (Figure 3–13). The lay rate is highly dependent upon pipe size and welding conditions, but under optimal conditions a daily production (working 24 hours) of 4–5 km is not unusual. The pipelaying for the Balticconnector natural gas pipeline will take place in the middle of the summer.

Figure 3–12. Typical pipelaying vessels – a dynamically positioned pipelaying vessel (*Solitaire*, left) and anchored pipelaying vessel (*Castoro Sei*, right). *(Ramboll 2013a)*

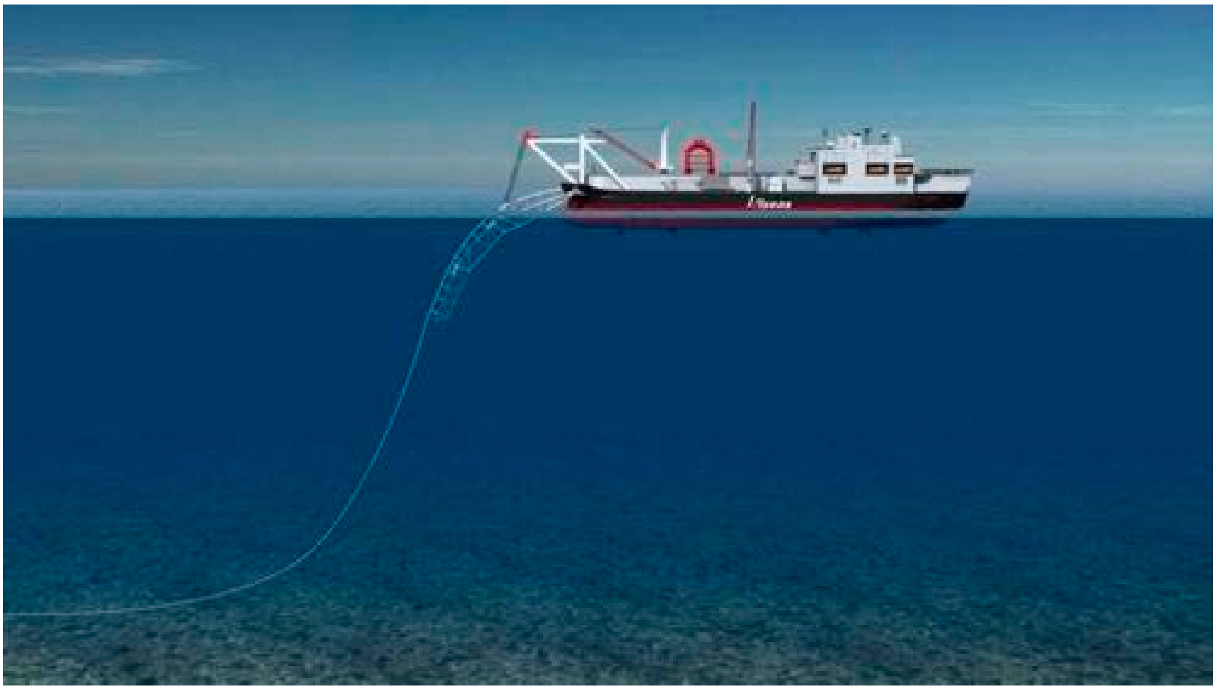


Figure 3–13. The S-lay method employed by a dynamically positioned pipelaying vessel. (*Allseas 2014*)

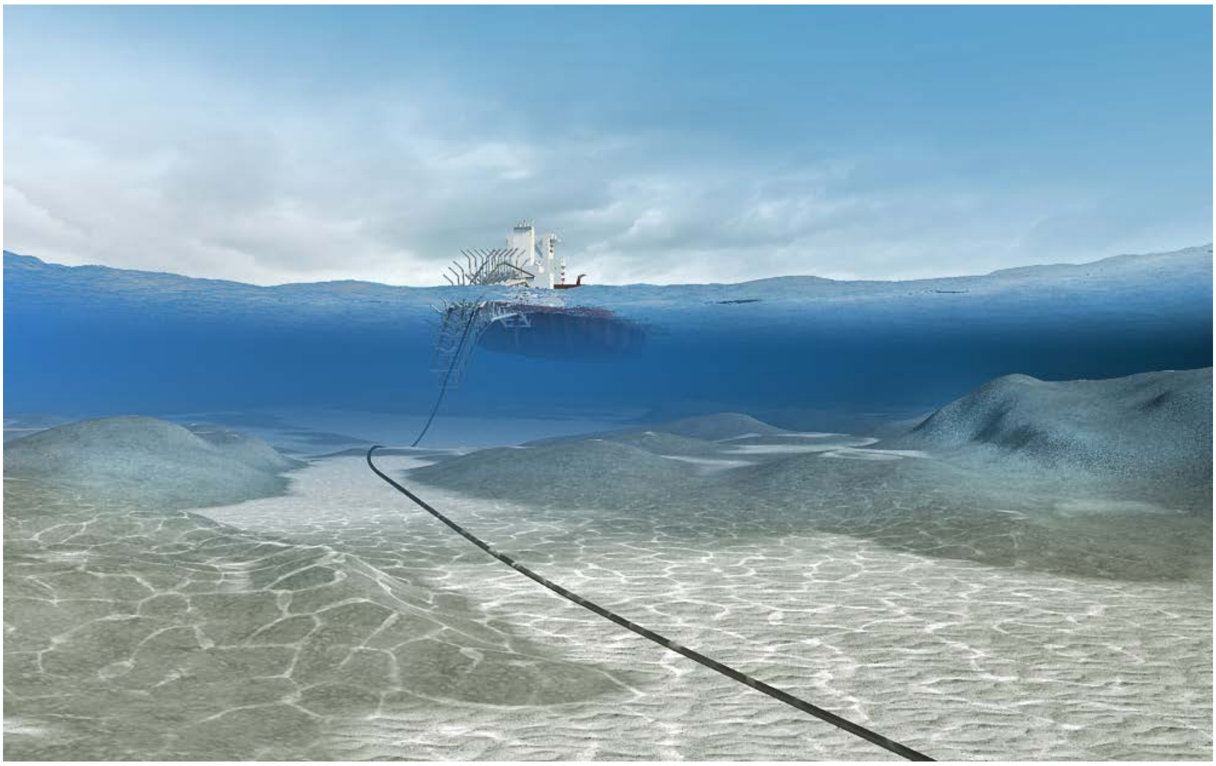


Figure 3–14. Visualization of pipelaying of the Balticconnector pipeline between bedrock outcrops. *(Ramboll 2014a)*

Pipelaying is weather dependent, and the tolerance depends upon the type and size of the pipelaying vessel and the supporting spread. At a certain sea state it becomes impossible to add more pipe to the string, which will then be kept under constant tension by the tensioners. Pipelaying will also have to be suspended if the weather prevents the vessels from docking at the pipelaying vessel to transfer pipe or other essential supplies or the tugboats from relocating the anchors (when dynamic positioning is not used). If the movements of the pipelaying vessel become so large that they endanger the integrity of the pipeline, the pipe string will have to be temporarily abandoned. A laydown head with an attached cable will be welded onto the pipe string, which will be lowered to the seabed. In case the pipelaying vessel is forced to abandon the site to seek shelter, the cable will be attached to a buoy for later retrieval. At the return of calm weather the pipe string will be winched aboard the pipelaying vessel, secured by the tensioners, the laydown head removed and pipelaying resumed. The above abandonment and recovery operations are fairly routine, but they may also be invoked in case of major mishaps (see section 8.16).

Safety zones for pipeline installation vessels will be agreed with the maritime authorities in Finland and in Estonia. Based on a preliminary assessment, a safety zone of 1,500 m will be adequate for all installation vessels, including anchor-handling pipelaying vessels.

Except possibly for straight laying on an even seabed, the touchdown point of the pipeline will be continuously monitored by a remotely operated vehicle (ROV) deployed from a dedicated survey vessel.

### 3.4.5 Pipeline tie-in

Logistics dictate that at least one tie-in must be performed between the pipeline section laid from the Estonian landfall and the pipeline section laid from the Finnish landfall.

As a first step, buoyancy elements will be installed and davit cables attached at locations determined by the lifting analysis. The offshore section will be lifted up, cut off at a length determined by the final metrology, an end plate welded on to prevent flooding and the pipe end lowered to the waterline. The near-shore section will then be lifted up and clamped in position, the laydown head removed and the pipe end prepared for welding. Finally, the offshore section will be lifted and clamped in position, the plate cut off and the pipe end prepared for welding, and the previously prepared pup piece lowered into place and welded in. The exposed steel will be provided with anti-corrosion coating and infill like any other offshore field joint.

Upon completion of the welding and protection, the clamps will be released and the pipe will be lowered onto the seabed in stages, the pipelaying vessel moving sideways to avoid overstressing of the pipe steel.

The operation is most feasibly carried out in rather shallow (depth less than 20 m) and sheltered waters close to one of the landfalls. The lay direction and construction sequence will be decided at later stages of the project design.

### 3.4.6 Landfalls

Alternative construction methods for the landfalls of the Balticconnector pipeline are as follows:

- bottom pull;
- microtunneling;
- horizontal directional drilling (HDD).

The most common method of landfall construction is bottom pull, and this method is the most feasible method for both of the Ingå landfall alternatives LF 1 and LF 2. In this rocky and sheltered Ingå archipelago no cofferdam would be required to protect the trench from sedimentation.

The bottom pull method is also suitable for the ALT EST 1 alternative at the Paldiski landfall with an open beach. For the ALT EST 2 alternative, an open trench through the limestone cliff is not appropriate, so microtunneling is the most feasible solution there.

#### Bottom pull

Bottom pull installation can be performed either to or from shore. The pipe will be pulled in a pre-dredged trench through the surf zone to a point above the high water mark. The depth of the trench must be sufficient to ensure that the pipeline is not exposed by seasonal or long-term variations of the seabed profile.

For a shore pull, a pulling station will be installed at the prepared onshore site, usually consisting of two linear winches connected to a hold-back anchor, which may be a sheet pile wall. The winch cables will be connected to the pull cable by means of a sheave arrangement, pulled in from the pipelaying vessel stationed offshore at the mouth of the trench. On the vessel the pull cable will be connected to a pull head, which will be welded onto the first pipe joint, and the pipeline will be pulled ashore as it is produced on the vessel. The figure (Figure 3–15) shows the pull head emerging from the sea.

For offshore pull, a pipe-stringing site will be set up on shore, and the landfall pipe will be welded to form one string. The pipelaying vessel will be positioned at the mouth of the pre-dredged trench and, using the winches on the vessel, the already prepared pipe string will be pulled through the trench onto the vessel, from where pipelaying will be continued.

#### Microtunneling

Microtunneling is a process that uses a remotely controlled Microtunnel Boring Machine (MTBM) (Figure 3–16) to directly install concrete jacking pipes forming an underground microtunnel to accommodate the pipeline inside.

Figure 3-15. Pull head emerging from the sea at shore pull. *(Ramboll 2014a)*

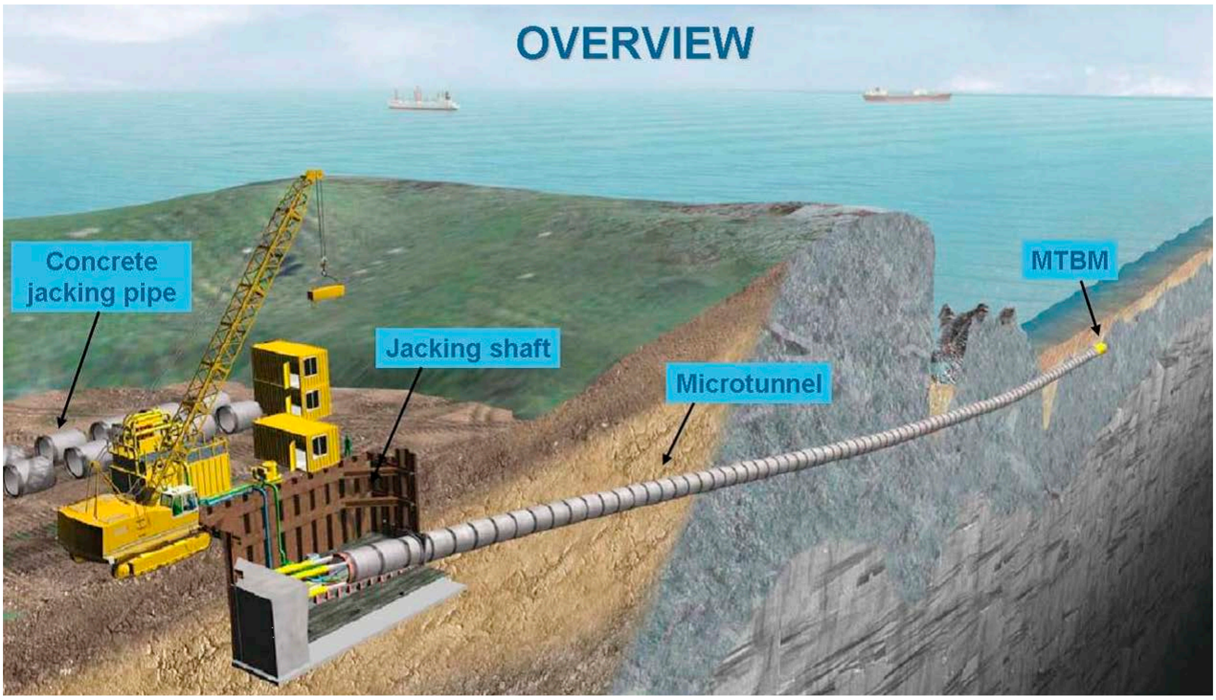



Figure 3-16. Landfall construction using the microtunneling method. (*Ramboll 2014a*)

Microtunnel construction comprises the following activities:

- Launch shaft excavation – required to ensure correct alignment of the microtunnel. Heavy equipment, such as excavators and trucks, is used for this task.
- Microtunnel excavation – typical microtunnel equipment spread consists mainly of a hydraulic jacking system to jack the pipe, a closed loop slurry system to remove the excavated tunnel debris, a slurry cleaning system to remove the debris from the slurry water, a crane to load and unload the concrete casings, and an electrical supply to power all of the above equipment.
- Pre-dredging and MTBM recovery – the recovery of the drilling head at the exit points requires dredging work.

The construction of the landfall microtunnel requires a temporary worksite of approximately 10,000 m². The maximum feasible length of the microtunnel is approximately 1,500 m.

### Horizontal directional drilling (HDD)

Horizontal directional drilling (HDD) is an installation method in which the prefabricated pipe string is pulled through a hole in the ground made by a directed drill string.

A drill rig will be placed on shore and a pilot string inserted into the ground. The drill bit will be hydraulically powered by bentonite drilling mud fed through the pilot string. The bentonite mud will transport the soil away and fill the hole behind the drill head, preventing it from collapsing. The diameter of the cutting head is larger than that of the pilot string, which will be encased by a drill string, and additional lengths of pilot string and drill pipe will be added as the drill bit advances through the soil.

For landfall construction a pilot hole will be drilled to a pre-dredged trench at the marine exit point. A crane barge with supporting equipment to handle drill pipe and hole openers (reamers) will be positioned offshore. A number of hole opening passes will be carried out until the drilled hole is sufficiently large to accommodate the topical pipeline, and the crane barge will then be replaced by the pipelaying vessel.

As in the case of bottom pull, the pipeline produced on the pipelaying vessel can then be pulled into the drilled hole from the vessel (shore pull). Alternatively, the pipeline can be welded up on shore and pulled onto the pipelaying vessel (offshore pull). The latter method requires a sufficiently large area on shore for pipe stringing.

The drill can be made to exit within a few meters from a target point located several kilometers away. If the exit point is unacceptable, the pilot string will be withdrawn at a certain distance and the route corrected.

The success of the horizontal directional drilling method depends on soil conditions, fairly uniform clay being the most appropriate, but drilling through solid bedrock is also perfectly feasible. Directional drilling does not involve any activities between the entry point and the exit point and is therefore a preferred method for crossing heavily built-up or environmentally sensitive areas.

## 3.4.7 Construction of onshore pipeline sections and related functions

### Work area

Both field and forest areas are suitable for natural gas pipeline construction. During construction, the installation of onshore pipeline sections will require a work area that is 28–32 m wide in forest areas and 33–37 m wide in field areas (Figure 3-17 and Figure 3-18).

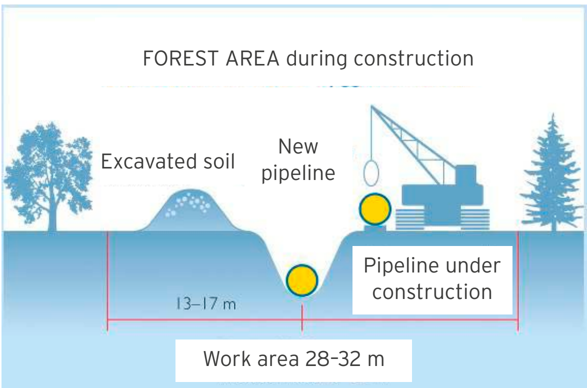



Figure 3-17. The work area required for onshore natural gas pipeline construction in forest sections. (*Gasum Corporation*)

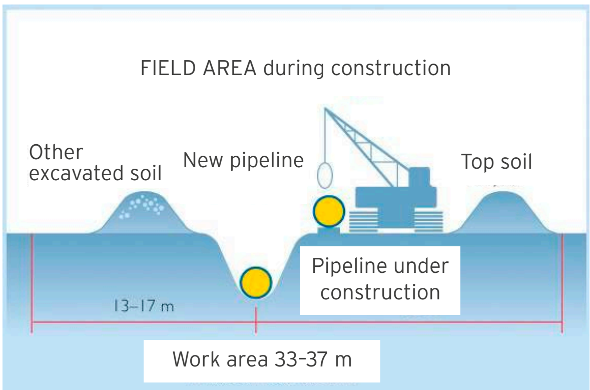



Figure 3-18. The work area required for onshore natural gas pipeline construction in field sections. (*Gasum Corporation*)


Figure 3-19. A natural gas pipeline section being laid. *(Gasum Corporation)*

**Pipeline construction**

An installation road will be constructed for site traffic and pipeline installation next to the pipeline trench along the pipeline route (Figure 3-19). The line pipes will be transported to the site on public roads and site roads taken over for the purpose. Where necessary, new roads will be constructed to provide access to the natural gas pipeline area.

To install the pipeline, a trench that is around 1.5–2 m deep will be prepared along the pipeline route. The excavated soil will be deposited next to the trench. In bedrock areas blasting will need to be used for trenching. The aim is to crush the rock blasted from the trench and use it for purposes such as installation road construction and post-lay trench backfilling.

The line pipes will be welded together to form the natural gas pipeline next to the trench or, in some cases, in the trench. All welds will be fully X-rayed by an external inspection body. Once the welds have been coated, the inspected natural gas pipeline will be placed in the finished trench using sidebooms or excavators.

The trench will be backfilled immediately after the completion of the pipelaying process, and the pipeline route will be marked with white signposts. Signposted and reinforced transmission pipeline crossing points for forestry machinery will also be constructed in forest areas.

**Pipeline crossings under roads and water bodies**

Paved public roads are usually crossed by laying the natural gas pipeline in steel casing pipes drilled or jacked under the road. Public and private roads with low volumes of traffic (less than 500 vehicles a day) can be crossed by digging them open and building a temporary overpass or diversion.

The pipeline can be laid under small brooks, ditches or rivers using conventional digging or horizontal directional drilling. The prerequisite for horizontal drilling is that the ground is soft and free from rocks. Horizontal drilling is a feasible method if there are sections along the natural gas pipeline route due to which the use of conventional digging is prevented or not recommendable. If open excavation is used, the river will be dammed by constructing a soil dam on both sides for the period of construction.

**Finishing and landscaping**

The finishing work required will take place on the worksite once construction is completed. Deposition areas and any damage caused by construction in the area will be repaired and landscaped. The installation road will be removed unless the landowner prefers to have it left in place. In field areas the installation road will be removed, subsurface drains repaired, field surface tilled and topsoil restored in areas where it had been removed.

Following construction and landscaping, the landowner can resume agriculture and forestry in the area. Trees may not, however, be planted in the pipeline control (usufruct) zone (5 m). In field areas the entire natural gas pipeline route can be used for farming.

### Compressor station

The compressor stations of the natural gas transmission network are used to increase gas pressure in the pipeline and to increase the transmission capacity of the natural gas pipeline network. The compressor station planned for Ingå and the related reception equipment will be constructed close to the offshore pipeline landfall and the onshore pipeline sections (Figure 1–5). Compressors are used to transmit gas in both directions: to the offshore or onshore pipeline section. Gas outlet pressure from the compressor station to the offshore or onshore pipeline section can be set at a specific level, and compressor capacity utilization can be optimized. The compressor capacity required will depend on the method of usage and network status during usage. The maximum compressor capacity requirement is around 15–20 MW. Gas pressure and flow rate will be raised to the level required by current network usage. The compressor station can adapt to various usage situations. Outlet pressure can be set at 50–70 bar. Compressor station flow rate can be set at 200,000–440,000 Nm$^3$/h depending on usage situation and network status.

In addition to the compressor unit, the main equipment of the compressor station includes gas filtering, gas cooling, station valves and an automated emergency shutdown system that empties the gas from the compressor station pipes if necessary (Figure 3–20). The area will be equipped with an uninterruptable power supply (UPS) system to ensure station access to electricity in case of a power failure. Natural gas from the transmission network will be used as fuel gas for the compressor, combusted in the unit's gas turbine section. Hot gases are created in natural gas combustion, and these will rotate the gas turbine. The exhaust gases (mainly water vapor and carbon dioxide) will be led into the atmosphere via the exhaust stack.

The compressor station will controlled by an automated system. The safe operation of the compressor station will be ensured with several local and automated safety systems that monitor and control all appropriate process factors that are critical from the safety perspective. The station will be equipped with gas leak and fire alarm systems. Critical components, such as compressor units and the electrical control room, will be equipped with a fire extinguishing system.

Figure 3–20. A 10 MW gas-turbine-powered pipeline compressor station in Kouvola, Finland *(Gasum Corporation)*.

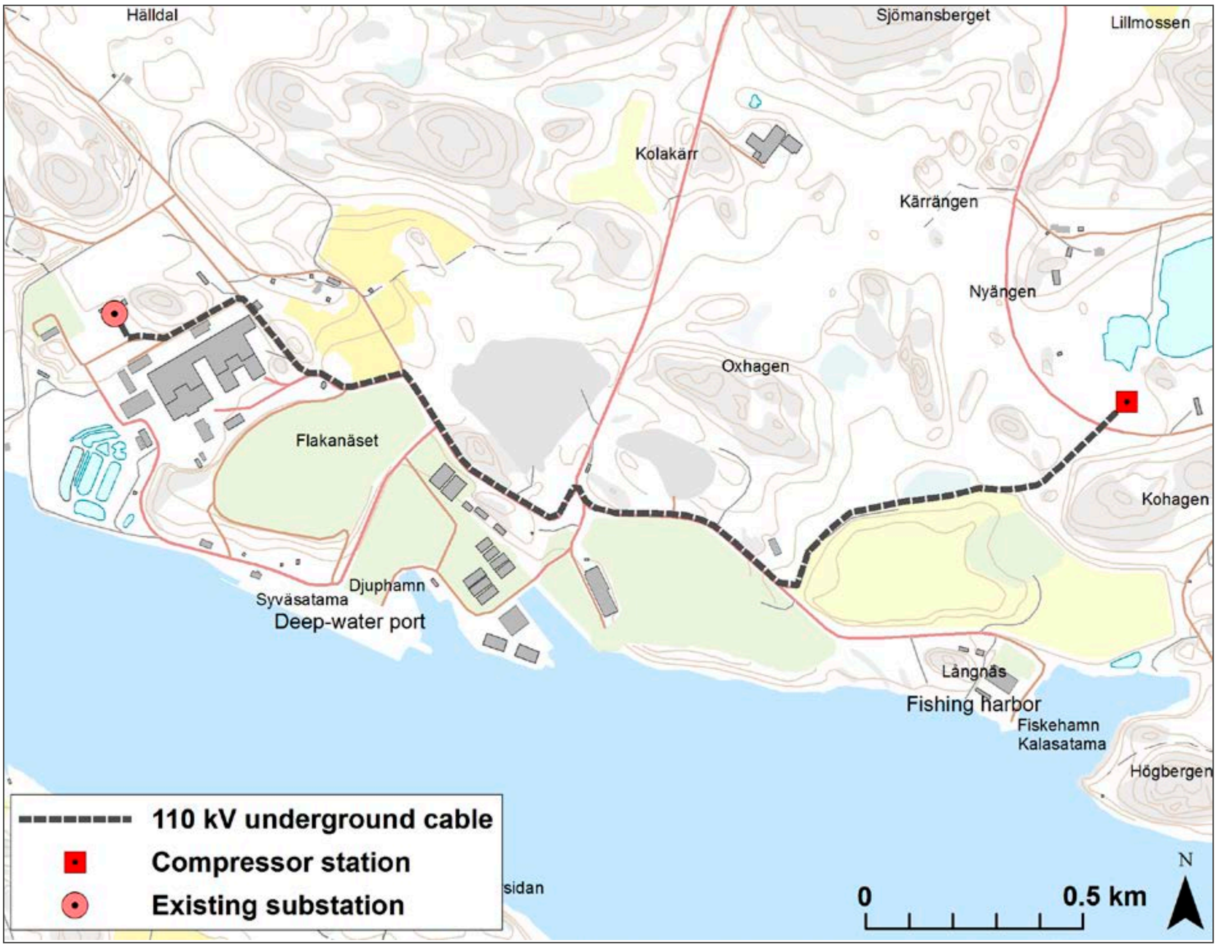



Figure 3-21. Preliminary underground cable routing required for a compressor station driven by an electric motor.

The compressor station may also be alternatively powered by an electric motor instead of a gas turbine, whereby there will be no exhaust emissions from the station. An electrically powered unit will, however, require a 110 kV power line that is approximately 2 km in length as well as local transformer stations in the area. The power line will be buried underground (Figure 3-21) if the decision is made in the project to opt for a compressor station driven by an electric motor. The underground cable will be installed at a depth of approximately 1 m, following existing roads wherever possible, and connected to an existing 110 kV substation in the Fortum area. The final decision on the power transmission type will be made once the technical design of the project progresses further.

### 3.4.8 Project logistics

The construction of the offshore pipeline will require onshore support operations that, in addition to steel pipe storage, will also serve as general storage facilities for consumables supporting vessel operations as well as premises for human resource management measures.

No separate concrete coating facility will be established for the Balticconnector project. The transport of steel line pipes protected against corrosion, anodes and materials used for concrete coating as well as the operations of the actual concrete coating facility are not included in the environmental impact assessment conducted. According to preliminary plans, the line pipes will be concrete-coated at an existing northern-European concrete-coating facility.

It is foreseen that at most one interim stockyard will be required for storage of coated pipes. The location of the storage facility established will be determined with a view to minimizing land and marine transport needs. The required storage area will be at most 10,000 m². From the interim stockyard the pipes will be transported directly to the pipelaying vessel. The logistics concept developed specifically for the project will comprise:

- transport of concrete-coated pipes to the interim stockyard;
- transport of concrete-coated pipes to the pipelaying vessels from the interim stockyard; and
- transport of rock from the quarry to the rock dumping sites.

If no interim stockyard is established, provisions and consumables for the offshore fleet can be supplied from the installation contractor's home base, and/or storage facilities provided at one of the landfall sites.

Offshore pipe supply is required due to the limited cargo capacity of the pipelaying vessel. A pipe supply vessel will transport the pipes from the stockyard to the pipelaying vessels. The average transport capacity of a pipe supply vessel is around 240 line pipes at a time. The pipelaying vessels usually have a cargo capacity of around 6,500 line pipes. More detailed information about supply and pipelaying vessels used in the project and related transport can be found in sections 3.4.4 and 8.8.

Efforts will be made to source material for pre-lay and post-lay rock installation from a local quarry and load it at the harbor to a vessel that is able to place the rock very precisely on the seabed through the use of fall pipes. The transport of line pipes, pipelaying as well as rock transport and dumping onto the seabed are included in the environmental impact assessments conducted. The temporary storage of line pipes, the operations of the quarry, and the storage of rock before transport are not included in the impact assessments. The amounts and characteristics of rock to be dumped are discussed further in section 3.4.1.

## 3.5 Pre-commissioning and commissioning

Inspections will be carried out on the installed pipeline before the commissioning of the gas pipeline. These measures will aim to verify the integrity of the pipeline and compliance with the requirements set. The pre-commissioning spread is envisaged to be located at one of the landfalls, most probably in Estonia.

Pre-commissioning and commissioning will comprise the following activities:

- flooding and hydrostatic testing;
- gauging and cleaning;
- de-watering and drying
- nitrogen purging and gas filling.

### 3.5.1 Flooding and hydrostatic testing

When all construction activities have been carried out, the final integrity of the installed pipeline will be documented by hydrostatic testing. In this, filtered seawater is pumped into the pipeline. The Balticconnector pipeline will be flooded immediately after pipelaying for stability reasons.

However, as any oxygen in the seawater will quickly be consumed by negligible rust formation, the treatment of the test water can probably be omitted. Furthermore, the risk of bacterial contamination is low if the residence time in the pipeline does not exceed 60 days.

To prevent internal corrosion of line pipe steel, the seawater may be treated with oxygen scavengers and/or biocides. The oxygen scavenger removes the oxygen which may fuel corrosion, and the biocide prevents the growth of anaerobic bacteria. A typical oxygen scavenger is sodium bisulfite ($NaHSO_3$), a dosage of 65 mg/l (ppm) being required for an oxygen concentration of 10 ppm. A common biocide is glutaraldehyde at an active concentration of 50–75 mg/l (ppm).

The hydrostatic testing will comprise a strength test as well as a leak test and will be carried out by pressurizing the water to the specified leak test pressure, which will be kept for the specified holding period typically of 24 hours. During the holding period the pressure will be closely monitored, and any pressure drop which cannot be ascribed to variations in atmospheric pressure, water levels or seawater temperature signals a leak, which must then be localized. To facilitate leak detection, the test water can be mixed with a powerful dye or a hydrocarbon tracer, which can be sensed by a 'sniffer fish' that is towed along the pipeline.

The use of dye can be minimized by mounting dye sticks at critical locations, such as tie-in points. Dye sticks or dye applied as a paint will be inserted by divers just prior to tie-in operations. The dye stick can be made of what is popularly labelled 'invisible' dye, which is fluorescent and visible only by a diver carrying an inspection tool.

Should a leak occur, it normally takes the form of a violent rupture, which is easily localized even if the pipeline has been trenched and backfilled. If a visual survey does not suffice to locate the failure, it is possible to launch a 'pinger' pig, which can be tracked acoustically until it stops at the rupture. Alternative means of location include the use of magnets or radioactive sources.

### 3.5.2 Gauging and cleaning

The pipeline will be cleaned and gauged internally by using pig trains. There are used to measure any dents in the line pipe wall that could induce failure in the long term or obstruct the passage of cleaning and batching pigs.

During and after water-filling the pipeline interior will be cleaned. The debris inside the pipeline will mostly be dust from construction, such as rust (iron oxide), welding powder, substances from the interior coating of the pipeline or concrete dust. The cleaning trains include both brush pigs and swabbing pigs, the latter removing any brushes that may have broken off. The pig trains are normally propelled by the treated seawater pumped in for the purpose of the hydrotesting, but further cleaning by running brush and swabbing pigs in air may take place during and after de-watering.

The cleaning operation may also be facilitated by gel-plug technology. A gel is a plastic fluid with the capability to pick up loose and loosely adhering solids. The gel slug will be inserted into the pipeline, followed by an appropriately designed scraper pig. The train will consist of more scraper pigs collecting any gel slipping by the pig driving the gel. Gels can be produced with a range of viscosities, including solid gel pigs, capable of removing wax or paraffin deposits.

### 3.5.3 De-watering and drying

The activities of de-watering and drying are particularly important for gas pipelines, because any remaining water may react with the gas to form hydrocarbon hydrates, which can obstruct the flow and in particular the proper functioning of valves.

The de-watering operation will be planned with a view towards the disposal of the water, particularly if it is treated with corrosion inhibitors. Therefore for the Balticconnector a temporary outfall pipeline must be constructed so the water can be discharged at sea after the separation of solids in a settling pond. The water will be discharged through a diffuser head to ensure dilution to a concentration. However, flooding with untreated test water, or using oxygen scavenger only, is also possible.

Pipeline de-watering runs will be carried out using air-propelled pig trains during or after cleaning. A typical de-watering pig is shown in the figure (Figure 3-22).

To dry the pipeline, the following methods can be used alone or in combination:

- methanol (or glycol) swabbing;
- hot air drying;
- vacuum drying.

In the swabbing method a batch of methanol or tri-ethylene glycol (TEG) is enclosed between pigs and propelled through the pipeline by compressed air. Residual water will be dissolved in the hygroscopic substance, leaving a film that is mostly methanol or glycol. An alternative procedure, which combines cleaning and drying in one operation, is gel pigging. Modern gel-forming agents can produce gels from an array of liquid components. By incorporating gels based on hygroscopic fluids, such as


Figure 3-22. A typical de-watering pig *(Ramboll a)*.

methanol, into the cleaning train, the water is removed along with the debris.

Hot air drying utilizes the ability of hot air to contain a large amount of water as vapor, while vacuum drying relies upon the lowering of the boiling point of water at low pressures. For the Balticconnector pipeline, the vacuum pumps will have to work for several days to decrease the pipeline pressure below a few millibars. To save time, vacuum drying is often used as the last step after most of the water has been removed by swabbing or gel pigging.

### 3.5.4 Nitrogen purging and gas filling

To prevent any internal corrosion between pre-commissioning and operation, the pipeline can be filled with a non-corrosive gas, such as nitrogen. A typical nitrogen purity would be 95% (i.e. 95% $N_2$, 5% atmospheric gases). However, if any free water is present, the nitrogen should constitute more than 99.98% of the gas.

For a vacuum-dried gas pipeline the nitrogen can simply be let in, while in other cases the air in the pipeline will be displaced by nitrogen in a process known as purging. Liquid nitrogen will be vaporized through heat exchangers and injected into the pipeline. To guarantee a low level of oxygen, the amount of injected nitrogen should be approximately twice the volume of the pipeline.

However, if the pipeline is completely clean and dry and is taken into operation within a reasonable time span (one year) after pre-commissioning, there is no need to fill the pipe with nitrogen or any other form of non-corrosive gas.

Gas filling of the pipeline will take place during the commissioning of the pipeline system, including the onshore sections and the compressor station.

## 3.6 In-use operations and control

The natural gas pipeline will be controlled and monitored from central control rooms located in Finland and Estonia and staffed around the clock. Central control room staff will monitor gas pipeline and compressor station process data and control the processes whenever necessary.

The pipeline system is equipped with remote-controlled safety cut-off devices to restore pipeline safety in the event of a disturbance.

Gasum is obliged to maintain the appropriate working order of the natural gas pipelines. This means periodic inspections as well as maintenance and servicing work on the pipeline. The pipeline will be subjected to regular internal and external inspections throughout its operational life. External inspections will include inspections of pipeline position and condition as well as corrosion protection. Internal inspections will be carried out using pigs. These will be driven through the pipeline along the gas flow and are used to gauge pipeline characteristics. The pigs have high-resolution sensors that detect the slightest of irregularities in the pipeline.

# 4 LICENSES, PERMITS, PLANS AND DECISIONS REQUIRED FOR THE PROJECT IN FINLAND

## 4.1 Licenses, permits, plans and decisions required

### 4.1.1 General

Following the EIA procedure, the project will proceed to the licensing and permitting stages in Finland. The Project Developers will decide on the basis of the results of the EIA procedure and other further studies and surveys for which alternative the licenses and permits will be applied for. The EIA report and the coordinating authority's statement issued on it will be appended to the applications. The following sections describe the licenses, permits and decisions required for the construction of the Balticconnector natural gas pipeline in Finland. The licenses, permits and decisions required in Estonia for the implementation of the project are described in the EIA report for Estonia (*www.balticconnector.fi*).

### 4.1.2 Water permit

The Water Act (587/2011) applies to Finland's territorial waters and Exclusive Economic Zone. Activities referred to in Chapter 3 (sections 2 and 3) of the Water Act require a water permit. Further provisions on the application of the Act, rights and permit requirements are laid down in Chapters 1 (sections 4 and 5), 2 (section 12) and 3 (section 16). Applications for a water permit must be submitted to the Regional State Administrative Agency of Southern Finland. Applications must contain the necessary information as well as sufficient plans regarding the activities and the planned construction projects. Applications must also contain information about the project's environmental impacts. The provisions of the Nature Conservation Act (1096/96) and the Antiquities Act (295/63) as well as the planning situation of the operating area must also be taken into consideration. The river basin management plan and marine strategy in accordance with the Act on Water Resources Management (1299/2004) are also taken into consideration in permit consideration.

### 4.1.3 Consent of the Government

The implementation of the project in Finland's Exclusive Economic Zone (EEZ) is subject to the consent of the Government of Finland in accordance with the Act on the Finnish Exclusive Economic Zone (*1058/2004*), the Government Rules of Procedure (*262/2003*, section 4 (7)) and the UN Convention on the Law of the Sea (UNCLOS, article 79 (24)).

According to section 6 of the Act on the Finnish Exclusive Economic Zone, the Government may, on application, give its consent to activities aimed at the economic exploitation of the EEZ (right of exploitation). Provisions on the content of the application are laid down in section 2 of the relevant Government decree (*1073/2004*).

The provisions of the Nature Conservation Act (*1096/96*) must also be taken into consideration in permit consideration. Applications for the consent of the Government must be submitted to the Ministry of Employment and the Economy.

### 4.1.4 Natural gas pipeline construction and operating licenses, safety licenses and other requirements

The other Finnish legislation applicable in the Exclusive Economic Zone is determined in sections 3–5 of the Act on the Exclusive Economic Zone of Finland (*1058/2004*).

The Pressure Equipment Act (*869/99*), Government decree on safety in the handling of natural gas (*551*/2009), Act on safety in the handling of dangerous chemicals and explosives (*390/2005*) and decree on surveillance of handling and storage of dangerous chemicals (855/2012) are not applied in the Finnish EEZ. There must, however, be complied with in Finland, including in Finland's territorial waters and coast.

Unlike the Seveso Directive (*96/82/EC*, as amended), which does not apply to the transport of dangerous substances in pipelines, including pumping stations, outside establishments covered by the Directive, the Finnish Act on safety in the handling of dangerous chemicals and explosives (*390/2005*) also applies to the transport of gas (e.g. sections 37–52 and 100–104). The Pressure Equipment Act (869/99), however, applies as regards risks arising from pressure equipment (*390/2005*, section 5).

According to the Government decree on safety in the handling of natural gas (*551/2009)*, a construction license is required for installation pipelines with an operating pressure exceeding 0.5 bar and with a diameter exceeding DN 25 mm or if the total combined nominal heat input of appliances on the site is 1.2 megawatts or higher (section 5). A regional construction license may be granted for the construction of such distribution and installation pipelines the maximum permitted operating pressure of which is 8 bar (section 6). The operating license for transmission pipelines is issued on the basis of a commissioning inspection (section 8). Applications for construction and operating licenses must be submitted to the Finnish Safety and Chemicals Agency (Tukes). A separate construction license is also required for the storage of natural gas if the amount of natural gas stored is at least five tonnes (section 9).

If the amount of gas is at least 50 tonnes, the requirements set by the Seveso Directive also apply as applicable through the Act on safety in the handling of dangerous chemicals and explosives (*390/2005*) and the relevant decree (*855/2012*). The decree on surveillance of handling and storage of dangerous chemicals (*551/2009*) lays down provisions concerning inspections carried out by an authorized inspection body before commissioning and during operation. The placement plan appended to the construction license application describes the technical scope of the project and the safety issues relating to the project, any risks and the plan for their prevention. The placement plan also describes the most significant environmental impacts of the project.

The structural requirements set for pipelines and installations are laid down in the Pressure Equipment Act (*869/99*). The Act is applied in the territory of Finland to gas pipelines that are classified as pressure equipment. Those placing pressure equipment on the market must be able to verify that the pressure equipment and its design and manufacture are in compliance with the technical requirements of the Act (section 6). Pressure equipment that may cause a significant hazard must be registered and inspected at specific intervals (periodic inspections) and, where necessary, modification inspections must be carried out to ensure that, when properly operated, the pressure equipment does not endanger anybody's health, safety or property. The Pressure Equipment Act does not require any licenses. Instead, it lays down provisions on requirements, inspections and monitoring for installation pipelines that must be taken into consideration in the construction license.

Provisions on the operation of the natural gas transmission network are laid down in the Natural Gas Market Act (*508/2000*). The Act is undergoing reform, and the wholesale and retail markets of natural gas are being opened up to competition. A working group has been appointed by the Ministry of Employment and the Economy for the reform of the Act, and the government proposal is due for completion in 2015.

Regional land use planning, local master planning and local detailed planning under the Land Use and Building Act (*132/99*) also require that the handling of chemicals and explosives is taken into consideration in coastal areas and water areas forming internal territorial waters.

### 4.1.5 Project license

According to the Natural Gas Market Act (*508/2000*, Chapter 6, section 5), the construction of a transmission pipeline crossing the national border requires a project license. The pipeline routing is not determined in conjunction with the license. The precondition for the granting of the license is that the construction of a transmission pipeline crossing the national border is appropriate in terms of the development of the natural gas market. The EIA report must be appended to the application the content of which is described in the Natural Gas Market Decree (*622/2000*, section 8). A project license must be applied for from the Ministry of Employment and the Economy.

### 4.1.6 Land acquisition and transmission pipeline expropriation permit

Land acquisition mainly takes place on the basis of voluntary agreements. In any involuntary situations an advance take-over or expropriation permit will, where necessary, be applied for from the Finnish Government for above-ground sections of high-pressure gas pipelines under the Act on the Expropriation of Immoveable Property and Special Rights (*603/77*). The application is submitted to the Ministry of Employment and the Economy, which acts as the presenting authority. The construction of a low-pressure natural gas pipeline requires a permit under the Land Use and Building Act (*132/99*, section 161). The application will be submitted to the local building control authority in Ingå. Under the Water Act, the right to use an area under water is granted in conjunction with the processing of the water permit application. There is no need for a separate expropriation procedure regarding underwater sections.

#### 4.1.7 Building permit and land use planning

The compressor station, which can be classified as a building, will require a building permit under the Land Use and Building Act (*132/99*) and Decree (*895/99*) (section 125). An action permit is required for the installation or location of structures and installations that are not considered a building (section 126, with more detailed provisions laid down in the Land Use and Building Decree (895/99), section 62)). Both permits are issued by the local building control authority.

Regional land use plans cover marine areas in internal waters but do not apply to the Exclusive Economic Zone. Municipal-level land use plans are restricted to on-shore areas and coastal areas.

## 4.2 Projects of Common Interest (PCI)

The construction of key trans-European energy infrastructure projects (Projects of Common Interest, PCI) is promoted under Regulation (EU) No 347/2013 on guidelines for trans-European energy infrastructure (Infrastructure Regulation). A key aim of the Infrastructure Regulation is to facilitate the implementation of PCIs by, for example, coordinating and accelerating permit granting processes. The Balticconnector natural gas pipeline project is included in the list of PCIs published by the European Commission in October 2013. In Finland provisions on the permit granting procedures for energy PCIs are laid down in Act 684/2014 (of August 22, 2014).

The PCI process is a procedure within which the environmental impact assessment and permit granting procedures based on national legislation are carried out. The authorities in accordance with the national sectoral legislation are, however, still responsible for their statutory decision-making roles. In Finland the competent authority is the Energy Authority, which is tasked with the streamlining of the assessment and permit granting procedures under the competence of other authorities by coordinating the processes as a whole.

The permit granting process relating to PCIs consists of three stages (Figure 4–1), which are the preparatory stage (Stage I), the pre-application procedure (Stage II) and the statutory permit granting procedure (Phase III). (*Energy Authority 2014a*)

TIMELINE OF STAGES OF PCI PERMIT GRANTING PROCESS (EXAMPLE)

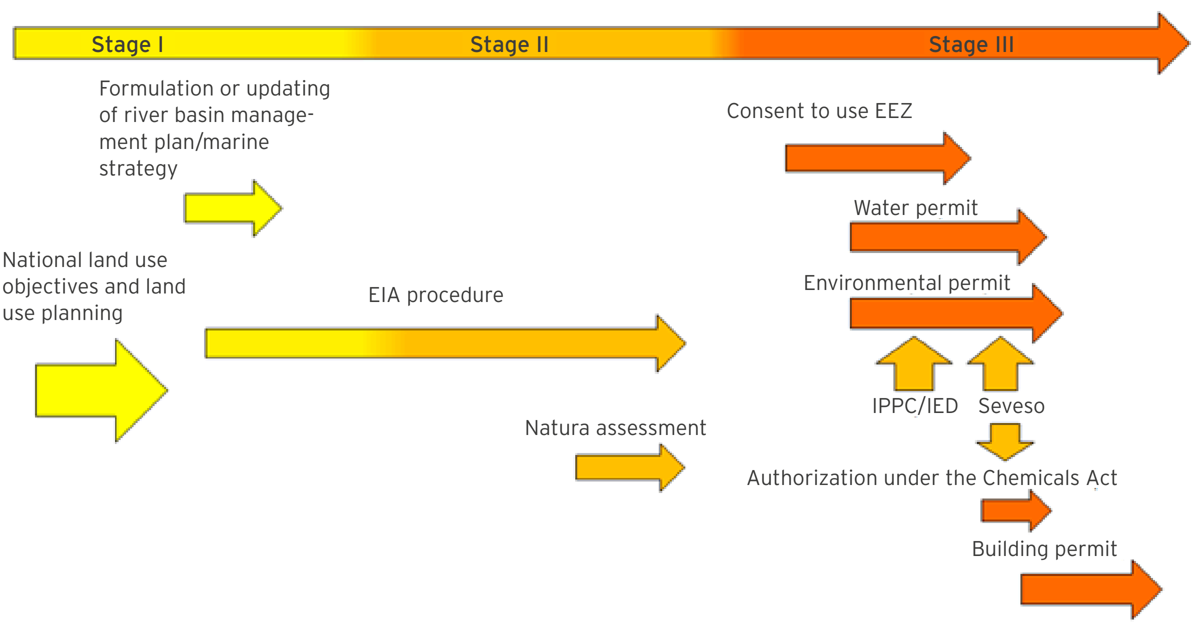



Figure 4–1. The stages of the permit granting process applied to PCIs (*Energy Authority 2014a*).

# 5 THE PROJECT'S RELATIONSHIP WITH PLANS AND PROGRAMS CONCERNING THE USE OF NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

The key plans and programs from the project's perspective concerning the use of natural resources and environmental protection (Table 5-1) include national target programs as well as international commitments. These do not usually impose a direct obligation on operators, but their objectives may be taken to operator level through issues such as water permits. Some plans and programs of significance to the project are presented in the table.

Table 5-1. The project's relationship with plans and programs concerning the use of natural resources and environmental protection.

| The project's relationship with plans, programs and agreements | | | |
|---|---|---|---|
| **Title** | **Content** | **Relationship with the project** | **Reference** |
| **UN Framework Convention on Climate Change** | The EU target adopted at the UNFCCC meeting in Kyoto in December 1997 was to reduce greenhouse gas emissions by at least 8% below 1990 levels. The first commitment period of the Kyoto Protocol was 2008–2012, and the second commitment period covers 2013-2020.<br><br>UNFCCC negotiations are currently underway for a new global climate agreement covering all countries, to be adopted in 2015 and to enter into force in 2020. | Carbon dioxide emissions from natural gas combustion are lower than those from other fossil fuels. Consequently, the project supports Finland's greenhouse gas reduction targets. Natural gas can also replace significant amounts of coal used as a fuel in heat and power production and therefore help achieve considerable cuts in carbon dioxide emissions. | UNFCCC (COP 3) in 1997 Kyoto; EU Member States adopted a burden-sharing agreement concerning emission reduction targets in 1998.<br><br>The latest UNCCC meeting (COP19) was held in Warsaw, Poland, in November 2013. |

| The project's relationship with plans, programs and agreements | | | |
|---|---|---|---|
| **Title** | **Content** | **Relationship with the project** | **Reference** |
| **EU Energy Strategy** | The EU Energy Strategy aims to secure competitive access to clean energy while combating climate change and responding to increasing global demand for energy and uncertainties in future energy supply.<br>To achieve the strategic objectives, an Action Plan was adopted, containing ten items, including developing the Internal Energy Market, ensuring security of supply for energy, and a commitment to greenhouse gases reduction. | The EU Action Plan supports the long-term objectives set for issues incl. greenhouse gases reduction. Carbon dioxide emissions from natural gas combustion are lower than those from other fossil fuels. Consequently, the project supports the objectives set in the EU Energy Strategy. | The EU Energy Strategy (An Energy Policy for Europe) was published on January 10, 2007. |
| **EU climate and energy package** | The European Commission's climate and energy package is a comprehensive set of legislation binding on the Member States. The EU has made a commitment to a 20% reduction in EU greenhouse gas emissions from the 1990 levels by 2020 and to raise the share of EU energy consumption produced from renewable resources to 20%. The European Commission has presented the new 2030 framework for climate and energy policies. The framework proposes the target of reducing greenhouse gas emissions by 40% below the 1990 level and issues including new indicators for competitive, secure and sustainable energy. | Carbon dioxide emissions from natural gas combustion are lower than those from other fossil fuels. This can help replace other fossil energy production based on combustion processes and therefore reduce average carbon dioxide emissions from energy production in Finland.<br>The natural gas transmission network can also be used for the transmission of and existing appliances can fueled with biogas produced from renewable materials. | The EU presented its package relating to renewable energies and climate change on January 23, 2008. |
| **Finland's National Energy and Climate Strategy** | On November 6, 2008 the Government adopted a long-term climate and energy strategy for Finland, containing detailed insights into climate and energy policy measures up to 2020 and suggestions up to 2050. The strategy update was completed in early 2013. The new strategy also entails a program to reduce oil dependence. Also related to the strategy update is the Energy and Climate Roadmap 2050, which presents the measures for reducing greenhouse gas emissions by at least 80%. | The use of natural gas is more energy-efficient than the use of other fossil fuels in combined heat and power (CHP) production in particular. Consequently, the overall efficiency of energy production can be increased by developing the use of natural gas. | Government report adopted on November 6, 2008 concerning energy and climate policy measures to be implemented in the forthcoming years. The update of the 2008 strategy was completed in early 2013. |
| **Maritime spatial planning (MSP)** | Adopted in 2014, the Maritime Spatial Planning Directive provides a common framework for marine spatial planning in Europe. The aim of maritime spatial planning (MSP) is to promote the sustainable use and effective management of marine areas. The Directive also<br>seeks to promote sustainable development in energy production, maritime transport, fishing and aquaculture and to improve the quality of the environment and increase the efficiency of nature conservation. Another aim is to adapt to the impacts of climate change. | Maritime spatial planning (MSP) is a tool for the coordination the use of marine areas and related competing interests. These interests include human activities (such as offshore pipelines and cables) as well as the protection of marine ecosystems and cultural heritage. MSPs are only legally binding through ratified bilateral or multilateral agreements and national legislation based on these. | Directive 2014/89/EU of the European Parliament and of the Council establishing a framework for maritime spatial planning (Maritime Spatial<br>Planning Directive). The national implementation of the Directive is yet to be completed. |

| The project's relationship with plans, programs and agreements | | | |
|---|---|---|---|
| **Title** | **Content** | **Relationship with the project** | **Reference** |
| **Riven basin management plans and legislation** | The river basin management plans and corresponding national legislation in accordance with the EU Water Framework Directive (2000/60/EC) apply to territorial waters. Finland's first river basin management plans were completed in 2009 and remain in force until 2015. Updates for 2016–2021 are currently under preparation. | The general aim of water management legislation is to protect, improve and restore waters to prevent the deterioration of their status and maintain at least good status. The project area off Ingå is included in the Gulf of Finland-Kymijoki River Basin District. According to the classification updated for the second river basin management planning period, the status of the coastal water bodies off Ingå is mainly poor. | EU Water Framework Directive (2000/60/EY).<br><br>In national implementation, provisions on river basin management and marine strategies are laid down in the Act on Water Resources Management (1299/2004) and the Decrees on Water Resources Management Regions (1303/2004), Water Resources Management (1040/2006) and the Management of the Marine Environment (980/2011). |
| **Marine management plans (marine strategies)** | The EU Marine Strategy Framework Directive (MSFD) (2008/56/EY) lays the obligation of an ecosystem approach to the management of human activities having an impact on the marine environment. The Directive aims to achieve good environmental status and sustainability in marine waters by 2020. Therefore each Member State should develop and implement a strategy to achieve this objective. The MSFD is implemented in Member States in stages through acts and decrees. The strategies are referred to as marine management plans (MMP). Finland's MMP, referred to as the marine strategy, will be formulated by 2015. It contains an assessment of current status and a definition of good environmental status (GES) and sets the objectives for the achievement of GES and indicators for the monitoring of GES. A decision on the second part, i.e. the marine strategy monitoring program was made in 2014.<br><br>The monitoring program is used to collect data about species, habitat types, seawater properties and pressures on the marine environment. The final stage is the consideration of the program of measures in 2015. | The key aim of marine management plans (marine strategies) is to ensure a healthy and functioning ecosystem, i.e. the entity of living organisms and non-living components. The pressures from human activities on the marine environment must be managed in a manner enabling GES and not compromising the capacity of marine ecosystems to respond to human-induced changes. According to the first part of the Finnish marine strategy, GES has not been achieved for any part of the Baltic Sea in the Finnish territory. The status is clearly the poorest in the Gulf of Finland and Archipelago Sea. Therefore the achievement of GES calls for measures in all of Finland's marine areas. | EU Marine Strategy Framework Directive (MSFD) (2008/56/EC).<br><br>The first part of Finland's marine strategy was adopted by the Government in 2012. |

| The project's relationship with plans, programs and agreements | | | |
|---|---|---|---|
| **Title** | **Content** | **Relationship with the project** | **Reference** |
| **Baltic Sea protection decisions, programs and agreements** | In 2009 a report on the challenges of the Baltic Sea and Baltic Sea policy was issued by the Government, in which Finland's objectives were outlined comprehensively. The main concerns of protection programs are eutrophication caused by the nutrient load ending up in the Baltic from drainage basins, hazardous substances, emissions, and shipping risks (such as accidents and non-indigenous species). | The Baltic Sea protection measures comprise national and international action. National programs aim to improve the status of coastal waters and preserve the area's nature values in Finland. International cooperation aims to protect the environment in offshore areas. | Decision-in-principle by the Government of Finland on measures to protect the Baltic Sea, the Programme for the Protection of the Baltic Sea, was published in 2002. The latest national protection program is the Water Protection Policy Outlines to 2015 document adopted by the Government in 2006. |
| **The Baltic Marine Environment Protection Commission (HELCOM, Helsinki Commission)** | The Baltic Marine Environment Protection Commission (HELCOM, Helsinki Commission) is the governing body of the Convention on the Protection of the Marine Environment of the Baltic Sea Area. HELCOM operates through intergovernmental cooperation between the Contracting Parties. It seeks to reduce the input of nutrients and hazardous substances into the Baltic Sea, improve navigation safety and preparedness for accidents and conserve and preserve the biodiversity of the marine and coastal environment. | The Baltic Sea Action Plan (BSAP) was adopted by HELCOM in 2007, and national Action Plans have been formulated on the basis of the BSAP. Finland's report on the implementation of HELCOM's BSAP was published in 2010.<br><br>The BSAP applies to offshore areas. | The first agreement was signed in 1974 by all Baltic Rim states. These coastal states and the European Economic Community signed the amended Convention in 1992, and the Convention entered into force in 2000. |
| **Securing critical infrastructure** | Security of supply is based on functioning international political, economic and technological links, secured continuity of operations in organizations and networks critical to the security of supply, and sector-specific security of supply measures. | The security of supply in energy maintenance is based on a variety of energy sources and fuels, a sufficiently extensive and well-distributed energy production capability and securely operating transmission systems. | Government decision on the security of supply goals of December 5, 2013. |

# 6 STARTING POINTS OF THE ENVIRONMENTAL IMPACT ASSESSMENT

## 6.1 Scoping of the assessment

The examined route of the Balticconnector natural gas pipeline will cover the following activities, which have been taken into consideration in the environmental impact assessments conducted:

### In Finland

- Offshore routing totaling around 81 km in length from Ingå to Paldiski (Figure 1-3);
- onshore routings totaling around 1 km in length from the Finnish landfalls to the Ingå compressor station (Figure 1-4 and Figure 1-5); and
- a compressor station in Ingå.

### In Estonia

- Offshore routing totaling around 81 km in length from Ingå to Paldiski (Figure 1-3);
- landfall alternatives ALT EST 1 and ALT EST 2 as well as an onshore routing of around 1.3 km in length from the Estonian landfall ALT EST 1 to a compressor station planned for Kersalu (Figure 1-6).

In the environmental impact assessment, the environmental impacts of the Balticconnector natural gas pipeline and of the activities arising from the project beyond the pipeline route were examined. Activities beyond the Balticconnector natural gas pipeline route include construction-related vessel traffic in the Gulf of Finland. A brief assessment of the environmental impacts of the decommissioning of the Balticconnector project was also carried out (see section 8.17).

This EIA report for Finland does not cover the environmental impacts of the Ingå LNG terminal project. The EIA report for the terminal project was submitted to the coordinating authority, the Uusimaa Centre for Economic Development, Transport and the Environment, in spring 2015. The potential cumulative impacts of the LNG terminal project and the Balticconnector project are discussed in section 8.20 on cumulative impacts of this report.

The EIA report for Estonia does not cover the environmental impacts of the planned compressor station on the Estonian side as it is included in the projects of other developers and the assessments concerning these are carried out in conjunction with the permit procedures relating to these projects. The potential cumulative impacts of the Balticconnector project and the Estonian compressor station and the other activities relating to it are described in the summary provided in Appendix 4 to this report and in the full EIA report for Estonia (*www.balticconnector.fi*). Project logistics and related scopings are described in section 3.4.8.

The scope and significance of the environmental impacts are determined depending on the nature of the receptor. Some of the impacts are only aimed at the local environment, while others may affect broad national entities.

In this context the examined area means the area determined for each impact type within which the environmental impact in question is studied and assessed. Efforts have been made to make the area determined so large that no significant environmental impacts can be assumed to occur outside the area. The direct impacts extend to the vicinity of the offshore pipeline and onshore activities. As regards the offshore areas of the Gulf of Finland, the descriptions of current status and the environmental impacts of the project cover the entire Gulf of Finland. As regards coastal and land areas, the main focus of this report in on the Finnish, with the most significant assessment findings for the corresponding areas in Estonia summarized in Appendix 4 to this report. The areas examined are described in greater detail specifically for each type of environmental impact in section 8.

## 6.2 Impacts assessed

In this project environmental impacts mean the direct and indirect environmental impacts caused by the planned Balticconnector natural gas pipeline project. Impacts during construction and operation as well as decommissioning were examined in the assessment. According to Finnish EIA Act, the assessment must examine the environmental impacts of the project on:

- human health, living conditions and amenity;
- soil, water, air, climate, organisms and biological diversity;
- community structure, buildings, landscape, townscape and cultural heritage;
- utilization of natural resources; and
- interactions between these factors.

Impacts identified in this project as the most significant impacts are impacts during construction on seabed, water quality, the marine environment, flora and fauna.

Also described in the impact assessments are the related uncertainties, measures taken to prevent and mitigate adverse effects, and plans for the monitoring of environmental impacts and any further measures following the EIA procedure.

## 6.3 Studies and surveys conducted on the project and other surveys employed in the assessment work

The offshore gas pipeline route has been studied in the following extensive geotechnical, acoustic and environmental studies in 2006, 2013 and 2014:

- acoustic studies, remote operated vehicle (ROV) and magnetometric studies *(MMT 2006 and 2014);*
- bathymetric studies to measure seabed topography *(MMT 2006 and 2014)*
- Side-scan sonar (SSS) studies to distinguish seabed characteristics and objects *(MMT 2006 and 2014);*
- sub-bottom profiler studies for sub-bottom imaging *(MMT 2006 ja 2014);*
- geotechnical sampling to obtain further data about the geotechnical properties of the seabed *(MMT 2006 and 201);*
- sediment and zoobenthos studies *(Ramboll 2014cc);*
- hard-bottom flora and fauna studies based on scuba diving *(Alleco Oy 2013);*
- aquatic fauna, zoobenthos and fish breeding areas around the LNG terminal planned for Ingå (*Kala- ja vesitutkimus Oy 2014*);
- fisheries studies (*Ramboll 2013b & d*);
- survey of fish breeding grounds (*University of Tartu 2013*);
- study of commercial fishing close to and further off the shore *(Ramboll 2013);*
- marine mammals surveys *(Ramboll 201c);*
- archaeological surveys (*SubZone Oy 2014, Mikroliitti Oy 2014*);
- nature surveys for onshore pipeline routings *(Ympäristösuunnittelu Enviro Oy 2014 and OÜ Tirts &Tigu 2014);*
- Ingå bird surveys; archipelago bird nesting and resting counts *(Ramboll Finland Oy 2014);*
- other bird surveys (*Estonian Ornithological Society 2013, Ramboll 2013e*).

## 6.4 Sensitive sites

Sensitive sites located close to the natural gas pipeline routing were mapped out in the environmental impact assessment. These are shown in the figures below (Figure 6–1) and (Figure 6–2).

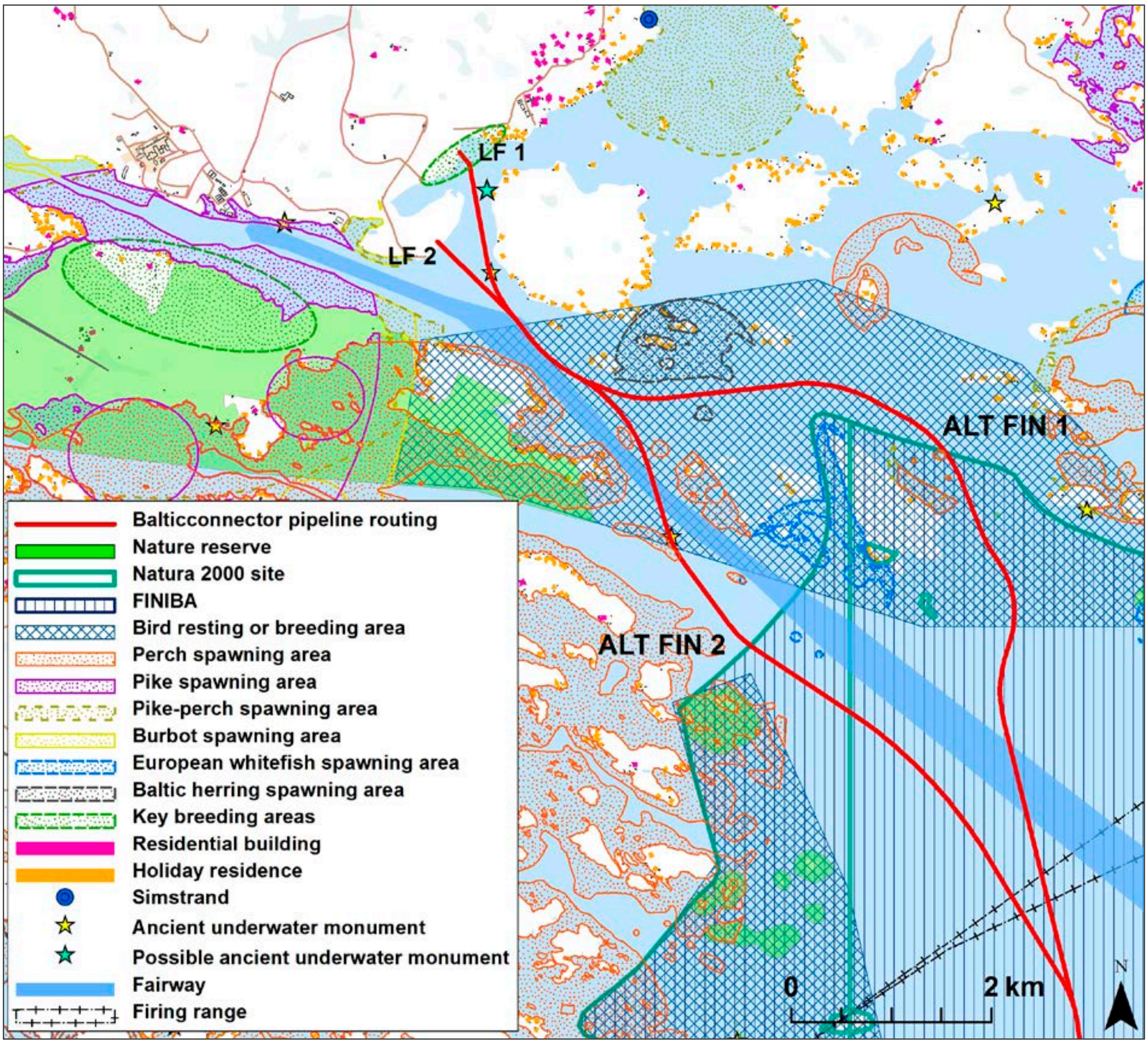



Figure 6-1. Sensitive sites located close to the pipeline routing in the Ingå archipelago.

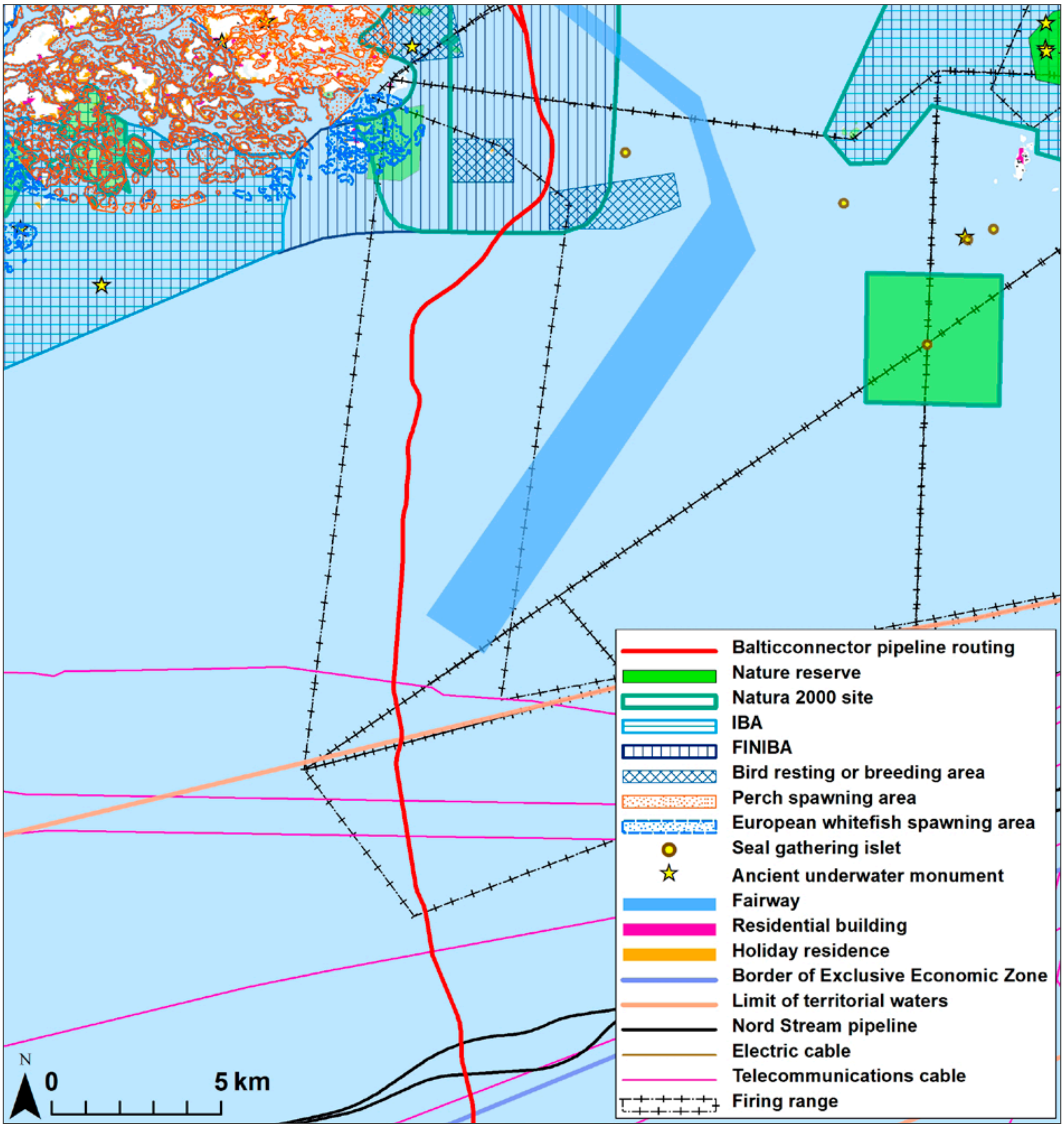



Figure 6-2. Sensitive sites located close to the pipeline routing in marine areas.

## 6.5 Assessment of the significance of the impacts

The multi-criteria decision analysis (MCDA) practices and tools developed in the EU LIFE+ IMPERIA project (*https:www.imperia.jyu.fi*) were employed as appropriate in the assessment of the significance of the environmental impacts reported in this EIA report. The components of impact significance as well as overall significance are described in summary tables at the end of each impact assessment section. The significance of impacts is also described in the comparison of the alternatives and the summary of the most significant impacts (section 8.20). The classification criteria for the components of impact significance employed in this project are presented in Appendix 3.

### 6.5.1 Components of impact significance

To assess the significance of the project's impacts, as assessment was conducted for each impact concerning the sensitivity of the area or site affected in the current state and the magnitude of change caused by the project. On the basis of these, an overall assessment of the significance of the impact in question was formed. The assessments of the sensitivity of the affected area or site and the magnitude of change were carried out by examining the elements shown in the figure (Figure 6-1).

### Sensitivity

The sensitivity of the receptor describes the characteristics of the affected organism, site or area. Its components are the legislative steering relating to the impact, the societal significance of the area or issue, and the receptor's susceptibility to change.

### Magnitude

The magnitude of change describes the characteristics of the change caused by the project where the direction of change can be negative or positive. The magnitude consists of the intensity and direction, spatial extent and duration of the change.

### 6.5.2 Assessment of the significance of impacts

The significance of the impacts was assessed on the basis of the sensitivity of the receptor and the magnitude of change caused by the project. An indicative table (Table 6-1), where red indicates a negative and green indicates a positive impact was used in the assessments.

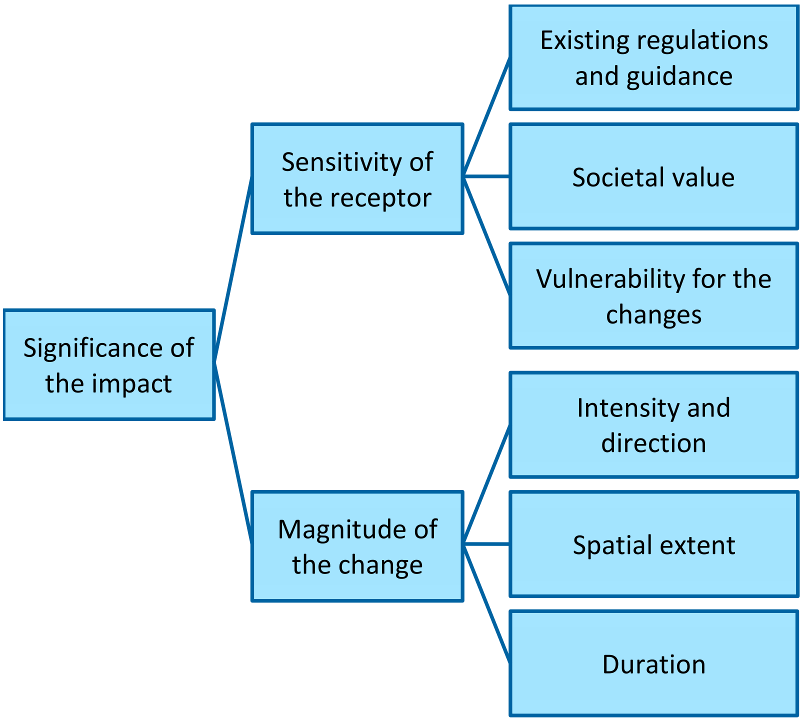



Figure 6-3. Components of impact significance. (*Imperia 2015*)

Table 6-1. Indicative table of the overall significance of impacts. (*Imperia 2015*)

| **Impact significance** | | **Negative** | | | **Magnitude of change** | | | | | **Positive** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Very high** | **High** | **Moderate** | **Low** | **No change** | **Low** | **Moderate** | **High** | **Very high** |
| **Sensitivity of the receptor** | **Low** | High* | Moderate* | Low | Low | No impact | Low | Low | Moderate* | High* |
| | **Moderate** | High | High* | Moderate | Low | No impact | Low | Moderate | High* | High |
| | **High** | Very high | High | High* | Moderate* | No impact | Moderate* | High* | High | Very high |
| | **Very high** | Very high | Very high | High | High* | No impact | High* | High | Very high | Very high |

* In these cases in particular it may be necessary to rate the significance as lower if the sensitivity or change is at the lower end of the category.

# 7 CURRENT STATUS OF THE ENVIRONMENT

## 7.1 Seabed, soil, bedrock and groundwater

### 7.1.1 Gulf of Finland

#### Bathymetry

The Baltic Sea is one of the largest inland seas in the world. It is, however, very shallow, with the average depth only being 55 m. There is major variation in water depth and seabed morphology. The depth of water in some of the deep basins of the Baltic Sea is several hundreds of meters. The Gulf of Finland is the easternmost arm of the Baltic Sea bordering on Finland, Estonia and Russia, accounting for around 5% (1,100 km³) of the total water volume of the Baltic Sea. The average depth of the Gulf of Finland is 38 m, while the maximum depth is 123 m. The relatively flat morphology of the Southern Baltic Sea differs from the fragmented seabed of the Northern Baltic Sea, particularly its coastal areas and archipelago. These differences in seabed morphology and structure between the areas are mainly due to bedrock differences. (*Baltic Sea Portal 2014*)

The depth of water along the route of the planned gas pipeline varies in the 0–93 m range. The seabed profile on the pipeline route is shown in the figure (Figure 7–1). The Gulf of Finland coast slopes more gently on the Finnish side than on the Estonian coast. There is an archipelago zone that is around 20 km wide off Ingå, Finland, where major changes in water depth are caused by bedrock ridges, mainly in the 5-25 m range. In the northern routing alternative (ALT FIN 2) the variation in seabed profile is steeper than in the southern alternative (ALT FIN 1). The depth of water in the LF1 and LF2 landfall areas is around 10 m, with slight variation seen above and below this depth.

In central parts of western Gulf of Finland the depth increases gradually and the average depth is around 80 m. The deepest point, 93 m, is located around 20 km from the coast of Estonia (KP 64, Figure 3–1). On the Estonian coast the water depth increases rapidly towards to open sea. In the more western landfall alternative, ALT EST 1, the depth goes down to 35 m over a distance of around 4 km, while in the more eastern alternative, ALT EST 2, the increase in depth is slightly less rapid (*MMT 2014*).

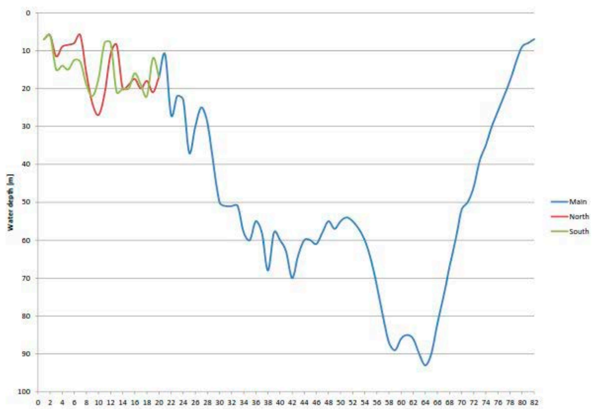



Figure 7–1. The vertical profile of the pipeline routing from Ingå to Paldiski. The green line refers to the routing alternative south of the island of Stora Fagerö, ALT FIN 1, and the red line to the northern routing alternative, ALT FIN 2 *(Ramboll 2014)*.

### Seabed morphology and sediments

The bedrock in the Gulf of Finland area is divided into two very different parts. The bedrock on the northern side of the gulf consists of Precambrian crystalline rock, while the bedrock on the southern side consists of sediment rock layers on top of the bedrock aged a few hundred million years. The Precambrian bedrock is considerably harder and more durable than the sedimentary rock on top of it. Due to the differences in erosion tolerance between the Finnish and Estonian bedrocks, there are clear differences in bedrock topography between the two sides of the Gulf of Finland.

Although the Finnish coast is extremely irregular, its bedrock topography is still relatively more even than the klint topography of the Estonian coast characterized by peninsulas often with rather steep cliffs running north or northwest. The deep gorges formed between the peninsulas are covered by sediment layers up to tens or even a hundred meters thick. The depth of water in these bays and inlets of today can be up to 40–50 m, with the outermost sections of the deepest bays being up to a maximum of 90 m.

The bedrock on the Estonian coast is exposed in places but often covered by sediments. This also applies to the seabed. On the northern coast of the Gulf of Finland the bedrock is often highly exposed in the littoral zones of the coast and archipelago, but bedrock exposed through sediment layers areas is also often found in the seabed. In most places, however, the bedrock is covered by glacial till covered by glacial and late glacial clay, with these then covered by even younger post-glacial clay (Figure 7-2 and Figure 7-3). Seabed depressions formed by bedrock and glacial till (Figure 7-4) and other sediments act as sedimentation basins where younger sediments were deposited over the past millennia to form almost horizontal clay and silt-clay deposits. The youngest units often found in the top layers of sedimentation basins are recent clays and muds with higher concentrations of organic matter and consequently also nutrients than older clays. In clay and mud areas, gas is also often found in sediments, formed mostly through the decomposition of organic matter. Similar layering also applies to sediments on the Estonian side.

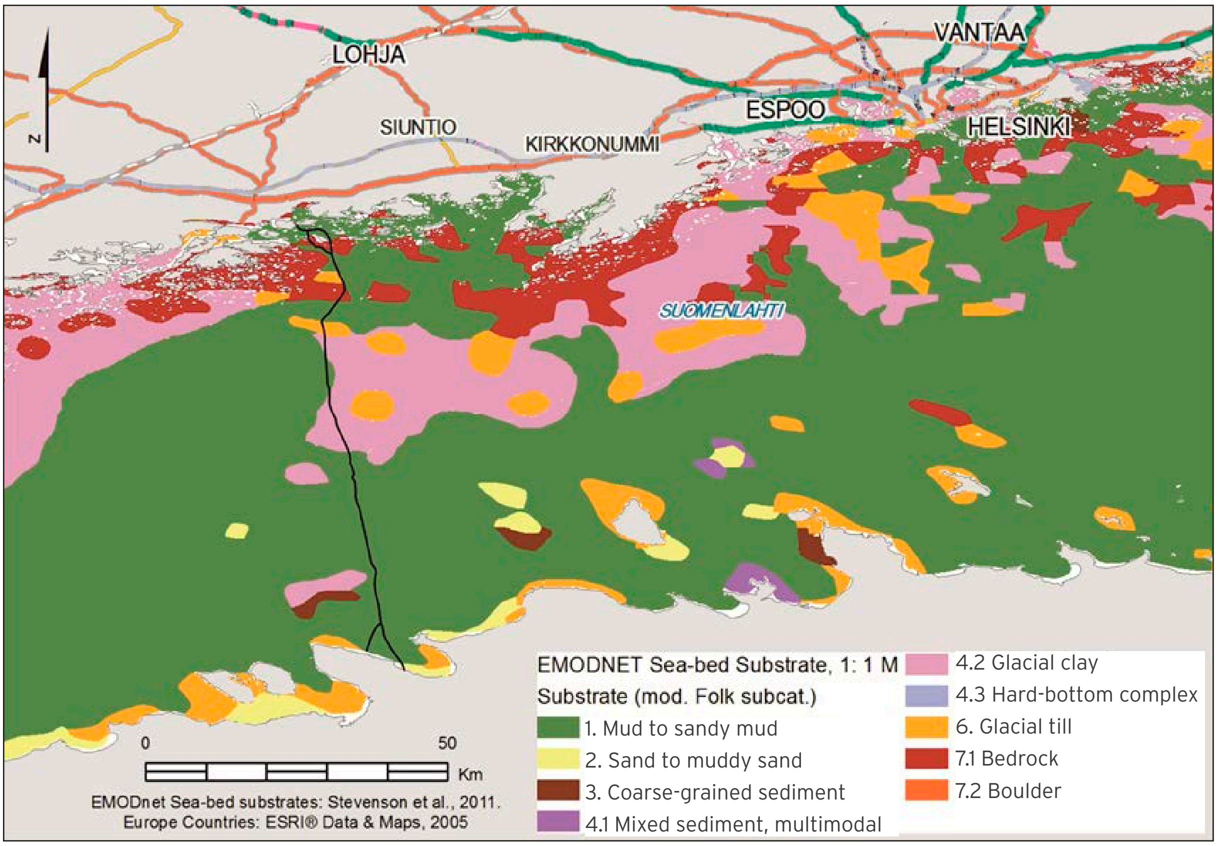



Figure 7-2. Seabed substrates in western Gulf of Finland, European Marine Observation and Data Network (EMODnet) seabed substrate map. *(Stevenson et al. 2011)*

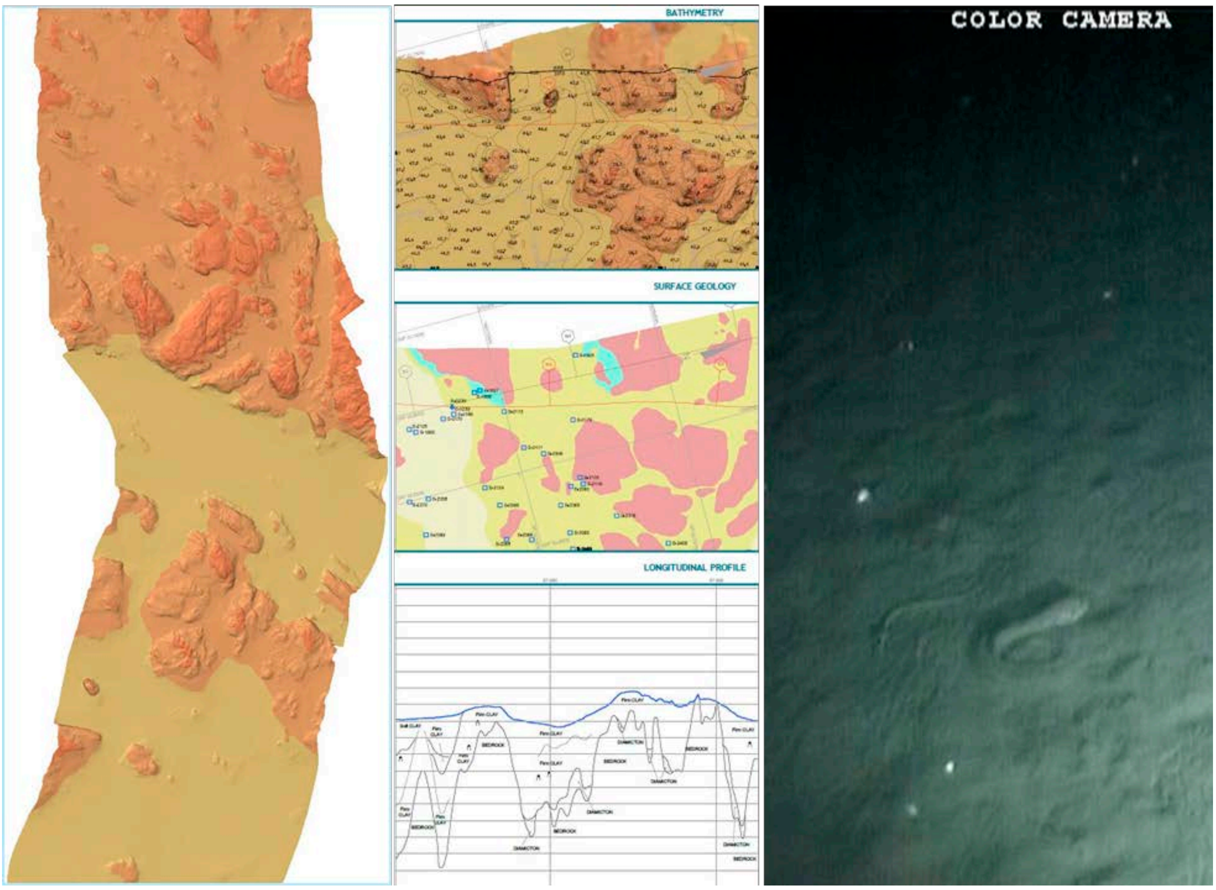



Figure 7–3. Seabed bathymetry (3D mapping of seabed), interpreted geology, seismic profiles and ROV images of seabed on the Balticconnector study corridor in southern parts of Finland's territorial waters, with the image on the right showing soft clay bottom and a viviparous blenny (*Zoarces viviparus*), a demersal species of the Baltic Sea. *(Images MMT/Gasum)*

### Glacial isostasy and post-glacial rebound

During the last ice ages the Baltic Sea basin was subjected to strong pressure as the area was depressed by heavy masses of ice. In the area currently the Gulf of Finland, the bedrock was suppressed by the ice masses by tens of meters, and the post-glacial rebound is still taking place, which can be seen as uplift of land in our coastal areas. The rate of rebound varies around the Baltic Sea and is approximately 0.3–0.6 cm a year in the Gulf of Finland area. Furthermore, the rate of rebound in the Baltic Sea basin is different at the different ends of the basin, resulting in different rates of impact on the seabed in the different parts of the basin. When undergoing uplift, sediments become exposed to the impacts of waves and currents, which increases the amount of material detached from sediment due to erosion. Due to the hardness of the bedrock, however, the uplift rate is not even. Instead, it often takes place spasmodically. The rate of this neotectonic motion is usually small, with no mentionable earthquakes usually occurring due to glacial isostatic adjustment in the Baltic Sea area.

### Metals and organic pollutants

Throughout its history, the Baltic Sea has received heavy metals from a variety of sources, including river water, coastal erosion and, to a slightly lesser extent, from the atmosphere. These used to originate from the natural environment, but human activities have resulted in an increase in the quantities of pollutants in the Baltic Sea. The Baltic now faces a large number of different organic pollutants and point source input from a variety of sources such as sewers, shipyards and marinas as well as airborne inputs. In the seabed the pollutants are mainly bound to the finest-grain material, corresponding to clay in terms of grain size. This is due to the fact that the particles of the fine fractions are negatively charged and have a large specific surface area to which positively charged heavy metals are fixed.

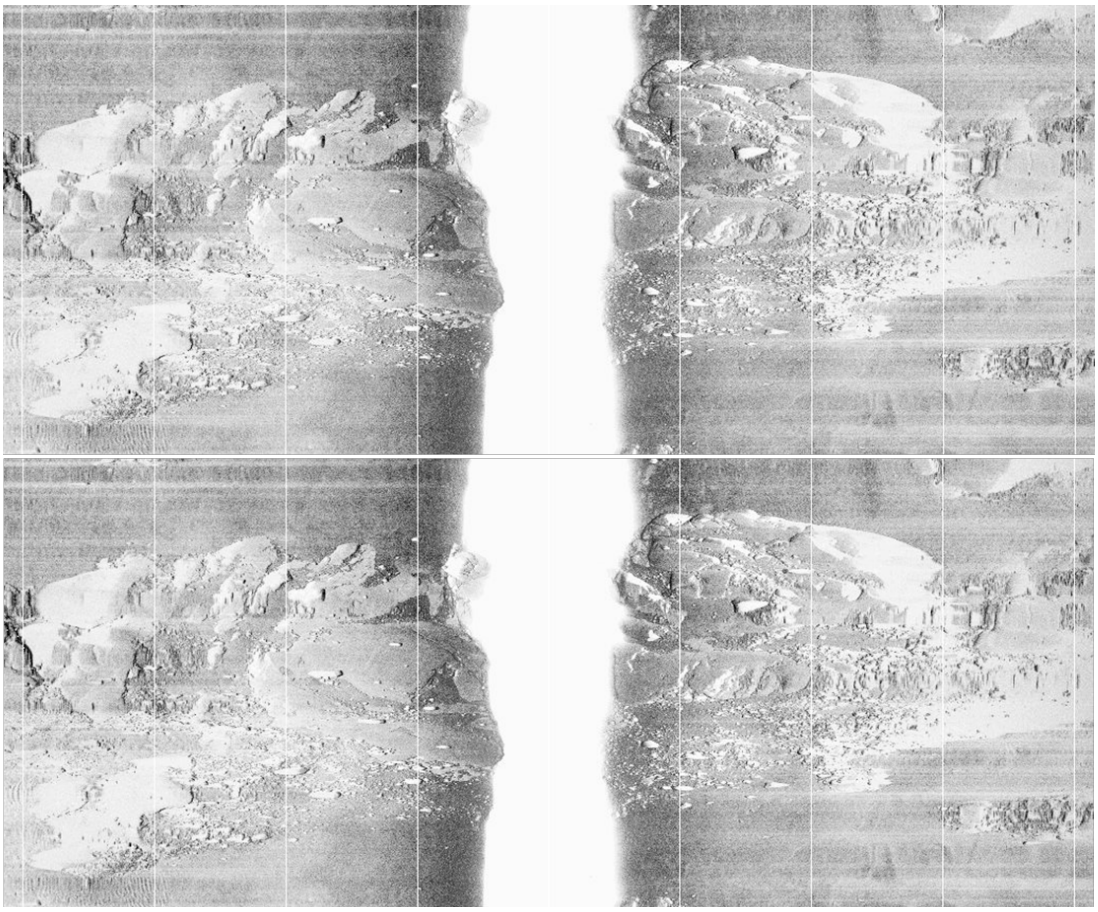


Figure 7-4. Side-scan sonar images of the seabed along the natural gas pipeline route at Kalbådan, Porkkala (KP ~18). Exposed bedrock and glacial till covering bedrock. *(MMT 20144)*

Pollutants are also to some extent fixed by organic matter.

To study sediment characteristics, dozens of samples were obtained from the Balticconnector pipeline study corridor and Port of Ingå in 2014, with the surface layers of 24 samples analyzed to establish their heavy metal and organic compound concentrations *(Ramboll 2014)*. The table (Table 7-1) presents the heavy metals in surface sediments along the gas pipeline route in 2013.

A comparison of concentrations in samples from the pipeline route with the Government Decree on the Assessment of Soil Contamination and Remediation Needs (214/2007) shows that only arsenic is slightly above the Decree's threshold value of 5 mg/kg (Table 7-1). The other heavy metal concentrations usually exceed natural background concentrations but are below the threshold values given in the Decree. The levels of organic compounds measures do not exceed the threshold values set either.

The Finnish guidelines on the dredging and deposition of sediments (*Ministry of the Environment 2004*) present the quality criteria for the assessment of the marine disposability of dredged sediments. The guidelines specify two pollutant levels: the lower level (level 1) and the higher level (level 2). The quality criteria are given for normalized concentrations, i.e. standard sediments with a specific grain size distributions and organic material composition. If the normalized values exceed level 1, the sediment is classified as possibly contaminated, while those exceeding level 2 are contaminated and may not be deposited.

In the pipeline samples, level 1 was exceeded for mercury, cadmium, chromium, copper, lead, nickel and zinc. Levels slightly above level 1 were also found for PCDD/Fs, petroleum hydrocarbons and TBTs (*Ramboll 2014*). The excesses were in all cases slight, with the levels remaining clearly below level 2.

Table 7-1. Heavy metal concentrations in surface sediments (mg/kg average and mg/kg normalized) along the gas pipeline route in 2013. *(Ramboll 2014)*. Number of samples analyzed and exceeding the limit of determination 17 (n = 17), excluding Cu 16 (n = 16), Cd 6 (n = 6) and Hg 2 (n = 2). Abbreviations used: GD = Government Decree, norm. = normalized, MoE = Ministry of the Environment.

| Metal | Average concentration in pipeline route study area, mg/kg av. (min. max.) | GD 214/2007 | | | Average concentration in pipeline route study area, mg/kg normalized (min. max.) | MoE (2004) | |
|---|---|---|---|---|---|---|---|
| | | Threshold value mg/kg | Lower guideline value mg/kg | Upper guideline value mg/kg | | Level 1 norm. mg/kg | Level 2 norm. mg/kg |
| **Arsenic** | 7.4 (1.6-14) | 5 | 50 | 100 | 7.8 (3-15) | 15 | 60 |
| **Mercury** | 0.12 (0.11-0.13) | 0.5 | 2 | 5 | 0.125 (0.11-0.14) | 0.1 | 1 |
| **Cadmium** | 0.60 (0.23-0.97) | 1 | 10 | 20 | 0.65 (0.27-1.07) | 0.5 | 2.5 |
| **Cobalt** | 11.0 (2.2-17) | 20 | 100 | 250 | 43 (13-85) | | |
| **Chromium** | 44.3 (7.7-74) | 100 | 200 | 300 | 43 (13-85) | 65 | 270 |
| **Copper** | 29.9 (12-48) | 100 | 150 | 200 | 30.3 (17-51) | 50 | 90 |
| **Lead** | 20.1 (4.5-47) | 60 | 200 | 750 | 20.8 (7-53) | 40 | 200 |
| **Nickel** | 26.8 (4.5-42) | 50 | 100 | 150 | 27.1 (4.5-47) | 45 | 60 |
| **Zinc** | 97.1 (20-180) | 200 | 250 | 400 | 101.1 (41-194) | 170 | 500 |

The modes of action of pollutants vary considerably depending on the substance and compound. Some tend to bioaccumulate in the food chain in the top predators, such as seals and White-tailed Eagle (*Haliaeetus albicilla)* as well as humans. The bioaccumulation of pollutants may cause health problems in various parts of the food chain, particularly in predators toward the top of the chain.

Seabed sediment layers may be resuspended into the water column due to natural factors such as bioturbation, the reworking of sediments by zoobenthos, and currents or human activities and be transported by currents to new sedimentation environments. The resuspension and transport of sediment particles and any pollutants contained by them are affected by prevailing physico-chemical conditions and sediment properties. Suspended sediments mainly move to accumulation areas, but at times they are deposited temporarily on transportation bottoms from where they will later move to a more permanent environment on accumulation bottoms. The seabed in the marine area of the pipeline route is in a relatively untouched state.

### Munitions and waste dumped in the sea

Both conventional munitions (such as depth charges, grenades and torpedoes) as well as chemical munitions were dumped in the Baltic Sea during and after the First and Second World War. Naval exercises are still undertaken in the Gulf of Finland, with munitions detected destroyed by exploding them in designated areas. Considerable amounts of chemical munitions were also dumped in the Baltic Sea during and after the Second World War. This dumping continued until 1972, which is when the dumping of toxic wastes in the sea was prohibited under the London Convention. There is no specific information available about the locations of the munitions dumped in the sea.

Marine litter is a growing problem around the world. Litter ends up in the sea from land-based activities as well as maritime activities. This litter consists of man-made products that are typically very slowly degradable. Litter is also often washed ashore by sea currents, but it is estimated that up to 70% of all marine litter ends up resting on the seabed. Plastic litter is the type of litter most commonly found in the Baltic Sea. In addition to plastic bottles and bags, items such as glass, rubber, metal, clothes, fishing nets, packaging materials, paper, cardboard and wood are found in the Baltic Sea. (*Baltic Sea Portal 2014*)

Of the total of 48 man-made objects (including munitions, metal waste, barrels) detected in the Balticconnector project study corridor, eight have been classified as probable munitions. Six of these are on the Estonian side and two on the Finnish side *(MMT 2006* and *2014)*.

## 7.1.2 Ingå

### 7.1.2.1 Seabed

In the Ingå area the seabed of the Gulf of Finland can be divided roughly into three main geological components: the bedrock as well as hard and soft soils. The bedrock is old, crystalline Precambrian rock, the same hard and durable bedrock that forms most of the onshore bedrock on the southern coast of Finland. It is mainly composed on different plutonic rocks of various degrees of metamorphosis (granites, granodiorites, diorites, etc.), mica schist and mica gneiss, various metavolcanic rocks and limestones.

The bedrock of the seafloor is in parts exposed, particularly in areas close to the coast, but in most places covered by a variety of soil types. The bedrock is often covered by a till bed or diamicton, with layers of other sediments deposited on top of it. In some places clays or other sediments cover the bedrock without an intermediate till bed. The clays are either glacial clays or younger clays deposited later during the various phases of the Baltic Sea. In places where sedimentation conditions have been favorable, clay sediments are covered by young deposits are covered by young clay-rich mud. Here and there there are also eroded gravel or sand formations inside or as the top layers of sediments. The bottom may also be covered by boulders of various sizes, appearances and numbers.

The topography of the area varies from relatively flat bottoms to rather sharp topography where cliffs rise in places from rather deep sediment bottoms toward the surface. Seabed topography affects near-bottom currents, and loose, suspended sediment materials are transported by these flows. Currents do not, however, necessarily follow the deepest channels and if they do, flows in the channels are often strong. Due to strong currents, debris accumulation in the channels does not take place. Instead, debris is transported by the currents to shallower bottoms with more favorable sedimentation conditions. Consequently, the accumulation areas of fine fractions are often quite flat and rather extensive plains or even mounds on the seabed.

In the area affected by the planned pipeline the seabed ranges from various types of clay bottom to hard glacial till and bedrock areas. Off the Ingå coast the two routing and landfall alternatives of the Balticconnector pipeline also run through highly varied seabed types. Both routing alternatives pass the island of Stora Fagerö and run in part along soft clay bottoms and in part hard till or bedrock bottoms. There are sections of exposed bedrock and glacial till in the study corridor of the southern routing alternative (ALT FIN 2) in almost the same ratio as in the northern alternative (ALT FIN 1). The biggest difference in seabed material between the routings is in clays. In the southern routing alternative the amount of younger and softer post-glacial clay is slightly larger than in the northern alternative where the clays east of Stora Fagerö are mainly glacial clays, with mainly younger post-glacial clays only found north and northwest of the island. There are bigger differences in seabed materials between the gas pipeline landfall alternatives. The northern landfall alternative, LF1, passes mainly along a section of sandy bottom, with some sections also running through post-glacial clay. The southern landfall alternative, LF2, passes almost entirely through soft post-glacial clay bottom.

#### 7.1.2.2 Soil, bedrock and groundwater

The soil at landfall LF1 by Bastubackaviken Bay consists of clay and mud, turning into clay and eventually into fine sand further inland. At landfall LF 2 at the Fjusö Peninsula the soil is leptosol that is up to 1 m in thickness. According to soil data from the Geological Survey of Finland *(2014a and b)*, there are areas with finer-grain soils, such as clay, fine sand, sand and till, between bedrock sections. The area has been submerged since the last ice age, with loose soil washed off by water, leaving areas of rock exposed. (*Kujansuu et al. 1993*)

The bedrock in the area was formed during the orogeny that took place around 1,900–1,700 million years ago. The bedrock is mainly composed of microcline granite with quartz, orthoclase and plagioclase as the main minerals, while the dark minerals found are biotite and garnet. (*Pöyry Finland Oy 2013a)*

The natural gas pipeline routing sections of Fjusö, Bränseludd and Kohagen are not located in classified groundwater areas important for water supply. No wells of water intended for human consumption were found in the area on the basis of maps either. The nearest area suitable for groundwater supply is Gripans, located around 900 m northeast from the LF1 landfall alternative of the natural gas pipeline.

There are plenty of bedrock sections in the area. In such areas groundwater is stored in fractures and fracture zones of the bedrock *(Geological Survey of Finland 2014c).* On the coast the groundwater surface level generally follows the sea level, and seawater ends up in the soil and bedrock via fractures and pores. Therefore the chloride concentration of groundwater in coastal areas is higher due to the impact of the Baltic Sea. (*Lamminen 1995*) Bedrock groundwater flows in bedrock fractures, with the flow of soil groundwater in the area guided by local topography. (*Pöyry Finland Oy 2013a)*

## 7.2 Hydrology, water quality and marine environment

### 7.2.1 Gulf of Finland

#### Ice conditions

There is major spatial and temporal variability in the ice conditions of the Gulf of Finland. The Gulf of Finland remains totally free of ice cover in very mild winters. In most years the eastern parts and part of the northern coast of the Gulf of Finland freeze over. On an average year the entire Gulf of Finland receives an ice cover. During cold winters almost the entire Baltic Sea may freeze over. The figure (Figure 7–5) shows that in a mild winter the edge of the ice-covered area extends close to the Balticconnector pipeline route in the offshore area. The ice conditions off Ingå are rather easy as the Ingå fairway is open almost throughout the year. In Estonia the winter is shorter than in Finland, and spring arrives

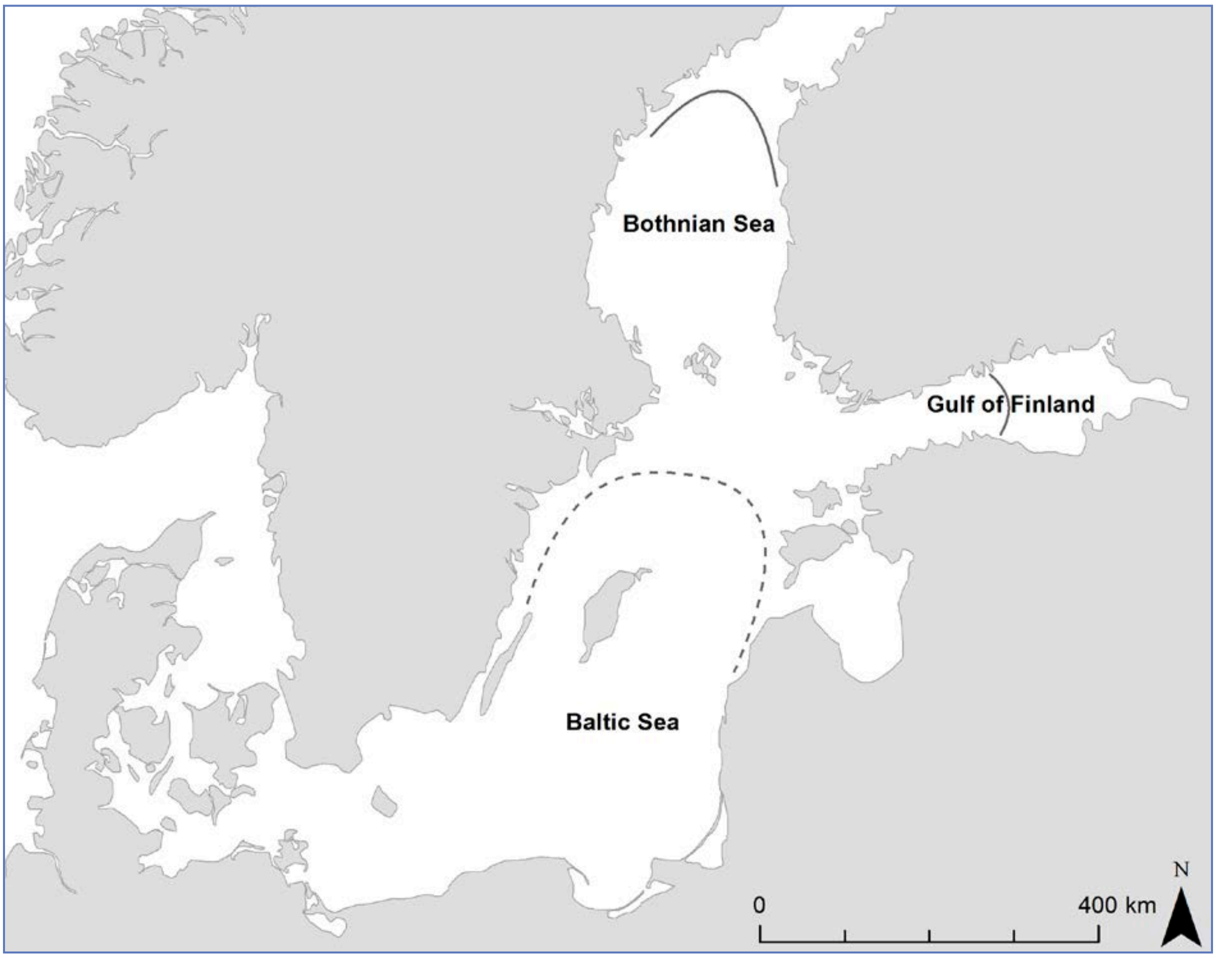



Figure 7–5. Ice cover in the Baltic Sea, with the solid line illustrating the situation in a mild winter, the broken line in an average winter and the dotted line in a very cold winter. *(DHI 2006)*

earlier. With southwestern winds prevailing, winter ice conditions are generally easier than on the Finnish coast.

The ice cover is usually at its largest at the turn of February and March, and typical ice thickness at that time of the year in the northern parts of the Gulf of Finland is around 60 cm. In normal winters the period of ice cover in western Gulf of Finland is 1–3 months and at most the ice-covered period may be last around five months. The ice cover may consist of fast ice or drift ice. In areas close to the coast and archipelago the ice is usually fast ice fastened to the coastline. Drift ice is carried along in offshore areas by winds and currents, covering distances up to 30 km in stormy weather. When driven together into a single mass, drift ice forms pack ice that may extend to depths up to 10 m. In shallow areas pack ice may scour the seabed.

### Flows and currents

Cyclonic mean circulation takes place in the surface waters of the Gulf of Finland where there is an eastward inflow of water at the Estonian coast and a westward outflow adjacent to the Finnish coast on the northern side of the gulf. According to recent modeling results, there are also several smaller gyres prevailing in the Gulf of Finland (Figure 7–6). The mean current velocities in the basic circulation are only a few centimeters per second. Velocities an order of magnitude above these are caused by winds either along or against the basic current. Currents are also created by factors such as sea surface inclination, density gradients (temperature and salinity), bathymetric variation, and fresh water input from rivers. The average flow velocities are 5–10 cm/s, but temporary peak rates may be up to 50–100 cm/s.

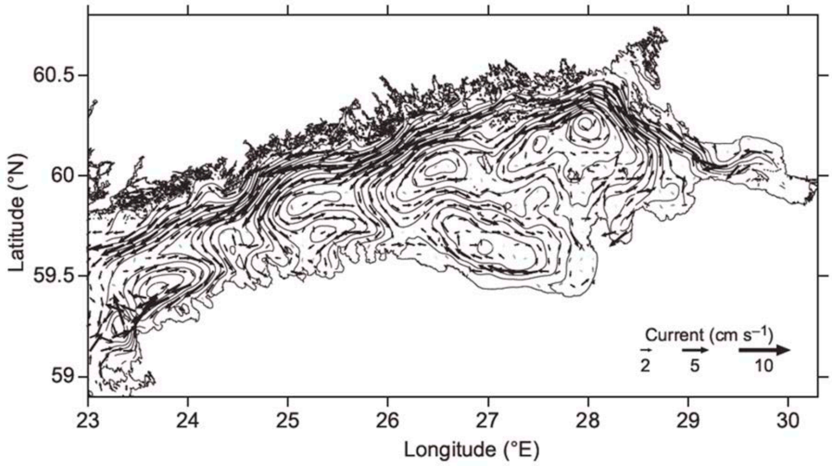



Figure 7-6. Average surface layer (4–8 m) current directions in the Gulf of Finland in 2006–2008 according to the HIROMB model. *(Elken et al. 2011)*

Near-bottom currents depend largely on bathymetry. Currents also occur vertically depending on density gradient differences between the various layers of water. In deep layers water moves from the Danish straits along deeps and sills. The exchange of water between deeps takes place over sills, whereby the flow velocity depends on gravity and the height of the sill. The is quite a lot of variation in near-bottom flow velocities, but the rates of these are usually clearly lower than those of surface currents. Findings from continuous measurement at control stations carried out in conjunction with monitoring conducted for the Nord Stream gas pipeline project showed average flow velocities of 4–6 cm/s near the bottom, with the highest velocities measured in western Gulf of Finland being 37 cm/s and in eastern Gulf of Finland 51 cm/s (*Ramboll 2013b, Luode Consulting Oy 2013*).

The directional and velocity distributions for the prevailing currents for the period from June 1 to November 1, 2012 at different depths for four points along the planned gas pipeline route were calculated in conjunction with the environmental impact assessment of the Balticconnector project. The locations of the points are shown in the figure (Figure 7-7). The distributions are given as percentages, i.e. they illustrate the rate of all flows during the period falling under the category presented. Wind has a major impact on surface currents in particular, and the wind distribution for the calculation period is presented in the figure (Figure 7–8). Typically for the area, southwesterly winds prevailed

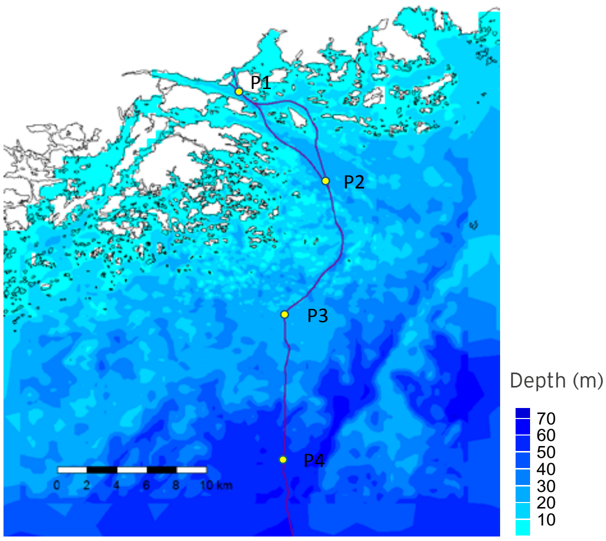



Figure 7-7. Current distribution observation points.

over the calculation period, with the most common wind speeds being 4–7 m/s. In addition to the wind conditions presented, currents are also affected by variation in air pressure and water level over more extensive areas. A more detailed description of the modeling is given in conjunction with the impact assessment in section 8.3.1 and in a separate report (*Lauri 2014*).

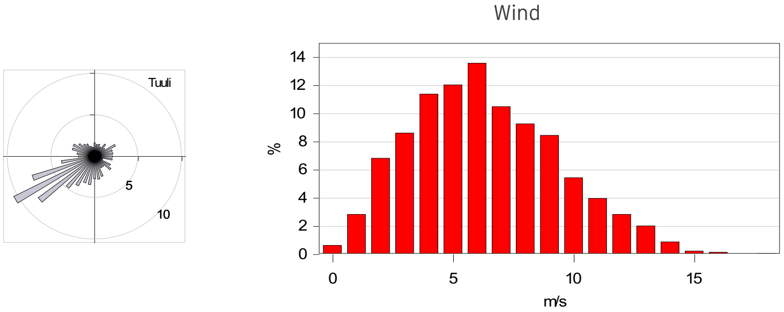



Figure 7-8. Wind direction and speed distribution, Mäkiluoto, Kirkkonummi, Finland, June 1 to November 1, 2012.

There was major variation in surface current (1 m) direction at Point 1 in the inner archipelago of Ingå, but northeasterly, easterly and southeasterly currents were slightly more common than other directions (Figure 7-9). Current velocities were mostly in the 5-10 cm/s range, with temporary peaks seen at 20 cm/s. In the middle layer (7 m) southeasterly and northwesterly currents prevailed, and velocities went below 5 cm/s. In deeper waters (14 m) the direction further narrowed down to northwesterly, and velocities on average slowed down.

In the outer archipelago of Ingå at point P2, easterly and southeasterly currents became more common on the surface, with current velocities also increasing on average and the maximum rates being around 35 cm/s (Figure 7-10). In deeper waters (22-26 m) the currents turned toward west-northwesterly, and velocities increased slightly on average but still remained mainly below 5 cm/s.

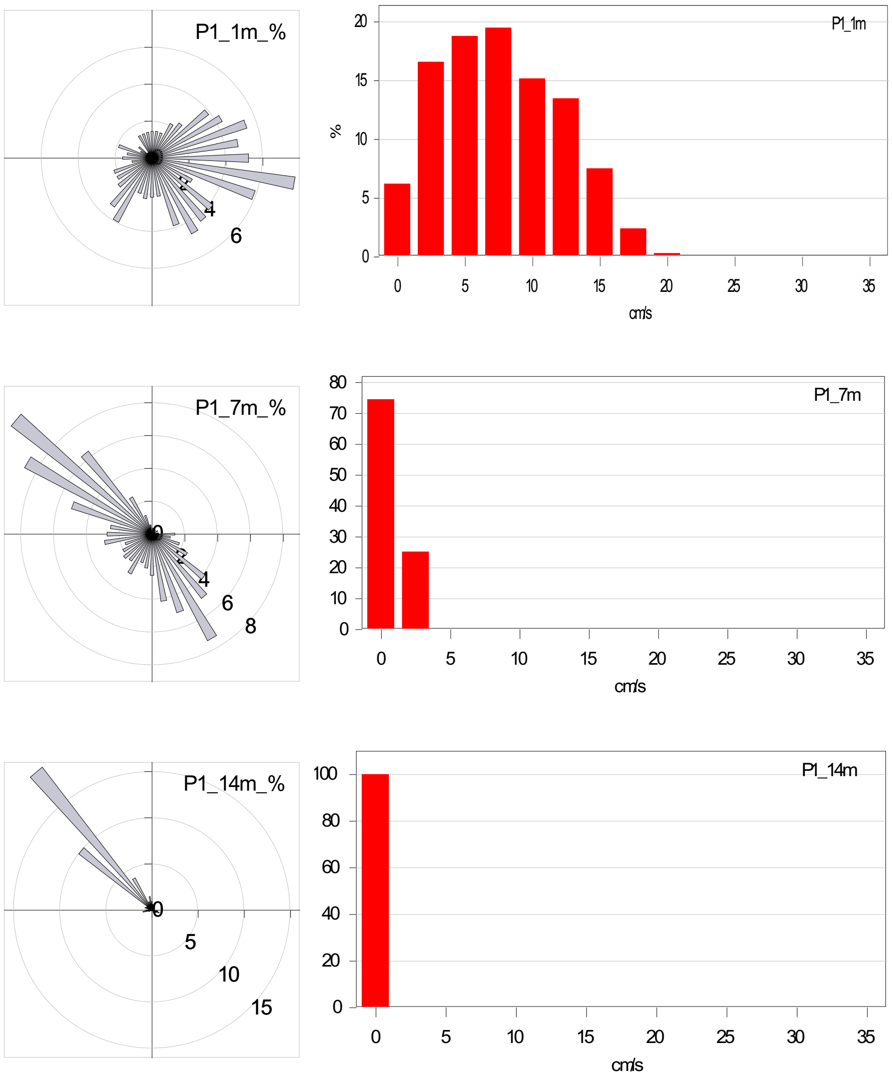



Figure 7-9. Current direction and velocity distributions for point P1 located in the inner archipelago of Ingå, June 1-November 1, 2012.

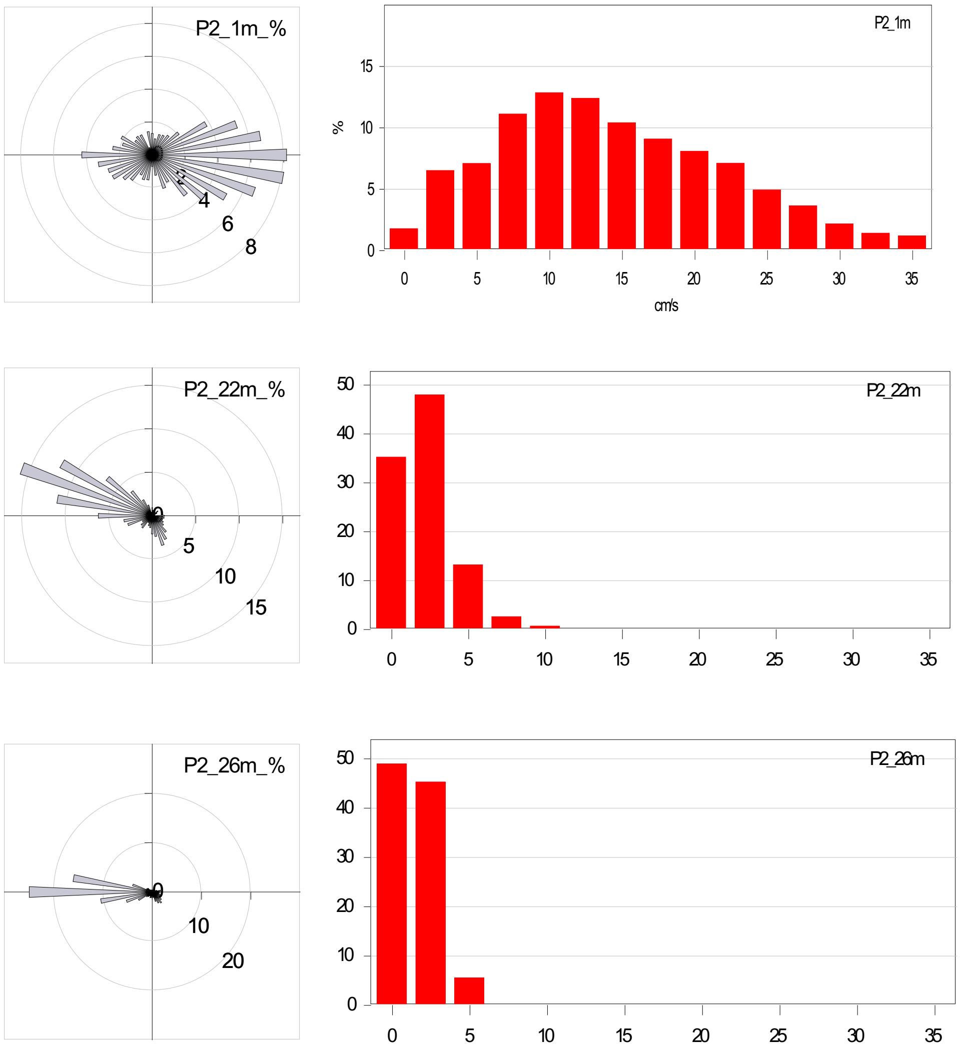



Figure 7-10. Current direction and velocity distributions for point P2 located in the outer archipelago of Ingå, June 1–November 1, 2012.

The current distributions for the offshore points P3 and P4 further out in the sea (Figure 7-11 and Figure 7-12) close to the surface (1 m) were mostly similar to those for point P2. In deeper waters the current turned from west-northwesterly toward southwesterly, with east-northeasterly flows also increasing. Variation in current directions was the most common at the outermost point, P4. As well as in direction, variation in current velocities also increased further off the coast.

The modeling results confirm there is strong spatial and temporal variation in currents. In addition to weather conditions, local changes in currents are increased by the feature-rich structure of the area off Ingå and the large geometric variation of the area.

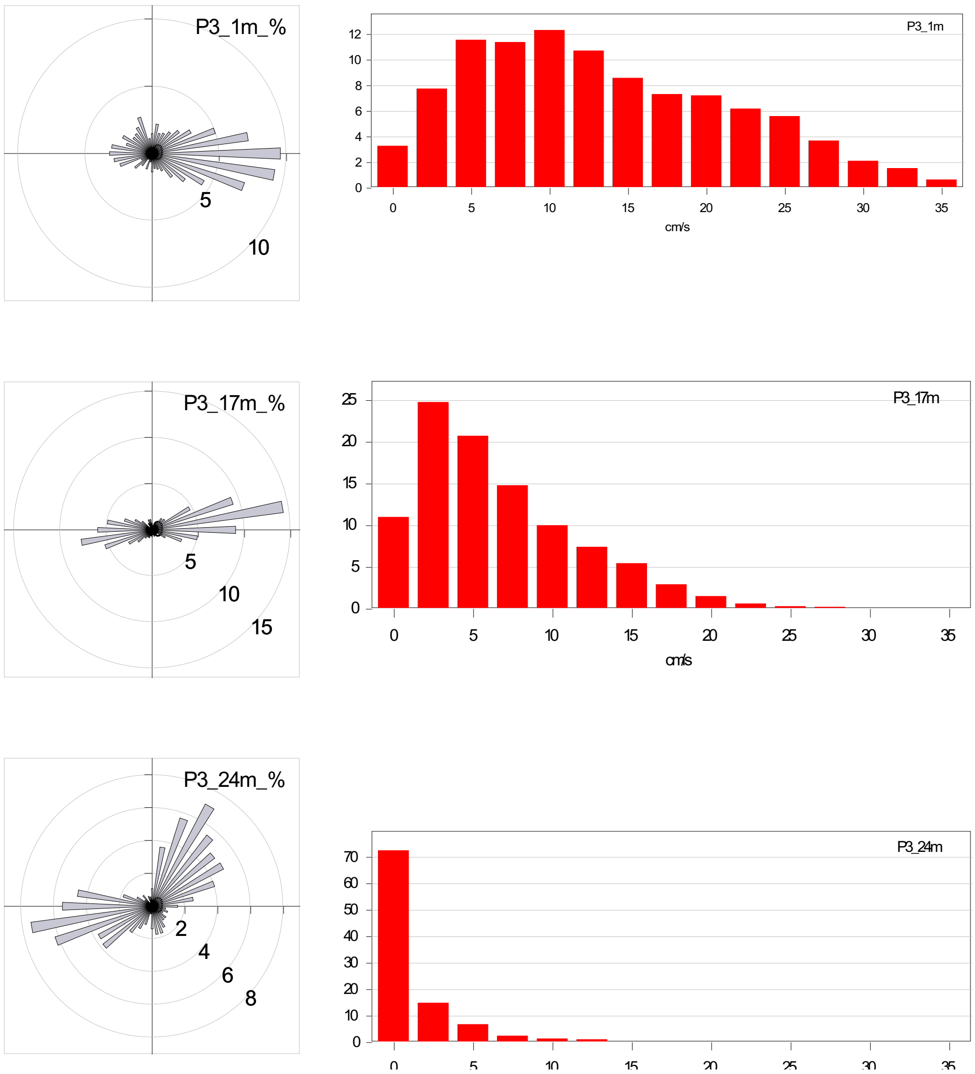



Figure 7-11. Current direction and velocity distributions for offshore point P3, June 1–November 1, 2012.

### Water quality and stratification

Due to its low salinity, the water of the Baltic is referred to as brackish water. The average salinity of the Baltic is less than 10‰ while the salinity of oceans is around 35‰. The salinity of the Baltic varies from 20‰ in the Danish straits to 0–2‰ in the eastern parts of the Gulf of Finland. In western Gulf of Finland the salinity level is usually 5–6‰.

There is a large input of fresh water into the Baltic Sea and the Gulf of Finland from rivers, but saline water is only received from the North Sea via the shallow Danish straits during occasional saline pulses. Since the inflowing water is more saline and heavier than brackish water, the Baltic Sea has a stratified salinity structure. A vertical gradient in salinity is called a halocline. In the western and central parts of the Gulf of Finland the halocline is formed close to the bottom, in depths exceeding 60 m, when bottom water from the Baltic proper flows to the bottom of the deeps. The water layers below the halocline usually suffer from oxygen deficit.

The thermocline, a steep gradient of rapid temperature change, is usually formed at a depth of 10–20 m and moves deeper once the summer progresses. The specific structure of the thermocline depends on prevailing weather conditions during different times of the year. Water from the warm surface layer will not mix with the cold water layer below the thermocline. Surface water is mixed by wind, but only occasional mixing takes place in the layer of water below the thermocline. In the autumn the surface water cools down and the thermocline disappears, with the water masses mixed by autumn storms and convection.

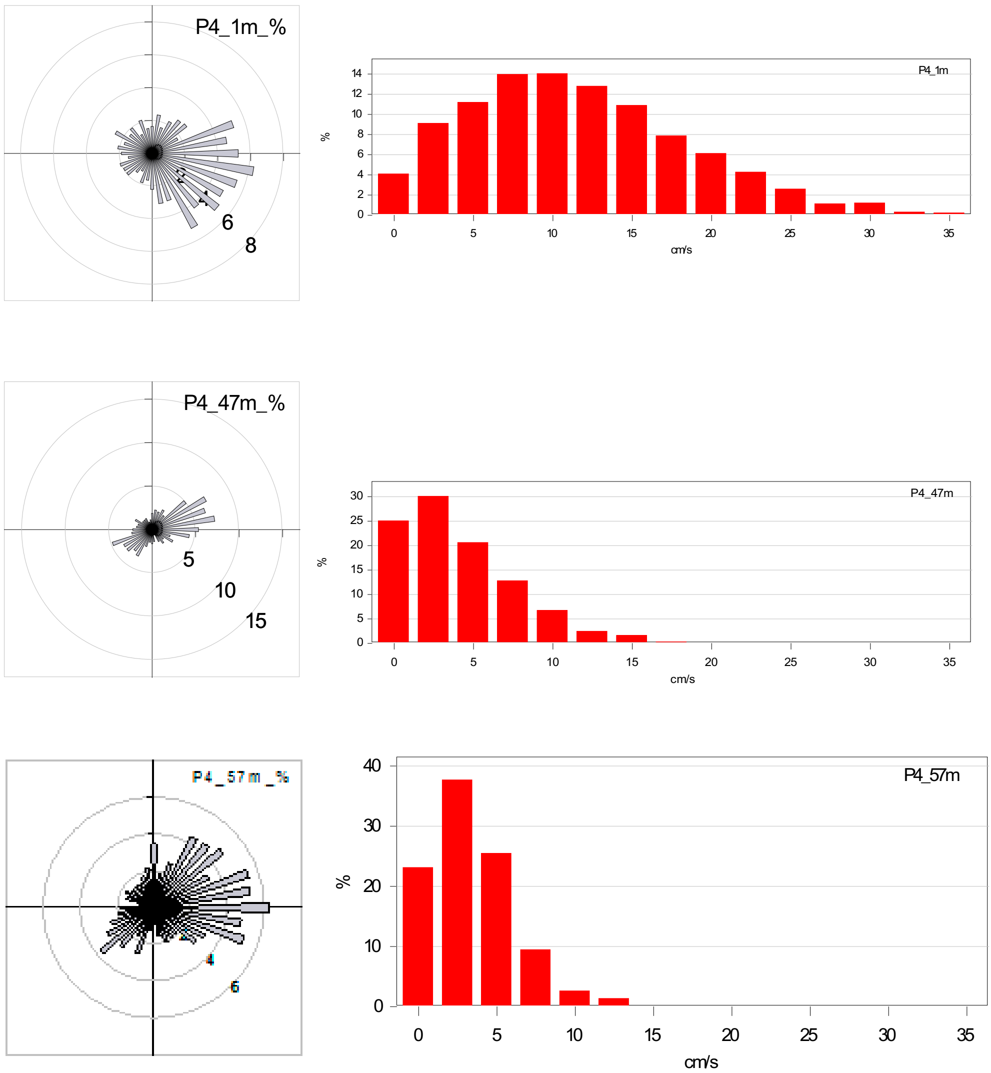



Figure 7-12. Current direction and velocity distributions for offshore point P4, June 1–November 1, 2012.

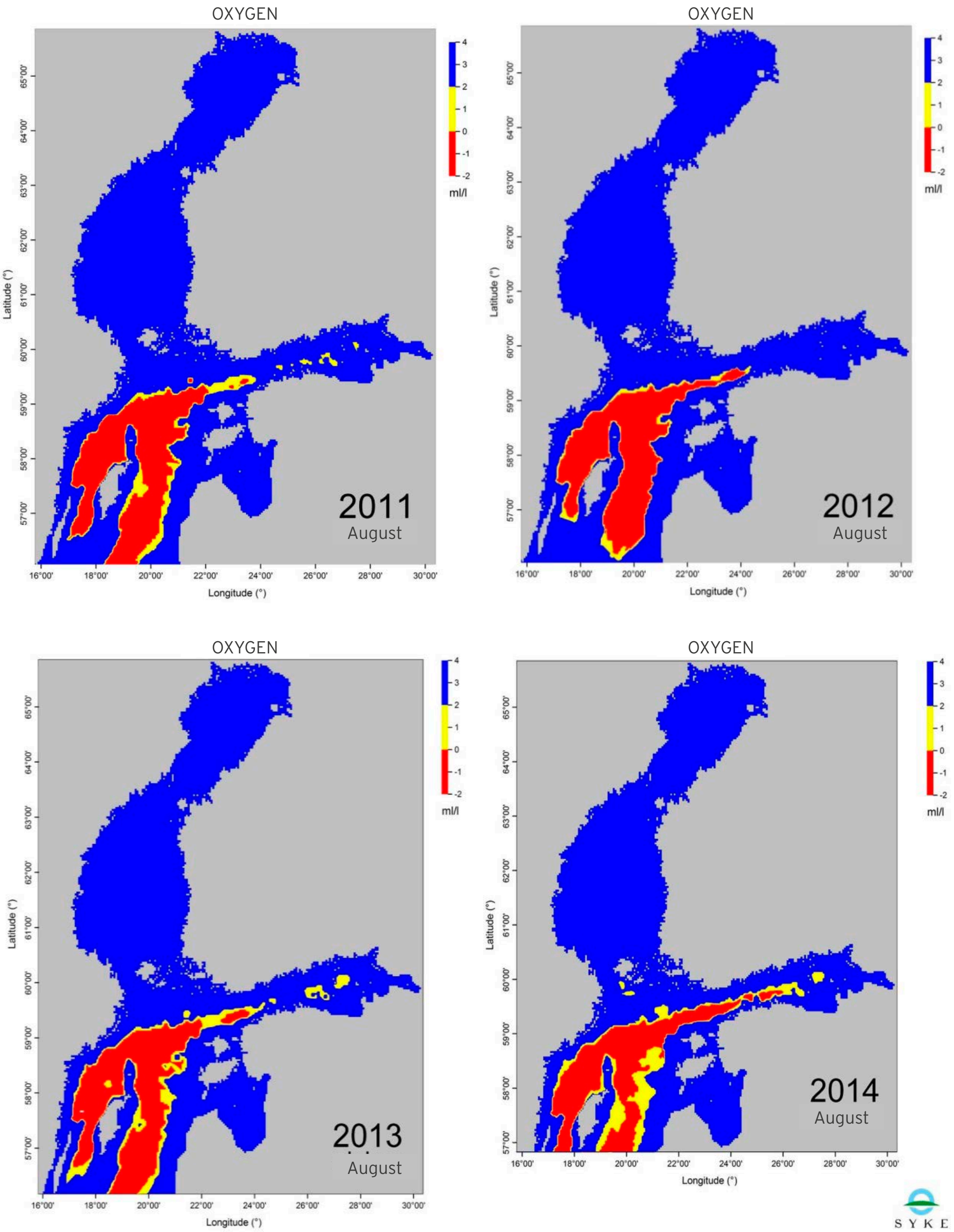



Figure 7-13. Near-bottom oxygen situation in Northern Baltic Sea in August 2011–2014 (Finnish Environment Institute, SYKE 2013–2014). Red = oxygen-depleted area with hydrogen sulfide, yellow = low oxygen level (0–2 ml/l) and blue = oxygen level above 2 ml/l.

In the Gulf of Finland variation in the oxygen situation is caused by thermal stratification, varying salinity stratification and varied seabed topography. There may even be major annual variation in salinity levels within a specific area. The oxygen situation of the offshore areas of the Gulf of Finland is linked with the near-bottom oxygen situation of the Baltic Sea proper and further with the saline pulses. In the past decades the Major Baltic Inflows have become less frequent and smaller in volume. The latest major inflow took place in 2003. Since then a period of stagnation has persisted and the oxygen situation has become worse in the Baltic proper as well as the Gulf of Finland.

In the Gulf of Finland oxygen depletion occurs in offshore areas as well as archipelago. The deficiency of oxygen is caused by bacterial decomposition of organic material, in which oxygen is consumed, and the fact that re-oxygenation is prevented by the stratified structure of the sea. In offshore areas the mixing of water is prevented by the deepwater halocline, while in the archipelago summer oxygen depletion is mainly caused by the thermocline.

Oxygen depletion is facilitated by eutrophication as it boosts the accelerated growth of phytoplankton, i.e. algal blooms. When the mass of phytoplankton settles on the bottom, it increases the volume of material for decomposition, a process where oxygen is consumed. When total oxygen depletion takes place near the bottom, decomposers will use other compounds instead of oxygen dissolved in the water, which results in the formation of toxic hydrogen sulfide. The acceleration of oxygen depletion also boosts eutrophication as, once oxygen runs out in near-bottom water, nutrients fixed in the bottom sediment are re-released into the water.

Eutrophication is caused by an excessive input of nutrients, nitrogen and phosphorus, into the Baltic Sea. The nutrients originate from point and diffuse sources. The sea also receives a direct input of organic matter, which increases oxygen consumption. Access to nutrients is an important factor regulating primary production. Only dissolved inorganic nitrogen (DIN) and phosphorus (DIP) fractions can be directly utilized by planktonic algae. In the Gulf of Finland primary production is mainly nitrogen-limited, and this trend has become stronger as a result of the deep-water and other internal load of the Baltic Sea and, on the other hand, reductions in external phosphorus emissions. In areas close to the coast, the growth-limiting nutrient may, however, vary depending on the nutrient load received from onshore sources.

Transparency is a measure of light penetration reduced by turbidity in the water column, i.e. the clarity of water. Transparency has been reduced on the coast of the Gulf of Finland since the 1970s throughout the coastal section from Hamina to Hitis. Turbidity is affected by substances dissolved in the water as well as the organic and inorganic particles in it. In the Baltic Sea the clarity of water is affected most significantly by dissolved organic substances ($COD_{Mn}$) and phytoplankton particles. (*Leppänen et al. 2012*)

#### Phytobenthos and zoobenthos

The littoral zone of the Gulf of Finland is characterized by major geographical, spatial and temporal variation in macrophytes, i.e. larger aquatic flora (algae, vascular plants) and zoobenthos associated with them. The number of macrophyte and zoobenthos species on rocky shores decreases geographically from the Archipelago Sea toward eastern Gulf of Finland or toward the Bothnian Sea and Bothnian Bay. The reason for this reduction in species number is the decrease in seawater salinity. Most organisms occurring in the Baltic Sea originate from oceanic conditions. The will not survive when the salinity level becomes too low. The largest geographical ecotones in terms of number of species are found east of Helsinki and at the Kvarken.

Macrophytes form zones extending down to a maximum of around 20 m from the surface of the sea. The strongest environmental factor affecting this zonation is the openness of the shore, i.e. the direction of the shore in relation to the prevailing winds and the location of the shore on the inner and outer archipelago axis. The zonation of algae naturally extends deeper on open shores. Depending on the species, macrophytes and zoobenthos associated with them are characterized by major seasonal variation or permanence. Some species are perennial and occur in the same locations year after year, while some only occur at a specific time of the year, such as the summer or mid-winter, from a couple of weeks to a few months. As a general rule, the zoobenthic species composition of the littoral zone is determined on the basis of the presence of algal species. The biggest threats faced by macrophytes and the zoobenthos associated with them are the overall marine eutrophication and its impacts including the decreased transparency, which restricts light penetration in the littoral zone.

Zoobenthos underneath the photic zone are defined as invertebrate zoobenthos that occur in depths where less than 1% of the surface sunlight remains. There is no vegetation in such depths due to the shortage of light. The areas below the photic zone may begin at the depth of a few meters or even more than 20 m. In the Gulf of Finland this profundal zone can be estimated to begin at the depth of around 9 m. The seabed in the profundal zone may be soft or hard bottom. Here the species and community structure of zoobenthos is primarily determined by bottom type.

A downward trend has been observed in the species number of soft-bottom zoobenthos in the Northern Baltic Sea and the Gulf of Finland since the early 1900s. On the other hand, biomass growth has been observed in places (e.g. *Perus & Bonsdorff 2004*). Another change in zoobenthos currently underway is a shift in the relative proportions of their functional groups. Groups feeding on benthic organic matter have increased at the expense of those filter-feeding in the water column (e.g. *Bonsdorff & Blomqvist 1993*); benthic feeders include the red-gilled mud worm (*Marenzelleria viridis*) and water column filter feeders include the Baltic macoma (*Macoma balthica*). These trends lead into a loss of zoobenthic diversity, with fewer species occurring and with those that do occur gaining larger relative proportions. The primary reason for the changes in the number of species and the functional groups is the overall eutrophication taking place in the marine area (*Perus & Bonsdorff* 2004). Eutrophication leads into local oxygen depletion in deep basins where the exchange of water is usually very low due to stratification caused by the thermocline and halocline. Tolerance of temporary oxygen deficiency varies between groups of animals. Bivalves can tolerate the longest periods of anoxia, but even they will die if the anoxia persists for a few weeks. Oxygen depletion results in seafloor desertification.

**Plankton communities**

Plankton mostly consists of small organisms drifting along with the currents. Plankton is divided into phytoplankton and zooplankton. The composition of plankton in different areas is highly dependent on water salinity levels as marine species require high salinity while freshwater species favor fresh water. The time of year plays a role through the amount of light, temperature and growth-limiting nutrients as well as the vertical mixing of water, which transports plankton away from the photic zone. These factors also cause species abundance in certain seasons. During the winter there is an abundance of nutrients usable by algae in the water column, but the growth of algae is limited by the shortage of light (short hours of sunlight, ice cover). Therefore planktonic organisms overwinter as resting stages on the bottom of the sea.

Because zooplankton mainly feed on phytoplankton, there is also seasonal variation in the composition of zooplankton. Factors limiting the growth of zooplankton populations also include temperature and predation. The volumes of plankton are at their lowest during the winter. In the spring when the ice melts and light levels increase and the water column becomes stratified, the amount of phytoplankton increases rapidly and, correspondingly, the amount of herbivorous zooplankton also increases. During the spring bloom, the phytoplankton community is dominated by diatoms and dinoflagellates. The increase in zooplankton is followed with a short lag by the appearance of carnivorous zooplankton.

The spring bloom of algae quickly uses up the dissolved nutrients in the top layer. Growth comes to a halt as the growth-limiting nutrient, which in the Gulf of Finland usually is dissolved nitrogen, is used up in surface-water layer. The numbers of zooplankton also collapse when the microalgal bloom comes to an end. Consequently, in the early summer phytoplankton production is usually low and the water becomes relatively clear again. Further into the summer as the water becomes warmer and the thermocline is formed, the phytoplankton stays in the warm surface water. The increase in nutrients caused by winds and upwelling may again result in a rapid increase in the abundance of algae, particularly during periods with low winds and high temperatures. Toward the end of the summer in July–August large blooms of cyanobacteria (blue-green algae) are usually formed. The algal blooms, some of which are toxic, are a regular phenomenon in the Baltic Sea and eastern Gulf of Finland. Eutrophication and limitation have favored cyanobacteria, which are also capable of fixing atmospheric nitrogen. The dead mass of plankton settles onto the seabed, is decomposed and oxygen is consumed.

### 7.2.2 Ingå

#### 7.2.2.1 Ecological and chemical status

The small coastal water bodies and marine area off Ingå belong to the Kymijoki-Gulf of Finland River Basin District for which a river basin management plan (*Kymijoki-Gulf of Finland River Basin District 2009*) and a more detailed action plan (*Uusimaa Centre for Economic Development, Transport and the Environment 2010*) have been formulated in accordance with the Act on Water Resources Management (1299/2004). The river basin management plan contains information including the water bodies in the area, the pressures they are subjected to as well as other human impacts on them, the ecological status of the water bodies, river basin management objectives and the protection and management measures required.

The starting point in the assessment of the ecological status of a water body is its assessed natural status. Indicators describing the current status of the water body, such as water nutrient concentrations or composition of biotic communities, are compared with the natural reference status of the water body prior to human activities. The ecological status of surface waters are classified by water body into five categories: high, good, moderate, poor and bad.

In river basin management planning coastal waters are divided into inner and outer archipelago, with the waters off Ingå divided into southwestern inner (SWi) and outer (SWo) archipelago. The water areas are further divided into smaller parts. The landfall area is located in the Fagerviken, Ingå, water body of the southwestern inner archipelago. It is bordered in the north by the Orslandet water body, which also belongs to the inner archipelago. Further off the shore the pipeline will run through the Upinniemenselkä and Porkkala-Jussarö water bodies of the southwestern outer archipelago.

Both of the inner archipelago water bodies mentioned above are currently classified as bad in terms of their ecological status. The ecological status of Upinniemenselkä is classified as poor and that of Porkkala-Jussarö as moderate. In a more recent classification proposal, which was published in 2013 but is yet to be adopted, the above-mentioned water bodies are classified as poor in their ecological status, excluding Orslandet, the status of which is still classified as bad. The changes in classification is not assessed to be due to changes in the status of the water bodies but, instead, to changes in data and classification criteria.

The various elements of ecological status classification (physical, chemical and biological quality elements) are examined in greater detail in conjunction with the following topics. The more recent classification published in 2013 and created on the basis of monitoring data obtained in 2006–2012 was used in the examinations.

The chemical status of the coastal water bodies of the area is classified as good on the basis of the quality standards regarding water concentrations. There are, however, very few studies available of substances in accordance with the Government Decree on Substances Dangerous and Harmful to the Aquatic Environment (1022/2006) concerning the area. The potential pollution of the seabed does not affect the chemical status classification of the water body.

#### 7.2.2.2 Water quality

The route of the planned Balticconnector gas pipeline will pass through the Ingå archipelago through the Norrfjärden, Skatafjärden (ALT FIN 1), Fageröfjärden (ALT FIN 2) open-sea sections further out to Barosundsfjärden. The Ingå archipelago is characterized by steep variation in depth as well as straits and mazes formed by rocky islands and shallows. (Figure 7-14)

Located west of the project area, Fagerviken receives point-source input from the Joddböle wastewater treatment plant of the Municipality of Ingå. The cooling water and wastewater of the Fortum power plant were also discharged into Fagerviken, but the plant was closed down in February 2014. Diffuse-source input is also received from the power plant area, activities at the Inkoo Shipping harbor, as well as agriculture, residential properties and atmospheric fallout. In recent years the point-source impacts on water quality have been very low, with no clear observable water quality impacts reported. Thermal load from the power plant could be detected as increased seawater temperatures when the plant was operational *(The Association for Water and Environment of Western Uusimaa, LUVY 2012–2014)*. Excluding the area closest to the shore, water quality in the project area is affected most strongly by the overall status of the archipelago area and western Gulf of Finland.

The impact of river waters off Ingå is generally low. In near-shore areas, however, the impact of fresh water may at times be significant, for example in the western Fagerviken Bay area due to the impact of streams flowing into the bay and in Barkarsundet due to the impact of the River Ingå. Particularly in the winter a thin surface layer underneath the ice cover may be formed by water low in salinity. In general the salinity of the water is around 6‰ in the area. The marine area of Ingå is prone to upwelling, with upwelling of water from the deep water layers often taking place in the summer. Upwelling occurs when strong winds from the mainland to the sea drives the warm water of the surface layer with a lower salinity level from the coast to the offshore areas and this water is replaced by colder, more saline and nutrient-rich water from the deeper layers.

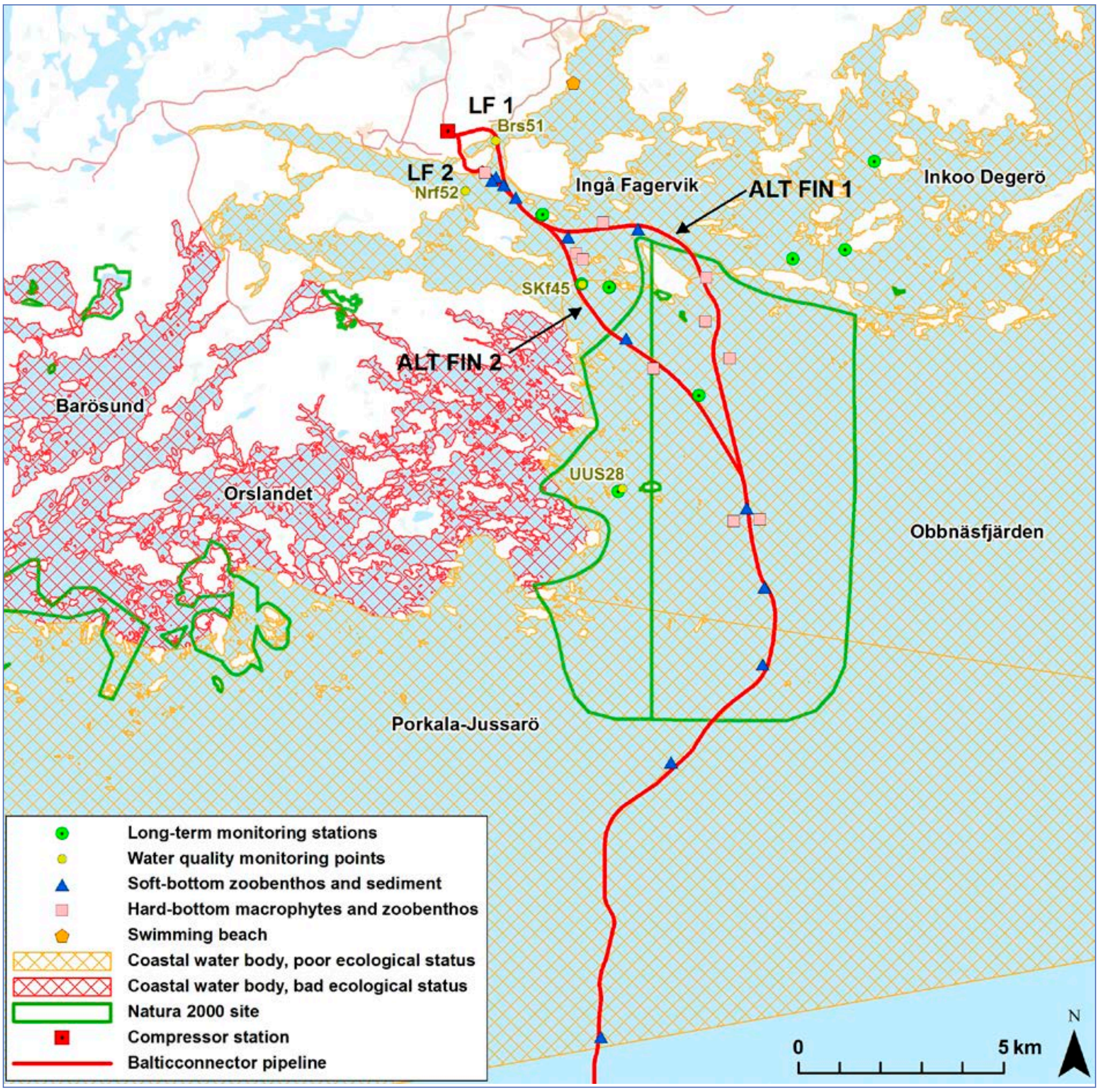



Figure 7-14. Balticconnector gas pipeline routing alternatives off Ingå, locations of the observation points examined and the nearest long-term monitoring points of the environmental administration.

The figures (Figure 7-15 and Figure 7-16) present findings illustrating water quality in the area from observation points near the pipeline route at Norrfjärden 52 (Nrf52), Barkasrsundet 51 (Brs51), Skatafjärden 45 (Skf45) and Uus-28, Bågaskär (UUS-28) (*Environmental administration, Hertta Environmental Information System 2014*). As a general rule water sampling at the stations took place three times a year: in February–April, in May and in August, on the basis of joint monitoring of Fagerviken, Ingå. The total water depths at the stations are 15 m, 15 m, 30 m and 25 m, respectively. The locations of the stations are shown on the map (Figure 7-14).

Transparency in the summer near the coast at Norrfjärden and Barkarsundet has been on average 1.7–1.8 m, increasing further off the coast at Skatafjärden to 2.5 m and at Bågaskär to 3.4 m. The variation in transparency has, however, been high: < 1.0–8.4 m.

The situation regarding turbidity values is the opposite, with the values becoming lower from the near-shore level of 3.6 FNU and reaching the levels of 2.6 FNU and 2.0 FNU further off the shore. Near-bottom turbidity values have on average been only slightly higher, but occasional clear increases have been recorded at Barkarsundet (maximum 44 FNU) due to the poor oxygen situation of the bottom. In general the turbidity of clear water is below 1 FNU and that of slightly turbid water 1–5 FNU. Turbidity visible to the naked eye is at the 10 FNU level.

In the winter transparency is as a general rule higher and turbidity values lower than in other times of the year. The seasonal variation is mainly due to weather conditions and algal production. Vessel traffic in the area may also cause temporary increases in turbidity and reductions in transparency.

The oxygen situation in the area has been reasonably good in winter and springs, but later in the summer oxygen depletion has often occurred near the bottom. The oxygen situation in the Barkarsundet deep in particular has regularly been poor in August due to the sheltered location and the long residence time of water. In Norrfjärden the exchange of water is more efficient and the oxygen situation on average better. Further out in Skatafjärden and Bågaskär oxygen depletion has also been detected, but the on the basis of the data the situation appears to have improved in recent years.

The reason for the poor oxygen situation of the hypolimnion is the abundant growth of planktonic algae in surface waters. The dead algae settle to the bottom, which is where they are decomposed by bacteria and oxygen is consumed in the process. If there is a lot of dead algae and the conditions for water exchange are poor, oxygen is depleted in near-bottom waters.

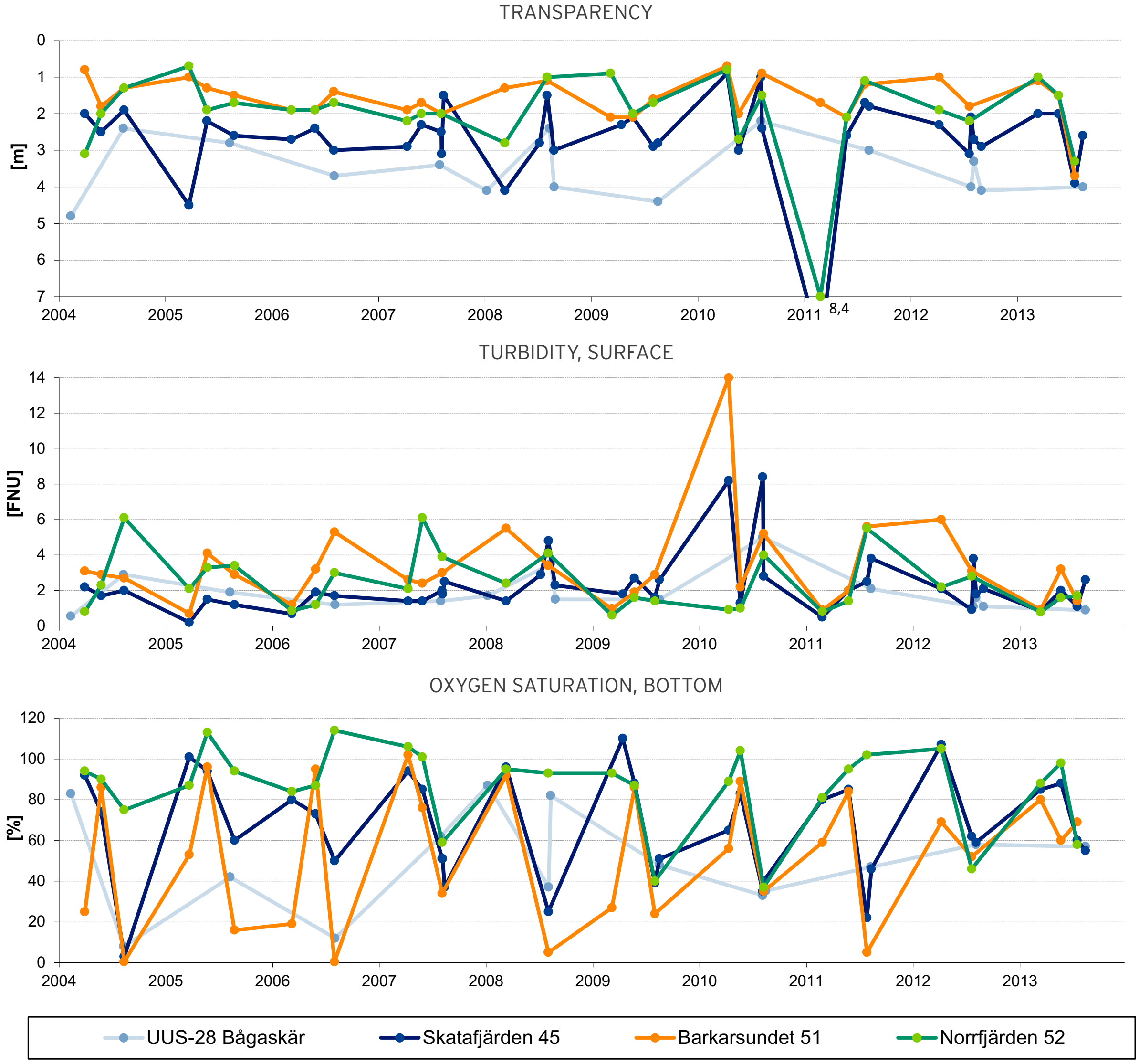



Figure 7-15. Transparency, turbidity (surface, 1 m) and near-bottom oxygen saturation (bottom, 15–30 m) at monitoring stations Norrfjärden 52, Barkasrsundet 51, Skatafjärden 45 and Uus-28, Bågaskär near the Balticconnector gas pipeline.

Among the main nutrients limiting algal production, the concentrations of phosphorus in particular are high off Ingå, indicating eutrophication. Total summertime phosphorus concentrations in recent years have averaged 36–39 µg/l in Norrfjärden and Barkarsundet and dropped slightly further off the shore, with the levels in Skatafjärden being 31 µg/l and Bågaskär 29 µg/l. Total nitrogen concentrations have varied correspondingly from the near-shore levels of 380–410 µg/l to 350–360 µg/l in the areas furthest off the shore. Nutrient levels are higher near the bottom where they cannot be used by algae, with nutrients also released by the decomposition of organic matter. In late summers in Barkarsundet the dissolution of nutrients, especially phosphorus, from bottom sediments, i.e. internal load, can also be detected due to the poor oxygen situation. No significant internal loading could be seen in the data examined from the other monitoring points. In the winter the water nutrient level is also higher as nutrients fixed in algal production are released into water.

Indicating the amount of algal production, the average summertime concentration of chlorophyll *a* has, in line with the nutrients, been the highest in the area examined in Barkarsundet (12 µg/l). The amounts of chlorophyll recorded at the other monitoring sites examined, Norrfjärden (7.6 µg/l), Skatafjärden (6.0 µg/l) and Bågaskär (3.4) µg/l, have been lower, but the entire area can be regarded as eutrophic.

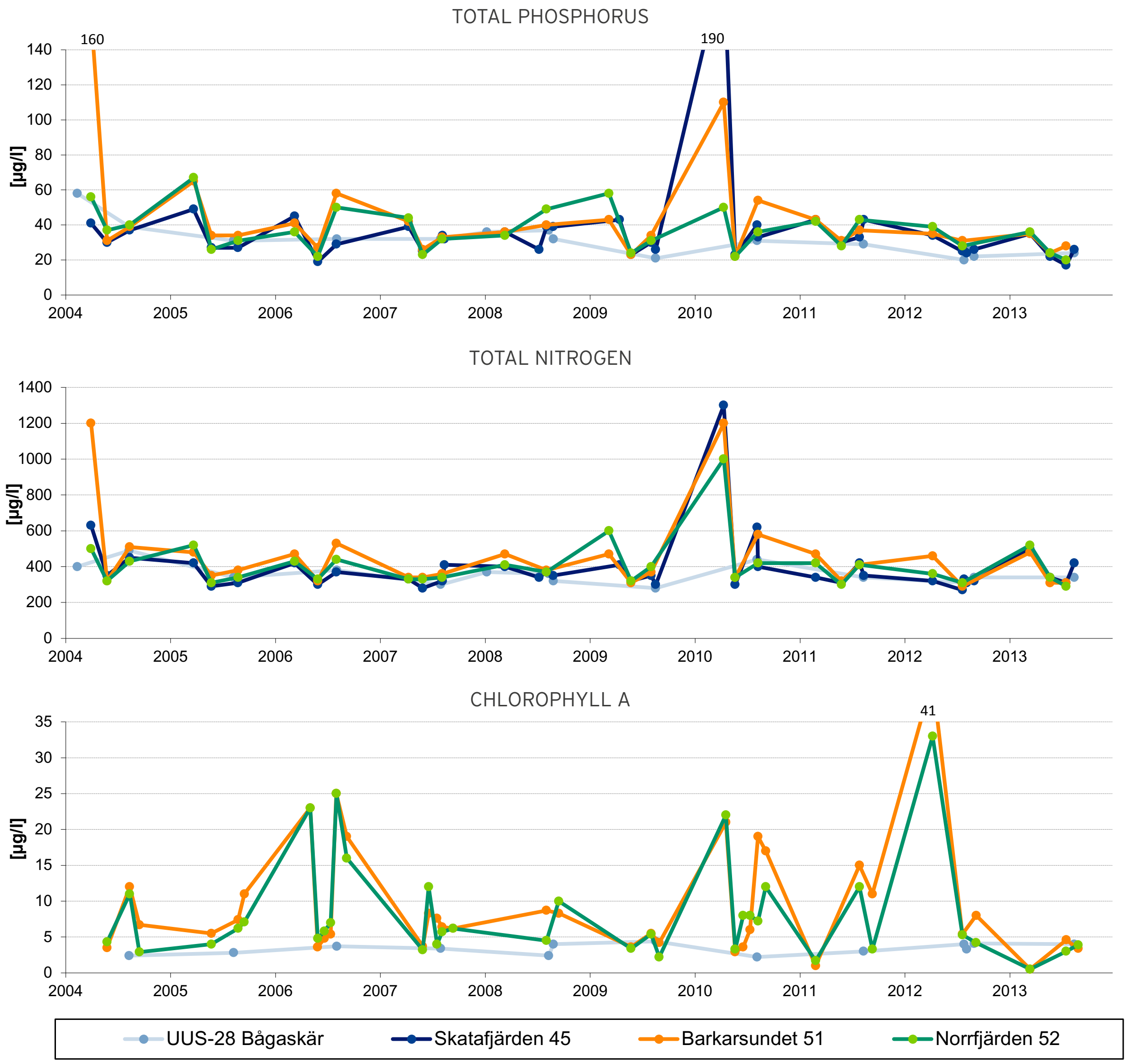



Figure 7-16. Total phosphorus (surface, 1 m), total nitrogen (surface, 1 m) and chlorophyll a (surface 0–4 m) concentrations at monitoring sites Norrfjärden 52, Barkasrsundet 51, Skatafjärden 45 and Uus-28, Bågaskär, near the Balticconnector pipeline route.

Total nutrient concentrations and transparency are used as the physico-chemical classification criteria in the assessment of ecological status. The water bodies in the area affected by the project are mainly classified as poor in terms of these elements (2013). The nitrogen level is, however, relatively lower than the phosphorus level, indicating a moderate status is places in the area (*Finland's Environmental Administration 2014*). Of the biological factors used in the ecological classification, the phytoplankton chlorophyll *a* values also indicate a poor status (*Finland's Environmental Administration 2014*). The limit values based on natural reference levels for the areas in the outer archipelago are lower than those for the inner archipelago.

#### 7.2.2.3 Marine environment

Aquatic flora and zoobenthic species and their community structure are affected the most by the archipelago nature of the area (*Rinne et al. 2011*). On the basis of this, the following sections discuss the ALT FIN 1, ALT FIN 2 and LF2 alternatives together and the LF1 separately. The ALT FIN 1 and ALT FIN 2 alternatives belong mainly to the outer archipelago and the area affected by LF2 to the inner archipelago. The area of the LF1 alternative is an inner bay.

The description of aquatic flora and zoobenthos in the project area is based on the vegetation and zoobenthos surveys conducted for the Balticconnector project in 2013 (*Leinikki & Leppänen 2013* and *Ramboll 2014*). For the LF1 landfall alternative data collected in conjunction with the Fjusö LNG terminal project was also employed (*Fish and Water Research Ltd 2014)*. Also utilized was data from the environmental administration's long-term monitoring lines located on islands in the immediate vicinity of the project area (aquatic plants register of the environmental administration). The observation sites of the aquatic plant and zoobenthos surveys are presented on the map in the figure (Figure 7-14).

**Aquatic flora**

The nature values and biodiversity of the project area are based on the species of aquatic flora and the zones formed by them in the outer archipelago in areas affected by alternatives ALT FIN 1 and ALT FIN 2. On the basis of the baseline data, aquatic flora mainly consists of hard-bottom macroalgal species and in part soft-bottom vascular plants. On the basis of the baseline data, the habitats of the area can be classified as the Natura habitat types of Reefs, and Sandbanks which are slightly covered by sea water all the time (*Airaksinen & Karttunen 2001*).

Filamentous, bladderwrack and red algal zones characteristic of the habitat type are formed by macroalgae. The species composition is typical of the season and area. The deepest depth of algal zone growth is at around 9 m. The sampling points of the baseline data were spread over the entire exposure gradient from the sheltered to the exposed archipelago zone. The growth depth of algal species as well as species diversity varied in the natural environment depending on the exposure of the coast to wind and waves, with increased exposure resulting in the deeper occurrence of algal zones and increased species diversity. On the basis of the baseline data, typical algal zonations occur in the area, but the depth dispersal of the bladderwrack and red algal zones did not reach the typical depth expected for the area. The most common species in hard bottoms in the filamentous algal zone are the green alga *Cladophora glomerata* and golden sea hair (*Dictyosiphon foeniculaceus)*, in the bladderwrack zone bladderwrack (*Fucus vesiculosus)* and sea felt (*Pilayella littoralis)* and in the red algal zone black siphon weed (*Polysiphonia fucoides)*, *Ceramium tenuicorn* and *Sphacelaria arctica*. The most common species on soft bottoms were sago pondweed *(Potamogeton pectinatus)* and horned pondweed *(Zannichellia major)*.

According to the baseline data there are no species in accordance with Annexes II and IV of the Habitats Directive or threatened species along the pipeline routings, excluding an area in ALT FIN 2 where eelgrass (*Zostera marina*) occurs. The classification of eelgrass is Near Threatened (NT) (*Rassi 2010*). Eelgrass is a perennial vascular grass occurring off the south-southwestern coast of Finland.

The area affected by the LF2 alternative is located in the inner archipelago and consists of stony shore sections that at the depth of around 2.5 m turn into soft bottom. The zones formed by algal species are narrow or missing altogether. Species diversity is lower than in the outer archipelago. At the LF2 alternative algal zonation and species composition are typical of the area. According to the baseline data there are no species in accordance with Annexes II and IV of the Habitats Directive or near-threatened or threatened species along the pipeline routing.

The nature values and biodiversity of the ALT FIN 1, ALT FIN 2 and LF2 areas concerning aquatic plants are illustrated in the figure (Figure 7-17). The figure provides a summary of the change in species coverage relative to change in depth for the most important macroalgae (Figure A) and vascular plants (Figure B) found in the areas of the ALT FIN 1, ALT FIN 2 and LF2 alternatives. Figures A and B were drawn in accordance with baseline data observations, with observations from all lines combined to produce an average. The species belong to the flora of the Baltic Sea and are common. The overall eutrophication development of the marine area is resulting in seasonal filamentous algae, which benefit from nutrient increases in the water column, gaining ground over perennial brown and red algae. This is a negative trend. In the figure the coverages and depth dispersal of such opportunistic algae (*Cladophora glomerata* and *Pilayella littoralis)* are relatively large (around 60% and depths up to 9 m), which reflects the relatively high level of nutrients in surface waters in the project area.

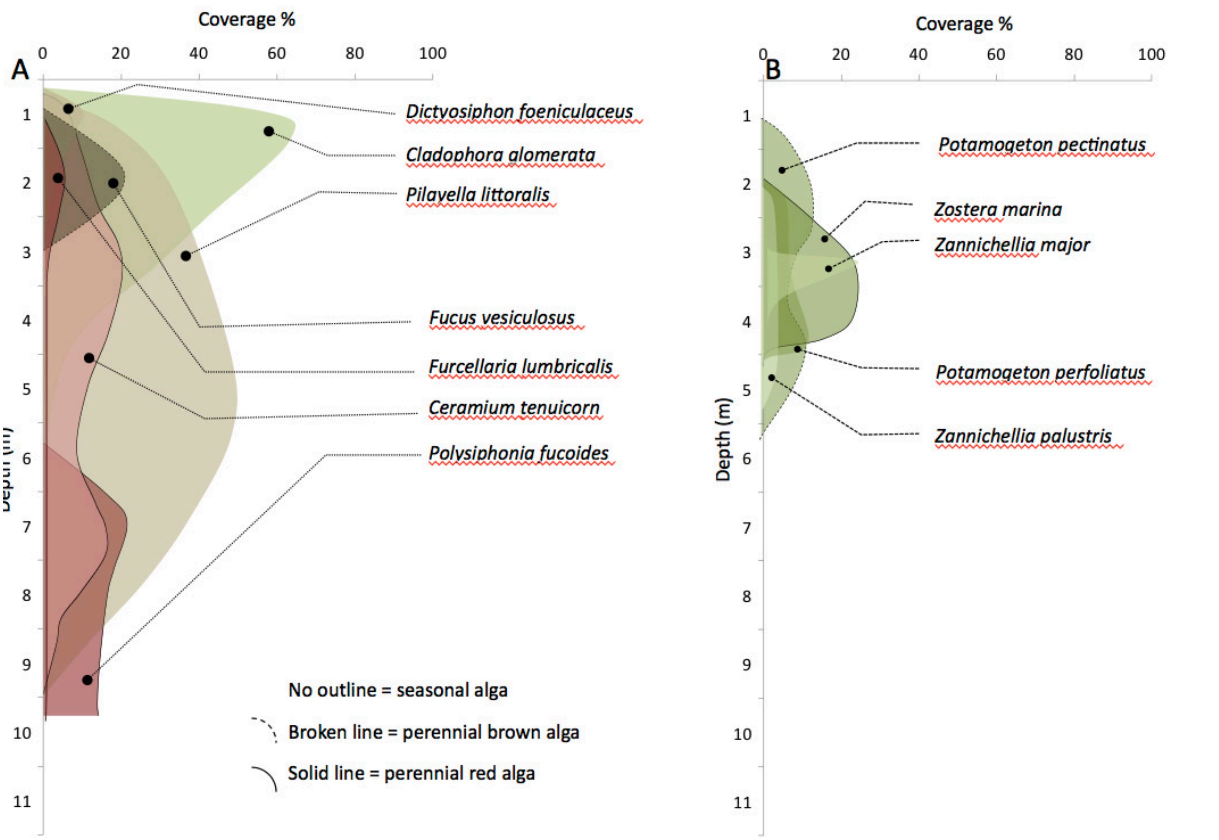



Figure 7–17. Nature values and protection criteria of underwater habitat types: algal zones, their species and depth dispersal. Macroalgae shown in Figure A and vascular plants in Figure B.

The LF1 landfall alternative is located in an inner bay and in a relatively shallow water area. In the monitoring lines hard rock bottoms extend to the depth of approximately 1.5 m, after which the bottom turns to a gravel bottom. There is a layer of several centimeters of soft sediments on top of the gravel bottom. Due to the absence of bottom suitable for macroalgae, there are no actual algal zones in the area. In some of the monitoring lines only seasonal filamentous algae and vascular plants occur. In some of the monitoring lines there is a filamentous algal zone, with perennial bladderwrack occurring infrequently. The algal zonation or the absence thereof is a natural phenomenon in the inner archipelago. The species observed in the monitoring lines are typical of the Finnish coast. According to the baseline data there were no species in accordance with Annexes II and IV of the Habitats Directive or near-threatened or threatened species in the area.

To establish the current status and development trend of aquatic flora, the baseline data collected was compared with data concerning the area surrounding the project area. If the baseline data is comparable with the environmental administration data collected from neighboring areas, it can be regarded as representative as a basis for the assessment. On the basis of a vegetation survey conducted on the project area in 2013 *(Leinikki & Leppänen 2013)*, the species composition is, apart from minor differences, almost identical to that in the permanent long-term monitoring lines of the environmental administration on islands in the immediate vicinity of the project area. The differences in species and community structure between the baseline data and the environmental administration data (aquatic plants register of the environmental administration) are based on factors relating to the natural lifecycles of aquatic flora are can be explained by natural species variation based on differences between exposure conditions of the collection shores.

As regards the depth dispersal of aquatic flora, the growth depths of algae and algal zonation in the project area were found to be lower in the baseline data than in monitoring carried out in the nearby monitoring sites of the environmental administration. The differences can be explained by different shore exposures, i.e. the direction of the shore section in relation to prevailing winds and islands, which affects growth depths. The environmental administration's monitoring lines were located on windward shores while the monitoring lines of the 2013 baseline data were mainly located on leeward shores toward the pipeline. It can be stated that the project area's macroalgal species and their depth dispersal is consistent with the environmental administration's nearby long-term monitoring areas and that the adjacent water area where the aquatic plant monitoring lines of the environmental administration area located can be used as a possible control area.

The bladderwrack zone of one of the most important components of the underwater environment of the Finnish coast. The abundance of the bladderwrack zone in the area affected by the ALT FIN 1 and ALT FIN 2 was found to be relatively low on the basis of the baseline data. It is a common ecological phenomenon that biodiversity increases along with increases in shore exposure and is at its highest on open shores. This phenomenon is particularly strong – but natural – with the bladderwrack, the keystone species in the littoral zone. The baseline data was collected from the sheltered sides on the islands where shores or underwater shore sections represented the sheltered archipelago in type despite being located in the open sea. On the other hand, some decline has taken place in the occurrence of bladderwrack in the past few years in the outer archipelago of western parts of the Gulf of Finland and the Archipelago Sea (*Finnish Environmental Institute 2014a*). The reason for the decline is unknown. In the 1980s, a major decline was detected in bladderwrack, with the reason for this believed to have been overgrowth of filamentous algae caused by excessive nutrient levels in the water column. The impacts of the large amount of filamentous algae included them growing over bladderwrack *(Kangas et al. 1982)*.

In the ecological status classification carried out by the environmental administration, the biological status of coastal waters is determined on the basis of chlorophyll *a*, macrophytes and zoobenthos. The indicator used for macrophytes is the occurrence of bladderwrack and the growth depth of the continuous bladderwrack zone (*Vuori et al. 2009*). According to the environmental administration's classification (Finland's Environmental Administration 2014), bladderwrack data for sheltered as well as exposed littoral zones in the project area in the Fagervik water body of the inner archipelago indicates poor status. For Porkkala–Jussarö the bladderwrack population of the sheltered littoral zone also indicates poor status. The classification did not include macrophyte data for the Upinniemenselkä open offshore section. The current status data on algal zones collected in 2013 and 2014 for the Balticconnector and LNG terminal projects supports the current classification under poor status.

Any change in macrophytes toward bad ecological status may take place quite rapidly under the impact of a disturbance if the ecologically significant perennial species have already undergone a decline. It may not necessarily be possible to determine any individual reason for a change in the ecological status of a water area.

**Zoobenthos**

The zoobenthos of the littoral zone can be divided into seasonal and perennial communities. Seasonal species are characterized by major seasonal succession, i.e. a sequential change in species composition. Perennial communities are relatively stable, with their presence lasting for years and any changes in them taking place over several years (*e.g. Boström et al. 2002*). Seasonal communities occur in the littoral zone from a couple of weeks to a few months.

Zoobenthos possibly occurring in algal zones in the area affected by the project was described on the basis of data obtained in a study conducted around 50 km from the project area (*Ruuskanen 2004*). The project area and the study site are both located in the same surface water type (southwestern outer archipelago and southwestern inner archipelago). Therefore the environmental conditions are comparable and it can also be assumed that the communities shaped by environmental conditions are, with some margin of error, comparable with each other. It should be noted that the purpose of this data is to provide a general outline of the species composition of the project area.

On the basis of the results (*Ruuskanen 2004*) it can be stated that the species number of algae has remained practically the same in 1974 and 2004. Boström et al. (*2002*) conducted a similar study on eelgrass (*Zostera marina*) and its associated fauna. According to data obtained from the aquatic plants register of the environmental administration, the species composition and zonation of perennial algae did not change significantly in 2004–2013 (with decline only seen in bladderwrack). It can be concluded on the basis of these three studies and data that the zoobenthos data collected in 2004 is sufficient for use in descriptions of species in the project area.

According to the data, around 24 mobile zoobenthos taxa presumably occur in the filamentous and bladderwrack zones of the open archipelago zones of the areas covered by the ALT FIN 1 and ALT FIN 2 alternatives. The relatively largest group in the filamentous and bladderwrack zones of the areas would be amphipods (*Gammarus)* (Figure 7–18, A & B). The dominant taxa in the area affected by the LF2 alternative, representing the sheltered archipelago zone, would be amphipods (*Gammarus)*, isopods (*Jaera)* and mud snails (*Hydrobia)*. The dominant taxa in the bladderwrack zone would be amphipods (*Gammarus*), isopods (*Jaera)* and mud snails (*Hydrobia)* (Figure 7–18, C & D).

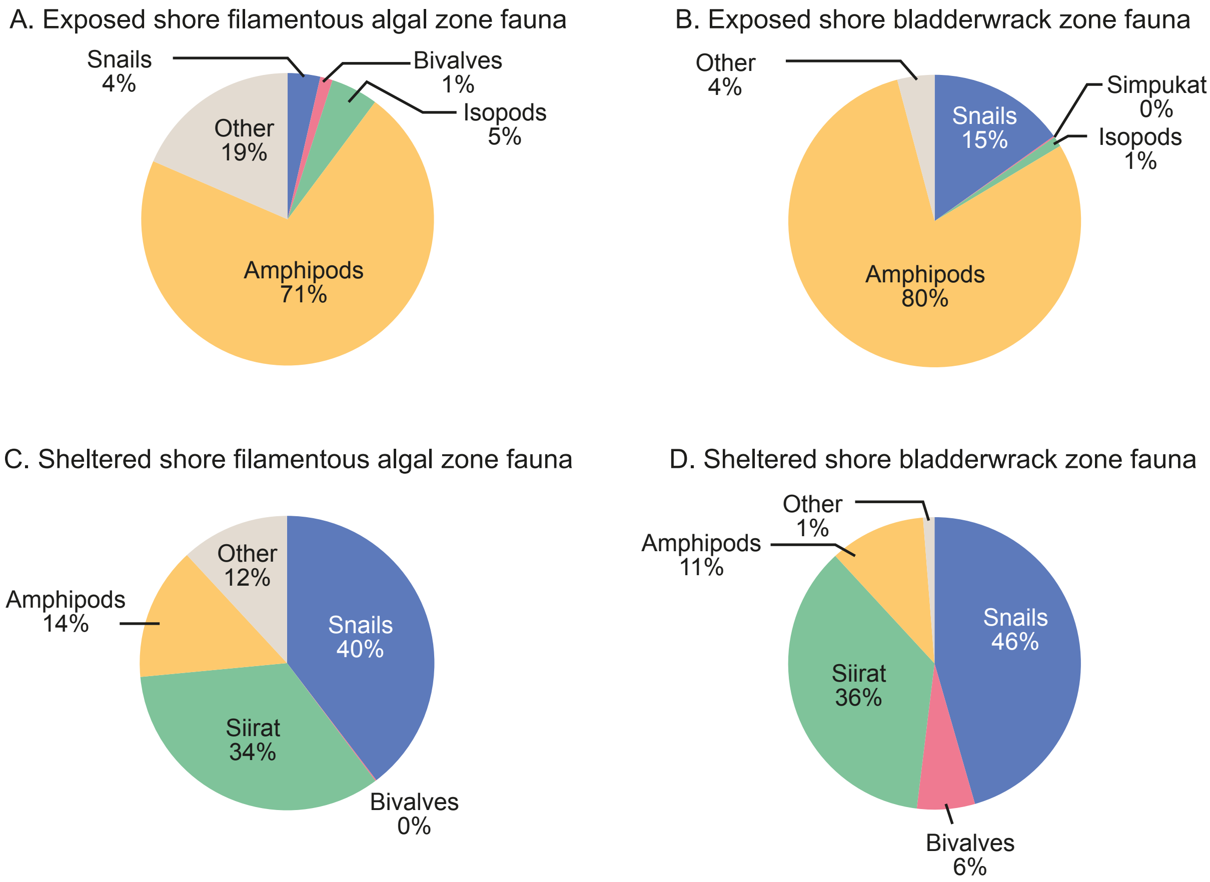



Figure 7-18. Fauna in the filamentous zone (A) and bladderwrack zone (B) of outer archipelago (open) and the filamentous zone (C) and bladderwrack zone (D) of inner archipelago in an area corresponding to the project area given as relative proportions.

No representative algal zones were found in the LF1 area. The seabed is mainly composed of soft bottom sediments, and coastal vegetation consisted mainly of soft-bottom vascular plants. Zoobenthos detected in the littoral zone were soft-bottom fauna such as ragworms (*Hediste diversicolor*), oligochaetes (*Potamothrix hammoniensis*), mud snails (*Hydrobia*), Baltic macoma (*Macoma baltica*) and larvae of *Chironomus plumosus* buzzer midges. All of these occur buried in benthic mud. The dominant groups are buzzer midges and bivalves (Figure 7-19). According to the baseline data there are no species in accordance with Annexes II and IV of the Habitats Directive or near-threatened or threatened species in the area.

The deep dark bottoms are mainly soft bottoms. The species occurring in these live burrowed in the soft bottom. The largest group of fauna in the dark bottoms of the Ingå area are bivalves (49%) and the second-largest ragworms (29%) (Figure 7-20). The dominant species in the bivalves group is Baltic macoma (*Macoma baltica*) and in the ragworms group red-gilled mud worm (*Marenzelleria* sp.). The species composition and ratios of species groups are typical of the Gulf of Finland. It should be noted that the species composition and ratios between species group change as the depth changes. The above is a summary of fauna occurring at the depth of 7-64 m.

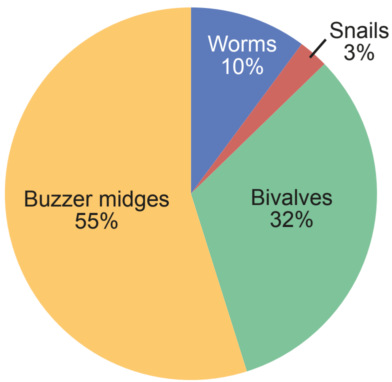



Figure 7-19. Soft-bottom invertebrates and their relative proportions in the littoral zone in the LF1 area.

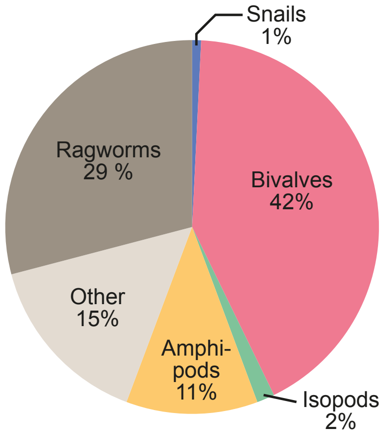



Figure 7-20. Relative proportions of deep dark-bottom invertebrates.

In the ecological classification used by the environmental administration, the brackish water benthic (BBI) index based on species richness and abundance is used for the status of coastal soft-bottom zoobenthic communities. The index is adapted to the conditions of the Baltic Sea and takes into consideration the impacts of the biodiversity of fauna that is limited by environmental factors and naturally low as well as the impact of depth on species composition. In the Fagervik water body of the inner archipelago of Ingå the status of zoobenthos is classified (2013) in deep bottoms as bad and in shallow soft bottoms as good, but deterioration in status can be observed in the latter. On the whole the status of zoobenthos is classified as moderate. In the Upinniemenselkä and Porkkala-Jussarö areas of the outer archipelago the status of zoobenthos is assessed as poor based mainly on deep-bottom data.

On the basis of BBI index values calculated using soft-bottom zoobenthos data collected in 2013 and 2014 for the Balticconnector and LNG terminal projects, the status of the areas is good/moderate, excluding the outermost and most exposed sampling sites where the seabed was practically lifeless. Consequently, the current status results are mainly in line with the existing classification.

### Habitat types

On the basis of the baseline data, the Natura habitat types and national habitat types presented in the table (Table 7-2) can be determined for the project area (*Raunio et al. 2008a, b*).

Table 7-2. Underwater Natura and national habitat types and underwater habitat types found in sampling on the basis of the baseline data.

| | Occurrence |
|---|---|
| **Natura habitat types:** | |
| Reefs | x |
| Sandbanks which are slightly covered by sea water all the time | x |
| | |
| **National habitat types** | |
| Filamentous algal zone of the hydrolittoral | x |
| Filamentous algal zone of the sublittoral | x |
| *Fucus* spp. communities on rocky and stony bottoms | x |
| *Cladophora aegagropila* communities | |
| Red algae communities | x |
| *Zostera marina* communities | x |
| Bottom dominated by submerged macrophytes | x |
| Charophyte meadows | |
| Bryophyte communities | |
| Blue mussel communities | x |
| Zoobenthic communities in the euphotic zone | x |
| Zoobenthic communities beyond the euphotic zone | x |

## 7.3 Fish and fisheries

Fishing taking place along the pipeline route in the Exclusive Economic Zones (EEZ) of Finland and Estonia was studied on the basis of the statistical rectangles of the International Council for the Exploration of the Sea (ICES). Statistics on catches were produced for the Estonian side concerning the area covered by ICES rectangles 47H4 and 48H4 (2011–2013) and for the Finnish side for the area covered by rectangles 48H4 and 48H3 (2010–2012) (*Ramboll 2013d, Ramboll 2013b,* ). As regards the Finnish EEZ, more specific data was obtained on the basis of a fishing survey among commercial fishers (*Ramboll 2013d*). The fishing survey was sent to 63 fishers who had submitted catch data in 2010–2012 for areas covered by statistical rectangles 48H3 and 48H4 (Figure 7-21).

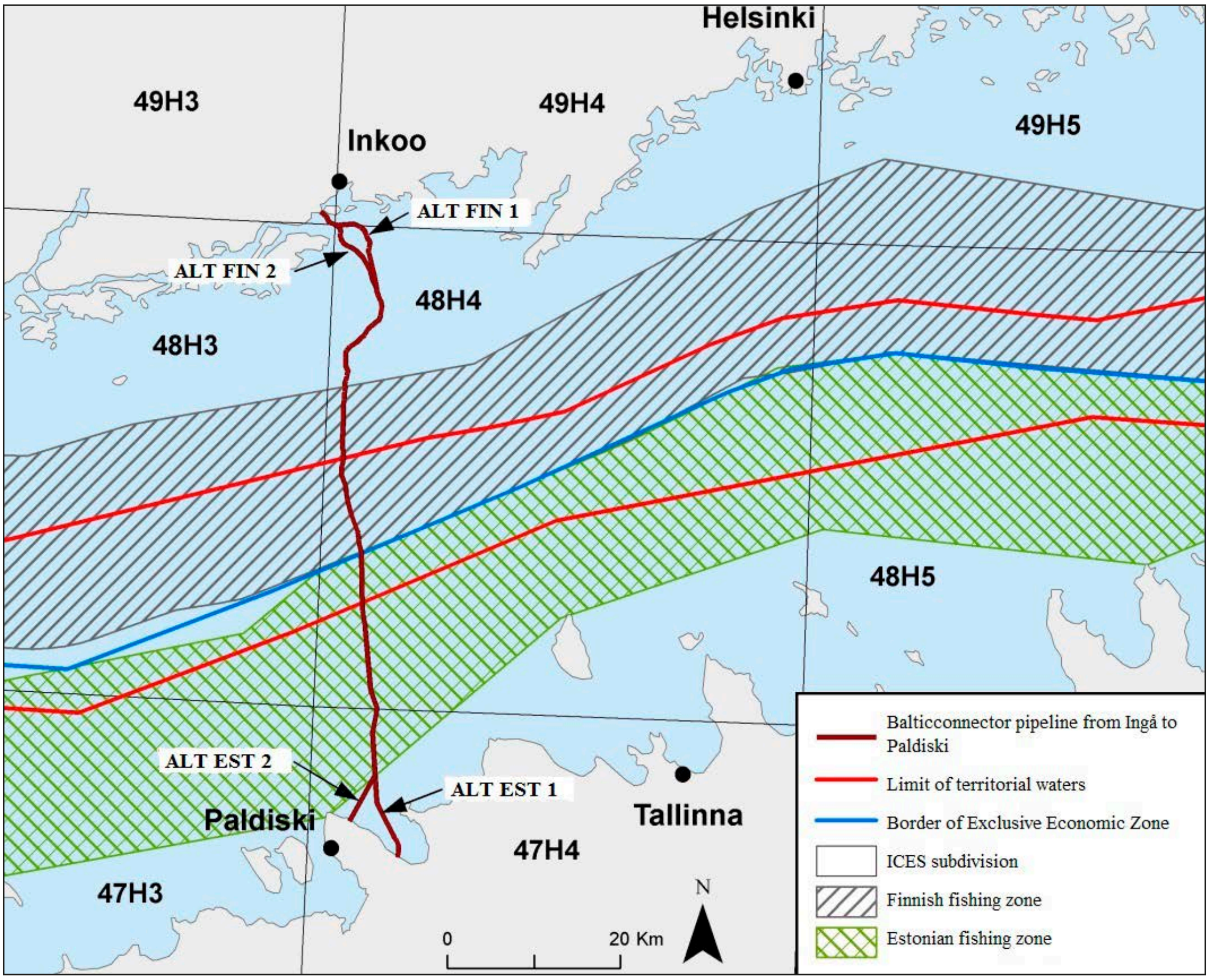



Figure 7-21. The Finnish and Estonian fishing zones and the ICES subdivisions in the project area.

The fish stock surveys conducted to provide background data for the EIA report focused on the area between the coast and outer archipelago (*Ramboll 2013d*). Therefore the fish fauna of the offshore areas is described on the basis of existing studies. In autumn 2013 echo-sounding and test trawling were carried out in the Gulf of Finland by the Finnish Game and Fisheries Research Institute using the marine research vessel R/V Aranda (*RKTL & SYKE 2013*). Corresponding monitoring has previously (2006–2012) been carried out in the Gulf of Finland in cooperation between Finland and Estonia (e.g. *ICES WGBIFS 2009–2011*). A survey of the status of the fish stocks was conducted on the basis of studies including those mentioned above (*Raitaniemi & Manninen 2014*). Furthermore, pelagic fish stocks of the Gulf of Finland have been studied in research projects including the one carried out in 2002–2006 where areas around the Gulf of Finland were surveyed using echo-sounding and a pelagic research trawl to study the structure of the fish stocks and any differences between areas (*Peltonen et al. 2006*). Research trawling also took place in conjunction with the Nord Stream gas pipeline project.

### 7.3.1 Gulf of Finland

#### 7.3.1.1 Fish fauna

The fish stocks of the Gulf of Finland consist of marine and freshwater species. The low salinity of the Gulf of Finland area is a limiting factor for many marine species, which live at the extremity of their distribution area in this area. The fish stocks of the Gulf of Finland are also affected by any changes taking place in the fish populations of the main basin of the Baltic Sea. The periods of oxygen depletion occurring in the deep basins also pose a challenge, limiting the habitats of demersal fish and zoobenthos.

The species of fish living in the offshore areas of the Gulf of Finland affected by the Balticconnector gas pipeline project can be divided into three groups: 1) pelagic schooling fish, 2) demersal fish and 3) migratory fish. The habitats, diets and migratory dynamics of each group differ from each other. In the texts below, 'offshore area' refers to the area without islands and deeper than 20 m stretching out after the outer archipelago.

**Pelagic schooling fish**

Pelagic schooling fish occurring in offshore areas include Baltic herring (*Clupea harengus membras*), sprat (*Sprattus sprattus*) and three-spined stickleback (*Gasterosteus aculeatus*) and, in smaller numbers, also ten-spined stickleback (*Pungitius pungitius*). According to Peltonen et al. *(2006*), the most common pelagic species in the offshore areas of the Gulf of Finland are Baltic herring, sprat and three-spined stickleback, the diet of all of which mainly consists of zooplankton. The share of other species in the offshore areas is small (*RKTL & SYKE 2013*). The Baltic herring and particularly sprat stocks of the Gulf of Finland are linked with the stocks found in the main basin of the Baltic Sea *(Raitaniemi & Manninen 2014*, *Aro 1989*). Sprat born in the main basin compete for food with the Baltic herring stocks of the Gulf of Finland when Baltic herring migrate to the main basin and, other the other hand, when sprat migrate to the Gulf of Finland. Therefore it would appear that the abundance of sprat has an impact on the growth of Baltic herring in the Gulf of Finland (*Peltonen et al. 2006*). Major annual population variation is typical for Baltic herring and sprat. For example, the spawning stock of Baltic herring in the main basin of the Baltic Sea and the Gulf of Finland in 2013 was almost 90% larger than in 2000 but only roughly one-half of the 1974 level (*Raitaniemi & Manninen 2014*). Correspondingly, the spawning stock of sprat in the Baltic Sea in 2013 was around one-half of that of the record year seen in 1996 (*Raitaniemi & Manninen 2014*).

According to Peltonen et al. *(2006*) the depth of occurrence of fish is affected by the stratification of the Gulf of Finland. According to echo-sounding surveys, the density of fish was the highest close to the thermocline. Sprat and Baltic herring in particular avoided the warm surface layer and the cold (below 3 °C) deep areas even where no limiting factor role was played by oxygen levels. Three-spined stickleback, however, favor warmer water and also move in surface waters.

Sprat and Baltic herring differ from each other in terms of spawning. Baltic herring spawn on littoral vegetation mainly in the spring (May–June), while sprat spawn in the open water in the summer months and their pelagic eggs require a minimum salinity of 5–6‰. This limits the possible spawning areas of sprat in the Gulf of Finland to the western parts of the gulf. The primary spawning grounds of sprat are, however, located in the main basin of the Baltic Sea in the southern parts of the Bornholm and Gdańsk as well as Gotland Deeps (*Koli 1990*). Three- and ten-spined stickleback, on the other hand, spawn in the summer close to the shore as well as in the archipelago and coastal rivers.

Pelagic schooling fish play a major role in the food chain, being a food source for species such as salmon (*Salmo salar)* and brown trout (*Salmo trutta)*. Baltic herring and sprat are also economically highly significant species of fish for commercial fishing in Finland as well as Estonia.

**Demersal fish**

Demersal species of fish found in the offshore areas of the Gulf of Finland include cod (*Gadus morhua*), lumpfish (*Cyclopterus lumpus*), short-horn sculpin (*Myoxocephalus scorpius*), longspined bullhead (*Taurulus bubalis*), fourhorn sculpin (*Myoxocephalus quadricornis),* snakeblenny (*Lumpenus lampretaeformis*), viviparous blenny (*Zoarces viviparus*) as well as the sand-bottom dwelling sandeels (*Hyperoplus lanceolatus, Ammodytes tobianus*), flounder (*Platichthys flesus*) and turbot (*Psetta maxima*). Most demersal species feed on zoobenthos, the occurrence of which in the deep bottoms of the Gulf of Finland is mainly limited to depths up to 70 m due to the poor oxygen situation.

Most demersal species spawn on the coast. An exception to this is cod which, like sprat, have pelagic eggs. The spawning grounds of cod are located at depths of 50–150 m in the southern parts of the Gotland Deep, the Bornholm Deep and Gdańsk Bay (*Koli 1990*). Because cod eggs need a minimum salinity of 10–11‰ for buoyancy as well as oxygen (more than 2 mg/l), the stratification of the Baltic Sea causes reproductive problems for cod. As a result of this, the status of cod stocks is poor.

Demersal fish play a role in the food chain. For example, viviparous blenny is an important part of the diet of many predatory fish species and aquatic birds, while fourhorn sculpin and lumpfish are items in the diet of cod. Commercially significant demersal fish species include cod and flounder, particularly off the Estonian coast.

### Migratory fish

The main migratory fish species occurring in the offshore areas of the Gulf of Finland are salmon (*Salmo salar*) and brown trout (*Salmo trutta*). Both salmon and brown trout spawn in rivers, from where their smolts migrate to the sea after the parr stage. It has been found in tagging research that salmon and brown trout of the Gulf of Finland remain mainly in the Gulf of Finland area during their feeding migration (*Mikkola 1995*). The most important items in the diet of salmon are Baltic herring and sprat, while brown trout feed closer to the coast and their main prey species are Baltic herring and sticklebacks. Salmon and brown trout are commercially important species in the marine areas as well as for fishing in the spawning rivers.

### 7.3.1.2 Fishing

Commercial fishing in the offshore areas of the Gulf of Finland consists almost exclusively of Baltic herring and sprat trawling. Trawling gear used includes pelagic and demersal trawls as well as their pair and single trawling variations depending on the method employed. Some salmon fishing also takes place, with longline fishing used as the technique (*Ramboll 2013a*). The use of driftnets, however, is now totally banned throughout the Baltic Sea.

Fishing quotas have been determined by the International Baltic Sea Fishery Commission (IBSFC) for sprat, Baltic herring, salmon and brown trout for the Baltic Sea, regulating issues including the trawling of Baltic herring and sprat. Baltic herring in the Gulf of Finland is regulated as sub-populations of the main basin populations of the Baltic Sea and of the Gulf of Finland. Correspondingly, sprat fishing is regulated on the basis of a quota covering the entire Baltic Sea, which in many years has also restricted the utilization of the Gulf of Finland Baltic herring quota.

There has been major annual variation between the percentages of catch of Baltic herring and sprat (Table 7-3 and Table 7-4). For example, in the 2011–2013 period the trawling harvests have collapsed to around one-half (Table 7-3). Trawling mainly takes place using pelagic and midwater trawls, which enables fishing in areas including those where the seabed is uneven. Demersal trawling was also reported in the project area, but the harvests from demersal trawling only accounted for 0–2% of the total (*Ramboll 2013d, Ramboll 2013b*). The offshore area located close to the project area can be regarded as a significant trawling area in the Gulf of Finland scope (*Nord Stream 2009aa*).

According to the fishing survey on 2012 targeted at the project area, the areas close to the gas pipeline in the Finnish EEZ, at least four trawlers operate in the project area. According to the extract from the commercial fishing register obtained from the Ministry of Agriculture and Forestry, pelagic and midwater trawling took place in the vicinity of the planned gas pipeline route off Ingå in 2010–2012 and, at least in 20102011, demersal trawling also took place (*Ramboll 2013d*). The trawling areas are mainly situated south of the baseline, i.e. the seaward limit of the internal waters, and the respondents carry out most of their trawling close to or south of the limit of Finland's territorial waters (Figure 7-22). In 2012 trawling only took place in the winter.

The catch reported for the project area in 2012 was around 1,350,000 kg of sprat and around 850,000 kg of Baltic herring (*Ramboll 2013d*). The catch from the project area for sprat accounted for 34.1% of the 2012 catch from rectangles 48H3 and 48H4. The corresponding figure for the Baltic herring catch is 22.7%.

Table 7-3. Sprat and Baltic herring catches (tonnes) for statistical rectangles 48H3 and 48H4 in 2010–2012 (Figure 7-21). (*Ramboll 2013d*)

| Species | 2010 | 2011 | 2012 | Total | % of total |
|---|---|---|---|---|---|
| Sprat | 6 507 | 5 311 | 3 957 | **15 775** | 58% |
| Baltic herring | 3 182 | 4 674 | 3 753 | **11 609** | 42% |
| **Total** | **9 689** | **9 985** | **7 710** | **27 384** | **100%** |

Table 7-4. Sprat, Baltic herring and smelt (*Osmerus eperlanus)* catches (tonnes) for statistical rectangles 48H4 and 47H4 in 2011-2013 (*Ramboll 2013b*).

| Species | 2011 | 2012 | 2013 | Total | % of total |
|---|---|---|---|---|---|
| Sprat | 7 257 | 6 056 | 3 473 | **16 786** | 77% |
| Baltic herring | 2 131 | 1 738 | 1 123 | **4 992** | 23% |
| Smelt | 2 | 0 | 0,7 | **2,7** | 0% |
| **Total** | **9 409** | **7 793** | **4 586** | **21 788** | **100%** |

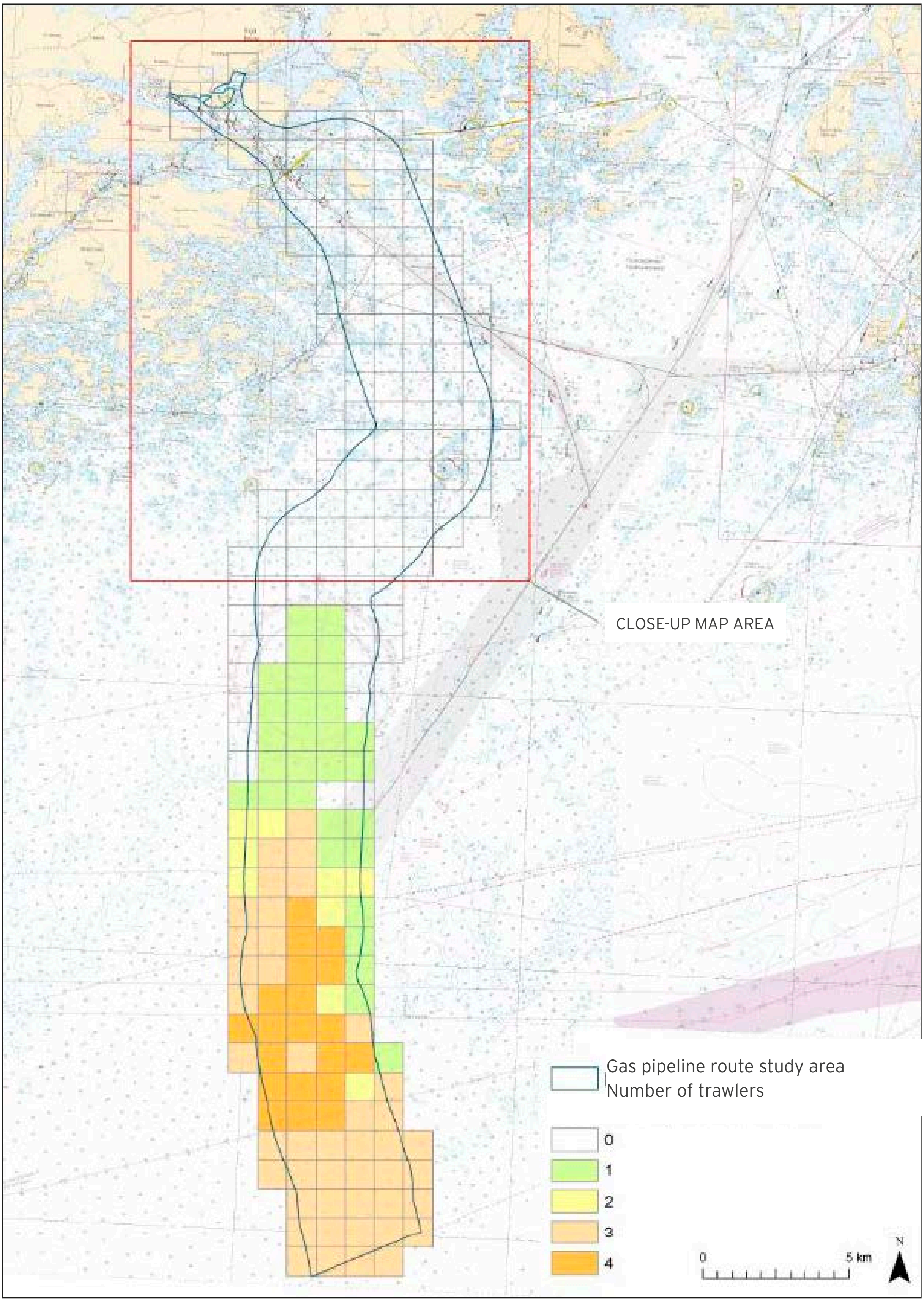



Figure 7-22. Locations of trawling areas of fishers responding to the commercial fishing survey in 2012. *(Ramboll 2013a)*

There are no protected areas in or close to the offshore section of the project area. Offshore fish stocks are, however, regulated on the basis of fishing quotas. The Baltic herring and sprat stocks are of very high significance to society, being the main catch target for trawlers on the Finnish as well as the Estonian side.

### 7.3.2 Ingå

Commercial fishing in the project area was studied using a fishing survey formulated for this project. The fishing survey was sent to 63 fishers who had submitted catch data in 2010–2012 for areas covered by statistical rectangles 48H3 or 48H4 (Figure 7-21). In addition, statistics were compiled for the total catches reported for the above-mentioned rectangles. A comprehensive survey of commercial fishing off the Finnish coast of the Gulf of Finland was conducted under the spatial plan for commercial fishing, in conjunction with which fish spawning areas were also studied in a comprehensive manner *(Haikonen & Laamanen 2011)*.

Recreational fishing was studied in the Ingå fishing area using a survey conducted on the basis of a sample drawn from the population register *(Seppänen et al. 2010)* and a survey among property owners in and close to Fagerviken relating to obligatory monitoring *(LUVY 2011)*.

Several fish stock surveys have been conducted for the Ingå coast. Fish stocks in the project area were studied using Coastal survey net sampling and, for pelagic fish reproduction, Gulf Olympia sampling for larvae *(Ramboll 2013d)*. In the inner sections of the archipelago, fish stocks and breeding grounds were surveyed in 2012 using juvenile seine sampling and in 2014 by conducting a spawning grounds survey for pike (*Esox lucius),* Gulf-Olympia juvenile sampling and juvenile seine sampling. The 2014 studies also took place in the area affected by the landfall alternative LF1 of the Balticconnector gas pipeline.

#### 7.3.2.1 Fish fauna

There are sheltered bays and inlets in the inner archipelago of Ingå with limited water exchange and mostly soft mud bottoms. There are also extensive reedbeds in these areas (Figure 7-23 and Figure 7-24). In the area surrounding the LF1 landfall alternative of the gas pipeline in Barkansundet, nutrient-rich water input from the Kyrkfjärden direction and the limited exchange of water cause reductions in oxygen levels in the winter and during late-summer phytoplankton blooms (*Holmberg 2013*). Fagerviken, on the other hand, has a sill-free connection with outer sea areas, whereby its water exchange levels are good. Consequently, Fagerviken is a rather marine-like environment, with only the innermost part of the bay being lower in salinity and water exchange levels (*Holmberg 2013*). In the area around the LF2 landfall alternative off the Fjusö Peninsula, the shores consist of more coarse-grained gravel-stone shores and bedrock (Figure 7-24). The depth increases from the Fjusö Peninsula toward Barösundfjärden, with the middle and outer archipelago featuring barren and stony shores near the project area.

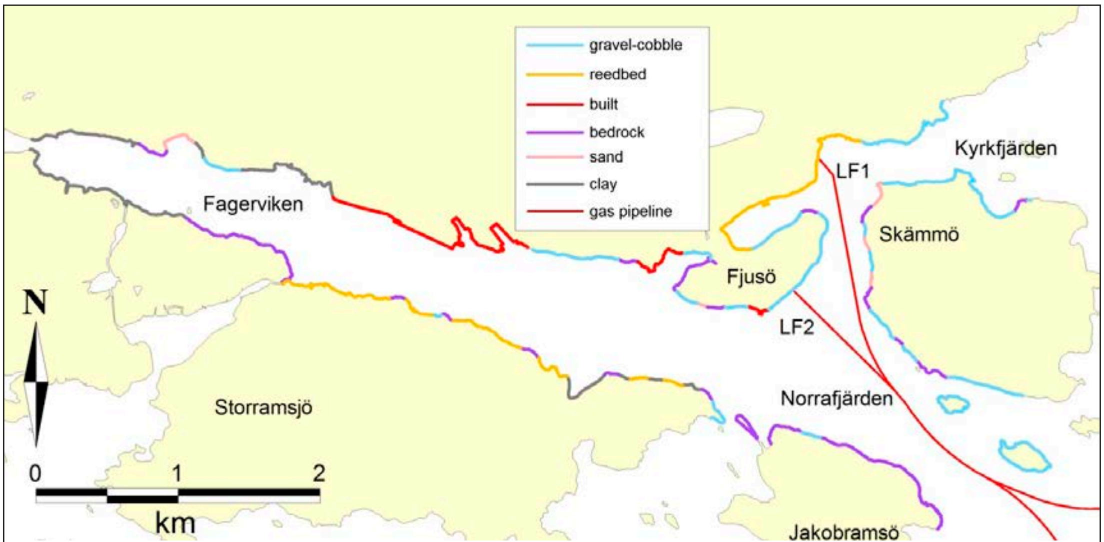



Figure 7-23. Shore types occurring close to the gas pipeline landfall site. Base map © Finnish Transport Agency 2011.

Figure 7–24. Cobble shore on the Fjusö Peninsula (left) and reedbed providing a potential reproduction area for pike in the bay area (right).

The nature of the archipelago zones is also reflected in local fish stocks. Freshwater species are more abundant in the inner archipelago. In the middle and outer archipelagos marine species as well as freshwater species are abundant. Typical freshwater species in the inner archipelago include Cyprinidae and Perciformes as well as pike (*Esox lucius*) and burbot (*Lota lota*). Cyprinidae occurring in the area include at least roach (*Rutilus rutilus*), bream (*Abramis brama*), silver bream (*Blicca bjoerkna*), ide (*Leuciscus idus*), bleak (*Alburnus alburnus*) and rudd (*Scardinius erythrophthalmus*), while Perciformes include perch (*Perca fluviatilis*), pike-perch (*Stizostedion lucioperca*) and ruffe (*Gymnocephalus cernuus*). In addition to the above, species occurring in the middle and outer archipelagos, and being abundant at times, include Baltic herring, sprat, European whitefish (*Coregonus lavaretus*) and flounder (*Platichthys flesus*). Migratory fish occurring in the area are salmon, brown trout (*Salmo trutta*), anadromous European whitefish, river lamprey (*Lampetra fluviatilis*), European eel (*Anguilla anguilla*) and vimba (*Vimba vimba*). Non-commercially-exploited species of fish occurring in the area include smelt (*Osmerus eperlanus*), sand goby (*Pomatoschistus minutus*), common coby (*Pomatoschistus microps*), minnow (*Phoxinus phoxinus*), bullhead (*Cottus cobio*), three-spined stickleback (*Gasterosteus aculeatus*), ten-spined stickleback (*Pungitius pungitius)* as well as straightnose pipefish (*Nerophis ophidion*) and broadnosed pipefish (*Sygnathus typhle*). Corresponding species occurring in the outer archipelago in addition to the above include sandeels (*Ammodytidae*), longspined bullhead (*Taurulus bubalis*) and viviparous blenny (*Zoarces viviparus*).

In the multi-mesh gillnet sampling carried out to study the structure of the fish stocks in the vicinity of the planned gas pipeline route (Coastal multi-mesh gillnet) the most common species in terms of number of individuals and weight in kilograms were roach, ruffe and perch (Figure 7–25, *Ramboll 2013d*). A total of 19 different fish species and two Cyprinidae hybrids were found in the samplings. The average unit catch was 103 individuals/net and 5 kg/net. The amount of catch (number of individuals and biomass) and well as the species richness was the highest in sampling sites in the inner archipelago. No exploratory fishing took place in the area affected by the LF1 landfall alternative but, belonging to the inner archipelago, fish stocks in this area are also dominated by Cyprinidae and Perciformes.

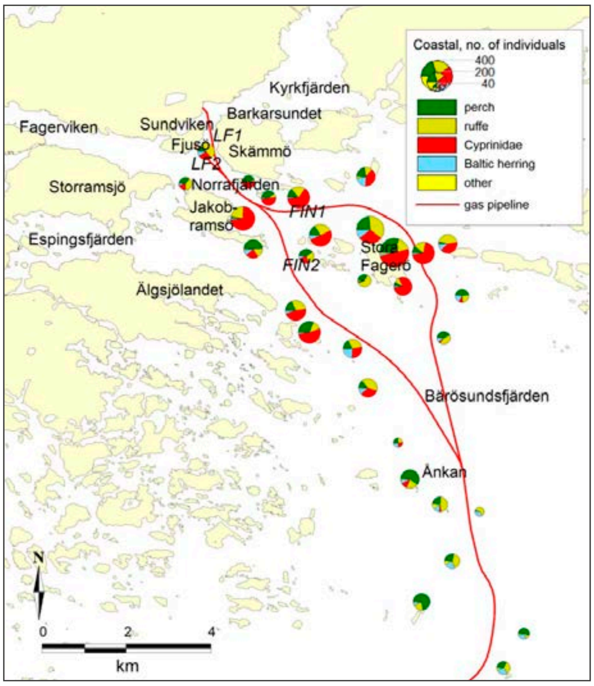



Figure 7–25. Unit catches by net obtained in multi-mesh gillnet sampling (Ramboll 2013d). Base map © Finnish Transport Agency 2011.

### Spawning and nursery areas

According to information obtained from commercial fishers, economically significant species of fish spawning in the project area or its immediate vicinity comprise the spring-spawning pike, perch, pike-perch and Baltic herring. According to the commercial fishers, the sea-spawning European whitefish, which spawns in the autumn, spawns at least in the gravel and cobble bottoms of the middle and outer archipelago. In addition, the winter-spawning burbot spawns in bay areas (Figure 7–26).

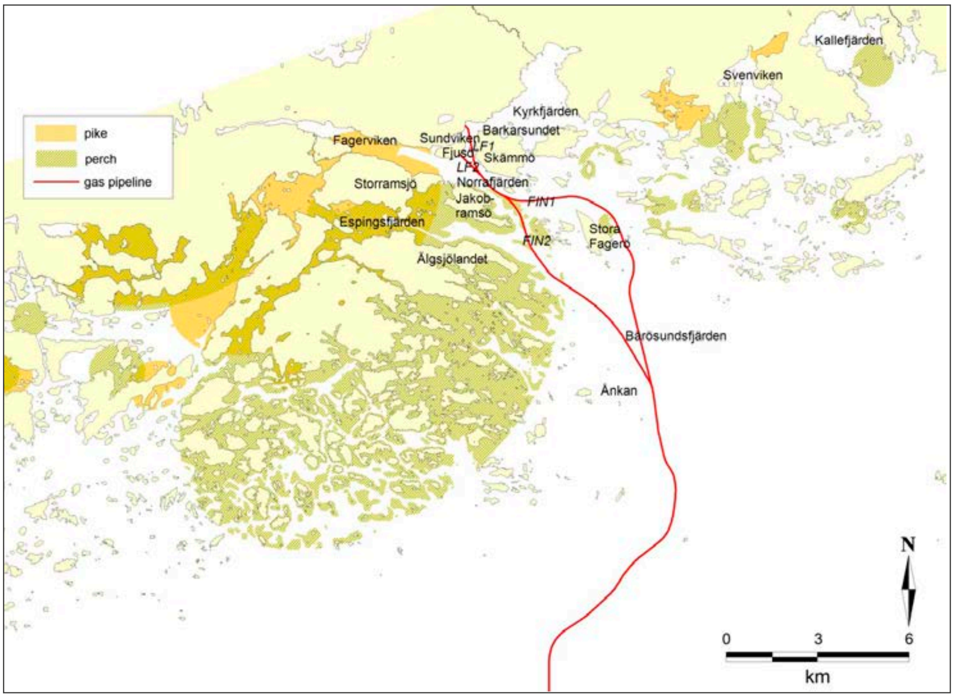



Figure 7–26. Pike, perch (top), pike-perch and burbot (middle) as well as Baltic herring and sea-spawning European whitefish (bottom) spawning areas as reported by commercial fishers. Base map © Finnish Transport Agency 2011.

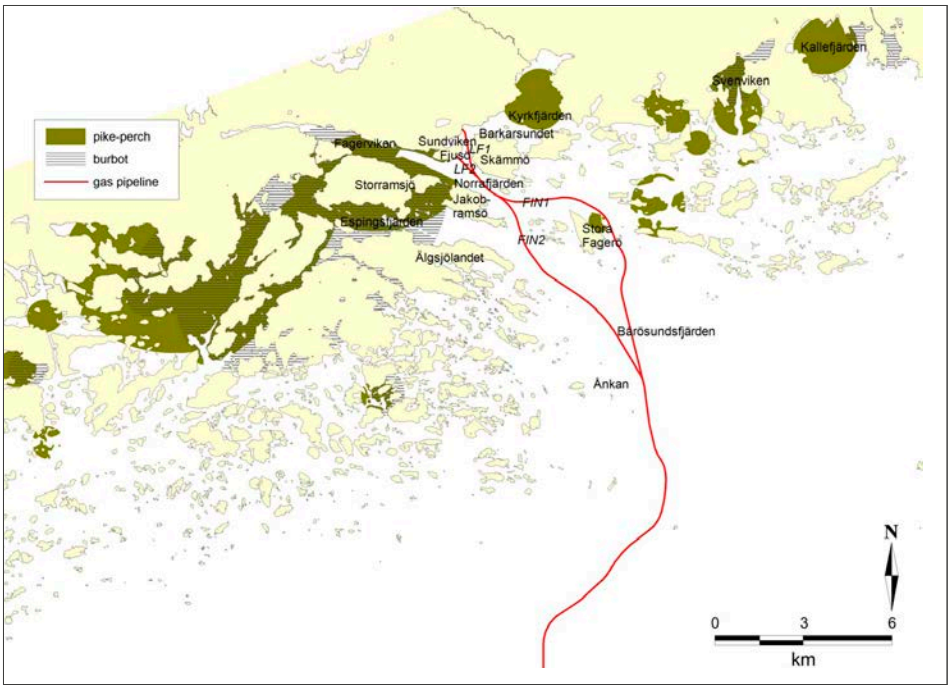



Figure 7–26. Pike, perch (top), pike-perch and burbot (middle) as well as Baltic herring and sea-spawning European whitefish (bottom) spawning areas as reported by commercial fishers. Base map © Finnish Transport Agency 2011.

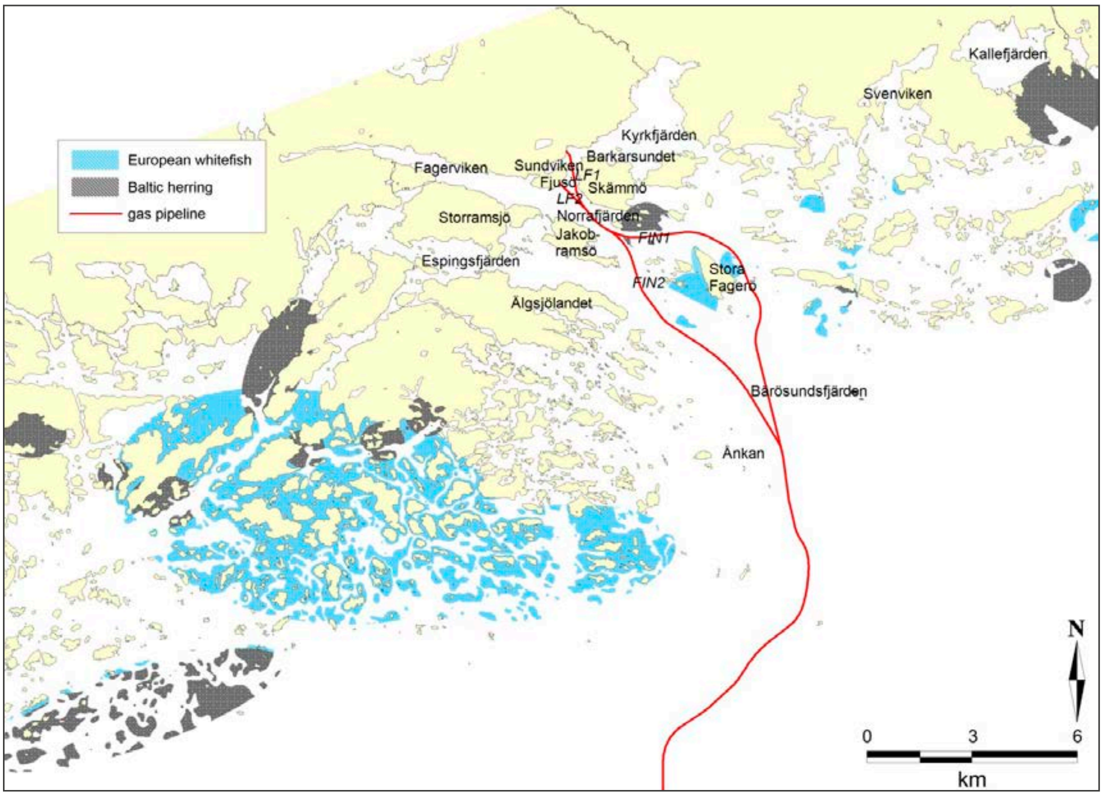



Figure 7-26. Pike, perch (top), pike-perch and burbot (middle) as well as Baltic herring and sea-spawning European whitefish (bottom) spawning areas as reported by commercial fishers. Base map © Finnish Transport Agency 2011.

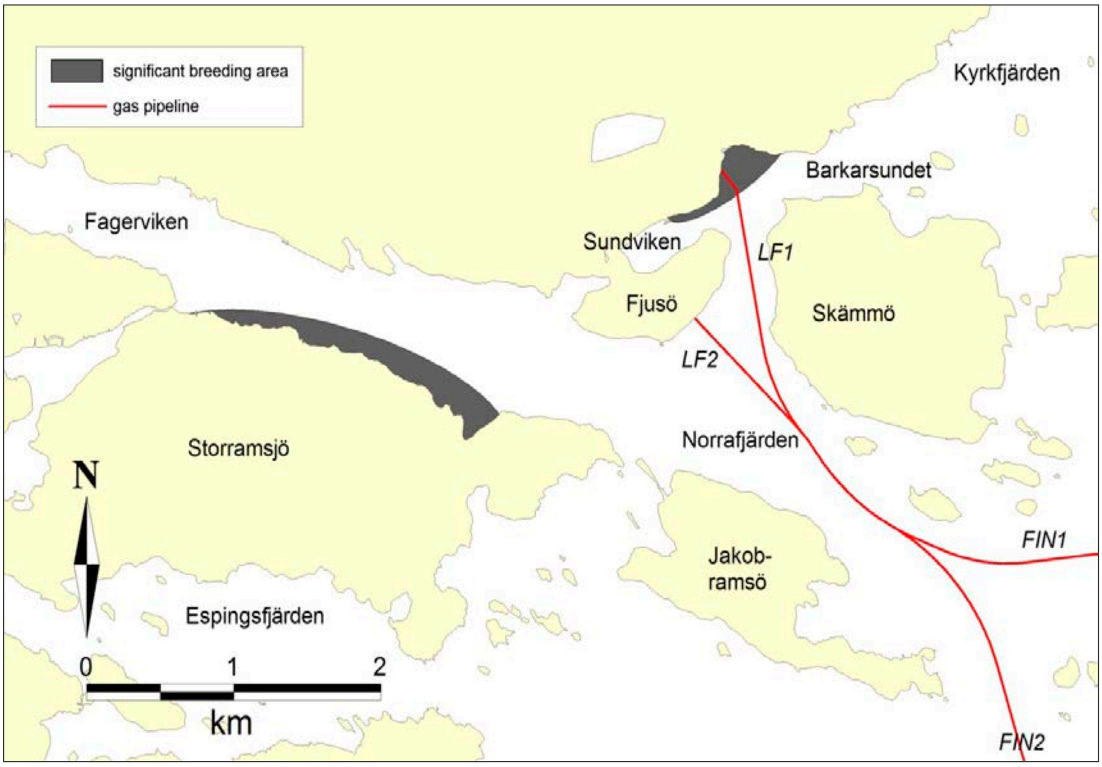



Figure 7-27. Significant reedbed/breeding areas in the project area. Base map © Finnish Transport Agency 2011.

Efforts were made to further specify the spawning grounds outlined by commercial fishers on the map by conducting juvenile surveys concerning the landfall area (*Ramboll 2013a, Haikonen et al. 2014, Vatanen & Haikonen 2012*). According to the results of the juvenile surveys (*Haikonen et al. 2014*) there are two significant reedbed areas in the immediate vicinity of the project area where pike, perch and probably also Cyprinidae spawn (Figure 7–27). These extensive reedbed areas also play an important role for juveniles of various ages as well as items in their diet (*Kallasvuo 2010*). A ditch also flows into the Barkarsundet reedbed area (LF1) and the back of the Fagerviken Bay. Spring-spawning species of fish typically favor bays where there is an inflowing ditch/stream. The ditches are probably also used as spawning grounds by spring-spawning species.

Fry or fingerlings of pike-perch were not found in the Fagerviken area in the juveniles survey (*Haikonen et al. 2014*), so it is likely that the most significant pike-perch spawning areas are found north/northeast of Skämmö and inner in Kyrkfjärden and the archipelago southwest of the project area. Kyrkfjärden is a closed area for pike-perch (Figure 7–29) and there are pike-perch spawning areas reported by commercial fishers at the back of the bay north of the island of Vålö (Figure 7–26, *Vatanen & Haikonen 2012*).

According to the Baltic herring juveniles survey conducted in 2013 (*Ramboll 2013a*), newly-hatched Baltic herring were found throughout the area studied. The most important Baltic herring spawning grounds in the project area would, however, appear to be located in the middle archipelago around the island of Stora Fagerö. Large amounts of juvenile Baltic herring of all sizes were found in the inner archipelago later on in the summer, indicating that Fagerviken and Kyrkfjärden are nursery areas for Baltic herring (*Haikonen et al. 2014*). Baltic herring benefit from the higher water temperature as well as better feeding conditions of the coast and bays compared with more exposed areas further off the shore (*Urho 1999*).

Other species of fish spawning in the area studied are, on the basis of juveniles surveys, roach, rudd and bleak, three-spined and ten-spined stickleback, straight-nose pipefish and sand goby (and possibly other goby species) (*Ramboll 2013d, Haikonen et al. 2014*).

Fish production in the area is also supported by transplanting. The Ingå Fishing Region and other operators transplanted species including brown trout, anadromous European whitefish, sea-spawning European whitefish, pike, eel and pike-perch in the area in 2012 and 2013.

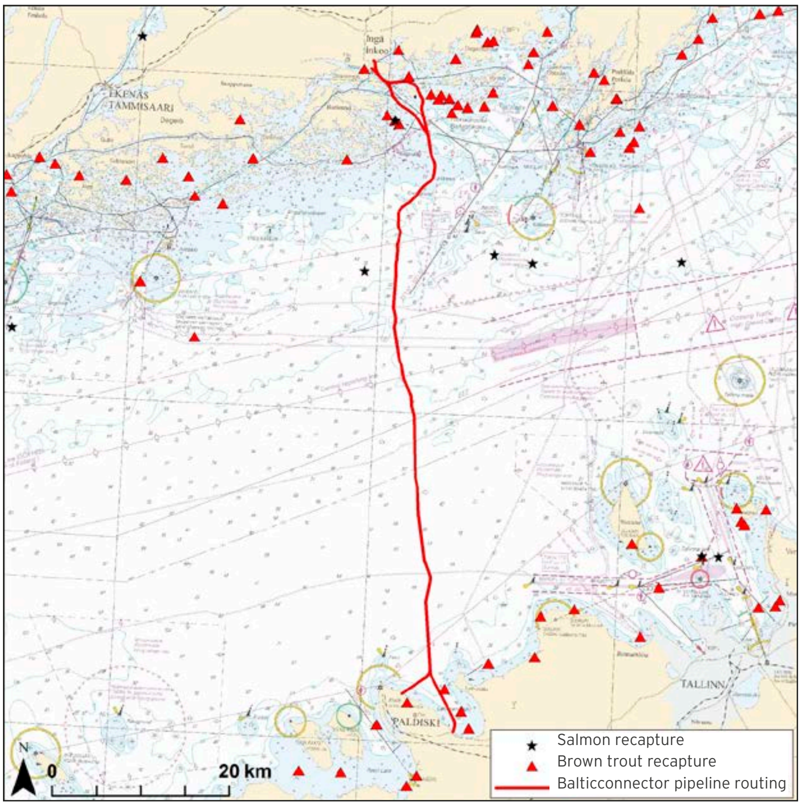



Figure 7–28. Carlin tags found near the project area on brown trout and salmon planted in Finland and Estonia. Brown trout (red triangles) and salmon (black stars). Most of the recaptures on the Estonian coast are individuals transplanted on the Finnish side.

**Fish migrations**

Fish migration mainly takes place between feeding and spawning grounds. For migratory fish, migrations may be highly extensive, as is the case with brown trout which migrates throughout the Gulf of Finland in the Finnish as well as Estonian coast (Figure 7–28). The spawning migrations of Baltic herring, on the other hand, take place between offshore areas and the coast. The migrations of perch and pike-perch, both common in the area, are typically more local and limited to migrations within the archipelago zone between bay areas and middle/outer archipelago.

Rivers in the area also affect fish movements in the area. River Fagerviksån flows into the innermost part of the Fagerviken Bay, with fish from the sea possibly spawning in the river. There is very little information available about Fagerviksån. River Ingå flows into the Kyrkfjärden Bay. There are no migration barriers in the river, whereby fish are able to move up-stream all the way to the headwater lake around 10 km from the mouth of the river. River Ingå is clay-turbid and eutrophic river in a drainage basin of an agricultural area. According to a study conducted in 1989, there are two rapids sites suitable for brown trout reproduction (*Marttinen & Koljonen 1989*) where breeding does not, however, take place according to findings from electrofishing surveys. River Ingå is not classified as a water body rich in salmon or European whitefish, and it is not a known brown trout river according to the brown trout protection and harvesting plan for the Gulf of Finland (*Lempinen 2001*). Vimba and probably also other spring-spawning fish migrate up River Ingå to spawn. It is also possible that small numbers of transplanted anadromous European whitefish spawn in the rivers of the area.

River Ingarskila runs into the sea around 10 km west from the project area and is a significant spawning river for brown trout. In addition to brown trout, species including lamprey and vimba also spawn up the river. Anadromous European whitefish has also been observed in River Ingarskila, but there is no proof of reproduction in the wild.

Due to the vicinity of River Ingarskila, brown trout smolts born in the wind as well as mature individuals heading for spawning grounds migrate in the Ingå archipelago. Brown trout smolts have been observed to migrate into the sea mainly in April, May and June (*Haikonen 2012, Haikonen & Tolvanen 2013*). There is no research data on the proportion of brown trout born in the wild among those caught in the Ingå area available at the moment.

**Threatened species occurring in the project area**

According to the Red List of Finnish Species (*Urho et al. 2010*), the red-listed species of fish in the project area are brown trout (Critically Endangered, CR), anadromous European whitefish (Endangered, EN), European eel (Endangered, EN), sea-spawning European whitefish (Vulnerable, VU), salmon (Vulnerable, VU) and river lamprey (Near Threatened, NT).

### 7.3.2.2 Fishing

The Ingå Fishing Region closed area in Kyrkfjärden and Barkarsundet in the project area or its immediate vicinity provides a closed season for pike-perch in the area for the June 1 to June 30 period until 2017 (Figure 7–29). Fishing is also prohibited in the nature reserve west and south of Storramsjö and Jakobsramsjö, although lure fishing and angling is permitted in the period from August 16 to April 14 and ice fishing from November 1 to March 31.

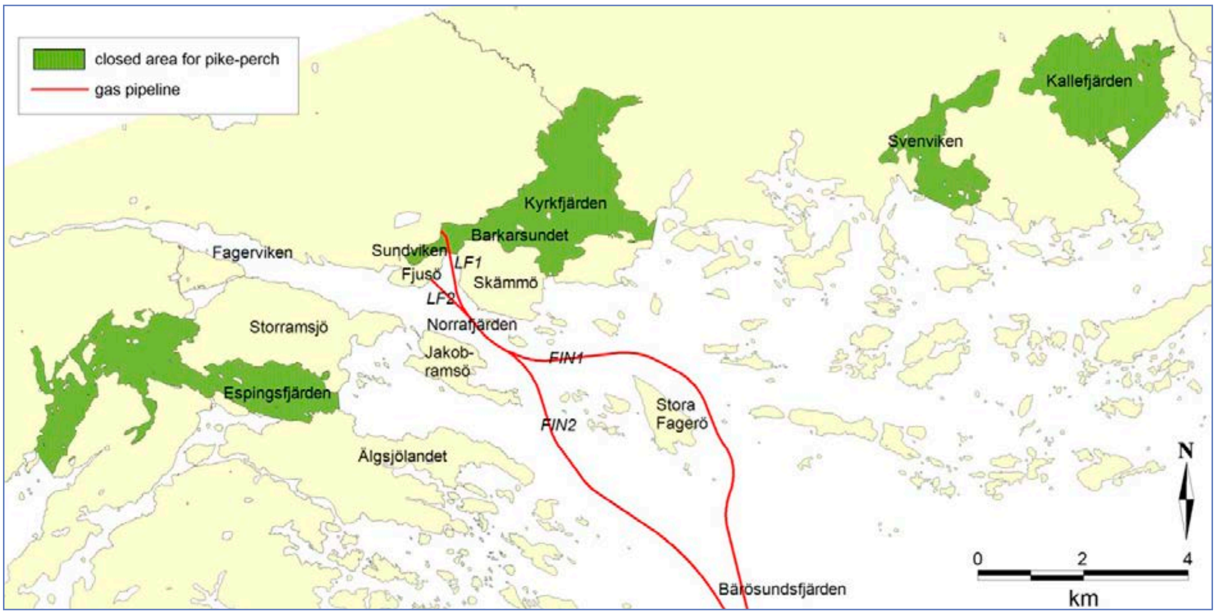



Figure 7–29. Closed areas in the Ingå Fishing Region. Base map © Finnish Transport Agency 2011.

### Commercial fishing

The most significant catch species for coastal fishing in the area of statistical rectangles 48H3 and 48H4 in 2010–2012 were pike-perch (32%) and perch (22%), which accounted for more than one-half of the total catch (*Ramboll 2013d*). Other abundant species in the catch were pike (16%), bream (9%), European whitefish (7%) and burbot (6%). The relative proportions of coastal catch species collected on the basis of the statistical rectangles differ clearly from the results obtained on the basis of the survey conducted among commercial fishers. This is due to the size of the statistical rectangles, 55 km * 55 km, being too large for area-specific examination.

The majority of the respondents to the survey targeted at the project area operated fishing trawls for Baltic herring and sprat in offshore areas. Only a few of the respondents fished close to the coast. The number of fishers in the commercial fishing survey conducted for the Fagerviken area under the obligatory monitoring scheme (*LUVY 2011*) has also been small (three commercial fishers). There are, however, fishers operating in the project area whose livelihoods are entirely or in part dependent on fishing. The most common types of gear used in coastal fishing are various nets and fykes. According to the survey, pike-perch, perch and pike are fished using nets in the inner archipelago and salmon and European whitefish using fykes, pound nets and seal-proof push-up fyke nets in the outer archipelago (Figure 7–30, *Ramboll 2013d*). As well as trawling, some net fishing of Baltic herring also takes place in the archipelago.

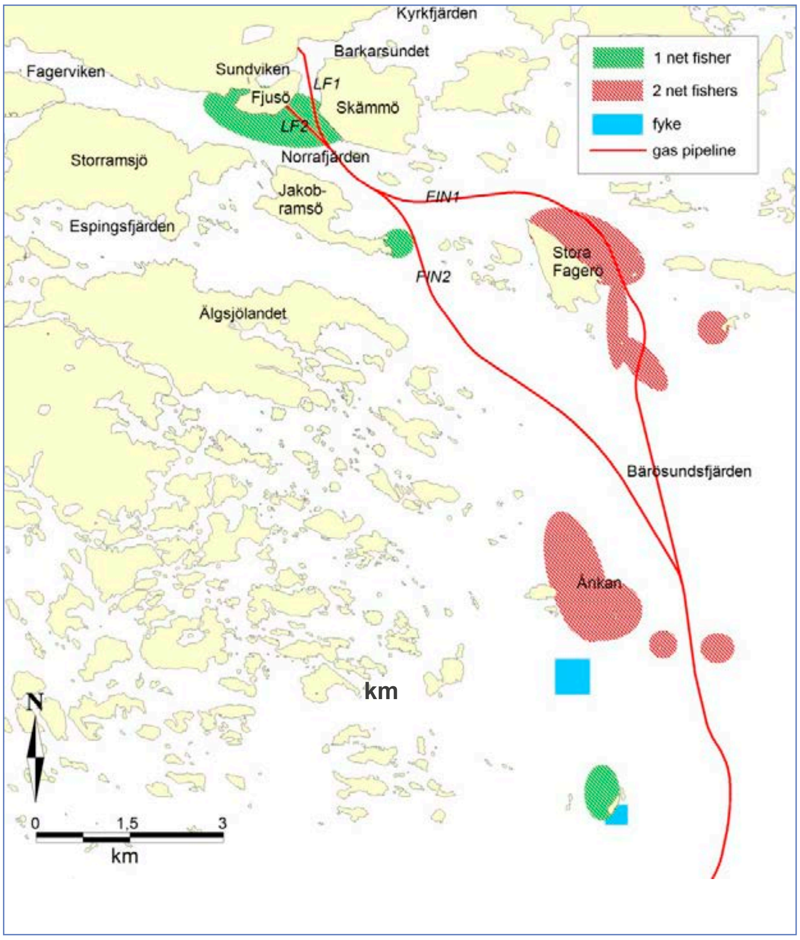



Figure 7–30. Locations of fishing grounds used by respondents to the commercial fishing survey off Ingå. Base map © Finnish Transport Agency 2011.

According LUVY *(2011)*, the most important catch species for coastal commercial fishing is pike-perch, with pike and perch also fished, while according to the results of the 2012 fishing survey targeted at the project area (*Ramboll 2013dd*) the most important catch species are perch and salmon. European whitefish and burbot can also be regarded to be of economic significance.

### Recreational fishing

According to a survey conducted on the basis of a sample drawn from the population register, in 2009 fishing took place in the Ingå Fishing Region on a total of 115,263 fishing days, accounting for 4% of the fishing days in the Uusimaa region on the whole (*Seppänen et al. 2011*) (Table 7–5). The number of people fishing in Ingå in 2009 is estimated to total around 21,000.

In 2009 the total catch from the Ingå Fishing Region was 100,000 kg (*Seppänen et al. 2011*). Perch, pike and pike-perch accounted for 86% of the total recreational fishing catch (Table 7-6).

According to the fishing survey targeted at Fagerviken and neighboring areas, one in three local property owners engage in subsistence or recreational fishing (*LUVY 2011*). Fishing activity was at its highest in the period between May and September. According to the survey, the most commonly used gear was net, but worm angling and spinning/trolling were also popular among those with holiday homes in the area in particular.

The household-specific catch reported in the survey was 65 kg, with as much as 80% of the total caught using nets. The catch was broken down between different species of fish as follows: pike-perch 24.3%, pike 21.7%, bream 18.9% and perch 12.4%. Other species caught include European whitefish, accounting for 3.2% of the total catch. According to LUVY *(2011)*, the status of pike-perch and pike stocks is relatively good in the Fagerviken area, but perch stocks have decreased while Cyprinidae, such as bream, which benefit from eutrophication, have increased.

Fishing tourism and types of fishing poorly visible in statistics, such as surf fishing for trout in the middle and outer archipelago and, to some extent, trolling for salmon, also take place in the area.

Table 7–5. Number of fishing days of recreational fishers (number and %) in Ingå Fishing Region in 2009 *(Seppänen et al. 2011)*.

| Type of fishing right | Fishing days | % |
|---|---|---|
| Angling and ice fishing under everyman's right | 36 956 | 32 |
| Lure fishing subject to provincial lure fishing fee | 27 147 | 24 |
| Lure fishing exempt from fee by persons aged under 18 or over 65 | 19 232 | 17 |
| Lure fishing permitted by owner of fishing waters | 6 487 | 6 |
| Other fishing permitted by owner | 25 441 | 22 |
| **Total** | **115 263** | **100** |

Table 7–6. Recreational fishing catches in the Ingå Fishing Region in 2009 *(Seppänen et al. 2011)*.

| Species | Catch, kg | Catch, % |
|---|---|---|
| Perch | 30 000 | 30 |
| Pike | 28 000 | 28 |
| Pike-perch | 28 000 | 28 |
| Bream | 7 000 | 7 |
| Roach | 5 000 | 5 |
| Other species | 2 000 | 2 |
| **Total** | **100 000** | **100** |

## 7.4 Noise and vibrations

### 7.4.1 Gulf of Finland

Airborne noise in the Gulf of Finland is mostly caused by vessel traffic and focuses on areas along the main fairways. In addition, noise is caused by construction and military activity. As well as anthropogenic sounds, the soundscape of the area also features natural sounds such as waves, wind, storms and ice movement.

There are no studies available concerning the levels of airborne sound in the Gulf of Finland, while some studies have been conducted on underwater noise in the Baltic Sea. The purpose of the EU-funded LIFE+ project Baltic Sea Information on the Acoustic Soundscape (BIAS) is to measure the levels of anthropogenic and natural underwater noise around the Baltic Sea at different times of the year in 2014–2016 (*BIAS 2014*). The project has 40 measurement stations around the Baltic Sea, and a sound map covering the entire sea will be produced on the basis of the findings.

Underwater noise in the Baltic Sea is caused particularly by vessel traffic and various types of underwater work such as dredging and blasting. Seismic studies may also generate noise. Ice movement, icebreaking and vessel traffic through ice cause a lot of noise in the Baltic Sea (*BIAS 2014*). In addition to ice movement, other natural sources such as wind, rain and waves generate sounds and may be carried underneath the surface. The noise caused by a storm may even drown out the sounds of ship engines. *(BIAS 2014)*

Underwater sound is composed of pressure and particle motion. The lowest frequencies of the marine soundscape (0.1–5 Hz) result from the Earth's seismic activity. Sounds in the 5–20 Hz range arise from wave turbulence. Wind mainly generates ambient noise exceeding 1 kHz. Vessel traffic is the most important source of sound in the 20200 Hz range in the soundscape of the Baltic Sea near fairways. Events in the atmosphere generate sounds in the 200–100,000 Hz range. Sounds exceeding 100 kHz are caused by thermal motion.

Oceanic underwater ambient curves were originally compiled by Wenz (*Wenz 1962*). Traffic noise is the cumulative effect of all distant shipping from the surrounding marine area. It generates a stationary maximum in ambient noise spectra, which may mask noise from other sources.

The ambient noise level within the 1/3 octave bands 63 and 125 Hz (center frequency) are suggested in Descriptor 11 (Noise/Energy) of the Marine Strategy Framework Directive 2008/56/EC to use for estimation of the ambient noise trends. The Wenz curve depicted noise levels are 90 dB and 85 dB (re 1 µPa) for these two center frequencies, respectively. Average broadband ambient noise levels of 111–117 dB (close to ship lanes) (re 1 µPa and per 1Hz) are reported in the study by Swedish Defence Research Agency (FOI 2012) near Norra Midsjöbanken (around 40 km east of Öland). Preliminary analyses of the BIAS LIFE+ project measurements indicate that in January the mean ambient noise levels at the 1/3 center frequencies may be lower as compared to the Wenz curves results (Table 7-7). The results presented in the table show clearly that the ambient noise level is directly linked with the rate of vessel traffic.

Most of the Baltic Sea marine area is impacted at least by a level of noise that has been estimated to mask the communication of animals (Figure 7-31).

Table 7-7. Average ambient noise sound pressure levels in the Gulf of Finland according to Wenz curves and BIAS project measurements, dB (± 10 dB) re 1 µPa/Hz.

| | 63 Hz mid frequency | 125 Hz mid frequency |
|---|---|---|
| Wenz (low traffic) | 65 | 65 |
| Wenz (moderate traffic) | 73 | 73 |
| BIAS Gulf of Finland (low) | 70 | 75 |
| BIAS Gulf of Finland (moderate) | 78 | 84 |

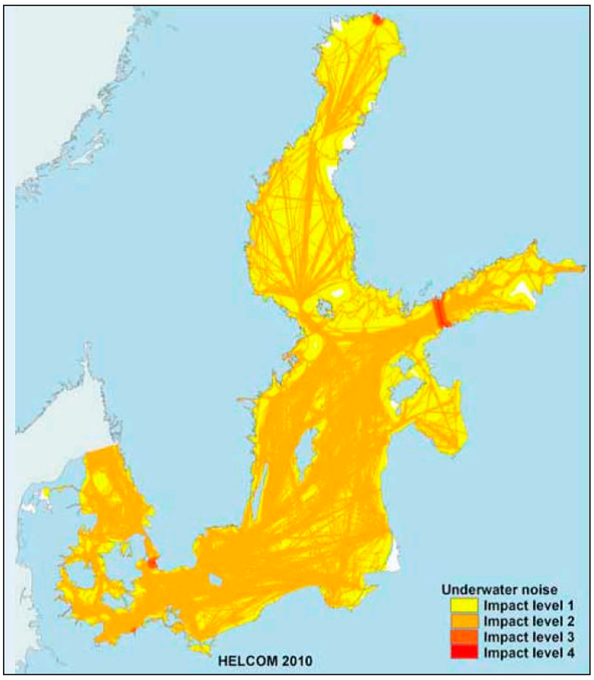



Figure 7-31. Distribution of underwater noise in the Baltic Sea in 2003–2007. Impact level 1 indicates that the noise is audible to biota; level 2 indicates that masking of communication occurs; level 3 indicates an avoidance reaction; level 4 indicates physiological impacts. *(Ramboll 2013a; HELCOM 2010)*

### 7.4.2 Ingå

#### Noise

There are currently no activities causing significant noise in the current Fjusö Peninsula project area of Ingå. Noise is caused west of the project area by Inkoo Shipping Oy harbor operations and Rudus Oy rock extraction activities.

In 2008 an environmental noise survey was conducted by Promethor Oy among operators in the area (*Promethor 2008*), which covered issues including the cumulative noise situation from all activities in the area. This also included the Ingå power plant of Fortum Power and Heat Oy, which was closed down in February 2014. According to the survey, the cumulative noise caused together by all operators (LAeq) has exceeded the daytime as well as nighttime permitted levels at holiday residences south of the Fagerviken Bay for current and forecast situations. The daytime excesses have been 5 dB (with the noise level at 50 dB) and night-time ones 10 dB (with the noise level at 50 dB). Holiday residences southwest of the power plant have also been subjected to noise levels exceeding the permitted levels, but these holiday residences are owned by Fortum Corporation. The equivalent sound level caused alone by the power plant has been 50 dB at holiday residences on the southern side of the bay.

The power station was clearly the most significant source of noise while it was operational and also caused the levels in excess of the permitted levels. While the power station was operational, the noise caused by other operators was not of very high significance. The current situation concerning all operators now that the Ingå power plant has been closed down has not been measured separately, but the reduction in noise levels near the power plant is significant.

There are no clear measurement results separately for Ingå as regards underwater noise situation along the planned pipeline route. The current vessel traffic of the Port of Ingå causes underwater noise close to fairways, but more detailed measurements have not been conducted for the area.

#### Vibrations

There is a rock extraction site of Rudus Oy in Joddböle, Ingå, the blasting operations of which generate vibration impacts in the local environment. An expansion of the rock extraction site is currently being planned. According to the environmental permit, the annual volume of rock extraction is 220,000 $m^3$ and, following the expansion, the annual volume would reach 575,000–7,500,000 $m^3$.

## 7.5 Traffic

### 7.5.1 Gulf of Finland

A large number of vessels travel in the Gulf of Finland every year. The planned offshore gas pipeline will cross fairways with regular traffic almost throughout the entire length of the pipeline. The majority of commercial traffic in the Gulf of Finland follows the Traffic Separation Scheme (TSS). Gulf of Finland vessel traffic is controlled by Vessel Traffic Service (VTS) centers in Helsinki, Tallinn and St. Petersburg as part of the mandatory Gulf of Finland Reporting System (GOFREP). All ships of 300 gross tonnage (GT) or over must comply with the system.

More detailed information about vessel traffic across the Gulf of Finland along the gas pipeline route between Finland and Estonia can be obtained by analyzing data from the Automatic Identification System (AIS). AIS is used for exchange of information between vessels and between vessels and base stations. AIS enables ships to see the locations, routes and speeds of other ships as well as the risks of collision.

The International Maritime Organization (IMO) requires that Class A AIS units to be fitted aboard all ships with gross tonnage of 300 or more. The exception to this are military vessels, which are not required to use the system. The totally voluntary Class B type AIS transceivers have in recent years become more common in smaller vessels (under 300 GT). *(Ramboll 2013a)*

#### Vessel traffic density

The vessel traffic density map (Figure 7-32) was compiled on the basis of data from AIS for 2012 and covers the gas pipeline route and part of the Gulf of Finland. The yellow color indicates low vessel density, while the green color indicates annual vessel traffic exceeding 1,500. The map shows that the majority of vessels follow the Traffic Separation Scheme (TSS) when entering and exiting the Gulf of Finland. Vessel traffic density is also high between Helsinki and Tallinn east of the planned Balticconnector gas pipeline route.

According to the vessel traffic density map, a total of 10 different routes either cross the planned pipeline route or run close to it. These 10 routes are indicated in the figure (Figure 7-32), with the annual numbers of crossings shown in figures. The majority of traffic entering (route G) or exiting (route F) the Gulf of Finland will cross the gas pipeline around its middle section. *(Ramboll 2013a)*

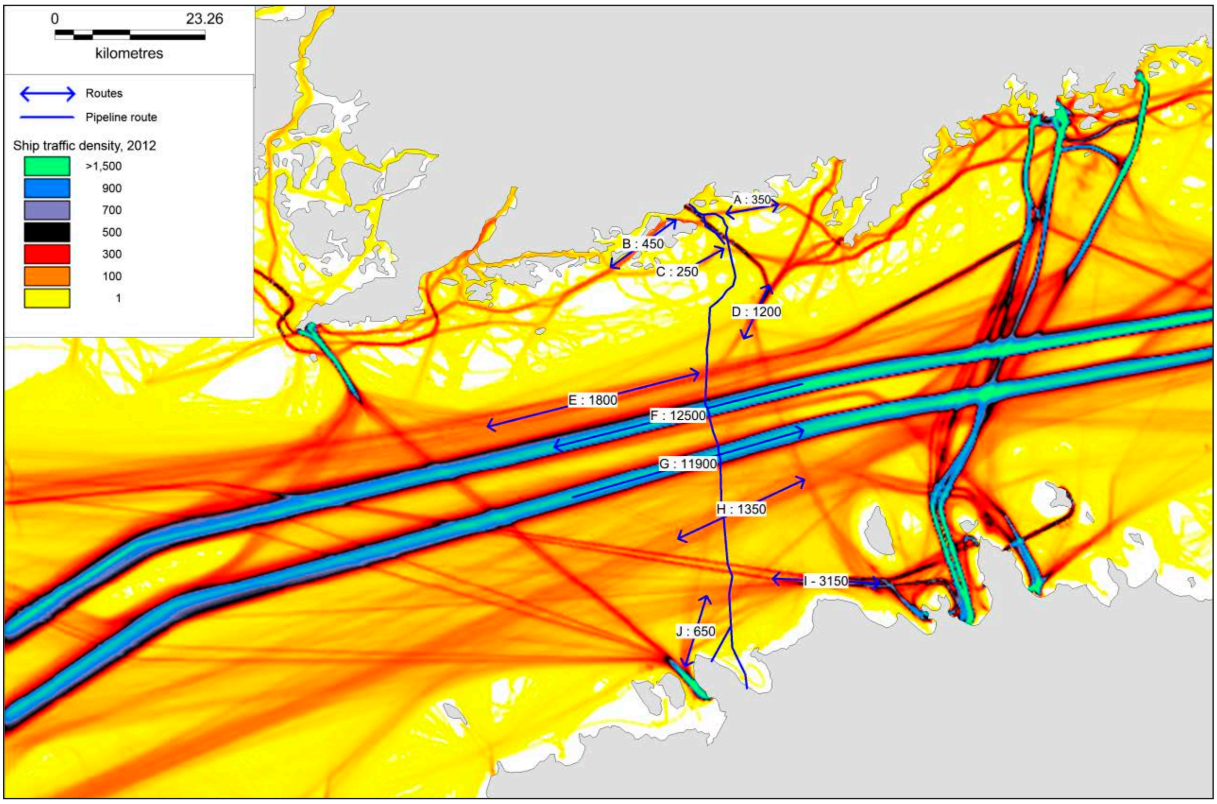



Figure 7-32. Vessel traffic density map. Based on AIS data for 2012. *(Ramboll 2013)*

There are coastal routes near the Finnish coast (routes A, B and C). In addition to permanent residences, there are plenty of holiday residences in the archipelago of Ingå and neighboring municipalities, and boat traffic is busy in the area. The coastal route from Helsinki to Hanko is one of Finland's busiest waterways. Thousands of boats use the coastal routes of Ingå during summer weekends. There are also a lot of commercial fishing boats operating in the route of the planned natural gas pipeline in Ingå. *(Ramboll 2013a)*

Route H also leads into and out of the Gulf of Finland, but vessels take a shortcut south of the TSS. Route I is intended for westbound traffic from and to Tallinn, while route J is used by traffic east and north of Paldiski. The southern harbor of Paldiski is located 50 km west of Tallinn and is the third-largest of the five Tallinn harbors. The core operations of the harbor focus on the handling of Estonian import and export as well as transshipment traffic. *(Ramboll 2013a)*

The annual amounts of vessel traffic crossing the Balticconnector gas pipeline routing by route are presented in the table (Table 7-8). Traffic volumes in the coastal routes A, B and C are rather low. On the other hand, the vessels using these routes are mostly pleasure boats, which are not required to be fitted with AIS, so the actual number of vessels in these routes is higher than the figures presented. *(Ramboll 2013)* According to a conservative estimate, vessel traffic volumes are anticipated to increase by around 4% *(Ramboll 2014a)*.

Table 7-8. Annual volume of vessel traffic on routes identified. Based on AIS data for 2012. *(Ramboll 2013a)*

| Route | Number of crossings |
|---|---:|
| A | 350 |
| B | 450 |
| C | 250 |
| D | 1 200 |
| E | 1 800 |
| F | 12 500 |
| G | 11 900 |
| H | 1 350 |
| I | 3 150 |
| J | 650 |

The breakdown of vessels by type is given in the table (Table 7-9) for each route. Most of the vessels traveling in routes A, B and C (category "Other vessels") are pleasure boats. For route C vessels in the "Other vessels" category also include patrol and rescue vessels. Cargo and container ships are the dominant type of vessel in routes D, F, G and H. Route E north of the TSS is mainly used by Finnish and Swedish passenger ferries. The breakdown of vessels crossing the Gulf of Finland by length (Table 7-10) illustrates the size of vessels found on the routes. *(Ramboll 2013a)*

Table 7-9. Breakdown of vessels by type on routes identified. Based on AIS data for 2012. *(Ramboll 2013a)*

| Route | Passenger ship | Cargo ship | Tanker | Other vessels |
|---|---|---|---|---|
| A | 0.4% | 1.6% | 1.6% | 96.4% |
| B | 3.7% | 9.5% | 1.2% | 85.7% |
| C | 0.6% | 5.3% | 0.0% | 94.1% |
| D | 1.7% | 75.4% | 3.9% | 19.0% |
| E | 67.4% | 27.0% | 0.7% | 4.9% |
| F | 6.0% | 63.3% | 29.4% | 1.3% |
| G | 5.8% | 63.1% | 29.8% | 1.3% |
| H | 0.0% | 95.0% | 1.9% | 3.1% |
| I | 34.6% | 27.8% | 20.1% | 17.6% |
| J | 0.2% | 35.1% | 32.6% | 32.1% |

Table 7-10. Breakdown of vessels by length on routes identified. Based on AIS data for 2012. *(Ramboll 2013a)*

| Route | 0-25 | 25-50 | 50-75 | 75-100 | 100-125 | 125-150 | 150-175 | 175-200 | 200-225 | >225 |
|---|---|---|---|---|---|---|---|---|---|---|
| A | 90.1% | 5.7% | 3.2% | 0.7% | 0.0% | 0.0% | 0.4% | 0.0% | 0.0% | 0.0% |
| B | 81.9% | 10.8% | 2.3% | 4.8% | 0.0% | 0.0% | 0.3% | 0.0% | 0.0% | 0.0% |
| C | 92.3% | 6.1% | 1.7% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| D | 4.6% | 11.0% | 32.5% | 31.1% | 8.3% | 5.7% | 3.5% | 3.1% | 0.3% | 0.0% |
| E | 1.9% | 2.3% | 2.8% | 9.3% | 4.8% | 1.7% | 20.1% | 25.7% | 30.4% | 1.1% |
| F | 1.1% | 0.5% | 0.9% | 15.5% | 14.0% | 18.2% | 15.9% | 15.6% | 7.1% | 11.1% |
| G | 1.1% | 0.5% | 0.9% | 15.1% | 13.9% | 18.0% | 16.3% | 15.5% | 7.5% | 11.1% |
| H | 2.3% | 1.5% | 4.2% | 61.5% | 13.7% | 15.4% | 0.6% | 0.2% | 0.0% | 0.6% |
| I | 10.4% | 5.4% | 7.0% | 25.2% | 7.2% | 5.2% | 2.5% | 19.2% | 12.1% | 5.8% |
| J | 14.6% | 20.1% | 9.8% | 41.5% | 2.7% | 8.3% | 1.9% | 0.7% | 0.5% | 0.0% |

### 7.5.2 Ingå

#### Maritime traffic

The Ingå fairway leading to Ingå runs in part parallel to and in part crosses the Balticconnector pipeline route. The fairway is 13 m deep and around 34 km long. In Ingå the fairway passes through a restricted area of the Finnish Defence Forces. *(Finnish Transport Agency 2013)*

The Inkoo Shipping harbor, a privately owned and public commercial harbor, lies west of the planned Finnish landfall alternatives of the Balticconnector pipeline. The harbor operates exclusively in tramp vessel services, with no regular liner shipping taking place. *(Inkoo Shipping 2014)* A total of 354 vessels arrived at the port in 2013 *(Finnish Port Association 2013)*. The port is kept open throughout the year.

West of the landfill sites there is the Fortum harbor that used to receive coal, oil and limestone. Around 120 vessels visited the harbor in 2005–2006 *(Western Finland Environmental Permit Authority 2008)*, but production at the Fortum Ingå coal power plant ended in February 2014. There is a Rudus Oy rock extraction site toward the west in Joddböle, Ingå. A total of around 400,500 tonnes of rock is transported from the area each year, mainly to Estonia. The transport takes place by ship and barge. The number of shipments from the area is around 175 vessels a year, with the average cargo size being around 2,300 tonnes. The shipments depart from the Inkoo Shipping port. *(Pöyry Finland Oy 2013b)*

Located east of the project area, the Joddböle fishing harbor has berths for commercial fishers of the municipality as well as areas reserved for boating businesses and archipelago transport *(Ingå Marina Oy 2013)*. There are several commercial fishers operating in the Ingå archipelago as well as a large number of recreational fishers. Fishing is an important livelihood for many residents of the archipelago. The majority of the commercial fishers operate in the coastal areas, with only few fishing in the offshore areas.

The Ingå archipelago is a popular boating area and sees busy pleasure boat traffic in the summer. The coastal route from Helsinki to Hanko is one of the busiest waterways in Finland, with the number of boats often reaching thousands a day in summer weekends. There is no passenger ship traffic on the Ingå route.

The Barösund Strait is a highly popular and nationally significant waterway. The cultural landscape around the Bärösund Strait is an essential element in the navigation history of the Gulf of Finland. *(Municipality of Ingå 2012)*

There is a great deal of variation in ice conditions around the Gulf of Finland in Finland's territorial waters. In mild winters the Gulf of Finland remains free of ice cover around the year, but in very cold winters almost the entire Baltic Sea can freeze over. The ice conditions in the Ingå project area are easy in normal winters, with the Ingå fairway remaining open almost throughout the year. *(Ramboll 2013a)*

### Road traffic

The road traffic route to the vicinity of the project area to the Fjusö Peninsula passes via Ingå Strandvägen road (Main Road 51) via Hamnvägen road (road 186) and Oljehamnsvägen (road 1211). There is currently a road connection to the Fjusö area, which will need to be improved and/or a new road connection built for the LNG terminal project possibly implemented in the area. Road transport for the Balticconnector project could use the same road connections or, correspondingly, road improvement and/or construction will take place for the project.

Daily traffic volume on Ingå Strandvägen road in 2013 was around 4,500–5,700 vehicles, of which 310–350 were heavy-duty vehicles. Traffic volumes north of Hamnvägen road in 2013 totaled 1,071 vehicles a day. Of this, around 118 vehicles a day were heavy-duty ones. Daily traffic volume on Oljehamnsvägen road in 2013 totaled 26 vehicles, of which a few were heavy-duty vehicles. *(Finnish Transport Agency 2014)*

## 7.6 Air quality

### 7.6.1 Gulf of Finland

Emissions into the air from shipping are generated in the combustion process of fuel used in ship engines. Ship combustion processes produce nitrogen oxide ($NO_x$), sulfur dioxides ($SO_2$), particulate emissions and carbon dioxide ($CO_2$).

Baltic Sea shipping emissions into the air in 2012 are shown in the table (Table 7-11). Also shown in the table are emissions from Finnish waterborne traffic in the Exclusive Economic Zone of Finland in 2011 (international traffic, domestic traffic). As regards total transport emissions in Finland, waterborne traffic is the largest contributor of sulfur dioxide emissions (94% of the total of sulfur dioxide emissions) and the second-largest contributor of other compounds (49% of the total of nitrogen oxide, 36% of the total of particulate and 36% of the total of carbon dioxide emissions from transport). Cargo ships generate considerably higher sulfur dioxide and nitrogen oxide emissions than passenger vessels. *(VTT 2012)*

Global limits on shipping emissions are in place under the MARPOL Convention. These controls are more stringent than in global traffic in the sulfur emission control areas (SECAs). In Northern Europe a SECA is formed by the Baltic Sea, North Sea and the English Channel. The reformed air pollution annex of the MARPOL Convention entered into force internationally on July 1, 2010, reducing the maximum sulfur content of marine fuels in the SECA from 1.5% to 1%. A further reduction in fuel sulfur content takes effect in 2015, taking the limit down to a maximum of 0.1%. *(Finnish Shipowners' Association 2014)*

Nitrogen oxide emissions from shipping will be restricted gradually in accordance with the air pollution annex of the MARPOL Convention. The revised Annex VI contains the global requirement that marine diesel engines installed on a ship constructed on or after January 1, 2011 must achieve a 15% reduction in the level of nitrogen oxide (NOx) emissions compared with the legislation currently in force. It also issues regulations on the establishment of Nitrogen Oxide Emission Control Areas (NECA), requiring that vessels passing through NECAs constructed on or after January 1, 2016 must emit 80% less nitrogen oxides in comparison with the current situation. Furthermore, vessels constructed on or after January 1, 1990 but before January 1, 2000, which have so far not been subject to regulation, must meet the current permitted level of nitrogen dioxide emissions (*Ramboll 2013a*).

Efforts are being made to reduce particulate emissions from shipping by lowering the sulfur content of fuels *(Finnish Shipowners' Association 2014)*. In the Baltic Sea shipping emissions into the air were cut in 2012 from the level seen the year earlier. As regards large ships, the reduction in emissions of nitrogen oxides was 5.7%, sulfur oxides 5.5%, fine particulate matter 5.3% and carbon dioxide 5.5%. There has been a steady decrease in particulate and sulfur emissions from shipping since 2010 due to the stricter emission limits under the MARPOL Convention in the SECAs and the EU Sulfur Directive, which sets the fuel sulfur content limit of 1% during voyages and 0.1% while at berth in ports. (*Jalkanen et all. 2013*)

The quality of air near the area affected by the project is good as regards human health. The average monthly nitrogen dioxide ($NO_2$) levels at the coastal measurement station of Lahemaa, Estonia, were in the 1.5–7 μ/m³ range in 2010. The annual mean guideline air quality value for nitrogen dioxide is 40 μ/m³. Nitrogen oxide emissions from shipping are a major contributor towards the eutrophication of the Baltic Sea. It has been estimated that in 2007 more than 6% of the total nitrogen concentration of the Baltic Sea was produced by shipping (*Ramboll 2013a*).

Table 7-11. Emissions into the air from Baltic Sea shipping and Finnish waterborne traffic (tonnes per year) (*VTT 2012, Jalkanen et al. 2013)*

| | Nitrogen oxides | Sulfur dioxide | Particulate matter | Carbon dioxide |
|---|---|---|---|---|
| | t | t | t | t |
| Baltic Sea (in 2012) | 370 000 | 84 000 | 23 000 | 19 000 000 |
| Finnish EEZ (in 2011) | 45 000 | 8 000 | 1 000 | 3 000 000 |

### 7.6.2 Ingå

Air emissions from the Municipality of Ingå in 2011 are shown in the table below (Table 7–12). At that time there was only one significant individual source of emissions, the 1,000 MW Ingå power plant of Fortum Power and Heat Oy. Annual emissions from energy production depended decisively on the operations of the power plant. In 2011 energy production was the largest source of nitrogen oxide, particulate and sulfur dioxide emissions in Ingå. Car traffic was the biggest source of carbon monoxide emissions and a significant source of volatile organic compounds (VOC). The combustion of wood accounted for a significant share of VOC emissions (47%). The table (Table 7–12) presents emissions from energy production and car traffic from 2011, but the emission figures for wood combustion and oil heating are from 2010. *(Aarnio et al. 2012)*

The most significant single source of emissions in the Municipality of Ingå, the Ingå power plant, was decommissioned in early 2014. Following this, air quality in the project area is mainly affected by rock extraction and crushing carried out by Rudus Oy and the operations of the Inkoo Shipping port. Rock extraction carried out near the compressor station mainly generates dust emissions from blasting and crushing as well as related movement of materials.

In Ingå air quality is monitored at one measurement station, located around 0.5 km from the center of Ingå. The station measures sulfur dioxide and nitrogen dioxide concentrations. *(Finnish Meteorological Institute 2014)*

Air quality in Ingå was relatively good in 2011. It can be assessed on the basis of measurements carried out in the Uusimaa region that the concentrations of nitrogen dioxide, respirable particulate matter and fine particulate matter are below the limit values. In residential areas with homes using firewood there may be occasional high concentrations of particulate matter and polyaromatic hydrocarbons. Fine particulate matter levels are affected considerably by long-range transport of pollutants, although the level and duration of these varies from year to year. It can be assessed on the basis of ozone concentrations measured in the Uusimaa region that the long-term thresholds set for health and vegetation protection were exceeded in Ingå. The average concentrations in 2011 were higher than the year earlier. The occurrence of long-range transport situations was also up slightly on the year before. *(Aarnio et al. 2012)*

Air pollution in the Municipality of Ingå was studied using lichen as an indicator in 2009. The clearest changes in lichen species were limited to the northern parts of the municipality and the vicinity of industrial facilities close to the central locality of Ingå. Air pollution load elsewhere in the municipality can be regarded as quite low on the basis of changes in lichen. *(Aarnio et al. 2012)*

## 7.7 Flora, fauna and protected sites

### 7.7.1 Gulf of Finland

The Baltic Sea is a young, shallow and brackish sea with cohabiting freshwater and marine species (*Finnish Environment Institute et al. 2014*). Water in the Baltic is strongly stratified due to the halocline and, in the summer, also the thermocline, with the differences between the biotic communities of the various layers in places being quite large. The species composition and ecosystem of the Baltic Sea is also affected by the slow exchange of water and the fact that at least part of the Baltic freezes over in the winter. Although the number of plant and animal species in the Baltic is low, the numbers of individuals of a species can be high. The highest abundance of freshwater species can be found in river estuaries and innermost sections of bays and inlets. Only few actual brackish-water species occur in the Baltic Sea. Due to the low salinity and low temperature, many species are smaller in the Baltic than in oceans. The low species diversity results in short food chains, making the Baltic sensitive to changes in species composition and introduction of non-indigenous species.

The Gulf of Finland is the easternmost arm of the Baltic Sea. Flowing to the eastern end of the Gulf of Finland, the Neva River is the largest river flowing into the Baltic. On the Finnish side, the northern coast of the Gulf of Finland is composed of a maze-like archipelago, shallow waters of a variety in depths as well as exposed

Table 7–12. Annual emissions in Ingå *(Aarnio et al. 2012)*.

| | Nitrogen oxides | Particulate matter | Sulfur dioxide | * Carbon monoxide | VOCs |
|---|---|---|---|---|---|
| | t/a | t/a | t/a | t/a | t/a |
| **Energy production** | 1 624 | 81 | 1 423 | 58 | 33 |
| **Car traffic** | 69 | 4 | 0.1 | 281 | 27 |
| **Port** | 13 | | 0.9 | | |
| **Wood combustion** | 10 | 25 | | | 55 |
| **Oil heating** | 3 | 0.1 | 2 | | 0.2 |
| **Total** | **1 719** | **110** | **1 426** | **339** | **116** |

granite bedrock. The southern coast on the Estonian side is characterized by limestone cliffs, a few islands and deeper waters. Due to the differences between the coastal areas, there are also differences in their plant and animal species composition and communities.

#### 7.7.1.1 Bird fauna

With a multitude of islands and islets as well as plenty of eutrophic bays and inlets and sandy beaches, the Gulf of Finland is an important nesting area for many bird species in the Baltic Sea area. The area is of significance to nesting aquatic and shore birds in particular but also to some species of birds of prey and passerines. As a bird-nesting environment, the Gulf of Finland is characterized by its barrenness. The coastal bays and inlets and shallow inner archipelago offer nutrient-rich habitats, but the islands and islets of the outer archipelago are barren. Therefore the Gulf of Finland is also an appropriate nesting area for many nesting species of the northern tundra, such as Barnacle Goose (*Branta leucopsis*), Common Eider (*Somateria mollissima*), Scaup (*Aythya marila*), Ringed Plover (*Charadrius hiaticula*) and Arctic Tern (*Sterna paradisaea*). On the other hand, some species of oligotrophic inland waters, such as Goosander (*Mergus merganser)* and Red-breasted Merganser *(Mergus serrator)*, Common, Herring and Lesser Black-backed Gull (*Larus canus, L. argentatus* and *L. fuscus*), Common Tern (*Sterna hirundo*) and Common Sandpiper (*Actitis hypoleucos*) are also common in the outer archipelago. Some passerine birds of mires and open habitats, such as Meadow Pipit (*Anthus pratensis),* White Wagtail (*Motacilla alba*) and Wheatear (*Oenanthe oenanthe*) commonly nest in the archipelago of the Gulf of Finland. Consequently, the nesting bird population of the Baltic Sea and, subsequently, that of the Gulf of Finland is a mixture of species representing many different zoogeographical areas and habitats (see also *Hildén & Hario 1993*).

There are clear differences between the nesting species of the coastal, inner and outer archipelagos. There are around 30 type species of the outer archipelago among the species breeding in the Gulf of Finland (Table 7-13). In this context a 'type species' means a species with its primary or otherwise important Finnish habitat found in the outer archipelago (see also *Väisänen et al. 1998*). The closer the area is to the coast and the larger and more wooded the islands are, the more continental the bird species composition becomes. There has been an increase in the populations of archipelago birds at a general level over the past decades (e.g. *Biodiversity 2013*). Among the most successful archipelago birds recently in the Gulf of Finland are Mute Swan (*Cygnus olor*), Barnacle Goose, Great Cormorant (*Phalacrocorax carbo*) and White-tailed Eagle (*Haliaeetus albicilla*) (*Hario & Rintala 2014, Rusanen et al. 2012, Stjernberg et al. 2013*).

There are seven species nesting in the Gulf of Finland that are classified in Finland as threatened (Table 7-13) and five that are included in Annex I to the Birds Directive of the EU. Velvet Scoter (*Melanitta fusca*) is the only species of bird breeding in the Gulf of Finland classified as threatened by the International Union for Conservation of Nature (IUCN), with is classification being Endangered (EN). Also occurring in the Gulf of Finland during migration periods and in the winter are Long-tailed Duck (*Clangula hyemalis*) and Steller's Eider (*Polysticta stelleri*), both of which are internationally classified as Vulnerable (VU). Special mention is deserved by the nominate subspecies of Lesser Black-backed Gull (*Larus fuscus fuscus)* almost endemic to the Baltic Sea area which, in addition to the Baltic Sea, also nests in inland areas of Finland and Russia all the way to the White Sea.

Table 7-13. Type species of the Gulf of Finland, their IUCN status in Finland and assessment of recent population development in Finnish archipelago (*Hario & Rintala 2014, Rusanen et al. 2012, Stjernberg et al. 2013*) or Finland on the whole (*Valkama et al. 2011, Väisänen & Lehikoinen 2013*). EN = Endangered, VU = Vulnerable, NT = Near Threatened, EU = species listed in Annex I to EU Birds Directive. + = increase in breeding population; - = decline in breeding population; 0 = stable breeding population.

| Species | IUCN status | Development | Species | IUCN status | Development |
|---|---|---|---|---|---|
| Mute Swan (*Cygnus olor*) | | + | Ruddy Turnstone (*Arenaria interpres*) | VU | - |
| Greylag Goose (*Anser anser*) | | + | Arctic Jaeger (*Stercorarius parasiticus*) | | + |
| Barnacle Goose (*Branta leucopsis*) | EU | + | Black-headed Gull (*Larus ridibundus*) | NT | 0 |
| Canada Goose (*B. canadensis*) | | + | Common Gull (*L. canus*) | | + |
| Common Shelduck (*Tadorna tadorna*) | VU | + | Herring Gull (*L. argentatus*) | | - |
| Tufted Duck (*Aythya fuligula*) | VU | - | Lesser Black-backed Gull (*L. fuscus fuscus*) | VU | - |
| Scaup (*A. marila*) | EN | - | Great Black-backed Gull (*L. marinus*) | | - |
| Common Eider (*Somateria mollissima*) | NT | - | Caspian Tern (*Hydroprogne caspia*) | NT, EU | 0 |
| Velvet Scoter (*Melanitta fusca*) | NT | - | Common Tern (*Sterna hirundo*) | EU | + |
| Red-breasted Merganser (*Mergus serrator*) | NT | - | Arctic Tern (*S. paradisaea*) | EU | + |
| Goosander (*M. merganser*) | NT | - | Razorbill (*Alca torda*) | | + |
| Great Cormorant (*Phalacrocorax carbo*) | | + | Black Guillemot (*Cepphus grylle*) | NT | - |
| White-tailed Eagle (*Haliaeetus albicilla*) | VU, EU | + | Rock Pipit (*Anthus petrosus*) | | + |
| Eurasian Oystercatcher (*Haematopus ostralegus*) | | + | Meadow Pipit (*A. pratensis*) | NT | - |
| Ringed Plover (*Charadrius hiaticula*) | | + | White Wagtail (*Motacilla alba*) | | 0 |
| Common Redshank (*Tringa totanus*) | | - | Wheatear (*Oenanthe oenanthe*) | VU | - |
| Common Sandpiper (*Actitis hypoleucos*) | NT | 0 | | | |

The Gulf of Finland is also an important area for migratory birds. Millions of aquatic and shore birds nesting in the Arctic tundra (Anseriformes, Gaviiformes, cormorants, waders and skuas) follow the coastline of the Gulf of Finland when migrating from their overwintering areas in Western Europe or the southern rim of the Baltic Sea to Russia and further to the northern tundra. For some species a significant proportion of the entire world population migrates through the area. Clearly the most abundant species are Barnacle Goose, Brent Goose (*Branta bernicla*), Long-tailed Duck and Common Scoter (*Melanitta nigra*) whose total daily numbers can exceptionally exceed 100,000 individuals (*Toivanen et al. 2014*). Other abundant migratory birds include Wigeon (*Anas penelope*), Velvet Scoter, Scaup, Red-throated Diver (*Gavia stellata*) and Black-throated Diver (*G. arctica*) and in some years Greater White-fronted Goose (*Anser albifrons*) and Tundra Bean Goose (*Anser fabalis rossicus*) (*Toivanen et al. 2014*).

The specific routes taken by migrating arctic birds over the Gulf of Finland vary from year to year depending on the weather conditions. Winds in particular play a role in the routes taken in relation to the shoreline. The time of the year also plays a role: in the spring the flyway of aquatic birds primarily passes along the northern edge of the Gulf of Finland, while in the autumn they often take a path across the offshore areas or along the Estonian coast (*Toivanen et al. 2014*). In the autumn and early winter a large number of aquatic birds, some of which are threatened or otherwise noteworthy species, rest and feed in the Gulf of Finland. In mild winters small numbers of aquatic birds may even attempt to overwinter in the area if the sea does not freeze over.

#### 7.7.1.2 Marine mammals

Three species of marine mammals inhabit the Gulf of Finland: the gray seal (*Halichoerus grypus*), the Baltic subspecies of the ringed seal (*Pusa hispida botnica*) and harbor porpoise (*Phocoena phocoena*). Small cetaceans and classified as Critically Endangered (CE), harbor porpoises are found infrequently in the Gulf of Finland (*Environmental administration 2013*). The occurrence of harbor porpoises in the Gulf of Finland was studied in the Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise (SAMBAH) project in 2011–2013 (www.sambah.org). During those two years, no harbor porpoises were observed in the Gulf of Finland, but they were found in southwestern parts of the Archipelago Sea. In the 2010 Red List of Finnish Species (*Rassi et al. 2010*) the harbor porpoise was classified as Regionally Extinct (RE), but in the Baltic Marine Environment Protection Commission (HELCOM) Red List the subpopulation (estimated 600 individuals) is the main basin of the Baltic Sea was classified as Critically Endangered (CE) (*HELCOM 2013, Environmental administration 2013*). The harbor porpoise is also included in the lists of species of Annexes II and IV of the EU Habitats Directive.

The gray sea populations have increased clearly in the Baltic Sea and also slightly in the Gulf of Finland (*e.g. HELCOM 2013, RKTL 2014a*). The counted Baltic Sea gray seal population in 2013 was around 30,000 individuals, of which around 15,000 were found in Finland and Estonia and approximately 500–1,000 in the Gulf of Finland (*Ahola 2014, RKTL 2014a*). Due to the strong population growth, the gray seal is no longer classified as threatened, and its current classification is Least Concern (LC). The gray seal is a game species in Finland. In Estonia it is not currently hunted and it is protected under the Nature Conservation Act (*HELCOM 2013*).

The population of the Baltic subspecies of the ringed seal is around 10,000 individuals (*RKTL 2012*). Around 75% of all of these are found in the Bothnian Bay and around 15% in eastern Gulf of Riga. The ringed sea population of the Archipelago Sea is estimated at 200–300 and eastern Gulf of Finland 50–150 individuals (*RKTL 2012, Ahola 2014*). Of the ringed seals found in the Gulf of Finland, most breed on the Russian side where the ice situation is more favorable during the pupping period. The Gulf of Finland population has undergone a strong decrease (*Kunnasranta 2010*). The ringed seal is a game species in Finland, but no hunting permits have been granted since 1988. In Estonia the ringed seal is protected under the Nature Conservation Act (*HELCOM 2013*). In the Red List of Finnish Species the ringed seal is classified as Near Threatened (NT), while the HELCOM Red List classifies the subspecies as Vulnerable (VU) (*Rassi et al. 2010, HELCOM 2013*) and the Estonian Red List as Endangered (EN) (*Red Data Book of Estonia 2008*).

The gray seal and the Baltic subspecies of the ringed seal are both included in the lists of species of Annexes II and V of the EU Habitats Directive. Annex II lists those species that require designation of special areas of conservation (Natura 2000 sites). The species covered by Annex V are those whose taking from the wild (hunting, collecting, etc.) requires regulation.

The most demanding period during the annual cycle of gray seals and ringed seals is the spring. They give birth in February–March onto sea ice or an islet (only gray seals). The nursing period is 5–7 weeks, after which the pups are weaned by the mothers. After the pupping period the seals undergo molting, which among ringed seals mainly takes place in April–May and among gray seals in May–June. During the pupping and molting periods seals are relatively immobile, mainly remaining on dry land while molting. Ringed seals show reasonably high place fidelity, while gray seals can move long distances depending on the season. In the summer and autumn gray seals disperse over extensive areas when looking for good feeding grounds, including offshore areas and sites further down south. *(RKTL 2012)*

#### 7.7.1.3 Nature reserves

Most of the nature reserves in the archipelago areas of the Gulf of Finland on the Finnish side were established in the 1920s and 1930s. In the 1980s three national parks were established in coastal areas: Eastern Gulf of Finland National Park in 1982, Archipelago National Park in 1983 and Ekenäs Archipelago National Park in 1989. The international and national objective has been to establish an ecologically coherent network of nature reserves in coastal and marine areas (*Finnish Environment Institute et al. 2014*). The first small nature reserves were established in Estonia in the 1910s and 1920s. Located on the northern coast of Estonia, the Lahemaa National Park was established in 1971. The coastal and marine areas of significance to archipelago nature, bird fauna and natural underwater environment are in both countries included in the Natura network. In some of the Natura sites the protection has been implemented through the establishment of nature reserves, but nature values can also be protected through other means.

A key role for the protection of the Baltic Sea is played by cooperation between the coastal states (*Finnish Environment Institute et al. 2014*). Finland and Estonia are also parties to several international agreements concerning the Baltic Sea. An agreement that has been of international significance is the Convention on the Protection of the Marine Environment of the Baltic Sea (the Helsinki Convention), which, following a reform, entered into force in 2000. The convention's implementation is governed by the Baltic Marine Environment Protection Commission (HELCOM), where the Baltic rim states cooperate with the European Commission. In 2009 the EU adopted the Strategy for the Baltic Region, and the implementation of its environmental aspects is sought under the Baltic Sea Action Plan adopted by HELCOM. The most significant marine and coastal areas from the conservation perspective are included in the HELCOM Marine Protected Areas (MPAs) (formerly Baltic Sea Protected Areas, BSPAs). Some HELCOM MPAs are also located on Russian territory in the eastern part of the Gulf of Finland.

### 7.7.2 Ingå

The project area is located in Finland in the hemiboreal zone and the Uusimaa biogeographical province (*OIVA service 2014*). Of the planned natural gas pipeline and related operations, only the compressor station and an onshore section of around 1 km in length will be located on the shore. The remainder is an offshore pipeline running via the Ingå archipelago to the offshore area.

The archipelago and marine area off Ingå is divided in the classification under the Water Framework Directive into southwestern inner archipelago and southwestern outer archipelago, with the border between these located at the island of Stora Fagerö (*OIVA service 2014*). In terms of plant geography, the archipelago has traditionally been divided into the mainland littoral zone, inner archipelago, outer archipelago and marine zone (*Häyrén 1948*). The beginning of the offshore section of the natural gas pipeline will pass through the mainland littoral zone and inner archipelago, which generally consist of large forested islands and sheltered waters. The majority of the offshore pipeline will be located in the outer archipelago and marine zone where islands are small and increasingly scarce. There are mainly treeless rocky islets and stone banks in the marine zone.

The Ingå archipelago is part of the western Uusimaa archipelago between Porkkala and Hankoniemi. There are several Natura 2000 sites in the western Uusimaa archipelago, of which the largest ones are archipelago and marine habitat types with significant nature values (section 7.7.2.1). These are valuable particularly from the perspectives of the protection of archipelago habitat types as well as seals, and birds migrating via these areas. The nature values of the archipelago area were already protected before the Natura network under national conservation programs, and several parts of the area have been established as areas of conservation. The main parts of the archipelago area are included in the Marine Protected Areas (MPAs) of the Baltic Marine Environment Protection Commission (HELCOM) and the list of Ramsar sites under the Convention on Wetlands in International Importance. The area belongs to Finland's Important Bird and Biodiversity Areas (FINIBA) and in part also to the Important Bird and Biodiversity Areas (IBA) of Europe. The archipelago sees recreational use related to boating and other outdoor recreation in particular. The construction of the planned natural gas

Table 7-14. Natura 2000 sites in the vicinity of the planned gas pipeline.

| Natura 2000 site | Site type | Other conservation values | Area (ha) | Distance from natural gas pipeline (km) |
|---|---|---|---|---|
| Ingå archipelago (FI0100017) | SCI and SPA | FINIBA | 203 (land area 135 ha, water area 68 ha) | 0 |
| Älgsjölandet and Rövass herb-rich forests (FI0100016) | SCI | Herb-Rich Forest Conservation Program | 23 | 4,5 |
| Kirkkonummi archipelago (FI0100026 and FI0100105) | SCI and SPA | HELCOM MPA, IBA (in most parts), Shore Conservation Program | 1 750 (SCI) and<br>14 234 (SPA) | 8 |
| Ekenäs and Hanko archipelago as well as Pojo Bay marine conservation site (FI0100005) | SCI and SPA | HELCOM MPA, Ramsar, IBA (in parts) and FINIBA (in most parts), national park (in parts), Shore, Waterfowl habitats, Herb-Rich Forest, Esker Conservation Programs (in small parts) | 52 630 | 9 |
| Kallbådan islets and waters (FI0100089) | SCI | Seal conservation area | 1 520 | 10 |
| Hanko eastern offshore area | SCI | HELCOM MPA | 11098 | 25 |

Ramsar = site protected under the Convention on Wetlands of International Importance. http://www.ramsar.org/

HELCOM MPA = Marine Protected Area of the Baltic Marine Environmental Commission (HELCOM). http://helcom.fi/action-areas/marine-protected-areas.

IBA = Important Bird and Biodiversity Area. International program of BirdLife International for the identification and conservation of sites important for bird populations. http://www.birdlife.org

FINIBA = Finnish Important Bird and Biodiversity Area. Project implemented by the Finnish Environment Institute and BirdLife Finland to map out and monitor important bird areas http://www.birdlife.fi/iba/

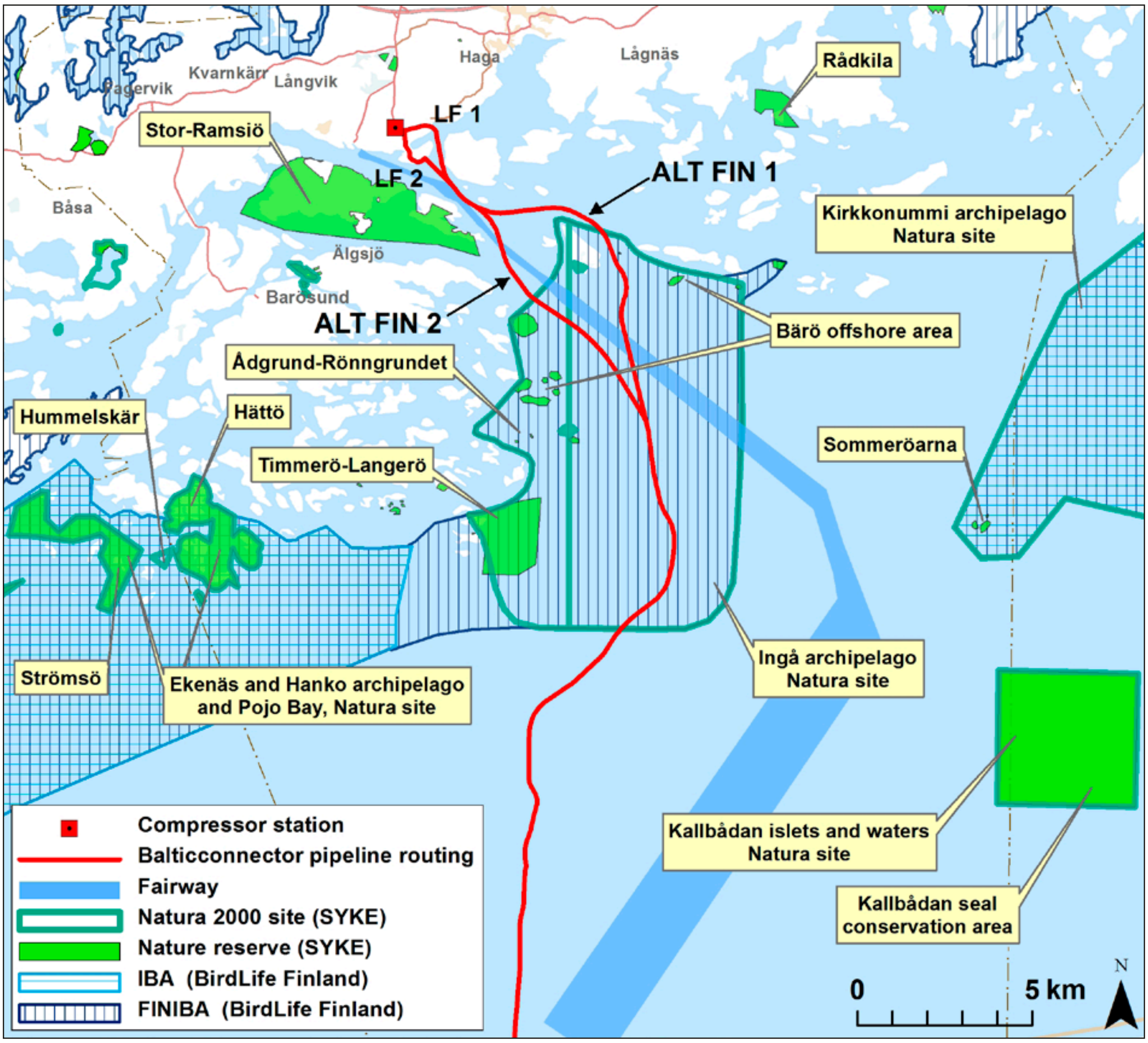



Figure 7-33. Natura 2000 sites, nature reserves and other important natural sites in the vicinity of the gas pipeline.

pipeline will apply to a small section of the archipelago that is large in area. According to the management plan of the eastern archipelago of Ekenäs and Hanko (*Metsähallitus 2012*), the Western Uusimaa archipelago area is shallow, maze-like and prone to eutrophication. Other factors posing a threat to the natural environment of the area include oil spills and environmental toxins. The environmental status and nature values of the area have a significant impact of its recreational values.

### 7.7.2.1 Natura 2000 sites

The offshore section of the natural gas pipeline will run over a section totaling around 12 km in length in an areas where there are islands and islets included in the Ingå archipelago Natura site (Figure 7-33). The waters within the Natura site borders are not included in the Natura site excluding the waters of the Timmerö nature reserve located in the northwestern part of the site around 3 km from the pipeline route. This means neither of the natural gas pipeline routing alternatives will pass through a land or water area of a Natura site. There are also four other Natura 2000 sites on Finnish territory within less than 10 km from the planned gas pipeline (Figure 7-33, Table 7-14). Three of these are archipelago and marine areas located 8–10 km from the natural gas pipeline. Furthermore, the Älgsjölandet and Rövass herb-rich forest Natura site is located a little under 5 km west of the natural gas pipeline. The Natura site descriptions and information about other conservation values of the Natura sites based on data from the Uusimaa Centre for Economic Development, Transport and the Environment (*2014)* are provided below.

Table 7-15. Habitat types motivating the site's designation as a Natura site.

| Habitat type | Share of area (%) |
|---|---|
| Sandbanks which are slightly covered by sea water all the time (1110) | <1 |
| Reefs (1170) | 1 |
| Annual vegetation of drift lines (1210) | 2 |
| Perennial vegetation of stony banks (1220) | 1 |
| Vegetated sea cliffs of the Atlantic and Baltic coasts (1230) | 4 |
| Baltic esker islands (1610) | 29 |
| Boreal Baltic islets and small islands (1620) | 15 |
| *Boreal Baltic coastal meadows (1630) | 1 |
| Boreal Baltic sandy beaches (1640) | <1 |
| *Fennoscandian lowland species-rich dry to mesic grasslands (6270) | <1 |
| *Western taiga (9010) | 1 |
| *Fennoscandian deciduous swamp woods (9080) | <1 |

*Priority natural habitat type

### Ingå archipelago

The Ingå archipelago Natura site (FI0100017, SCI and SPA) covers the land areas within the site borders (135 ha), excluding Påvskär (Hovskär), southwestern Stora Fagerö, and Fagerögrunden. Of the waters, only the Timmerö nature reserve waters (68 ha) in the southwestern section of the Natura site around 3 km from the planned natural gas pipeline, are included in the Natura site. The Natura site implementation method in around nature reserves is statutory land use planning.

The Ingå archipelago Natura site is significant for birds in particular. Species breeding in the area include Caspian Tern, Black Guillemot (*Cepphus grylle*), Lesser Black-backed Gull, Ruddy Turnstone and a large number of Common and Arctic Terns as well as a significant Gray Heron (*Ardea cinerea*) population. Gray seals are found in the southeastern part of the Natura site near Hästen. The habitat types specified in the table (Table 7-15) form the basis of designation of the site as a Natura site. In addition to habitat types, the site is protected under Annex I of the Birds Directive as it is a habitat of Common Tern, Arctic Tern, Red-backed Shrike (*Lanius collurio*), Caspian Tern and one threatened species under strict protection as well as the migratory species Gray Heron, Gadwall (*Anas strepera*), Ruddy Turnstone (*Arenaria interpres*), Eurasean Hobby (*Falco subbuteo*), Velvet Scoter and Common Red-shank (*Tringa totanus*).

The islands and islets of the Natura site are rocky, excluding the esker island of Stora Fagerö. The Barö offshore nature reserve (YSA010484), consisting of several small islands and islets is located in the northwestern and western part of the Natura site, of the islands of which Stengrundet is located less than 200 m from the ALT FIN 1 alternative and Ytterharun around 500 m from the ALT FIN 2. In addition, in the western part of the Natura site the nature reserves of Timmerö-Langerö (YSA014152) and Ådgrund-Rönngrundet (YSA011646) are located around 3 km from the planned natural gas pipeline. Small islands located outside nature reserves but designated as protected areas in the partial local master plan of the outer archipelago of Ingå are Låggrundet, located around 350 m from ALT FIN 1, Abborpinnarna islets, located around 230 m from ALT FIN 1, and Änkan, located less than 500 m away.

The Ingå archipelago is part of the extensive set of sites in the Western Gulf of Finland archipelago classified as Finnish Important Bird and Biodiversity Areas (FINIBA) (*Leivo et al. 2001*, section 7.7.2.3).

### Älgsjölandet and Rövass herb-rich forests

The Älgsjölandet and Rövass herb-rich forests (FI0100016, SCI) Natura site includes valuable herb-rich forests with broadleaved deciduous trees and wooded pastures in the sheltered inner archipelago of Ingå in western parts of the island of Älgsjölandet and northern parts of the island of Orslandet. Consisting of several sub-sites close to each other, the site is included in the national Herb-Rich Forest Conservation Program sites of Älgsjölandet oak woods (LHO010081) and Rövass herb-rich forests with broadleaved deciduous trees (LHO010080). The majority of the site is already protected as the Älgsjölandet oak woods (YSA013393) and Rövass herb-rich forest (YSA201147) nature reserves. The natural gas pipeline route would run around 4.5 km the Natura site northeast of Älgsjölandet.

### Kirkkonummi archipelago

The Kirkkonummi archipelago Natura site (FI0100026, SCI and FI0100105, SPA) is a zone around the Kirkkonummi coast extending in the west to Sommarn, Ingå, and in the east almost to the border of Espoo. Of the SCI waters, only the nature reserve and Sommarn waters are included in the Natura site. The area is important for the conservation of archipelago habitat types and several species of bird. The area is protected due to its fifteen Habitats Directive habitat types, several Birds Directive species and migratory species.

Located closest to the planned gas pipeline at around 8.5 km from the route is the Sommaröarna nature reserve (YSA011088). The waters surrounding the islands (around 275 ha) are an important bird feeding area and also likely to have a high degree of representativity of the natural habitat type on the site. The waters extend to an area around 8 km from the planned gas pipeline. The Porkkala archipelago nature reserve (ESA010041) is around 14.5 km from the planned gas pipeline.

The Kirkkonummi archipelago belongs to the HELCOM MPA network and FINIBAs (*Leivo et al. 2001*, section 7.7.2.3). The border of the IBA in the west is the same as the Natural site border, and the natural gas pipeline would pass west of the area at a distance of around 8 km.

#### Ekenäs and Hanko archipelago and Pojo Bay marine protected area

The Natura site of the Ekenäs and Hanko archipelago and Pojo Bay marine protected area (FI0100005, SCI and SPA) covers a complete series of marine, outer and inner archipelago zones and therefore represents all of the coastal areas in miniature. The numerous fladas and shallow bays and inlets are important breeding and resting grounds for birds. The objective in the extensive marine area is to protect the seabed, underwater natural environment and water quality. Almost 30 habitat types of the Habitats Directive, the gray seal and two other species of Annex II to the Habitats Directive as well as numerous Birds Directive species and migratory bird species are the grounds for the conservation of the area.

Located closest to the planned natural gas pipeline is the Nothamn-Strömsö-Hättö area in the eastern part of the site (land area 464 ha and water area 3,174 ha). It covers more than twenty largish islands belonging to the marine zone and a large number small outer archipelago islands protected as the Hättö (YSA010084), Hummelskär (YSA013635) and Strömsö (YSA012073) nature reserves.

The Natura sites and the areas near it are part of the FINIBA of Tammisaari-Ingå western archipelago (*Leivo et al. 2002*, section 7.7.2.3). The Natura site also belongs to the HELCOM MPA network and the list of Ramsar sites under the Convention on Wetlands in International Importance. Part of the Natura site belongs to the Ekenäs Archipelago National Park. The natural gas pipeline would be located around 9 km southwest and west of the Natura site. The IBA border is located around 4 km from the natural gas pipeline.

#### Kallbådan islets and waters

The Kallbådan islets and waters Natura site (FI0100089, SCI) is located in an offshore area southwest of Porkkala Peninsula and comprises mainly water areas. The Kallbådan lighthouse islet is located in the middle of the site, surrounded by several smaller islets and rocks. This Natura site is protected due to its *Boreal Baltic islets and small islands* habitat type and the gray seal, a species listed in Annex II to the Habitats Directive. Established under Government Decree on August 9, 2001, the Kallbådan seal conservation area (HYL010002) has borders equal to those of the Nature site borders. The natural gas pipeline would be located around 10 km west of the Natura site.

#### Hanko eastern offshore area

The Hanko eastern offshore area (FI0100107, SCI) is located in an offshore area off Hanko and Raseborg. Around 1,200 ha of the *Reefs* habitat type is found in the area. The site supplements the outermost sections of other sites in the Natura 2000 network and, together with these, forms an uninterrupted series of ecotones of the Reefs habitat type from the species-poor occurrences of the pelagic zone via the outer archipelago's bladderwrack zones to occurrences in the middle and inner archipelago. The area is proposed for inclusion in the HELCOM MPA network. The distance of the planned natural gas pipeline from the area is around 25 km.

### 7.7.2.2 Nature reserves

A total of eight nature reserves or sites protected as habitat types under the Nature Conservation Act but not included in the Natural network are located in marine areas and on islands less than 10 km from the planned natural gas pipeline (Figure 7–33, Table 7–16). The one closest to both of the routing alternatives and the compressor station is the Stor-Ramsiö nature reserve described below. The others are islands and groups of islands small in area as well as sandy beaches and coastal meadows. The nature reserves located on Natura sites are referred to in conjunction with the Natura site description in section 7.7.2.1. There are also three nature reserves or comparable sites on the mainland within 5 km from the project area.

#### Stor-Ramsiö nature reserve

The Stor-Ramsiö nature reserve (YSA014191) covers a part of the islands of Storramsjö and Jakobramsjö as well as the surrounding waters, including islands and islets. The area of the reserve is 928 ha. The features of the island of Storramsjö include unbuilt shores, sheep pastures, common alder (*Alnus glutinosa*) woods, spruce mires, springs and wetlands as well as small islets with bird colonies. Bird species breeding in the area include Osprey (*Pandion haliaetus)* and a colony of Black-headed Gulls (*Larus ridibundus*) and aquatic birds such as reat Crested Grebe (*Podiceps cristatus*), Mute Swan, Common Goldeneye (*Bucephala clangula*), Common Eider, Tufted Duck (*Aythya fuligula*)

Table 7-16. Nature reserves (YSA = private nature reserve, HYL = seal conservation area) and sites protected as habitat types under the Nature Conservation Act (LTA) in areas around the natural gas pipeline.

| Name of area | Distance (km) from the natural gas pipeline ALT FIN 1 / ALT FIN 2 |
|---|---|
| **In Natura 2000 sites on islands or in marine areas (within 10 km):** | |
| Barö offshore nature reserve (YSA010484) | 0.2/0.5 |
| Ådgrund-Rönngrundet nature reserve (YSA011646) | 3.2/3.0 |
| Timmerö-Langerö nature reserve (YSA014152) | 3.3 |
| Älgsjölandet oak woods nature reserve (YSA013393) | 4.5 |
| Rövass herb-rich forest nature reserve (YSA201147) | 4.8 |
| Sommaröarna nature reserve (YSA011088) | 8.5 |
| Hättö nature reserve (YSA010084) | 9.0 |
| Kallbådan seal conservation area (HYL010002) | 9.8 |
| **On islands or in marine areas outside Natura 2000 site (within 10 km):** | |
| Stor-Ramsiö nature reserve (YSA014191) | 0.6 |
| Lilla Lövö southern seashore meadow (LTA201077) | 4.8/3.5 |
| Rolling Stone (YSA203373) | 4.3/6.6 |
| Langlö northern seashore meadow (LTA010109) | 5.0 |
| Rådkila nature reserve (YSA010062) | 5.6/8.0 |
| Granö nature reserve (YSA202667) | 5.8/5.7 |
| Ärtrisharu sand beach (LTA201172) | 6.1/6.2 |
| Paradisöarna (Tiftöklobbarna and Högklobben) nature reserve (YSA014130) | 7.2/6.9 |
| **On the mainland outside Natura 2000 sites (within 5 km):** | |
| Stormossen old-growth area (to be established as a nature reserve) | 1.6 |
| Max damm (YSA203476) | 2.6/3.0 |
| Varsbergen hardwood forest (LTA010139) | 4.8 |

and Common Pochard (*A. ferina*). The nature reserve is located on the southern side of the Norrfjärden Bay around 500 m from the planned natural gas pipeline at its closest.

### 7.7.2.3 IBAs and FINIBAs

Internationally and nationally important bird and biodiversity areas are determined in the International Bird and Biodiversity Areas projects of BirdLife, the partnership for bird conservation and birds as a recreational activity. These areas may be important for birds for breeding, overwintering or migration. The BirdLife International Important Bird and Biodiversity Areas (IBA) program seeks to identify and protect globally important IBAs (*Leivo 2000*). The Finnish Important Bird Areas (FINIBA) project is an identification and monitoring project implemented in cooperation between the Finnish Environment Institute and BirdLife Finland and its member organizations (*Leivo et al. 2001*). The project has produced a nationwide networks of FINIBAs, which is not, however, an actual conservation program. Some of the FINIBAs are also IBAs, but they usually cover a larger area.

The Ingå archipelago, through which the planned natural gas pipeline will pass, belongs to the Western Gulf of Finland archipelago FINIBA (110129). The Western Gulf of Finland archipelago is an extensive (422,232 ha) set of areas (*Leivo et al. 2001*). It contains three IBAs, the nearest of which is the western archipelago of Ekenäs-Ingå, which at its nearest is 4 km from the planned natural gas pipeline to the west. The other two IBAs are located further into the west. There are 23 FINIBA criteria species in the Western Gulf of Finland archipelago, with most of these type species for the archipelago. Important breeding species include Common Shelduck (*Tadorna tadorna*), Common Eider, Velvet Scoter, Dunlin (*Calidris alpina schinzii*), Lesser Black-backed Gull, Caspian Tern, Little Tern (*Sternula albifrons*), Common Murre (*Uria aalge*) and Red-breasted Flycatcher (*Ficedula parva*).

Located east of the planned natural gas pipeline is the Kirkkonummi archipelago IBA (FI082), which is part of the Kirkkonummi-Espoo archipelago FINIBA (210248). The distance of the natural gas pipeline routing from the borders of these areas is around 8 km at its shortest. The area is an important breeding ground for species such as Lesser Black-Backed Gull and Caspian Tern. North of the Fjusö Peninsula at a distance of around 3 km is Lake Marsjö which, together with a few other lakes, belongs to the Karis lake area FINIBA (210257). These are breeding lakes for the Black-throated Diver.

#### 7.7.2.4 Fjusö Peninsula flora and fauna

**General features of the flora**

The onshore pipeline route alternatives and compressor station are located on a shore area east of the Port of Ingå on the Fjusö Peninsula and Bränseludd and Kohagen rock outcrop ranges. The area that is around 1 km³ is part of the area owned by the National Emergency Supply Agency. There is a road connection to the peninsula, but the area is fenced and access to the area is restricted.

According to the nature survey conducted for the LNG terminal (*Ympäristösuunnittelu Enviro Oy 2014*), the Fjusö Peninsula is a rocky peninsula with sparse Scots pine (*Pinus sylvestris)* woods on rocky terrain and Scots pine and Norway spruce (*Picea abies)* dominated heath forests. More mesic forest types can be found in small batches by the Sundviken Bay. The oldest forest compartments can be found in eastern parts of the Fjusö Peninsula. The southern shore of the peninsula is barren and rocky, but the Djupviken and Sundviken coves are sheltered. The coves have zones of common reed (*Phragmites australis*) ranging from a few meters to 20–30 m. Common alder (*Alnus glutinosa*) is found in many places close to the shore. Large hop trefoil (*Trifolium aureum*), classified as Near Threatened (NT) is found by the road passing through the Fjusö Peninsula (*Rassi et al. 2010*). Also found on the peninsula is lesser butterfly orchid (*Platanthera bifolia*), which is a protected species but not threatened or near threatened. Under the Nature Conservation Act (sections 43 and 48), it is prohibited to pick a protected plant species, but the protection does not preclude the use of land for farming, forestry or development.

The rock outcrops at Bränseludd and Kohagen are barren, and their vegetation is similar to that on the Fjusö Peninsula. The tops of the rock outcrops have extensive lichen cover and a lot of dead standing trees due to dry summers. Plants growing on the relatively steep western face of the Kohagen rock outcrop include wild pansy (*Viola tricolor*), sticky catchfly (*Lychnis viscaria*) and male fern (*Dryopteris filix-mas*). Rock campion (*Silene rupestris*) grows on top of Bränseludd. The areas outside the rock outcrops are mainly commercial forests with an overstory of Norway spruce and Scots pine. The western slope of Kohagen features mature spruce-dominated mesic heath forests and there are two herb-rich forest compartments that are spruce-dominated and have rather old trees. Small areas of moist tall herb meadows can be found on the northern shore and coastal slope of Sundviken.

Thinned *Betula* spp. dominated forests, spruce-dominated mixed forests and former meadows that have been or are being afforested can be found south of the Svartbäck pond. In the more open sections of the meadow southwest of the pond there is an abundance of wood cow-wheat (*Melampyrum nemorosum*), and on two small areas of exposed bedrock dry meadow species such as lady's bedstraw (*Galium verum*) and downy oat-grass (*Helictotrichon pubescens*). Lady's bedstraw is classified as Vulnerable (VU) (*Rassi et al. 2010*). The Svartbäck pond is surrounded by a dense bed of common reed that is around 30 in width. Separated by an embankment, the western end of the pond features common reed and broadleaf cattail (*Typha latifolia*).

**Valuable habitat types**

The best-preserved herb-rich forest compartments can according to a nature survey (*Ympäristösuunnittelu Enviro Oy 2014*) be regarded as locally valuable. These are the common alder forest on the western shore of Sundviken and the herb-rich forest areas north of Bränseludd rock outcrop area (Figure 7–34). These are described below. Other noteworthy sites include the small herb-rich forests of the southern and northern shore of Sundviken, the old-growth forest of Fjusö and the most barren rocky terrains of the area (Figure 7–34). The tops of rock outcrops and luxurious herb-rich forest patches can be interpreted as habitats of special importance under section 10 of the Forest Act.

The Sundviken herb-rich common alder forest is a small area between Sundviken and the Fjusö road. Its trees are younger than in other herb-rich common alder forests in the Sundviken coastal area but its vegetation is considerably more diverse. The dominant plant species is lady fern *(Athyrium filix-femina)*. The site is between a moist eutrophic herb-rich forest and a common alder swamp and likely to be a part of a more extensive swamp area covered due to landfilling operations. Both of the above-mentioned habitat types are classified as vulnerable in Southern Finland (*Raunio et al. 2008*). The site does not meet the criteria for common alder woods protected as a habitat type under section 29 of the Nature Conservation Act.

The southern sections of the herb-rich forests northeast of Bränseludd consist of a moist herb-rich fern forest with seepage springs and with small compartments of thin-peated rich spruce mires. The trees are mature Norway spruces and a few large common alders. The forest north of the herb-rich fern forest is a well-lighted forest dominated by *Betula* spp. with open patches. Its field layer has mesic herb-rich forest species, such as lesser butterfly orchid, as well as garden species. The center of the herb-rich forest north of Bränseludd consists of herb-rich fern forest and the edges of mesic herb-rich forest that towards the higher slope sections gradually turns via a herb-rich heath forest into a mesic heath forest. The trees are stout Norway spruces and large aspens (*Populus tremula)*. The area is kept moist by water seeping down the slope. The herb-rich forests of Bränseludd are mesic and moist mesotrophic herb-rich forests. Mesic mesotrophic herb-rich forests is a habitat type that is vulnerable

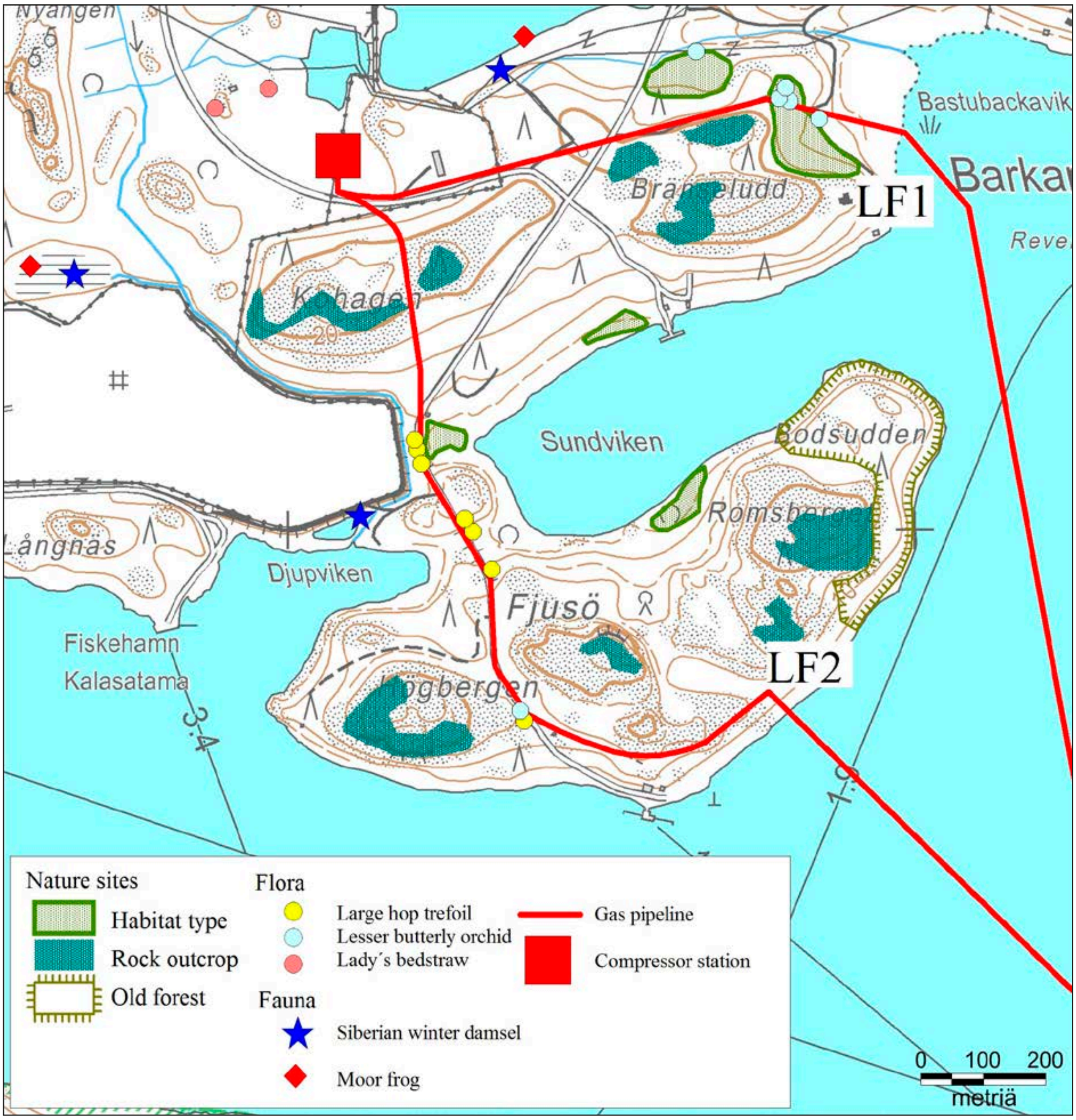



Figure 7–34. Locally valuable habitat types, sites of noteworthy plant species, and observation sites of moor frog (Rana arvalis) and Siberian winter damsel (Sympecma paedisca) on the Fjusö Peninsula (*Ympäristösuunnittelu Enviro Oy 2014 and Finventia 2013*).

in Southern Finland and moist mesotrophic herb-rich forests are a near threatened habitat type throughout Finland (*Raunio et al. 2008*).

The end of the natural gas pipelines and the compressor station will be located around 400 m from the Oxhagen forest area that has been regarded as a habitat with significant nature values in several nature surveys (*FCG Planeko Oy 2008, Ympäristötutkimus Yrjölä Oy 2012, Pöyry Finland Oy 2013a, Finventia 2013*). Around 20 ha in area, the forest area has small areas of mires, herb-rich forests and rock outcrops, with bird species of old forests occurring in the area.

#### Breeding birds

The Fjusö Peninsula and the nearby land area (Svartbäck) provide a diversity of habitats for birds. The area has habitats including very many types of forest, rocky and sandy beaches, built areas, a eutrophic pond, and reedbeds. Therefore there is also a diversity of breeding bird species, with 63 breeding species found in the inventory conducted in summer 2014

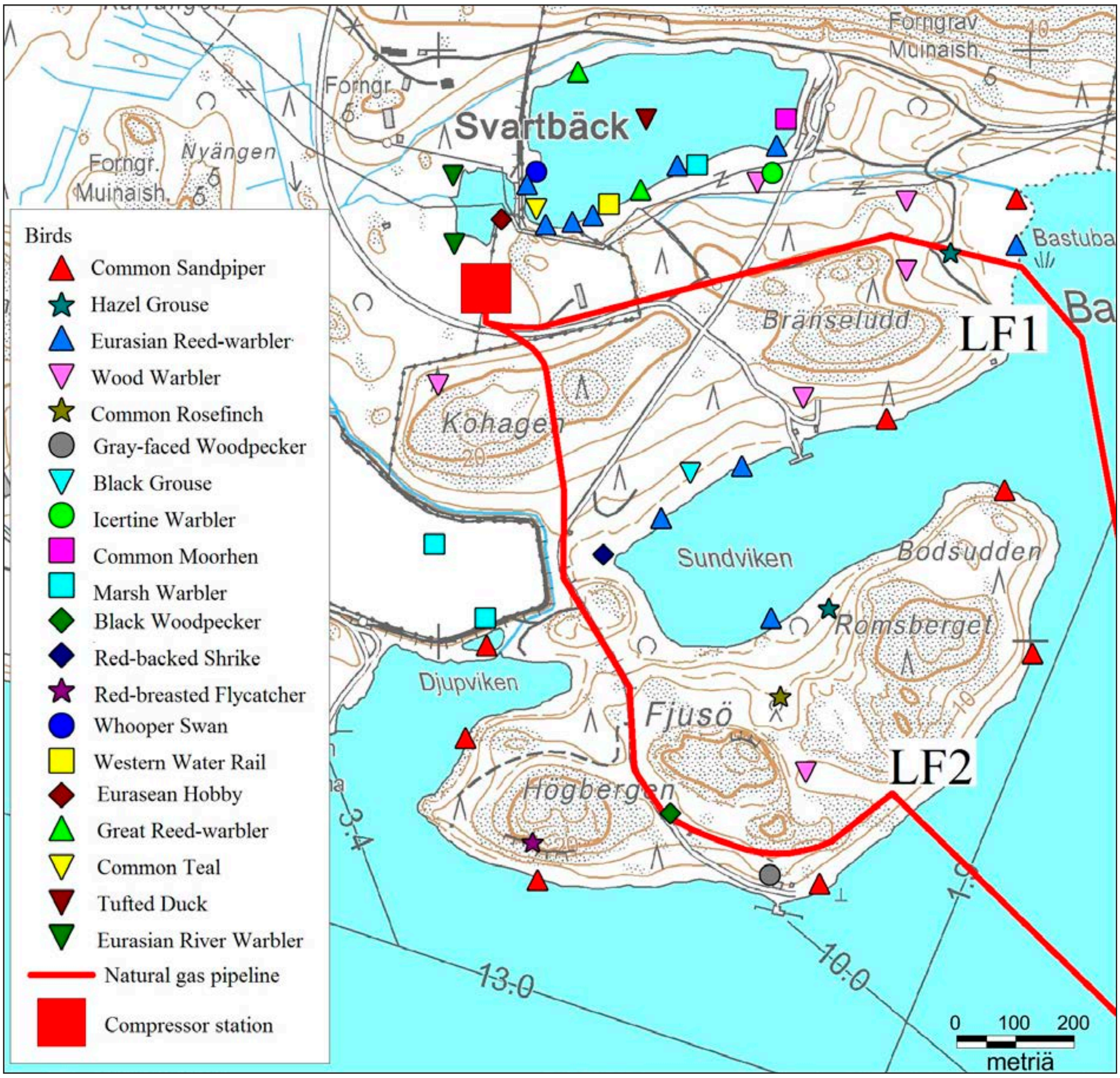



Figure 7-35. Noteworthy bird observations on the Fjusö Peninsula (*Ympäristösuunnittelu Enviro 2014*).

Figure 7-36. The islet of Fagerögrundet and Common Eiders on a rocky shore. (*Ramboll Oy 2013e*)

(*Ympäristösuunnittelu Enviro Oy 2014*). The number of species is high in relation to the size of the area (around 130 ha).

There are several breeding species that are noteworthy from the conservation perspective in the Fjusö and Svartbäck area (*Ympäristötutkimus Yrjölä Oy 2012, Ympäristösuunnittelu Enviro Oy 2014*). Species breeding in the area include five threatened species classified as Vulnerable (VU): Tufted Duck, Horned Grebe (*Podiceps auritus*), Common Moorhen (*Gallinula chloropus*), Wheatear and Great Reed-warbler (*Acrocephalus arundinaceus*). All these excluding Wheatear occur in the eutrophic pond at the northern perimeter of the area (Figure 7-35). Wheatears have been observed in the manipulated, open areas in the southwestern part of the area. There are also five species nesting in the area that are classified as Near Threatened (NT)i: Black Grouse (*Tetrao tetrix*), Common Sandpiper, Meadow Pipit, Wood Warbler (*Phylloscopus sibilatrix*) and Common Rosefinch (*Carpodacus erythrinus*). Common Sandpiper is a seashore species while Black Grouse and Wood Warbler are found in forests in the area. Meadow Pipit occurs in areas including open mine areas and Common Rosefinch in scrubs or deciduous forests.

Species listed in Annex I to the EU Birds Directive occurring in the Fjusö area are Whooper Swan (*Cygnus cygnus*), Black Grouse, Hazel Grouse (*Tetrastes bonasia*), Horned Grebe, Black Woodpecker (*Dryocopus martius*), Gray-faced Woodpecker (*Picus canus*), Red-breasted Flycatcher and Red-backed Shrike. Of these, Red-backed Shrike is also classified as Regionally Threatened (RT). Five breeding species are classified as Finland's international responsibility species: Whooper Swan, Common Teal (*Anas crecca*), Tufted Duck, Black Grouse and Common Sandpiper.

Of the above species of significance from the conservation perspective, Black Grouse, Hazer Grouse, Black Woodpecker and Gray-faced Woodpecker are resident birds remaining in the area around the year. The rest are migratory birds only found in the area during the breeding season.

#### Other fauna

In spring 2014 two or three moor frogs (*Rana arvalis*) were detected by sound on the southern shore of the larger section of the Svartbäck pond (*Ympäristösuunnittelu Enviro Oy 2014*) (Figure 7-34). Several moor frogs had previously been found in pools in the northern section of the deposition area around 400 m west from the planned compressor station (*Finventia 2013*). The moor frog is protected under Annex IV to the Habitats Directive, and the destruction and deterioration of its breeding and resting places is prohibited under section 49 of the Nature Conservation Act. Siberian winter damsel (*Sympecma paedisca*), a species protected under Annex IV to the Habitats Directive was observed on the northern shore of Djupviken and the southern shore of the larger Svartbäck pond in summer 2014 (*Ympäristösuunnittelu Enviro Oy 2014*) (Figure 7-34). The sites of the sightings are shores of sheltered waters typical of the Siberian winter damsel and there are likely to be breeding grounds of the species in the area. In 2013 a Siberian winter damsel was sighted around 400 m from the planned compressor station (*Finventia 2013*).

The area relatively small amounts of forest in the Fjusö area suitable for the Siberian flying squirrel (*Pteromys volans*), and the species was not sighted in spring 2014 (*Ympäristösuunnittelu Enviro Oy 2014*). The nearest known habitat of the Siberian flying squirrel is east of Stormossen around 1.5 km away (*Pöyry Finland Oy 2013a*). A few dozen Northern Bats (*Eptesicus nilssonii*) and whiskered bats (steppe whiskered bat and/or Brandt's myotis, *Myotis mystacinus* and/or *M. brandtii*), with individual sightings of Daubenton's myotis (*Myotis daubentonii*) and brown big-eared bat (*Plecotus auritus*) also made in a bat survey conducted in the Joddböle area (*Finventia 2013*). Bats were also detected near the Oljehamnsvägen road leading to the Fjusö Peninsula. The Siberian flying squirrel as well as the bat are species protected under Annex IV(a) to the Habitats Directive.

### 7.7.2.5 Flora of islands and shores in the marine area and fauna of the marine area

#### Flora

The majority of the islands located in the vicinity of the planned natural gas pipeline routing are less than 5 km from the landfall site. The largest of the islands located closest to the pipeline routes are Skämmö, Storramsjö, Jakobramsjö and Älgsjölandet (ALT FIN 2). Also located close to these is the esker island of Stora Fagerö located in the Ingå archipelago Natura site. Stora Fagerö has Scots pine dominated dry heath forests, Norway spruce and mixed forests as well as common alder swamps (*Uusimaa Centre for Economic Development, Transport and the Environment 2014*). The other islands in the Natura site are smaller, rocky and have few trees. Their locations in relation to the pipeline routings are discussed in section 7.7.2.1. There are also numerous small islands and islets in the area. The small islands and islets are at their closest to the pipeline routings around Stora Fagerö. In the area south of Stora Fagerö the gas pipeline will pass through open waters east of the Tuvorna and Änkan islets. In the southern section of the Natura site the pipeline will pass between the small islands of Sadeln and Hästen and then run towards the open sea.

The coastal and aquatic vegetation of the Ingå archipelago is scarce and typical of barren shore areas but more abundant on the sheltered shores of the large islands (Figure 7-36). According to a survey of the underwater natural environment conducted for the pipeline routings, reefs are common in the area affected by the planned natural gas pipeline but are not very representative as regards their plant species composition (*Alleco Oy 2013*). Seabed flora, fauna and habitat types are covered in section 7.2.

### Bird fauna

A diverse range of archipelago birds breed in the archipelago of the marine area, i.e. the Ingå Fageröfjärden–Barösundsfjärden archipelago (*Ramboll 2013e*). There are many large and forested islands, such as Jakobramsö, Skämmö and Stora Fagerö, close to the planned natural gas pipeline route in the northern sections of the marine area, i.e. in the inner archipelago. The breeding bird populations of their interiors consist of continental forest type species, but there are also archipelago type species breeding in the littoral zones of these islands, such as Anseriformes, waders and Laridae. The Osprey and a threatened species of bird of prey under strict protection nest in this area.

According to a breeding birds survey conducted in 2013, there are at least 26 archipelago bird species nesting in the area affected by the planned gas pipeline (Table 7-17; *Ramboll 2013e*). The most abundant of these are Common Eider, Common Gull, Black-headed Gull as well as Common and Arctic Tern. Tufted Duck and Common Sandpiper are also common. The breeding populations focus on a few significant islands or islets with gull and tern colonies (Figure 7-37). Colonies of Laridae also offer protection to Anseriformes (Tufted Duck, Common Eider) and waders (Common Red-shank, Ringed Plover) as the colonies are quick to defend against predators. Clearly the highest diversity and abundance in breeding birds can be found in the archipelago around the island of Stora Fagerö (Figure 7-37) where there are many almost treeless small islets favored by gull and tern colonies. The most important breeding islets on the basis of number of couples and species abundance are Fagerögrundet, Storoxen, Oxen, Lilla Högholm, Hjortronklobben and Stengrundet (Figure 7-37). Levels of recreational use and other traffic are high on islands closer to the mainland which, in addition to the high vegetation cover of the islands, is likely to be the reason for their lower species abundance than in the Stora Fagerö area (*Ramboll 2013e*).

Table 7-17. Aquatic and shore bird species detected in a breeding birds survey in 2013 and their total numbers of couples on 34 islands. *(Ramboll Finland Oy 2013e)*

| Species | Number of couples |
|---|---|
| Mute Swan (*Cygnus olor)* | 22 |
| Greylag Goose (*Anser anser)* | 17 |
| Barnacle Goose (*Branta leucopsis)* | 17 |
| Canada Goose (*B. canadensis)* | 8 |
| Common Teal (*Anas crecca)* | 1 |
| Mallard (*A. platyrhynchos)* | 10 |
| Northern Shoveler (*A. clypeata)* | 1 |
| Tufted Duck (*Aythya fuligula)* | 21 |
| Eider (*Somateria mollissima)* | 188 |
| Velvet Scoter (*Melanitta fusca)* | 2 |
| Common Goldeneye (*Bucephala clangula)* | 13 |
| Red-breasted Merganser (*Mergus serrator)* | 6 |
| Goosander (*M. merganser)* | 9 |
| Great Crested Grebe (*Podiceps cristatus)* | 5 |
| Eurasian Oystercatcher (*Haematopus ostralegus)* | 14 |
| Ringed Plover (*Charadrius hiaticula)* | 1 |
| Common Redshank (*Tringa totanus)* | 16 |
| Common Sandpiper (*Actitis hypoleucos)* | 19 |
| Ruddy Turnstone (*Arenaria interpres)* | 1 |
| Black-headed Gull (*Larus ridibundus)* | 85 |
| Common Gull (*L. canus)* | 142 |
| Herring Gull (*L. argentatus)* | 13 |
| Great Black-backed Gull (*L. marinus)* | 6 |
| Common/Arctic Tern (*Sterna hirundo/ paradisaea)* | 305 |
| Caspian Tern (*Hydroprogne caspia)* | 3 |
| Black Guillemot (*Cepphus grylle)* | 3 |

*Birds breeding in the Ingå archipelago study area include, according to the breeding birds survey and the Ingå archipelago Natura site description, at least 21 bird species of conservation significance (Table 7 18; Ramboll 2013e, Uusimaa Centre for Economic Development 2014a). There are five IUCN red-listed species nesting in the area: Tufted Duck, White-tailed Eagle, Ruddy Turnstone, Lesser Black-backed Gull and Wheatear, all of which are classified as Vulnerable (VU). Tufted Duck is quite abundant in the ar-ea as 21 couples were sighted in the 2013 breeding birds survey (Ramboll 2013e). There is a clear focus in breeding Tufted Ducks on islands that also have breeding Laridae colonies. The largest number of breeding Tufted Ducks is found on Fagerögrunden (9 couples) and Stengrundet (4 couples). Ten species classified as Near Threatened (NT) were found breeding in the area: Common Eider, Velvet Scoter, Red-breasted Mergan-ser, Goosander, Ringed Plover, Common Red-shank, Common Sandpiper, Black-headed Gull, Caspian Tern and Black Guillemot (Ramboll 2013e). Of these the breeding abundance of Common*

*Eider, Common Sandpiper and Black-headed Gull is quite high, while the abundance of the other species mentioned is low. Six species listed in Annex I to the EU Birds Directive nest in the area studied: Barnacle Goose, White-tailed Eagle, Common and Arctic Tern, Caspian Tern and Red-backed Shrike. The breeding abun-dance of Barnacle Goose as well as Common and Arctic Tern is high in the area accord-ing to the 2013 survey.*

*According to the breeding birds survey and the Ingå archipelago Natura site description, the bird species breeding in the archipelago area include 12 species that are regarded as Finland's international responsibility species. These are Common Teal, Tufted Duck, Common Eider, Velvet Scoter, Common Goldeneye, Red-breasted Merganser, Goosan-der, Common Sandpiper, Ruddy Turnstone, lesser Black-backed Gull, Common Tern and Black Guillemot (Ramboll 2013e, Uusimaa Centre for Economic Development, Transport and the Environment 2014a).*

Table 7–18. Species of bird of conservation significance breeding in the project area. IUCN = IUCN classification (VU = Vulnerable, NT = Near Threatened), EU = species listed in Annex I to the EU Birds Directive, IRS = Finland's international responsibility species *(Ramboll Finland Oy 2013e)*.

| Species | IUCN | EU | IRS |
|---|---|---|---|
| Barnacle Goose (*Branta leucopsis*) | | x | |
| Common Teal (*Anas crecca*) | | | x |
| Tufted Duck (*Aythya fuligula*) | VU | | x |
| Common Eider (*Somateria mollissima*) | NT | | x |
| Velvet Scoter (*Melanitta fusca*) | NT | | x |
| Common Goldeneye (*Bucephala clangula*) | | | x |
| Red-breasted Merganser (*Mergus serrator*) | NT | | x |
| Goosander (*M. merganser*) | NT | | x |
| White-tailed Eagle (*Haliaeetus albicilla*) | VU | x | |
| Ringed Plover (*Charadrius hiaticula*) | NT | | |
| Common Redshank (*Tringa totanus*) | NT | | |
| Common Sandpiper (*Actitis hypoleucos*) | NT | | x |
| Ruddy Turnstone (*Arenaria interpres*) | VU | | x |
| Black-headed Gull (*Larus ridibundus*) | NT | | |
| Lesser Black-backed Gull (*L. fuscus fuscus*) | VU | | x |
| Common Tern (*Sterna hirundo*) | | x | x |
| Arctic Tern (*Sterna paradisaea*) | | x | |
| Caspian Tern (*Hydroprogne caspia*) | NT | x | |
| Black Guillemot (*Cepphus grylle*) | NT | | x |
| Wheatear (*Oenanthe oenanthe*) | VU | | |
| Red-backed Shrike (*Lanius collurio*) | | x | |

In addition to breeding birds, the offshore area is important for birds resting during spring and autumn migrations as well as for overwintering birds. The numbers resting during migration are at times large, with even hundreds of resting and molting Greylag Geese (*Anser anser*), Mute Swans, Common Goldeneyes and Tufted Ducks gathering in the shallows near the islands, i.e. close to the islands and islets of the Gåsö-Barö offshore area (*Ramboll 2013a*). The Tufted Duck is classified as Vulnerable (VU) (*Rassi et al. 2010*), while the Common Goldeneye is Finland's international responsibility species.

According to resting birds inventories conducted in 2013, the most abundant species among those resting in the area are Common Eider, Long-tailed Duck, Great Cormorant, Mute Swan and Greylag Goose (*Ramboll 2013ee*). Of these, Common Eider is classified as Near Threatened (NT) and is also Finland's international responsibility species. The maximum number of Common Eider individuals sighted in the 2013 survey was around 1,800. The largest flocks are found in southern parts of the Natura site in the Sadeln area, but relatively large numbers also occur in the Gåsö-Barö offshore area (Figure 7–37) (*Ramboll 2013e*).

The most significant species resting in the area during spring and autumn migration is probably the Long-tailed Duck. The species has declined consider-ably over the past decades, which is why it has been classified as Vulnerable (VU) by the IUCN. The largest number of Long-tailed Ducks, around 3,900 individuals, was sighted in the 2013 birds survey (*Ramboll 2013e*) in May and the second-largest, 1,300 individuals, in November. Like Common Eider, the largest numbers of Long-tailed Ducks gather in the outermost archipelago zone and, in particular, close to the small islands and islets of that zone (Figure 7–37), i.e. the area south of Sadeln and in the Hästen-Hästgrundet shallows. When feeding, Long-tailed Duck usually dive to 3–10 m although they are capable of diving to depths of up to 50–60 m (*Carboneras & Kirwan 2014*). Shallows are important feeding areas for the species. The numbers of Long-tailed Ducks resting in the outer archipelago of the Uusimaa region were also studied in autumn 2011 (*Ellermaa & Lehikoinen 2011*). Only a small number of Long-tailed Ducks were counted in the project area around Sadeln in the outer archipelago of Ingå. On the other hand, the number sighted in the shallows around Hästen was around 1,500 and in the Hästengrund shal-lows 2,900 (*Ellermaa & Lehikoinen 2011*). Overall the Ingå project area is not particularly significant for the Long-tailed Duck, and there are clearly more important areas off Helsinki-Kirkkonummi and off Hanko (*Ellermaa & Lehikoinen 2011*).

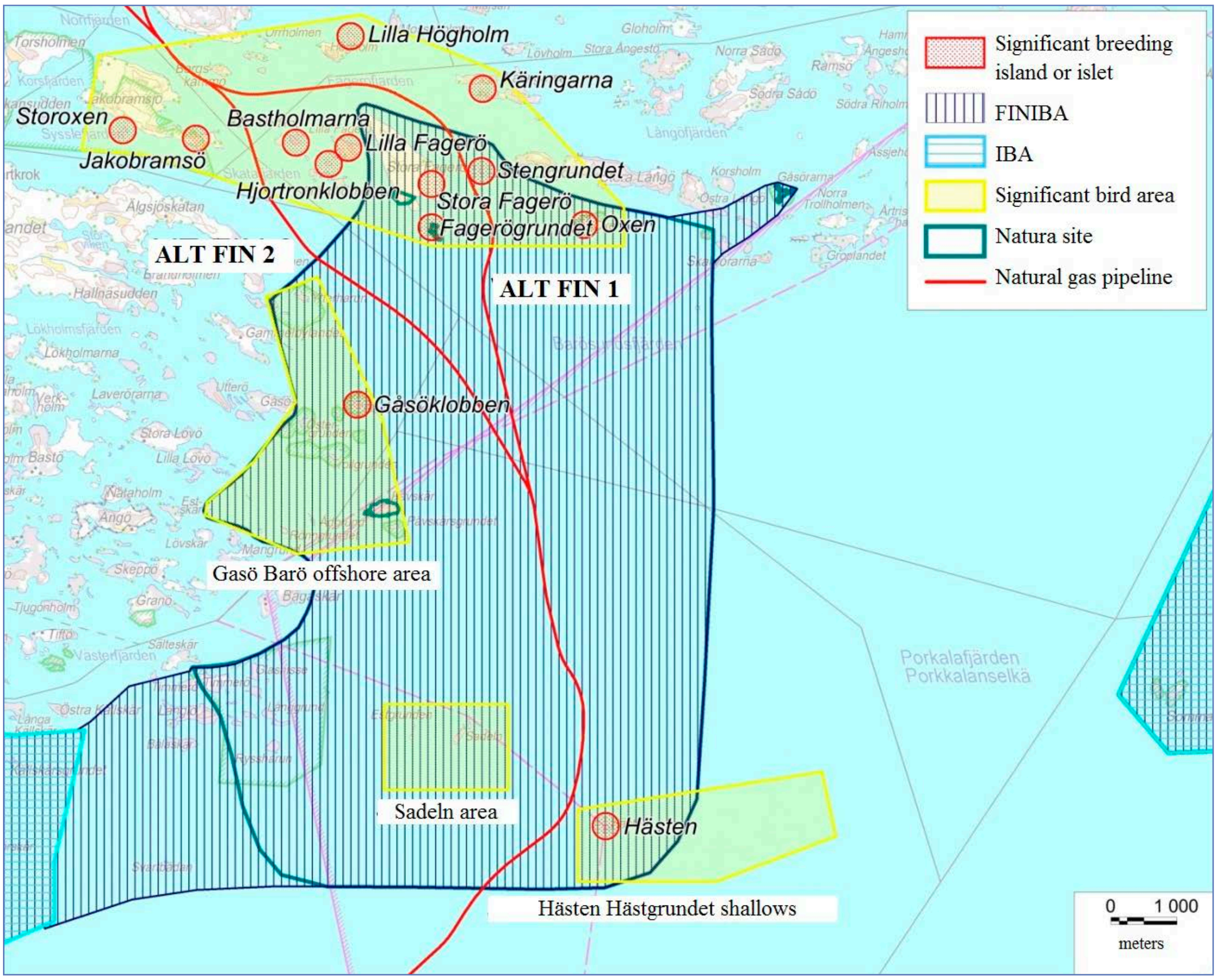



Figure 7-37. The most significant bird breeding islets (Ramboll Finland Oy 2013a) and other important bird areas in the Ingå archipelago area.

### Marine mammals

Annual gray seal and ringed seal inventories are conducted by the Finnish Game and Fisheries Institute (RKTL) during their molting season in April–June when they gather on certain sites and can be counted (*RKTL 2012*). The count is performed by means of an aerial census over suitable islets.

There are no areas of significance to either of the seal species in the immediate vicinity of the planned natural gas pipeline route (*Ramboll 2013c*), and the nearest areas important to ringed seals can be found in the Archipelago Sea. The nearest gray seal molting site in the 2000s has been Storbrottet, located north-east of Hästen and around 2.1 km east of the planned gas pipeline (Figure 7-38). A total of 19 gray seals were counted on the site in 2008. No sightings of seals have been made since then on the site.

The next-closest gray seal molting grounds are located several kilometers east and southeast of Storbrottet (Figure 7-38). The most significant occurrence area is Kallbådan, which is the most important area of occurrence for the gray seal in the Gulf of Finland. The Kallbådan group of islets is located around 12 km from the planned gas pipeline route. At best more than 300 gray seals have been counted in Kallbådan during the molting season (*Ramboll 2013c*), but in recent years the numbers have been slightly smaller, apparently due to disturbance (*Ahola 2014*). The numbers sighted on other sites have been clearly lower, with no annual sightings of gray seals made on them. Sommarhällen and Sankbådan are located 8–12 km east of the natural gas pipeline (Figure 7-38).

Outside molting seasons, seals move actively and extensively along the coast in search of food, usually alone or in small groups. There are no locations known in the Ingå archipelago with seals occurring in large numbers outside the molting season. According to the Natura site description, individual gray seals are found in the Natura site near Hästen (*Uusimaa Centre for Economic Development, Transport and the Environment 2014*).

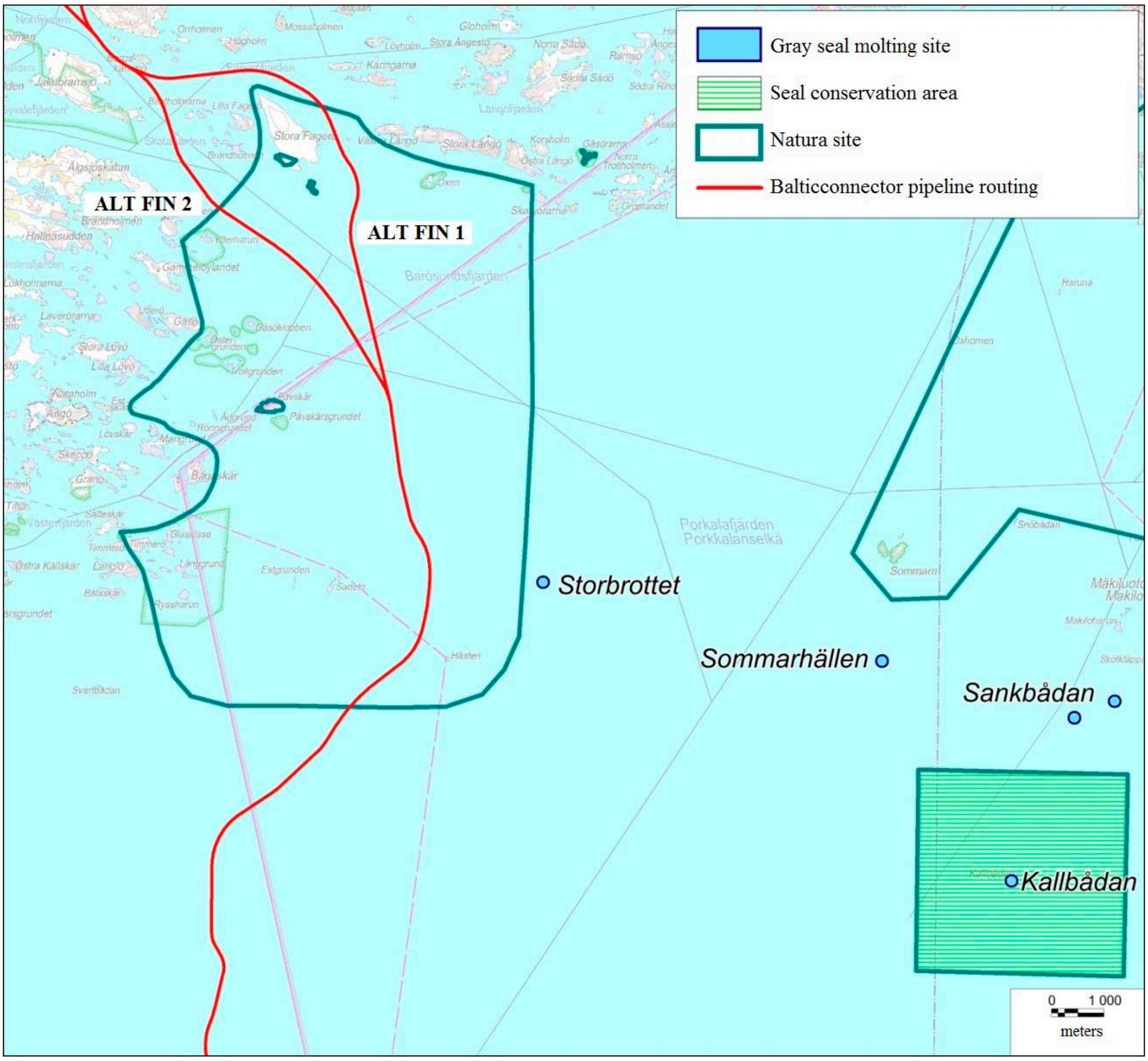



Figure 7-38. The most important seal molting areas. (Ramboll Finland Oy 2013b)

## 7.8 Land use and built environment

### 7.8.1 Gulf of Finland

The planned natural gas pipeline passes through Finnish and Estonian territorial waters and, after the limit of territorial waters, through the Exclusive Economic Zones of both countries (Figure 7-39).

There are areas used by the Finnish Defence Forces near the planned gas pipeline route on the Finnish side. The route passes through the Upinniemi restricted area and Upinniemi firing range. The purpose of the restricted areas is to contribute towards the safeguarding of Finland's territorial integrity. Special regulations apply to restricted areas; activities not allowed in a restricted area without permission include scuba diving or other underwater activity which does not normally form part of navigation, such as anchoring of buoys at the bottom, anchoring a vessel other than a pleasure craft, excavation and deposition of benthic material, cable-laying or use of sonars. Seabed exploration and mapping are also prohibited without permission. Firing of weapons regularly takes place in the firing range of the Finnish Defence Forces, during which strict restrictions on activities apply. In addition to the Finnish Defence Forces, the Estonian Defence Forces also have a practice area near the planned natural gas pipeline route on the Estonian coast of the Gulf of Finland. There is ship and boat traffic in the marine areas and holiday residences and marinas on the islands.

### 7.8.2 Ingå

The mainland-side section of the project area is located in Jöddböle, Ingå, around 4 km from the center of Ingå (Figure 7-40). At the end of 2013 the population of Ingå was 5,562 *(Statistics Finland 2014b).* There are around 2,000 holiday residences and 300 permanent residents in the Ingå archipelago.

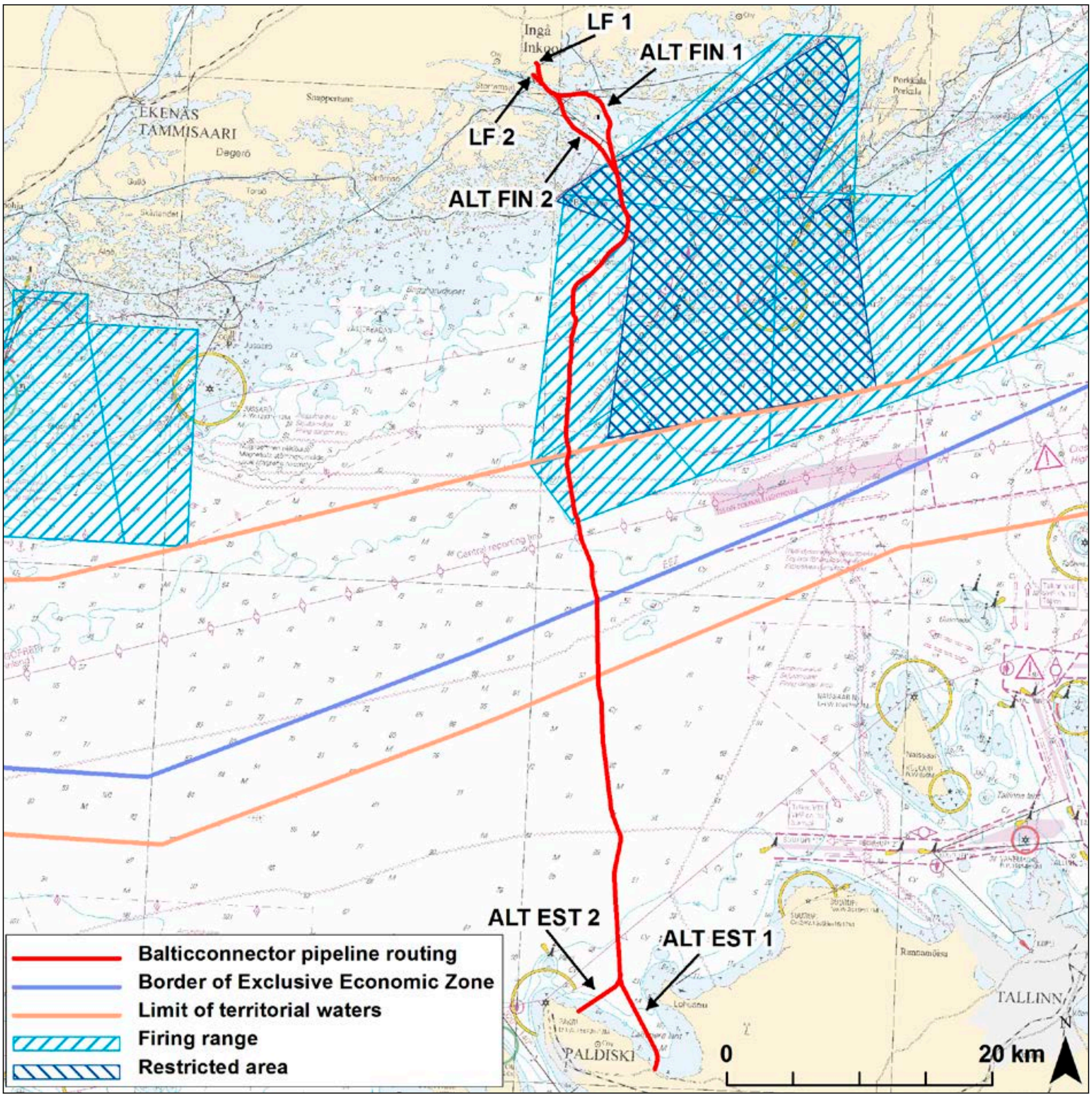



Figure 7-39. Limits of Finnish and Estonian territorial waters, the border of the Exclusive Economic Zone, and military area of the Defence Forces in the vicinity of the planned gas pipeline route.

The area around the project area is in part a heavily manipulated zone of port, rock extraction and other heavy-duty operations. The area has facilities including the decommissioned Fortum power plant, State emergency supplies storage facility for liquid fuels, fly ash deposition area, Ingå deep water port, wastewater treatment plant, fishing harbor and boat winter storage facility. Quite a large number of holiday residences can be found on nearby shore areas.

In Ingå the project area (landfall and onshore pipeline routing alternatives) as well as areas immediately adjacent to it are mainly fenced (Figure 7-40). The fenced area relates to the activities of the National Emergency Supply Agency, and access to the area is restricted. The area is therefore not currently used for residential or holiday accommodation, recreation or other public or private access. The area is mostly covered by forest. A rock outcrop ridge called Telegrafbergen is located in the northern section of the fenced area.

Motor gasoline and light fuel oil are stored in a National Emergency Supply Agency facility located in caves inside the bedrock. Products are usually delivered to and from the facility by ship, but road tankers can also be used. The facility serves as an emergency supplies storage facility, whereby deliveries take place very seldom during normal periods. The transfer of liquid fuels from the quay to the storage tanks takes place via underground pipelines. There are also pipelines from

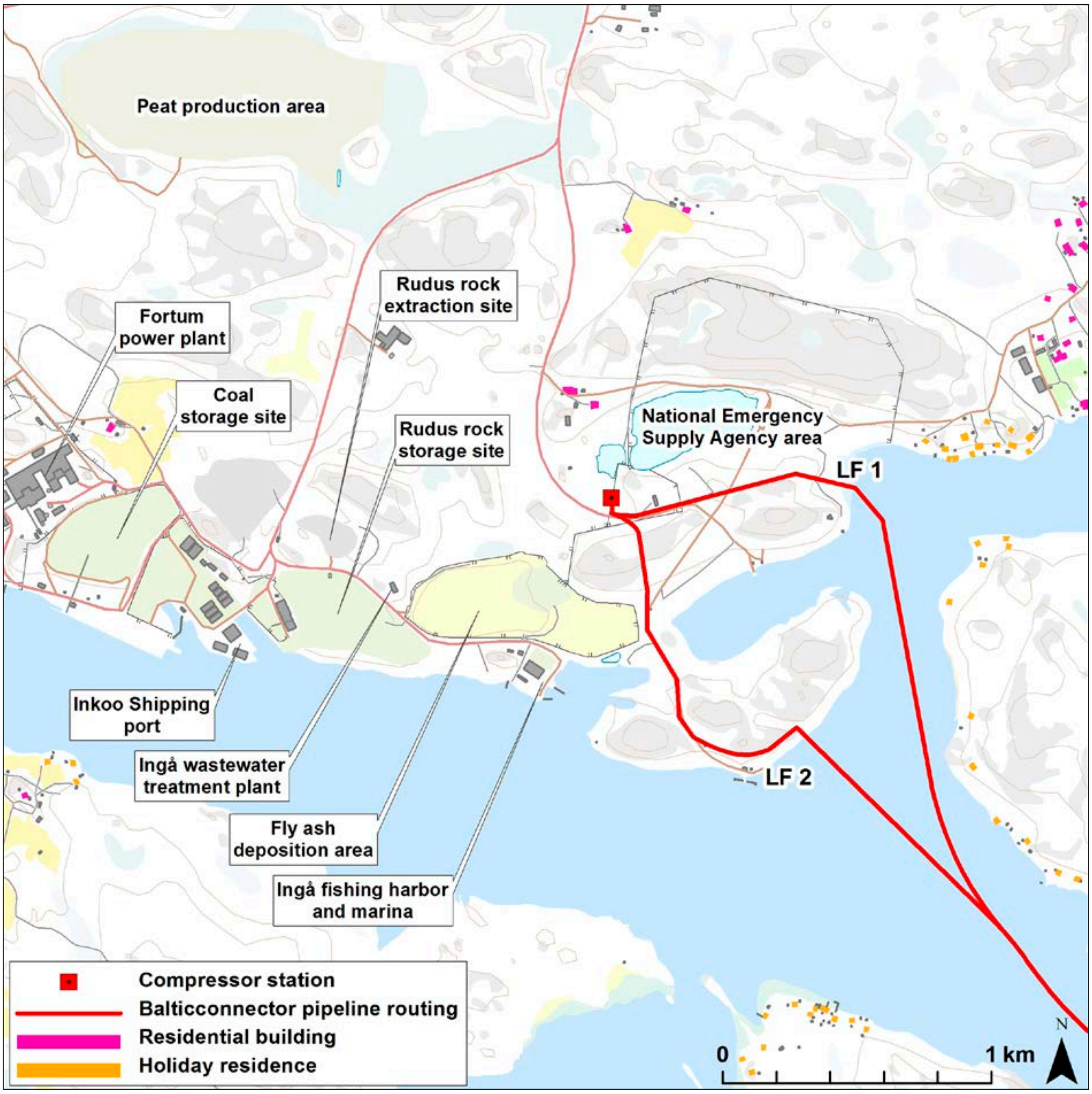



Figure 7-40. The project area and operations in its vicinity.

the storage facility to the vehicle loading area and a pipeline from the light fuel oil storage facility to the quay on the seafront. *(Uusimaa Regional Environment Centre 2005)*

The Fjusö Peninsula mainly consists of forests and exposed bedrock. There are some roads in the immediate vicinity of the project area (see section 7.5.2). There is an oil harbor relating to the State emergency supply storage facility on the southern shore of the peninsula, with a deep water route of 10 m in depth leading into the harbor. There is an ash deposition area west of Fjusö, while the Ingå fishing harbor and marina is located around 200 m to the west. The Ingå deep water port is located another 1.5 km to the west. There is a facility referred to as the 'coastal quay' north of Fjusö on the northern shore of Sundviken. The coastal quay is used on rare occasions for the refueling of vessels of the Defence Forces and other authorities. There is a heating plant for the production of heat required by the emergency supply storage facility in the area of the National Emergency Supply Agency *(Uusimaa Regional Environment Centre 2005)*.

Located a little under 1 km from Fjusö, the island of Storramsjö mostly consists of a nature reserve. There are a few permanent and holiday residences on the island (Figure 7-41 and Figure 7-42). Less than 1 km southeast from Fjusö on the island of Jakobramsjö there is a public recreational area, and the southern section of the island is included in a nature reserve. Located south of the center of Ingå, around 2.5 km northeast of Fjusö as the crow flies, there is a public swimming beach. There are several holiday residences and the Östergård farm on the island of Skämmö, which at its closest is around 300 m from Fjusö.

Located around 600 m northeast from Fjusö, there are several holiday residences on the Bastubackan hill and seafront area and, immediately to the northeast from these, there is the nearest area with several residential buildings. The buildings located in the southwestern corner of Telegrafbergen appearing as residential buildings in the material provided by the National Land Survey of Finland (Figure 7-41 and Figure 7-42) are not in private residential use.

At its nearest the LF1 landfall would be around 300 m from the Bastubackan holiday residences, around 150 m from the Skämmö island holiday residences and, at its nearest, less than 900 m from the Bastubackan residential buildings. Landfall LF2 would at its nearest be located less than 300 m from the Skämmö island holiday residences and around 600 m from Jakobramsjö island holiday residences. The nearest residential buildings in Bastubackan are located around 1.5 km away.

The shortest distance between the offshore gas pipeline ALT FIN 1 and a holiday residence (Skämmö) is around 150 m. With ALT FIN 2 the shortest distance to a holiday residence (Bastholmarna) is around 130 m.

Activities in the surrounding marine areas include boat traffic to and from the fishing harbor and marina, boating by private holiday and permanent residents, vessel traffic to and from the Port of Ingå, and recreational fishing. There is a marina on the eastern shore of the island of Jakobramsjö.

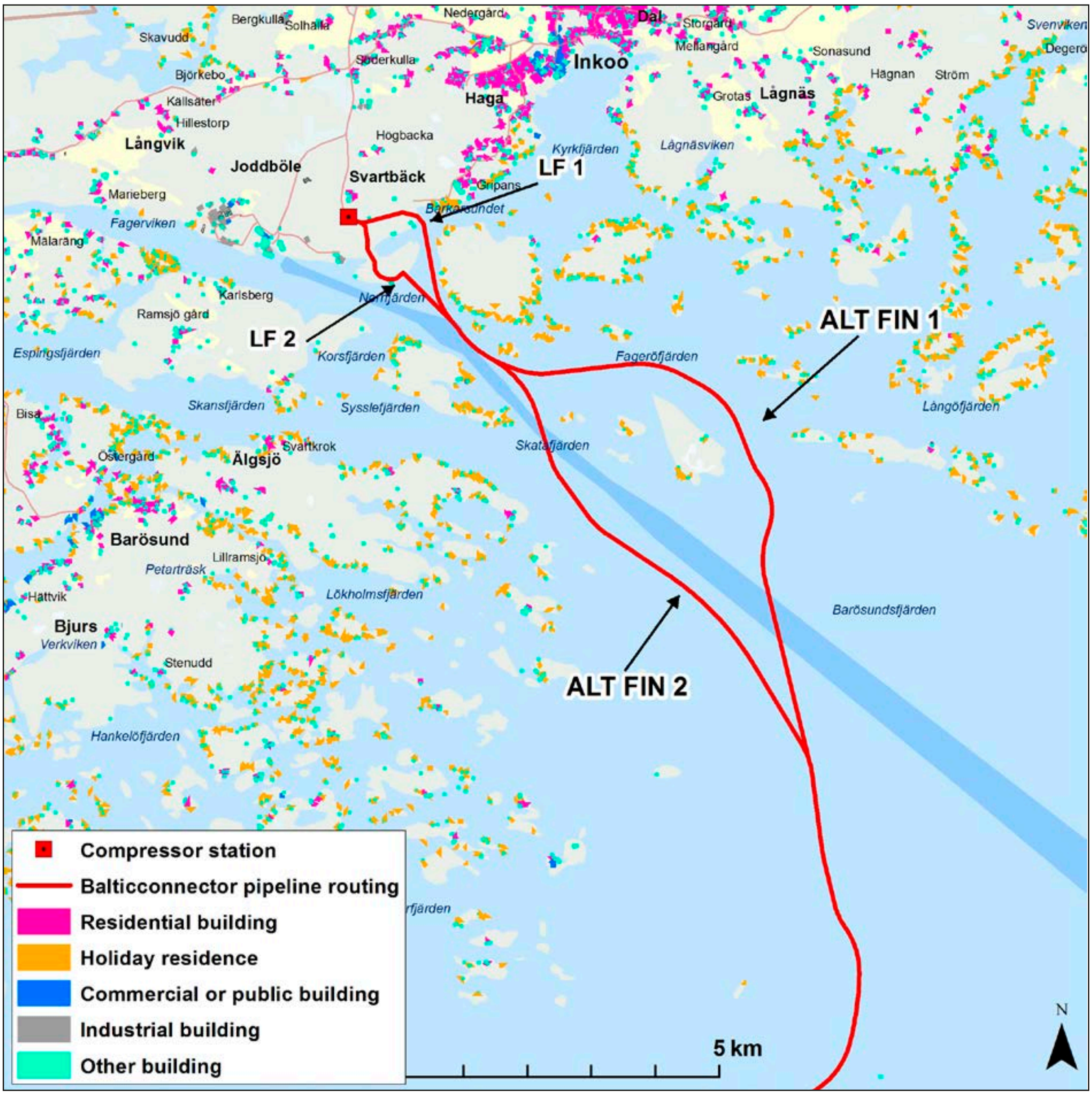



Figure 7-41. Buildings and settlements in the Ingå archipelago.

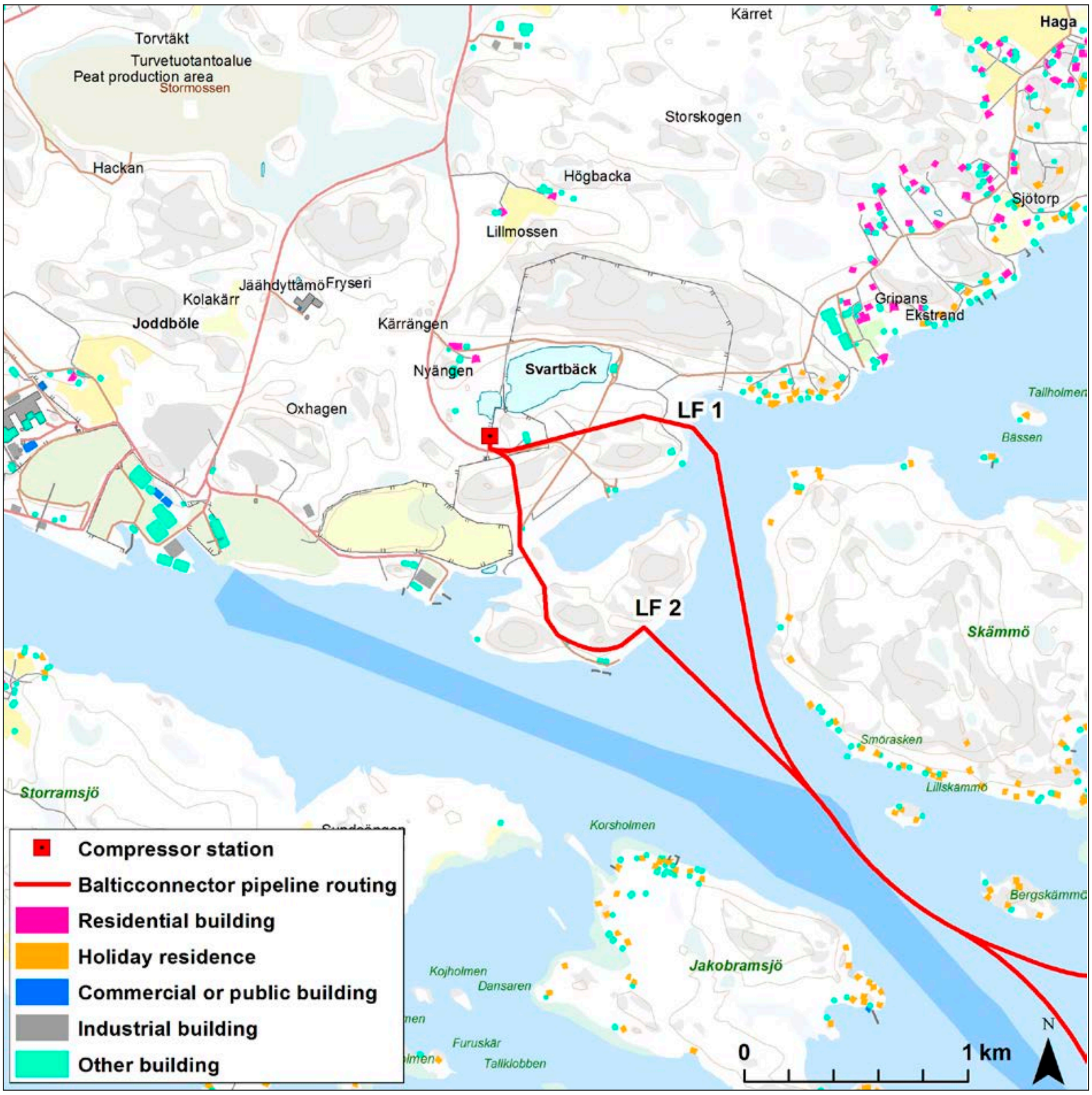



Figure 7–42. Buildings and settlements in the Ingå archipelago.

### 7.8.2.1 Land use planning system

Land use planning takes place to guide the usage and construction of areas. The Finnish land use planning systems consists of natural land use guidelines, regional land use planning, local master plans and local detailed plans. The regional development strategy and regional program (which in Uusimaa form the Helsinki-Uusimaa Regional Programme) are also parts of the land use planning system. The regional land use plan governs the preparation of local master plans and local detailed plans. Local master plans govern local detailed planning. Local detail plans and certain local master plans can lay down direct guidelines on construction and other land use.

### 7.8.2.2 National land use guidelines

The national land use guidelines are part of the land use planning system under the Land Use and Building Act *(132/1999)*. Under the Act, the guidelines must be taken into account and their implementation must be promoted in regional planning, municipal statutory land use planning and the activities of central government authorities.

The guidelines are primarily put into practice in regional land use planning. In regional land use planning the guidelines are adapted to regional and local circumstances and objectives. The guidelines are also taken into consideration in regional development strategies and programs. Some of the guidelines are such by nature that they are taken directly into consideration in municipal land use planning. The local master plan is a key planning level in municipalities in the process to take national land use guidelines and the regional land use plan to the concrete level.

National land use objectives may concern matters which have:

- international or more extensive than regional bearing on local structure, land use, or the transport or power network;
- a significant impact on national cultural or natural heritage; or
- nationally significant impact on ecological sustainability, the economy of the local structure, or avoidance of environmental hazards.

The national land use guidelines are divided into the following sets of guidelines, with those listed under number 4 applying to this project in particular:

1. A well-functioning regional structure
2. A more coherent urban structure and the quality of the living environment
3. The cultural and natural heritage, recreation and natural resources
4. Well-functioning communication networks and energy supply
5. Special issues concerning the Helsinki region
6. Areas of outstanding interest as natural and cultural sites

#### The Helsinki-Uusimaa Regional Programme

The Helsinki-Uusimaa Regional Programme contains the long-term vision and strategy for the region (regional development strategy 2040) as well as the strategic choices for the development measures (regional programme 2014–2017). The Regional Council adopted the programme on December 11, 2013.

According to the vision of the Helsinki-Uusimaa Regional Programme:

*In 2040, Helsinki-Uusimaa Region will be on top of the Baltic Sea Region when it comes to creating and taking advantage of socio-economic growth, enabling a well-functioning everyday life for its inhabitants and arranging activities in an ecologically and economically sustainable way.*

The strategic development objectives for the Helsinki-Uusimaa Region for the period up to 2040 are to make the Region:

1. Cradle for smart growth – foundation in sustainable development and intelligent solutions.
2. Easy to reach and live and work in – emphasis on effortless transport, working and functioning, and an agreeable living environment.
3. Clean and beautiful – sensible use of natural resources, maintenance of biodiversity and becoming carbon neutral.

The regional development measures are guided by the strategic priorities of the Helsinki-Uusimaa Regional Programme 2014–2017, which are:

1. Opportunities for growth
2. Practical everyday life
3. Sustainable ecology

### 7.8.2.3 Land use plans in effect and pending

#### Regional land use plans

The following regional land use plans currently in effect apply to the area: Helsinki-Uusimaa regional land use plan (adopted on August 15, 2007), first-phase Helsinki-Uusimaa regional land use plan (Supreme Administrative Court October 8, 2012) and second-phase Helsinki-Uusimaa regional land use plan (adopted on October 30, 2014) (Figure 7–43). In the regional land use plan the mainland-side section of the project area is located in an industrial area, excluding the Fjusö Peninsula, for which there is no separate area reservation in the plan. *The industrial area is reserved for construction generating industrial employment. In more detailed planning on the basis of more in-depth studies, industrial facilities and/or installations handling hazardous chemicals can be designated for the area. Significant environmental disturbances must be prevented through technical solutions and/or designation of sufficient safety areas. Where liquid fuels or other dangerous substances are stored and/or produced in the area, the environmental risks posed by the storage must be taken into consideration in the planning and design of the area and its surroundings.*

There is also a feature notation on the industrial area: area with significant rock resources. *Attention must be paid to preserving the capacity for rock extraction in land use planning concerning the area. The actual purpose of use designated for the area in the regional land use plan or other legally binding plan must be taken into consideration in the planning and implementation of rock extraction.*

There is an energy supply site notation (EN) on the eastern part of Fjusö. *The notation designates important facilities or structures serving energy supply. The specific location and size of the area designated with the site notation will be determined in more detailed planning. The area will be reserved for energy supply needs. Significant environmental disturbances must be prevented through technical solutions and/or designation of sufficient safety areas.*

There is a non-binding plan notation for a natural gas main pipeline routing designated a few kilometers west from the project area.

The southwestern part of Fjusö is designated as a traffic area intended for harbor operations. In the marine areas there is a plan notation for the need for connecting natural gas transmission pipeline. *To*

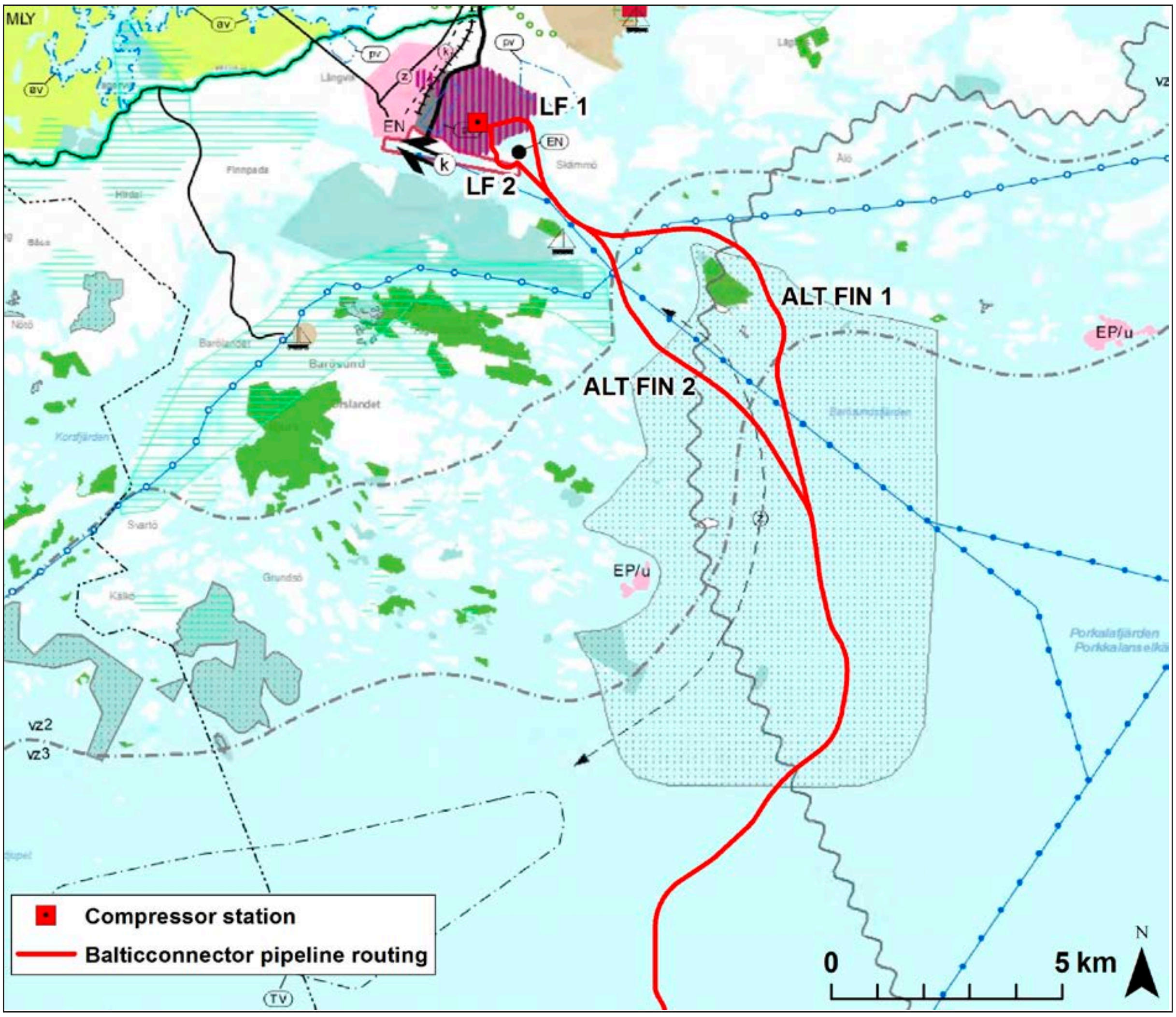



Figure 7–43. Combined map extract: Helsinki-Uusimaa regional land use plan and first- and second-phase Helsinki-Uusimaa regional land use plans. *(© Uusimaa Regional Council & NLS, License No 744/MYY/06)*

*implement the connection, the most appropriate alternatives from the land use and environmental perspectives must be studied in the more detailed planning and design of the natural gas main pipeline.* There are plan notations for shipping and boating routes in the plan. The Ingå archipelago Natura 2000 site designated in the regional land use plan coincides with the offshore routings.

There are plan notations for shipping and boating routes in the plan. The Ingå archipelago Natura 2000 site designated in the regional land use plan coincides with the offshore routings. There is a plan notation in the marine area for a 110 kV power line or need for a major offshore cable connection. The connection need relates to the power transmission of the Ingå-Raseborg offshore wind farm.

Fourth-phase Helsinki-Uusimaa regional land use planning is currently underway (draft map, Figure 7-44). The land use plan aims to support sustainable competitiveness and wellbeing in the region. The objectives set in the Helsinki-Uusimaa Regional Programme will also be promoted through the land use choices made. The fourth-phase plan will be more strategic than the previous regional land use plans. It will determine the major collective development policies for the following themes:

- business and innovation;
- logistics;
- wind energy;
- green infrastructure;
- cultural heritage.

The draft plan was on public display from January 20 to February 20, 2015. A non-binding natural gas main pipeline routing is designated for the area in the draft. The third-phase Helsinki-Uusimaa regional land use plan does not apply to the area.

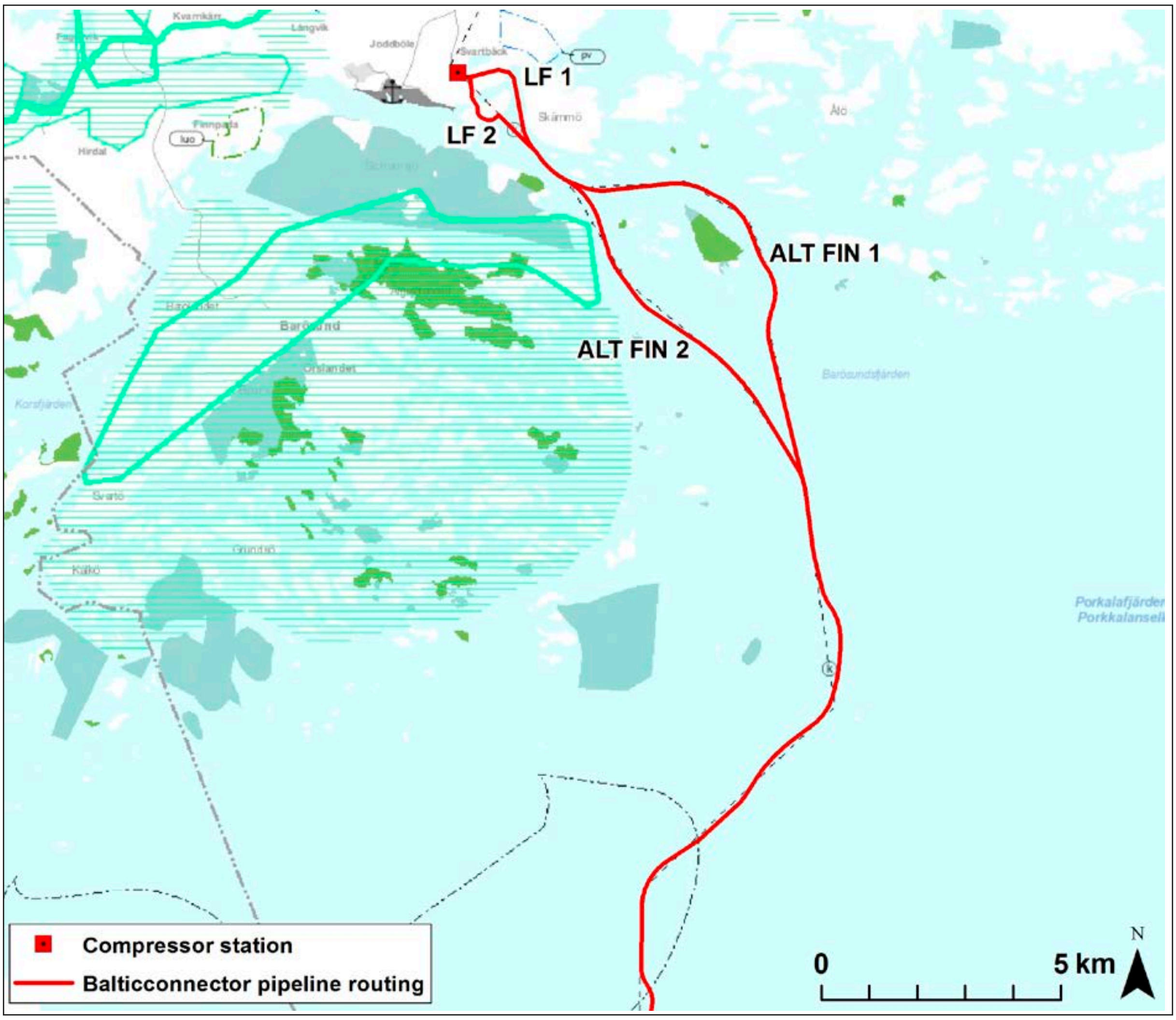



Figure 7-44. Extract from the draft fourth-phase Helsinki-Uusimaa regional land use plan (January 20, 2015).

### Local master plans

Two local master plans apply to the mainland-side sections of the project area, of which the Ingå mainland partial local master plan is non-appealable and the Ingå strategic local master plan pending. The non-appealable Ingå outer archipelago partial local master plan and the non-appealable (reform pending) Ingå inner archipelago partial local plan apply to the marine areas.

The Ingå mainland partial local master plan (June 13, 2002) (Figure 7-44) has a designation TC, i.e. an area for enterprise activities with need for planning, for the project area. In the plan, the natural gas pipeline is designated for an area north of the Fortum power plant area. There is no plan notation for a gas pipeline in the project area. North of landfall LF1 there is the sl 138 notation for a site protected or intended for protection under the Nature Conservation Act. *Alteration of the natural environmental status of the site is subject to permit as laid down in section 128 of the Land Use and Building Act until the site has been designated as a conservation site under the Nature Conservation Act.* There is a residential area designated under the land reservation notation A2 east of the sl site. The section of waters designated with the w land reservation notation *is subject to permit for landscape work as laid down in section 128 of the Land Use and Building Act.*

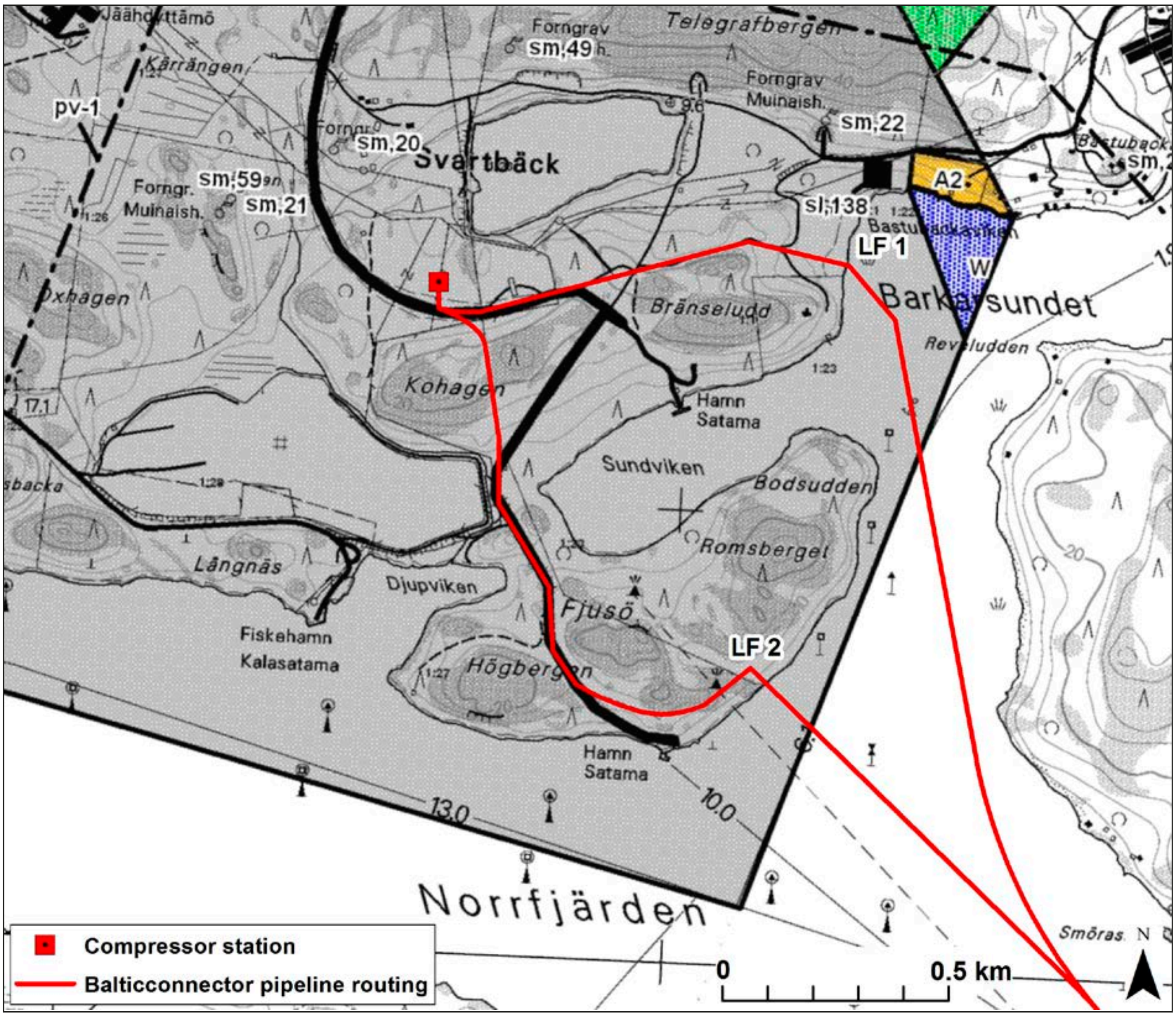



Figure 7-45. Extract from the Ingå mainland local master plan (© Municipality of Ingå & NLS, License No 302/MMY/10). (© *Municipality of Ingå & NLS 2013*)

The Ingå strategic partial local master plan is under preparation (Figure 7-45). In the draft plan (October 19, 2012) the mainland area is designated as an area for local detailed planning and an area for future expansion of community structure. *The expansion of community structure must be connected with current community structure in a manner promoting the viability of Ingå center services and public transport. There is a fixed-term building restriction in effect in the area under section 43(3) of the Land Use and Building Act. The aim is to implement the expansion of community structure through local detailed planning.*

The entire area on the mainland side is covered by the sub-area notation 'Establishment consultation zone' (Seveso). *The notation designates a consultation zone surrounding an establishment with installations handling or storing dangerous substances. The zone is based on the Seveso II Directive. A statement from rescue service authorities and, where necessary, from the Finnish Safety and Chemicals Agency (Tukes) must be requested when planning activities within the zone.*

A few ancient monuments are also designated near the project area under the designation sm. The shipping lane leading to the deep water harbor is designated in the plan.

There are designations including holiday residences, recreational areas and marinas in the Ingå inner archipelago partial local master plan (June 22, 1992). Fairways to the deep harbor and Fjusö oil harbor are also designated in the plan.

The process to amend the Ingå inner archipelago local master plan (Figure 7-47) is underway, and the preparatory material was on public display from June 10 to August 30, 2013. In the draft plan, new sites for the construction of holiday residences have been designated on islands east and south of Fjusö.

In the Ingå outer archipelago partial local master plan (2000) (Figure 7-48) the routings pass close to

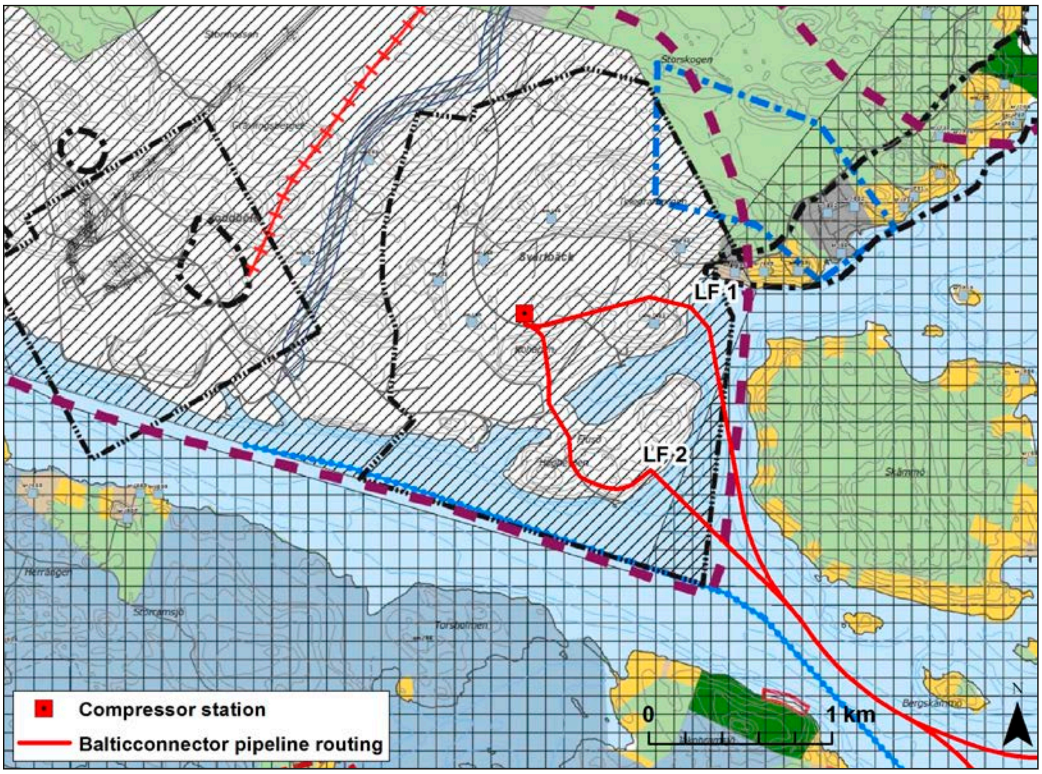



Figure 7-46. Extract from the draft Ingå strategic local master plan currently under preparation (October 19, 2012). *(© Municipality of Ingå)*

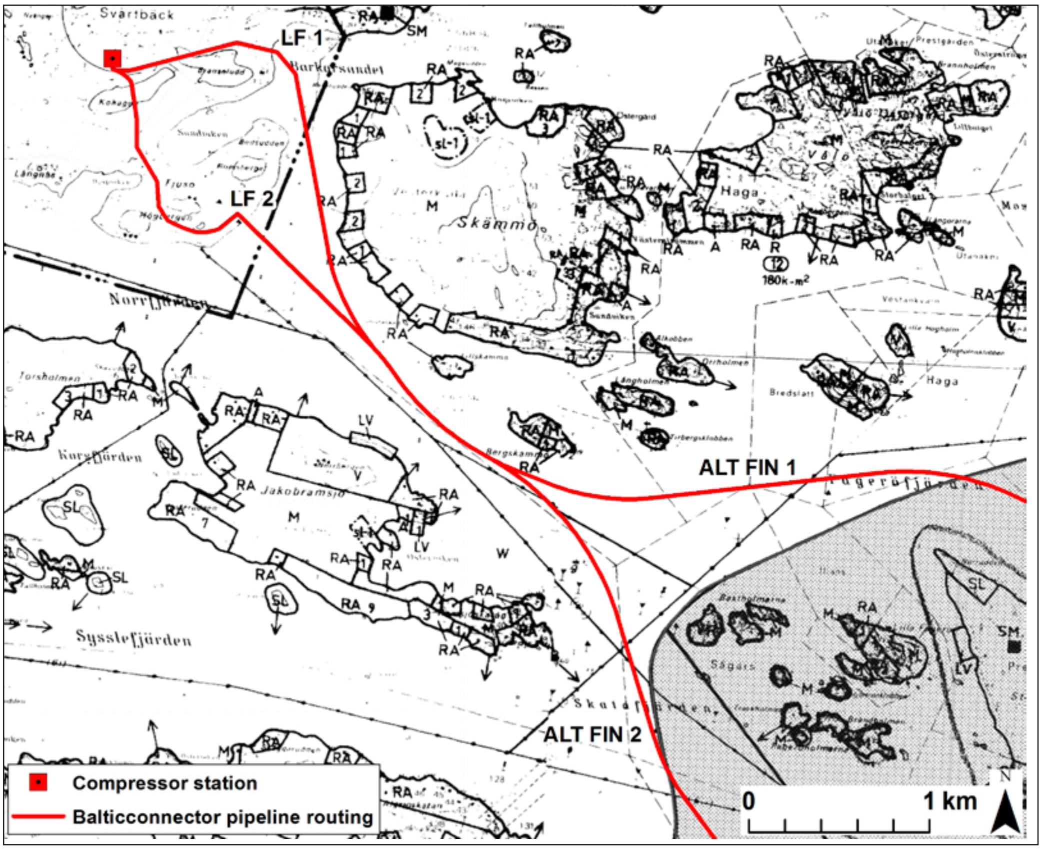



Figure 7-47. Extract from Ingå inner archipelago local master plan. *(© Municipality of Ingå & NLS 2013)*

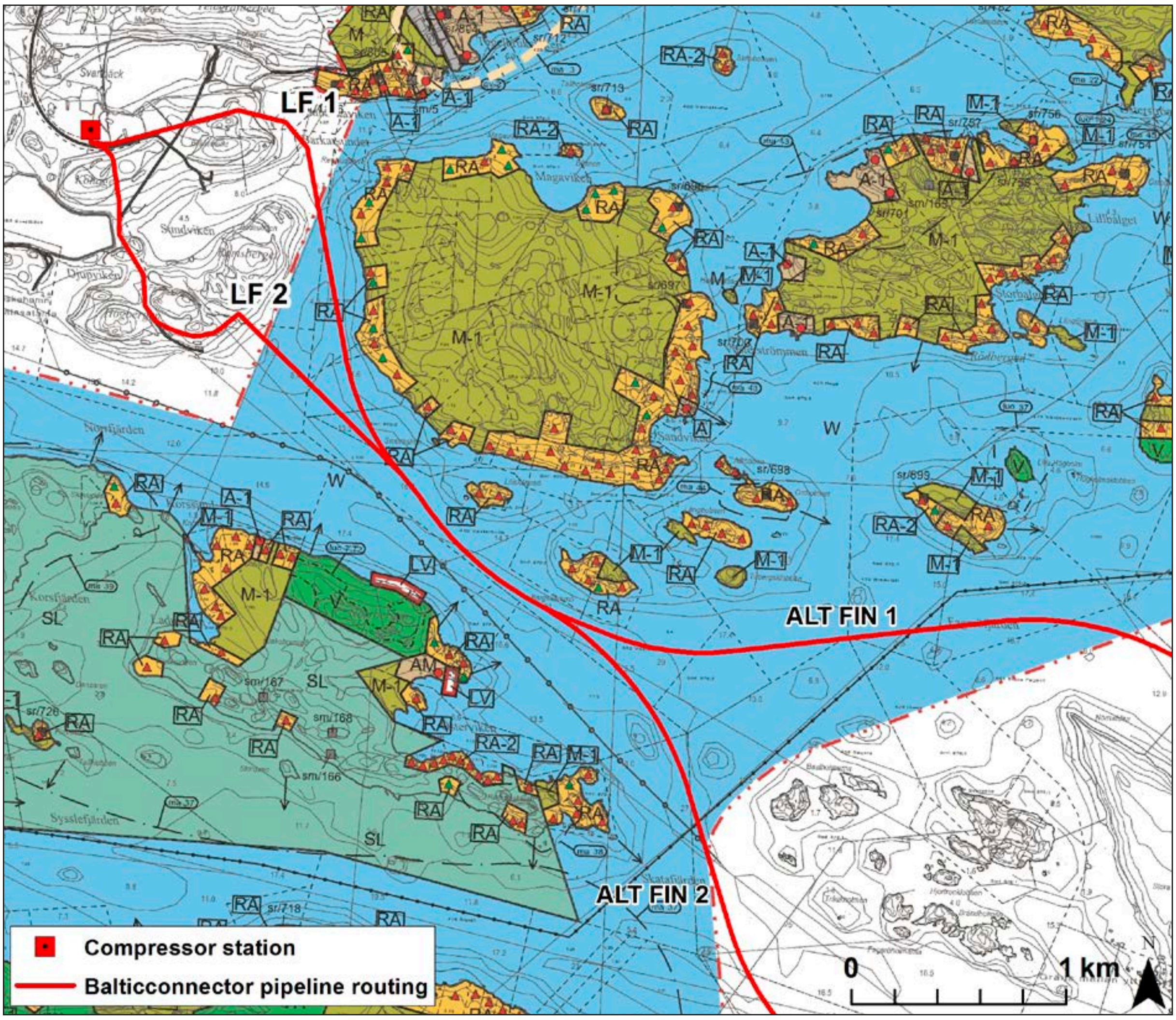



Figure 7–48. Extract from draft Ingå inner archipelago local master plan. *(© Municipality of Ingå, NLS & Finnish Transport Agency 2013)*

conservation sites designated with the SL/N notation, i.e. conservation areas belonging to the Natura site, passing particularly close to the islets of Änkan and Abborpinnarna (ALT FIN 2). The ALT FIN 2 routing alternative coincides with a relic (sm). *The area is protected under the Antiquities Act. Under the Act, it is forbidden to excavate, cover, alter, damage or remove ancient monuments or to disturb them in any way without permission stipulated in the Act. The National Board of Antiquities must be provided with the opportunity to issue a statement prior to any decision on an a application for a permit pertaining to the area.* The routings cross shipping lanes. The ALT FIN 1 route alternative crosses the border of a valuable landscape (ma) designated in the plan southeast of Stora Fagerö. *This broken line is an approximation of the landscape entities with landscape and nature values. The area's landscape values must be taken particularly into consideration when carrying out measures affecting the status of the environment and in more detailed land use planning and implementation.* It also passes by the islet of Låggrundet, which us designated as a nature reserve (SL). There is also a permanent site for fishing gear designated in the plan on the islet. *Buildings or jetties should not be placed within 50 m from the gear attachment point on the shore.*

### Local detailed plans

There is a legally binding local detailed plan for Joddböle in effect in the project area (May 28, 2009) (Figure 7–49). The mainland-side project area in included in the areas of land reservation notations E-1 and E-2. The E-1 land reservation notation designates the State emergency supplies storage facility for liquid fuels. *Buildings, structures and equipment necessary for the operations of the area may be constructed in the area. The area must be closed and guarded. No permanent residence is permitted in the area. Above-ground and underground construction is permitted in the area.*

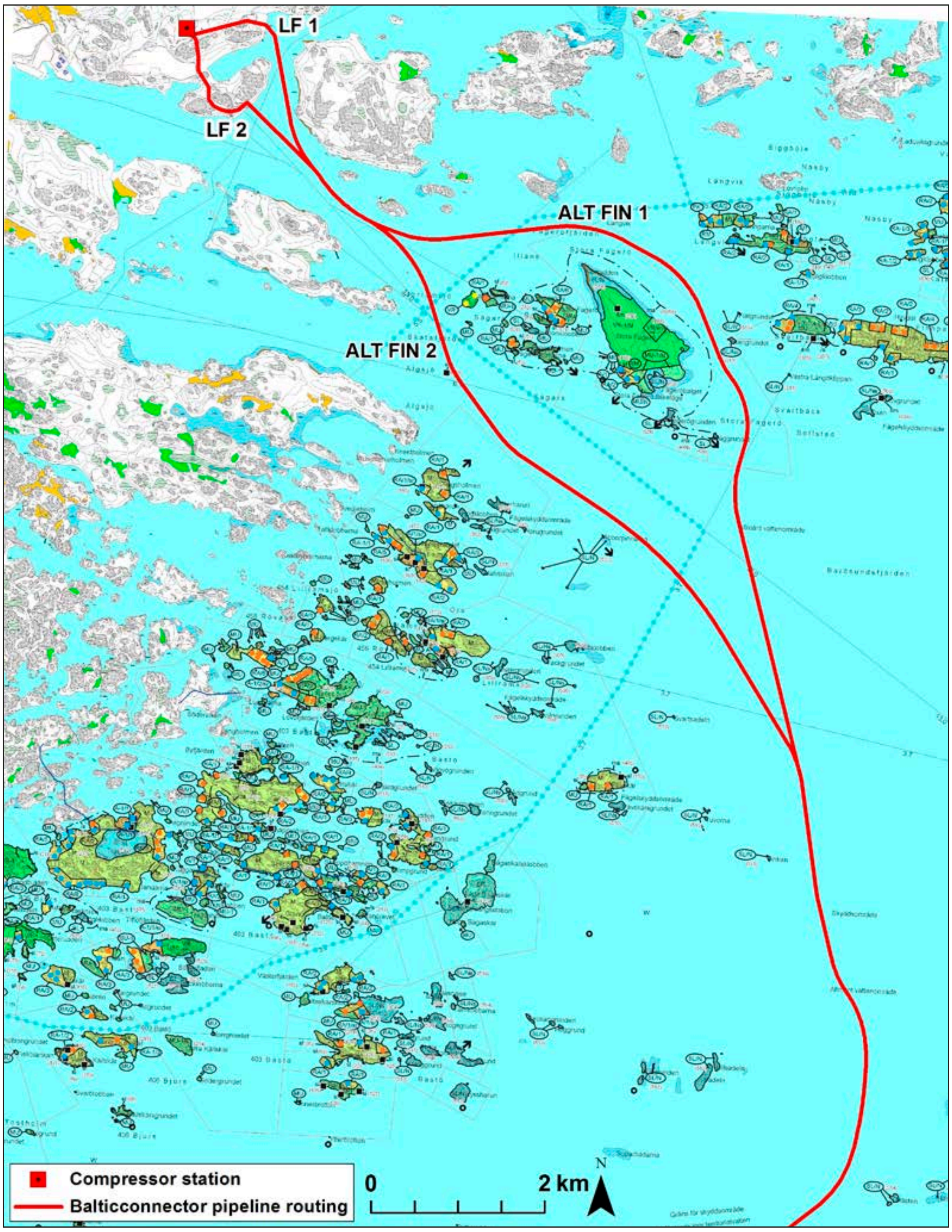



Figure 7-49. Extract from Ingå outer archipelago local master plan. *(© Municipality of Ingå & NLS 2013)*

The E-2 land reservation notation designates a special block area intended for the handling and storage of liquid fuels, including liquefied natural gas. *The area must be closed and guarded. No permanent residence is permitted in the area. Underground construction is permitted in the area.*

The local detailed plan designates the offshore pipeline landfalls west of the oil harbor quay on the southern shore of Fjusö and by Bastubackaviken Bay between the Telegrafbergen and Bränseludden hills. The landfalls are designated with the ET-1 land reservation notation as areas of buildings and installations serving maintenance of infrastructure technology. *The area is intended as a landfall site of an offshore pipeline. Buildings, structures and equipment necessary for the operations of the area may be constructed in the area.*

The plan designates the sections of the area reserved for a non-binding offshore pipeline. The western and eastern shore areas of Fjusö are designated with a sub-area notation as a part of the area to be planted or kept in its natural state. The waters and oil harbor are designated in the plan.

The entire project area is included in the Seveso consultation zone. *When planning the placement of* *operations involving a hazard within the major-accident hazard zone, a statement must be requested from the municipal fire and rescue service authorities and, where necessary, from Tukes.*

The plan issues general regulations, one of which pertains to landscape: *Before the construction of block areas, measures and plans to protect and improve the landscape must be presented for the entire area. The unbuilt sections of block areas, which are not used for the purpose of use of the block area, traffic, recreation or other such activity, must be maintained in a well-kept condition. Existing trees must, whenever possible, be preserved.*

A building area e–1, with a permitted building volume of 1,000 floor sqm, is designated for the EN–1 area of the plan. *Buildings and installations serving maintenance of infrastructure technology may be constructed in the area* of the building area.

The process to amend the Joddböle local detailed plan is underway. The participation and assessment plan concerning the plan amendment was drawn up on August 15, 2012 *(FCG Oy)*. The plan amendment pertains to plans to construct a full-scale LNG terminal and connecting pipelines, and the amendment area is in part located on the Balticconnector project area.

### Ingå land use strategy

The Joddböle area is examined and envisaged as a significant industrial and port operations area in the Ingå land use strategy adopted by the municipal council of Ingå on March 24, 2011.

## 7.9 Landscape and cultural heritage

### 7.9.1 Gulf of Finland

The wrecks of ships and other vessels that can be considered to be over one hundred years old, or parts thereof, as well as other man-made underwater structures that are reminders of past history are protected under the Antiquities Act (295/1963). In the Gulf of Finland the monuments of cultural heritage of material relevance to the project mainly consist of underwater shipwrecks and other marine archaeology sites. Wrecks can be found particularly along fairways and close to ports. In addition, it is known from experience that in offshore areas shipwrecks may be discovered in unexpected locations without being able to anticipate their locations in advance on the basis of written sources or historical maps. Other archaeological sites can usually be found in shallow areas that used to be above the sea level. Ancient underwater monuments are protected under the Antiquities Act in a manner corresponding to the protection of ancient monuments located on land.

The underwater cultural heritage found in Finnish waters has been surveyed in conjunction with the Balticconnector project on the basis of previous inventory data (incl. *National Board of Antiquities 2014*) and the first stage of the underwater archaeological inventory

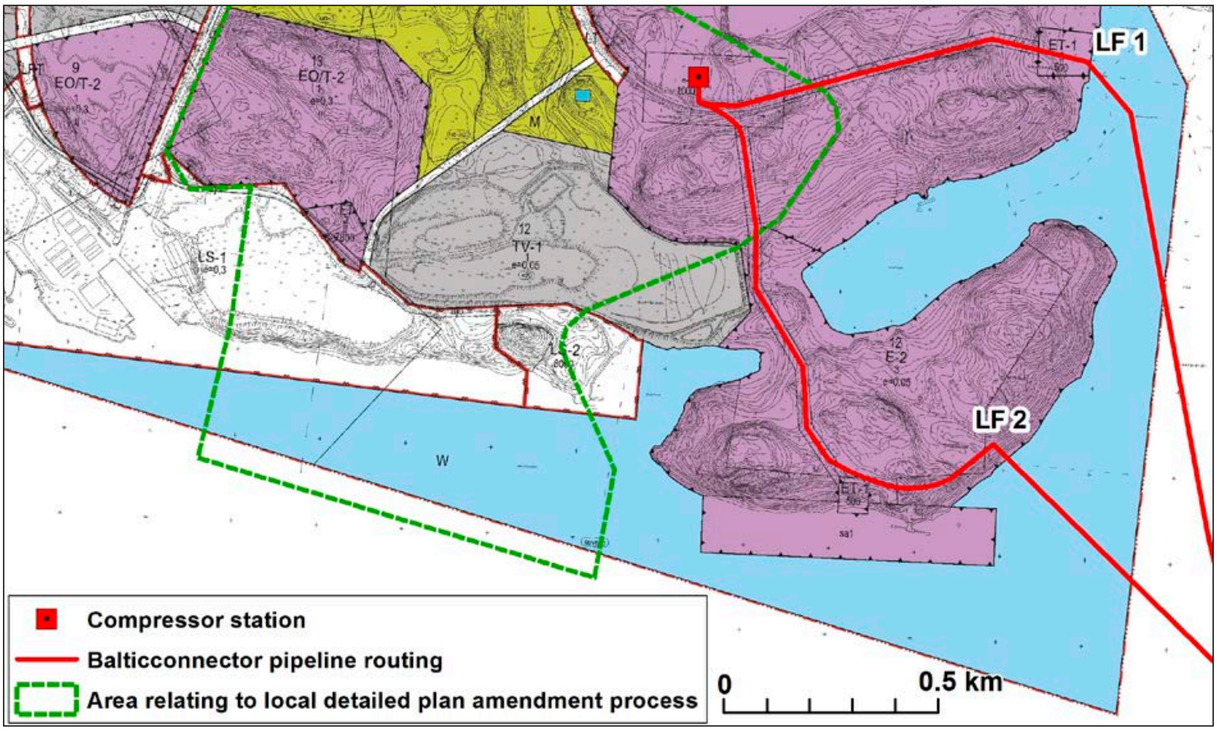



Figure 7–50. Extract from the Joddböle local detailed plan (© Municipality of Ingå). The borders of the area relating to the amendment of the local detailed plan currently pending are shown in green, and the natural gas pipeline routings and compressor station relating to the LNG terminal project are shown in red.

based on side-scan sonar data (*SubZone Oy 2014*). In the survey 11 sites were detected that may be cultural objects, i.e. objects that are products of human activities. Of these, a site located off the southwestern coast of the island of Skämmö may be a previously unknown ancient monument. The underwater cultural heritage sites, previously known and any potential new ones alike, covered by the survey are presented in greater detail in section 7.9.2.

According underwater inventory data, there are two shipwreck sites in Estonia near the pipeline routing (*Hüdrograafia Infosüsteem/Veeteede Amet*). The assessment of the nature and value of the sites and the impacts of the natural gas pipeline will require more detailed studies in Estonia as well.

### 7.9.2 Ingå

The project area – the Fjusö Peninsula and its immediate surroundings – is located at the southern edge of the Ingå mainland littoral zone. The peninsula protrudes into the crossing point of three straits and is located in a visible place on view axes opening out across the waters via the open landscape spaces of the straits. The nearest islands, belonging to the inner archipelago zone, are Storramsjö, Jakobramsjö and Skämmö, all of which have holiday residences on their shores. The connection to the offshore areas opens toward the southeast.

When laid on the seabed in the marine area, the natural gas pipeline will not have any landscape impacts, so marine landscapes are not covered in this context.

The Fjusö Peninsula mainly consists of natural environment, but the area is directly connected with a zone of heavy-duty operations that are industrial in nature in the littoral zone of Ingå. As well as natural areas, there are also, for example, a road leading to the harbor, harbor and/or quay structures, and an oil pipeline from the harbor area in a southern part of the peninsula toward the north on the Fjusö Peninsula. There are activities of the National Emergency Supply Agency on the northern side of the peninsula. Despite the area's activities, from the sea the Fjusö area appears as a zone of natural environment as views of the structures are obscured by trees and topography. Only the quay and jetty structures are clearly visible from the sea. There is a small fishing harbor and an extensive ash deposition area on the west-southwestern side of Fjusö. To the west there are heavy operations, such as rock extraction and port operations, as well as a decommissioned power station.

The Fjusö Peninsula is rocky and has diverse topography (Figure 7–50). The tops of the ridges of rock outcrops are around 35 m above the sea level at their highest. The shores are mostly in their natural state. The compressor station will be located in a southern part of the Oljehamnsvägen road in a forested, low-lying natural area with flat topography close to the gate area of the National Emergency Supply Agency.

The features of the landscape of the area for the natural gas pipeline alternatives and compressor station areas are illustrated in photographs taken during on-site visits (Figure 7–50). The indicative points and directions of photography are given on the map. Unless otherwise specified, the photographs were taken in June 2014.

Several new projects are being planned for the industrial areas of the Joddböle-Fjusö coastal zone (including LNG terminal, large-scale rock extraction) which, if realized, will change the local landscape considerably.

If the compressor station is powered by electricity, the route of the possible underground cable will pass through an intensively manipulated coastal zone that is industrial by nature and does not feature any particular landscape or cultural environment values. The cable routing follows the current road network and passes along the perimeter of the ash deposition site.

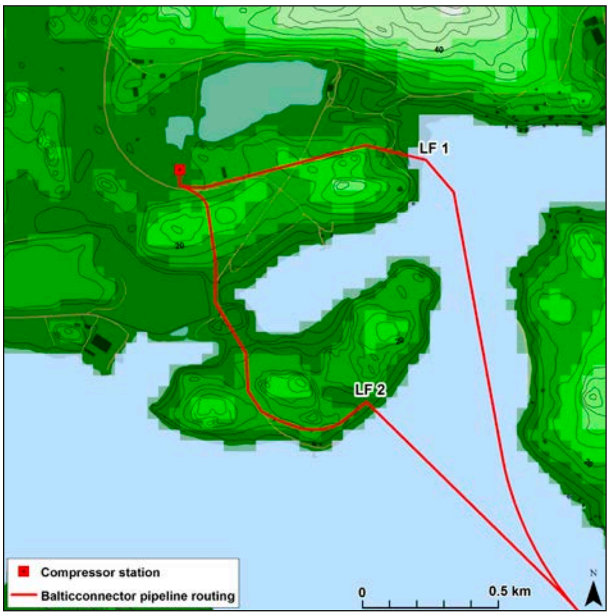
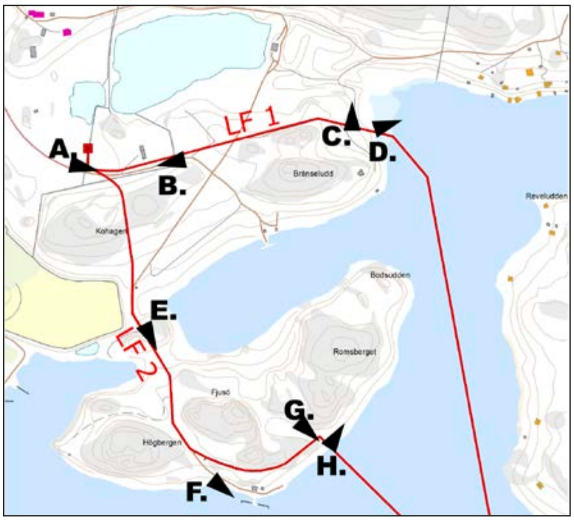



Figure 7–51. Topography and locations of gas pipeline routings and the compressor station in the Fjusö area. The contour interval is 5 m.


LF 1
LF 2
A.
B.
C.
D.
E.
F.
G.
H.
Bränseludd
Kohagen
Reveludden
Bodsudden
Romsberget
Fjusö
Högbergen

A.

B.

C.

D.

E.

F.

G.

H.

Figure 7–52. A–H. Views from the natural gas pipeline and compressor station area.

### Valuable on-shore sites

There are no nationally valuable landscape areas, nationally significant built cultural environments or regionally or locally valuable landscape areas and/or cultural environments in Fjusö in the project area. There are no known ancient monuments in the area where the project will result in on-shore intervention (*National Board of Antiquities 2014; Mikroliitti Oy 2014*).

The nearest ancient monuments are located around 100–200 m from the areas subject to intervention (Figure 7–52 and Figure 7–53). According to the Registry of Ancient Monuments, there is an ancient monument, the Bränsleudd burial cairn (Registry of Ancient Monuments ID 1000012186), but the monument was no longer detected in conjunction with the 2014 ancient monuments inventory *(Mikroliitti Oy 2014)*. The nearest ancient monument site to the planned compressor station, located southwest of the station area, is the Early Metal Age Kohagen burial cairn (Registry ID 1000009755). The site was not included in the ancient monuments inventory conducted for this project, but it has been included in inventories concerning EIA procedures of other projects in the Joddböle area.

According to information obtained from the Provincial Museum of Western Uusimaa, there are the Kyrkfjärden villas from the turn of the 1800s and 1900s, which are of at least local cultural historical significance, located northeast of landfall alternative LF1.

### Valuable underwater sites

The underwater cultural heritage found on Finnish territory has been surveyed in conjunction with the Balticconnector project on the basis of previous inventory data (incl. *National Board of Antiquities 2014*) and the first stage of the underwater archaeological inventory based on side-scan sonar data (*SubZone Oy 2014*). The purpose of the survey was to assess the suitability of the scan data produced in 2006 and 2013 for archaeological use and to study whether any sites indicating ancient underwater monuments can be detected in the material. The work also involved the assessment of the situation of three previously known ancient monuments close to the pipeline routing alternatives, the shipwreck off the western shore of Skämmö (id 1428), Severnyi Oriel shipwreck (id 1426) and Västra Långö shipwreck (id 1435). Of these, 1426 is presumed to be the Severnyi Oriel, or Eagle of the North, a Russian warship that shipwrecked in 1789 during the Bärösund sea battle between Sweden and Russia. The hull as well as structural components scattered around it remain from the large wooden warship. There is no specific information about the current extent of the shipwreck area or locations of the related items.

According to the survey, the scan data south of latitude N 59°55′ (2013) is suitable for archaeological inventories, while scan data north of this latitude (2006) was found to be unsuitable for archaeological inventories. Consequently, it was proposed in the report that side-scan sonar studies suitable for archeological use be carried out north of latitude N 59°55′ over a band that is around 300 m wide in the next stage of the archaeological inventory.

In the survey, 11 sites were detected that may be cultural objects, i.e. objects that are products of human activities. Of these, a site located off the southwestern coast of the island of Skämmö may be a previously unknown ancient monument. Of the previously known three sites, the shipwreck off the western shore of Skämmö (id 1428) could be seen, but the Severnyi Oriel shipwreck (id 1426) and Västra Långö shipwreck (id 1435) were not visible. It was not possible to assess the current condition of the sites or, consequently, the working distance required for their preservation in a construction project, on the basis of the scan data and archival and registry data. The underwater cultural heritage sites, previously known and any potential new ones alike, covered by the survey, are shown on the map (Figure 7-53 and Figure 7-54).

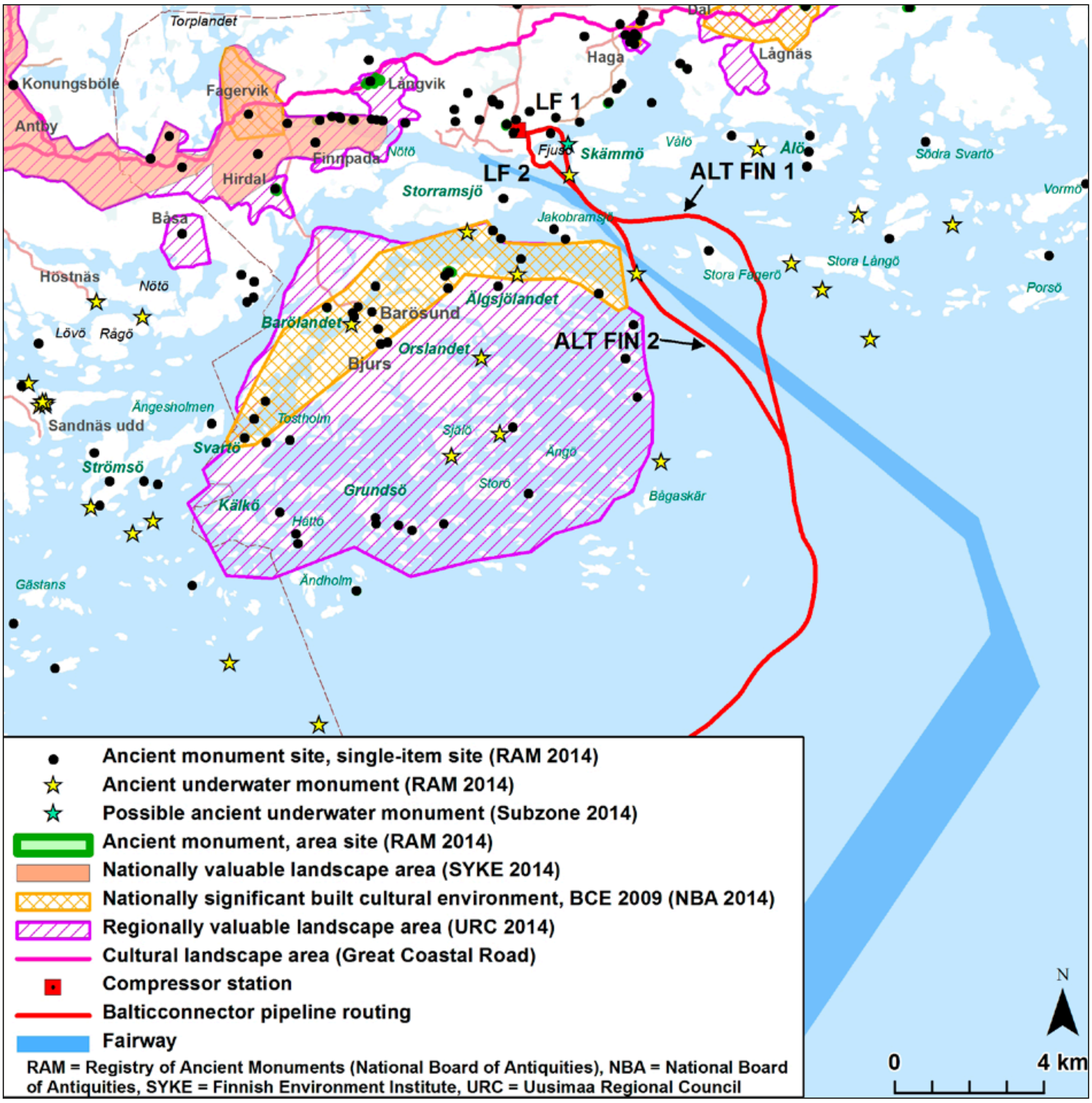



Figure 7-53. Valuable landscape and cultural environment sites in the project area and its immediate vicinity.

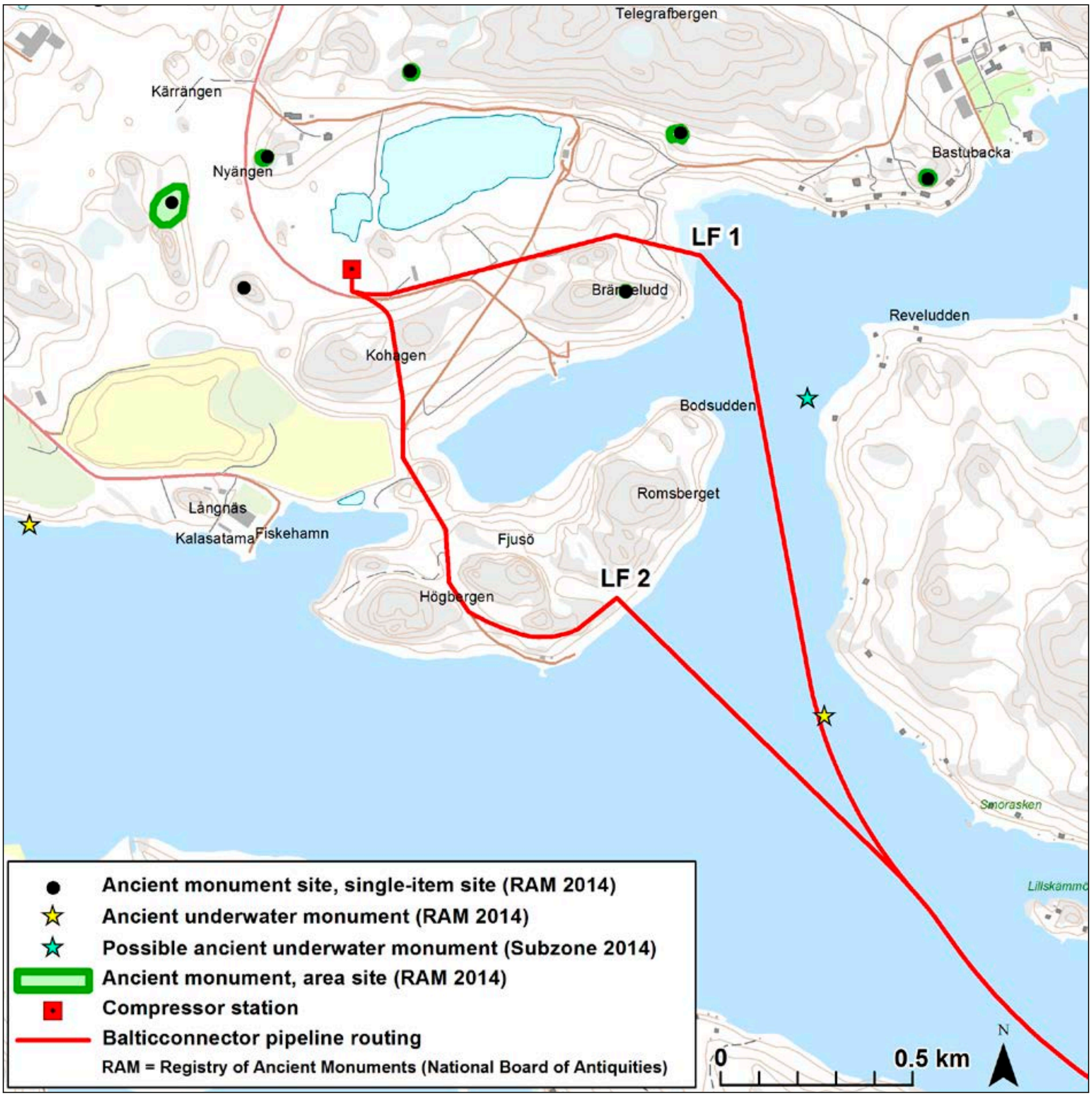



Figure 7-54. Valuable landscape and cultural environment sites in the project area and its immediate vicinity (close-up).

## 7.10 People and society

### 7.10.1 Gulf of Finland

There are no settlements in the actual offshore area of the Gulf of Finland. There are some holiday residences off the northern shore of the Gulf of Finland in the Ingå archipelago in the vicinity of the Balticconnector natural gas pipeline routing (see section 7.10.2). There are no holiday residences in the outer archipelago of Ingå before the beginning of the offshore areas in the vicinity of the pipeline routing. There is no archipelago on the southern coast of the Gulf of Finland off Paldiski.

Several regular shipping routes cross the Balticconnector natural gas pipeline in offshore areas. These are used for the Stockholm–Tallinn, Ventspils (Latvia)–St. Petersburg, Rostock–Helsinki, Travemünde–Helsinki, Stockholm–St. Petersburg and Stockholm–Helsinki services.

Fishing taking place in pelagial areas of the Gulf of Finland is usually commercial fishing, with trawl and longline fishing carried out in these areas. Trawls are mainly used to catch Baltic herring and sprat *(RKTL 2014b)*. Offshore fishing is governed by catch and fishing quotas. The largest trawlers accounting for two-thirds of the Baltic herring and sprat catches mainly fish in the Baltic Sea main basin and therefore will not cause any significant traffic across the Balticconnector pipeline *(Suomen ammattikalastajaliitto ry 2015)*.

### 7.10.2 Ingå

#### Population

The population of the Municipality of Ingå is around 5,500 (December 31, 2011), and the immigration rate is positive at 0.3%. Ingå is a bilingual municipality, with 55% of the population being Swedish-speaking and 42% Finnish-speaking. Around half of the population live in the built-up area of the center of Ingå. According to statistics from 2013, there are 2,748 permanently occupied dwellings in Ingå. Ingå is an important municipality for holiday residence. The number of holiday residences was around 2,200, while the number of permanent dwellings was 2,700. The number of holiday residences in Ingå has increased from the 1,551 in 1991 to the current 2,218. The rate of increase in the number of holiday residences over the past two decades has been around 43% (Municipality of Ingå 2014a). The summer holiday season can be regarded as resulting in a major increase in the municipality's population as, in addition to holiday residents, a lot of boaters also visit Ingå in summer and at summer weekends.

According to the draft local master plan of the inner archipelago of the Municipality of Ingå (*Arkkitehtitoimisto Arkitekturum Oy 2013*), the area covered by the update to the local master plan is 19,000 ha, of which land areas account for 7,600 ha. The shoreline of Ingå is around 492 km long (*Municipality of Ingå 2014a*).

Private individuals and enterprises from the Helsinki Metropolitan Area own 69% of the holiday residences in the area, while permanent Ingå residents own 13%. There are around 160 permanent residents in the Ingå archipelago.

#### Settlements

There are permanent as well as holiday residences in the coastal and archipelago areas of Ingå. The natural environment of the coast, the waters and the reasonably sparsely built areas play a role for those living in the area around the year as well as for holiday residents (Figure 7–41 and Figure 7–42).

The Balticconnector natural gas pipeline routing alternatives differ, as regards the ALT FIN 1 and ALT FIN 2 alternatives, for the routings around the island of Stora Fagerö in that, when passing the island of Jakobramsjö, ALT FIN 2 runs around 500 m from the group of holiday residences on the southeastern peninsula of Jakobramsjö, while ALT FIN 1 runs around 750 m from the group of holiday residences. Five of the holiday residences in the westernmost part of the island of Skämmö are located 150–200 m from the offshore pipeline (ALT FIN 1).

The LF1 and LF2 landfall alternatives are both located in an area designated as an industrial area in land use plans. In the project area in the Svartbäck and Fjusö areas there are some residences within 0.5 km from the Balticconnector natural gas pipeline landfall sites. There are no residences on the Fjusö Peninsula.

Landfall LF1 is located in the northeastern part of the Bränseudd Peninsula. There are holiday residences on the coast on the other side of the bay around 400 northeast from LF1. There are several holiday residences and the Östergård farm on the island of Skämmö, which at its closest is around 300 m from Fjusö. Located around 600 m northeast from Fjusö, there are several holiday residences on the Bastubacka hill and seafront area and, immediately to the northeast from these, there is the nearest area with several residential buildings. The buildings located in the southwestern corner of Telegrafbergen appearing as residential buildings in the material provided by the National Land Survey of Finland are not in private residential use. Located south of the center of Ingå, around 2.5 km northeast of Fjusö as the crow flies, there is a public swimming beach.

With the LF2 landfall alternative the pipeline would make landfall on the Fjusö Peninsula, from where the pipeline would further continue to the compressor station. The distance from LF2 to the nearest holiday residences, located northeast of the site in Bastubacka, is around 400 m. There are a few scattered holiday residences on the other side of the strait around 400 m east from LF2. The Längnäs fishing harbor is located around 500 m west from the pipeline from LF2 toward the compressor station.

There are fewer residences close to LF2 than there are to LF1, but there are archipelago residences near the shipping route to the port, on the shores of the islands of Jakobramsjö, Skämmö and Stora Fagerö a few hundred meters from the pipeline route. Archipelago and holiday residences have been designated in land use plans and constructed on the outer islands off the western side of Stora Fagerö. The ALT FIN 1 alternative passes around 600 m and ALT FIN 2 more than 1 km from these planned sites. The nearest permanent dwellings to the compressor station are located around 400 m north of the compressor station.

#### Recreation and tourism

In Ingå a total of 1,318 ha of area have been designated for recreation, of which 1,208 ha are designated for camping, hiking or other outdoor activities (VR) and 110 ha for general recreation (V). These have a total combined shoreline of around 90 km.

There is an outdoor recreation area administered by Uudenmaan virkistysalueyhdistys association for recreation areas that is 32 ha in area in the northern part of the island of Stora Fagerö. The pipeline routing alternative ALT FIN 1 passes less than 1 km from the shore of the northern part of Stora Fagerö. There are areas for recreation and outdoor activities owned by various municipalities and organizations outside the project area in Ingå, and these are beyond the reach of the project's impacts.

According to a report on the Ingå outer archipelago partial local master plan (*Pöyry 2000*), the outer archipelago comprises more than 1,000 islands, almost 400 km of coastline, 500 pieces of real estate, 350 landowners, 400 holiday residences and more than 30 permanent dwellings. A total of 140 ha (divided into 12 areas) are reserved for recreation in the outer archipelago, while around 240 ha belong to protected areas.

In the coastal local master plan of the inner archipelago, 17 areas are reserved as marinas. The theoretical capacity of the marinas is around 1,400 berth if all berths are in use. In addition to berthing sites designated in the coastal local master plan, there are smaller, private jetties with berths as well as natural harbors in recreational areas. The main service marinas are those located in the center of Ingå and in Bärösund. The Ingå Marina, which provides services for pleasure craft in particular, is located in the center by Kyrkfjärden on both sides of River Ingå. There is a fairway that is 1.9 m deep to the port.

The Ingå archipelago area in general is assessed to have significant recreational value. Recreational uses include boating, fishing, outdoor pursuits, wildlife-watching and landscape values. In the winter if the waters freeze over, people move on the ice using a variety of modes of transport, ski, skate and ice-fish. The project area does not differ particularly from other archipelago areas of Ingå in terms of recreational use. Located south of the center of Ingå, around 2.5 km northeast of Fjusö as the crow flies, there is a public swimming beach.

The tourism and recreational appeal of Ingå is based on the marine and coastal areas and archipelago.

### Livelihoods and employment

There were around 1,300 jobs in Ingå in 2012. In 2012 around 2,500 residents of the Municipality of Ingå were employed (*Statistics Finland 2014b*). Jobs in the Ingå area are focused particularly on the Joddböle port and industrial area. Service-sector jobs are centralized in the center of Ingå (*FCG Oy 2012*).

In addition to municipal services, the most important employment providers are the renewed port, rock extraction site and the heavy industry area in general. The National Emergency Supply Agency, a fishing harbor and boat winter storage facility also operate in the area. The Fortum Ingå power plant was decommissioned in 2014.

There is a boat hotel in conjunction with the Ingå Marina, offering boat storage, maintenance and repair services. There is also commercial fishing, subsistence fishing and recreational fishing in the area. According to the Ingå Fishing Region management plan from the early 2000s there are around 30 commercial fishers in the Ingå area, with the number varying by a few persons a year. There are both full-time and part-time commercial fishers. In conjunction with the environmental impact assessment of the LNG terminal, fisheries surveys were conducted in 2012, including a commercial fishing survey (*Ramboll 2013d*). The total catch of the 8 fishers responding to the survey off Ingå was 2.2 million kg in 2012. Commercial fishers mainly use salmon fykes in the summer season. The dominant method in other seasons is net fishing for pike-perch. Net, fyke and pound net fishing mainly takes place in coastal areas and the archipelago. Trawling takes place in offshore areas further off the mainland, with the main catches being Baltic herring and sprat. The large unit catches of trawling explain the high rates of commercial fishing catches in terms of kilograms.

The annual number of recreational fishers is estimated to be around 18,700 and the recreational catch around 230,000 kg a year. There is no fish farming subject to a permit in the area. There are 859 register units of owners of waters, of which 210 are joint register units.

According to the 2012 fisheries survey (*Pöyry Finland Oy 2013a*), 44% of households responding to the survey engaged in recreational fishing in the marine area off Ingå. The majority of subsistence fishing takes place in the summer, with only few carrying out winter net fishing.

# 8 ASSESSMENT METHODS AND THE ENVIRONMENTAL IMPACTS ASSESSED

## 8.1 Seabed

### 8.1.1 Assessment methods and assessment uncertainties

The impacts on the seabed were assessed by examining the potential impacts on the seabed caused by the project particularly during the construction phase. The environmental impact assessment is based on an expert assessment of the quality of the sediment, particularly of its grain size and water content, in the project area in western Gulf of Finland.

Water content illustrates the looseness of the sediment, i.e. how easily the sediment can be removed from the bottom by currents or mechanical intervention. The higher the water content the looser the sediment material. If the sediment is dense, which is usually the case with sediments such as old glacial clays, the material is bound together by strong cohesion, whereby particles will not come off easily even if subjected to a relatively strong force. Near-bottom currents have to be quite strong to be able to detach particles from dense and smooth glacial clay surfaces. On the other hand, loose sediments containing water, such as mud, are sensitive to external impacts and are easily suspended, creating clouds of fine fractions in the water column.

The assessment also covers concentrations of harmful substances, and these are compared with sediment reference values provided in literature, in this case the Government Decree on the Assessment of Soil Contamination and Remediation Needs (Government Decree 214/2007). The sediment concentrations measured are also compared with the highest no-effect concentration (HNEC). When employing species sensitivity distributions (SSDs), this level is referred to as the HC5 (HC = hazardous concentration) where, according to toxicity tests, the sediment is hazardous to 5% of the soil organisms or processes. The values used in a publication of the Finnish Environment Institute *(Reinikainen 2007)* are employed as reference values. Concentrations found in sediment samples from the pipeline route are also compared with background concentrations of samples taken off the coast of the Gulf of Finland in 2001 and 2004 *(Vallius 2007)*. If the concentrations of harmful substances found in analyses of samples obtained from the Balticconnector natural gas pipeline study corridor are close to the background concentrations of coastal sediments provided, the material can be regarded as being almost at the natural level in terms of composition.

The assessment of environmental impacts on the seabed was conducted on the basis of extensive background data as regards the quality of the seabed as well as its chemical composition. As the seabed measurements were carried out with full coverage, no surprises are to be expected in the construction phase as regards seabed properties, i.e. uncertainties have been minimized through research method optimization. The chemical composition of sediments can also be regarded as being sufficiently well known on the basis of the data available. The biggest individual uncertainty in the environmental impact assessment is the choice of construction methods. The actual environmental impacts of the construction project can be affected through route optimization and correct selection of construction methods.

The environmental impact assessment was conducted by an experienced researcher specializing in marine geology and sediment geochemistry.

### 8.1.2 Impacts during construction

#### Impacts on the seabed

##### Gulf of Finland

The construction of the Balticconnector pipeline will result in impacts on the seabed of the Gulf of Finland. Depending on the section of seabed and the need for seabed intervention, there will be the need in places to plough (clay bottoms), dredge (harder bottoms) or blast (bedrock) the seabed. Seabed leveling may also take place through subsea rock installation to create transition sections for freespan rectification.

The most extensive blasting work will be required in the pipeline's landfall zone and the area close to the shore where blasting will be needed to lower bedrock peaks by approximately 1.5 m. The final route optimization will involve the avoidance of bedrock, whereby the amount of blasting required is likely to be below the preliminary estimates. Otherwise the pipeline will be laid on clay, whereby ploughing will be the most common method of seabed intervention employed. Blasting may also possibly take place on two sites in the Exclusive Economic Zone of Finland in the context of clearance of wartime munitions unless these can be avoided through route optimization. These sites are located at depths of 65–66 m on soft clay bottoms.

Rock blasting and hard-bottom dredging will result in lower levels of suspension of fine fractions in the water column than seabed intervention in clay-rich areas. Clay bottom intervention will result in the suspension of fine fractions up to considerable extents, but even in these cases the impact will be reasonably short-term and reversible. Sediment dispersion modeling is covered in section 8.3.

The topography of the seabed will be changed in the impact area of the natural gas pipeline, partly due to the above-mentioned seabed interventions and party due to anchoring. In addition, depressions in the seabed will be caused by the clearance of explosive remnants of war. Protrusions from the seabed, on the other hand, will result from subsea rock installation to protect the pipeline. Depending on seabed material and the construction methods selected, the impacts will be either long-term and permanent or short-term and reversible. Hard-bottom interventions will result in long-term or permanent changes in seabed topography, while soft-bottom interventions will result in short-term and partly or fully reversible changes.

The Gulf of Finland seabed can in the Ingå area be roughly divided into three main geological components: the bedrock as well as hard and soft soils. The bedrock is very stable and will remain unchanged throughout the construction period, excluding any blasting carried out. From the project perspective, hard soils can be regarded to comprise glacial tills as well as gravels and sands. Hard soils will need to be moved during the project, but the material will – with the exception of fine soil types – be such that cannot to any noticeable extent be moved by even strong currents. Therefore they will remain relatively stable during the project, excluding any earthmoving work. The stability of sand mainly depends on near-bottom currents. Changes in currents in an area caused by construction or natural conditions may subject some sand deposits to erosion and redeposition in another location relatively close to the site of origin. Soft soils include clays, which are in part quite stable and in part relatively sensitive to erosion. Old, compact clays are quite hard, and cohesion between mineral structures in such clays keeps them in a highly compacted state. A large force is required to detach material from the surface of such clay deposits. The most erosion-sensitive types are soft muds containing water, which usually have an above-average organic matter content.

All geological units may face a variety of impacts during pipeline construction. Impacts on bedrock will occur in sections where seabed blasting is required. Other types of intervention will be employed on glacial till and other soil types. It is estimated on the basis of the technical feasibility study and other studies *(incl. MMT 2014)* carried out for the project that seabed blasting and dredging over a section totaling almost 20 km will be required during construction. The largest amount of seabed intervention work will take place on soft bottoms, which is where ploughing will be used. Consequently, the impacts will mainly focus on soft sediments as these are easy to dig or otherwise manipulate, but these may also be changed "involuntarily" due to near-bottom currents caused by construction. Where an anchored pipelaying vessel is used in construction (close to the shore where the use of an unanchored vessel is not possible), the handling of anchors will also result in seabed intervention. In these cases as well the softest sediments will be those the most easily impacted by construction work. Low impacts on the seabed will result from the clearance of wartime munitions.

### Ingå

Off the Ingå coast the two routing and landfall alternatives of the Balticconnector pipeline run through highly varied seabed types. Both routing alternatives pass the island of Stora Fagerö and run in part along soft clay bottoms and in part hard till or bedrock bottoms. The biggest difference between the routing alternatives is in the depth of water. Water depth along the more northern alternative is on average 5–10 m shallower than along the southern alternative. The ratio of exposed bedrock and glacial till along the study corridor of the southern routing alternative is almost equal to that for the northern routing. The biggest difference in seabed material between the routings is in clays. In the southern routing alternative the amount of younger and softer post-glacial clay is slightly larger than in the northern alternative where the clays east of Stora Fagerö are mainly glacial clays, with mainly younger post-glacial clays only found north and northwest of the island.

The gas pipeline routing alternatives differ so much from each other in terms of seabed materials that the selection of alternatives plays a role regarding environmental impacts in the area. The more northern alternative, ALT FIN 1, runs along sand bottom areas, while a smaller section is soft post-glacial clay. The impacts of this alternative are assessed to be slightly lower than those of the more southern alternative, ALT FIN 2. ALT FIN 2 runs almost entirely on soft post-glacial bottom the intervention of which causes considerably higher rates of turbidity and potential release of harmful substances or nutrients into the water column than in the more northern sand-bottom areas.

### Harmful substances in the seabed

It can be stated concerning the concentrations of harmful substances in suspended sediments that the sediments are for the most part relatively clean on the basis of the guidelines values for soil and dredged materials, and they are not assessed to cause significant adverse effects on the marine environment (Table 7-1).

The concentration levels analyzed from sediments from the study corridor of the Balticconnector pipeline route were compared with the background concentrations of samples obtained from coastal sediments in the Gulf of Finland in 2001 and 2004 *(Vallius 2007)* as well as with the highest no-effect concentration (HNEC) *(Reinikainen 2007)* (Table 8-1) and the Interim Sediment Quality Guideline (ISQG) and Probable Effects Level (PEL) of the Canadian Sediment Quality Guidelines (*Canadian Council of Ministers of the Environment 2002*).

None of the samples collected from the Balticconnector study corridor had arsenic concentrations above the background concentrations reported by Vallius (*2007*). All of the samples exceeded the HNEC, which is clearly too low for marine sediments. Eight of the samples exceed the Canadian ISQG level for arsenic (7.24 mg/kg) but are clearly below the PEL (41.6 mg/kg). As regards cobalt and chromium, only four samples and, as regards copper, six samples had concentrations slightly above the sediment background levels reported by Vallius (*2007*). Nine of the samples exceed the Canadian ISQG level for chromium (52.3 mg/kg) but are clearly below the PEL (160 mg/kg). The same samples also exceed the ISQG level for copper (18.7 mg/kg) but are clearly below the PEL (108 mg/kg). For lead, six samples exceed the background levels reported by Vallius (*2007*) to some extent but are below the HNEC (55 mg/kg) given by Reinikainen (*2007*). Five of these exceed the ISQG level (30.2 mg/kg) but are clearly below the PEL (112 mg/kg). As regards nickel, seven samples from the Balticconnector corridor and, as regards zinc, six samples slightly exceed the background levels reported by Vallius (*2007*). The Canadian ISQG level for zinc (124 mg/kg) is almost the same as that of Vallius (120 mg/kg). Only two samples from the Balticconnector corridor had mercury in a concentration above the limit of determination. These clearly exceeded the Vallius (*2007*) background levels but were so low as to be clearly below the reference value of 0.037 mg/kg (inorganic mercury) given by Reinikainen (*2007*), while the higher concentration (0.013 mg/kg) is close to the Canadian ISQG level. Of the samples taken from the Balticconnector corridor, only six have cadmium levels clearly above the background levels reported by Vallius for cadmium, but these are still at the same level as the reference value given by Reinikainen at 0.79 mg/kg. Only two samples from the Ingå archipelago are slightly above the values (0.80–0.97 mg/kg). Both also slightly exceed the Canadian ISQG level (0.7 mg/kg) but are clearly below the PEL (4.2 mg/kg).

Table 8-1. Heavy metal concentrations in surface sediments (mg/kg average) along the gas pipeline route in 2013. *(Ramboll 2014)*. Number of samples analyzed and exceeding the limit of determination 17 (n = 17), excluding Cu 16 (n = 16), Cd 6 (n = 6) and Hg 2 (n = 2).
Abbreviations used: HNEC = highest no-effect concentration; HAC = highest ecologically acceptable concentration; HC5 = hazardous concentration (on the basis of toxicity tests, the sediment is hazardous to 5% of species or processes); ISQG = Interim Sediment Quality Guideline; PEL = Probable Effects Level.

| Metal | Average concentration in pipeline route study area, mg/kg av. (min. max.) | GD 214/2007 | | | Reinikainen (2007) | | Vallius (2007) | CCME (2002) | CCME (2002) |
|---|---|---|---|---|---|---|---|---|---|
| | | Threshold value mg/kg | Lower guideline value mg/kg | Upper guideline value mg/kg | HNEC (HC5) mg/kg | HAC (HC50) mg/kg | Sediment back-ground levels mg/kg | ISQG mg/kg | PEL mg/kg |
| **Arsenic** | 7.4 (1.6-14) | 5 | 50 | 100 | 0.9 | 56 | 16.4 | 7.24 | 41.6 |
| **Mercury** | 0.12 (0.11-0.13) | 0.5 | 2 | 5 | 0.037 | 3.7 | 0.017 | 0.13 | 0.7 |
| **Cadmium** | 0.60 (0.23-0.97) | 1 | 10 | 20 | 0.79 | 12 | 0.16 | 0.7 | 4.2 |
| **Cobalt** | 11.0 (2.2-17) | 20 | 100 | 250 | 2.4 | 170 | 15.6 | - | - |
| **Chromium** | 44.3 (7.7-74) | 100 | 200 | 300 | 0.38 | 120 | 69.4 | 52.3 | 160 |
| **Copper** | 29.9 (12-48) | 100 | 150 | 200 | 3.4 | 125 | 30.2 | 18.7 | 108 |
| **Lead** | 20.1 (4.5-47) | 60 | 200 | 750 | 55 | 490 | 24.0 | 30.2 | 112 |
| **Nickel** | 26.8 (4.5-42) | 50 | 100 | 150 | 0.26 | 65 | 34.9 | - | - |
| **Zinc** | 97.1 (20-180) | 200 | 250 | 400 | 16 | 210 | 120 | 124 | 271 |

The metals and compounds reported from the Balticconnector study corridor were in all cases considerably below the highest ecologically acceptable concentrations (HAC) reported by Reinikainen *(2007)* (Table 81), and the same applies to the Canadian PELs *(Canadian Council of Ministers of the Environment 2002)*. Therefore the surface sediments are not on the basis of the concentrations of harmful substances found in analyses assessed to cause any abnormal environmental impacts.

According to the studies conducted in 2013, the concentrations of organic compounds were low, in some cases even below the limit of determination *(Ramboll 2014)*. The concentrations of harmful organic substances analyzed were generally quite low. The sum concentrations of those including PCBs as well as the concentrations of all individual PCB congeners were in all samples below the determination limits if the analysis method of the laboratory. The concentrations of dioxins and furans were below the threshold values set in the relevant Government decree (*Government Decree 2007*) in all samples. The concentrations of organotin compounds (tribultin, TBT, and triphenyltin, TPT) were for the most part quite low. The TPT concentration was below the laboratory's limit of determination (5 µg/kg) in all samples. The TBT concentrations were below the limit of determination or quite low, being in the 2…65 µg/kg range and below the threshold value of the Government decree. The concentrations of polycyclic aromatic hydrocarbons (PAH) were mainly below the laboratory's limit of determination, with the limit of determination only exceeded at a few sampling points. The concentrations measured did not exceed the threshold values of the Government decree (*Government Decree 214/2007*).

The occurrence of petroleum hydrocarbon fractions (medium and heavy fractions) was studied for points near Fjusö, in the middle archipelago and in offshore areas *(Ramboll 2014c)*. Petroleum hydrocarbon concentrations were for the most part below the limit of determination. Those samples in which small quantities of petroleum hydrocarbons were detected were clearly below the threshold value set in the Government decree (*Government Decree 2007*). According to the results, no contamination caused by petroleum hydrocarbons could be detected in the sediments.

As regards the impacts of harmful substances in fine-grain sediments, the magnitude of change will be low, the reference values will not usually be exceeded, and there will not be any significant increase in load. The impacts of any minor changes will be short-term and reversible. Nutrients released into the aqueous phase during construction will have a short-term impact.

### 8.1.3 Impacts during operation

The Balticconnector natural gas pipeline will cover a strip of the seabed in the Gulf of Finland. The pipeline and the subsea rock berms protecting it will in many places create a protrusion from the seabed, which will have some impact on local near-bottom flows of water. This may result in slight changes in erosion and accumulation conditions in the immediate vicinity of the pipeline.

The friction in the pipeline caused by the flow of compressed gas may result in a rise in the temperature of the pipeline amounting to a few degrees. This will impact the seabed sediment at a maximum radius of a few meters from the gas pipeline. This change in temperature will not play any practical role as regards sediment characteristics. Pipeline stability and durability will be monitored throughout its operational life and whenever necessary, including due to erosion caused by currents, the stability of the pipeline will be ensured through maintenance measures. Pipeline maintenance measures will include the addition of soil around the pipeline wherever necessary. Such measures may contribute toward changes in near-bottom flows, whereby changes in flows may cause changes in erosion or sediment accumulation in nearby areas. The cumulative impacts of the resuspension of sediments caused by soil addition for maintenance reasons and any increase in net sedimentation caused by flow changes are, however, estimated to be low.

### 8.1.4 Summary of the significance of impacts and comparison of alternatives

The seabed's vulnerability for change due to the project is low. Soft-bottom seabed interventions will be short-term and in part or fully reversible. Any permanent changes in hard bottoms will be low in terms of significance. The sensitivity of the receptor (seabed) is assessed as moderate (Table 8–2).

The impacts of construction on the seabed will be low in terms of magnitude and extent due to the limited area required by the pipeline. The duration of the impact will be short as the most significant impacts will be restricted to the pipeline construction phase. The magnitude of change is assessed as low (Table 8–2).

The impacts on the seabed will mainly be targeted at the pipeline construction phase. This is when fine fractions are suspended into the water column for a limited period of time and eventually in part accumulated in other areas. The suspension phase will, however, only last for a relatively short period of time, and the turbidity impact will not be very significant. Although there may be major temporary impacts, the overall significance of the impacts during the construction of the Balticconnector pipeline can be regarded as low (Table 8–2). On the basis of the concentrations measured from surface sediment samples from the Balticconnector pipeline area, it can be considered that the harmful substances in sediments will not have a significant impact on the environment around the pipeline.

The magnitude of the physical impacts of seabed intervention will overall be low in the Gulf of Finland, but in near-coast areas, particularly the Ingå area, which is surrounded by archipelago, the impacts will be higher for a limited period of time. The overall impact in that area will still, however, be low. No permanent changes with environmental significance will take place on the Finnish side.

There is variation in the types of seabed in the areas covered by the different alternatives. On the whole the differences between the routing alternatives are so low that no significant differences are assessed to be found between them; the final route optimization in the areas of the different alternatives can play a bigger role in this highly varied geological environment that the choice of the actual routing alternative. The classification criteria used for the determination of the sensitivity of receptors and the magnitude of change are described in Appendix 3 to this EIA report.

Table 8-2. Overall significance of impacts on the seabed, C = during construction, O = during operation. There is no significant difference between the alternatives.

| Impact significance | | Magnitude of change | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Very high** | **High** | **Moderate** | **Low** | **No change** | **Low** | **Moderate** | **High** | **Very high** |
| **Sensitivity of the receptor** | **Low** | High | Moderate | Low | Low | No impact | Low | Low | Moderate | High |
| | **Moderate** | High | High | Moderate | **C & O Low** | No impact | Low | Moderate | High | High |
| | **High** | Very high | High | High | Moderate | No impact | Moderate | High | High | Very high |
| | **Very high** | Very high | Very high | High | High | No impact | High | High | Very high | Very high |

### 8.1.5 Prevention and mitigation of adverse impacts

In the construction phase efforts will be made to minimize environmental impacts through route optimization and by always selecting the most appropriate method for the work stages. Route optimization seeks to avoid difficult construction sites and bypass them whenever possible. This way seabed intervention is minimized and intervention measures only take place to the extent necessary to create a foundation for the pipeline that is as stable and durable as possible. For example, bedrock and glacial till outcrops will be avoided as much as possible as they are laborious to remove. Gorges and cliffs will also avoided because of the large-scale earthmoving work required.

Pipelaying measures will be selected with a view to minimizing any adverse effects on the environment. In offshore areas, dynamically positioned pipelaying vessels can be used to clearly reduce the need for seabed intervention from the levels seen with the anchor-handling carried out by anchor-positioned pipelaying vessels.

## 8.2 Soil, bedrock and groundwater

### 8.2.1 Assessment methods and assessment uncertainties

The current status of soil, bedrock and groundwater as well as environmental impacts on them were assessed on the basis of existing public data. Most of the soil and bedrock data was obtained from the online database of the Geological Survey of Finland *(Geological Survey of Finland 2014a)* and soil map data *(Geological Survey of Finland 2014b)* as well as the spatial data sets and services website of the National Land Survey of Finland *(National Land Survey of Finland 2014)*.

Impacts on soil and bedrock and groundwater were assessed in relation to the conditions of the natural gas pipeline landfall alternatives and onshore routings. Impacts during construction as well as operation were taken into consideration in the impact assessment. Impacts around the onshore routing alternatives were examined over a zone extending around 100 m on both sides of the routings. More detailed information about bedrock, soil and groundwater conditions along the pipeline routings will be obtained once progress is made in the technical design of the project.

Environmental impacts were assessed as an expert assignment carried out by geologists specializing in soil, bedrock and groundwater.

### 8.2.2 Impacts during construction

No valuable bedrock areas or groundwater areas suitable for water supply can be found at the landfall alternatives, LF1 and LF2.

During construction, overburden will be removed from the pipeline trench down to a depth of around 2 m. According to preliminary estimates, in the LF1 alternative the volume of material estimated to be removed from the trench will total 1,280 solid m$^{3\text{-theor}}$ and from the work area around 8,140 m$^{3\text{-theor}}$. In the LF2 alternative around 1,214 m$^{3\text{-theor}}$ will be removed from the trench and around 8,800 m$^{3\text{-theor}}$ from the work area. The material removed from the trench will be deposited next to the trench. Following the installation of the natural gas pipeline, the trench will be backfilled with the overburden, and the pipeline route will be marked with white signposts. The removal of protective soil material may increase surface runoff during construction. Increased surface runoff may increase the input of solids into ditches near the worksite. Any turbidity will, however, be temporary and the adverse effect mainly visual. Once construction is completed, the soil will be restored and vegetation will be gradually restored with the exception of the control zone (usufruct area) where no trees may be planted.

During construction, bedrock extraction and blasting will have to be carried out for the pipeline trench. The volume of rock to be extracted and blasted to make the trench will in the LF1 landfall alternative be around 1,431 m$^{3\text{-theor}}$ and in LF2 around 2,290 m$^{3\text{-theor}}$. Blasting will also take place in the work area, but the volumes extracted will be very small. Bedrock extraction will change the bedrock permanently in the area, but the scale of extraction will be very small, whereby the impact will be low. The bedrock in the area mainly consists of microcline and does not contains heavy metals or sulfides, so the material extracted can employed further in the area for purposes as the foundations of maintenance roads is the material otherwise meets the geotechnical construction requirements.

The construction of the pipeline will have a very low or no impact on groundwater in the area. The area is owned by the National Emergency Supply Agency and there are no private wells in the area. The removal of overburden during construction may increase the quantity of water absorbed and, consequently, the quantity of groundwater formed. This is not, however, assessed to have quality impacts on groundwater. Should the pipeline trench at some point extend to the top of the water table, soil intervention during construction may result in momentary turbidity in groundwater but will not cause any deterioration in quality.

The construction of the compressor station will require the removal of soft materials and the leveling of the ground before the construction of the foundations. The materials removed will be taken to a soil landfill site or utilized in other construction in the area if possible considering the geotechnical properties of the material. The construction of the compressor station will not have adverse effects on soil, bedrock or groundwater.

If the compressor station is powered by electricity, the electricity will be supplied by the Fortum substation located in the area, from where a 110 kV underground cable will be laid to the compressor station. According to the preliminary plan, the underground cable will run along current roads in a pipeline trench already containing other cables and, for part of the way, also the main pipeline of the Ingå wastewater purification plant, by the Fiskehamnsvägen road. The digging of the trench and the installation of the underground cable will not cause adverse effects on soil or bedrock or impacts on groundwater.

### 8.2.3 Impacts during operation

The impacts of the natural gas pipeline on soil, bedrock and groundwater during pipeline operation will be considerably lower than during construction. During operation the pipeline will be underground. The operation of the pipeline – i.e. the flow of gas in the pipeline – will not create any noise or other disturbance above the ground. The natural gas pipeline will be clearly marked with signposts. This will increase awareness about the pipeline and prevent pipeline damage caused by outsiders.

In the event of pipeline damage during operation, natural gas will not absorb in the ground or mix with groundwater. Instead, in normal temperature it is vaporized and evaporates into the air. Digging with minor local impacts mainly on soil may only be required due to pipeline maintenance and servicing.

During operation, turbine washing water and residual condensate of the natural gas pipeline are created at the compressor station, and these may contain small quantities of oil from the equipment. There will be designated containers for oily water and turbine washing water, which will be emptied when necessary. Oil absorbent peat will also be stored at the station for use in the event of an oil spill in conjunction with maintenance work. The operation of the compressor station will not have adverse effects on soil, bedrock or groundwater.

### 8.2.4 Summary of the significance of impacts and comparison of alternatives

There are no valuable bedrock areas or groundwater areas suitable for water supply at the landfall alternatives, the respective natural pipeline routings or the area of the planned compressor station. The changes caused by the project will affect an area that is small in size and reserved for industrial operations, with opportunities for other activities such as recreation being very limited in the area. The sensitivity of the receptor is assessed as low (Table 8-3).

The impacts on soil, bedrock and groundwater will be very low during construction and operation. The soil will in part be restored, and the blasting of bedrock will be small in scale. There will not be any quality-reducing impacts on groundwater. The magnitude of changes caused by the project and overall significance of the impacts is assessed as low (Table 8-3).

In the LF2 landfall alternative soil materials will need to be handled and bedrock blasted to a slightly larger extent than in the LF1 alternative, but there is no significant difference between the alternatives as regards their environmental impacts.

The impacts of the natural gas pipeline on soil, bedrock and groundwater during pipeline operation will be considerably lower than during construction. The classification criteria used for the determination of the sensitivity of receptors and the magnitude of change are described in Appendix 3 to this EIA report.

Table 8-3. Overall significance of impacts on soil, bedrock and groundwater, C = during construction, O = during operation. There is no significant difference between the alternatives.

| Impact significance | | Magnitude of change | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Very high** | **High** | **Moderate** | **Low** | **No change** | **Low** | **Moderate** | **High** | **Very high** |
| **Sensitivity of the receptor** | **Low** | High | Moderate | Low | **C & O Low** | No impact | Low | Low | Moderate | High |
| | **Moderate** | High | High | Moderate | Low | No impact | Low | Moderate | High | High |
| | **High** | Very high | High | High | Moderate | No impact | Moderate | High | High | Very high |
| | **Very high** | Very high | Very high | High | High | No impact | High | High | Very high | Very high |

### 8.2.5 Prevention and mitigation of adverse impacts

The construction of the natural gas pipeline will be carried out with a view to minimizing adverse impacts on soil, bedrock or groundwater. Bedrock will be permanently altered by bedrock extraction and blasting. The removal of soft materials from the trench constitutes normal construction activity that will mainly mix the soil materials but will not cause adverse effects. The condition of machinery and other equipment using fuels will be checked before work commences and monitored during work. This enables the speedy detection of any fuel spills and taking of response measures, whereby soil or groundwater contamination due to a spill will be highly unlikely. The potential impacts of seabed intervention measures on the nearest properties can be eliminated through careful planning and design and correct working methods (e.g. any wells of neighboring properties can be taken into consideration in blasting design).

## 8.3 Hydrology and water quality

The project's biggest impacts on waters will be caused by marine works on the seabed relating to the pre-lay, pipelaying and post-lay coverage and protection stages. During construction, deposition of sediments into the water will take place, resulting in turbidity in the construction area. Turbidity will be transported by currents, resulting in its dispersal and, as the solids are resettled on the seabed, the loss of turbidity. The level of turbidity can be described and measured on the basis of the concentration of suspended solids (mg/l) or turbidity units (FNU). Their correspondence depends on the type of material. The conversion factor 3.4 mg/l/NTU was used on the basis of values measured from the Baltic Sea in monitoring relating to the Nord Stream pipeline *(Ramboll 2011–2013)*. In these calculations an increase of 10 mg/l in suspended solids concentration corresponded to the measured turbidity value of 5 NTU, with the average background turbidity (2 NTU) taken into consideration in this.

In general the turbidity of clear water is below 1 NTU and that of slightly turbid water 1–5 NTU. Turbidity visible to the naked eye is at the 10 NTU level. During spring flooding, river water turbidity may reach the level of 100 NTU or above. Turbidity in the water column further results in the reduction of transparency.

The assessment of impacts during construction was based on the water system modeling carried out in conjunction with this EIA procedure (*Lauri 2014*). On the basis of the high hydrographic variation in near-shore archipelago areas, the large scale of seabed intervention and the assessment of the differences between the landfall and routing alternatives, the modeling focuses on the inner and outer archipelago off Ingå. The offshore areas and, consequently, the impacts on western Gulf of Finland were also taken into consideration in the examination.

### 8.3.1 Assessment methods and assessment uncertainties

The assessment of the impacts of the construction of the natural gas pipeline on waters is based on data including the following:

1. the results of the water system modeling carried out for the project;
2. the results of the monitoring of the construction of the Nord Stream gas pipeline;
3. the results and conclusions obtained from monitoring of other marine construction projects, such as fairway and harbor dredging.

The water system model is a simplified mathematical description of the movements of water and transport of materials. It is based on water depth data, known physical constants and general flow equations. The model uses the initial data provided to calculate flow fields and directions, dilutions and outflows of materials. In the marine environment events are much more complex, with processes taking place that have not been taken into consideration in the model, such as sediment resuspension caused by currents and waves and chemical processes caused by changes in conditions.

The model was employed to assess the impacts of landfall dredging, ploughing relating to pipeline trenching, subsea rock installation, and pipeline covering on concentrations of suspended solids in water. The loads caused by other measures, such as underwater bedrock blasting, munitions clearance or pipelaying were not modeled as the loads from these were assessed to be clearly lower. The data for the construction period is based on the preliminary project designs produced (*Ramboll 2014*) and, with the exception of subsea rock installation, the specific seabed intervention methods, volumes of materials and, as regards the ALT FIN 1 routing alternative, the exact intervention areas will be specified further during further planning and design stages. The preliminary assessment of the seabed intervention taking place during construction is, however, conservative and based on the worst-case scenario; the scale of seabed intervention is likely to become smaller once progress is made in the technical design of the project. The aim was also to moderately overestimate the load values to ensure the actual solids concentrations will be lower than the calculated values.

The volumes of material used in the modeling are based on estimates from a specific point in planning and design, after which the volumes have been specified further as progress has been made in the design process, and these will be specified even further during the detailed design phase. The impacts on waters will depend on the working method and intensity of implementation, whereby the lack of precision in volumes of materials will mainly be reflected in the estimates of the duration of work. Larger volumes will increase the duration of work if conducted at the corresponding intensity. There is major variation in the types of seabed found along the planned pipeline route from clays to hard glacial till and bedrock bottoms. The volumes of material have so far only been estimated on the Finnish side considering bedrock blasting, while the modeling took place concerning softer sediments resulting in higher loads. The scale of blasting required on the Finnish side will be considerably larger than on the Estonian side due to the bedrock peaks found in the area.

In the modeling, the load on the waters caused by construction work is assessed as even throughout the period, but in reality temporal variation in levels may be significant depending on issues such as variation in working methods, sediment type and layers. It should also be taken into consideration in the examination of the modeling results that certain hydrological and meteorological conditions were used in the calculations, whereby any major differences in conditions from those during the calculation period will also affect the calculation results. Despite the variation in loads and environmental conditions resulting in uncertainties in the assessment, modeling results usually provide a good indication of the flow conditions, dispersal of materials as well as variation between areas and concentration levels. The reliability of the modeling results is further improved by the modeler's extensive experience in and knowledge of modeling of the impacts of marine works.

Comparisons with projects implemented previously provide the more reliable assessment the closer the projects are to each other in terms of conditions, geography, implementation method, volumes and seabed type. In the Nord Stream gas pipeline project (constructed in 2009–2012), the technical properties of the pipeline as well as the methods employed in its construction and testing were essentially similar to those of the project currently under assessment. The diameter and capacity of the Nord Stream pipeline are, however, around twice those of the planned Balticconnector pipeline, whereby as a general rule the impacts relating to trench size and water flows in the nearby area will be slightly smaller in this project. The Nord Stream pipeline runs through Finland's territorial waters in offshore areas close to the middle section of the Gulf of Finland and not in archipelago areas like the route of the Balticconnector pipeline off Ingå. Where applicable, efforts have also been made to compare near-shore impacts with the Nord Stream landfall areas in Vyborg, Russia, and Lubmin, Germany, where the conditions, however, differ considerably from those off Ingå as regards issues such as seabed type and openness of the waters. It can be stated that the results available from monitoring relating to the work conducted on the Nord Stream pipeline provide measured empirical data for the assessment process, particularly concerning offshore areas, but the comparability of the projects concerning near-shore areas is poorer due to the individual conditions of these areas.

Due to the different characteristics of the areas, the impacts of the natural gas pipeline were assessed as separate entities for the near-shore areas and the offshore areas of the Gulf of Finland. The assessment of the impacts on waters was conducted by experts with long and diverse experience in the assessment of the impacts of marine works in a variety of marine works projects.

### 8.3.2 Impacts during construction

#### 8.3.2.1 Water system modeling

The following is a summary of the key findings of the water system modeling carried out for the EIA procedure (*Lauri 2014*). The water system modeling report is available in Finnish on the Gasum website (*www.balticconnector.fi*). Further details of the principles, implementation and results of the calculations are provided in the report. The key results of the water system modeling concerning the Estonian alternatives are presented in Appendix 4 to this EIA report and in the EIA report for Estonia.

The modeling covered the pipeline route from the landfall site to the limit of Finland's territorial waters. There were two landfall alternatives included, LF1 (more northern) and LF2 (more southern). Two pipeline routing alternatives were examined in the Ingå archipelago: the one passing north (ALT FIN 1) and the one passing south (ALT FIN 2) of the island of Stora Fagerö. Figure 81The figure Figure 81–1) presents the modeling area and the grid network used for the coastal area. The model calculates the flows and water quality for each grid cell, whereby the grid size reflects the resolution of the model. The modeling focuses on the coastal area where there are lots of seabed intervention sites due to the varied vertical profile. According to the preliminary plan, the scale of construction required in the offshore areas in the middle section of the Gulf of Finland will be small.

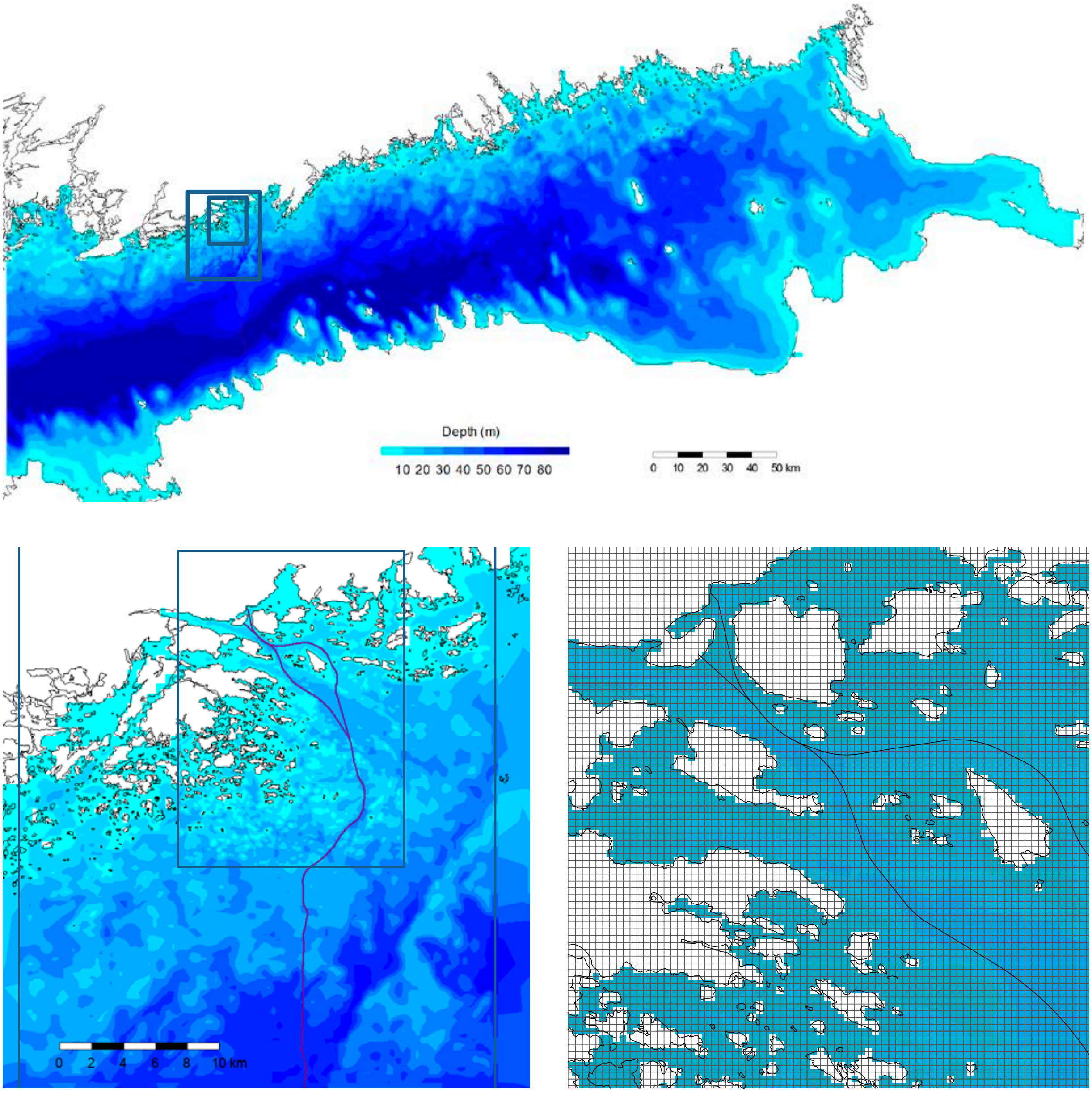



Figure 8–1. The modeled marine area and its bathymetry. The image below shows the area covered by the close-up sample grid. The image also shows the size of the grid network used for the near-shore area. (*Lauri 2014*)

Wind, its speed and direction, plays an essential role in the formation of currents that dilute and transport substances. Wind measurements made at the Mäkiluoto marine weather observation station in the period from August 14 to September 19, 2012 were used in the calculations. There was no clear main wind direction prevailed during the observation period, and the average wind speed was slightly below the average reported for the area. Lower wind speeds on average cause lower flow velocities, which reduces mixing and increases close-range concentrations but, on the other hand, also reduces the size of the affected areaFigure 82. Wind speeds varied within the 0–12 m/s range, with speeds in the 2–6 m/s range being dominanFigure 82 8-2). Marine works often need to be interrupted if wind speeds exceed these.

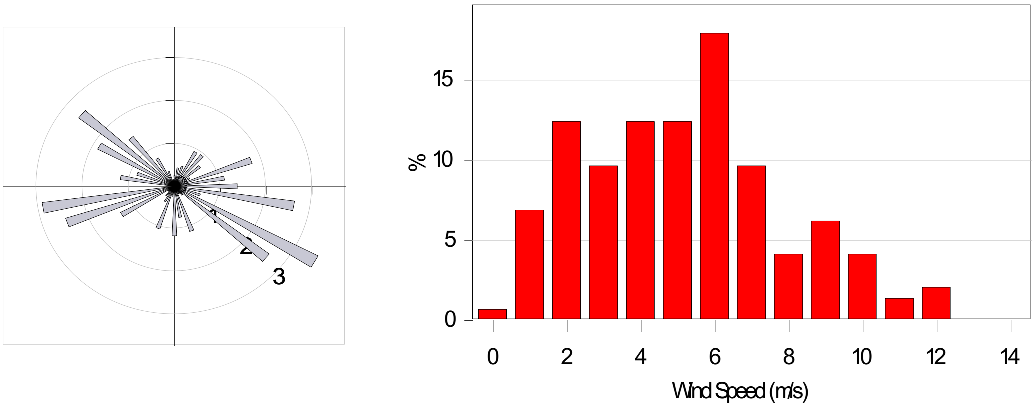



Figure 8-2. Wind directions and speed distribution during the period from August 14 to September 19, 2012, Mäkiluoto marine weather observation station. (*Lauri 2014*)

### Marine works for the landfalls

The pipeline trench from the landfall site down to the depth of 11 m is assumed to be constructed by dredging from the surface.

#### Load applied in the model

The trench cross sectional area applied is 9 m². The load on the waters resulting from dredging was assessed as follows:

- dredging capacity 83 tonnes per hour (2,000 tonnes per day);
- dredging taking place 16 hours a day (between 06:00 and 22:00);
- 2% of volume of material dredged suspended into water;
- dredged material deposited next to the trench, with the load from deposition assessed as being equal to that of dredging;
- progress made at around 100 m/day, whereby the total period of dredging will be 16 days for the ALT FIN 1 routing alternative and 9 days for ALT FIN 2; and
- the material dredged is presumed to consist entirely of clay, with the settlement rate being 7 cm a day, excluding the rate near the bottom at 1/5 of this, i.e. 1.4 cm per day. This is an overestimate if some of the material is silt, which will settle onto the bottom more quickly.

With these assumptions the suspended solids load from dredging will be 26.7 tonnes per day (1.67 tonnes per hour). The total load will be the load from dredging plus the load from deposition, i.e. 3.34 tonnes per hour or 53.4 tonnes per day (based on 16 working hours a day).

### Impacts of landfall dredging on concentrations of suspended solids in water

Average concentration fields calculated at two-day intervals as well as time series for three data points, t1, t2 and t3 were produced from the model for both routing alternatives. The locations of the data points are shown in the figure (Figure 8-3).

According to the modeling results, due to the shallowness of the near-shore areas there are no significant differences in the landfall alternatives between the surface and bottom as solids will be suspended throughout the water Figure 84mass. The largest concentrations will be found near dredging areas, where the levels can be in the 15–30 mg/l for LF1 and 5–15 mg/l for LF2. In LF1, near-shore dredging will take place in more sheltered waters than in LF2, whereby the concentrations will be higher (Figure 8-4).

LF1 alternative

LF2 alternative

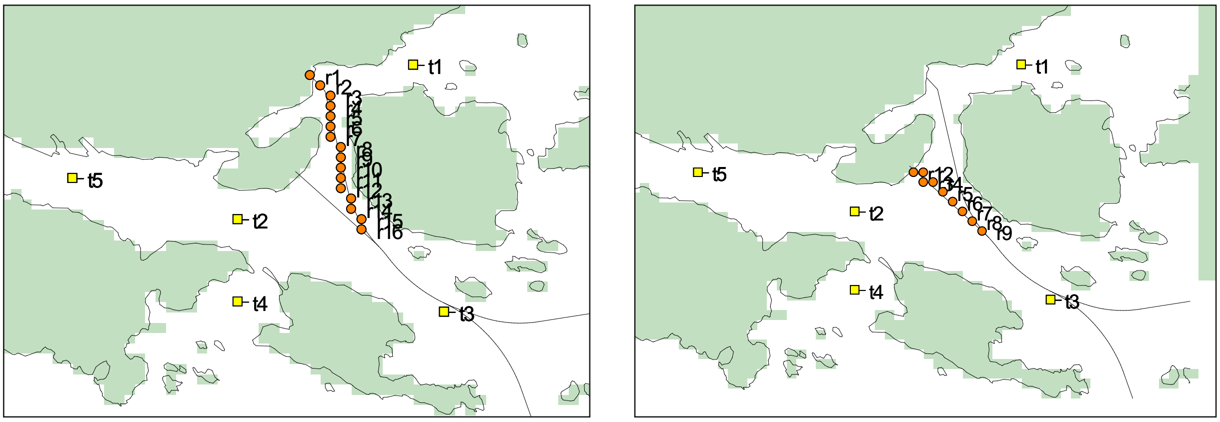



Figure 8-3. Load points (r1–r16) and data points (t1–t5) for the landfall alternatives. *(Lauri 2014)*

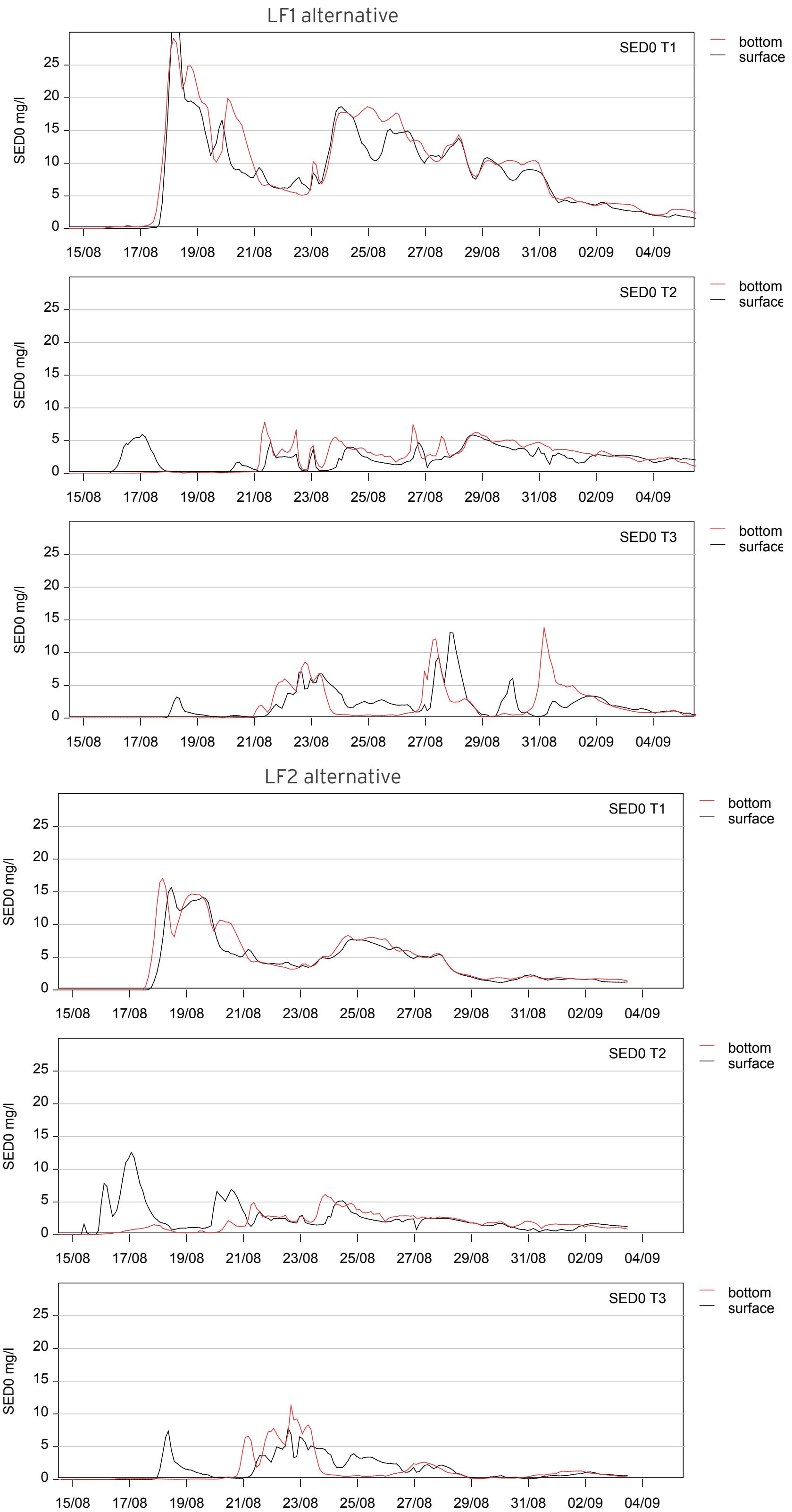



Figure 8-4. Time series of concentrations of suspended solids from dredging for the LF1 and LF2 landfall alternatives for the calculation period from August 15 to September 6 at data points t1, t2 Figure 83and t3. The data points are shown in the previous Figure 8-3). *(Lauri 2014)*

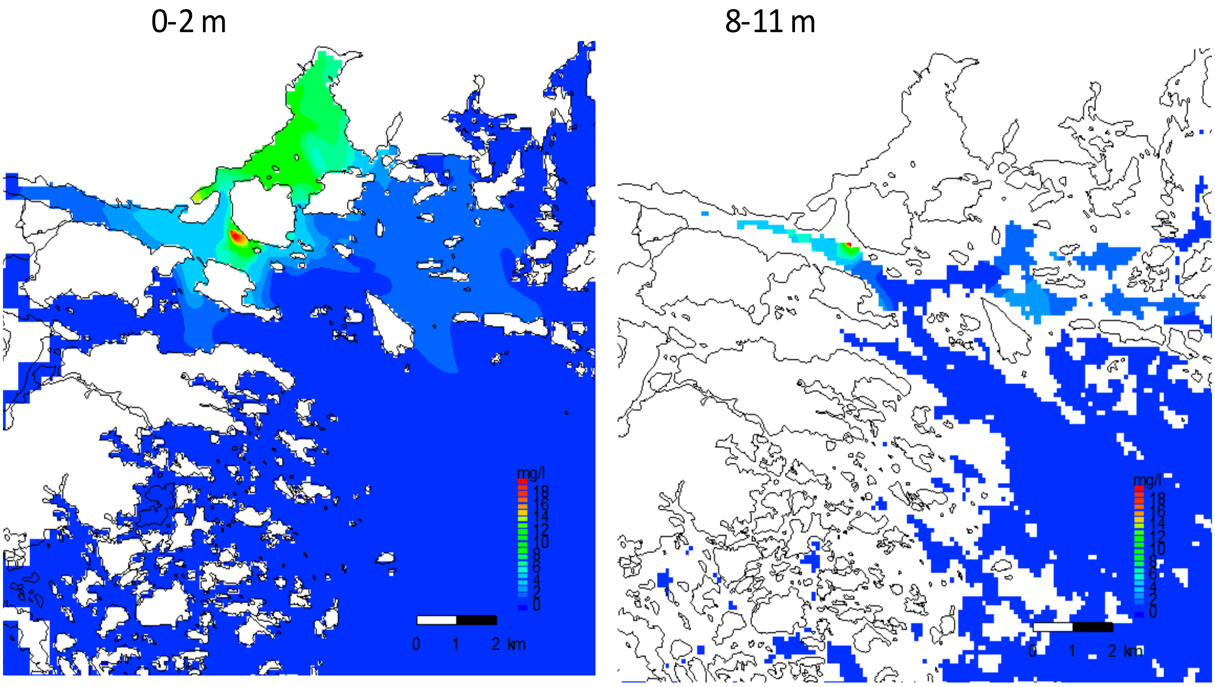



Figure 8-5. Spatial distribution of concentrations of suspended solids when the affected area is at its largest for LF1 as a two-day average for August 2–28. (*Lauri 2014*)

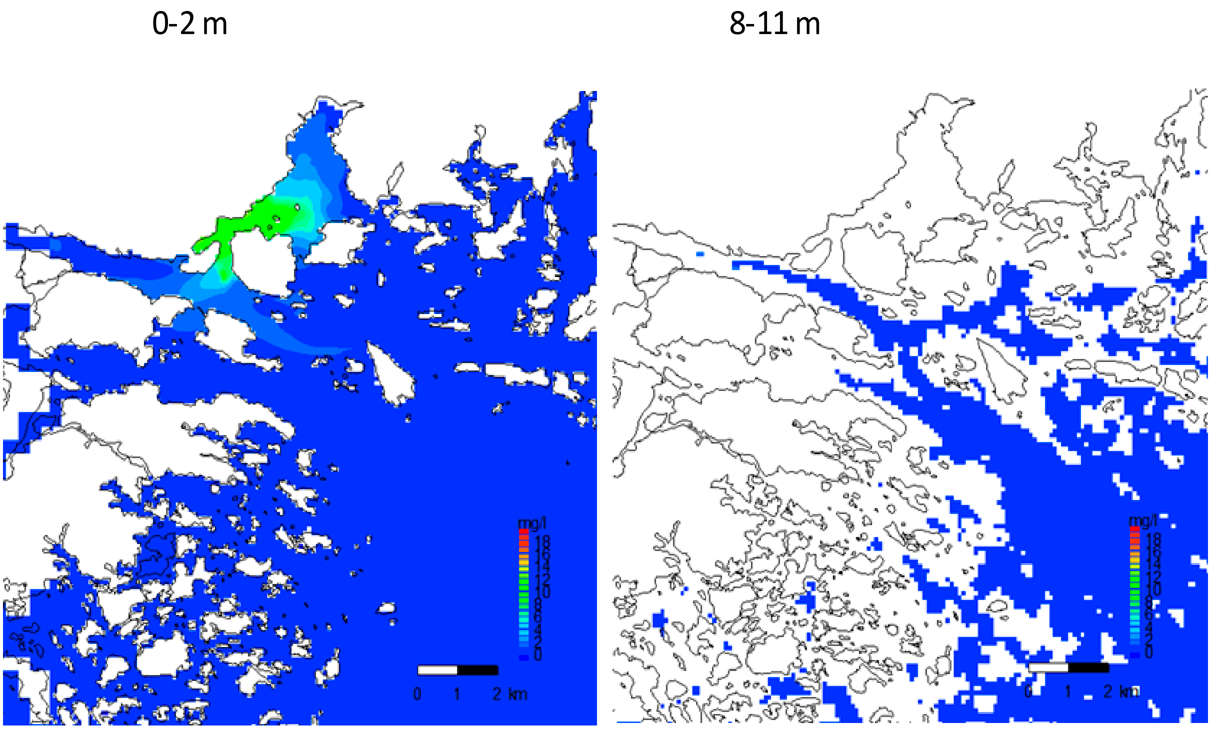



Figure 8-6. Spatial distribution of concentrations of suspended solids when the affected area is at its largest for LF2 as a two-day average for August 18–20. (*Lauri 2014*)

With the LF1 landfall alternative the volumes of material will be larger, and therefore the dredging period will be longer. In terms of size of area, the affected area will be at its largest in LF1 after approximately two weeks of work when dredging will have progressed to the western side of the island of Skämmö. At that point the size of the area of turbidity will be around 5 km², with the area of mild turbidity extending to the area off the center of Ingå and also to the official swimming beach of Björkkudde Figure 84in Ingå. With the LF2 landfall alternative the area of turbidity will be around half Figure 84(FiguFigure 85 Figure 8-5).

### Pre-lay subsea rock installation

#### Load applied in the model

In soft sections soft sediment will be displaced by rock, whereby fine material will be suspended into water. The load resulting from subsea rock installation was assessed as follows:

- the sediment load in tonnes is assessed to be 2% of the volume of rock installed, e.g. volume of rock 1,000 m³ => load 20 tonnes;
- the load will be targeted at the bottommost 3–7 m from the bottom from the depth of the installation site;
- installation capacity is assumed to be 1,000 m³/hour, (depending on equipment this may be, e.g. 500–2,000 tonnes per hour, density of crushed rock around 1.5 tonnes/m³), whereby the load would be 20 tonnes per hour;
- The installation is assumed to take place continuously until the entire volume of rock to be installed is in place; e.g. the installation of 2,000 m³ of rock will in such a case take two hours and the total load will be 40 tonnes of suspended solids.
- The composition of the seabed is assumed to be as follows: depth less than 50 m, 60% clay (grain size <2 μm) and 35% silt (grain size 2–60 μm), depth more than 50 m, 80% clay, 20% silt.
- The rates of settlement were entered as follows: for clay a settlement rate of 60 cm/day, resedimentation rate 15 cm/day, for silt a settlement rate of 200 cm/day, resedimentation rate 50 cm/day.

#### Calculation procedure

According to preliminary estimates, there will be around one hundred subsea rock installation sites on the Finnish side. The volume of rock to be installed will exceed 130,000 m³, and the total combined length of the sections where rock will be installed will be around 4 km. Seabed type data was combined with the installation site data, after which those sites where the volume of rock to be installed in clay-bottom areas will exceed 2,000 m³ were selected for the modeling. Sediment load at bedrock bottom sections was assumed to be low and at sand bottoms to settle quickly, whereby such sections were not included in the calculations. The rock installation sites are shown in the figure (Figure 8–7), in which the modeled sites are also indicated. A few of these are located in the archipelago area, but most are located in the offshore area.

On the basis of measurement data from the Mäkiluoto marine weather observation station, two different five-day wind scenarios were selected for the calculations:

1. average wind period 6.2 m/s, southwesterly winds (June 31–August 5);
2. calm wind period 4.0 m/s, northeasterly winds (August 8–13).

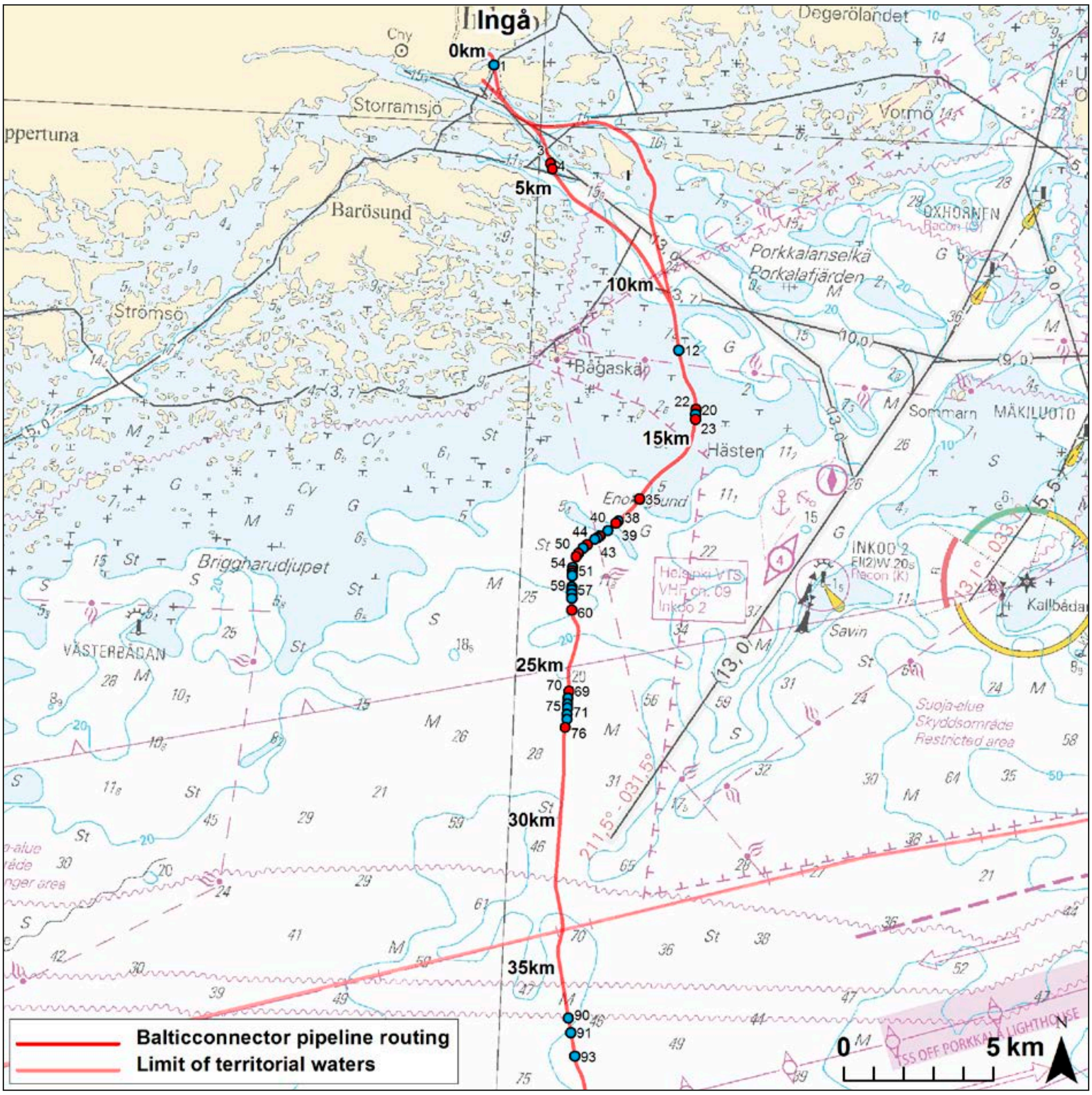



Figure 8–7. Subsea rock installation sites (> 1,000 m³) in marine areas on the Finnish side. The modeled installation sites are shown in red.

### Impact of subsea rock installation on concentrations of suspended solids in water

Concentration fields were produced from the model for points close to the coast at two and five days from load commencement. For points further off the shore, concentration fields were only produced at two days from load commencement, because for any further points the concentrations were already diluted efficiently and resedimentation took place two days from load commencement.

According to the modeling conducted, at all rock installation sites the concentrations of suspended solids were below 15 mg/l, including in periods immediately after the installation. The highest turbidity impacts were created at the near-shore installation points 3 and 4 and further off the shore at points 20, 23, 50 and 69. At point 50 the volume of rock installed and the volume of rock installed on a clay-bottom section were the largest, around 6,200 m³ of rock, of which 4,300 m³ on clay bottoms. At points 3 and 4 the volumes of rock will be 2,000 m³ for both sites, and the sites are close to each other, which will cause cumulative impacts. At the near-shore installation site 1 the volume of rock will be rather small, around 1,200 m³.

The locations of the load points and time-series points produced for installation sites 3 and 4 are given in the figure ( Figure 8–8).

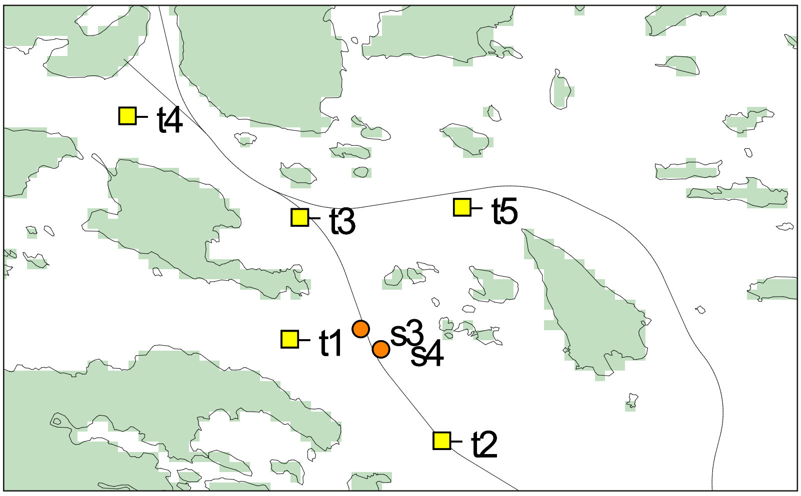



Figure 8-8. Subsea rock installation sites 3 and 4 and data points t1-t5. *(Lauri 2014)*

Subsea rock installation will result in a brief turbidity burst at the installation sites of points 3 and 4 where the concentrations of suspended solids will in the average wind scenario rise to the level of 10–12 mg/l on the bottom and in the low-wind scenario to a slightly higher level of 14–15 mg (Figure 8-9).

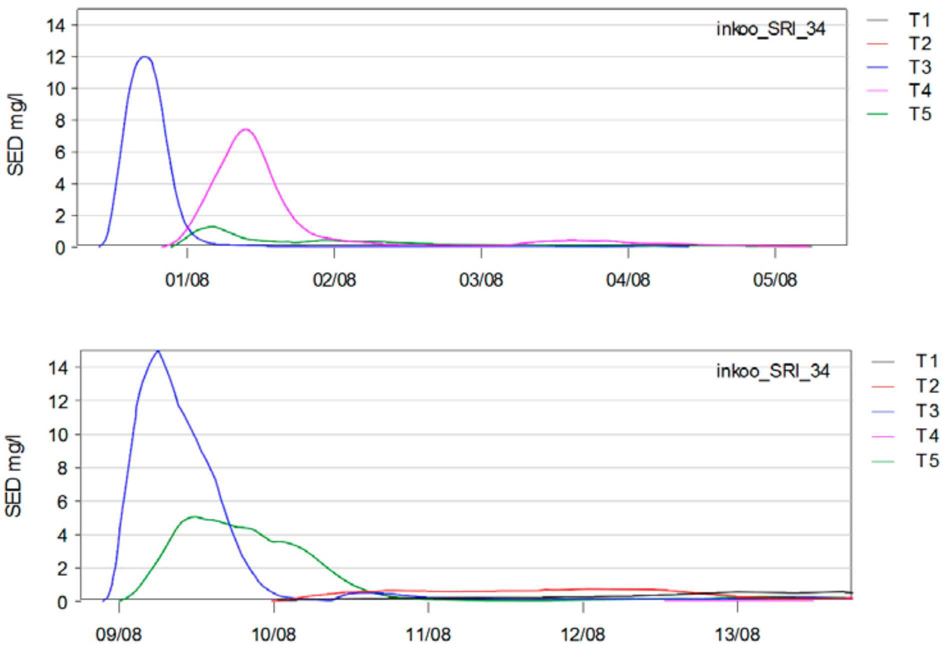
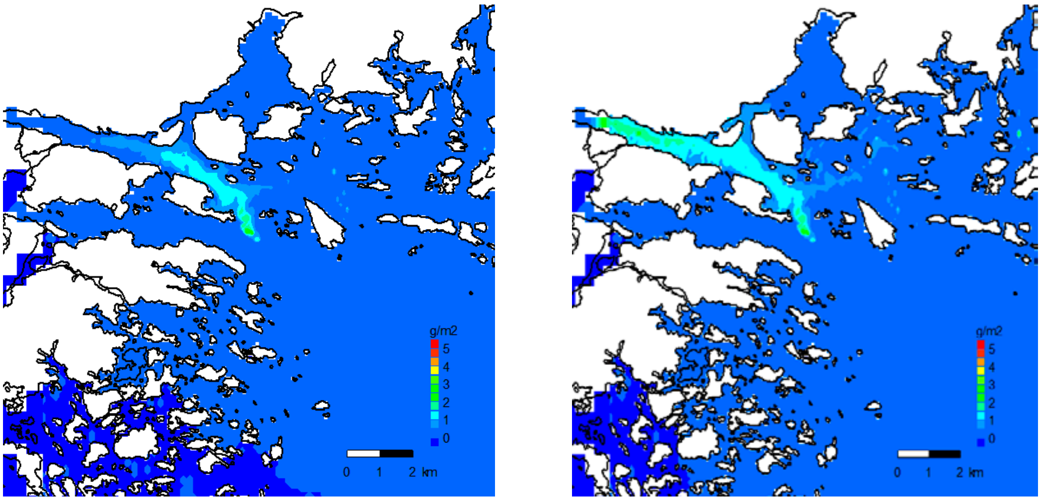


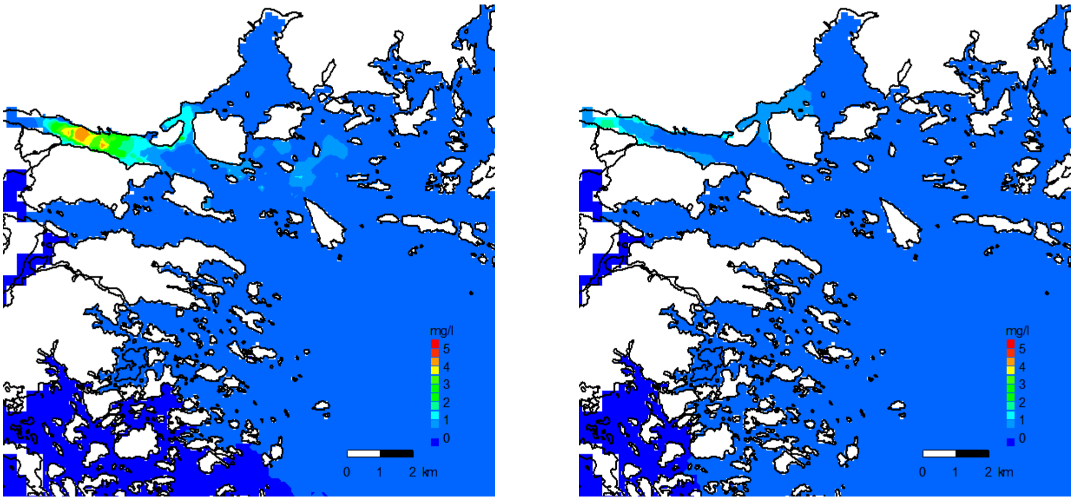

Figure 8-9. Concentration of suspended solids in water at subsea rock installation sites 3 and 4 at data points t1-t5 in the average wind scenario (top) and low-wind scenario (bottom).

The direction of the transport of turbidity depends on the prevailing wind and flow conditions. With the southwesterly winds applied in the calculations for the average wind scenario, the turbidity is transported along the fairway toward Norrfjärden and is at its highest at data points t3 and t4. In the bay the calculated concentrations are at their highest in the 4–5 mg/l range. The turbidity will also be dispersed to a large extent along the bottom, whereby the impacts on the surface will be clearly lower. The turbidity will settle on the bottom, with the coarser material settling closer to the worksite and finer fractions transported further. Deposition to the bottom will be in the range of 2–3 g/m² (Figure 8-10).

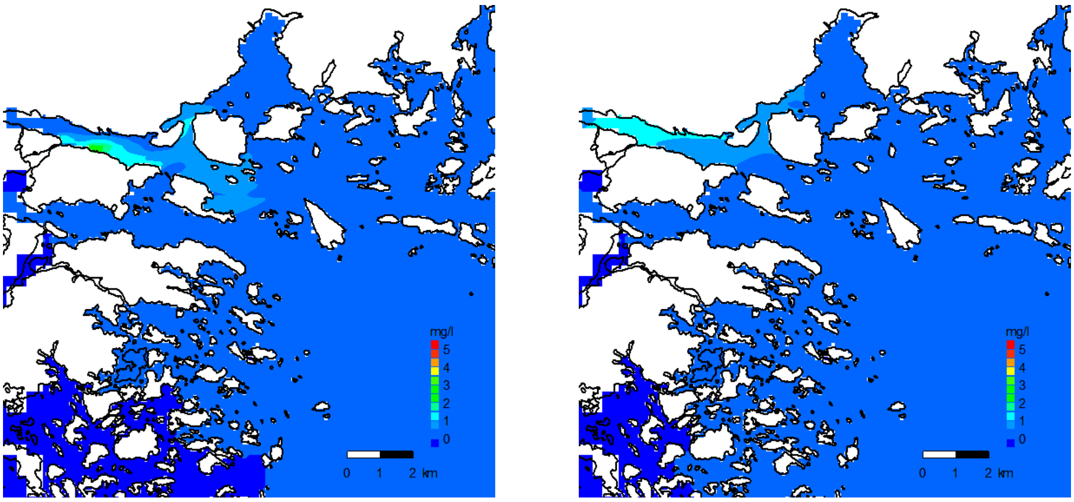
With low northeasterly winds the turbidity will be dispersed along the coast to the archipelago off Ingå, with the concentrations of suspended solids increasing in the bottom layer at 3–4 mg/l. The size of the area of turbidity is around 2 km² (Figure 8-11).




Accumulation

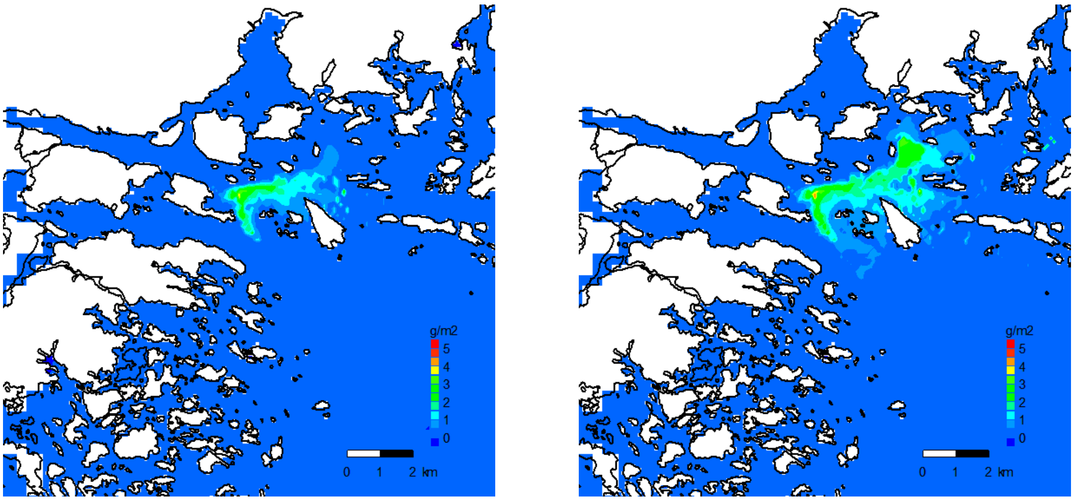



Concentration, bottom

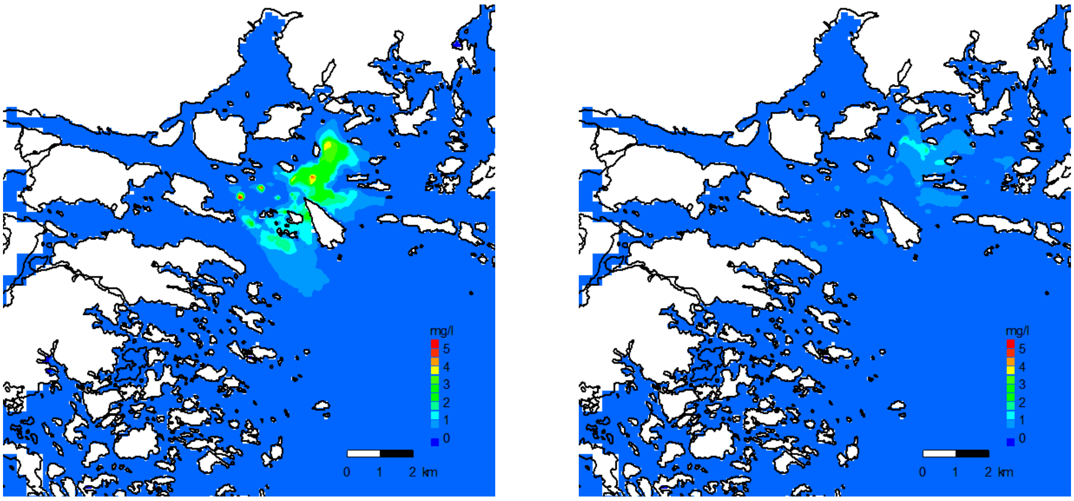



Concentration, surface

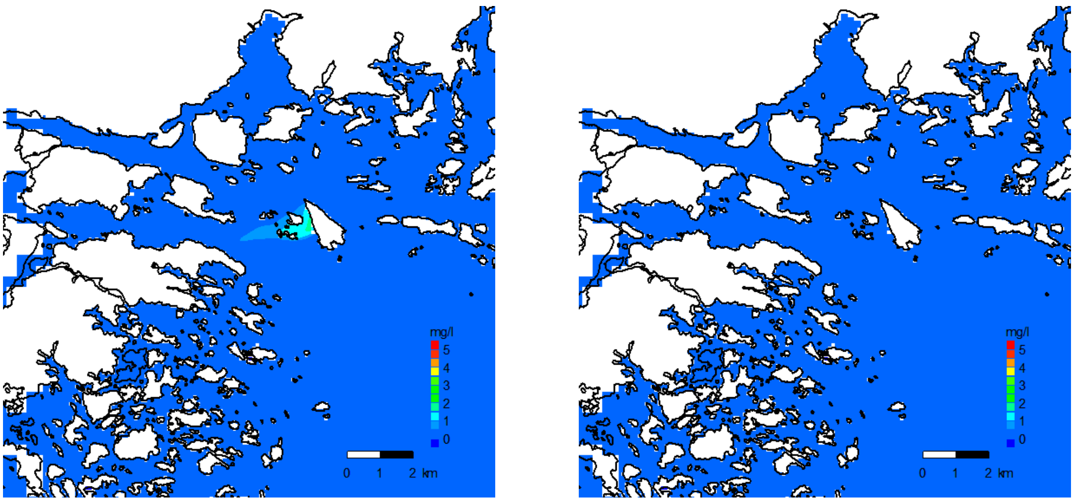
Figure 8-10. Accumulation of suspended solids on the bottom and concentrations of suspended solids in the bottom and surface layers with southwesterly average winds for installation sites 3 and 4. The figures on the left show the situation at two days and those on the right at five days from rock installation.




Accumulation

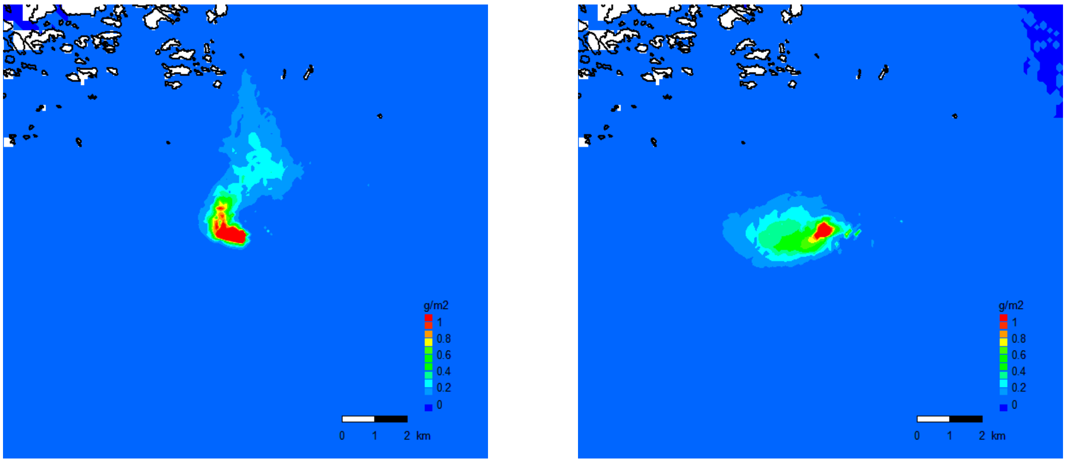



Concentration, bottom

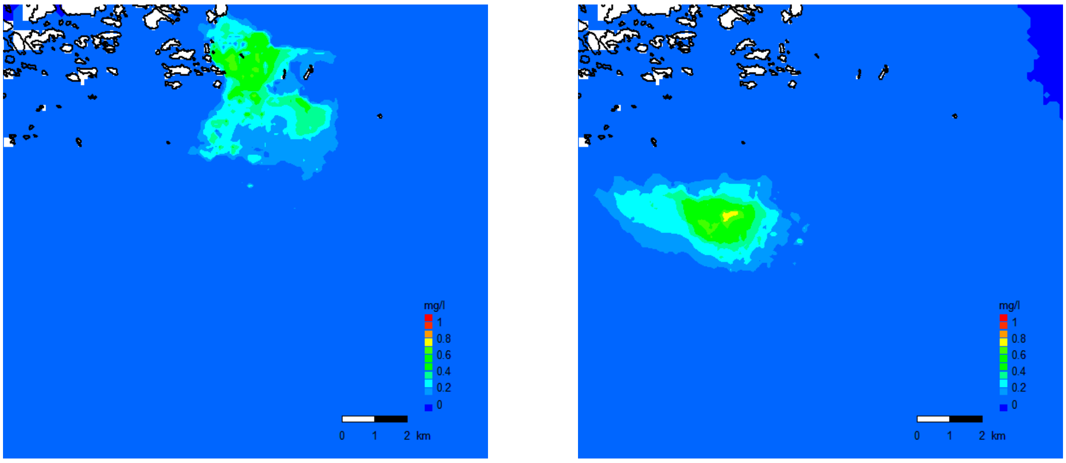



Concentration, surface

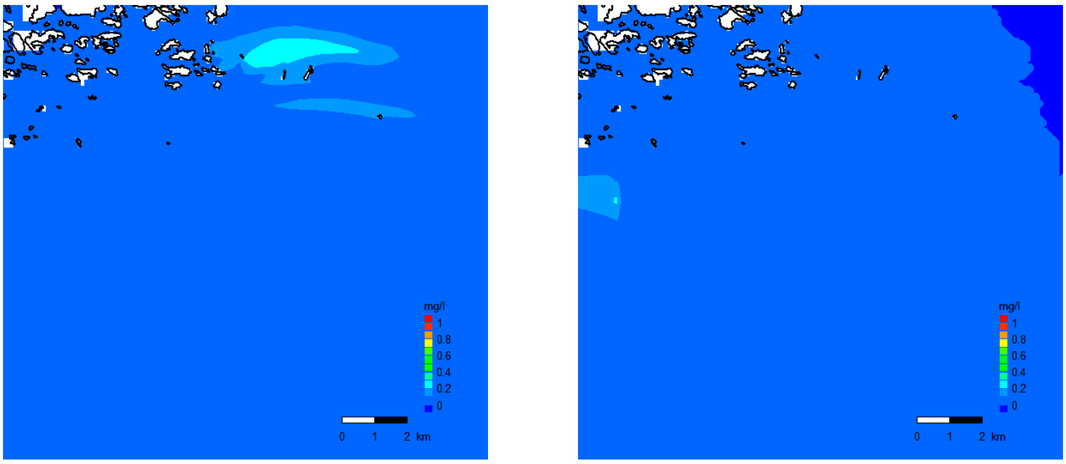
Figure 8-11. Accumulation of suspended solids on the bottom and concentrations of suspended solids in the bottom and surface layers with low northeasterly winds for installation sites 3 and 4. The figures on the left show the situation at two days and those on the right at five days from rock installation.




Accumulation




Concentration, bottom




Concentration, surface

Figure 8-12. Accumulation of suspended solids on the bottom at two days and concentrations of suspended solids in the bottom and surface layers for installation site 50. Average wind scenario on the left and low-wind scenario on the right.

At installation point 50 the volume of rock installed on the clay bottom will be around 4,100 m³. Even on the bottom the maximum increases will be clearly below 10 mg/l while the area of turbidity will be around 5 km². The rapid exchange and large volumes of water will reduce the concentrations rapidly. Only around 1 g/m² will be deposited on the bottom in the areas nearby (Figure 8-12).

### Pipeline route ploughing

In the modeling ploughing is assumed to be used to produce the pipeline trench in section where the bottom consists of clay, glacial till or sand.

#### Load applied in the model

The suspended solids load caused by ploughing was estimated to be 2% of the seabed material displaced by the plough. This includes the suspension of solids caused by the propeller wash impact of the plough tow vessel. The cross sectional area of the trench ploughed is assumed to be 9 m² and the ploughing rate 0.25 m/s. Bottom density is estimated at 1,500 kg/m³ and water content 50%. With these values the load obtained was 121 tonnes per hour. In bedrock sections of the seabed the load of suspended solids was assumed to be zero.

#### Calculation procedure

In the modeling, ploughing was assumed to take place in two stages, with stage 1 covering the ploughing from the starting point (the crossing point of the Ingå landfall alternatives) continuously approximately to KP 12.4 (measured along the route south of Stora Fagerö), and stage 2 from KP 12.4 approximately to KP 23. The sections were calculated over a period of five days for the average wind scenario and low-wind scenario. There were two routing alternatives for section 1. These passed north and south of the island of Stora Fagerö. The duration of ploughing for the more northern route was around 19 hours and for the more southern route 15 hours in the calculations. The ploughing load lines are shown in the figure (Figure 8-13).

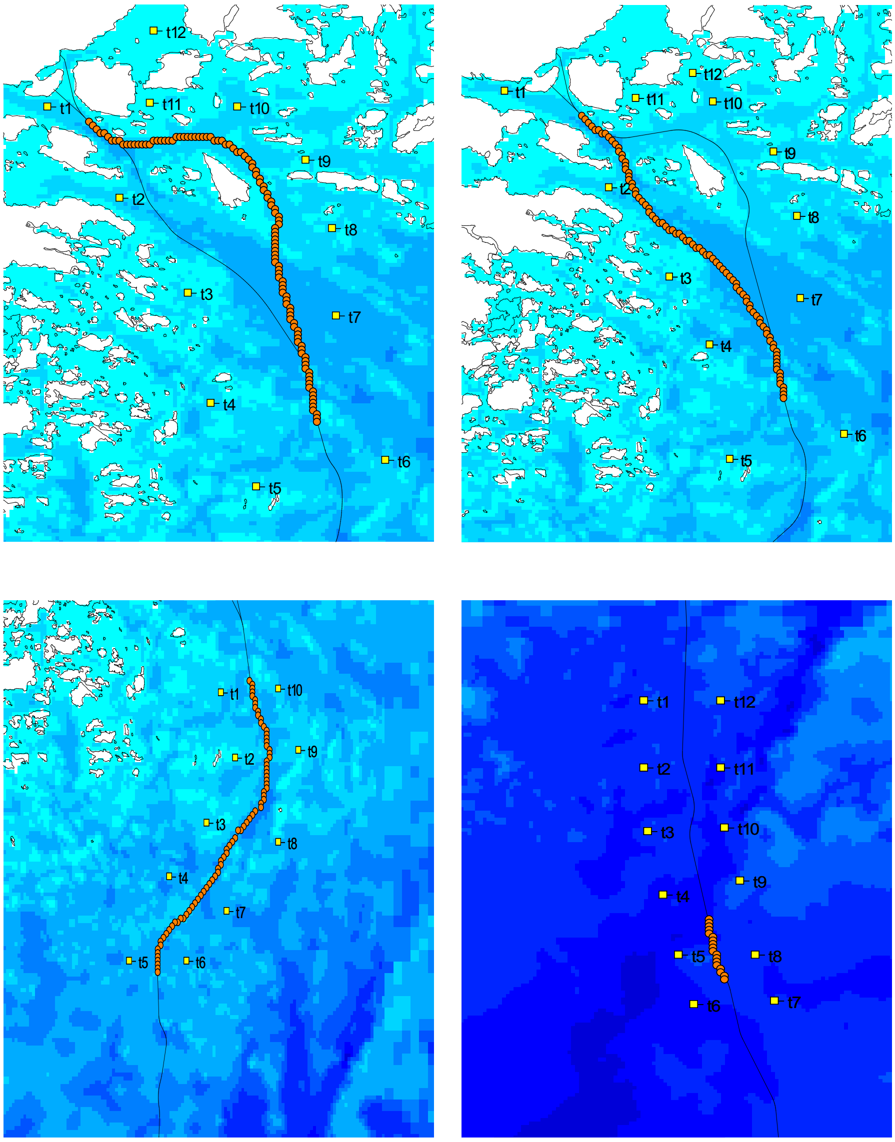
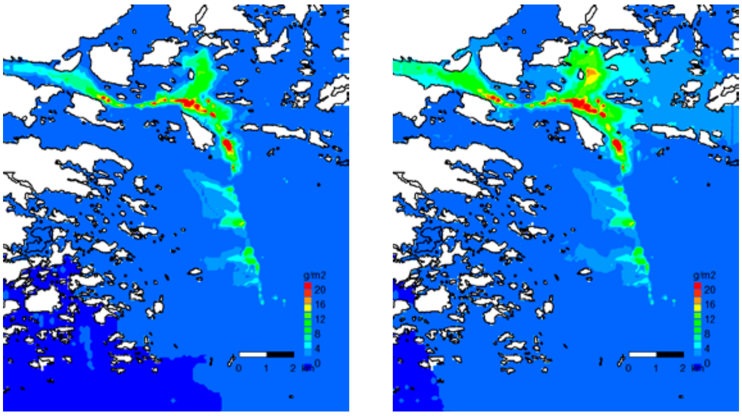


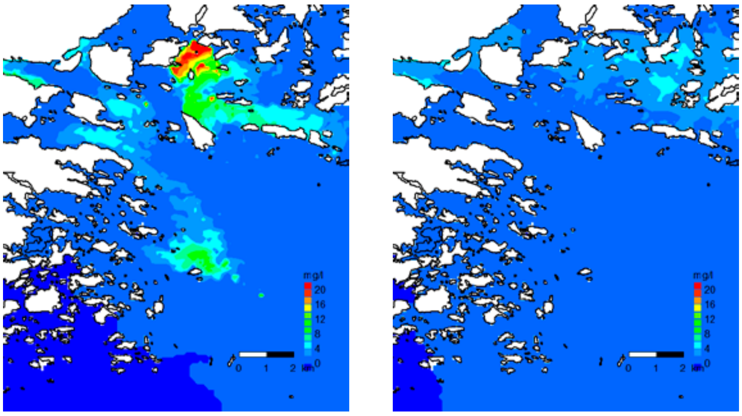

Figure 8-13. Ploughing load lines.

### Impact of ploughing on concentrations of suspended solids in water

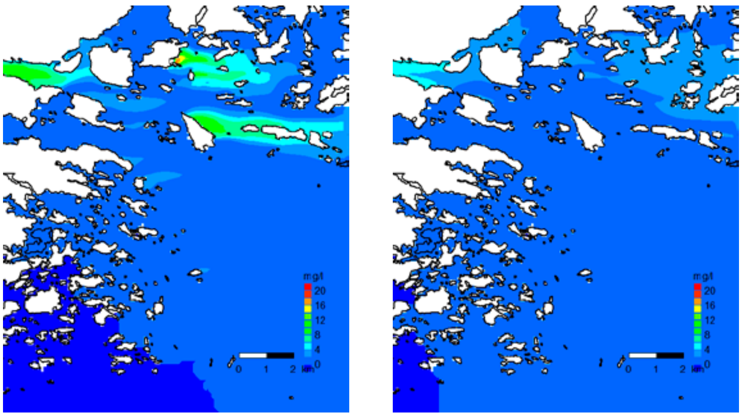
For the ALT FIN 1 routing alternative in the Ingå archipelago, the calculations provide the maximum concentration levels of 50 mg/l for the bottom layer. On the surface the concentrations will be clearly lower at around 12 mg/l. The maximum concentrations for the low-wind scenario are slightly higher due to a lower rate of dilution, being at the level of 60 mg/l in the bottom layer. The bottom turbidity area will be quite large, around 10–15 km², covering a large proportion of the archipelago off Ingå. The maximum bottom deposition rates will at the 20 g/m² level (Figure 8-14 and Figure 8-15).



Accumulation at 2 and 5 days

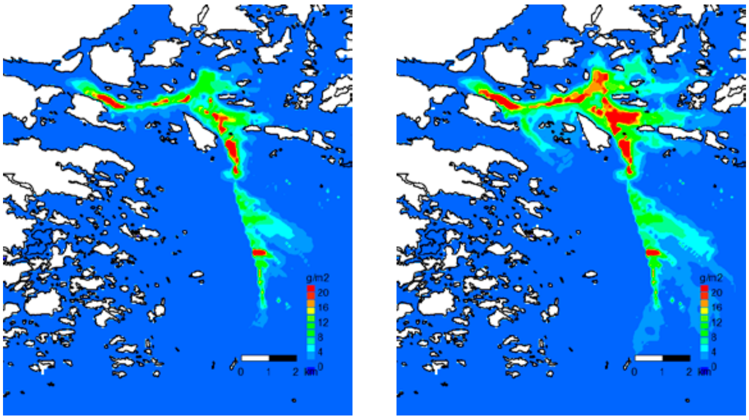


Concentration, bottom at 2 and 5 days

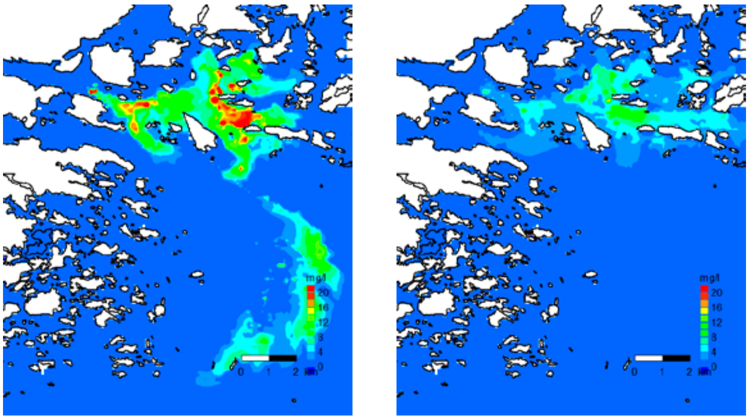


Concentration, surface at 2 and 5 days

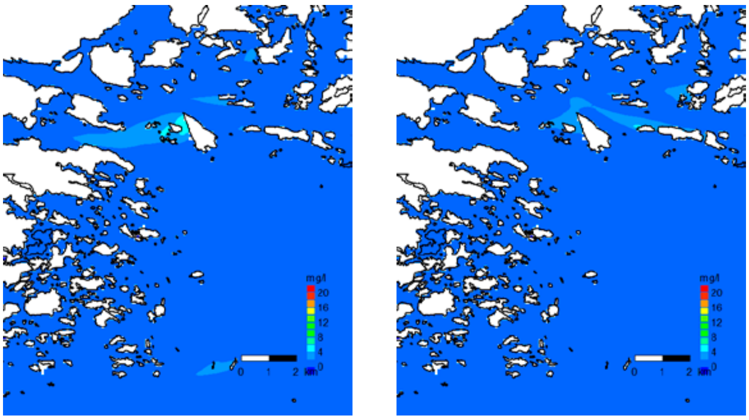
Figure 8-14. Accumulation of suspended solids in the bottom layer in the average wind scenario at 2 and 5 days, and concentrations of suspended solids in the bottom and surface layers for the ALT FIN 1 routing alternative.



Accumulation at 2 and 5 days



Concentration, bottom at 2 and 5 days



Concentration, surface at 2 and 5 days

Figure 8-15. Accumulation of suspended solids in the bottom layer in the low-wind scenario at 2 and 5 days, and concentrations of suspended solids in the bottom and surface layers for the ALT FIN 1 routing alternative.

### Post-lay pipeline covering

Following installation, the pipeline will be covered with a 1–2 m layer of rock.

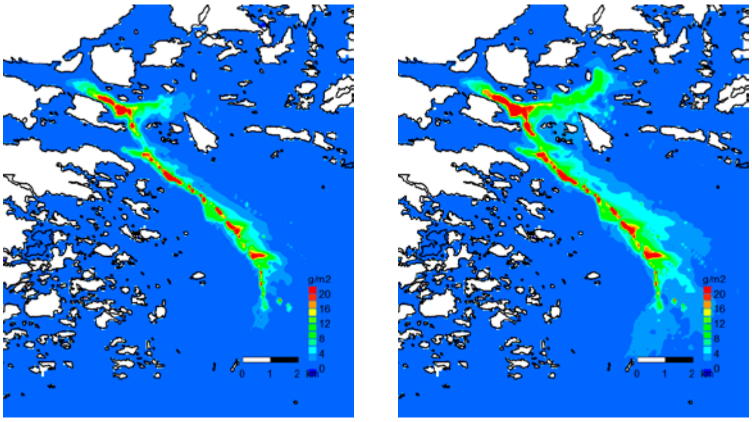
#### Load applied in the model

The volume of rock required to cover the pipeline will be around 10 $m^3/m$ where 1 m of rock will be installed on top of the pipeline. At the assumed rate of rock installation of 1,000 $m^3/h$, the load value is 20 tonnes per hour. This assessment is based on the seabed consisting of 60% of clay, 35% silt and 5% of coarser materials.

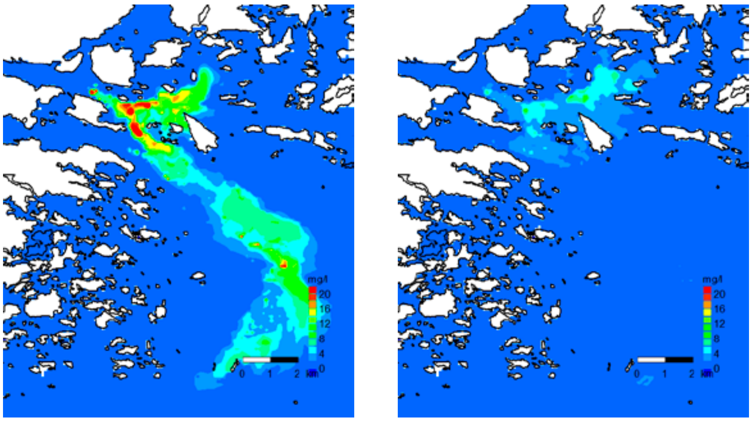
In sections where the seabed consists of bedrock the load will be clearly lower. The load from a 2 m layer of rock to cover the pipeline was assessed to result in load corresponding to that of 1 m of rock.

#### Calculation procedure

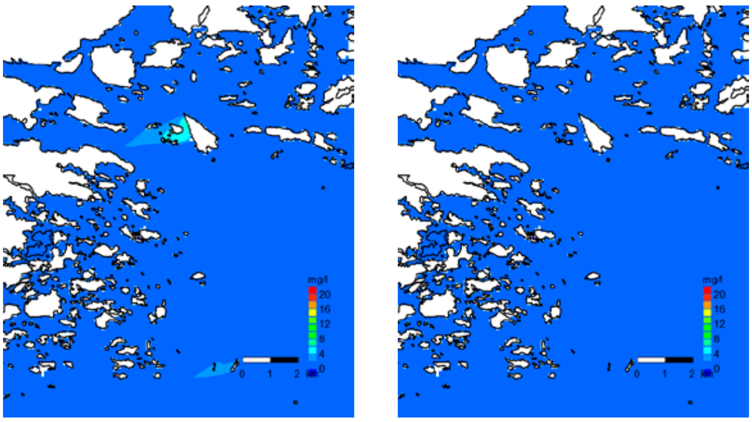
The calculation was based on loading intervals of 10 hours a day, in which case the pipeline-covering operation progresses around 1 km per day. The load was allocated for the entire period at the same rate, although in bedrock bottom sections the sediment loads



Accumulation at 2 and 5 days



Concentration, bottom at 2 and 5 days



Concentration, surface at 2 and 5 days

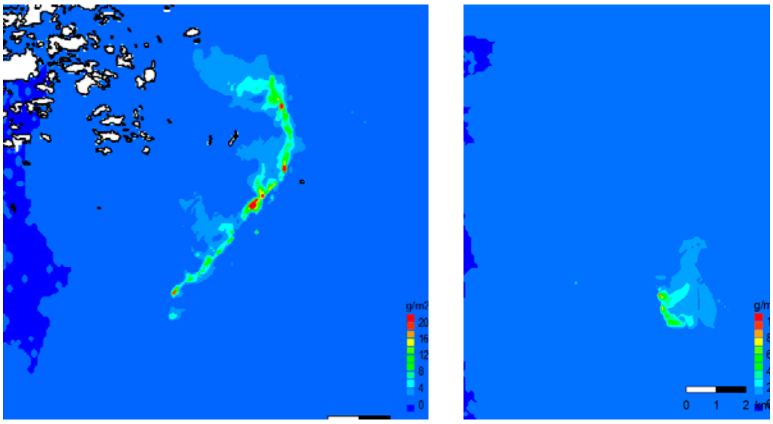
For the ALT FIN 2 routing alternative the bottom-layer turbidity will be dispersed along the fairway, with the maximum concentrations being in the 30–40 mg/l range. This means the turbidity cloud will be ribbon-like and will not extend as clearly to the archipelago off Ingå as is the case with ALT FIN 1. The maximum concentrations, 20 mg/m², are close to those with ALT FIN 1, but the areas are smaller in size (Figure 8-16).

Figure 8-16. Accumulation of suspended solids in the bottom layer in the low-wind scenario at 2 and 5 days, and concentrations of suspended solids in the bottom and surface layers for the ALT FIN 2 routing alternative.

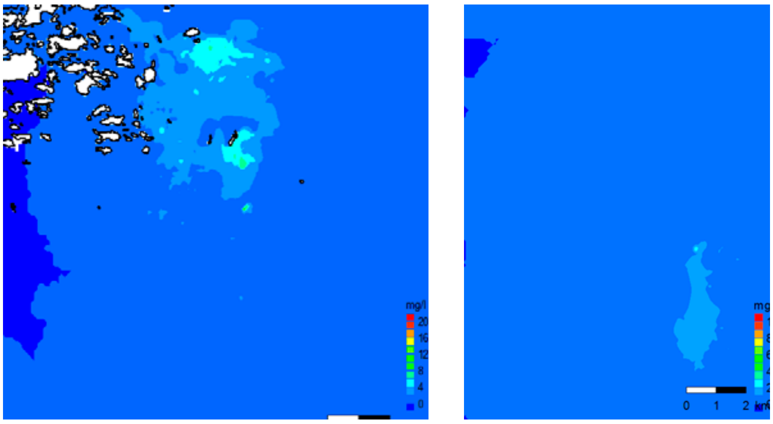
will presumably be clearly below the levels seen on clay bottoms. The calculation commenced with the wind data for July 31 and the calculation period was 23 days.

### Impacts of pipeline covering on concentrations of suspended solids in water

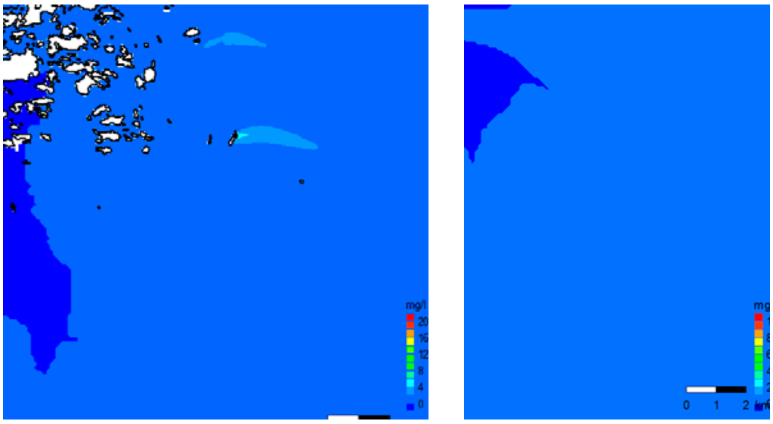
The impacts of marine works on water quality depend on issues such as the amount of load, its intensity and duration as well as any overlaps with other marine works. The load used in the model, 20 tonnes per hour, is the same as that assessed for rock installation in terms of intensity, but the duration is clearly longer.Concentration in the surface layer at 5, 10 and 15 days The impacts of the ALT FIN 1 routing alternative are targeted more clearly at the area off Ingå, with the maximum concentration of suspended solids in the bottom layer being 30 mg/lConcentration in the surface layer at 5, 10 and 15 days–18). The impacts of the ALT FIN 2 alternative can be seen more clearly in the Norrfjärden area. Further off the shore the impacts on suspended



Accumulation at 2 and 5 days



Concentration, bottom at 2 and 5 days

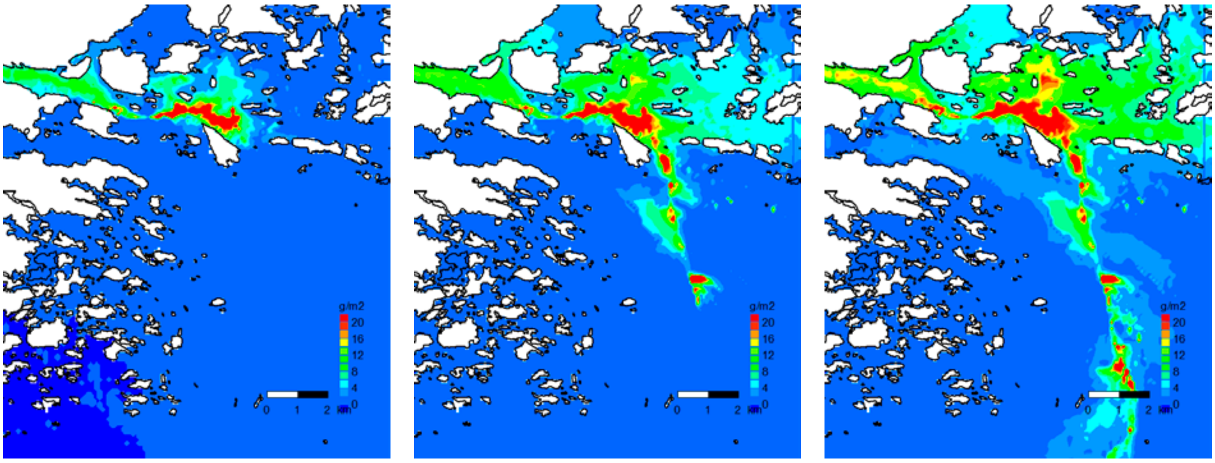


Concentration, surface at 2 and 5 days

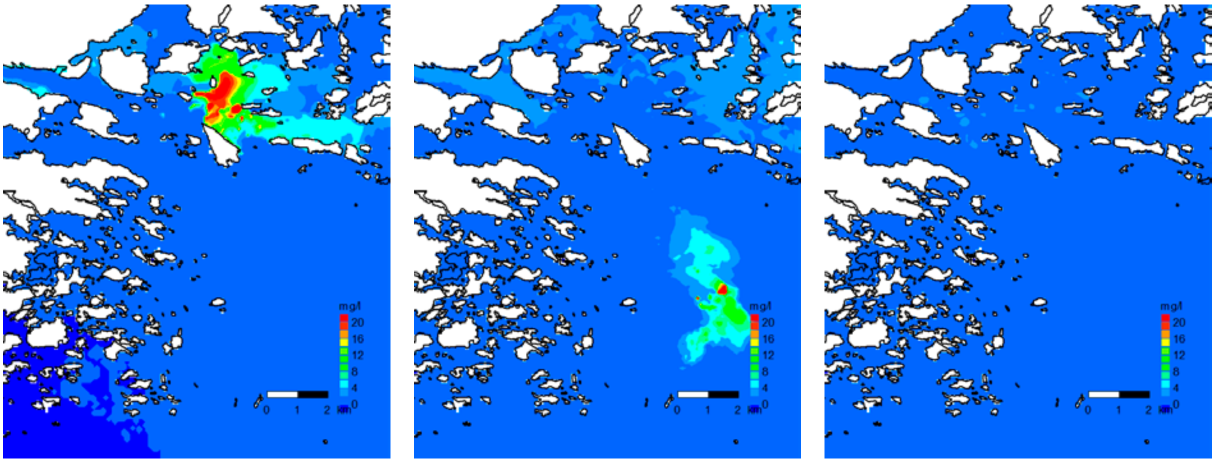
In marine areas further off the shore the load will be diluted rapidly into the large volumes of water and the impacts on water quality will be lower than closer to the shore. The maximum concentrations of suspended solids at the data points are slightly above 10 mg/l, and the turbidity and accumulation are clearly smaller as can be seen in the figure (Figure 8-17). Due to the depth of the area the turbidity cloud will not reach the surface waters.

Figure 8-17. Accumulation of suspended solids in the bottom layer in the average wind scenario at 2 and 5 days, and concentrations of suspended solids in the bottom and surface layers further off the shore.

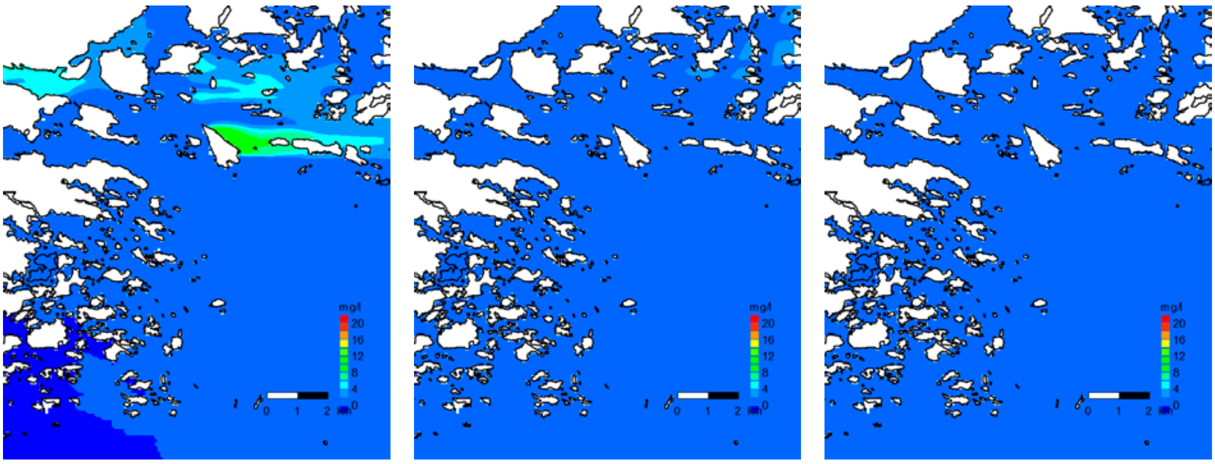
solids concentration and turbidity are low, being clearly below 10 mg/l. In regional assessment the continuous movement of the load source as the work progresses must be taken into consideration. The estimated load is based on the assumption that the covering operation will progress around 1 km a dayConcentration in the surface layer at 5, 10 and 15 days. This means that, for example, on the route north of the island of Stora Fagerö (ALT FIN 1) the covering of 5 km of pipeline will take around five days, which is when the highest levels of turbidity will be seen along the route as is shown in the figurConcentration in the surface layer at 5, 10 and 15 days8-19).



Accumulation in the bottom layer at 5, 10 and 15 days

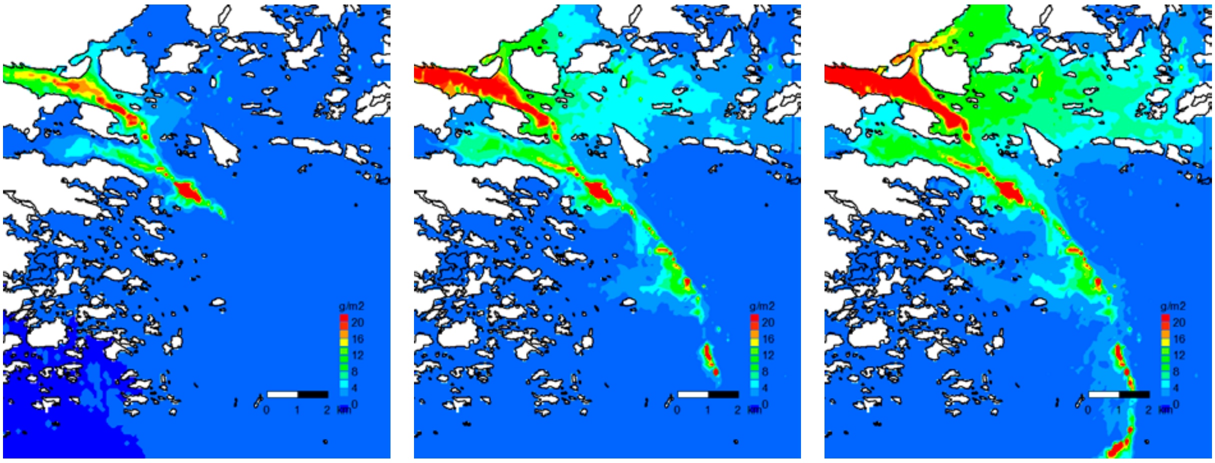


Concentration in the bottom layer at 5, 10 and 15 days

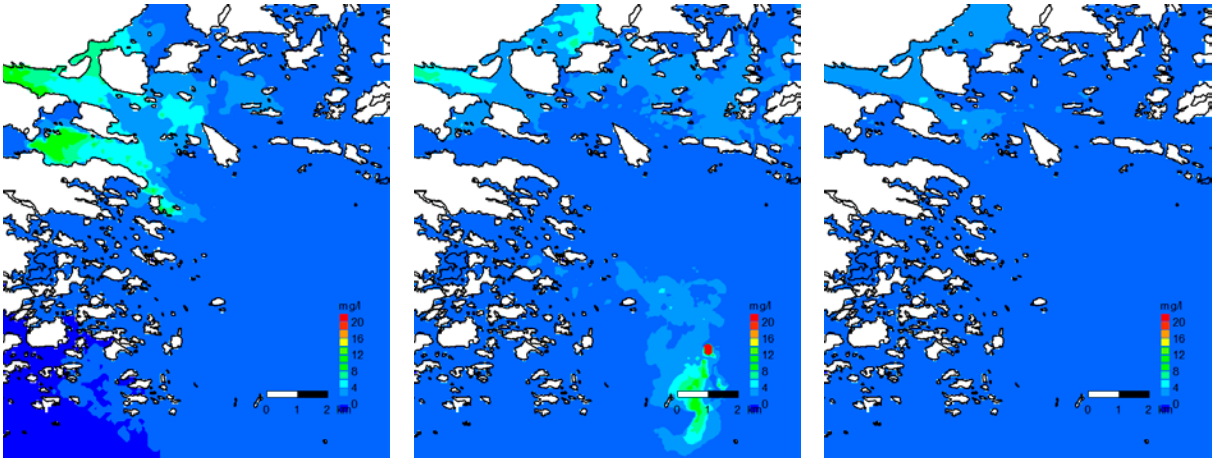


Concentration in the surface layer at 5, 10 and 15 days

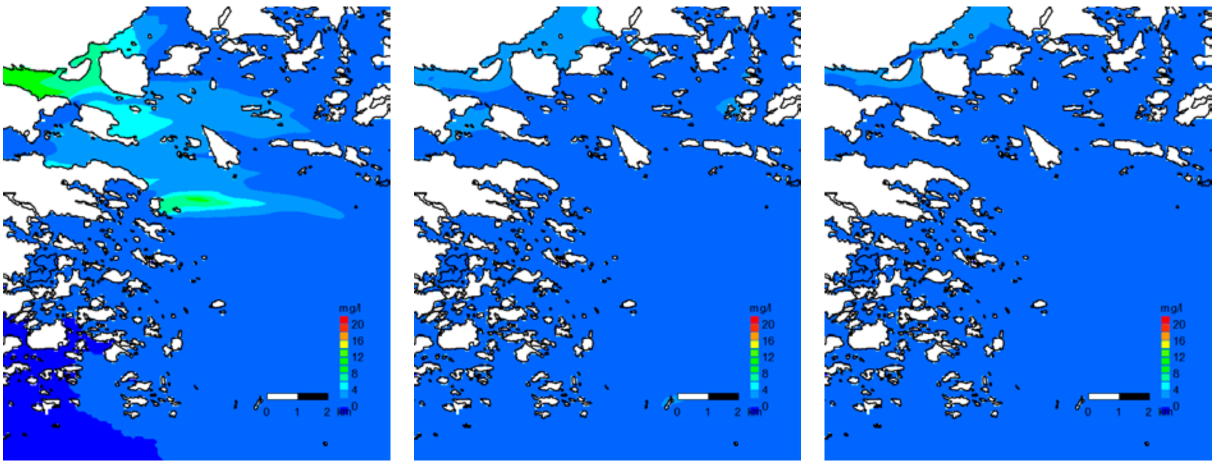
Figure 8-18. Accumulation of suspended solids with the ALT FIN 1 alternative, and bottom and surface layer concentrations of suspended solids at 5, 10 and 15 days from the commencement of work.



Accumulation in the bottom layer at 5, 10 and 15 days



Concentration in the bottom layer at 5, 10 and 15 days



Concentration in the surface layer at 5, 10 and 15 days

Figure 8-19. Accumulation of suspended solids with the ALT FIN 2 alternative, and bottom and surface layer concentrations of suspended solids at 5, 10 and 15 days from the commencement of work.

### Conclusions on the water system modeling results

#### Gulf of Finland

Seabed interventions during construction modeled for western Gulf of Finland will be relatively small in scope, with the impacts on water quality being very low due to the large volumes and efficient exchange of water. Due to the stratification of the water column, the impacts are also likely to be restricted to the near-bottom layers and will not in practice reach the surface.

According to the modeling carried out, the maximum increase in near-bottom solids concentrations will remain below 15 mg/l in the bottom layer of the offshore area. The biggest turbidity impacts will be generated along the pipeline in conjunction with ploughing. The affected area is estimated to extend approximately to a maximum of 1 km from the pipeline. The maximum concentrations caused by rock dumping and pipeline protection in the offshore areas will be around 10 mg/l on sites where the volumes of rock will be the largest and the seabed is rich in clay. Turbidity and accumulation areas will be clearly smaller than in near-shore areas.

#### Ingå

According to assessments made on the basis of the results of water system modeling carried out off Ingå, turbidity caused by the various phases in the construction of the natural gas pipeline will be relatively low. The biggest impacts will be seen near the coast where flow rates are lower and exchange of water slower than in offshore areas. In near-shore areas, turbidity will be seen most clearly in surface waters and near the shore due to shallowness. The maximum concentrations of suspended solids, 50–70 mg/l in the hypolimnion, will be at their highest near the shore in conjunction with seabed ploughing, particularly when carried out on the ALT FIN 1 routing alternative. On the surface concentrations of suspended solids exceeding 10 mg/l will be visible to the naked eye as turbidity. The turbidity impacts will be lower if the pipeline routing alternative ALT FIN 2 and landfall alternative LF2 are chosen, in which case the duration of work and volumes handled will be smaller and the impacts on the Ingå archipelago will be lower.

The suspended solids will settle near the work area, with the calculated accumulation being around 20 g/m² or 200 kg/ha at its highest. The density of the material will need to be more than 1,000 kg/m³ for it to actually be deposited on the seabed. The accumulation rate in question means that, for example, the even spread of material with the density of 1,020 kg/m³ will increase the thickness of the sediment by around 0.27 mm. In reality the deposition will not be even. Instead, material will accumulate unevenly on the seabed, but in any case the sediment accumulation impact of the operations will be low and be mainly targeted at the immediate vicinity of the work area.

### 8.3.2.2 Findings on other projects

#### Findings on the impacts of previous dredging operations on water bodies

The intensity and extent of impacts on water bodies can also be reflected against previous dredging operations and experiences gained from their monitoring:

#### Raahe fairway and port dredging in summer 2008

- The volume of material dredged from the port area totaled around 1.7 million m³ and from fairways 321,000 m³.
- The most extensive turbidity areas seen temporarily were around 10 km².
- On the basis of the monitoring results, the dredging was not found to result in any significant accumulation of organotin compounds on fish or bivalves.
- No changes in vegetation were found on the shores of nearby islands in the 2005–2008 period.

#### Pitkäviiri, Pyhtää, trial extraction of marine sand in 1985 (100,000 m³)

- Around 500 mg/l of suspended solids in the immediate vicinity of the vessel.
- Around 50 mg/l of suspended solids at 20–200 m from the vessel.
- At 1 hour after extraction turbidity could only be detected in the near-bottom water layer.

#### Seabed dredging relating to the deepening of the Port of Hamina and the fairway leading to the port in 2009 *(Association for Water and Environment of River Kymijoki 2010)*.

- On the basis of turbidity measurements, low impacts on the water body were detected in the near-bottom water layer in front of the deposition basin, the deposition area and around the dredging sites.
- Overall the impacts on the water body of the dredging were low in 2009. The dredging could also not be demonstrated to have had long-term impacts on water quality.
- In sedimenting material the concentrations of organotin compounds were slightly higher after the commencement of dredging than prior to dredging.

#### Covering of MS Estonia, Utö, in 1996 (380,000 m³ of gravel)

- On-site turbidity value 200 times the normal level.
- 50 times at 0.5 km from the site.
- Very low turbidity (FTU 0.5–1.0) at 2–3 km from the site.

#### Construction of Pori offshore prototype wind farm

*(Kokemäenjoen vesistön vesiensuojeluyhdistys 2013)*

- During dredging and the construction of foundations, a cloud of turbidity could be seen to disperse toward the offshore area. The turbidity cloud was not in the same direction as the prevailing wind direction.
- At 1 km from the work site the turbidity was still visible to the naked eye. It was also detected in monitoring that the impacts of dredging covered a larger area in deeper water layers than on the surface.
- According to the results, no clear signs of the dredging work could be seen in the other water quality variables studied. During dredging, there was a slight increase in the electrical conductivity and total phosphorus concentration in the epilimnion while work was in progress.

#### Findings from monitoring of the construction of the Nord Stream gas pipeline 2009–2012 (Nord Stream 2013a, Ramboll 2011–2013)

In the monitoring of the impacts of the Nord Stream project during construction, continuous turbidity monitoring was mainly used as the monitoring method. On the basis of data gathered from the Baltic Sea area, the conversion factor used in the assessment of suspended sediment concentrations was 3.4. In these calculations an increase of 10 mg/l in suspended solids concentration corresponded to the measured turbidity value of 5 NTU, with the average background turbidity (2 NTU) taken into consideration in this. The following presents the turbidity impacts detected during the construction of the Nord Stream gas pipeline by work method.

On the basis of the monitoring results, subsea rock installation only resulted in increased turbidity at deep-water installation sites in the Finnish Exclusive Economic Zone in the bottommost layer just above the seabed. Increased turbidity was limited to the bottommost 10 m water layer above the seabed. The impacted distance from the rock installation site, taken as the 10 mg/l contour, was less than 1 km. All in all the changes in water quality above the seabed resulting from rock installation were temporary and local and their significance was low.

A minor, temporary increase in turbidity during pipelay by the anchored lay barge was recorded near the seabed at a short distance from the pipeline alignment. No increased turbidity was observed during pipelay by the dynamically positioned pipelaying vessel, indicating that neither thruster wash nor pipeline touchdown had caused any measurable resuspension of sediments from the seabed.

The significance of the impact of the pipeline as a physical structure on the seabed on local sedimentation and erosion patterns was assessed to be minor or no impact. Minor small-scale current changes were detected at a short distance from the pipeline in the sections where the pipeline is clearly exposed. The impact of the pipeline at distances over 50 m is negligible. On soft seabed areas where changes in sedimentation and erosion patterns could be possible, the pipelines are normally embedded deeper into the sediments and any minor impacts are too small to cause significant scouring.

During munitions clearance, minor impacts on water quality were observed. The area where minor elevated turbidity values existed was restricted to the vicinity of the activity.

Ploughing was mainly used as a method in Swedish and Danish sections of the Nord Stream pipeline, with the maximum values ranging slightly below and above 10 mg/l. The short-term dredging maximum concentrations were 50–60 mg/l off the coast of Germany near the landfall site. In general the impacts of the construction of the Nord Stream pipeline on water quality were temporary, local and low.

### 8.3.2.3 Assessment of impacts on water quality

#### Construction

On the basis of the results of water system modeling, Nord Stream gas pipeline monitoring and general knowledge gained from marine works, the following can be stated regarding the impacts on water quality arising from the construction of the natural gas pipeline.

During construction, a turbidity cloud consisting of fine-grained material will be observed in the operating area, but this will usually dissipate and disappear quickly. Water is transported and diluted by currents, making it cleaner as particles settle on the bottom due to gravity. The salinity of seawater also facilitates the settlement of solids as it reduces the repulsion forces between particles.

The calculated level of impacts will be the highest in near-bottom water layers in near-shore areas. Ploughing will be the work stage causing the highest levels of turbidity, but even the maximum concentrations of these are assessed to remain below 100 mg/l, with concentrations usually rapidly reduced to a level below 10 mg/l. If jetting is used as a pipeline trenching method, the loads would appear to be higher than with ploughing. The suspension of solids caused by the propeller wash impact of the plough tow vessel was taken into consideration in the load assessment conducted for ploughing. Turbidity will also be caused by pipelaying vessels if dynamically positioned vessels are used. The turbidity impact will be stronger in shallow areas than further off the shore. Changes in wind direction will create a potential impact area around the construction site, the extent of which as well as the dispersal direction of turbidity will vary depending on the wind and flow situation. The division of the work into stages will result in repeated turbidity bursts varying in locations and also visible to the surface occurring throughout the construction period. Impacts outside the coastal area will be low, focusing on the deeper water layers in the immediate vicinity of the construction site. Sediment accumulation will increase during the work but will remain small in quantity due to the short duration.

In marine areas, particularly those close to the shore and close to fairways, changes in turbidity also occur naturally. Findings from continuous measurement at control stations carried out in conjunction with monitoring conducted for the Nord Stream gas pipeline project show mostly minor near-bottom turbidity, but strong flows were detected in near-bottom water in the context of stormy weather, coupled with rapid increases in turbidity, with the highest turbidity value being 23 NTU at control station 1 (Figure 820, *Luode Consulting Oy 2013*). Nord Stream control station 1 is located in western Gulf of Finland in the Ekenäs archipelago at the depth of 43 m. Construction work did not impact water quality at the control stations, and the measurement results have been used as background data for the monitoring of the impacts of the project's construction work.

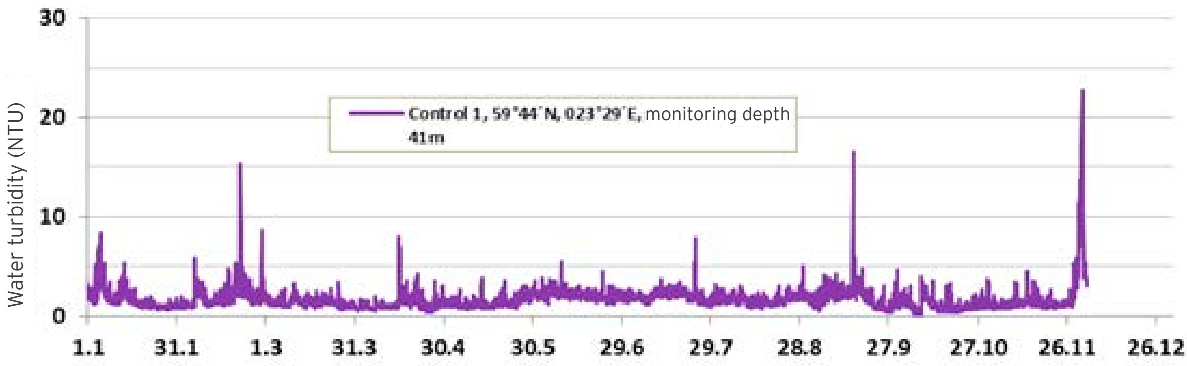



Figure 8-20. Seawater turbidity at 1 m from the seabed in continuous measurement at a western Gulf of Finland control station of the Nord Stream gas pipeline project in 2012. (Luode Consulting Oy 2013)

In some sections extraction may need to involve blasting.

Blasting will be carried out using explosives suitable for underwater blasting placed in drilling holes in the bedrock. The holes will be drilled from a surface platform or by divers, and in shallow sections drilling can be carried out using machinery from the shore. The rock blasted will be removed and usually utilized in construction. An explosion generates a rapid increase in pressure, a blast, which is followed by a rapid decrease in pressure. The blast will result in fine materials from the breaking bedrock being released into water, and the short-term flow will also suspend sediments dug for the blasting work into water. The removal of fine fractions from the top of the bedrock will cause turbidity impacts similar to those presented for dredging. The turbidity cloud created will move with currents. The material will mostly be minerals, whereby it will settle quite quickly. Due to their very brief duration, the water quality impacts of turbidity clouds are assessed to be low in comparison with impacts including those of dredging and ploughing. The impacts of blasts are the highest on aquatic organisms. The impacts will depend very highly on the detonation velocity of the explosive used. Blasting will cause temporary turbidity in the area as well as explosive residues in the water body that may contain small quantities of nitrogen and other harmful substances. In larger-scale underwater blasting operations some littering has been observed to result from blasting work.

Because the increase in turbidity is limited to near-bottom layers, with the exclusion of more shallow areas near the shore, the transparency impacts will mainly be low. The maximum concentrations in the surface layer (15–30 mg/l of solids) according to the modeling results can be assessed to correspond approximately to a turbidity level of 10–15 NTU. Based on the interdependence of turbidity and transparency, transparency can be assessed to be temporarily reduced during construction in near-shore areas from the current 2–3 m to less than 1 m. The impacts of reduced transparency are discussed in greater detail in conjunction with aquatic fauna in section 8.4.2.1 and from the local residents' perspective in section 8.13.2.

Turbidity will also result in a temporary elevation in the concentrations of phosphorus bound to suspended solids in particular. Nitrogen concentrations will also be increased due to sediment dispersal and blasting. At the same time there will be a slight increase in chemical oxygen demand ($COD_{Mn}$) and color value of water. There was quite a lot of variation in the nutrient concentrations of sediment samples taken along the pipeline routing. The highest sediment nutrient concentrations were found in the Ingå archipelago in the ALT FIN 1 and ALT FIN 2 routing alternative areas. The sediment nutrient level and variation were in the range of those found in studies relating to the Nord Stream pipeline (*Nord Stream 2009b*). On the basis of modeling and sediment findings, the eutrophicating effects that increase phytoplankton production and, consequently, also zooplankton production will be local and on the whole low. On the other hand turbidity will also reduce phytoplankton production by reducing light penetration. Turbidity will mainly be limited to water masses below the photic zone, with hardly any impacts seen on primary production in the photic zone.

Variation in turbidity is common in the vicinity of fairways due to shipping stern wake and propeller wash impact, which may result in erosion in coastal and shallow areas, increasing the rate of suspended solids. Vessel traffic during the construction of the Balticconnector pipeline relating to seabed intervention, pipelaying and pipe transport will contribute towards an increase in the impacts of vessel traffic near the pipeline route and islands close to the Ingå fairway. The impacts of vessel traffic will, however, depend on many different factors, such as vessel speed, distance from the shore, depth of water, and seabed type. Considering the volumes transported by the vessels (see section 8.8) and the current high traffic intensity in the area, the impacts of increased vessel traffic are estimated to be low on the whole.

As stated above, construction measures and seabed intervention in the project area will result in the resuspension of sediment material into the aqueous phase. Heavy metals and other harmful substances may also be released from sediment into the aqueous phase in suspended solids. The concentrations of harmful substances in sediments have as a general rule been found to be low in the construction area. In sediments harmful substances are most likely to be attached to organic or inorganic solids. Therefore it is likely that they will also be attached to solids in the aqueous phase.

However, it should be noted that the mobility of heavy metals such as nickel and cadmium will be strongly dependent on the physical conditions prevailing in the project area (e.g. pH and redox potential). A decrease in water pH to a clearly acidic level may result in the dissolution of metals from solids and an increase in the bioavailability of these harmful substances in the aqueous phase. In practice the occurrence of such conditions in the marine area is highly unlikely. Harmful substances are therefore likely to be dispersed with suspended matter along the flow directions but to be eventually resedimented with the solids.

#### Pipeline cleaning and marine impacts of flooding

Following the pressure test, the seawater used to flood the pipeline will be filtered and treated with oxygen scavengers (e.g. sodium bisulfite, $NaHSO_3$) and/or biocides (e.g. glutaraldehyde). Oxygen scavengers remove oxygen that may fuel corrosion, and biocides prevent the growth of anaerobic bacteria.

A typical dosage of sodium bisulfite is 65 mg/l (ppm) being required for an oxygen concentration of 10 ppm and for glutaraldehyde 50–75 mg/l (ppm).

Alternatively, sodium hydroxide (lye) can be used as a biocide, enabling the increase of water pH above 10 and therefore preventing the growth of anaerobic bacteria in the pipeline. The use of sodium hydroxide may, however, cause other technical problems in the pipeline relating to carbonate and hydroxide precipitate formation. The pipeline pressure test takes around 24 hours, while the total maximum treatment period is 60 days. Flooding can also be carried out using clean water without any additives.

Sodium bisulfite and sodium hydroxide are natural substances already present in seawater, and the treatment poses no risk to the marine environment. Glutaraldehyde is rapidly biodegradable but highly toxic to aquatic organisms, whereby special care must be taken in its dosage.

The impact and quantities can be illustrated on the basis of a calculation whereby, when full, the natural gas pipeline will contain around 15,700 m³ of flooding water (inner diameter 0.5 m, length 80 km). If the pipeline is emptied with a pipe that is 30 cm in diameter and the dewatering rate is 1 m/s, the flow rate obtained is approximately 0.07 m³/s. With these sample values a continuous flooding run with a volume of water corresponding to the volume of the pipeline would take three days. That volume of water would, for example, contain around 1,000 kg of sodium bisulfite (at 65 mg/l).

When using oxygen scavengers or biocides, the water removed is led into a basin for the settlement of solids and any impurities in them. Following the settlement process, the water is pumped into a marine area where mixing will take place rapidly. If the flooding is carried out using filtered water, there is no need for settling and the water can be led in a controlled manner into the sea. The initial water dilution and mixing as well as the mixture – plume – created near the discharge area was outlined using Cormix (Mixing Zone Expert System, United States Environmental Protection Agency) modeling. This calculation model is not an actual water system model to solve precise flow fields, but it does, however, use flow and movement equations to provide mathematical forecasts of the shape, movement and mixing rate of the plume, i.e. the wastewater mixture created in the given circumstances. The calculation model provides an idea of the initial dilutions.

In the calculation, the discharge rate was 1 m/s and water of equal density was discharged from a round pipe into a flow at the rate of 10 cm/s (Figure 821). The graph shows that the flooding water is already diluted over a distance of 100 m by around 1:90, which means the concentration of e.g. sodium bisulfite falls clearly below 1 mg/l.

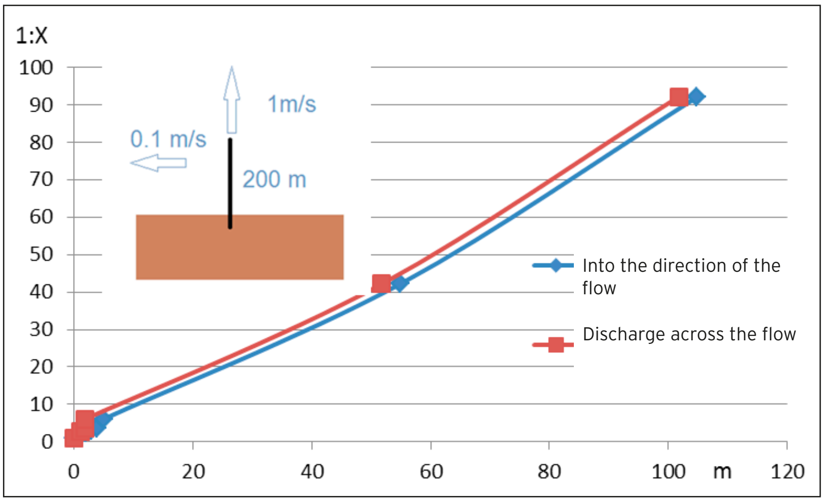



Figure 8-21. Calculated graph for the dilution of discharge water at the mouth of the discharge pipe.

The impacts of flooding water were monitored in Portovaya Bay, Vyborg, Russia, in conjunction with the Nord Stream gas pipeline project. The impacts concerning the levels of oxygen, salinity and solids in water were low and may also have been caused by natural variation due to weather conditions. No harmful substances were detected in conjunction with pressure testing and flooding. The substances used for flooding water treatment were sodium bisulfite and sodium hydroxide.

Due to the small volume of water and the short duration of discharge, the impact of flooding water can be assessed as low on the basis of the experiences gained from the Nord Stream project.

#### Other impacts on water bodies

There are stations for the long-term monitoring of the status of the marine environment maintained by the Finnish Environment Institute and the Uusimaa Centre for Economic Development, Transport and the Environment in the area affected by the Balticconnector pipeline. The one closest to the pipeline routing is Skatafjärden 45, and findings from the station have also been used in the water quality description of this EIA report. The locations of the stations are shown on the map (Figure 714). Local short-term turbidity is not assessed to have a decisive impact on water quality monitoring at the nearby stations. Adverse effects can also be prevented through careful selection of the construction period and measures to prevent the spread of turbidity.

### 8.3.3 Impacts during operation

The natural gas pipeline will not have an impact on water quality in normal situations during operation. During operation, the impacts of the pipeline on the marine environment will mainly be restricted to minor flow amendments due to morphometric changes caused by the pipeline itself and its construction (covering and protection) in areas near the pipeline, such as increased turbulence around the pipeline at faster bottom flow velocities. Changes in flow velocities and directions may affect the transport and accumulation of materials in the close vicinity of the pipeline. According to measurements carried out for the Nord Stream project, the impacts only extend up to tens of meters from the pipeline.

Potential impacts of pipeline anti-corrosion measures, coating and protective anodes on water quality are to do with substances, mainly metal ions, released from materials during pipeline lifecycles, but their impacts will be highly marginal. The release of metal ions depends on the total quantity of material and the ion release rate. The zinc/aluminum anodes installed in the pipeline may cause a slight increase in the concentrations of zinc and aluminum in the immediate vicinity of the pipeline, but the concentrations will rapidly become smaller in the sea due to currents and water turnover. Most metals will settle and accumulate in the bottom sediment. This, however, is affected by a variety of factors, such as oxygen and pH levels. In addition to aluminum and zinc, anodes may also contain small amounts of other metals and impurities. The impacts of anodes on metal concentrations in seawater were monitored in conjunction with the construction of the Nord Stream gas pipeline. The metal concentrations were generally in the same magnitude near the pipeline and in the reference areas.

The pipeline may also have minor temperature impacts on surrounding seawater because of the increase in pipeline temperature caused by friction due to the flow of pressurized gas (pipeline design temperature 50 °C). The covering of the pipeline will reduce the temperature impacts on water.

### 8.3.4 Summary of the significance of impacts and comparison of alternatives

The legislative steering and societal significance of the archipelago area off Ingå can be regarded as high on the basis of the objectives set in legislation concerning river basin management and marine strategies, marine conservation programs, and recreational use of waters. On the other hand, these waters cannot be regarded as particularly susceptible to changes as regards the Balticconnector project considering the temporally and spatially restricted nature of the changes caused by the project. Therefore the sensitivity of the receptor area is on the whole assesses as moderate (Table 8-4). There are no significant differences between the landfall and routing alternatives off Ingå as regards the current status of water or sensitivity. The exchange of water in the area affected by the LF1 landfall alternative is, however, slower than elsewhere in the area. A summary of the sensitivity of the area and the significance of the impacts from the human perspective is provided in section 8.13.4.

According to assessments made on the basis of the results of water system modeling carried out off Ingå, turbidity caused by the various phases in the construction of the natural gas pipeline will be relatively low. The biggest impacts will be seen near the coast where flow rates are lower and exchange of water slower than in offshore areas. Ploughing and dredging are the methods causing the highest levels of turbidity. On average the level of turbidity caused by the increase in the concentration of suspended solids will be around 2–5 times that seen currently in the marine area, with the occasional higher levels of turbidity occurring naturally at times in near-bottom layers. Because the increase in turbidity is limited to near-bottom layers, with the exclusion of areas very close to the shore, the transparency impacts will mainly be low.

Changes in wind direction will create a potential impact area around the construction site, the extent of which as well as the dispersal direction of turbidity will vary depending on the wind and flow situation. The area of turbidity may at times be rather extensive, particularly close to the bottom, extending several kilometers from the pipeline. The division of the work into stages will result in repeated turbidity bursts varying in locations occurring throughout the construction period. Taking all measures into consideration, the duration of construction will also be several months and take place over two periods without ice cover. Sediment accumulation will increase during the work but will remain locally small in quantity due to the short duration. The significance of the impacts in coastal waters off Ingå is assessed as moderate (Table 8-4).

The impacts will already be clearly reduced in the outer archipelago and be limited to the immediate vicinity of the pipeline. In the offshore areas the impacts will be reduced further due to the large volumes of water and, on the other hand, the smaller scale of marine works required. Due to the large depths, the impacts will in practice not reach the surface layer. As regards the offshore area, the magnitude and also the overall significance of the impacts on the water body during construction is assessed as low (Table 84).

During pipeline operation there will only be very low impacts in the form of bottom flows and resulting erosion impacts in the immediate vicinity of the pipeline. The magnitude and overall significance of the impacts is assessed as low or very low.

The classification criteria used for the determination of the sensitivity of receptors and the magnitude of change are described in Appendix 3 to this EIA report.

Table 8-4. Overall significance of impacts on water quality. C = during construction, O = during operation, A = archipelago area, OS = offshore area. The differences between the alternatives are minor.

| Impact significance | | Magnitude of change | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Very high** | **High** | **Moderate** | **Low** | **No change** | **Low** | **Moderate** | **High** | **Very high** |
| **Sensitivity of the receptor** | **Low** | High | Moderate | Low | Low | No impact | Low | Low | Moderate | High |
| | **Moderate** | High | High | **C/A Moderate** | **C/OS Low** | **O No impact / Very low** | Low | Moderate | High | High |
| | **High** | Very high | High | High | Moderate | No impact | Moderate | High | High | Very high |
| | **Very high** | Very high | Very high | High | High | No impact | High | High | Very high | Very high |

### 8.3.5 Prevention and mitigation of adverse impacts

Pipeline route determination and optimization has taken place since 2006. The work is still underway, and the aim is to minimize environmental impacts regarding issues such as seabed morphology to minimize the need for seabed intervention. The length of the pipeline and the avoidance of critical objects, such as underwater ordinance, are also part of the pipeline route optimization process.

Whenever necessary, a dynamically positioned pipelaying vessel or pipelaying and anchor-handling vessels that are as small as possible will be used for seabed intervention during the construction phase to mitigate environmental impacts. Subsea rock installation will take place using a fall pipe that enables rock depositioning at great precision as well as the minimization of sediment dispersal. There are also several other methods relating to seabed intervention to prepare the foundation for the pipeline on the seabed. At this point in the design process these methods have not been fully decided on, but the environmental impacts will be taken into consideration in the final choice of methods. For example, the method with the highest environmental impacts – jetting – will only be used in those areas where it cannot by techno-economically be replaced by other methods.

Sediment dispersal caused by underwater blasting can be reduced by removing loose sediment layers from on top of hard bottoms before commencing blasting operations. Where necessary, the dispersion of turbidity can be reduced in the inner archipelago by using a variety of protection methods (such as bubble curtains) taking, however, their technical suitability and occupational safety aspects into consideration.

Particular attention will be paid to munitions clearance in the vicinity of the pipeline. The clearance methods used will be approved by the authorities and have been used previously. The munitions clearance will be carried out by the Defence Forces, and separate environmental and safety plans in which the environmental impact mitigation perspectives will be taken into consideration will be drawn up for the clearance work.

Waste generated in construction work will be collected and disposed from worksites to the appropriate collection points and will not be released into water. Particular attention will be paid to hazardous waste such as oils, greases and solvents, which will be sorted and handled in the appropriate manner.

The water used in the pressure testing of the natural gas pipeline will be treated through the settlement of solids and any impurities in them to remove these from the water drained from the pipeline. The water will be led via a temporary outfall pipeline for discharge in the offshore area to maximize mixing. Efforts will be made to avoid the use of biocides that are harmful to aquatic organisms.

The sediment erosion impact caused by propeller and wake wash from vessel traffic relating to pipeline construction can to some extent be mitigated though the choice of routing and vessels and by lowering speeds in the most sensitive areas.

Methods available for the prevention and mitigation of impacts on the recreational use of the area are described in section 8.13.5.

## 8.4 Marine environment

### 8.4.1 Assessment methods and assessment uncertainties

Marine biodiversity in the area consists of species of aquatic flora, the zones formed by them and the invertebrate zoobenthos occurring in them. Impacts during project construction and operation were examined through expert assessment on the basis of changes in those environmental factors that most determine biodiversity in the area. Both the littoral zone in Ingå and the deeper offshore areas were taken into consideration in the assessment.

The examination and assessment of the project's impacts focused on perennial communities that are regarded as important for nature values and biodiversity. The baseline data was also examined in relation to longer-term development of biotic communities in the area to be able to assess the change in the general status of the marine area without the project (the zero alternative). The species of aquatic flora, the zones formed by them and the invertebrates occurring in them were examined in the assessment. Data on current status obtained from various studies as well the modeling conducted in conjunction with the project *(Lauri 2014)* were used as a basis for the assessment. The modeling method as well as the uncertainties relating to its initial technical data are described in section 8.3.1.

As regards zoobenthos, the environmental impacts of the project during construction and operation were assessed on the basis of numbers of individuals and relations of functional groups. Zoobenthos in the littoral zone of the area affected by the project was described on the basis of data obtained in a study conducted around 50 km from the project area (*Ruuskanen 2004*). Although the project area and the study site area both located in the same surface water type (southwestern outer archipelago and southwestern inner archipelago), with in principle equal conditions, the geographical distance between the study site and the project area may affect the structure of the community of organisms and therefore cause uncertainties.

The impacts of the project on zoobenthos below the photic zone was assessed on the basis of two sets of baseline data on zoobenthos *(Ramboll 2014b; Leinikki & Leppänen 2013)*. One of the sets of data deals with soft-bottom fauna and the other hard-bottom fauna.

In both zoobenthos sampling took place in compliance with the common sampling methods.

Uncertainties relating to the assessment include the unpredictable cumulative impact of different projects. The littoral zone consists of microhabitats, and the accumulation of suspended solids may be higher in some areas due to currents than is predicted. In such cases the impacts will also be stronger. The exchange of water in bays and coves may be slower than the rate applied in the modeling, whereby the retention of suspended solids will be longer and the impact higher.

The assessment was conducted by an experienced marine biologist specialized in the studies and assessments of the interactions of organisms and environmental changes.

### 8.4.2 Impacts during construction

Activities causing impacts in the pipeline route area during construction are mainly dredging, subsea rock installation and blasting and the suspended solids released by these, which will result in turbidity in surface waters and be resedimented on the bottom. The following sections discuss the ALT FIN 1, ALT FIN 2 and LF2 alternatives together and the LF1 separately on the basis of different seabed types. The impacts during construction on the marine environment in the deeper waters of the offshore areas are also outlined.

#### 8.4.2.1 Impacts on aquatic flora

**Gulf of Finland**

The photic layer of water in which primary producers are capable of photosynthesis only extends to the depth of 10–20 m in the Gulf of Finland. In depths below this there are no macrophytes, i.e. large aquatic plants and algae, and in offshore areas primary production only comprises phytoplankton.

In the scale of the Gulf of Finland the impacts of the project will not be significant to the aquatic flora of the littoral zone. The project's impacts mainly focus on areas in the vicinity of the pipeline.

**Ingå**

The potential changes in aquatic flora caused by the project will be mostly negative. Turbidity and resedimentation of suspended solids are harmful to the vital functions of aquatic flora. Because of the potential increases in nutrient levels, the biomass, or abundance, of aquatic flora may increase temporarily, but in an area that is already eutrophic this is regarded as harmful development.

The areas of alternatives ALT FIN 1 and LF2 are not included in the Natura network and no species listed in Annexes II and IV to the Habitats Directive occur in them. Eelgrass (*Zostera marina*), a species classified as Near Threatened (NT), occurs in the area affected by the ALT FIN 2 routing alternative (*Rassi 2010*). The biodiversity of the littoral zone will not on the whole be significantly reduced due to the project's impact.

In the areas affected by the ALT FIN 1 and ALT FIN 2 alternatives, dredging, blasting and pipeline covering will result in the highest levels of suspended solids loads near the sites of these operations and will be reduced as the distance increases. On average the suspended solids load in the waters during the dredging period will be around 2–12 mg/l. The reduction in transparency caused by turbidity in the water column will in practice be from an average of 4 m to around 0.7–1 m (Figure 8-22). The period of impact will at the local level be relatively short, whereby it will not have a significant impact on algal photosynthesis or survival. As regards nutrients, no reliable assessment of the change in the quantity of emissions can be made on the basis of existing data as the nutrients released from sediments will not as such be accessible by aquatic flora.

The figure (Figure 8-22) illustrates the impact and duration of activities during construction in relation to the long-term occurrence of aquatic flora. The figure shows the changes in transparency (●) and the lower growth limit of algae (○) and their trend lines for 2001–2013 in the areas of the ALT FIN 1 and ALT FIN 2 alternatives in accordance with the Finnish environmental administration's water quality monitoring data (Hertta database) and data from the aquatic plants register. An arrow is included in the figure, with its height depicting turbidity in the water column caused by the activity (i.e. reduction in transparency) from around 4 m to around 0.7–1 m. The width of the arrow depicts the period of dredging, which is from two days to two weeks. The duration of turbidity is obtained from the modeling conducted for the project (Lauri 2014). The development of the depth of the lower growth limit of algae depends on the development of transparency, but the reduction in transparency caused by the project is so brief that it will not have a significant impact on the development of the lower growth limit of the algal population. The lower growth limit of algae is a nature value. The transparency points represent the annual average. The smallest individual transparency value measured was 1.4 m.

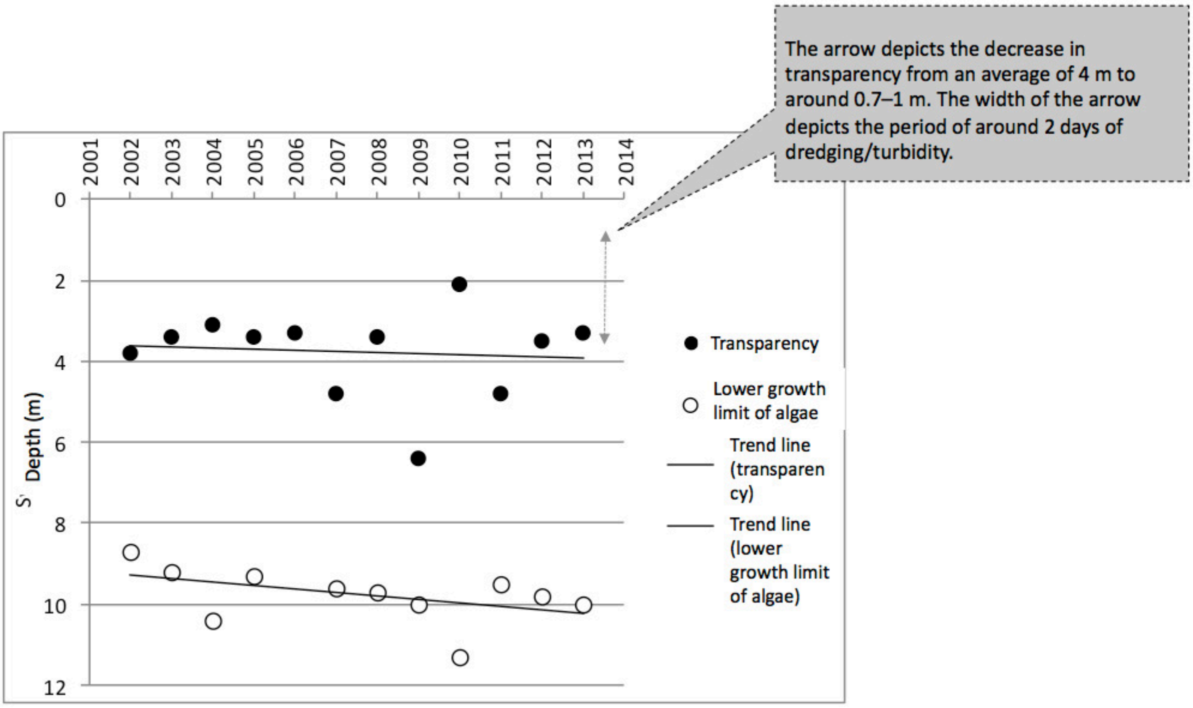



Figure 8-22. Illustration of the impacts and duration of dredging and other activities in relation to the long-term occurrence of aquatic flora.

The figure (Figure 8-22) shows that there is an interdependent and improving trend in transparency and the lower growth limit of algae in 2001–2013. The figure presents a period of around two days to a week of turbidity randomly placed on the time axis. It should be noted that the maximum level of turbidity is seen at construction activities, while further at the littoral zone turbidity is lower.

Results of studies conducted in controlled research settings are available concerning the resettlement of sediments released by dredging and their impacts on the littoral zone. Berger et al. *(2003)* found in their laboratory tests that the reproductive success of a keystone species of the Finnish coast, bladderwrack (*Fucus vesiculosus)* is 13% if the concentration of deposited inorganic matter is 1 g/dw/dm$^{-2}$ and only 2% if the concentration is 3 g/dw/dm$^{-2}$. These quantities per area are based on a research setup where bladderwrack germlings and inorganic matter were deposited on an area of 1 dm². The reproductive success was measured on the basis of the probability of the survival of the germlings deposited. The probability of the survival of the deposited bladderwrack germlings is normally around 60%. In this case the average depth of the bladderwrack zone was around 2 m. The findings of Berger et al. (*2003*) can be applied to this case as follows: If it is assumed that the entire water column above the bladderwrack zone (2 m) is evenly turbid at 8 mg/l of suspended solids, the quantity of resuspended solids would be 0.16 g/dm². It could be assumed on the basis of the result that resuspended solids would not have a reducing impact on bladderwrack reproduction. If the bladderwrack zone declined, the impacts on the diversity invertebrates living in could be seen with a lag of 1–2 years (*Kangas et al. 1982, Kraufvelin & Salovius 2004*).

The littoral zone conditions of landfalls LF1 and LF2 differ considerably from each other. LF1 is a sheltered and relatively shallow bay with soft bottom dominating. In this bottom zoobenthos buried in the soft benthos and vascular plants occur. The area around LF2 has a hard bottom and a slope that increases relatively steeply in depth. Here the dominant group of animals are invertebrates occurring on the bottom and the flora consists of macroalgae occurring on rock surfaces.

In the areas of landfalls LF1 and LF2 the potential changes in aquatic flora caused by the project's impacts will be mainly negative. Increased turbidity and resedimentation of solids are harmful to the vital functions of aquatic flora as they prevent their access to light for photosynthesis or cover suitable substrates. Because of the potential increases in nutrient levels, the biomass, or abundance, of aquatic flora may actually increase, but in an area that is already eutrophic this is regarded as harmful development.

The areas of alternatives ALT FIN 1 and LF2 are not included in the Natura network and no species listed in Annexes II and IV to the Habitats Directive occur in them. Eelgrass (*Zostera marina*), a species classified as Near Threatened (NT), occurs in the area affected by the ALT FIN 2 routing alternative (*Rassi 2010*). The biodiversity of the littoral zone will not on the whole be significantly reduced due to the project's impact.

In the landfall LF2 area, dredging will result in an increase in suspended solids load, and the load will be at its highest in the vicinity of the construction site off Fjusö and be reduced rapidly as the distance increases. The affected areas will be Barkarsundet and the area off Fjusö. On average the suspended solids load in these waters during the dredging period will be around 5–8 mg/l. The period of impact will be relatively short, whereby it will not have a significant impact on algal photosynthesis or survival.

In the LF1 area, 9–16 days of dredging will result in an elevated suspended solids load, which will be at its highest in the vicinity of the dredging site and reduced as the distance increases. The main affected areas will be Barkarsundet and Kyrkfjärden. The average suspended solids load in these waters during the dredging period will be 10 mg/l. The average turbidity in the area is around 2–4 FNU and occasionally up to 12 FNU in 2004–2013 (Figure 7–15). A change of one FNU can be detected by a meter and a change of 10 FNU is visible to the naked eye. In the natural environment turbidity may occasionally reach 50 FNU during the spring bloom of plankton. As regards nutrients, no reliable assessment of the change in the quantity of emissions can be made as the nutrients released from sediments will not as such be accessible by aquatic flora.

The magnitude of change caused by the project can be assessed on the basis of the reduction in biodiversity from the baseline concerning all of the alternatives. The nature values and biodiversity of the project area consist of macroalgae and vascular plants which, on the basis of the baseline data, were at most average. The project's impacts will be temporally relatively brief in relation to the lifecycle of aquatic flora. The turbidity-related impacts will in all project alternatives be relatively short-term and will not be significant. As regards nutrients, the risk involved is the excessive growth of filamentous algae boosted by the release of nutrients. The growing season of filamentous algae will, however, as a general rule be over after mid-August, and the increase in nutrients will not be seen in the growth of filamentous algae at that point. It should be noted concerning the assessment of the seriousness of the changes in suspended solids that the depth of water in the areas affected by the ALT 1 and ALT FIN 2 alternatives is more than 10 m, and most of the impacts will take place in near-bottom areas. As a general rule, organisms in the littoral zone occur above the depth of 10 m. The impact will be slightly higher in the area of ALT FIN 1 than that of ALT FIN 2. It should also be noted concerning the assessment of the seriousness of the changes in suspended solids that LF2 is at the end of a peninsula where the exchange of water towards the offshore area is relatively good, while LF1 is a sheltered bay where the retention of water is longer and the natural suspended solids load from rivers higher.

As regards the dispersal of suspended solids in the water column, the change will be observable throughout the construction period. Regarding the resedimentation of solids, the change will almost fully reversible, excluding the dredging site. The change will be non-recurring and temporally limited to the construction period. In summary it can be stated that the significance of the duration of the impact will be low for ALT FIN 1, ALT FIN 2 as well as LF1 and LF2.

In the LF1 and LF2 areas the status of the project area will not change concerning turbidity and the conditions will not deteriorate essentially in proportion to the whole. The potential increase in growth caused by nutrients will be non-recurring and focus on a period outside the growing period, with no essential change seen in the status of the area. The resedimented solids can be assessed to cause a local decline in current flora in the vicinity of the dredging site of the LF1 landfall alternative, but this change will be reversible. It should be noted that the shores of the islands close to LF1 are subjected to a major human impact and already affected by erosion. The littoral zone of LF2 extends deeper than that of LF1 and is therefore more protected against wave erosion. With both alternatives, LF1 and LF2, the habitat types and species viability of the areas will be preserved on the larger scale, but habitat conditions may be adversely affected in the vicinity of dredging and blasting sites.

In the LF1 and LF2 areas the impact of turbidity will last for a few days following the completion of dredging. As regards nutrients, the assessed change will be limited to one growing season. The impacts of the resedimentation of suspended solids may be seen for several years in the vicinity of the dredging areas but, in proportion to the entire area, the change will be moderate. The change concerning nutrients and turbidity will be reversible. In summary it can be stated the magnitude and direction of change of the project's impact for LF1 will be moderate and for LF2 lower.

#### 8.4.2.2 Impacts on zoobenthos

**Gulf of Finland**

The species composition of zoobenthos becomes less diverse from the coast toward the offshore areas due to the deep-bottom oxygen depletion that is typical of the Gulf of Finland. The impact of the gas pipeline project will be aimed at profundal soft-bottom zoobenthos buried in the mud. The deep-bottom zoobenthos mainly consists of species that are tolerant of low oxygen levels. According to samples obtained, in the deepest sections of the pipeline routing (> 60 m) the bottoms consist practically entirely of dead black mud.

According to the water system modeling carried out, resedimentation during construction will be at its highest in terms of quantities close to the pipeline within a radius of a few hundred meters in the offshore sections. In offshore areas the dispersal of suspended solids takes place in deeper layers of water. Considering the relatively low diversity of the soft-bottom zoobenthos and the results of the dispersion modeling, it can be assessed that the resedimented materials will not have a significant impact on the soft-bottom zoobenthic communities on the whole.

The duration of the impact will depend on the quality and quantity of the resedimented material. Sediments with a higher degree of inorganic matter are more harmful than those with a proportionally higher content of organic matter. Dredging mainly releases inorganic sediments. Zoobenthic communities that have declined or disappeared seek to be restored. The restoration period depends on the species lifecycle and dispersal model. The colonialization of species moving with currents in the water column takes place before that of species moving along the bottom *(e.g. Valanko et al. 2010)*. In normal conditions it can be assessed that a disturbed site will be restored in a few years, provided that other environmental conditions are favorable. In the deep bottoms of the Gulf of Finland restoration may be delayed due to the poor oxygen situation.

### Ingå

The following sections discuss the ALT FIN 1, ALT FIN 2 and LF2 alternatives together and the LF1 separately on the basis of different seabed types.

The possible largest zoobenthos groups occurring in conjunction with hard rock-bottom algal zones of the areas affected by the ALT FIN 1, ALT FIN 2 and LF2 alternatives are likely to be snails and isopods in the sheltered archipelago and amphipods in the filamentous algal and bladderwrack zones. These groups mostly occur swimming among algae, on bladderwrack or grazing on the bottom. The potential minor decline in perennial macroalgae might result in the disappearance of some of the invertebrates for which habitats are provided by bladderwrack in the vicinity of the construction site. There are no bladderwrack communities in the pipeline intervention area, and any minor impact will be created through deposition of suspended solids.

It can be stated generally that the decline mechanism in hard bedrock bottom invertebrates (ALT FIN 1, ALT FIN 2 and LF2 areas) is the same as that in soft-bottom invertebrates (LF1 area). The occurrence of zoobenthos depends on the occurrence of food sources. The main food sources for soft-bottom (LF1) organisms are sedimentary organic matter and food floating in the water column. Hard bedrock-bottom (LF2) invertebrates feed on macroalgae, organic matter on the seabed and food floating in the water column. If food sources are lost, the animals are lost as well. The restoration of food sources will result in the return of animals, provided that physico-chemical factors are also favorable. With all of the project alternatives, the resedimentation of suspended solids will be harmful to the vital function of fauna as it may cover and suffocate their access to food. Zoobenthos is capable of surviving resedimentation relatively well.

Zoobenthos detected in landfall LF1 area were ragworms (*Hediste diversicolor),* oligochaetes (*Potamothrix hammoniensis),* mud snails (*Hydrobia)*, Baltic macoma (*Macoma baltica*) and larvae of *Chironomus plumosus* buzzer midges. The worms are detritus feeders and the bivalves filter feeders. All of these occur buried in benthic mud. The viability of detritus feeders is affected the most by access to edible organic matter on top of the seabed. The solids resettling on the bottom in conjunction with dredging and blasting mainly consist of inorganic matter. Filter-feeders source their food by straining it from the water column. As a rule, dredging and blasting will not affect the quality of the water column in a manner reducing filter feeders' access to food with the exception of the period while dredging and blasting is in progress. Any decline in zoobenthos will be followed by their recolonialization of the area (*Valanko et al. 2010*).

The largest zoobenthos groups of the landfall LF2 area are snails, isopods and amphipods. Snails graze on organic matter on algae and rocks. Isopods and amphipods graze on filamentous algae and bladderwrack. All of these groups occur on plants and rocks or hiding amid algae. The biggest impact of suspended solids resettling on the bottom in conjunction with dredging is mainly to do with the reduced viability of macroalgae, which is reflected in poorer access to food in zoobenthos.

According to the modeling results, dredging conducted in the area will increase the suspended solids load in the area, and the load will be at its highest in the vicinity of the pipeline and be reduced as the distance increases in all alternatives.

The LF1 landfall alternative affects the entire Barkarsundet and Kyrkfjärden. The average suspended solids load on the waters in the area will be around 10 mg/l during the dredging period. According to the baseline data, the nature values and biodiversity of the LF1 area were not significant and the project's impacts will be relatively brief in terms of duration. It should be noted in the assessment of the seriousness of changes in suspended solids that Kyrkfjärden is a bay with restricted exchange of water, whereby the resedimentation of suspended solids may end up being long-term, but not serious. The suspended solids load regarding the other areas was discussed in conjunction with aquatic flora. The LF2 landfall alternative mainly involves hard bedrock bottoms and sand bottoms. It can be stated that if the suspended solids load will not have a significant impact on macroalgae it will not have a significant impact on zoobenthos associated with the algae either.

With all of the alternatives, resedimented suspended solids may have a local impact in the vicinity of the dredging site and result in minor decline, but the change will be reversible. The habitat types and species viability in the area will mainly remain unchanged, but there may be a temporary deterioration in habitat conditions in the vicinity of dredging sites. Overall the adverse effects on the characteristics of the area will be low. With all of the alternatives, the change in the resedimentation of solids in proportion to the entire area will be observable until the following year, after which the impact will be covered due to natural water movements in the sea. As regards the resedimentation of suspended solids, the change will be almost fully reversible. The change will be non-recurring and will occur in the autumn mainly during the dredging period and outside the breeding season.

### 8.4.3 Impacts during operation

Impacts during the operation of the natural gas pipeline will mainly arise from the flow changes created around the pipeline *(e.g. Quinn 2006)*. Flows created around the pipeline will move sediments in a manner whereby the finest fractions will be washed away.

Donavaro & Fraschetti (*2002*) provide universally applicable verification of the interdependence of grain size and species composition, and this phenomenon also applies to the Gulf of Finland. It can therefore be assessed that changes in sediment grain size will also result in changes in the structure of the zoobenthic community. The impacts will be based on the pipeline affecting the flows of water, which in turn will affect the quality of the benthos. In practice the species occurring in the affected area will be the same but the number of individuals will be lower. The change will take place over several years or decades. The impact will extend a few hundred meters around the pipeline. The significance of the impact will, however, be relatively low.

The movement of sediment materials taking place around the pipeline will not have an impact on the organisms of the littoral zone. The dredging sites located in the areas of the LF1 and LF2 landfall sites will receive new zoobenthos communities.

### 8.4.4 Summary of the significance of impacts and comparison of alternatives

The natural gas pipeline will be located in a shallow littoral zone at the Ingå landfall site, and this area is strongly subjected to human impact. Typical underwater habitat types are found in the area. The area is relatively stable as regards those environmental variables that have the highest impact on the development of aquatic flora in the littoral zone. An exception to this is the decline of bladderwrack, particularly on the shores of outer islands. There are permanent macrophyte monitoring stations of the environmental administration in the area. The sensitivity of the receptor is assessed as moderate as regards aquatic flora and zoobenthos of the littoral zone (Table 8–5).

Measures taken during project construction will release suspended sediments into the water column, which will result in turbidity and prevent light penetration to plants. The resedimentation of suspended solids will reduce the viability of the zoobenthos. The impacts will, however, be local and temporally restricted in conjunction with dredging operations. On the basis of the water system modeling results, the suspended solids mixing with the water column are assessed to restrict the depth penetration of light for the duration of the dredging process. Geographically the impact will extend to the littoral zones of the nearby islands but will mainly be restricted to areas in the vicinity of the pipeline. The duration of the reduction in transparency caused by turbidity is assessed to be so short in relation to the lifecycles of macroalgae and vascular plants that it will not have a significant impact on them. No impacts on the growth of filamentous algae can be expected to arise from the release of nutrients into the water column.

According to the results of the water system modeling conducted for the project, suspended solids will be dispersed more extensively and in higher concentrations in the areas of the ALT FIN 1 and LF1 alternatives than in the areas of ALT FIN 2 and LF2. The overall significance of the impacts for aquatic flora and zoobenthos in the littoral zone is assessed as low as regards the ALT FIN 1, ALT FIN 2 and LF2 alternatives and as moderate as regards the LF1 alternative (Table 8–5).

In the offshore area species diversity is low because the low oxygen level of the water column prevents the occurrence of organisms. Considering the relatively low baseline diversity of the zoobenthos and the results of the water system modeling, it can be assessed that the resedimented materials will not have a significant impact on the soft-bottom zoobenthic communities on the whole below the photic zone. The duration of the impact will depend on the quality and quantity of the resedimented material. In normal conditions it can be assessed that a site disturbed by construction will be restored in a few years, provided that other environmental conditions are favorable. In this case recolonialization may be delayed due to the low or non-existent oxygen level of the deep bottom waters (Table 8–5).

During pipeline operation, changes in sediment grain size will also result in changes in the structure of the zoobenthic community in the offshore areas. The change will take place over several years or decades. The impact will extend a few hundred meters around the pipeline. The significance of the impact will, however, be relatively low. (Table 8–5).

The project will not cause any significant impacts on aquatic flora or zoobenthos of the littoral zone during pipeline operation. The classification criteria used for the determination of the sensitivity of receptors and the magnitude of change are described in Appendix 3 to this EIA report.

Table 8-5. Overall significance of impacts on aquatic flora and zoobenthos of the littoral zone. OS = offshore area, C = during construction, O = during operation.

| Impact significance | | Magnitude of change | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Very high** | **High** | **Moderate** | **Low** | **No change** | **Low** | **Moderate** | **High** | **Very high** |
| **Sensitivity of the receptor** | **Low** | High | Moderate | **OS/C<br>Low** | **OS/O<br>Low** | No impact | Low | Low | Moderate | High |
| | **Moderate** | High | High | **C<br>LF1<br>Moderate** | **C<br>ALT1, ALT2, LF2<br>Low** | **O<br>FL1, LF2, ALT1, ALT2<br>No impact/ Low** | Low | Moderate | High | High |
| | **High** | Very high | High | High | Moderate | No impact | Moderate | High | High | Very high |
| | **Very high** | Very high | Very high | High | High | No impact | High | High | Very high | Very high |

### 8.4.5 Prevention and mitigation of adverse impacts

The project's impacts can be mitigated by carrying out the dredging outside the growing season of littoral organisms, whereby the release of nutrients will also take place outside the growing season and the eutrophicating impacts increasing the growth of filamentous algae will not be seen during the construction year (and the nutrients will be mixed into the Baltic Sea). The growing and reproduction season of the species of the highest significance to biodiversity is in June–July. The impacts can be mitigated by conducting construction in the autumn, which is when the reproduction and growing periods of aquatic flora and invertebrates will already be over.

## 8.5 Fish and fisheries

### 8.5.1 Assessment methods and assessment uncertainties

The background data used in the assessment of the impacts on fish and fisheries consists of descriptions of current status and the their background data, technical data relating to the project, the suspended solids dispersal model relating to marine works (*Lauri 2014*) as well as the underwater noise impact assessment report produced for the project (*Klauson et al. 2014*).

The impact assessments were conducted as expert assessments on the basis of literature and observations made in conjunction with the monitoring of projects of corresponding types (e.g. the Fenno-Skan 2 and Estlink 2 offshore cables and the Nord Stream gas pipeline project).

In the assessment, the impact mechanisms of the various marine works operations on fish and fisheries were identified and their level of impact classified for each area: 1) the offshore area of the Gulf of Finland, 2) the coast of Ingå (routing alternatives ALT FIN 1 and ALT FIN 2) and 3) the Finnish landfall site alternatives (LF1 and LF2). The key findings of the environmental impact assessment for Estonia can be found in Appendix 4 to this report and the EIA report for Estonia.

There are uncertainties relating to the impact assessment as regards the impact mechanisms (suspended solids dispersal model and underwater noise assessment) as well as the fish occurring in the project area at different times of the year and their spawning grounds. In general the data is, however, at a sufficient level for the assessment of key impacts.

The experts conducting the assessment have broad experience in fish and fisheries as well as the impacts of various types of marine works projects on them.

### 8.5.2 Impacts during construction

A detailed description of the marine works required for the project can be found in chapter 3. In general terms seabed intervention will take place to facilitate pipeline installation and to protect the pipeline. Several different seabed intervention methods will be employed depending of the type of seabed. With the exception of the landfall area, marine works will move along and will only last for a short period of time in each location. On the other hand, work will take place in several stages: 1) seabed intervention, 2) pipelaying and 3) post-lay covering of the pipeline. The dredging period will be longer in the landfall area. Seabed intervention sections will be located along the pipeline route, but their focus will be on the section on the Finnish side.

The main impact mechanisms of marine works relating to seabed intervention and pipelaying are assessed to be underwater noise, dispersal of suspended solids, and destruction/amendment of benthic habitats in the intervention areas. The assessment of underwater noise and its results are presented in greater detail in section 8.6, while the dispersal of suspended solids is discussed in section 8.3. The concentrations of harmful substances in the project area will be so low (section 8.1) that their bioaccumulation in fish was not assessed separately. Normalized in accordance with the Finnish guidelines on the dredging and deposition sediments (*Ministry of the Environment 2004*), pollutant level 2 was not exceeded for any substance. It can be stated on the basis of the above that the project will not have an impact on the utilization of fish for human consumption. The main impact mechanisms are discussed on a general level in the following.

### Underwater noise

There are big differences between the auditory capacities of different fish species (*Andersson 2011*). Species of fish can be roughly divided into three groups on the basis of their auditory capacity: 1) fish species without a swim bladder or other receptor of sound pressure (e.g. several demersal fish in the project area); 2) fish species that have a swim bladder for the reception of sound pressure but do not have a developed sense of hearing. Fish species occurring in the project area and belonging to this group include salmon, brown trout, perch and European whitefish; 3) fish species with a sense of hearing that is more developed than that of the second group. These hearing specialists include Baltic herring and Cyprinidae. In addition to hearing, fish also sense vibrations through their lateral line sensory organ. Most species of fish are able to sense frequencies in the range of 20 Hz–1 kHz (*Vehanen et al. 2010*). Consequently, graphic representations of the sound "thresholds" of various species of fish have been determined for a variety frequencies (e.g. *Popper & Hastings 2009*).

The way fish respond to a sound detected by them plays a significant role from the impact perspective. According to Nedwell et al. *(2003*), noise may have 1) primary impacts, such as fatal injury near to powerful sources, 2) secondary effects, such as injury (e.g. deafness), which may have long-term implications for survival, 3) behavioral effects, such as avoidance of an area (including the flight response). Fish may be injured (e.g. in the swim bladder) by loud noises – and even by a single impulse. Fish response will also be affected by ambient noise and habituation. There are shipping lanes and traffic increasing ambient noise in practice throughout the pipeline route, and therefore the fish in the area are habituated to underwater sounds. The assessed ambient noise level in the project area is 58–130 dB (*Klauson et al. 2014*).

In addition to species of fish, there is major variation in response between their various growth stages. The assessment of impacts is made difficult by the difficulty of distinguishing between the responses triggered by the different mechanisms (such as noise and turbidity) in natural conditions. For example, it was observed regarding the construction of the Lillgrund Offshore Wind Farm in Sweden that fish were not deterred by turbidity caused by dredging but rather by the general activity and noise caused by construction work (*Bergström et al. 2007*). In Finland deterring has been studied in contexts such as the dredging of the fairway off Kokkola (*Pohjanmaan tutkimuspalvelu Oy 1998*). Exploratory fishing carried out during dredging showed the smallest net catches in the immediate vicinity of the dredging site. The changes in species composition were small, but there were changes in the sizes of individuals within species. Dredging did not appear to disturb Baltic herring or juvenile European whitefish, with these caught right next to the dredging crew. There was no significant reduction in ruffes and juvenile perches in the dredging area, but large perches were not caught before around 1.5. km from the dredging machinery. The flight response was the clearest among large European whitefish, with the work deterring them to distances of 3–5 km from the dredging area. It was found in the study that in offshore areas the deterring effect extended further than in the archipelago where sound attenuation was clearly faster (*Pohjanmaan tutkimuspalvelu 1998*).

The vessels, machinery and methods used in seabed intervention and pipelaying will cause loud noises that will be transported over large distances, up to tens of kilometers, in water. According to a general assessment made by *Klauson et al. (2014)*, the sound pressure level caused by the dredger, pipelaying vessel and supply vessels will be 185–190 dB re 1 μPa at 1 m from the source (@ 1 m). The most significant source of noise in seabed intervention will, however, be underwater blasting. Explosions cause very high short-term levels of sound pressure the level of which will depend on issues including their TNT charge mass. In their report compiled for the project, Klauson et al. *(2014*) assess the safe distances for marine organisms various TNT charge masses.

### Turbidity and increased sedimentation caused by marine works

Increased turbidity and sedimentation caused by marine works have a negative impact on fish. The sensitivity of fish to the occurrence of suspended solids depends on the species and lifecycle stage of the fish (embryo, juvenile or mature) (*Keller et al. 2006*). In the worst-case scenario, a high suspended solids concentration may cause injury and even mortality in juvenile fish, eggs and fry. This may be due to reasons such as solids attaching to their gills and interfering with their oxygen intake. Newly hatched fish in particular are sensitive because their gills and oxygen consumption are larger in proportion to their weight (*Keller et al. 2006*). Resettling solids may also suffocate fish eggs (e.g.

autumn-spawning European whitefish) or increase the washing off of Baltic herring eggs from their spawning substrate.

Even relatively low concentrations of suspended solids may hamper food intake in fish that find their food by eyesight as their catch efficiency will be reduced. For example, Baltic herring fry catch their food by eyesight, so turbidity will have an adverse effect on their feeding (*Keller et al. 2006*). For example, suspended solids concentration at 20 mg/l has been found to have a negative impact on food intake in Baltic herring fry (*Keller et al. 2006*) and significant reductions in growth rates were found at 540 mg/l (*Messieh et al. 1981*). On the other hand, the impacts of turbidity on mature fish are only low as in most cases they will leave the area (*Hammar & Wikström 2005*). As regards fish food intake, increases in suspended solids also affect zooplankton. Elevated concentrations of suspended solids are particularly harmful to zooplankton species including large water fleas (*Cladocera*), which are favored as food by fish.

Species-specific limit values for the deterring effect on fish have been provided, and these are in the 3–100 mg/l range and most commonly in the 10–20 mg/l range (*Engell-Sørensen & Skyt 2001*). The recommended limit value for fish and fisheries in inland waters given in the EU Freshwater Fish Directive is 25 mg/l (*Freshwater Fish Directive 78/659/EEC*). There is, however, a great deal of variation in response to suspended solids between fish species.

#### Habitat destruction in seabed intervention areas

Fish spawning areas are highly centralized and fish occurring over an area that may be very extensive may originate from breeding taking place in a small individual site. On the Finnish coast fish breeding areas are mainly located in the littoral zone (0–6 m) on littoral vegetation or gravel bottoms. The gas pipeline will only pass through the littoral zone in the landfall area. On deeper bottoms marine works may destroy demersal fish habitats and feeding grounds.

### 8.5.2.1 Offshore area of the Gulf of Finland

#### Fish fauna

In the overall examination of the mechanisms impacting fish, the factor assessed as the most significant in the offshore area was the noise caused by blasting and other marine works. Other impacts include turbidity and increased sedimentation caused by marine works as well as habitat destruction in the seabed intervention area. Indirect impacts on fish may also occur via food sources.

The significant species of fish for the offshore ecosystem are Baltic herring and sprat. Both are pelagic species, i.e. schooling fish found in the open water column. Mostly mature individuals as well as juvenile age groups of these species are found in the offshore areas of the Gulf of Finland. Baltic herring spawn on littoral vegetation in the archipelago zone, from where juveniles move close to the coast to grow. Sprat, on the other hand, mainly spawn in the main basin of the Baltic Sea. Therefore marine works carried out in the offshore area will not have an impact on the breeding of sprat or Baltic herring

The suspended solids impact from offshore seabed intervention is estimated to be limited to near-bottom areas in the vicinity of the worksites. According to the modeling results, only temporary concentration increases exceeding 10 mg/l will be found near the bottom at distances exceeding 1 km from the seabed intervention sites (*Lauri 2014*). Considering the magnitude and brief duration of the suspended solids load, the adverse impact caused is estimated to be low.

Underwater explosions are critical to mature pelagic fish in the zone where the pressure wave will cause physiological damage or even death. The safe distance for marine organisms has been assessed as regards blasting work (see section 8.6). It is difficult to assess the fish mortality rate in conjunction with blasting work as this is affected by several different factors, such as the size of the charge, seabed topography and the occurrence of fish in the area. Fish are typically deterred from the lethal zone by pre-blasting operations (drilling and vessel traffic). In practice the impact on the fish stock of a shoal of fish possibly destroyed by a pressure wave is comparable with the catch from one trawl carried out by a fishing vessel. The occurrence of fish too close to a blasting site can be prevented using several methods. The noise caused by explosions has a deterring effect that changes fish behavior further away over a distance of several kilometers. The deterring of fish from the area will, however, be temporary. Despite the short-term duration of underwater noise, the extent of the affected area and the potential mortality in mature fish raise the impact to moderate/low.

Demersal fish found in offshore areas and their rate of occurrence in deep bottoms are insufficiently known as they are of no economic significance, excluding cod and flounder. It can, however, be said that there are no significant amounts of demersal fish nursery grounds at depths exceeding 20 m in the offshore zone of the project. Therefore any impacts will be targeted at mature and juvenile fish.

The behavior of demersal fish in conjunction with underwater blasting is more problematic than that of pelagic schooling fish. Demersal fish typically seek shelter on the bottom in locations such as by the sides of rocks, which is why they may remain in the project area despite efforts to deter them. On the other hand, demersal fish are not as sensitive to the impacts of underwater noise and pressure waves as they may be protected by seabed topography and many have a weak auditory sense (no swim bladder).

Seabed intervention destroys demersal fish habitats and feeding grounds. Areas to undergo intervention are found over a distance of tens of kilometers. On the other hand, these areas are narrow (tens of meters wide), whereby only a small amount of local seabed destruction will take place. In addition, the seabed intervention area will be replaced with coarse rock material which is likely to serve as a demersal fish habitat and feeding ground in the future. It is possible that certain species of fish will even favor these rock-filled areas. The impact on demersal fish on the whole is estimated to be low.

Migratory fish (mainly salmon and brown trout) found in the offshore areas of the Gulf of Finland are primarily there for feeding and, in the spring and summer, also for their migration towards rivers where spawning and nursery stages take place. Salmon and brown trout smolts remain close to the shore, so any impacts will mainly be targeted at mature fish. The impacts can be regarded to be similar to those on pelagic schooling fish.

#### Fishing

Adverse effects on fishing in the offshore areas of the Gulf of Finland will mainly be caused by the prevention of trawling in the project area during construction. Fishing vessels operating in the area will be disturbed by increased vessel traffic, seabed intervention work, pipelaying as well as pipeline protection measures. For example, a great deal of seabed intervention work will be carried out in trawling areas, and this is likely to result in restrictions to access by other vessels in the area during the work. In addition, measures such as explosions may deter fish from their typical distribution areas, making it more difficult to locate them.

All of the above-mentioned impacts during construction will be temporary and of short-term local duration. The significance of the adverse impacts to trawling will also largely depend on the timing of the work. The adverse impact on fishing during construction is assessed as low or moderate depending on the timing of the work.

### 8.5.2.2 Ingå archipelago zone

#### Fish fauna

In the overall examination of the mechanisms impacting fish, the mechanisms assessed as the most significant in the Ingå archipelago zone are the loss of habitat in the LF1 landfall alternative and the suspended solids impact caused by marine works, particularly in the route north of the island of Stora Fagerö and in the inner archipelago. In addition, underwater noise arising from blasting in particular was assessed as moderate for both routing alternatives. The project was not considered to have a significant impact on the spawning migration of migratory fish to destinations such as River Ingarskila.

During pipeline construction there will be impacts on the entire archipelago zone. Critical factors regarding impacts on fish populations are spawning and nursery sites as impacts on these may have permanent impacts on fish stocks. There are spawning grounds for economically significant species including the sea-spawning European whitefish and Baltic herring in the middle and outer archipelago. Of these species, sea-spawning European whitefish is classified as Vulnerable (VU), and there is no research data on its breeding rates in the area. On the basis of studies conducted, however, it can be stated that the breeding rates of sea-spawning European whitefish are overall low in the Gulf of Finland, and the majority of European whitefish caught originate from large-scale transplanting that is also carried out in the Ingå area (anadromous European whitefish and sea-spawning European whitefish).

The spawning grounds of sea-spawning European whitefish and Baltic herring are located in shallow waters, for European whitefish mainly on gravel bottoms that are 1–5 m deep and for Baltic herring in the vegetation zone, in the Gulf of Finland usually at a depth of 1–5 m. Spawning areas can presumably be found in areas affected by the ALT FIN 1 as well as the ALT FIN 2 routing alternatives. An autumn-spawning species, sea-spawning European whitefish spawns on gravel bottoms in October–November and the eggs remain in place throughout the winter until the spring. The eggs are therefore susceptible to the suffocating effect of resedimenting suspended solids for a long period time in the spawning areas. Correspondingly, the washing off of Baltic herring eggs deposited in early summer on vegetation in increased by suspended solids settling on the vegetation. The higher impact of the route north of the island of Stora Fagerö is based on the suspended solids dispersal model produced for marine works, according to which the impacts of ALT FIN 1 will be higher. The preferability of ALT FIN 2 is also supported by the fact that there is a shipping route running close to the gas pipeline section throughout the way, and fish and fish spawning grounds are continuously subjected to the adverse effects of vessel traffic in the area. This reduces the level of naturalness of the area.

There are also breeding sites for many species of fish that are not exploited commercially. There is no data available on these, however. It can be stated on a general level that the same impact mechanisms (suspended solids load and underwater noise) will also have a negative impact on the breeding of other species of fish in the area.

Underwater noise, particularly explosions, may also affect the movement of fish to spawning sites. In the worst-case scenario, spawning fish may be deterred from their spawning sites. There are major differences between fish species regarding sensitivity to disturbances. For example, European whitefish is regarded as a species that is sensitive to disturbances. As a general rule, however, it can be stated that the reproductive instinct in fish is strong, and the disturbance will have to be high or be targeted at the spawning area to prevent fish reproduction. For example, in conjunction with the construction of the Vuosaari Harbor, Helsinki, Baltic herring were found to spawn on their traditional spawning site in the vicinity of the harbor construction site despite the intensive marine works (dredging and filling as well as high levels of vessel traffic) underway (*Vatanen & Niinimäki 2005, Vatanen et al. 2006, Vatanen & Haikonen 2007, Vatanen et al. 2012*). Correspondingly during the dredging and depositing of dredging materials carried out to construct the Jätkäsaari harbor area in Helsinki in 2010 and 2011, Baltic herring spawned in the immediate vicinity of marine works sites (*Vatanen 2011, 2012*). Despite their good sense of hearing, Baltic herring have not been found to be sensitive to sounds (*Mann et al. 2001*). The biggest disturbance to the spawning success of Baltic herring will be caused by currents generated by vessels moving in the fairway and the suspended solids released from dredging and deposition, which will deteriorate the status of spawning sites and the vegetation used as spawning substrate and increase the washing of eggs off their substrate.

As regards mature fish, the impacts of marine construction can be regarded as causing mainly temporary behavioral changes (deterring effect), excluding the lethal zone of blasting operations. It is possible that, in addition to mature fish, juveniles will also die in conjunction with underwater blasting carried out in the Ingå archipelago area. The rate of fish mortality caused by blasting is, however, difficult to estimate (see section 8.5.2.1).

The impacts during the construction of the landfall areas will affect the inner archipelago where the commercially significant species of fish are pike-perch, pike and perch. The spawning and nursery sites of all of the above species are mainly located in the inner archipelago. Juvenile Baltic herring also seek their way close to the shore where water is warmer and the food situation good.

The landfall alternatives are very different from each other in terms of type and impacts. LF1 is located in a shallow bay area with spawning and nursery sites of several species of fish. In the actual landfall site there is also an extensive reedbed that is significant for issues including the breeding of pike as well as Perciformes and Cyprinidae. Correspondingly, landfall at LF2 is made on a rocky shore section where vegetation is already in a rather poor condition and there are no significant fish spawning sites in the area.

On the basis of the suspended solids modeling conducted for the project, the suspended solids impact of the more northern landfall alternative (LF1) will be clearly higher than that of the more southern alternative (LF2), and the significant suspended solids impacts will extend further toward Kyrkfjärden (*Lauri 2014*). This is due to the longer dredging period and the larger volumes of materials involved. In practice the species spawning in the inner archipelago are spring-spawners, with the exception of the winter-spawning burbot. The eggs of spring-spawning fish will only be susceptible to the suspended solids load for a few weeks, in April, May or June depending on the species. After this there will be fry susceptible to the suspended solids load in the area. Later on in the summer, once the juveniles have become better swimmers and therefore are capable of avoiding the highest levels of turbidity, the adverse effects on breeding will be clearly reduced. Consequently, the timing of the marine works in the landfall area will play a significant role as regards the magnitude of the adverse effect. It was assumed in the assessment of impacts that marine works will take place during the spawning and nursery periods of spring-spawning species of fish (April–July). On the basis of this, the adverse effects of suspended solids are assessed to be moderate/high for the LF1 landfall and moderate for LF2.

The landfall marine works will only comprise dredging as there is no need for blasting. The noise caused by dredging will not differ significantly from the noise caused by vessels moving in the nearby fairway. In the maze-like and in part shallow archipelago noise is also carried over distances that are considerably shorter than in the offshore areas. The adverse impact of noise concerning the landfall areas is assessed as low.

In summary, it can be stated concerning the impacts on fish arising from the construction of the Ingå archipelago section and landfall sites that the negative impacts on breeding areas, the actual spawning and fry will be the most significant as these will affect the status of the fish populations. In other respects the impacts will be temporary and area-specific and mainly cause behavioral changes (deterring) in fish. The most significant impact was assessed to be seen in the area of the LF1 landfall alternative where a significant breeding reedbed will be destroyed. The suspended solids impact of dredging was also assessed as more detrimental with LF1 than with LF2. In the middle and outer archipelagos the impacts of both alternatives (ALT FIN 1 and ALT FIN 2) were similar, excluding the suspended solids impact which was higher with the alternative ALT FIN 1 passing north of Stora Fagerö. The level of naturalness of ALT FIN 1 can also be regarded as higher as a shipping route runs close to the ALT FIN 2 alternative. A lot of earthworks, including blasting, will be carried out along the pipeline route passing through the Ingå archipelago, which will result in high levels of underwater noise and suspended solids. The impacts of the noise and the suspended solids will be temporary, however.

#### Fishing

Marine construction taking place in the archipelago zone will have an impact on fishing through reductions in catches and hampering of fishing. The decline in catches may be caused by the deterral of fish (temporary impact) or breeding failure (long-term impact). Fishing will be hampered if marine works prevent the use of fishing sites on a temporary or permanent basis. In areas where fishing can be carried out, slime/dirt accrual on nets may increase as the suspended solids load is elevated. This will have an adverse effect on the efficiency of the fishing gear and increase the time required to clean them. Furthermore, adverse effects may arise indirectly when fishing takes place in new sites located further away. This will increase the costs arising from and the time required for fishing. At times marine works may also make it more difficult to market fish. The adverse effects on subsistence and recreational fishing can be regarded as similar, although the financial losses will be lower. Fishing tourism in the area may also suffer from the marine works. The level of the adverse effect will be depend significantly on the timing of the marine works.

On the basis of the overall examination, significant impacts on fishing during construction in the Ingå archipelago zone will comprise underwater noise and disturbance, increase in suspended solids concentration caused by marine works, and temporary loss of fishing sites.

There are net and fyke fishing sites in the project area or its immediate vicinity in the middle and outer as well as inner archipelago. There are more net fishing sites near the ALT FIN 1 alternative passing north of the island of Stora Fagerö, and with this alternative the adverse effect on commercial fishing will also be higher than along the routing of ALT FIN 2. However, it should be noted that fish will be deterred temporarily from an extensive area by large-scale blasting and seabed intervention.

As regards the landfall alternatives, the impacts of LF1 on fishing are assessed as higher than those of LF2. Dredging extending to the inner bay area (LF1) will affect fish reproduction and extend the suspended solids impacts further to the Kyrkfjärden area, whereby the affected area will be larger.

### 8.5.3 Impacts during operation

#### 8.5.3.1 Offshore area of the Gulf of Finland

#### Fish fauna

There will be no significant impacts from the commissioning and operation of the gas pipeline on fish in the offshore area. For example, the underwater sounds arising from operation are estimated to be insignificant in relation to the ambient noise level in the project area (*Klauson et al. 2014*).

The subsea rock installation taking place to protect the gas pipeline may in soft-bottom areas create new utilizable habitats for demersal fish. On the other hand, in accumulation bottoms these rock beds will be quite rapidly buried in fine-grain material due to sedimentation and resuspension. Changes in the seabed along the gas pipeline route may be of minor advantage to some demersal fish.

In the event of a leak, natural gas will not mix with seawater. Instead, it will vaporize immediately and evaporate into the air. In repair situations short-term disruptions may occur locally.

#### Fishing

The gas pipeline will be located in an area where trawling is carried out. Trawling in the area is mainly mid-water and surface trawling. According to studies conducted (*Ramboll 2013d* and *2013b*), the share of bottom-trawling is very small on the Finnish as well as Estonian side and does not even take place every year. It is, however, possible that bottom-trawling will become more common in the area in the coming decades. The Balticconnector gas pipeline will be covered in the trawling areas in a manner ensuring it will not disturb trawling. The reconciliation of offshore gas pipelines and fishing has been studied extensively regarding the North Sea, and guidelines are available for design (e.g. *DNV 2010*).

Once covered, the gas pipeline will not cause an adverse impact on offshore fishing. The impact is estimated to be insignificant (no impact) or very low.

#### 8.5.3.2 Ingå archipelago zone

#### Fish fauna

In conjunction with the commissioning of the gas pipeline, attention should be paid to the disposal of the water used for the pressure test. The water should be disposed of in an area where the exchange of water is good. For example, the disposal of water in the shallow area with limited exchange of water at Barkarsundet might affect the oxygen level, which would result in a momentary deterioration in the living conditions of fish.

The impacts of the gas pipeline during operation will be very low on fish in the archipelago zone. The pipeline will be placed in a trench and covered throughout the archipelago zone section. The covering of the pipeline with rock material on the soft bottoms may also create new habitats and attract demersal fish in the archipelago area. The impact is likely to be very low, however.

In the event of a leak, natural gas will not mix with seawater. Instead, it vaporizes immediately and evaporates into the air. In repair situations short-term disruptions may occur locally.

### Fishing

Because the gas pipeline will be placed in a trench and covered throughout the archipelago zone section, there will not be any significant impacts on fishing during pipeline operation. In possible repair situations short-term disruptions may occur locally.

## 8.5.4 Summary of the significance of impacts and comparison of alternatives

There are no conservation areas in or near the offshore area, and fish stocks are regulated on the basis of catch quotas. The Baltic herring and sprat stocks are of very high significance to society, being the main catch target for trawlers on the Finnish as well as the Estonian side. No significant reproduction of pelagic fish species takes place in the offshore areas of the project, however. The occurrence of demersal fish is in part of the project area is at times limited due to the poor oxygen situation. The sensitivity of the offshore areas of the project is classified as low (Table 8–6).

The sensitivity of landfall LF1 is classified as high and that of the other alternatives and moderate (Table 86). The assessments are affected by the nature reserves and the closed areas of the Ingå Fishing Region (partly in the project area) specified in legislation. Threatened species of fish also occur in the project area (brown trout, anadromous European whitefish, sea-spawning European whitefish, European eel, salmon and river lamprey), with the sea-spawning European whitefish breeding in the project area. The societal significance of the area is increased by the commercial fishing and recreational use (subsistence and recreational fishing) taking place in the area, which can at times be regarded as rather extensive. Due to their limited nature, fish-spawning sites are also clearly susceptible to changes caused by marine construction, particularly at the landfall sites.

### Fish fauna

The project's impact will be limited to the period during construction, which is when the load will be at its highest. As regards fish, significant impacts during construction were assessed to occur in situations where there are adverse effects on fish spawning areas, spawning or fry. In these respects the most significant impacts will be targeted at the inner archipelago (spring-spawning fish species, possibly some species seeking to spawn in rivers) as well as middle and outer archipelago (Baltic herring and sea-spawning European whitefish) of Ingå. Significant impacts may arise from the destruction of spawning and nursery habitats in the landfall areas and from suspended solids impact and underwater noise throughout the archipelago zone area. On the basis of the above, the overall significance of the impacts off the coast of Ingå as assessed as high as regards the LF1 landfall area and as moderate as regards the other alternatives (Table 8–6). Although the alternatives were assessed as falling under the 'moderate' category, with the exception of LF1, there were clear differences between the alternatives. For example, the level of naturalness is higher along the ALT FIN 1 routing alternative, and its suspended solids impact will be higher than that of ALT FIN 2, which will run close to a shipping route and where the suspended solids impact will be lower.

In the offshore area fish populations will be impacted in an extensive area by underwater explosions in particular, resulting in behavioral changes over several kilometers and risk of injury up to hundreds of meters from the blasting site. The duration of the impact will be very short, however. The suspended solids impact will be low and short-term in the offshore area. Demersal fish will also be affected by changes in the benthos, which may have either negative or positive impacts depending on the species of fish. No significant fish spawning areas can be found in the offshore zone of the project area. The impact on fisheries is reduced by the fact that the impact focus will be on mature fish. The sensitivity of the area is, however, clearly lower than that of the archipelago zone. On the basis of these, the overall significance of the impacts in the offshore areas is assessed as low (Table 8–6).

The impacts during commissioning and operation on fish in the Ingå archipelago zone are classified as insignificant (no impacts) or very low.

### Fishing

Any significant impacts on fishing will also focus on the construction period. There will be a significant impact during construction on fishing throughout the archipelago zone because fish will be deterred due to the increased concentration of suspended solids and underwater noise from explosions resulting from seabed intervention operations. The adverse effect caused by the deterred fish will be temporary and can be addressed through compensations to commercial fishers. Any impacts on fish breeding areas will, however, result in permanent adverse effects. The most adverse impacts will be the high suspended solids impacts caused by seabed intervention for the ALT FIN 1 routing alternative and LF1 landfall. Other impacts assessed as significant are underwater noise (ALT FIN 1 and ALT FIN 2) and the impact of the LF1 landfall alternative on fish breeding success. The adverse effects relating to suspended solids and underwater noise will occur while work is in progress, while the adverse effect caused by LF1 on breeding success in the area is assessed to be a permanent impact. On the basis of the above, the overall significance of the impacts off the coast of Ingå is assessed as moderate as regards all of the alternatives (Table 8–6).

In the offshore area there will be disturbance to trawling because the movement of vessels not participating in the work will need to be restricted. Fish may also be deterred by explosions. The impacts during construction will be temporary and of short-term duration locally. On the basis of the above, the overall significance of the impacts in the offshore areas as assessed as moderate (Table 8-6).

The natural gas pipeline will be covered in areas where trawling takes place. Therefore the project will not have impacts on fishing during pipeline operation. The classification criteria used for the determination of the sensitivity of receptors and the magnitude of change are described in Appendix 3 to this EIA report.

Table 8-6. Overall significance of the impacts on fish and fisheries. A = archipelago area, OS = offshore area. The project will not have any significant impacts on fish or fishing during pipeline operation.

| Impact significance | | Magnitude of change | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Very high** | **High** | **Moderate** | **Low** | **No change** | **Low** | **Moderate** | **High** | **Very high** |
| **Sensitivity of the receptor** | **Low** | High | Moderate | **OS Fishing Low / Moderate** | **OS Fish Low** | No impact | Low | Low | Moderate | High |
| | **Moderate** | High | High | **A Fish/Fishing ALT 1, ALT 2, LF2 Moderate** | Low | No impact | Low | Moderate | High | High |
| | **High** | Very high | **A Fish, LF1 High** | **A Fishing, LF1 Moderate/High** | Moderate | No impact | Moderate | High | High | Very high |
| | **Very high** | Very high | Very high | High | High | No impact | High | High | Very high | Very high |

### 8.5.5 Prevention and mitigation of adverse impacts

Adverse impacts can best be reduced during the project design phase by taking fisheries into consideration where possible in the selection of routing alternatives and the detailed design of pipeline routing.

On the basis of the impact assessment, the project's impacts on fisheries will be at their highest when targeted at fish breeding. It will not be possible to fully avoid fish breeding and nursery periods in the project area. This is because there are breeding and nursery sites for species spawning in the spring, autumn as well as winter in the area. The breeding period of spring- and summer-spawning species is, however, likely to be the most significant period for fish breeding in the Ingå archipelago zone. Consequently, the adverse impacts could be reduced considerably if seabed intervention could be avoided in the inner archipelago in particular during May, June and July. On the other hand, the extension of the construction period by a year is overall likely to be more harmful to the environment than a shorter construction period.

Fish mortality caused by blasting work can be reduced by deterring the fish from the danger zone before explosions. Fish can be deterred using methods such as acoustic deterrents or smaller charges before actual blasting.

Methods such as bubble curtains are recommended in literature to reduce sound pressure levels during blasting. Their benefits are difficult to assess, however, due to limited experience in their use. Bubble curtains do not provide an efficient barrier against low frequencies and they are susceptible to factors such as water currents and unevenness of the seabed.

The will not be any impacts during pipeline operation on fish that could be mitigated to a significant extent. As regards trawling, experience gained from the North Sea concerning the reconciliation of gas pipelines and trawling should be taken into consideration (e.g. *DNV 2010*).

General adverse impact on fish and fishing can be compensated for by levying a fisheries fee. Compensations to commercial fishers can be agreed upon in advance with fishers operating in the project area or compensations can be determined in arrears in accordance with actual adverse impacts. The proposal for the fisheries fee will be submitted in conjunction with the project permit application on the basis of the adverse impact on fisheries caused by the project.

## 8.6 Noise

### 8.6.1 Assessment methods and assessment uncertainties

#### Onshore noise

Onshore environmental noise arising from natural gas pipeline construction and normal operation was assessed on the basis of noise modeling for the ALT EST 1 and ALT EST 2 routing alternatives and the LF1 and LF2 landfall alternatives. In Finland the assessment also covered the construction and operation of the compressor station. A brief description of impacts in offshore areas of the Gulf of Finland is also provided in this report.

Above-water activities near the coast during pipelaying as well as onshore activities during construction were modeled using the same static noise propagation calculation by utilizing the calculation of noise exposure level $L_{AE}$ for sound source emissions. As continuous progress will be made in the activities, it is possible to determine the equivalent sound level $L_{Aeq}$ situation within one daytime period. In this it is assumed that construction can take place in the daytime between 7:00 and 22:00 and that progress will be made within one day by the pipelaying vessel near the coast.

The noise impact examination area extends in Ingå on the pipeline route from the sea and the compressor station approximately 1 km from the noise source up to the 45 dB(A) propagation plot. Noise propagation over the terrain was illustrated using computer software on noise dispersion where sound waves from sound sources are calculated onto a digital 3D map as sound pressure at the immission (reception) point. The software used was CadnaA v.4.4 (Datakustik GmbH) with the Nordic noise modeling method (*Kragh 1982*). The model takes into consideration the geometric attenuation of noise, topography, buildings and other reflective surfaces as well as absorption constants for the ground and atmosphere. Noise sources can be determined as point, line or surface sources.

The noise map produced provides equivalent sound level plots with initial parameters selected at 5 dB intervals. The Nordic Prediction Method was employed in the noise propagation calculations. The impact of forest and softer soil was taken into consideration by using restricted ground absorption areas. Hard ground is generally determined for industrial facilities, water and road surfaces. Noise propagation is typically calculated conservatively in the model, with environmental conditions points set as favorable for noise dispersion (slight tailwind from noise source to each calculation point).

Both estimated as well as measured values for corresponding components (including rock drilling and blasting, pipelaying vessel, compressor station noise sources and general construction period noise) were utilized in the initial sound power level values (total sound power level $L_W$ and frequency spectrum by octave band) for the noise calculations. The determinations of building sound source sound power levels included interior-to-exterior noise in a manner whereby wall materials were assumed to have the rate of airborne sound insulation of an industrial building typical for the material's properties.

As a general rule, surface sound sources were used to, for example, cover an entire building's wall surface area and area sources for an entire set of buildings. Some compressor station functions were also modeled as individual point or surface sources of sound. The

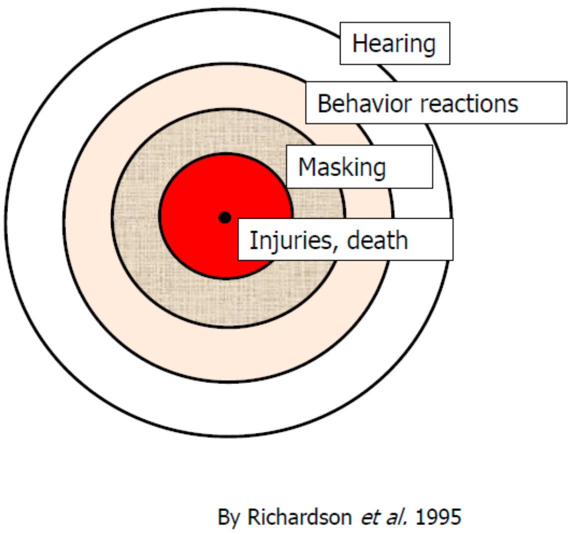



Figure 8-23. Theoretical zones of noise influence on marine organisms. *(Richardson et al. 1995)*

sound source descriptions are, however, only preliminary at this stage, and they cannot be determined specifically due to the general nature of the preliminary design process.

The further away the noise source is, the more significant the impacts of annual weather variation and wind direction in particular will be on the actual sound level of an area. Therefore the uncertainty of the calculations increases the further an area is from the sound sources. In addition, the uncertainty of the assessment is affected by the assessments of noise emission levels and the locations of noise emission sources. Typically the uncertainty involved in the calculation part only is around ± 3 dB to a distance of 1 km. The total uncertainty here was estimated as slightly higher (+2–-5 dB), with the project modeled as in compliance with the presumed maximum and noise-generating activities taking place throughout the period of operation at 100% capacity. The results of the noise modeling were applied to the assessment of impacts in the offshore areas of the Gulf of Finland.

The noise modeling and assessment work was conducted by an experienced noise expert.

### Underwater noise

Underwater noise calculations were carried throughout the pipeline route and for the different project alternatives. The sensitive areas (protected areas) located in the vicinity of the pipeline route and the impact of noise on them were taken into particular consideration in the noise calculations.

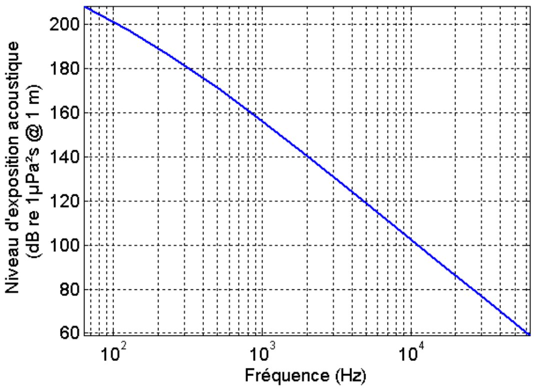
Pressure waves produced by underwater explosions travel in water in the same way as in the air. Pressure waves may damage nearby structures and have adverse impacts on people, fish and other animals in water, in the worst case killing them if too close to the site of explosion. The lethal range may be tens of meters, and serious impacts may be caused even further. Further away from the explosion site the pressure wave created will have a deterring impact on organisms such as fish.

Depending on the distance between source and receiver, four zones are used to estimate underwater noise impact on marine organisms (Figure 8-23). These zones are: 1) hearing, 2) behavior reactions, 3) masking and 4) injuries and death. The dangerous zone corresponds to the area near the noise source where the received sound level is high enough to cause organism tissue damage resulting in either temporary threshold shift (TTS) or permanent threshold shift (PTS) or even more severe damage causing death.

Sources of underwater noise during the project activities are seabed intervention (subsea rock installation, dredging and blasting), pipelaying and trenching, landfall construction, pipeline inspection and maintenance and gas flow The noisiest activities are seabed excavation (dredging or blasting), pipelaying and trenching. These activities are included in the worst-case scenarios, which are expected to generate the highest noise levels. Constructional phase worst-case scenarios are:

- blasting of bedrock peaks at pipeline route near Ingå;
- pipelaying at pipeline route near Ingå;
- pipelaying at pipeline route near Paldiski;

A graph illustrating the sound source noise emission level for blasting work as a function of frequency is shown in the figure (Figure 8-24).



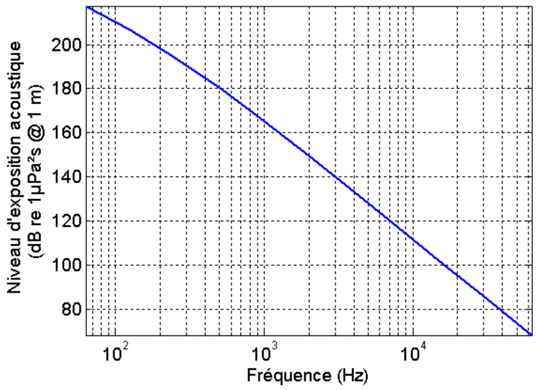




Figure 8-24. Model of source level from explosive blasting (*Santos et al. 2010*). Left: 1kg of equivalent TNT confined and blast duration of 3ms. Right: 1 kg of equivalent TNT unconfined and blast duration of 3 ms.

To protect mammals from underwater blasting-generated noise, the following relationship to calculate the safe distance has been suggested which originates from the U.S. Navy Diver Formula. The Navy Diver Formula is designed for unconfined charges and is very conservative:

Dangerous zone radius (ft) = 520 (lbs/delay)$^{1/3}$

A modern equation is proposed by Konya (*Navigation Study 2012*). This formula agrees better with the measurements of pressures generated in the water from underwater blasts with the explosives in boreholes. The general equation for predicting the distance at which the shock pressure in the water is 50 psi (0.34 MPa) is:

Dangerous zone radius (ft) = 132 (lbs/delay)$^{1/3}$

The source levels of the typical vessels involved in pipelaying are taken based on data from previous similar projects for the construction of the North Stream and South Stream natural gas pipelines (*Jasco 2013* and *FOI*). Continuous noise, broadband SL (dB re 1 µPa at 1 m):

- pipelaying vessel 190 dB
- anchor-handling vessel 190 dB
- supply vessel 185 dB
- dredging/trenching vessel 190 dB

A group of vessels has the equivalent source level (SL) of 194 dB re 1 µPa at 1 m.

There is a great deal of uncertainty involved in underwater noise propagation. The conservative approach generally overestimates noise levels at large distances. Temperature gradients, bottom topography, and currents are noted to cause sound levels to attenuate more rapidly than expected from geometric spreading.

The uncertainties in the SPL assessment are linked to the following factors:

- The model of geometrical spreading used for this preliminary assessment is simplistic and does not take into account the effects of the marine environment.
- Variability of the ambient noise level which, at certain levels and/or ranges, may mask the noise of construction work. The ambient noise level depends on existing human activities in the area and in the sea state.
- Seasonal changes of water column properties which have a major impact on the propagation of the noise introduced by construction work. Temperature and salinity profiles of the sea vary in space (vertically and horizontally) and time (daily and seasonal trends). Sound waves are highly sensitive to stratification, and a negative vertical temperature gradient will result in the refraction of sound waves towards the seabed where they will be subject to the influence of sediment. Conversely, in the absence of stratification (homogeneous medium), sound can carry further because acoustic ray paths interact far less with the boundaries such as surface and seabed.
- Uncertain values of source levels of ships.
- Effect of bathymetry and sea bottom sediment composition on sound propagation, which has a major impact on the propagation of the noise introduced by construction work. Sound-propagation losses are greater as waters become shallower, a cumulative loss effect that derives from shoaling caused by changing bathymetry. The effect is linked to the interaction of sound waves with the interfaces of the sea waveguide (surface and seabed). Furthermore, it should be noted that sea waves tend to surge as they encounter shallower water, which increases their contribution to ambient noise.

The assessment was conducted by experienced noise experts participating in the EU LIFE+ BIAS project.

### 8.6.2 Impacts during construction

#### 8.6.2.1 Above-water noise

**Gulf of Finland**

The above-water noise impacts concerning the pipeline route across the Gulf of Finland were not examined separately using noise modeling as the result is in the same range as the modeling results for Ingå and Paldiski (see Appendix 4), i.e. the 45 dB(A) zone may, according to the calculations, extend to around 500 m from the pipelaying vessel (LAeq, 15 h). The noise level is regarded as normal above-water shipping noise, with any noise pollution load occurring locally being very short-term in nature.

**Ingå**

ALT FIN 1 routing alternative

Above-water noise propagation for pipelaying in the ALT EST 1 passing north of the island of Stora Fagerö in Ingå is shown on the noise map below (Figure 8-25).

According to the model, the 45 dB(A) noise zone may extend to around 500 m from the planned pipelaying vessel route on both sides of the vessel. In this routing alternative there are no holiday residences within the 45 dB(A) zone before the point where the route alternatives merge with each other. At the merging point by the holiday residences of the island of Bergskämmö, the equivalent sound level for a day may exceed the 45 dB(A) daily guideline value. There may even be higher momentary peaks in sound levels when pipelaying is taking place right in front of the island. All in all the noise impacts will, however, be short-term.

ALT FIN 2 routing alternative

Above-water noise propagation for pipelaying in the ALT EST 2 passing south of the island of Stora Fagerö in Ingå is shown on the noise map below (Figure 8-27).

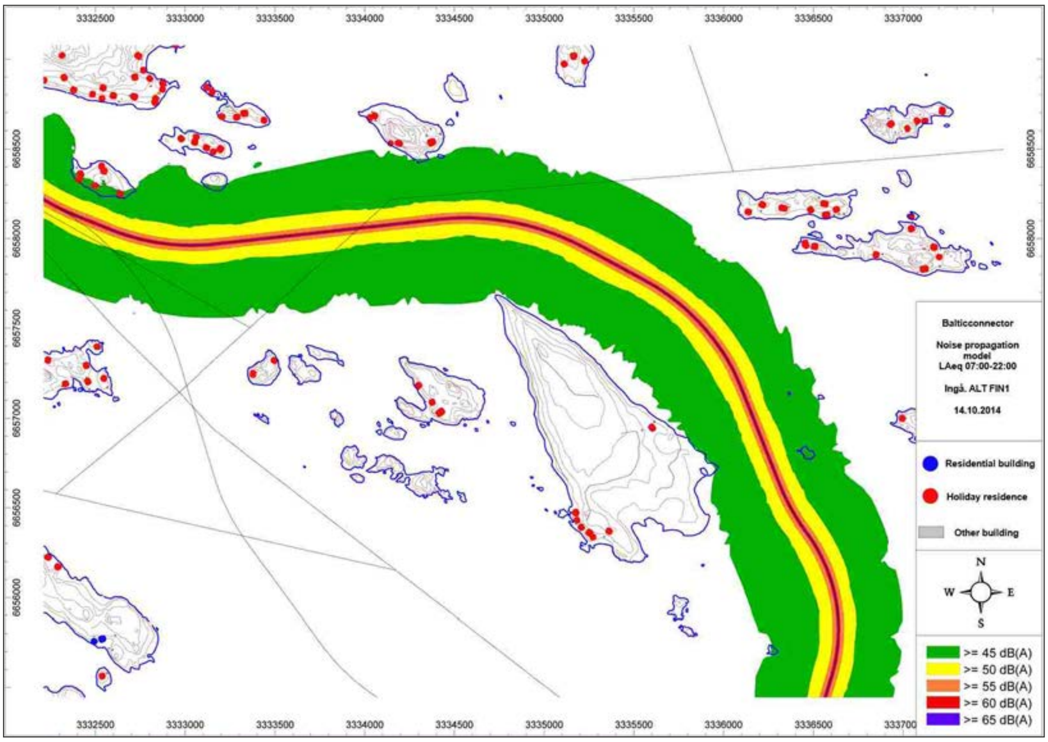



Figure 8-25. Noise model for the ALT FIN 1 routing alternative during construction. Noise propagation is shown as equivalent sound level for the daytime (LAeq, 07:00–22:00). Under optimal conditions the pipelaying vessel will make progress at around 4–5 km a day.

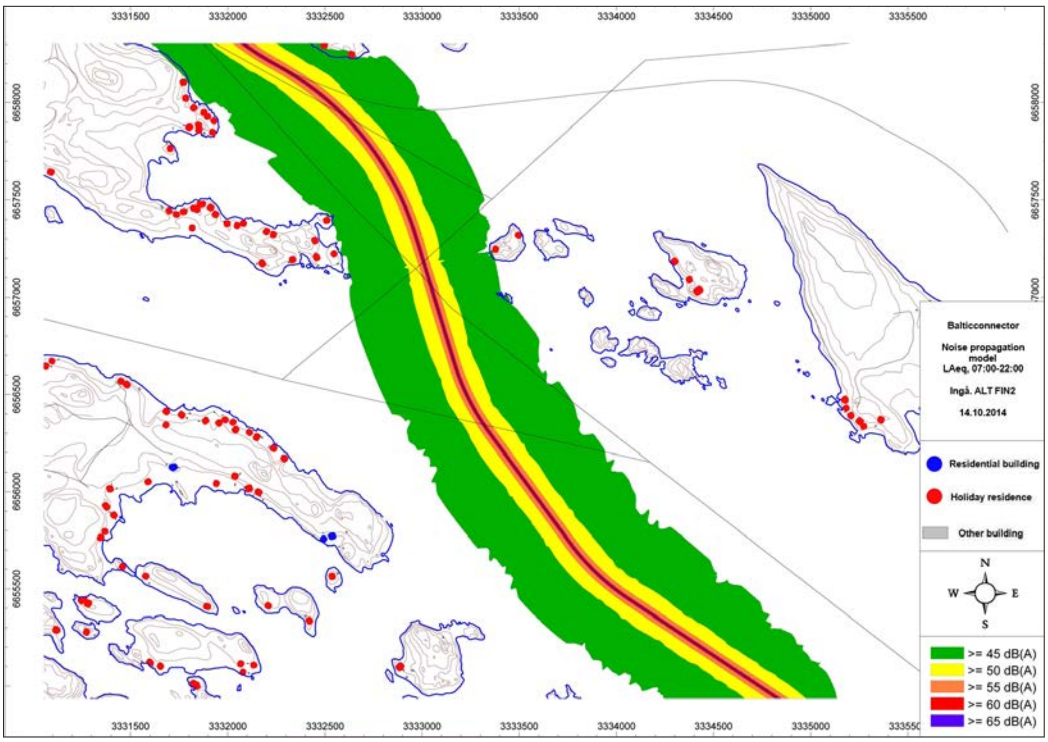



Figure 8-26. Noise model for the ALT FIN 2 routing alternative during construction. Noise propagation is shown as equivalent sound level for the daytime (LAeq, 07:00–22:00). Under optimal conditions the pipelaying vessel will make progress at around 4–5 km a day.

According to the model, the 45 dB(A) noise zone may extend to around 500 m from the planned pipelaying vessel route on both sides of the vessel. In this routing alternative there are no holiday residences within the calculated 45 dB(A) zone before the point where the route alternatives merge with each other. At the merging point by the holiday residences of the island of Bergskämmö, the equivalent sound level for a day may exceed the 45 dB(A) daily guideline value. There may even be higher momentary peaks in sound levels when pipelaying is taking place right in front of the island. All in all the noise impacts will, however, be short-term.

At sections passing the nearest nature reserves the noise level may, according to the model, be around 45–50 dB(A), which is slightly above the daily guideline value of 45 dB(A) set for nature reserves. The nighttime guideline value does not apply to such nature reserves that are not commonly used for visits or nature-watching during the nighttime. The general rule applied to levels above the guideline value at nature reserves has been that the levels need not be below the guideline value throughout the nature reserve (*Ministry of the Environment 1992*).

The daily guideline value of 45 dB set for nature reserves is exceeded in the ALT FIN 1 alternative on the island of Stengrundet located east of Stora Fagerö, which belongs to the Barö nature reserve. In the ALT FIN 2 alternative the noise level is exceeded at the northeastern edge of the Stor-Ramsiö nature reserve. Other islands designated as nature reserves in the area will be included in the noise zone. Small islands in the Ingå archipelago included in the Natura site and within the noise zone are the Abborpinnarna islets in ALT FIN 2 and Låggrundet in ALT FIN 1. The Ytterharu islands in ALT FIN 2 and the outer Änkan island will be close to the perimeter of the noise zone. The above-mentioned islands in the Natura site are designated as nature reserves in the partial local master plan of the Ingå outer archipelago.

### Landfall LF1

Noise propagation during construction for the LF1 landfall alternative (7:00–22:00) up to the compressor station is shown on the map below (Figure 8–27).

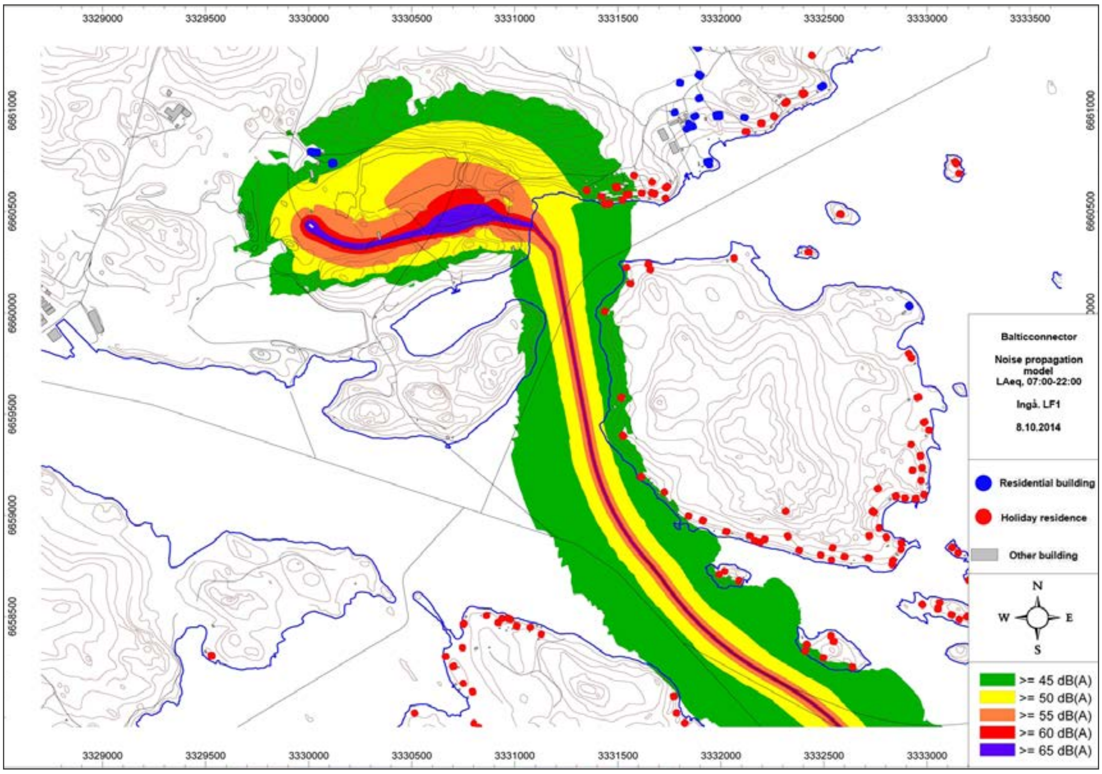



Figure 8–27. Noise model for LF1 during construction. The model is based on the assumed situation where both pipelaying and onshore construction take place around the clock throughout the area over a period of 24 hours, while in reality the onshore work will progress in stages over a longer period of time.

According to the model, the 45 dB(A) equivalent sound level zone may extend over the holiday residences on the western side of the island of Skämmö. There may even be higher momentary peaks in sound levels when pipelaying is taking place right in front of the island. All in all the noise impacts will, however, be short-term locally.

The 45 dB(A) noise zone may extend to around 800 m during construction of the LF1 landfall alternative up to the compressor station as bedrock blasting will be required. The model is based on the basic assumption of onshore extraction including drilling, blasting and earthmoving. Blasting will take place to a depth of around 2 m, whereby some of the noise propagation will be more vertical rather than horizontal. According to the model, there will be some holiday residences at Bastubackan within the 45 dB(A) noise zone. All in all the noise impacts would, however, be short-term.

#### Landfall LF2

Noise propagation during construction for the LF2 landfall alternative (7:00–22:00) up to the compressor station is shown on the map below (Figure 8–28).

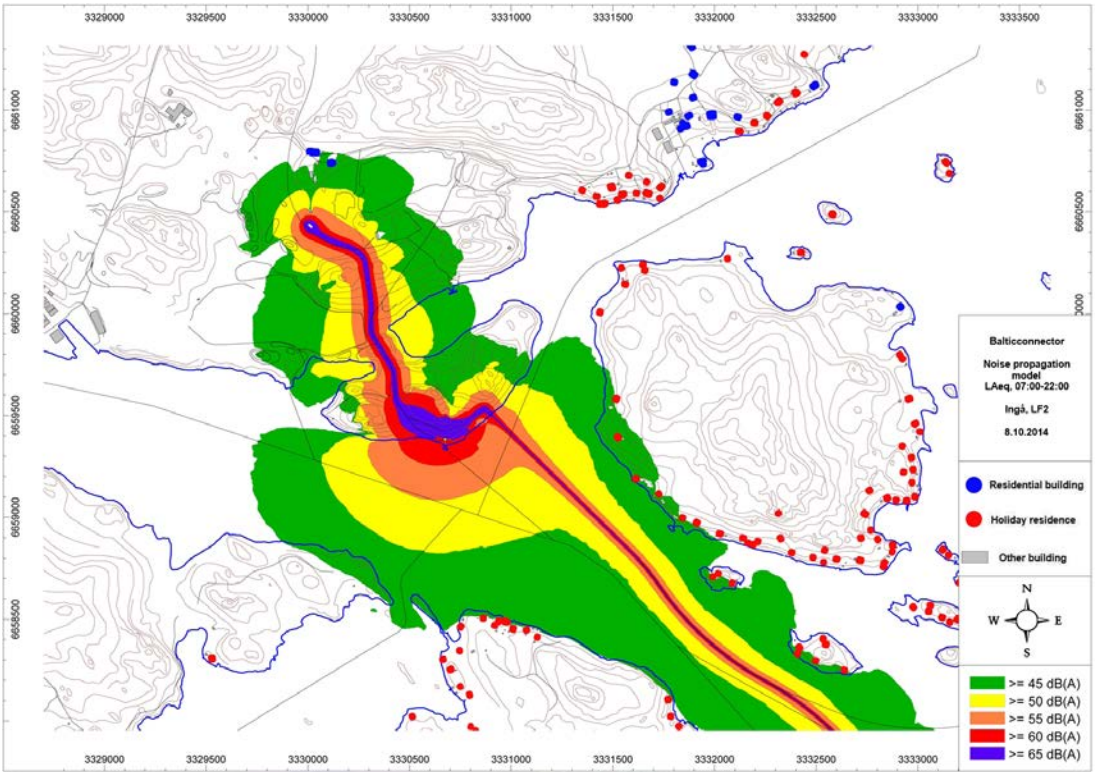



Figure 8–28. Noise model for LF2 during construction. The model is based on the assumed situation where both pipelaying and onshore construction take place around the clock throughout the area over a period of 24 hours, while in reality the onshore work will progress in stages over a longer period of time.

According to the model, the 45 dB(A) equivalent sound level zone may extend over the holiday residences on the western side of the island of Skämmö and on the island of Jakobramsjö. There may even be higher momentary peaks in sound levels when pipelaying is taking place right in front of the island. All in all the noise impacts would, however, be short-term.

### 8.6.2.2 Underwater noise

#### Gulf of Finland

The propagation of underwater noise is affected by the underwater acoustics of the Baltic Sea. The Baltic Sea is relatively shallow, which results in some frequencies being filtered out. *(BIAS 2014)* The propagation of sound close to the shore differs from that in offshore areas. As well as depth, the propagation of sound in water is also affected by the salinity and temperature of water as well as the stratification of these, with sound attenuation caused by the gradients. The quality of the seabed also affects sound propagation as soft bottoms reduce sound reflection while hard rocky bottoms reflect sound, resulting in only minor propagation loss. *(Poikonen & Madekivi 2010)* For part of the year the Baltic Sea is covered by ice, and the ice cover may affect the underwater soundscape. There is, however, currently very little research data on these. *(BIAS 2014)*

According to the assessment calculations, the maximum level of underwater noise in the Gulf of Finland during the construction of the natural gas pipeline will be around 145 dB (re 1 µPa) at 1 km from the pipelaying vessel and at the closest point of approach (CPA) of the vessels (NLP, see Table 8-8) around 155 dB (re 1 µPa) where the vessel is at the same point as the receiver. The level can be regarded as such that can be heard by many marine mammals, and it may also significantly mask other sounds. The sound level is high enough to be able to cause a temporary threshold shift (TTS) only within a few meters from the pipelaying vessels.

### Ingå

Excavation and seabed leveling can be performed either by dredging or blasting, depending on the soil conditions and the environment. In the conservative assessment given here it is assumed that only blasting will be employed for excavation (the level of noise arising from dredging is lower than from explosions). The pipeline will pass through the Ingå archipelago Natura 2000 site, and blasting may cause adverse impacts on marine organisms in the area.

The table below presents the safe distances for unconfined and confined charges (Table 8-7). The safe distances given designate the near-field shock pressure wave effect. These safe distances must be complied with during blasting, and mitigation measures (section 8.6.4) must be implemented to prevent injuries in marine organisms, particularly mammals, caused by

The table (Table 8-7) presents the minimum safe distances for blasting. The received levels (RL) for various marine mammals can also be calculated at the closest point of approach (CPA) of the vessel fleet along the pipelaying route (Table 8-8). On the basis of the calculations, at Noise Level Point (NLP) 6 (Figure 8-29), where the CPA is 233 m, noise from underwater blasting may cause significant disturbance to the behavior and communication of mammals such as harbor porpoises (TTS). There may be a bigger impact on seals, in which a Permanent Threshold Shift (PTS) may take place at NLP6.

The noise levels caused by pipelaying and blasting over that 0-20 km section of the pipeline was assessed at the edge of the nature reserves, i.e. at NLP 1-NLP 11 (Table 8-8 and Figure 8-29).

Table 8-7. Calculated safe distances for shock pressure wave effect from blasting.

| TNT charge, kg | Source Level, dB | Safe distance for unconfined charges, m | Safe distance for charges in boreholes, m |
|---|---|---|---|
| 10 | 241 | 444 | 113 |
| 20 | 244 | 560 | 142 |
| 40 | 247 | 705 | 179 |
| 50 | 248 | 760 | 193 |
| 100 | 251 | 444 | 113 |

Table 8-8. Sound pressure levels dB re 1 µPa (at the closest point of approach, CPA) for ALT FIN 1 and ALT FIN 2 in Ingå.

| ALT FIN 1 | | | | ALT FIN 2 | | | |
|---|---|---|---|---|---|---|---|
| NLP | CPA (m) | Received level | Uncertainty | NLP | CPA | Received level | Uncertainty |
| | | dB (re 1 µPa) | dB (re 1µPa) | | | dB (re 1 µPa) | dB (re 1 µPa) |
| 1 | 15 767 | 123 | 20 | 1 | 15 767 | 123 | 20 |
| 2 | 12 474 | 125 | 20 | 2 | 12 474 | 125 | 20 |
| 3 | 9 187 | 128 | 20 | 3 | 9 187 | 128 | 20 |
| 4 | 2 460 | 137 | 17 | 4 | 2 460 | 137 | 17 |
| 5 | 2 754 | 136 | 17 | 5 | 652 | 147 | 14 |
| 6 | 232 | 154 | 12 | 6 | 2 017 | 139 | 16 |
| 7 | 3 331 | 135 | 18 | 7 | 4 185 | 135 | 18 |
| 8 | 1 965 | 139 | 16 | 8 | 1 895 | 139 | 16 |
| 9 | 8 132 | 128 | 20 | 9 | 8 132 | 128 | 20 |
| 10 | 10 630 | 126 | 20 | 10 | 10 630 | 126 | 20 |
| 11 | 11 398 | 126 | 20 | 11 | 11 398 | 126 | 20 |

The highest continuous broadband noise levels can be seen in the Ingå archipelago Natura site (Figure 8-29). In this area the sound pressure level (SPL) varies from 135 dB (ALT FIN 1 and ALT FIN 2) at the border NLPs up to 195 dB near the pipeline route. Ambient noise level may therefore be exceeded by 70–130 dB. SPL at the border of the most distant nature reserves close to the Finnish coast does not exceed 128 dB. Ambient noise level may be exceeded by 63 dB.

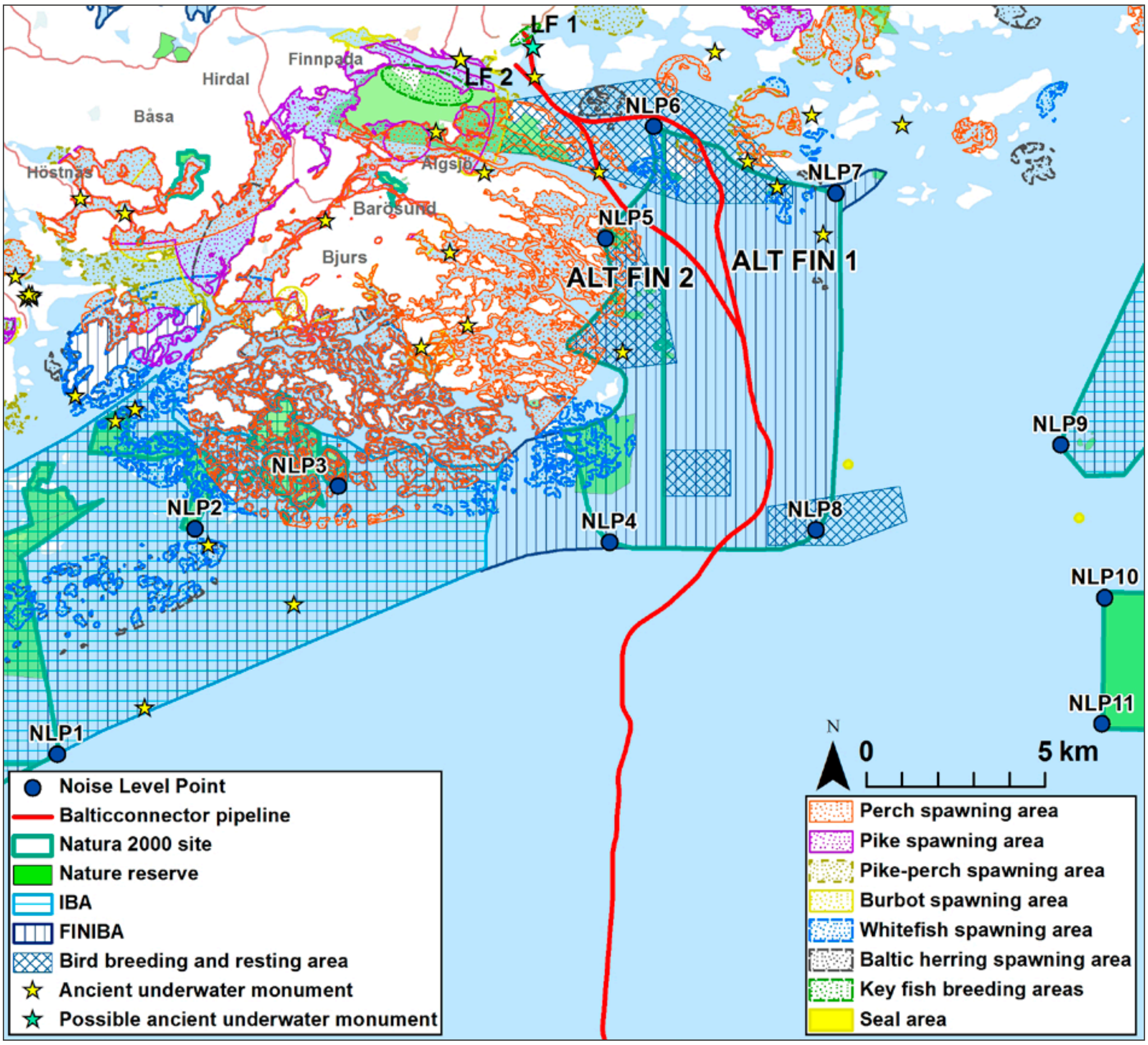



Figure 8-29. Noise levels from pipelaying and blasting at NLP 1–NLP 11. Nature reserves are shown in green and the Natura site in yellow.

As regards noise, the impact assessment causing impacts on people is presented in section 8.13 and on fauna and protected sites in section 8.10.

### 8.6.3 Impacts during operation

As a general rule, noise impacts during pipeline operation will only comprise noise caused by the compressor station, which will consist of noise generated by the compressor and the gas turbine powering it. Outdoor noise sources include the gas turbine air intake, exhaust gas outlet and any condenser fans. The situation during operation was calculated to produce a noise propagation calculation for continuous operating noise, excluding any temporary periods of pipeline blowdown. According to the results, the 45 dB(A) noise zone will extend to a maximum of around 150 m from the compressor station. The maximum equivalent sound level LAeq at the nearest residential building in Ingå will be 38 dB(A). Noise impacts during operation will be low and very local.

During pre-commissioning, underwater noise will be generated from water intake and discharge, in which pigging will also be used. Pipeline operation noise sources can be classified as either continuous or intermittent. During operation, noise will be generated by 1) gas-borne noise from pipeline and 2) maintenance works, such as the use of vessels and helicopters. Based on data from similar reports, the noise impact from these actions will, however, be insignificant. For maintenance purposes, pipeline blowdowns (releases of natural gas) may be carried out, resulting in a strong whistle-like sound. Blowdowns only last a few minutes and take place very seldom (a few times a year over the entire Finnish natural gas pipeline network). Local residents will be notified in advance about blowdowns.

### 8.6.4 Summary of the significance of impacts and comparison of alternatives

Most of the Baltic Sea marine area is impacted at least by a level of noise that has been estimated to mask the communication of animals. In the Ingå archipelago the pipeline will pass through the Natura site and close to other conservation areas. Above-ground noise is caused on the mainland west of the project area by Inkoo Shipping Oy port operations and Rudus Oy rock extraction activities. The sensitivity of the receptor in the archipelago area is assessed as moderate as regards underwater noise and low as regards above-ground noise. In offshore areas the sensitivity of the receptor is assessed as low (Table 8-9).

The above-ground and above-water noise impacts will be at their highest during pipeline construction. However, the noise pollution will be transient and only last for a very brief period of time in the area and, in optimal conditions, pipelaying will progress at the rate of 4–5 km a day. In general the noise impacts from construction may cause temporary but no long-term disturbance.

As regards the above-water and above-ground noise impacts during construction, in both of the routing alternatives, ALT FIN 1 and ALT FIN 2, the guideline value for noise may be exceeded temporarily at the nearest holiday residences close to Fjusö. The differences relating to the pipelaying vessel route will be very small, however. As regards underwater noise, slightly higher noise levels will be generated in the nearest nature reserves by ALT FIN 1 than by ALT FIN 2.

Regarding the landfall alternatives, LF1 may result in the daily guideline value of 45 dB(A) being exceeded over the short term at the nearest holiday residences west of the island of Skämmö. Consequently, the noise impacts of LF1 regarding the landfall site and blasting would be slightly higher than those of LF2.

According to the calculations, the maximum underwater noise level in the Gulf of Finland during the construction of the natural gas pipeline will be audible by many marine mammals, and the noise may also significantly mask other sounds. The sound level is high enough to be able to cause a temporary threshold shift (TTS) only within a few meters from the pipelaying vessels.

According to the calculations, the levels of noise from underwater blasting may cause significant disturbance to the behavior and communication of marine organisms such as harbor porpoises. There may be a bigger impact on seals, in which a Permanent Threshold Shift (PTS) may take place in the area. Noise impacts during operation will be very low.

The overall significance of the impacts from underwater and above-ground noise in the offshore areas is assessed as low and in the archipelago area as moderate (Table 8-9). The classification criteria used for the determination of the sensitivity of receptors and the magnitude of change are described in Appendix 3 to this EIA report.

Table 8-9. Overall significance of noise impacts during construction. A = archipelago, OS = offshore area, U = underwater noise, AG =above-ground noise. There is no significant difference between the alternatives. The noise impacts during operation will be insignificant. Above-ground noise impact during operation will be very low (compressor station operations).

| Impact significance | | Magnitude of change | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Very high** | **High** | **Moderate** | **Low** | **No change** | **Low** | **Moderate** | **High** | **Very high** |
| **Sensitivity of the receptor** | **Low** | High | Moderate | Low | **OS/AG & U Low** | 0 No impact | Low | Low | Moderate | High |
| | **Moderate** | High | High | **A/AG & U Moderate** | Low | No impact | Low | Moderate | High | High |
| | **High** | Very high | High | High | Moderate | No impact | Moderate | High | High | Very high |
| | **Very high** | Very high | Very high | High | High | No impact | High | High | Very high | Very high |

### 8.6.5 Prevention and mitigation of adverse impacts

Any levels above the guideline values found in the above-ground noise modeling conducted for this report can be prevented in many ways. It should be noted about the models that all of the equipment modeled were assumed to operate at 100% capacity throughout the period of work in the calculations. In reality there is major variation in the periods of time taken for each operation and, accordingly, in the noise emissions generated by them.

The best way to prevent the creation and dispersal of noise during construction is planning and design. Noise emissions can be limited and optimized through measures such as the choice of equipment and equipment noise control enclosures during construction. Sources of noise can be placed in locations such as those in which direct visual contact with receptors that are sensitive to noise is prevented. The noisiest operations can also be scheduled to only take place in the daytime.

The following mitigation measures can be used for underwater noise:

- Underwater pipeline construction should be designed, where possible, to avoid times when sensitive marine organisms, especially mammals, fish and birds, are particularly susceptible to disturbance, such as mating, breeding, feeding or migration.
- The response of marine organisms depends on the distance between the source and the receiver. The dangerous zone corresponds to the area near the noise source where the received sound level is high enough to cause injury (TTS, PTS) or even more severe damage causing death. Warning sounds can be used to deter marine mammals and fish temporarily from the dangerous zone. Underwater noise mitigation technologies currently being developed for shallower areas include bubble curtains, hydro sound dampers (HSD) and cofferdams.
- During pipeline construction, underwater explosions are planned for the blasting of bedrock sections and rock fragmenting before dredging. Blasting is the loudest source of underwater noise, and special care must be taken in such operations. The radii of the dangerous zones is smaller with confined charges where boreholes are used than with open-water unconfined charge explosions.

## 8.7 Vibrations

### 8.7.1 Assessment methods and assessment uncertainties

Vibrations caused by blasting work were examined in the environmental impact assessment. Vibration levels were assessed in relation to distance from the vibration source based on available data and previous experiences. Volumes of material removed through blasting were also examined in this context. Buildings located in the vicinity of the project area as well as any disturbance experienced by people were taken into consideration in the assessment.

There are several uncertainties relating to the assessment of vibration impacts. These include the geological characteristics affecting the propagation of vibrations as well as the structural characteristics of the buildings in the area possibly affected. In addition, the level of vibration annoyance experienced and the occurrence of any damage are impacted by several different factors. The blasting surveys to be conducted at later stages of the project will enable surveys of vibration impacts through vibration measurements and impact calculations.

The impact assessment was conducted by experienced geology experts and an environmental expert.

### 8.7.2 Impacts during construction

During construction vibrations from the environmental perspective are produced mainly by explosions carried out during blasting work in seabed intervention and the blasting of the onshore natural gas pipeline corridor. Explosions may also be used in the clearance of underwater ordnance, such as mines.

The most extensive blasting work will be required in the pipeline's landfall zone and the area close to the shore where blasting will be needed to lower bedrock peaks by approximately 1.5 m. According to a conservative and preliminary estimate, the volume extracted will total around 85,000 m3 between the shore and Kilometer Point 26.9. The final route optimization will involve the avoidance of bedrock, whereby the amount of blasting required is likely to be below the preliminary estimates.

In underwater blasting, the field to be blasted in that session is drilled and charged with explosives. The size of the field and the depth of the boreholes will depend on issues such as seabed topography and the equipment used. Other vessel traffic and other construction work will be taken into consideration in blasting design. According to preliminary estimates, there will be 1–5 blasts per shift.

Blasting will also be required for both of the landfall alternatives for the structures of the onshore natural gas pipeline section. Bedrock material will be removed using drilling, blasting and loosening. Excavation will be carried out using normal bench blasting equipment. Charges will be placed in boreholes drilled into the bedrock, and the charged field will be blasted. Depending on the situation, a bedrock field that is on average 5–15 m thick will be blasted at a time, averaging around 5,000 $m^3$ in volume. Blasting will be carried out for a near-vertical rock face (gradient around 7:1).

The level of vibrations caused by blasting will mainly depend on the momentaneous explosive amount. Other factors affecting the vibrations created include a variety of blasting technology matters such as the type of explosive, the direction of drilling and detonator, the use of stemming, and the choice of ignition system. The rate of vibration is also affected significantly by the structure of the bedrock and soil, their moisture, temperature as well as topography. On hard grounds (such as solid rock or glacial till) vibration attenuation is very rapid.

In blasting, a stress wave is created in the bedrock, causing vibrations. Vibrations can be described using peak particle velocity (PPV) (mm/s) and frequency (Hz). PPV close to the blasting site may exceed 100 mm/s, while in locations further away the level is often one-tenth of this as the stress wave loses its energy as the distance increases. The frequency of vibrations at close distances will be around 50–220 Hz, but it will be reduced as the distance increases.

The vibrations may damage structures and sensitive instruments as well as cause annoyance in people and animals. Structural damage to buildings is not merely caused by the level of vibration. Instead, the structure's own weight, condition and other characteristics and loads affect a structure's vibration tolerance. Instruments sensitive to vibrations include computers, microscopes and measuring equipment, which may suffer from damage or breakage due to vibrations. In practice the risk of structural or equipment damage resulting from excavation vibrations only occurs within 50–100 m measured directly from the excavation site. Human perception of vibrations is subjective. According to the United States Bureau of Mines (USBM), humans detect vibrations at peak particle velocities (PPV) of 2–10 mm/s, with PPVs exceeding 20 mm/s often causing annoyance.

The vibration impact from excavation blasts will be short-term in nature. Vibrations caused by blasts will usually only last a few seconds at a time. Vibrations are usually detectable up to 500 m from the excavation site when blasting is carried out in a controlled manner. Vibrations may, however, also extend further depending on issues such as soil geology.

Vibration impacts may be caused close to shores by blasting of the offshore sections of the pipeline. Blasting during the construction of the onshore pipeline section will also generate vibration impacts in the local environment.

Vibrations from blasting may have a temporary impact on the residential comfort of the nearest residents. The ALT FIN 1 pipeline routing alternative will run around 150–200 m from the nearest holiday residences, of which there are five in the westernmost part of the island of Skämmö. With ALT FIN 2 the shortest distance to a holiday residence (Bastholmarna) is around 130 m. The LF1 landfall would at its closest be around 300 m from the Bastubackan holiday residences and around 150 m of those on the island of Skämmö. The holiday residences closest to the LF2 landfall are less than 300 m away on the island of Skämmö. Vibrations will be detectable in these buildings for a short period of time, but according to the assessment there will no impacts on the buildings as in practice the risk of structural damage due to blasting vibrations exists within 50–100 m measured directly from the blasting site.

### 8.7.3 Impacts during operation

No vibrations will arise from activities during pipeline operation.

### 8.7.4 Summary of the significance of impacts

The nearest buildings are located so far from the onshore pipeline sections that no vibration impacts are assessed to occur on them. The sensitivity of the receptor is assessed as low. The ALT FIN 1 alternative will pass 150–200 m from the nearest holiday residences. There are underwater observation stations and measuring equipment for long-term monitoring points of the Finnish environmental administration in the vicinity of the area. The sensitivity of the receptor in the offshore as well as coastal area is assessed as low (Table 8-10).

Vibrations during construction will mainly be caused by blasting explosions. Vibrations from underwater explosions may have a temporary impact on the residential comfort of the nearest residents. Vibrations may be temporarily detectable in holiday residences closest to the ALT FIN 1 and ALT FIN 2 routing alternatives and landfalls LF1 and LF2, but adverse impacts are not assessed to occur on buildings. No vibration impacts are assessed to occur from landfall LF2. There will be no vibration impacts from the project during operation.

The overall significance of impacts during project construction is assessed as low (Table 8-10). The classification criteria used for the determination of the sensitivity of receptors and the magnitude of change are described in Appendix 3 to this EIA report.

Table 8-10. Overall significance of vibration impacts. C = during construction, O = during operation. Alternatives ALT FIN 2, LF1 and LF2 are assessed as not causing vibration impacts during construction.

| Impact significance | | Magnitude of change | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Very high** | **High** | **Moderate** | **Low** | **No change** | **Low** | **Moderate** | **High** | **Very high** |
| **Sensitivity of the receptor** | **Low** | High | Moderate | Low | **C / ALT 1 Low** | **O No impact** | Low | Low | Moderate | High |
| | **Moderate** | High | High | Moderate | Low | No impact | Low | Moderate | High | High |
| | **High** | Very high | High | High | Moderate | No impact | Moderate | High | High | Very high |
| | **Very high** | Very high | Very high | High | High | No impact | High | High | Very high | Very high |

### 8.7.5 Prevention and mitigation of adverse impacts

Vibration impacts can be reduced through good blasting design. Special restrictions will be placed on pressure waves and vibrations generated by the work. The results of the EIA procedure and the detailed studies conducted after the procedure will be used to optimize the route of the Balticconnector pipeline in order to minimize the need for seabed intervention

It may not be possible to fully prevent perceived vibrations affecting residential comfort, but the risk of technical damage to the nearest buildings, structures and measuring instruments can be eliminated through careful planning and design and correct work methods.

## 8.8 Traffic and traffic safety

### 8.8.1 Assessment methods and assessment uncertainties

The assessment of impacts on maritime traffic covers operations during the construction and operation phases of the project, subject to certain restrictions. As regards the period of construction, the assessment covers vessel traffic relating to seabed intervention, pipe supply, pipelaying and subsea rock installation. Measures during pipeline operation included in the impact assessment are mainly to do with vessel traffic required for pipeline maintenance.

The impacts of these activities on other vessel traffic were assessed on the basis of the number of vessels and the access restrictions caused by the safety zones to other vessels. Data from the Automatic Identification System (AIS) and Traffic Separation Scheme (TSS) of the Gulf of Finland was utilized in the assessment. The impact assessment examined the planned information provision and maintenance of contacts relating to shipping management during pipeline installation.

The assessment of road traffic impacts took place through an examination of deliveries relating to the construction and operation of the onshore pipeline section and related routes and transport volumes. The area examined covered the roads leading to the project area. Transport relating to line pipe coating and storage was not included in the assessment.

The assessment was conducted as an expert assessment based on current traffic volumes, separate studies, expert interviews and other reference material.

The assessment involves certain assumptions about vessel traffic volumes and routes based on the AIS. In reality, vessels may not necessarily use the same routes, which introduces slight while not significant uncertainty to the results.

The assessment was conducted by an experienced expert specializing in traffic impacts.

### 8.8.2 Impacts during construction

#### 8.8.2.1 Maritime traffic

**Seabed intervention and subsea rock installation**

In the first phase of the construction of the offshore natural gas pipeline, seabed intervention will be required for some pipeline sections using dredging, ploughing or bedrock blasting. Munitions found on the pipeline route will also have to be cleared.

Rock installation to a total volume of around 985,933 m³ will take place in the pre- and post-lay phases. The rock material will be delivered to the installation site using a vessel with a loading capacity of around 24,000 tonnes. There will be around 65 rock shipments. A rock installation vessel will be used for the transport and installation of the rock material. The vessel has a typical rock installation speed of around 2,000 tonnes per hour. Depending on the volume of rock installed, the vessel will remain at each installation site for a few days at the most.

Seabed intervention and subsea rock installation will mainly focus on areas off the Finnish coast, but some intervention measures will also take place in the Gulf of Finland and coastal areas near Paldiski. Due to the safety zone established, the project will result in navigational restrictions on other maritime traffic because the work area will need to be avoided by regular vessel traffic in the area, taking the safety distance into consideration. In addition, the shipping route usually used by vessels may need to be narrowed down temporarily, restricting the area available to other vessel traffic.

Seabed intervention will mainly result in momentary local impacts on other vessel traffic with a maximum duration of few days for each area as the avoidance of the area will be needed during intervention in compliance with the safety restrictions. In the offshore areas vessel diversion from the intervention area will be reasonably easy, but in narrower sections, such as the Ingå fairway, there may be temporary disturbances to marine and port traffic due to the safety restrictions. The clearance of munitions found on the seabed will also result in corresponding temporary impacts on other vessel traffic as the clearance operations and related explosions will restrict access to the immediate vicinity of the site. Efforts will be made to conduct such measures within a very short period of time, however. If necessary, the avoidance of the site can also take place by vessels changing their course, whereby only low impacts are assessed to arise from seabed intervention and subsea rock installation on other maritime traffic considering the short period of time that the restrictions will be in effect in each area.

### Pipelaying

The offshore natural gas pipeline will be installed using either an anchored or dynamically positioned (DP) pipelaying vessel. An anchored vessel is held in position by anchor-handling vessels, while the correct position of a DP pipelaying vessel is maintained with propellers and thrusters.

Depending on its type, the pipelaying vessel will be assisted by anchor tugboats, pipe supply vessels and various survey and/or monitoring vessels For each anchor-positioned pipelaying vessel, 2–6 anchor-handling vessels will typically be required. These are typically quite large (total length around 100 m). One service vessel will also be required for each pipelaying vessel. Dynamically positioned multi-purpose vessels will be used for anchor handling and maintenance functions.

Dynamically positioned pipelaying vessels will be favored in the pipelaying process. Pipelaying and anchoring vessels that are as small as possible to minimize environmental impacts will be used in areas where it is not possible to use a dynamically positioned pipelaying vessel (such as coastal areas).

The average transport capacity of a pipe supply vessel is around 240 line pipes at a time, whereby around 27 shipments will be required in total. Under optimal conditions the lay rate will be around 4–5 km per day. The logistics solution will be designed in a manner enabling the minimization of onshore and offshore transport distances as efficiently as possible.

It is estimated that three pipe supply vessels will operate simultaneously during the pipelaying process: one unloading pipes onto the pipelaying vessel, one loading pipes from the onshore stockyard and one en-route between the stockyard and the pipelaying vessel. The pipe supply vessels will use regular shipping lanes when moving between the stockyard and pipelaying vessel and will therefore contribute toward a slight increase in traffic on the lanes. Considering the relatively small volumes (27 shipments), the increase is not assessed to have a significant impact. As the pipelaying vessels will be capable of normal navigation while outside the safety zone of the pipelaying vessel, the impacts on other maritime traffic will be low.

One pipelaying vessel, with a safety zone established around the vessel, will be used during pipeline construction. Safety zones for pipeline installation vessels will be agreed with the maritime authorities in Finland and in Estonia. Based on a preliminary assessment, a safety zone of 1,500 m will be adequate for all installation vessels, including anchor-handling vessels. Vessels not included in the pipelaying fleet will not be allowed access to the safety zone. Instead, the area will have to be avoided by them.

The diameter of the safety zone will be around 3 km, and other vessels will have to keep a minimum safety distance of 1.5 km from the pipelaying vessel. The safety zone will affect other vessel traffic as it will take space in shipping lanes. In areas where fairways with high traffic intensity are crossed or where the work takes place close to a very narrow fairway section, the safety zone will result in impacts on other vessel traffic. In these areas other vessels will have to navigate with greater care than normally, and vessels may have to change trajectory to bypass the safety zone. Some vessels may also have to divert to longer routes due to the rerouting.

In the Gulf of Finland, where fairway crossings take place in the open sea, the impacts on other vessel traffic will be low as there will be plenty of space around the safety zone of the pipelaying vessel for diversionary routes, resulting in only short detours. In narrower sections close to the coast, however, the diversionary routes may be longer and their safety zone will require exceptional traffic control measures. Pipelaying taking place in the Ingå fairway area will result in a temporary restriction on traffic toward the Port of Ingå for a few days, which is when the port will be closed down temporarily. The safety restrictions may also cause temporary disturbance to other vessels operating on the Ingå fairway. In the ALT FIN 2 routing alternative, the pipeline will run over a longer distance close to the fairway, whereby the impacts of pipelaying measures on traffic on the fairway will be slightly higher that than those of the ALT FIN 1 alternative. Construction in the coastal area will take a few months, during which there will be impacts on vessel traffic. In the summer season in particular, with a lot of pleasure boats visiting the area, construction may be perceived as a disturbance. Impacts on people are covered in more detail in section 8.13.2. The impacts on vessel traffic and traffic safety are, however, assessed to be low in terms of their significance considering the duration of the impact and existing navigation and traffic control measures.

In the Gulf of Finland, especially on shipping routes F and G with high traffic intensity, most of the vessels are cargo ships (around 63%). A significant proportion of vessels on routes D and F are cargo ships, but the traffic volumes on these routes are considerably lower. The largest numbers of tankers operate on routes J, I, F and G, while the largest numbers of passenger ships are found on routes E and I. Cargo ships and tankers account for very little of the traffic on the routes on the Finnish side, and the majority of the traffic consists of other vessels, such as pleasure boats. On the routes on the Estonian side, vessel traffic is spread more evenly, consisting of passenger, cargo, tanker as well as other types of vessel (Figure 7–32).

The biggest impacts of the safety zone relating to pipelaying will targeted at tanker transport as tankers only have a limited capacity for sudden changes in direction due to their large inertia. Therefore their diversionary route will need be longer around the safety zone in case of a re-routing. Large cargo and passenger ships are also quite slow at changing trajectory, which must be taken into consideration in routing decisions. Smaller vessels, such as high-speed passenger ferries and pleasure boats, are capable of changing trajectory rather quickly. The navigation of modern vessels these days is based on a navigation system consisting of electronic navigational charts and, in addition, all vessels with gross tonnage of 300 or more must be fitted with Class A type AIS transceivers. The voluntary Class B type transceivers have also become more common in smaller vessels (under 300 GT).

The impacts caused by the safety zone on other vessel traffic and traffic safety are on the whole assessed as low, considering that the impacts will only occur during pipeline construction. The impacts will be short-term and local.

#### 8.8.2.2 Road traffic

Line pipes for the offshore natural gas pipeline will be shipped to a harbor storage facility and further to the pipelaying vessel. Therefore the transport of the pipes will not have an impact on road traffic in Finland.

The rock used for subsea rock installation will be transported from the quarry to the harbor by truck. The trucks have a capacity for around 40 tonnes. The volume of rock required for pre-lay and post-lay rock installation totals around 985,933 m³, requiring around 38,000 deliveries, but these will be divided between Estonia and Finland. The rock material will be transported from the quarry to the nearest harbor, which helps minimize the transport distance. The deliveries will result in a temporary increase in traffic volumes to the selected harbor during pipeline construction. The impacts on other traffic and traffic safety will be moderate. Considering the short duration of the impacts, the impacts of rock transport are, on the whole, assesses as low, however. One option is also to use a rock extraction enterprise operating in Ingå, whereby the rock material can be shipped directly to the project area.

The components of the onshore natural gas pipeline can be transported to Ingå by ship or truck. The maximum length of the onshore pipeline section is around 1.5 km, whereby the 125 line pipes can be delivered in one shipment by sea or, alternatively, a number of deliveries by truck corresponding to the number of line pipes needed will be required. No oversized loads will be required for line pipe transport. Where possible, the soil and rocks removed in earthworks will be used for purposes such as landscaping and for the construction of the installation road and the backfilling of the pipeline trench in the pipeline route area. The purpose of this is to minimize the transport distances of materials.

During construction, there will be some heavy traffic in the Ingå area due to transport of machinery and passenger transport of employees participating in construction work. Compared with current traffic volumes on Ingå Strandvägen road and Hamnvägen road, the increase in traffic volumes caused by the project will be very low and will not be visible in traffic in the area in practice. For Oljehamnsvägen road the increase will be more significant. Progress at around 0.5–1.5 km a week will be made on the construction of the onshore pipeline, whereby traffic related to the work will only burden local roads for a few weeks. The impacts on other traffic and traffic safety will be low and short-term.

### 8.8.3 Impacts during operation

#### Maritime traffic

Regular inspections and maintenance inside and outside the pipeline will take place during pipeline operation. Activities relating to pipeline maintenance will create some vessel traffic along the pipeline route. The vessels may cause temporary disturbance to other vessel traffic during maintenance work. The measures will, however, last for a very short period of time, take place seldom and only take place in a small area at a time, whereby the impacts on other vessel traffic are estimated to be low. During the operation of the natural gas pipeline the pipeline route may restrict the availability of anchoring sites and pose risks in the form of gas leaks or vessel grounding.

### Road traffic

The natural gas pipeline will cause hardly any road traffic during pipeline operation, excluding maintenance work. Maintenance work will result in traffic a few times a year. Maintenance traffic will be low and short-term, and it is not assessed to have an adverse impact on other traffic.

## 8.8.4 Summary of the significance of impacts and comparison of alternatives

A large number of vessels travel in the Gulf of Finland every year. Vessel traffic volumes in the coastal areas of Ingå in the vicinity of the planned Balticconnector natural gas pipeline route are also high. There are holiday residences close to the route, but vessel traffic is a familiar phenomenon in the area. The assessment of the impacts on people is reported in section 8.13. The sensitivity of the receptor is assessed as low (Table 811).

The construction phase of the offshore natural gas pipeline is assessed to cause low impacts on maritime and road traffic. The impacts during pipeline operation on maritime and road traffic will be very low. There are no differences between the routing alternatives.

Seabed intervention will mainly result in momentary local impacts on other vessel traffic with a maximum duration of few days for each area as the avoidance of the area will needed during intervention.

The pipelaying vessel will require a safety zone that is around 3 km in diameter. The safety zone will affect other vessel traffic as it will take space in shipping lanes. In areas where fairways with high traffic intensity are crossed or where the work takes place close to a very narrow fairway section, the safety zone will result in impacts on other vessel traffic. In these areas other vessels will have to navigate with greater care than normally, and vessels may have to change trajectory to bypass the safety zone. Some vessels may also have to divert to longer routes due to the re-routing. The impacts on vessel traffic and traffic safety are, however, assessed to be low in terms of their significance considering the duration of the impact and existing navigation and traffic control measures. The impacts will be local and short-term, and there are no significant differences between the routing alternatives.

Progress at around 0.5–1.5 km a week will be made on the construction of the onshore pipeline, whereby traffic related to the work will only burden local roads for a few weeks. The impacts on other traffic and traffic safety will be low and short-term.

Regular inspections and maintenance inside and outside the pipeline will take place during pipeline operation. The measures will, however, last for a very short period of time, take place seldom and only take place in a small area at a time, whereby the impacts on other traffic are estimated to be low.

The overall significance of impacts during construction and operation is assessed as low (Table 8-11). The classification criteria used for the determination of the sensitivity of receptors and the magnitude of change are described in Appendix 3 to this EIA report.

Table 8-11. Overall significance of traffic and traffic safety impacts, C = during construction, O = during operation. There is no significant difference between the alternatives.

| Impact significance | | Magnitude of change | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Very high | High | Moderate | Low | No change | Low | Moderate | High | Very high |
| Sensitivity of the receptor | Low | High | Moderate | Low | C / O Low | No impact | Low | Low | Moderate | High |
| | Moderate | High | High | Moderate | Low | No impact | Low | Moderate | High | High |
| | High | Very high | High | High | Moderate | No impact | Moderate | High | High | Very high |
| | Very high | Very high | Very high | High | High | No impact | High | High | Very high | Very high |

## 8.8.5 Prevention and mitigation of adverse impacts

The Gulf of Finland Mandatory Ship Reporting System (GOFREP) and international maritime legislation will be complied with in the project. Close contacts will be maintained with the Coast Guard and relevant maritime authorities throughout the construction period, providing them with information about progress made in construction work. Up-to-date information about vessel work plans is maintained in the GOFREP system. The Coast Guard notifies seafarers of construction work and shipping restrictions (including Notices to Mariners and navtex broadcasts).

Other maritime traffic will also be monitored continuously during installation work from the pipelaying vessel and, where necessary, also from other vessels in the pipelaying fleet. Any vessels nearby will be alerted and provided with the coordinates of the safety zone. Where necessary, measures will be taken to prevent accidents. Special attention to safety will be paid during fairway crossings and in other areas with high traffic intensity because the pipelaying vessel must be able to proceed and position the anchors without disturbance caused by other vessels.

## 8.9 Air emissions

### 8.9.1 Assessment methods and assessment uncertainties

Dust generation caused by earthworks was estimated on the basis of excavation volumes based on preliminary design data. The estimate of air emissions from vessel traffic during construction was calculated taking the number and types of vessels participating in construction as well as their use in construction into consideration. Emissions into the air were calculated on the basis of the estimated vessel fuel consumption rate. Initial data provided in the tables below was used in the emission calculations (Table 8–12 and Table 8–13).

Emissions into air from a natural gas-fueled compressor station (nitrogen oxides, carbon dioxide) and vessels participating in inspections and maintenance of the offshore pipeline were taken into consideration in the calculations. The type of fuel and the size and estimated usage rate of the facility were taken into account in the calculation of emissions from the compressor station. Emissions from natural gas used as a fuel vary depending on the usage rate of the compressor station. The environmental impact assessment was conducted using the emission limit values specified in the Decree on small combustion plants (750/2013[1]). Examined in the emission calculations was a situation where:

- annual operating hours total 5,400;
- average natural gas heat input is 19 MW;
- nitrogen oxide emissions from the gas turbine are 50 mg/Nm³.

Amounts of emissions have been illustrated by comparing them with the total emission rates of the location municipality and emissions from the largest sources nearby.

Air impurities are compared with limit, guideline and target values. Limit values for nitrogen dioxide, sulfur dioxide, respirable particulate matter and fine particulate matter in outdoor air to prevent health hazards are provided in Government Decree 38/2011. In addition, guideline values for nitrogen dioxide, sulfur dioxide and respirable particulate matter in outdoor air are provided in Government Decision 480/1996. To protect plants and the ecosystem, a critical level that must not be exceeded has been set for sulfur dioxide and nitrogen oxides. The critical level for sulfur dioxide is 20 µg/m³ and for nitrogen oxides 30 µg/m³. The critical levels apply to areas outside the built-up environment. *(Government Decree 38/2011)*

The uncertainties concerning vessel emissions are to do with vessel traffic volumes and fuel consumption, which at this point are preliminary. The uncertainties concerning onshore sections are to do with volumes of material extracted and the quantity of natural gas consumed at the compressor station, which will be specified further at later stages of the design process. Even

1 Government Decree on the environmental protection requirements set for energy production units with a heat input below 50 MW.

Table 8–12. Initial data on vessels during construction in the Gulf of Finland employed in the emissions calculations.

| | Useful power | Average distance | Period of operation, hours |
|---|---|---|---|
| **Subsea rock installation vessels (Nordnes)** | 9 000 kW | 40 km | 890 |
| **Pipelaying vessel (Solitaire)** | 51 000 kW | | 490 |
| **Pipe supply vessels (3)** | 3 000 t | 40 km | |
| **Service vessel** | 2 000 kW | | 490 |

Table 8–13. Initial data used in calculations.

| | |
|---|---|
| **Fuel consumption** | 190 g/kWh |
| **Emission factors** | |
| - **nitrogen oxides ($NO_x$)** | 12 g/kWh |
| - **particulate matter** | 1.35 g/kg of fuel |
| - **carbon dioxide** | 3.2 t/t of fuel |
| **Fuel sulfur content** | 0.1% |

Table 8-14. Air emissions from vessels participating in offshore pipeline construction for the entire pipeline (tonnes total)

| Nitrogen oxides | Sulfur dioxide | Respirable particulate matter | Carbon dioxide |
|---|---|---|---|
| t | t | t | t |
| 400 | 14 | 9 | 22 000 |

considering the uncertainties, the air quality impacts of the project will be rather low. The assessment was conducted by an experienced environmental hygienist.

### 8.9.2 Impacts during construction

Air quality impacts during construction in the Gulf of Finland are to do with exhaust gases from vessel traffic during pipe transport, pipelaying and seabed intervention. In Ingå, impacts during construction are to do with earthworks on the mainland.

On the Estonian side vessel emissions into the air will be corresponding to those in Finland, excluding emissions related to seabed intervention, which in Finland will take place closer to the mainland. In Estonia the Balticconnector project will not involve bedrock blasting concerning onshore pipeline sections.

#### Vessel air emissions

Construction work will involve seabed intervention measures such as digging, dredging and blasting, rock dumping, munition clearance, pipe transport to pipelaying vessels, offshore pipelaying with related support activities, and other activities involving vessels. Most of the air emissions generated by vessels will be caused by transport and vessel activity relating to pipe transport, pipelaying and subsea rock installation. There will be one pipelaying vessel operating at sea during the pipelaying process. In addition to this, there will be three pipe supply vessels operating simultaneously – one unloading pipes onto the pipelaying vessel, one loading pipes from the onshore stockyard and one delivering pipes to the pipelaying vessel. Vessel air emissions relating to pipeline construction and installation will be generated over a period of two years, of which pipelaying will account for around two months. Emissions will be generated at sea, i.e. mainly in areas with no residences. The vessels will move along as the work progresses, so the sources of emission will not be located in the same area all the time during the construction period. Consequently, the emissions will be dispersed over a large area.

Vessel traffic generates nitrogen oxide, sulfur dioxide, particulate and carbon dioxide emissions into the air. An estimate of the total emissions into the air from vessels participating in pipeline construction during construction and installation is presented in the table below (Table 8-14). Around 59% of the total emission rate will be targeted at the Exclusive Economic Zone of Finland and 41% of that of Estonia. There is no significant difference between the alternatives. The impact of vessel traffic emissions on air quality is assessed as low.

In 2012 annual emission rates from Baltic Sea shipping for nitrogen oxides totaled 370,000 tonnes, sulfur dioxide 84,000 tonnes, particulate matter 23,000 tonnes and carbon dioxide 19,000,000 tonnes (*Jalkanen 2013*). Emissions from vessel traffic involved in the construction of the Balticconnector project will be less than 1% of the current shipping emissions in the Baltic Sea area. To illustrate the emissions rate, the rate can be compared with the average emissions from the Ingå power plant in 1999–2011. Emissions from vessels participating in the construction of the gas pipeline will amount to 15% of the average annual nitrogen oxide emissions and less than 1% of the sulfur dioxide emissions of the power plant.

#### Earthworks

In Ingå the construction of the onshore natural gas pipeline section will involve earthworks generating dust, such as removal of topsoil, leveling, excavation and digging. Earthworks will as a general rule be carried out in the daytime, whereby any impacts from construction will be limited to daytime hours approximately between 7:00 and 22:00. One of the environmental impacts during construction will be dust generated into the air by excavation as well as machinery. The duration of earthworks will be less than a year.

The volume of excavation to take place for the work area and onshore pipeline sections from the landfall to the compressor station will for the LF1 landfall total around 1,300 $m^3$ and for the LF2 landfall around 2,000 $m^3$. The volumes will be very small compared with the current extraction taking place around 250 m from the compressor station site at the Rudus Oy site totaling around 200,000 $m^3$ a year. Dust generation relating to earthworks is assessed to remain in the immediate vicinity of the worksite as the bedrock extraction will not involve crushing. There is no significant difference between the landfall alternatives LF1 and LF as regards dust generation.

### 8.9.3 Impacts during operation

Air emissions on the mainland will be generated from the operation of the compressor station and at sea from pipeline inspections and maintenance.

### Compressor station

The compressor station can be fueled by electricity or natural gas. If the station is fueled by natural gas, natural gas will be used at the compressor station to fuel a gas turbine with a maximum heat input of around 23 MW. Small amounts of carbon dioxide ($CO_2$), nitrogen oxides ($NO_x$) and water vapor are emitted in the combustion of natural gas. The combustion of natural gas does not result in practically any sulfur dioxide of particulate emissions. If fueled by electricity, there will be no local flue gas emissions from the compressor station.

Annual nitrogen oxide emissions from a natural gas-fueled compressor station will be around 15 tonnes. This corresponds to around 1% of the total nitrogen oxide emissions in the Municipality of Ingå in 2011. Air emissions from the compressor station will not be significant, and the impact of nitrogen oxide emissions on air quality will be very low. Annual carbon dioxide emissions from natural gas use at the compressor station will be around 20,000 tonnes a year. Carbon dioxide emissions from the nearby Ingå coal power plant in 2012 totaled 203,802 $tCO_2eq$ *(Energy Authority 2014)*. Carbon dioxide emissions from the compressor station will be quite low. The quantity of methane emissions will be affected by maintenance operations and unexpected malfunctions of the compressor. Annual combined methane emissions from the compressor and the transmission network are estimated to be in the range of 50–100 tonnes. The amount will be rather small. Emission limits set in the Decree on small combustion plants will be complied with at the compressor station. The usage rate of the compressor station will vary depending on natural gas consumption.

### Natural gas pipeline

No emissions into the air will be created in normal pipeline operation. Some blowdowns (releases of natural gas) will be carried out in conjunction with pipeline commissioning. These will result in minor methane ($CH_4$) emissions into the air as natural gas contains around 98% methane. Minor methane emissions will also take place in conjunction with pigging taking place during periodic pipeline inspections. Pipeline blowdowns will be required a few times a year. Natural gas transmitted in the transmission network is not odorized.

Inspections and maintenance of the offshore pipeline will be carried out from on board vessels throughout the operational life of the pipeline, i.e. 50 years. Emissions will be generated at sea and dispersed over an extensive area. The volume of vessel traffic relating to inspections and maintenance will be low, whereby vessel air emissions and impacts on air quality will be low.

## 8.9.4 Summary of the significance of impacts and comparison of alternatives

Guideline and limit values have been set for air quality, and limit values are in place for vessel sulfur dioxide emissions. The impacts will mainly be created further out at sea in areas where there are few people. Therefore the societal significance of the receptor is low. The susceptibility of the receptor to changes is low because the level of shipping emissions in the area is already high and a large power plant affected air quality on the mainland until early 2014. The sensitivity of the receptor is assessed as low (Table 8-15).

Emissions and impacts on air quality and the climate during the construction of the ALT FIN 1 and ALT FIN 2 routing alternatives and the LF1 and LF2 landfall alternatives will be quite low, with no significant differences between the alternatives. The impacts of the implementation alternatives on air quality during construction will last for two years and focus on the vicinity of the vessels participating in construction, i.e. mainly on areas further out at sea where there are few people. The extent of temporary construction-related blasting on the mainland will be considerably smaller than that of existing rock extraction operations near the compressor station.

The impacts on air quality and climate during the operation of the natural gas pipeline will be low, with no clear difference seen between the alternatives. Emissions into the air will mainly be generated at the compressor station, where the amount of emissions from natural gas combustion will be small and focus on an area that until 2014 was subjected to a considerably higher load from the nearby power station.

The significance of the impacts during construction and operation are assessed as low (Table 8-15). The classification criteria used for the determination of the sensitivity of receptors and the magnitude of change are described in Appendix 3 to this EIA report.

Table 8-15. Overall significance of impacts of air emissions, C = during construction, O = during operation. There is no significant difference between the alternatives.

| Impact significance | | Magnitude of change | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Very high | High | Moderate | Low | No change | Low | Moderate | High | Very high |
| Sensitivity of the receptor | Low | High | Moderate | Low | C / O Low | No impact | Low | Low | Moderate | High |
| | Moderate | High | High | Moderate | Low | No impact | Low | Moderate | High | High |
| | High | Very high | High | High | Moderate | No impact | Moderate | High | High | Very high |
| | Very high | Very high | Very high | High | High | No impact | High | High | Very high | Very high |

### 8.9.5 Prevention and mitigation of adverse impacts

Nitrogen oxide emissions into the air from the compressor station can be reduced through combustion methods. Dust generation from earthworks can be reduced through dust prevention measures.

## 8.10 Flora, fauna and protected sites

### 8.10.1 Assessment methods and assessment uncertainties

In the assessment of the impacts on the natural environment, the current status of the natural environment was described and the impacts of the implementation of the various project alternatives on terrestrial and aquatic flora and fauna, habitat types as well as receptors significant from the conservation perspective and, more broadly, on biodiversity and interactions were assessed. The impacts on benthic organisms and underwater habitat types were mainly assessed in conjunction with the assessments of the impacts on the marine environment in section 8.4 and those on fish and fisheries in section 8.5. As regards fauna, this section contains the assessments of the impacts on marine mammals and birds.

Presented in section 6.3, the special reports produced for the project were utilized in the impact assessment.

The following nature surveys concerning an area on the western side of the Fjusö Peninsula conducted for the local detailed plan amendment, Gasum Corporation Finngulf LNG terminal project and Rudus Oy rock extraction project were also available for the assessment:

- nature survey for the Joddböle detailed land use plan amendment *(FCG Planeko Oy 2008);*
- nature and Siberian flying squirrel survey for the LNG terminal area Ingå-Siuntio natural gas pipelines (*Pöyry Finland Oy 2013a*);
- Ingå terminal area bird survey (*Ympäristötutkimus Yrjölä Oy 2012*);
- Nature survey on Joddböle, Ingå, and neighboring areas (*Finventia 2013*).

Data on Natura 2000 sites, national conservation program sites, nature reserves and other nationally significant natural sites was collected from the environmental administration's environmental and geographical information service (*OIVA service 2014*). Also available for the area was environmental data from the Hiisi environmental mapping system and Natura site descriptions of the Uusimaa Centre for Economic Development, Transport and the Environment. Also used in the assessment was data on the current status and threats of the Baltic Sea and the Gulf of Finland from various sources (including *Leppänen et al. 2012, Finnish Environment Institute et al. 2014, Anon. 2014*).

The assessment took place in compliance with current guidelines on nature surveys and the assessments of impacts on the natural environment and Natura sites (incl. *Söderman 2003, Sierla et al. 2004* and *Ministry of the Environment 2013*). As regards natural sites, the assessment covered their conservation value, representativity and IUCN Red List status (*Raunio et al. 2008*). As regards species, the factors examined were their habitat requirements, conservation value and IUCN Red List status (*Rassi et al. 2010*). The criteria for the deterioration of habitat types derived from the definitions of a favorable conservation status are reduction of area or deterioration of ecosystem structure and functioning necessary for the habitat's typical species *(Ministry of the Environment 2013)*. At the species level, deterioration means deterioration of the quality of the habitat of the species, reduction in distribution, reduction in population size or disappearance of population (*Ministry of the Environment 2013*). As regards the project, its various types of impacts and cumulative impacts and their dispersal and magnitude as well as duration and permanence/reversibility during the construction, operation and decommissioning phases were taken into consideration. Data regarding noise, turbidity and dispersal of air emissions is based on modeling, calculations and impact assessments conducted during the EIA procedure. The impact assessment includes a separate Natura 2000 assessment screening report (*Appendix 2*), a summary of which can be found in section 8.10.3.

The nature surveys available for the assessment of the impacts on the natural environment covered the area affected by the project extensively enough and pertained to groups of species and habitat types that are material to the assessment. Nature surveys always involve uncertainties relating to methodology, but the level of this is not regarded as out of the ordinary in this assessment. Annual variation also takes place in species occurrence due to reasons including weather conditions. Other uncertainties involved in the impact assessments discussed in this EIA report result in some uncertainty in the assessments of impacts on the natural environment conducted on the basis of them. The assessment of impacts on the natural environment was conducted by an experienced biologist and animal ecologist and the Natura 2000 assessment screening by an experienced biologist.

### 8.10.2 Impacts during construction

#### 8.10.2.1 Impacts in the Gulf of Finland

The impacts of the project on the natural environment of the offshore areas of the Gulf of Finland will not be very significant because the area's nature values are lower than those of the near-shore areas, the need for seabed intervention is lower and impacts will be mitigated by the large volume of water. According to the sediment dispersion modeling (*Lauri 2014*) and the assessment of the impacts on water bodies (section 8.3), turbidity will be limited to the immediate vicinity of the construction site. Impacts on water bodies were also found to be temporary, local and low in the environmental monitoring carried out during the construction of the Nord Stream gas pipeline project (*Nord Stream 2013a*). In offshore areas the duration of noise and disturbance impacts will also be shorter than in archipelago areas because construction work will progress faster further off the shore.

Ice conditions permitting, a certain amount of birds are found in the offshore areas of the Gulf of Finland around the year: Anseriformes, Gaviiformes, cormorants, gulls, terns and Alcidae, with seals and occasionally also harbor porpoises also found. No particularly important feeding areas attracting large numbers of individuals are known in the area covered by the natural gas pipeline project. Among the groups of birds mentioned above, Anseriformes in particular feed in shallow areas very rarely found in open sea areas. Adverse impact on animals can be reduced by observing the species during construction and using mitigation methods during work stages that cause the highest levels of underwater noise (for mitigation measures see section 8.10.6).

#### 8.10.2.2 Impacts in the archipelago and marine areas

**Impact mechanisms**

Impacts on the natural environment in the marine area during pipeline construction will result from visual disturbance caused by vessels, above-water and underwater noise generated by vessels and intervention measures, pressure waves from blasting, and suspended solids, nutrients and possible harmful substances released into water (Table 8-16). Impacts may occur along the pipeline route throughout the two-year period of construction, but the strongest impacts will be seen at and in the immediate vicinity of the pipeline section under construction at the time. Seabed intervention, pipelaying and pipeline covering will take place in phases; at certain points along the pipeline route the impacts will be repeated but there will be a break between them.

The largest extent of seabed intervention measures will be required in the shallow and sheltered coastal areas where habitat and species diversity is also the highest. This area is already affected by human impacts such as eutrophication, vessel traffic, hunting and pleasure boating. Local plant and animal populations and ecosystems have adapted to some of the pressure factors but, on the other hand, the existing pressure may also reduce the capacity of the area to tolerate any further pressure. According to the impact assessments conducted relating to water bodies and noise (section 8.3 and section 8.6), the impacts during construction will be limited to a relatively narrow zone along the pipeline route and its immediate vicinity. The noise and disturbance impacts of the shipping of rock and line pipes will also extend to the transport routes.

**Impacts on birds**

Turbidity resulting from seabed intervention may temporarily affect food sourcing among aquatic birds in the area where turbidity occurs and affect the occurrence of their diet organisms, such as fish and bivalves, in the vicinity of the pipeline. Sediments settling on the bottom may cover blue mussel (*Mytilus edulis)* communities from which in Eider in particular and during migration/winter also Long-tailed Duck source their food. Fish and small aquatic organisms belong to the diet of birds including the White-tailed Eagle and Osprey, waders, gulls, terns and Alcidae. During the nesting period in particular the need for food is high as the parents need to stay in good condition and feeding the young further increases the need for food. The impacts of increased turbidity on fish stocks and other aspects of the marine environment in the offshore areas of the Gulf of Finland are estimated to be low as the turbidity is estimated

Table 8-16. The most significant activities and impact mechanisms during the various project phases from the perspective of impacts on the natural environment.

| Project phase | Activity | Consequence | Impact on natural environment |
|---|---|---|---|
| **Construction** | Munitions clearance, blasting, seabed filling, subsea rock installation, dredging | Destruction of seabed and benthic organisms directly or due to sediment accumulation | Direct impacts on bird feeding areas. Indirect impacts on birds and seals due to issues including changes in fish populations. |
| | Munitions clearance, pipelaying, anchoring, blasting, dredging. | Mixing of sediments and any harmful substances contained by sediments with seawater. | Temporary prevention of feeding of birds and marine mammals due to turbidity, reduction in photosynthesis in underwater plants if turbidity persists, introduction of harmful substances into organisms and food chains, eutrophication caused by nutrients. |
| | Munitions clearance, pipelaying, blasting, dredging, seabed filling, subsea rock installation, vessel traffic, pipeline testing. | Underwater and above-water noise and visual disturbance. | Disturbance to birds and marine mammals; auditory injury to marine mammals caused by underwater noise. |
| | Vessel traffic. | Risk of oil spill, risk of non-indigenous species, coastal and seabed erosion. | Low impacts on the marine ecosystem. |
| **Operation** | Maintenance and monitoring. | Minor visual disturbance and noise. | Minor disturbance to birds and marine mammals. |

to be restricted to areas in the vicinity of the pipeline and near the bottom and only occur for a few days. The impacts of offshore turbidity on bird fauna are also likely to be low since the impacts on fish, bivalves and other small fauna that they feed on are estimated to be very local and short-term.

In the inner archipelago, both of the pipeline routing alternatives (ALT FIN 1 and ALT FIN 2) pass only a few hundred meters from islands and islets with significant bird value that are breeding sites for several threatened species and species otherwise noteworthy from the conservation perspective (see section 7.7). Birds nesting on these islets may experience significant temporary disturbance to food sourcing if turbidity is high and occurs during their breeding season. When feeding their young, the parents fly between food sourcing and nesting sites tens or even hundreds of times a day. If the parents will need to look for alternative food sourcing or feeding areas and the related journeys become longer, the cumulative impact may in the worst-case scenario be significant.

Direct noise or visual disturbance during the breeding period may cause significant adverse impacts on birds despite the short period of time required for construction work. Birds may abandon their nesting islet if strong noise or traffic occurs to close to it. If they abandon a nest with eggs or young chicks, their breeding may fail totally due to a single disturbance event. During the incubation period from April to early June, cool weather usually still prevails in the archipelago, whereby the developing eggs or young chicks may become too cold or be destroyed due to an interruption to incubation. When the parent leaves, eggs and chicks may also be taken by nest predators such as minks, gulls or corvids. Some of the bird species breeding in the area invest so much of their resources on each brood that they may not be able to produce a new brood to replace a destroyed one in the same year. Disturbance during nestling period may cause broods to scatter, making them vulnerable to predators. Bird populations in the archipelago of the Stora Fagerö area in particular will be subjected to the impacts of noise and other disturbances as the planned routing alternatives run close to nesting islets. A threatened bird species under strict protection also breeds in the area.

Different bird species respond differently to disturbance caused by humans, and human activity may result in changes in bird behavior at distances up to 1-2 km (*Ruddock & Whitfield 2007*). The disturbance stimulus required for birds to escape from the nest during the incubation or nestling period will, however, need to be stronger (louder sound or movement within a shorter distance) than for them to leave another site as birds are highly reluctant to leave their nest. Feeding or resting birds may take flight to avoid a disturbance that is more than 1 km away, but a parent that is incubating or chick-rearing at the nest will in practice not escape due to a visual disturbance further than 200 m away. Activities in the gas pipeline area during construction and operation will not take place within the escape distance of nesting birds, whereby the impacts of the movement of vessels and machinery on birds will be low.

Birds resting and feeding in the area may move away from the vessels, but they will be able to return to the same area as soon as the disturbance has passed.

Loud and unexpected noises may, however, result in birds escaping from their nest at a distance of several hundreds of meters. As regards above-water noise, noise caused by the project may disturb birds at least on a few of the nearest important breeding islands and islets. With the ALT FIN 1 alternative the island of Stengrundet and with ALT FIN 2 one of the Bastholmarna islands are located within 500 m from the pipeline. Species including four pairs of Tufted Duck (Vulnerable, VU), and Caspian Tern, Common Tern and Arctic Tern, which are protected under Annex I to Birds Directive. Nesting on the southwesternmost islet of Bastuholmarna there are 14 pairs of Common Eider and a Goosander, both species classified as Near Threatened (NT). However, the duration of above-water noise will be brief, and it is not assessed for either of the routing alternatives to act as such a strong stimulus that would result in birds escaping from their nests even on the nearest islets. Therefore the impacts of above-water noise on birds will be low on the whole.

Underwater noise may cause direct and harmful impacts on diving birds. Large flocks of Long-tailed Ducks and Common Eiders, which catch their food by diving, gather in the project area after their nesting season in the spring and during their migration in the spring and autumn. Gaviiformes, Great Cormorants, Alcidae and other divers occur in smaller numbers than Long-tailed Duck and Common Eider. Of the important bird gathering areas located in the area affected by the natural gas pipeline, those closest to the pipeline route are the Gåsö-Barö offshore section close to ALT FIN 2 and the Hästen-Hästgrundet shallows (section 7.7, Figure 7-37). The former is an important gathering site for Common Eiders and the latter an important resting area Long-tailed Ducks. There is not much knowledge about how birds response to underwater noise, but underwater noise may probably cause some changes in the behavior of birds feeding in these areas as there will be temporary peaks in noise levels, particularly during blasting work. Loud and unexpected noise may injure a bird diving near a blasting site as the noise and pressure waves may affect its breathing and oxygen consumption. As regards the offshore areas on the whole, there are no known bird gathering or feeding areas in addition to those mentioned above, and birds are likely to move further as soon as vessels and machinery arrive at the site. The potential injuries caused by noise are likely to affect a small number of individuals, and therefore the impact of underwater noise on birds is also assessed as low.

### Impacts on marine mammals

Increased turbidity affects marine mammals in the same way as birds: it may have a temporary adverse impact on their feeding by deterring fish and reducing visibility. The impacts of turbidity on fish populations (section 8.5) and other aspects of the marine environment in the offshore areas of the Gulf of Finland are estimated to be low, whereby the impacts on marine mammals are also likely to be low. In addition, marine mammals are only found infrequently, either individually or at most in small groups, in the area affected by the project.

Like birds, marine mammals may also be disturbed by the movement of machinery as well as the noise caused by machinery and construction work. Noise in particular and also the possible departure of fish from the area due to noise (section 8.5) will force marine mammals to move elsewhere as well. Visual disturbance is unlikely to have a significant impact on marine mammals, which mainly live in water, and there are no islets where large numbers of seals gather in the area.

According to calculations conducted, the level of underwater noise at the pipeline route may on the basis of data available in literature cause at least temporary damage to hearing in cetaceans and seals in the immediate vicinity of the worksite (*Southall et al. 2007, Lucke et al. 2009*). However, it is likely that any individual seals and harbor porpoises feeding in the area will move further away from the worksite as soon as the vessels and machinery arrive at the site before any hearing damage can occur. At the perimeter of the Ingå archipelago Natura site around 2–3 km away, noise is likely to cause minor disturbance to normal animal behavior at the most. For example, in seals noise from motorboats has been found to cause intra-species aggression, alert behaviors and changes in orientation (*Tripovich et al. 2012*). In harbor porpoises noise affects echolocation and causes behavioral changes with, for example, aversive behavioral reactions observed at sound exposure levels of 145 dB (*Lucke et al. 2009*).

The nearest known seal molting site where gray seals may gather is located a little over 2 km from the natural gas pipeline routing (Storbrottet, Figure 7-38). Seals only occur individually or in small groups outside the known seal islets. Therefore only individual seals will be affected by noise. Harbor porpoises only occur occasionally in the area. In the worst cases, however, underwater noise may injure individual marine mammals. Therefore measures mitigating the impacts of pressure waves must be employed in blasting to prevent injuries in marine mammals.

### Other impacts

In addition to impacts on birds and seals, turbidity may prevent photosynthesis in aquatic and littoral plants if persisting for a long period. Temporary turbidity, sediment accumulation or nutrient release from sediments is not assessed to have a significant impact on underwater macroalgae or vascular plants in the Ingå archipelago (section 8.3). The same is likely to apply to helophytes, with the possible exception of sheltered and shallow shores of the mainland and inner archipelago where the input of sediments containing clay may cause minor local eutrophication. Eutrophication can be seen in phenomena such as increased reedbed expansion.

Sediment mixing may result in the release of harmful substances into seawater and their entry into organisms and food chains. According to preliminary estimates, elevated concentrations of harmful substances are most likely to occur in the waters close to the Port of Ingå and in the vicinity of the fairway. The concentrations are low on the basis of the results of sediment sampling (section 8.3).

The transport of rock and line pipes relating to the project involves the normal shipping risks, such as the risk of oil spill or risk of introduction of non-indigenous species. Risks relating to oil spills and operations such as munitions clearance are covered in section 8.16. The risk of introduction of non-indigenous species is low in conjunction with the project as transport will take place locally. Vessel traffic also causes nitrogen oxide, sulfur dioxide, particulate and carbon dioxide emissions, but their impact in the project will be low in comparison with other waterborne transport or, for example, average emissions from the Ingå power plant (section 8.9).

### 8.10.2.3 Impacts on the Fjusö Peninsula

Construction carried out for the project on the Fjusö Peninsula will involve the construction of the landfall site, onshore section of the natural gas pipeline and the compressor station. The length of the LF1 alternative making landfall at Bastubackaviken in the eastern part of the peninsula is around 1.0 km and that of LF2 making landfall on the southern shore of the Fjusö Peninsula is around 1.5 km. Both routing alternatives border on a forest area but mainly run along existing road connections. In forests the construction of the pipeline will require a work area that is roughly 30 m wide. As a general rule, this will result in the disappearance of flora and fauna currently found on the pipeline route, but these may later be restored partially. Flora and fauna will disappear under the compressor station. During construction, there will be transient disturbance, noise, vibrations and dust dispersal in the area around the worksite. Moisture, soil and lighting conditions may also undergo a temporary or permanent change. Dust generation caused by rock blasting is assessed to be limited to the immediate vicinity of the worksite as no crushing will take place (section 8.9). The 45 dB(A) noise zone will extend to a maximum of 800 m (section 8.6.2). Short-term noise exposure is not likely to have a significant impact on birds or other animals, and there are no nature sites that are particularly sensitive to noise in the vicinity of the peninsula. Low-frequency ambient noise is known to have an adverse impact on functions such as avian acoustic signaling (e.g. *Slabbekoorn & Ripmeester 2008*), whereby the adverse impacts on birds will be at their lowest outside the bird singing and breeding season of March–July.

The majority of the nature sites identified in the nature survey (*Ympäristösuunnittelu Enviro Oy 2014*) will be outside the gas pipeline routings and no other impact than noise is assessed to occur on them. The LF1 routing runs along an existing road via the northern section of a herb-rich forest northeast of Bränseludd. The impact on the herb-rich forest will be low, especially if the gas pipeline is constructed north of the road where the forest is dryer and dominated by *Betula* spp. Protected lesser butterfly orchids grow close to the road, but the species is common in eutrophic forests of Southern Finland and only some of the sites where the species is found are on the route. The herb-rich forest north of Bränseludd is located around 30 m from the road. Water seeps down the slope to the moist herb-rich forest, whereby the forest may only be impacted by construction if there is a change in moisture conditions or sediments are transported by discharged water. At LF1 there is more littoral vegetation and plants will have to be removed to a larger extent than at LF2 where the shore is more barren. The LF2 route runs close to a lady fern-dominated herb-rich common alder forest in the innermost section of Sundviken Bay. The small forest will be overtaken by construction if the pipeline route passes east of the road. For LF2 it will be necessary to blast some of the lower slope of the bedrock outcrop hill of the Fjusö Peninsula and pass over the Kohagen hill, which also consists of bedrock outcrops. Movement on Kohagen in particular may damage vegetation on top of the outcrops, but the impact will not be significant as corresponding plants favoring rocky outcrops occur commonly in the coastal area. Large hop trefoil, classified as Near Threatened (NT), is found by the road passing through the Fjusö Peninsula at LF2. The dry, meadow-like habitats by the roadside may be preserved if sand and gravel are used as topsoil at the pipeline.

There are no valuable habitat types or habitats of threatened or noteworthy plant species at the compressor station site south of the Svartbäck pond (*Ympäristösuunnittelu Enviro Oy 2014*). A more open meadow area can be found west of the compressor station, and the lady's bedstraw, classified as Vulnerable (VU), growing on its exposed bedrock sections will not be affected by the construction work. If the compressor station is powered by electricity, the planned power line will run along the edge of the Oxhagen forest, which has been found to have diverse nature values. The nearest nature sites (Oxhagen herb-rich forest B and C) are located some tens of meters away, whereby the power line should preferably be placed on the deposition area side.

Impacts of the construction of the Fjusö area on birds will be low as construction will not result in significant destruction or fragmentation of bird habitats. For example, according to the 2013 nature survey (*Ympäristösuunnittelu Enviro Oy 2014*), only a few observations were made of species of conservation significance along the planned pipeline routing alternatives or compressor station site (Figure 7–35). Construction will cause disturbance and small-scale habitat loss in forests of the Fjusö Peninsula and Kohagen (LF2) as well as Bränseludd (LF1). Species noteworthy from the conservation perspective observed during nature surveys only include Gray-faced Woodpecker, Black Woodpecker and Hazel Grouse, all of which are listed in Annex I to the Birds Directive. With a diverse bird population, the Svartbäck pond is the only site in the area with a high occurrence of bird species noteworthy from the conservation perspective (Figure 7–35). The impacts of construction will not, however, extend significantly to the pond as the distance from the planned compressor station and routing (LF1) will even at its shortest be 100 m.

The shores of the Svartbäck pond provide a habitat for moor frog and Siberian winter damsel, both species listed in Annex IV(a) to the Habitats Directive (*Ympäristösuunnittelu Enviro Oy 2014*). The shores of the pond and habitats suitable for moor frog found by the Bastubackan ditch as well as the observation site of Siberian winter damsel by Djupviken cove will be outside the project's sphere of impact. Both species were also found in 2013 in the pond located southwest of the compressor station and north of the ash deposition site (*Finventia 2013*). If the compressor station is powered by electricity, the planned power line will run by the pond and digging may also affect the pond habitat (Figure 3–21). The Fjusö Peninsula is a fenced area, whereby its significance to larger land animals is likely to minor, and the habitats of the peninsula are unlikely to be altered significantly by the construction of the gas pipeline or the compressor station.

#### 8.10.2.4 Summary of impacts on nature reserves and nationally valuable nature sites

Most of the nature reserves and nationally valuable nature sites located in the vicinity of the project area will not be affected by the project. Impacts on birds in the Barö offshore area nature reserve (YSA010484) islands and islets are possible during construction. The impacts will be due to disturbance, noise and turbidity caused by construction but will be temporary and can be mitigated by taking bird breeding into consideration in the scheduling of the work. Noise and turbidity of near-shore waters will extend to part of the Stor-Ramsiö nature reserve (YSA014191), but these are not assessed to have an impact on its nature values.

The impacts on birds described in section 8.10.2.2 apply to the section of the Western Gulf of Finland archipelago FINIBA located in the Ingå archipelago area. The impacts for the extensive entity of areas as a whole will be low and will not jeopardize its bird population values. The project's impacts will not extend to the international IBAs of the western Ekenäs-Ingå archipelago or Kirkkonummi archipelago.

### 8.10.3 Natura 2000 assessment screening

#### 8.10.3.1 Screening methods

A separate screening to establish whether there is a need to conduct a Natura 2000 assessment of the impacts of the Balticconnector project on Finland's Natura sites was also conducted (*Appendix 2*). The following is a summary of the screening report.

The Natura 2000 assessment screening was conducted to assess whether any of the project's routing alternatives will have such impacts on a Natura site that necessitate a Natura 2000 assessment procedure referred to in the Nature Conservation Act. Under section 65 of the Nature Conservation Act, an appropriate impact assessment must be conducted if a project or plan located in or outside a Natura site, either individually or in combination with other projects and plans, is likely to have a significant adverse effect on the ecological value of a Natura site. The obligation to conduct the assessment arises if the project's impacts are a) targeted at the nature (ecological) values due to which the Natura site is protected, b) deteriorating in nature, c) significant in terms of their type or quality and d) not ruled out on the basis of objective factors (*Ministry of the Environment 2013*). The motivation for the designation of the Natura site for the Sites of Community Importance (SCI) comprises the habitat types listed in Annex I to the Habitats Directive and species listed in Annex II to the Habitats Directive mentioned in the standard data form and for the Special Protection Areas (SPA) species listed in Annex I to the Birds Directive mentioned in the special data form and migratory bird species resting regularly in the area.

The screening was conducted as an expert assessment primarily based on existing data. The studies, surveys and impact assessments conducted during the EIA process were yet to be completed when the screening was conducted. The field observations of the birds survey (*Ramboll 2013e*) were available. Environmental monitoring reports from the Vuosaari Harbor project (*Vatanen et al. 2012*) and Nord Stream gas pipeline project (*Nord Stream 2013c*) and impact assessments conducted for the Finngulf LNG terminal project (*Pöyry Finland Oy 2013a*) were utilized in the screening. Impacts on water bodies caused by construction of the natural gas pipeline were assessed as the most potential adverse impacts of the project. Noise and direct disturbance were regarded as other significant impacts caused by construction work. The project description given in the screening report is mostly in line with the more specified project description of the EIA report phase.

#### 8.10.3.2 Impacts on the Ingå archipelago Natura site

The pipeline section running through the Ingå archipelago Natura site (FI0100017, SCI and SPA) is around 12 km long in both of the routing alternatives. The onshore pipeline routing alternatives will not pass through any land or water areas included in the Natura site. With the ALT FIN 1 alternative the pipeline would at its closest pass a little under 200 m from the island of Stengrundet and around 230 m from the island of Låggrundet. Both are small rocky islands southeast of the island of Stora Fagerö. With the ALT FIN 2 alternative the pipeline would run around 230 m from the Abborpinnarna islets and around 500 m from the Ytterharu islands. Further out in the outer archipelago the natural gas pipeline would run a little less than 500 m from the small island of Änkan. Of waters within the Natura site, only the TimmeröLangerö nature reserve waters around 3.3. km from the natural gas pipeline are included in the Natura network. The description of the Natura site as well as the results of the birds survey conducted on the Ingå archipelago area as well as data on seal occurrence can be found in section 7.7.

According to the Natura 2000 assessment screening conducted, the only habitat types listed in the Habitats Directive on which the project might have a deteriorating impact are underwater habitat types and annual vegetation on drift lines. Underwater habitat types can only be found in the waters of the TimmeröLangerö nature reserve as the other waters are not included in the Natura site. Turbidity is not assessed to extend to the Timmerö-Langerö nature reserve. According to the sediment dispersal model (*YVA Oy 2014*), only minor turbidity may reach the area during subsea rock installation and ploughing taking place south of the area. The project is not assessed to have a significant adverse impact on the growth conditions of bladderwrack forming drift lines (section 8.4).

According to a survey conducted later during the EIA procedure, there are reefs along the pipeline routing, but these cannot be regarded as very representative as regards their aquatic flora and therefore the construction of the natural gas pipeline is not assessed to pose a significant threat to the *Reefs* habitat type (*Alleco Oy 2013*). The status of reefs should be monitored after construction. As regards the ALT FIN 1 routing alternative, which passes close to the island of Stora Fagerö, the monitoring should also cover the underwater elements of the *Baltic esker islands with sandy, rocky and shingle beach vegetation and sublittoral vegetation* habitat type. Very little bladderwrack was found off Ingå but, to avoid additional turbidity, dredging can be scheduled not to coincide with the bladderwrack reproduction period. According to information received from the Ministry of the Environment in May 2014, the Ingå archipelago is not included in the habitat type updates where underwater habitats may be added to the Natura network.

According to the Natura 2000 assessment screening, impacts on the Birds Directive species and bird species regularly resting in the area are possible, but they are assessed to be low and short-term. Adverse impacts on birds can be reduced significantly or eliminated fully by paying attention to the scheduling of construction work near the most important bird islets and islands.

#### 8.10.3.3 Impacts on other Natura sites

The planned gas pipeline routing runs around 4.5 km from the Älgsjölandet and Rövass herb-rich forests (FI0100016, SCI), around 8 km from the Kirkkonummi archipelago (FI0100026, SCI and FI0100105, SPA), around 9 km from the Ekenäs and Hanko archipelago and the Pojo Bay marine protected area (FI0100005, SCI and SPA), around 10 km from the Kallbådan islets and waters (FI0100089, SCI) and around 25 km from the Hanko eastern offshore area (FI0100107, SCI). The project will not cause impacts on the Älgsjölandet and Rövass herb-rich forests. The sites located in the archipelago and marine areas are so far away that turbidity and underwater noise are not expected to reach them to an extent with deteriorating impacts.

#### 8.10.3.4 Conclusions of the Natura 2000 assessment screening

The conclusion of the screening was that, if executed in the appropriate manner, pipeline construction and operation will not deteriorate the nature values due to which the Natura sites located close to the project area were included in the Natura network. Cumulative impacts due to turbidity may be caused with the Raseborg-Ingå offshore wind farm project and the construction of the LNG terminal, whereby the construction of these projects should not take place simultaneously. The assessment did not bring up issues necessitating a full Natura 2000 assessment (appropriate assessment) under section 65 of the Nature Conservation Act.

### 8.10.4 Impacts during operation

#### Impacts on the archipelago and marine areas

The impacts during the operation of the natural gas pipeline in archipelago and marine areas will be low. Periodic inspections and servicing and maintenance tasks may cause minor disturbances to birds and marine mammals, but these will not differ from the disturbance caused by other movement in the area. The flow of natural gas in the pipeline will only generate very low levels of underwater noise (section 8.6). The impacts of any gas leaks are assessed in section 8.16.

#### Impacts on the Fjusö Peninsula

Flora in the onshore gas pipeline work area will be allowed to restore naturally following pipeline construction. An area along the line of the pipe that is approximately 5 m in width will be kept treeless and cleared of shrubbery. Impacts during operation on flora and fauna will be restricted to the cleared zone and areas near it, with changes taking place in species composition from the current situation. An increase in flora such as grasses and sedges and a decrease in herb-rich forest plants are likely to be seen in the cleared zone. The edge effect will not extend very far into the environment, and the zone that is kept clear of trees and shrubbery will not restrict the movement of animals or cause significant habitat changes for breeding birds. The compressor station will be controlled by an automated system. According to calculation results, the 45 dB(A) noise zone will extend to a maximum of around 150 m from the compressor station (section 8.6). This means there will some noise disturbance to species of bird occurring at the Svartbäck pond that are noteworthy from the conservation perspective. If the compressor station is fueled by natural gas, its operation will emit nitrogen oxides into the air, but the impact on air quality will be low, however (section 8.9). Nitrogen emissions are not assessed to result in significant impacts on the natural environment around the compressor station.

### 8.10.5 Summary of the significance of impacts and comparison of alternatives

The entire Baltic Sea area is for reasons such as its low species diversity and short food chains sensitive to change and has low tolerance to added pressure. The sensitivity of the receptor is assessed as moderate in the offshore areas (Table 8–17).

In Finland the offshore section of the natural gas pipeline will run for around 12 km through the Ingå archipelago area the islands and some of the waters of which are included in the Natura 2000 network pursuant to the Habitats and Birds Directives. The pipeline routing alternatives do not pass through any land or water areas included in the Natura site. The Ingå archipelago is part of the western Uusimaa archipelago area that has several Natura 2000 network sites and nature reserves. The most extensive of these are archipelago and marine area entities that are significant in particular for the conservation of archipelago habitat types as well as birds breeding in and migrating via the area as well as for seal conservation. Some of these areas are also HELCOM MPAs, Ramsar sites and IBAs and FINIBAs. The sensitivity of the area to change is increased by the shallowness and maze-like structure of the area as well as its susceptibility to eutrophication. The sensitivity of the receptor is assessed as high in the coastal area of Ingå (Table 8–17).

The impacts of the project on the natural environment of the offshore areas of the Gulf of Finland will not be very significant as the area's nature values are lower than those of the near-shore areas, the need for seabed intervention is lower and impacts will be mitigated by the large volume of water (Table 8–17).

The construction of the planned natural gas pipeline will only apply to a very small section of the Ingå archipelago that is large in area. The project's impacts on the natural environment of the archipelago and offshore areas will be the highest during construction in the coastal area and very low during operation and maintenance (Table 8–17). Impacts during construction will be caused by disturbance, above-water and underwater noise and turbidity caused by seabed intervention measures and pipelaying. The impacts will be targeted particularly at birds and possibly also at seals. The impacts of the ALT FIN 1 routing alternative on littoral vegetation (turbidity) and bird populations in the Natura site of the Ingå archipelago will be slightly higher than those of ALT FIN 2, because the planned pipeline will run close to significant bird areas and a nesting site of a species under strict protection.

The construction of the compressor station and the onshore section of the natural gas pipeline will only have low impacts on the natural environment. The impacts will be slightly higher with the LF2 landfall alternative (minor loss of and change in flora along the pipeline) than with LF1. The impacts during the operation of the natural gas pipeline will be low, but the compressor station will generate minor noise disturbance to the Svartbäck pond, which is of bird population value.

The classification criteria used for the determination of the sensitivity of receptors and the magnitude of change are described in Appendix 3 to this EIA report.

Table 8-17. Overall significance of impacts on flora, fauna and protected sites. C = during construction, O = during operation, A = archipelago area, OS = offshore area. The impacts during operation will be very low.

| Impact significance | | Magnitude of change | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Very high** | **High** | **Moderate** | **Low** | **No change** | **Low** | **Moderate** | **High** | **Very high** |
| Sensitivity of the receptor | **Low** | High | Moderate | Low | Low | No impact | Low | Low | Moderate | High |
| | **Moderate** | High | High | Moderate | **C/OS Low** | **O/OS No impact/ Very low** | Low | Moderate | High | High |
| | **High** | Very high | High | **C/A Moderate** | Moderate | **O/A No impact/ Very low** | Moderate | High | High | Very high |
| | **Very high** | Very high | Very high | High | High | No impact | High | High | Very high | Very high |

### 8.10.6 Prevention and mitigation of adverse impacts

Efforts have been made to route the pipeline as far as possible from areas with significant nature values already in the initial stages of design. Natural gas pipeline route optimization will take place as progress is made in the design process. The re-routing of the pipeline in the archipelago area would not, however, considerably change the impacts caused by construction on the natural environment.

Seabed intervention and pipelaying work should be planned with a view to minimizing the duration of work stages causing disturbance in the vicinity of islands and islets with valuable bird populations in the area around the island of Stora Fagerö (Figure 7-37) during the breeding season from April 1 to July 31. In the vicinity of other islets, disturbance should be minimized from May 1 to July 15. To prevent adverse impacts, monitoring can be carried out at worksites during the project implementation phase. If marine mammals or large number of diving birds are detected, work can be suspended temporarily or efforts can be made to deter the animals by using acoustic deterrents (pingers). It is also recommended that pingers be used in conjunction with explosions in the offshore areas to deter marine mammals and in the vicinity of the HästenHästgrundet shallows, which are important to the Long-tailed Duck. It is recommended that the small nature sites of the Fjusö Peninsula be taken into account, but these will not require any special measures.

Adverse impacts on the natural environment can be mitigated through measures that will reduce noise or prevent the discharge of harmful substances into water and air. In the coastal area it is recommended that pipelaying and anchor-handling vessels that are as small as possible be used. On the basis of the studies conducted, the project will not have such impacts on bird habitats that necessitate compensation measures such as the setting up of artificial nesting sites.

## 8.11 Land use and built environment

### 8.11.1 Assessment methods and assessment uncertainties

The project's impacts on land use, the built environment and land use plans were assessed as an expert assessment. In the assessment, land use and land use planning situation concerning the project area and the area around it as well as distance to settlements and other important items were studied. The assessment examined the changes to current land use in and around the project area (within a couple of kilometers). Permanently inhabited as well as holiday residences in the vicinity of the project area were identified and the changes caused by the project to them assessed. The relationship of the project with land use plans currently in effect as well as any need to amend or formulate plans were also described.

Data sources used in the description of the current situation and the impact assessment were the OIVA service of the environmental administration, publications of the Ministry of the Environment and municipalities, and the technical design documents of the project. Also employed to facilitate the assessment were information sources such as maps, aerial photographs, various registers, geographic information and information received from the authorities. Other separate reports produced for the EIA report, such as the project's noise and dust impact assessments, were also utilized in the work. An important source of information consisted of land use plans that are currently in effect or pending as well as related material and other EIA projects in the area.

The extent to which the project will be taken into account in pending land use plan projects and how the authorities will interpret the need to amend land use plans currently in effect can be regarded as uncertainties relating to the assessment. The assessment was conducted by an experienced land use expert.

### 8.11.2 Impacts during construction

#### 8.11.2.1 Gulf of Finland

The planned natural gas pipeline route will pass through the Upinniemi firing range and cut across the southwestern perimeter of the Upinniemi restricted area. Several special regulations apply to the restricted area, and certain activities, such as cable-laying or use of sonars, are prohibited in the area without separate permission. In Finland a preliminary statement has been issued by the Defence Forces and the Ministry of Defence concerning gas pipeline routes, and this has been taken in to account in the routing plans for the gas pipeline. The project will not result in any restrictions or impacts on the operations of the Defence Forces. The Estonian Defence Forces also have a practice area close to the planned gas pipeline route.

The safety zones required for the vessels used in construction may cause temporary adverse effects on ship and boat movement during construction. The project will have no impact on shipping and boating lanes during pipeline operation. There is no difference between the ALT FIN 1 and ALT FIN 2 alternatives as regards land use.

#### 8.11.2.2 Ingå area

**Impacts on land use and built environment in the area**

Both of the landfall sites, onshore pipeline sections and the compressor station fall on a fenced area owned by the National Emergency Supply Agency to which access is restricted. The landfall sites and pipeline routings will have hardly any impacts on current land use or built environment in the area. It is, however, possible, that pipelines in the area (underground fuel transmission pipelines) may need to be moved.

The installation of the pipeline under the ground will require a work area that is 28–32 m wide in the forest sections during construction. Trees will be cut from work areas, and current ground vegetation will be destroyed. In bedrock areas the trench for the pipeline will have to be blasted. Signposted and reinforced transmission pipeline crossing points for forestry machinery will be constructed in forest areas. An installation road will be constructed for site traffic and pipeline installation next to the pipeline trench along the pipeline route. The impacts on land use will not be significant.

At its nearest the LF1 landfall would be around 300 m from the Bastubacka holiday residences, a little over 150 m from the Skämmö island holiday residences and, at its nearest, a little over 900 m from the Bastubacka residential buildings. Landfall LF2 would at its nearest be located less than 600 m from the Skämmö island holiday residences and around 1 km from the Jakobramsjö island holiday residences. The nearest residential buildings in Bastubackan are located around 1.5 km away. The shortest distance between the offshore gas pipeline alternative ALT FIN 1 and a holiday residence (Skämmö) is around 150 m. The shortest distance between ALT FIN 2 and a holiday residence (Bastholmarna) is around 150 m.

Residential properties close to the landfall sites may suffer from noise disturbance due to rock blasting during construction. The pipelaying vessel may also cause temporary levels above the guideline value when the vessel passes holiday residences in the Ingå archipelago. Noise impacts from construction may cause temporary but no long-term disturbance. Noise impacts on residential buildings and holiday residences are described in greater detail in section 8.6.

Following construction and landscaping, the landowner can resume agriculture and forestry in the area. Trees may not, however, be planted in the pipeline control (usufruct) zone (5 m). In field areas the entire natural gas pipeline route can be used for farming.

If the compressor station turbines are powered by electricity instead of natural gas, power supply will be arranged via an underground cable in conjunction with current roads from the existing Fortum substation (Figure 3–21) to the compressor station. This alternative is unlikely to have impacts on land use, but activities currently taking place (Figure 7–40) and planned for the underground cable area must be taken in to account and reconciled.

**Relationship with land use plans**

**Regional land use plans**

The project is in compliance with the land reservation for construction generating industrial employment designated in the regional land use plan and in harmony with the energy supply (EU) plan notation designated for Fjusö. It is also in compliance with the draft fourth-phase Helsinki-Uusimaa regional land use plan.

In the regional land use plan the area is also designated as an area with rock resources, to which a planning regulation for the preservation of capacities for rock extraction applies. A section of the natural gas pipeline routings as well as the compressor station are planned for that area. However, it should be noted that the delimitations outlined in the regional land use plan are non-specific and the regional land use plan is not in effect in areas covered by a legally binding local master plan or local detailed plan. There is a legally binding local detailed plan for the area. However, the regional land use plan is used as a guideline when amendments are made to a local master plan or detailed plan or other measures are taken to organize land use.

The regional land use plan does not designate any natural gas pipelines for the project area on the mainland or in marine areas. There is, however, a plan notation in the marine areas concerning the need for a main natural gas pipeline between Estonia and Finland. On the mainland a non-binding main natural gas pipeline is designated for an area further off west toward Siuntio. In the marine areas the pipeline runs through a Natura site designated in the regional land use plan. The project is not in significant conflict with the regional land use plan.

#### Local master plans

In the local master plan for Ingå mainland, the designated main purpose of the area (TC = for enterprise activities with need for planning) is likely to be sufficient for the project. The LF1 landfall alternative is located close to a residential area with two building sites on the southern shore of Bastubacka. However, the landfall is unlikely to prevent the construction of the buildings. In the plan, a natural gas pipeline is designated with a binding notation further to the west, while no natural gas pipeline is designated for the project area. The underground construction of the natural gas pipeline will not, however, prevent the activities designated for the area under land reservation notations. It is unlikely that amendments to the local master plan are required for the project.

The project is not in conflict with the local master plan of the Ingå inner archipelago. The plan as well as the draft plan for an amendment to the local master plan of the Ingå archipelago designate new building sites for holiday residences on islands east and south of Fjusö. Landfall LF2 may cause some disturbance to holiday residents.

The preliminary routing of the ALT FIN 2 alternative falls on an ancient monument designated in the partial local master plan of Ingå outer archipelago. ALT FIN 1 crosses the border of a valuable landscape designated in the plan. There is a permanent site for fishing gear designated in the plan on the islet of Låggrundet, a protected area, with the related plan regulation stating that buildings or jetties should not be placed within 50 m from the gear attachment point on the shore. Plan notations and regulations must be taken into account in the more specific routing design of the pipeline, but the project is not in conflict with the land use plan.

#### Local detailed plan

The project is in compliance with the land reservation notation E-2 of the Joddböle local detailed plan as regards the Fjusö side, but on the northern side, which is where the compressor station is planned, the land reservation designation is E-1, the main purpose of which is: State emergency supplies storage facility for liquid fuels where *buildings, structures and equipment necessary for the operations of the area* may be constructed. The difference of the main purpose of the area does not, however, prevent the implementation of the project, and it is most likely that the plan will not need to be amended due to the difference. The plans for the gas pipeline project were already known and taken into account when the land use plan was drawn up. The compressor station would be located in compliance with the plan in building area e-1 designated for buildings and installations serving maintenance of infrastructure technology.

The mainland sections of the natural gas pipeline are designated in the plan as non-binding sections of the area reserved for an underground pipeline, and the project is not in significant conflict with the local detailed plan regarding these. The landfall sites, on the other hand, are designated in a binding manner in the local detailed plan. The LF1 landfall is as designated in the local detailed plan, but LF2 differs from the local detailed plan. The eastern shore area of Fjusö, which is where LF2 is planned, is designated with a sub-area notation as a part of the area to be planted or kept in its natural state. In this respect the project is not in compliance with the local detailed plan. The general regulation given in the plan concerning landscape must be taken into account in project implementation.

The project is likely to require an amendment to the Joddböle local detailed plan if LF2 is selected. A process to amend to Joddböle local detailed plan for the possible LNG terminal is pending for an area west of the Balticconnector project area. The Balticconnector project will, as regards the compressor station and onshore sections of the pipeline, be located in part on the area covered by the amendment. If the Balticconnector requires an amendment to the local detailed plan, the projects should be examined together and it might be appropriate to combine the processes for amendments to the local detailed plan.

### 8.11.3 Impacts during operation

The differences between impacts during construction and operation on land use are so small that the impacts are presented together in section 8.11.2.

### 8.11.4 Summary of the significance of impacts

There are areas used by the Finnish Defence Forces in the vicinity of the planned natural gas pipeline route. The route passes through the Upinniemi restricted area and Upinniemi firing range. The purpose of the restricted areas is to contribute towards the safeguarding of Finland's territorial integrity. They are important for the arrangement of national security and territorial surveillance and their boundaries are carefully determined in Finnish territorial waters. Special restrictions apply to these areas. The sensitivity of the receptor is assessed as moderate (Table 8-23).

In Ingå the area around the onshore pipeline sections and the compressor station is in part a heavily manipulated zone of port, rock extraction and other heavy operations. The mainland project area is fenced. The fenced area relates to the activities of the National Emergency Supply Agency, and access to the area is restricted. The area is therefore not currently used for permanent or holiday residences, recreation or other public or private access. The sensitivity of the receptor is assessed as low (Table 8-23).

The project will not result in any restrictions or impacts on the operations of the Defence Forces in the Gulf of Finland. The safety zones required for the vessels used in construction may cause temporary adverse effects on ship and boat movement during construction. The project will have no impact on shipping and boating lanes during pipeline operation.

In Ingå the impacts caused by the project will mainly be local, targeted at a fenced area. The most significant impacts are related to the possible need for an amendment to the land use plan as regards LF2.

There is no significant difference between the project alternatives. The overall significance of the impacts on land use is low (Table 8-23). The classification criteria used for the determination of the sensitivity of receptors and the magnitude of change are described in Appendix 3 to this EIA report.

Table 8-18. Overall significance of the impacts on land use and the built environment. C = during construction, O = during operation, W = water body (marine area), L = land area. There is no significant difference between the alternatives.

| Impact significance | | Magnitude of change | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Very high** | **High** | **Moderate** | **Low** | **No change** | **Low** | **Moderate** | **High** | **Very high** |
| **Sensitivity of the receptor** | **Low** | High | Moderate | Low | **L C / O Low** | No impact | Low | Low | Moderate | High |
| | **Moderate** | High | High | Moderate | **W C / O Low** | No impact | Low | Moderate | High | High |
| | **High** | Very high | High | High | Moderate | No impact | Moderate | High | High | Very high |
| | **Very high** | Very high | Very high | High | High | No impact | High | High | Very high | Very high |

### 8.11.5 Prevention and mitigation of adverse impacts

The project will not have impacts on land use or the built environments high enough to necessitate the application of measures to prevent or mitigate adverse impacts. Only the need for an amendment to the Joddböle local detailed plan could be eliminated by routing the LF2 landfall in an area in compliance with the plan if LF2 is selected. On the other hand, the process to amend the Joddböle local detailed plan for the possible LNG terminal is pending for an area west of the Balticconnector project area, and any need for a plan amendment due to LF2 could also be examined in this context.

## 8.12 Landscape and cultural environment

### 8.12.1 Assessment methods and assessment uncertainties

The extent of the area studied in Ingå is determined as follows for the impact assessment:

- the landfall site alternatives: the area where the structures will be located + connection with the environment + areas from where the structures will be clearly visible;
- the natural gas pipeline: the pipeline area + work areas around it + connection with surrounding landscape spaces;
- the compressor station: the compressor station area + connection with the surrounding landscape entity; and
- the possible underground cable route: the transmission line right-of-way corridor.

The impact assessment was conducted as an expert assessment based on maps and aerial photographs, previous inventories and studies on conditions in the area as well as new studies and surveys conducted during the project. The survey of ancient monuments in the area was carried out on the basis of data from the from the Registry of Ancient Monuments of the National Board of Antiquities *(2014)* and an ancient monuments inventory conducted in summer 2014 (*Mikroliitti Oy 2014*).

As regards the offshore sections, the natural gas pipeline to be laid on the seabed will not have landscape impacts, but there may be impacts on underwater cultural heritage. Underwater cultural heritage was mapped out on the basis of the Registry of Ancient Monuments as well as a report produced in summer 2014 on the basis of scanning data from 2006 and 2013 (*SubZone Oy 2014*).

As regards landscape, uncertainties in the assessment are caused by the fact that the routings and project design documents are preliminary. However, the results regarding onshore activities are not likely to change much. As regards underwater cultural heritage, uncertainties in the assessment are caused by the fact that it was not possible to assess the current condition or exact location of the objects and sites on the basis of the scanning data or archive and registry data. Further studies will be required concerning the relationship of the natural gas pipeline project with underwater cultural heritage. The impact assessment was conducted as an expert assessment by an experienced landscape architect.

### 8.12.2 Impacts during construction

The work area required by the onshore section of the natural gas pipeline during construction is a corridor approximately 30–40 m in width. In forest sections trees will be cut and current ground vegetation will be damaged or removed. The work area can, however, be made narrower if necessary. The work area will stand out from surrounding natural areas and correspond to landscape damage in nature. In bedrock sections blasting will be required for pipeline installation. After the installation of the pipeline the trench will be backfilled and the finishing work required will take place on the worksite. The worksite areas around the pipeline can be landscaped and restored as natural areas. The pipeline area will also be landscaped, but a strip that is around 5 m wide will need to remain treeless. Figures relating to pipeline installation can be found in conjunction with the project description in section 3.4.7.

Tree removal and ground intervention work will be required for the construction of the compressor station. Considering the nature of the area as an entity, the impacts on the landscape will not be significant. The possible underground cable route to the compressor station will either follow the current road network or the perimeter of the ash deposition site. The impacts on the landscape will be local and, considering the nature of the area, low.

There are no known fixed ancient monuments along the onshore sections of the pipeline routings or on the compressor station site. However, if any previously unknown ancient monuments are detected in conjunction with the construction work, these are protected under the Antiquities Act.

The natural gas pipeline installed on the seabed may cause impacts on underwater cultural heritage either directly due to construction or due to changes in water flows resulting from construction. Seabed intervention such as dredging, ploughing, trenching and subsea rock installation during construction may result in mechanical damage to or even the destruction of any ancient underwater monuments located in or close to the construction area. Any anchoring of vessels during construction may damage ancient monuments. Explosions may also cause mechanical damage to items. There will be no landscape impacts.

Further studies will be required for impact assessment concerning underwater cultural heritage. Once progress is made in project design, with the pipeline route location and installation methods clarified further to a sufficient extent, more detailed studies must be carried out concerning known or possible new fixed ancient underwater monuments in the direct vicinity of the pipeline route (condition, more specific location, extent, relation to the natural gas pipeline and the working area required for pipeline installation). The scanning data for the area north of the N 59° 55′ latitude from 2006 has been found to be unsuitable for archaeological inventory, whereby it is recommended that side-scan sonar studies suitable for archaeological use be carried out for this section (*SubZone 2014*). The studies must be programmed in cooperation with the National Board of Antiquities. Any previously unknown ancient underwater monuments detected in conjunction with the construction work are protected under the Antiquities Act. On the basis of current preliminary data, two of the possible ancient monuments mapped out are located in the vicinity of ALT FIN 1 and one in the vicinity of ALT FIN 2.

### 8.12.3 Impacts during operation

During construction, the possible landfall site structures may be visible from surrounding areas. As regards vistas opening toward the area, LF2 in the coastal zone opening toward the offshore area is located on a more visible site than LF1, which is located in a sheltered innermost section of the bay with reedbeds. Both landfall site alternatives are currently natural areas, but LF2 is located immediately east of a current harbor quay.

The project will not have significant impacts on the Kyrkfjärden villas located northeast of LF1. The status of the villas in the landscape entity will not change, and the vistas from Bastubackaviken toward the project area are likely to be largely restored after pipeline construction following the recovery of the reedbeds and littoral vegetation. The direction of the primary vistas from the villas to the sea is not toward the landfall site.

After the construction phase, worksite areas around the pipeline can be gradually restored as natural areas. The pipeline area will stand out from the otherwise forested environment as a treeless corridor. Both pipeline routing alternatives run through an area with natural areas as well as human activities that have modified the terrain. Neither of the routing alternatives will cause significant landscape impacts.

The compressor station will turn what is currently a natural area into a built environment (Figure 3-20). Due to the nature of the Joddböle–Fjusö area entity, which is already modified by industrial activities, the impacts on the landscape will not be significant. The possible underground cable route will blend into the Joddböle zone of industrial activities.

As regards the offshore sections, the natural gas pipeline will not cause any impacts on the landscape or cultural environment during operation.

### 8.12.4 Summary of the significance of impacts

Although the Fjusö Peninsula area by nature largely consists of natural environment, there are already human activities modifying the terrain and industrial in nature in the immediate vicinity of the structures required by the project. The Fjusö area is a continuation to an extensive zone with heavy industrial activities in Joddböle. The sensitivity of the receptor is assessed as low (Table 8-19).

The landscape impacts of the onshore natural gas pipeline sections, the compressor station and the possible underground cable in the onshore areas of Fjusö-Joddböle, Ingå, will be low. The impacts in relation to the broader landscape entity will also be low in the industrial area. The project will not cause impacts on valuable landscape or cultural environment items in the land area. When viewed from sea in areas close to the sites, the structures of the natural gas landfall sites may be visible in the landscape but, on the basis of the preliminary design documents, the impact will be local. Structures close to the shore will not have a significant adverse impact on the visual uniformity of the landscape in the area.

Further studies will be required for the assessment of the significance of the impacts concerning underwater cultural heritage. Once progress is made in project design, more detailed studies must be conducted concerning fixed ancient underwater monuments (condition, more specific location, extent, relationship with the natural gas pipeline and the work area required for pipeline installation).

There is no significant difference between the project alternatives as regards landscape and cultural environment. The overall significance of the impacts is assessed as low (Table 8-19). The classification criteria used for the determination of the sensitivity of receptors and the magnitude of change are described in Appendix 3 to this EIA report.

### 8.12.5 Prevention and mitigation of adverse impacts

The project will not have significant adverse impacts on the landscape or cultural environment in the onshore sections in Ingå. If the visibility of the structures in the landscape is to be reduced, efforts can be made to minimize the width of the work area required for natural gas pipeline installation. Solutions to adapt the structures as well as possible to the surrounding landscape can also be sought in the more detailed design of the natural gas pipeline landfall sites.

Possible impacts on underwater cultural heritage can be prevented through solutions in more detailed design of the pipeline routing (routing, extent of installation site, installation methods, etc.). More detailed studies of underwater cultural heritage will be needed for the determination of the measures and safety distances required. These further studies must be programmed in cooperation with the National Board of Antiquities. Any adverse impacts on underwater cultural heritage will be prevented by identifying the locations and extents of any ancient underwater monuments along or around the pipeline route by completing the underwater archaeological inventory started in 2014. Sufficient data for the more detailed design of the pipeline routing and the avoidance of any items will be obtained by carrying out the necessary further surveys of the seabed, visual inspections of any anomalies and studies of the type and extent of any items close to the pipeline construction area. Not using an anchored pipelaying vessel will play an important role in the prevention of adverse impacts.

## 8.13 People and society

### 8.13.1 Assessment methods and assessment uncertainties

To conduct the assessment of the impacts on people and society, the potential impacts on people, stakeholders and the surrounding community were first identified. The magnitude of the change caused by the impact was assessed in relation to the magnitude and direction of the impact. The magnitude of the change was also assessed on the basis of its scope and duration. The sensitivity of the receptor was also assessed. Sensitivity describes how sensitive those experiencing the impacts are to the impact or the change caused by the impact. The significance of the impact on a stakeholder, community or individual was assessed by combining the magnitude of the change caused by the impact and the sensitivity of the receptor.

The assessments of the impacts on people and society were mainly conducted as expert assessments. A public consultation event open to all was organized in the EIA program phase of the Balticconnector project. Another public event will be organized following the completion of the EIA report in spring 2015. An EIA monitoring group to guide the assessment work was able 8-19. Overall significance of landscape impacts. C = during construction, O = during operation. There is no significant difference between the alternatives.

| Impact significance | | Magnitude of change | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Very high | High | Moderate | Low | No change | Low | Moderate | High | Very high |
| Sensitivity of the receptor | Low | High | Moderate | Low | C / O Low | No impact | Low | Low | Moderate | High |
| | Moderate | High | High | Moderate | Low | No impact | Low | Moderate | High | High |
| | High | Very high | High | High | Moderate | No impact | Moderate | High | High | Very high |
| | Very high | Very high | Very high | High | High | No impact | High | High | Very high | Very high |

also established for the project, consisting of authorities, organizations and associations. The monitoring group convened in January 2015 to comment on the draft EIA report. Issues brought up at public events organized in conjunction with the Ingå mine project of Rudus Oy, particularly concerning the cumulative impacts of the projects, were also utilized in the assessment.

No separate interviews or methods such as resident surveys have been used for the Balticconnector project. Information about local residential conditions and recreational use was, however, obtained from sources such as the monitoring group. Uncertainties in the assessment are caused by people experiencing the adverse effect of the impacts highly subjectively, whereby the experienced adverse impact cannot be assessed directly. The project's impacts on people will, however, focus on the period during construction and be temporary and short-term in nature. Therefore the uncertainties do not significantly undermine the results of the impact assessment.

The impact assessment was conducted by experienced experts specializing in social impacts.

### 8.13.2 Impacts during construction

As regards the offshore pipeline routing, actual impacts on people will only arise on the coastal areas of Finland and Estonia. There are no residences in the vicinity of the pipeline routing outside the near-shore islands. In the offshore areas there is only vessel traffic on which there may be impacts (see section 8.8). Impacts will be caused almost exclusively during the construction of the natural gas pipeline. The adverse effects caused by the construction of the natural gas pipeline will, however, be non-persistent in nature, whereby their impact will not last for a long time. Compared with the normal situation, some work conducted during construction may to some extent cause annoyance. The most significant impacts are to do with increased waterborne traffic and temporary noise impacts in sea and land areas during construction as well as other impacts relating to construction and installation work (Table 8-20).

#### Impacts generated

During the construction phase, seabed intervention will mainly result in momentary local impacts on other vessel traffic with a maximum duration of few days for each area as the avoidance of the area will be needed during intervention. During pipelaying, other vessels in the area will need to maintain a safety zone of at least 1.5 km from the pipelaying vessel. Construction will take a few months in the coastal areas, with impacts on ship and boat traffic generated during this period. The impacts are, however, assessed as low in significance, taking into account the duration of the impact and existing navigational and traffic control measures but, in the summer in particular when there are a lot of pleasure boats in the area, the construction work may be perceived as disturbing. In the ALT FIN 2 alternative the pipeline routing runs over a longer section close to a fairway, whereby the impacts of measures during pipelaying on traffic on the fairway will be slightly higher than in ALT FIN 1. The adverse impact can be mitigated by notifying boaters of construction work and restrictions, and this will also help increase the safety of boaters in the area. In addition to notices given by the Coast Guard, boaters in the Ingå area can, where necessary, also be informed through a variety of measures to make sure the information also reaches boats not equipped with a radio.

The above-ground and above-water noise impacts will be at their highest during pipeline construction. The highest levels of noise during construction will be generated by blasting work, and local increases in noise may also be caused by vessel traffic during pipeline installation. It is reported in the noise impact section that above-water noise will extend 500 m from the noise sources (section 8.8.1). The equivalent sound level for one day may exceed the daily guideline value of 45 dB(A) with ALT FIN 1 and ALT FIN 2 at the holiday residence of the island of Bergskämmö, with LF1 for the holiday residences on the western side of the island of Skämmö and with LF2 for the holiday residences on

Table 8-20. The most significant direct and indirect impacts during construction.

| Source of impact | Direct impact | Indirect impact |
|---|---|---|
| Increased vessel traffic and vessel safety zones | Short-term route changes caused by increased traffic | Temporary local restrictions on traffic<br>Temporary changes to accustomed movement at sea<br>The Port of Ingå will be closed for a few days due to installation work. |
| Pipelaying vessel activity during construction | Noise caused by installation work | Short-term noise impact on living conditions and amenity in the coastal residential zone around 500 m from the installation site |
| Seabed intervention and natural gas pipeline installation work | Noise and vibrations<br>Increased water turbidity<br>Deterring of fish | Short-term adverse impact on amenity<br>Short-term reduction in recreational opportunities<br>Short-term reduction in recreational value of recreational fishing<br>Short-term aesthetic degradation caused by increased water turbidity<br>Temporary reduction in recreational value caused by increased water turbidity |
| Construction and installation work in land and sea areas | Employment impacts | Temporary increase in purchasing power during construction |

the western side of the island of Skämmö and on the northern shore of the island of Jakobramsjö. There may even be higher momentary peaks in sound levels when pipelaying is taking place right in front of the island. The adverse impact of the noise will, however, be short-term and limited to the construction period. The difference between the ALT FIN 1 and ALT FIN 2 alternatives cannot be regarded as significant as regards noise impacts. However, the route taken by ALT FIN 2 east of Jakobramsjö passes closer to holiday residences than ALT FIN 1, whereby ALT FIN 2 may affect the recreational conditions of a larger number of (a few dozen) holiday residents. With the LF1 landfall alternative, there will be a larger number of holiday residents within reach of the noise impacts in the shore area of Backarsundet than with LF2. LF1 is closer to holiday and permanent residences than LF2, whereby slightly higher temporary adverse effects may be caused on recreational conditions with LF1.

Vibrations created in blasting during pipeline construction may affect the residential comfort of local residents as temporary vibrations may be perceived in the buildings nearest to the pipeline. No impacts are assessed to arise on buildings. Dust generated in earthworks is assessed to remain in the immediate vicinity of the worksite and have no impacts on people or recreation in the local area.

Short-term and local increase in water turbidity caused by seabed intervention (excavation, underwater blasting) may cause a low adverse impact on the recreational use of the areas. The adverse impact, which will mainly be aesthetic, caused by turbidity on the recreational use of shores and waters off Ingå will be seen during a maximum of two periods without sea ice cover. Due to division of the work into stages and the movement of the worksite locations, the affected area will vary in terms of place and therefore the adverse impacts will not be targeted at the same area during the entire construction period. The strongest impacts will be seen close to the coast in the Barkarsundet and Norrfjärden areas. For example, turbidity during construction can be expected at the public swimming beach near the center of Ingå and the shore areas of several holiday residences. Further out in the archipelago the adverse impact will be lower as turbidity will mainly remain close to the bottom. Turbidity will not cause any health hazards but will result in a short-term aesthetic degradation.

During construction there will be adverse effects on fishing in the archipelago zone as fish will be deterred by seabed intervention work. The adverse effect caused by the deterring of fish will be temporary. The deterring of fish may also result in a temporary adverse effect on recreational fishing as well. There may be short-term changes in recreational catches relating to catches as well as recreational value.

As regards the surrounding society, there will be direct and indirect impacts on local enterprises, particularly during the construction of the natural gas pipeline. Services relating to the pipelaying fleet will be required in the port area, in which local enterprises may be utilized. The construction phase will have a direct local impact on transport. Short-term increases in demand can be expected as indirect impacts relating to food, accommodation and retail services during construction since the personnel participating in installation work will mainly be workforce specialized in the installation phase arriving from outside the area. Pipelaying taking place in the Ingå fairway area will result in a temporary restriction on traffic toward the Port of Ingå for a few days, which is when the port will be closed down temporarily.

The compressor station will be powered by natural gas or, alternatively, by electricity. The latter alternative will require a 110 kV underground cable that is approximately 2 km in length (Figure 3–21) and local transformer stations in the area. The impacts during the construction of the underground cable, such as noise, dust and vibrations, will be limited to the excavation and installation of the underground cable. Underground cable installation will not cause any significant adverse impact on the amenity of permanent or holiday residents. There are no residences close to the underground cable route.

#### Perception of impacts

Human perception of adverse effects or their impacts on amenity and living conditions depends on the individual. The perception of the significance of impacts is affected by nature values perceived by people (short-term impact on seawater, fish stocks, birds and other organisms), landscape values, change in property value, disturbance to recreational use and temporary impacts on waterborne traffic. The impacts regarding the physical natural environment as well as recreational values, landscape degradation and waterborne traffic will be short-term, however. The value of residential and holiday properties is not likely to be affected as, following the brief construction period, the offshore natural gas pipeline buried in the seabed will not have any significant impacts on people.

The construction of the natural gas pipeline may be perceived as abnormal and disturbing, particularly during the summer when there are lots of recreational activities in the area, such as boating and spending time at a holiday home. Although the adverse impacts will be temporary and short-term, some individual residents, holiday residents or others using the area for recreation may due to their circumstances be more susceptible to adverse impacts than others. The adverse impacts on people during the construction of the LF1 landfall alternative will affect permanent or holiday residents of around 20 seafront properties, and possibly also central Ingå seafront residents and recreational users, swimming beach users and marina users. Measures during construction may cause temporary upset, a short-term adverse impact on recreational value and disturbance during construction that will not in their nature be permanent. The way adverse impacts are perceived depends on the individual. None of the adverse impacts are, however, assessed to result in a permanent change or adverse impact on residents, recreational use or living conditions.

### 8.13.3 Impacts during operation

As regards local economy, the employment-generating impact during pipeline operation will be rather low. Direct local employment generation will mainly relate to maintenance and service jobs.

Once operational, the natural gas pipeline will not restrict boating, fishing and any type of recreational use. Underwater noise during operation will not affect people or residential communities. According to the noise impact modeling carried out, noise (the 45 dB(A) noise zone) from the onshore compressor station audible outside the station, comprising the noise from the compressor and the gas turbine it is powered by, will extend to a maximum of 150 m from the compressor station. The compressor station will be located in an industrial area, with the nearest residential buildings around 400 m away. The maximum equivalent sound level LAeq at the nearest residential building in Ingå will be 38 dB(A). Consequently, noise impacts during operation will be low and very local.

As regards landscape impacts during construction, landfall site structures may be visible from surrounding areas. The structures located close to the shore will not, however, significantly reduce the visual uniformity of the landscape in the area. After the construction phase, worksite areas around the pipeline can be gradually restored as natural areas. The pipeline area will stand out from the otherwise forested environment as a treeless corridor. Both pipeline routing alternatives run through an area with natural areas as well as human activities that have modified the terrain. Neither of the routing alternatives will cause significant landscape impacts.

The compressor station will turn what is currently a natural area into a built environment Due to the nature of the Joddböle–Fjusö area entity, which is already modified by industrial activities, the impacts on the landscape will not be significant. The possible underground cable route will blend into the Joddböle zone of industrial activities. As regards the offshore sections, the natural gas pipeline will not cause any impacts on the landscape or cultural environment during operation.

Air emissions on the mainland will be generated from the operation of the compressor station and at sea from pipeline inspections and maintenance. Air emissions from the compressor station will not be significant, and the impact of nitrogen oxide emissions on air quality will be very low. This corresponds to around 1% of the total nitrogen oxide emissions in the Municipality of Ingå in 2011. If the station is powered by natural gas, natural gas will be used to fuel the gas turbine of the station, whereby in practice there will be not sulfur dioxide or particulate emissions at all from the combustion of gas.

### 8.13.4 Summary of the significance of impacts

The societal significance of the project for energy supply and supply security between the countries is high. From the perspective of the permanent and holiday residents of Ingå, the susceptibility of the area to change is high during construction. On the whole, the sensitivity of the receptor to changes during construction is assessed as moderate (Table 8-20). Once the pipeline is completed, the sensitivity will be reduced to low, however.

The impacts on people and society will focus almost entirely on the period of natural gas pipeline construction. The impacts are to do with temporary noise impacts in water and land areas, increased vessel traffic and short-term vibration impacts on land and at sea. The very short-term increase in turbidity in waters close to the offshore pipeline will cause a very low adverse impact on recreational use and fishing. The impacts will be short in duration and temporary in nature. There are no significant differences between the routing and landfall alternatives as regards impacts. The overall significance of impacts during construction and operation is assessed as low (Table 8-20). The construction of the natural gas pipeline may be perceived as abnormal and disturbing, particularly during the summer when there are lots of recreational activities in the area, such as boating and spending time at a holiday home. The classification criteria used for the determination of the sensitivity of receptors and the magnitude of change are described in Appendix 3 to this EIA report.

Table 8-21. Overall significance of impacts on people and society. C = during construction, O = during operation. There is no significant difference between the alternatives.

| Impact significance | | Magnitude of change | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Very high** | **High** | **Moderate** | **Low** | **No change** | **Low** | **Moderate** | **High** | **Very high** |
| Sensitivity of the receptor | **Low** | High | Moderate | Low | Low | No impact | Low | Low | Moderate | High |
| | **Moderate** | High | High | Moderate | **C / O Low** | No impact | Low | Moderate | High | High |
| | **High** | Very high | High | High | Moderate | No impact | Moderate | High | High | Very high |
| | **Very high** | Very high | Very high | High | High | No impact | High | High | Very high | Very high |

### 8.13.5 Prevention and mitigation of adverse impacts

Efforts will be made to carry out construction work efficiently and without interruptions in order to minimize the duration of disturbance in the marine area. It will not be possible to fully prevent adverse impacts during the construction of the offshore pipeline as regards the dredging and blasting required as well as the movements of the pipelaying fleet. Efforts will be made to mitigate the adverse impacts by scheduling the measures that generate noise or temporary turbidity outside the busiest seasons of recreational use or the best fishing-related spawning and fishing seasons. The Björkudden swimming beach designated under the Bathing Waters Directive will be taken separately into consideration if construction takes place during the summer bathing season. The municipality and health surveillance authorities will be informed in advance of any work that may have an adverse impact on water quality to prevent any additional adverse effects on the monitoring of bathing water quality or bathing water assessment. Information about installation work and schedules will be provided locally through advance notifications as well as notifications while work is in progress. Efforts will be made to include permanent residents, holiday residents as well as boaters in those who will receive the notifications.

## 8.14 Use of natural resources

### 8.14.1 Assessment methods and assessment uncertainties

Impacts on natural resource use during the project construction and operation were assessed as an expert assessment in which the planned and existing marine extraction sites in the vicinity of the Balticconnector pipeline routing were identified and the project's impacts on the basis of the distance between these sites and the pipeline routing were assessed. Data on current and planned marine extraction sites was obtained from the Municipality of Ingå, the Regional State Administrative Agency for Southern Finland and Morenia Oy. The project's impacts on onshore extraction activities are described in section 8.11.

Uncertainties in the impact assessment are caused by the fact that the development of extraction technologies cannot be anticipated and plans concerning extraction operations cannot be forecast for the entire period of pipeline operation (with the estimated operational life of the pipeline being 50 years). The assessment was conducted by an experienced environmental expert.

### 8.14.2 Impacts during construction

No marine extraction permits have been issued for the area off Ingå, and there are no known plans for marine extraction in the area (*Municipality of Ingå 2014b and Morenia Oy 2014*). The nearest areas where marine extraction has taken place are located off Helsinki and Sipoo tens of kilometers away from the planned natural gas pipeline route (*Regional State Administrative Agency for Southern Finland 2014a*).

Seabed intervention, rock dumping, pipelaying and munitions clearance during natural gas pipeline construction could cause disturbance impacts on marine extraction areas if these are located near the route. The impacts would be short-term and local. Marine extraction activities are not, however, estimated to take place within such a distance from the pipeline where construction would result in impacts on extraction.

The are no known current or planned marine extraction activities in the vicinity of the Balticconnector natural gas pipeline route in Estonia either. The nearest marine sand extraction site is located around 26 km from the planned pipeline route. Therefore the project will not have impacts on natural resource use during construction.

### 8.14.3 Impacts during operation

Marine extraction will not be possible along the natural gas pipeline route during pipeline operation. There is no current or planned seabed extraction activity in the vicinity of the natural gas pipeline (*Municipality of Ingå 2014 and Morenia Oy 2014*).

The planned natural gas pipeline will restrict seabed extraction locally during pipeline operation. The impacted area will be limited to the planned route and not extend to other areas in the Gulf of Finland. Should marine extraction be planned during the natural pipeline operation period near the route, the project developer must negotiate with the Balticconnector Project Developers about the size of the safety zone required by the natural gas pipeline. Marine extraction cannot take place within the safety zone. The safety zone is, however, narrow in relation to the size of seabed in the Gulf of Finland so the impacts will not be significant. In addition, the majority of the natural gas pipeline route passes through sections that are too deep for commercially viable extraction using current technology. There is no significant difference between the project alternatives as regards marine extraction because the alternative routings are located close to each other.

### 8.14.4 Summary of the significance of impacts and comparison of alternatives

The natural gas pipeline route may in part be located in such areas where marine extraction might take place later on. The sensitivity of the receptor is, however, assessed as low (Table 8-21).

The project will have no impact on marine extraction sites during pipeline construction. Extraction will not be possible along or in the immediate vicinity of the natural gas pipeline route during pipeline operation (around 50 years). The significance of the impact during operation is, however, assessed as low (Table 8-21), because the impact will be very local (narrow area) and will not extend outside the safety zone of the pipeline route. There is no significant difference between the alternatives. The classification criteria used for the determination of the sensitivity of receptors and the magnitude of change are described in Appendix 3 to this EIA report.

Table 8-22. Overall significance of impacts on natural resource use, C = during construction, O = during operation. There is no significant difference between the alternatives.

| Impact significance | | Magnitude of change | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Very high** | **High** | **Moderate** | **Low** | **No change** | **Low** | **Moderate** | **High** | **Very high** |
| **Sensitivity of the receptor** | **Low** | High | Moderate | Low | **O**<br>**Low** | **C**<br>**No impact** | Low | Low | Moderate | High |
| | **Moderate** | High | High | Moderate | Low | No impact | Low | Moderate | High | High |
| | **High** | Very high | High | High | Moderate | No impact | Moderate | High | High | Very high |
| | **Very high** | Very high | Very high | High | High | No impact | High | High | Very high | Very high |

### 8.14.5 Prevention and mitigation of adverse impacts

The impacts of the natural gas pipeline on marine extraction activities can be mitigated by taking existing and planned act ivies into consideration in route design.

## 8.15 Waste and waste handling

### 8.15.1 Assessment methods and assessment uncertainties

The impact assessment is based on project technical data, estimated waste types and an expert assessment conducted on the basis of these. Impacts during construction and operation were taken into consideration in the impact assessment. Uncertainty in the assessment is caused by the volumes of waste not being known at the project preliminary design stage. The impact assessment was conducted by an experienced environmental expert.

### 8.15.2 Most common types of waste generated during the project

The waste generated from Balticconnector pipeline project can be classified into non-hazardous and hazardous waste.

Non-hazardous pipeline construction wastes include human waste, litter, pipe marking and spacers, waste from coating products, welding rods, timber skids, and rock.

All waste which contains (or at any time contained) oil, grease, solvents, or other petroleum products falls within the scope of the oil and hazardous substances control and disposal procedures. This material should be segregated for handling and disposal as hazardous wastes.

The most common types of waste generated during the Balticconnector project are shown in the table below 2).

Table 8-23. Most common types of waste generated during the Balticconnector project.

| Classification | Physical form | Waste type |
|---|---|---|
| Non-hazardous | Solid wastes | Domestic/office waste |
| | | Abrasive grit blast |
| | | Metal cuttings |
| | | Paper and cardboard |
| | | Recyclable plastic |
| | | Tires / rubbers |
| | | Electrical cable waste |
| | | Wood |
| | Liquid wastes | Oils - cooking oil |
| Hazardous | Solid wastes | Clinical waste |
| | | Contaminated materials |
| | | Oily rags |
| | Liquid wastes | Oils - lubricating oil/Oils - fuel |
| | | Paints and coatings |
| | | Solvents, degreasers and thinners |
| | | Water - oily |
| | | Water - hydrotest water |
| | | Water - treatment chemicals |

### 8.15.3 Impacts during construction

All waste disposal will take place in compliance with applicable internationally recognized standards and methods and local legislation. Waste generated on board pipelaying vessels will be placed in tightly sealed containers. Such waste includes pipe milling and beveling waste, welding powder, pieces of heat-shrink sleeve, polyurethane filler and oils.

All (hazardous and non-hazardous) waste will be collected by a licensed contractor for disposal only at licensed and approved facilities. All everyday waste will be removed from the construction site on a daily basis unless otherwise approved or directed.

All drill cuttings and drilling mud from landfall approach methods will be disposed of at approved locations. Disposal options may include spreading over the construction site in an approved upland location, or hauling to an approved licensed landfill or other site.

All rock and other natural debris will be removed from the construction site by the completion of clean-up. All litter and wastes from contractor yards, pipe stockpile sites, and staging areas, will be removed when the work is completed at each location.

It must be ensured that all hazardous and potentially hazardous materials are transported, stored and handled in accordance with all applicable legislation.

Workers exposed to or required to handle dangerous materials must be trained appropriately and in accordance with the manufacturer's recommendations.

If toxic or hazardous waste materials or containers are encountered during construction, the work must stop immediately to prevent disturbing or further disturbing the waste material, and all relevant parties must be notified immediately. The work may not restart until clearance is granted.

There is no significant difference between the project alternatives as regards waste generation and handling during construction.

### 8.15.4 Impacts during operation

In Finland the operation of the compressor station and, regarding the entire project, pipeline inspection measures will generate small amounts of hazardous waste, such as lubricating oils, gas turbine cleaners and glycol. The relevant regulations will be complied with in the handling of these. Control work during operation will also generate municipal waste at central control rooms. Waste generated during operation will be sorted by waste type.

There is no significant difference between the project alternatives as regards waste generation and handling during operation.

### 8.15.5 Prevention and mitigation of adverse impacts

Adverse impacts caused by waste will be prevented by complying with the internationally recognized standards and methods as well as local legislation in the handling of waste. Efforts will be made to reuse waste as much as possible at the source or other sites.

## 8.16 Exceptional and accident situations

### 8.16.1 Assessment methods and assessment uncertainties

The assessment of the impacts of exceptional and accident situations along the natural gas pipeline route in Finland and Estonia during the operation of the gas pipeline is based on a quantitative risk assessment conducted for the project *(Ramboll 2014b)*. The assessment covers the risks related to human safety and structural integrity and is based on the occurrence frequency of pipeline damage resulting in an offshore gas leak calculated using a mathematical model. Offshore gas leaks result in a cloud of gas on the sea surface, with the risks posed to human safety assessed on the basis of the size of the cloud for various sizes of pipeline damage. The amount of pipeline damage depends on issues such as the structure of the gas pipeline and environmental conditions. The occurrence frequency of pipeline damage in this risk assessment usually equals the occurrence frequency of the release of a gas cloud.

The assessment of the impacts of exceptional and accident situations during construction is based on the identification of typical environmental and safety risks and the assessment of their impacts. The risk assessment conducted for the Nord Stream project was also utilized in the identification of exceptional and accident situations and impact assessments during pipeline installation *(Nord Stream 2009b)*.

On the basis of the studies conducted so far it is not possible to conduct a specific environmental risk assessment regarding munitions and barrels as these are yet to be mapped out in detail. More detailed seabed surveys will be carried out at a later project design stage, with more detailed mapping of munitions and barrels also taking place in that context.

The risk assessment relating to the operation phase of the Balticconnector project covers the natural gas pipeline routings ALT FIN 1 and ALT FIN 2 as well as the LF2 landfall alternative, but the risk assessment does not include the gas pipeline section as regards the LF1 landfall alternative. The risk assessment will be specified further once more detailed seabed surveys to thoroughly map out the munitions and barrels have been completed. The risk assessment carried out can also be regarded as indicative as regards the LF1 landfall alternative. The impact assessment was conducted by an experienced environmental hygienist.

### 8.16.2 Impacts during construction

The most significant risks relating to the construction of the natural gas pipeline comprise the collision of installation vessels participating in pipelaying with other vessels as well as any munitions and barrels containing hazardous substances found in the seabed in the construction area.

#### Safety incidents identified

The following accident and disturbance situations have been identified for natural gas pipeline construction:

- installation vessel collision with a passing ship;
- vessel oil spill;
- fire on board an installation vessel;
- grounding of an installation vessel
- sinking or capsize of an installation vessel;
- oil spills in conjunction with bunkering;
- risks relating to munitions and barrels containing hazardous substances found on the seabed.

### Environmental impacts and probability of accident and disturbance situations

The rate of vessel traffic relating to pipeline installation will be rather high. There will be three pipe supply vessels, a pipelaying vessel and vessels relating to seabed intervention moving in the construction area and lanes leading into it (see section 3.4). The collision of a pipelaying vessel, pipe supply vessel or vessel participating in seabed intervention with a passing ship is unlikely but possible. The consequences correspond to those of other collisions of corresponding vessels. There are around 2,000 large vessels at sea in the Baltic Sea at any given time. The risk of accident caused by the Balticconnector project is very small as the increase in vessel traffic arising from the project is small. The number of vessel collisions in the Gulf of Finland has decreased considerably in the past years, with no collision accidents taking place in 2012 *(HELCOM 2014, RKTL 2012)*.

A vessel oil spill can consist of shipping fuel or crude oil transported by a tanker. The majority of oil-spillage accidents are caused by a vessel's fuel spilling into the sea as a result of an incident such as grounding. In 2004–2010 there were 4–13 accidents in the Baltic Sea resulting in an oil spill *(Pålsson)*. The increased risk of oil spill caused by the Balticconnector project is very small as the increase in vessel traffic arising from the project will be small.

The impacts of oil leaking from a ship depend especially on the size of the oil spill but also on the type of oil, time of year, weather conditions and whether or not the oil stays off the shore or washes up on the shore. Oil-related accidents can result in various degrees of shore pollution, damage to birds and coverage of plants and cause damage to animals on land when washed ashore as well as suffocating or contaminating underwater plant and animal communities *(Oilrisk)*. Oil spills of fuel used by vessels amount to spills of tens or a maximum of 100–200 tonnes, while tanker spills may be tens of thousands of tonnes *(Finnish Association for Nature Conservation 2014, Finnish Game and Fisheries Institute 2012)*.

There have been four vessel oil spills with at least 500 tonnes of oil released in the Baltic Sea in waters where Finland is responsible for pollution prevention. These incidents took place in the 1970s and 1980s. The quantity of oil released into the sea in the most serious vessel oil spills was small compared with the major accidents that have taken place in other marine areas *(Finnish Game and Fisheries Institute 2012)*.

In conjunction with geophysical surveys conducted on the natural gas pipeline corridor *(MMT 2014 and 2006)*, a total of 48 items were found over the entire study corridor that are assessed to be man-made and that can, for example, be metal waste, barrels or munitions (see section ). Of these 8 are assessed to possibly be munitions, with 2 of these located in the exclusive economic zone of Finland and 6 in that of Estonia. *(MMT 2014 and 2006)* The munitions will be cleared before the construction of the gas pipeline.

There may also be barrels containing substances that are harmful to the environment along the routing and study corridor of the planned natural gas pipeline. If a barrel is damaged during pipeline installation or maintenance work, its contents may leak into the sea. Any environmental damage will depend on the harmfulness of the substances in the barrel. Barrels will be removed before the construction of the gas pipeline.

The accident and disturbance situations relating to the construction of the ALT FIN 1 and ALT FIN 2 routing alternatives and the LF1 and LF2 landfall alternatives correspond to those in the construction of the Nord Stream gas pipeline completed previously. The Balticconnector project will, however, involve more seabed intervention and related rock transport and explosions.

### Accident prevention

The prevention of safety incidents is the primary goal set for planning. Planning will take place in compliance with legislation as well as safety and occupational health and safety rules. Efforts will be made to prevent vessel collisions and groundings through traffic control.

The detailed mapping of munitions and barrels is yet to take place. To prevent any risks relating to munitions and barrels in the natural gas pipeline corridor, more detailed underwater studies involving the more detailed mapping of munitions and barrels will take place before the installation of the pipeline. The disposal of munitions and barrels will be negotiated with the relevant national authorities. The munitions clearance plan will be drawn up with a view to minimizing any impacts on fish, birds and mammals. In addition, the necessary safety zones will be established and other vessels notified of the schedules and methods of munitions clearance in the appropriate manner to avoid the risk of accidents.

The table (Table 8-23) contains a summary of accident situations relating to the construction of an offshore natural gas pipeline, their consequences and possible impacts, as well as measures taken in preparation.

Table 8-24. Most significant possible accident situations, their consequences and possible impacts as well as measures taken to prevent accidents.

| | Consequence | Possible impact and probability | Prevention measures |
|---|---|---|---|
| Alternatives ALT FIN 1, ALT FIN 2, LF1 and LF2 | | | |
| **Vessel collision** | Vessel damage, sinking or fire | - personal injuries<br>- economic loss<br>- spread of flue gases into the environment from a fire<br>- oil spill<br>- chemical spill | - safety zones<br>- fire and oil spill response equipment<br>- personnel training |
| **Grounding of an installation vessel** | Oil spill | - shore oil pollution<br>- birds fouled by oil<br>- other environmental damage | - safety zones<br>- fire and oil spill response equipment<br>- personnel training |
| | Vessel damage or sinking | - personal injuries<br>- economic loss<br>- oil spill | - safety zones<br>- oil spill response equipment<br>- personnel training |
| **Explosion of munition on the seabed** | Pressure wave | - personal injuries<br>- economic loss<br>- damage to fish, birds and mammals | - more specific mapping of munitions in advance |
| **Leakage of barrel on the seabed** | Chemical spill into the sea | - environmental damage | - more specific mapping and removal of barrels in advance |
| **Explosion accident during seabed intervention** | Pressure wave | - personal injuries<br>- economic loss | - design and planning |

### 8.16.3 Impacts during operation

#### 8.16.3.1 Occurrence frequency of offshore natural gas pipeline leaks

Possible damage to the gas pipeline and resulting pipeline malfunction could have consequences to human safety. The risk assessment conducted for the Balticconnector project (*Ramboll 2014b*) identified the sections where the pipeline must be protected to prevent pipeline damage The quantitative assessments of the risk presented below therefore represent the magnitudes of risk without any protective measures, which are already included in the pipeline design. The measures to protect the pipeline will reduce the risk to an acceptable level, whereby the frequency of accidents at this stage of the design process may be a maximum of once in 100,000 years per 1 km of pipeline. The premise applied in the design and protection of the natural gas pipeline is for the above-mentioned risk not be exceeded.

Damage to the natural gas pipeline can be caused by the following:

- contact with an anchor (emergency anchoring or anchor dragging);
- contact with trawling gear;
- vessel sinking;
- vessel grounding;
- damage caused by ice formation.

#### Anchoring

Emergency anchoring may be required in a situation where a vessel begins to drift due to a mechanical problem caused by an issue such as a power cut and the vessel loses propulsion. If an anchor of a drifting vessel is lowered on top of the natural gas pipeline, it may hit the pipeline. In the risk assessment this situation is referred to as a 'dropped anchor'. An anchor could also damage the gas pipeline in a situation where the anchor is lowered before the pipeline but comes in contact with or gets caught in the gas pipeline ('dragged anchor'). An anchor hitting the gas pipeline may cause an indentation the size of which determines whether or not gas will be released from the pipeline. In the risk assessment, mathematical models were used to calculate the probability of contact between an anchor and the gas pipeline and a resulting gas leak. Issues taken into consideration in the model included:

- vessel traffic (routes, number and size of vessels);
- gas pipeline characteristics (routing, trenches, water depth).

The occurrence frequency of malfunctions in the natural gas pipeline before any protective measures obtained for the entire length of the pipeline for the ALT FIN 1 alternative is 4,15 * $10^{-3}$ years, which corresponds to a return period of 241 years and for the ALT FIN 2 alternative 4,21 * $10^{-3}$, which corresponds to a return period of 238 years. The probability of pipeline damage is the highest in the pipeline sections between KP 36–39 and

44–47, which are located to the north of the mid-section of the pipeline for a distance of around 2–5 km and to the south for around 3–7 km (Figure 31) *(Ramboll 2014b)*. There is no significance difference between the ALT FIN 1 and ALT FIN 2 alternatives.

### Vessel sinking

A vessel sinking while crossing the natural gas pipeline could damage the pipeline by touching it directly or when hitting the seabed. The probability of a vessel sinking was obtained by using IMO[2] data to calculate the general probability for the sinking of a cargo ship per hour traveled. IMO statistics for 2002 and 2003 on serious and very serious casualties were used as the initial data. According to IMO data, in 2002 there were 30 foundering (sinking or submerging) casualty events while in 2003 the figure was 34. The distance traveled by the vessels was taken into consideration when calculating the probability of a vessel sinking in the Balticconnector gas pipeline area. The probability of a vessel sinking without any pipeline protection measures for the entire length of the pipeline for the ALT FIN 1 alternative is $5.61 * 10^{-5}$ years, which corresponds to a return period of 17,825 years and for the ALT FIN 2 alternative $5.71 * 10^{-5}$, which corresponds to a return period of 17,513 years. *(Ramboll 2014b)*. There is no significance difference between the ALT FIN 1 and ALT FIN 2 alternatives.

### Vessel grounding

The grounding of a vessel in the coastal area could without any protective measures pose a risk of damage to the natural gas pipeline. The protection of the pipeline with a trench will be sufficient to reduce the risk posed by vessels grounding to an acceptable level. The laying of the pipeline in a trench near the landfalls must be designed particularly carefully. In Finland the landfall will be close to the fairway leading to the Port of Ingå and close to a lighthouse used for navigation by vessels approaching the port. If a vessel at that point fails to take the next turn in time, grounding close to the natural gas pipeline is possible. For safety reasons the pipeline will be placed in a trench in that section and also protected with a layer of rock *(Ramboll 2014b and 2006)*.

### Probability of the different incidents combined

The probability of damage to the natural gas pipeline caused by the different factors is the highest in pipeline sections KP 37–39 and KPI 44–46 mainly due to the large volume of vessel traffic crossing the pipeline *(Ramboll 2014b)*. Without any protective measures an accident would take place once in 238 years in the ALT FIN 1 alternative and once in the ALT FIN 2 alternative. In the risk assessment those sections that need to be protected to keep the risk at an acceptable level (i.e. at a maximum accident frequency of once in 100,000 years per 1 km of pipeline) were identified. The natural gas pipeline will be designed and protected to ensure the above-mentioned risk is not exceeded.

### Ice formation

In the winter ice accumulation may take place in coastal areas, creating pressure on the seabed. The pipeline could be damaged by ice if not placed appropriately in a trench. Ice accumulation takes place when ice is pushed by strong winds and currents from offshore areas towards the coast. The islands on the Finnish coast are likely to reduce ice accumulation events close to the landfall sites. At depths of water exceeding 20 m ice accumulation is not expected to be a problem for the gas pipeline as the maximum height of ice ridges observed accumulating in the area has been 15 m. In areas where ice formation is assessed to pose a risk of pipeline damage the gas pipeline will be protected by trenching. According to the preliminary plan, these sections total around 20 km, mainly in sections KP 7–23 near Ingå and KP 76–80 near Paldiski. *(Ramboll 2014a and b)*

### Trawling

According to analyses conducted for other natural gas pipeline projects, pipelines are able to withstand the impacts of trawling gear touching a pipeline or being pulled over it. The highest impact on a pipeline is seen in the event of trawling gear becoming snagged under the pipeline. This can only take place in those sections where a freespan is high. The components of trawling gear are weak enough to break before damage to the pipeline occurs *(Ramboll 2009b)*.

#### 8.16.3.2 Consequences of offshore natural gas pipeline leak

The consequences of a leak from the natural gas pipeline were examined concerning human safety.

A possible consequence of an offshore gas leak is the formation of a gas cloud close to the surface of the sea. If the concentration of gas in the cloud formed is appropriate for ignition, an ignition source (such as a passing ship) may ignite the cloud and cause an accident involving humans.

Gas released from a damaged offshore gas pipeline will spread into the surrounding water column in a conical formation moving towards the surface (Figure 8-30). Once on the surface, the gas will begin dispersion in the air. Gas does not dissolve in sea water. When mixed with air, gas forms a mixture that is flammable in certain gas concentrations. The lower explosive limit (LEL) of gas is approximately 4%. In concentrations below this the gas cloud will not be flammable. In this risk assessment the gas cloud is, in accordance with standard risk assessment practice, regarded as flammable in concentrations half of the LEL, which for natural gas means at 2%. *(Ramboll 2014b)*

2 International Maritime Organization.

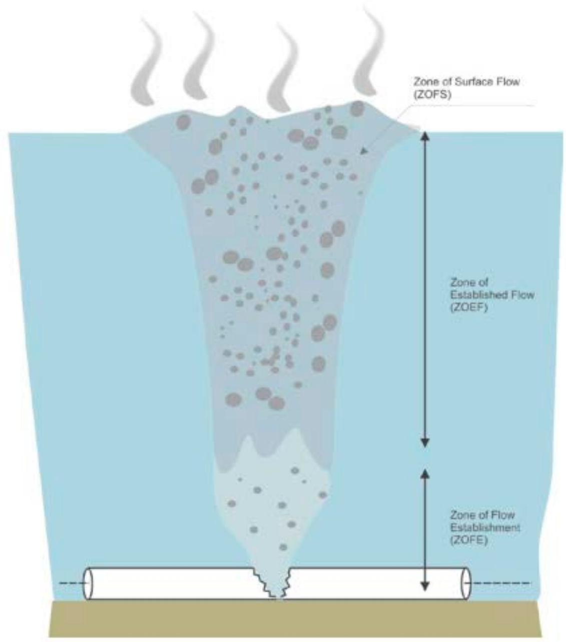



Figure 8-30. Release of gas from a damaged offshore pipeline (*Ramboll 2014b*).

The figure (Figure 8-31) shows the dispersion of gas that has reached the surface in the air due to wind. The upper explosive limit (UEL) of gas, above which gas is not flammable, is shown in red in the figure. The area shown in yellow indicates the lower explosive limit (LEL), i.e. 4%, and the area shown in white indicates one-half of the LEL, i.e. gas concentration at 2%. Although a cloud of gas cannot in principle be ignited at concentrations below the LEL or above the UEL, in this risk assessment the entire gas cloud is assumed to be flammable when calculating the distance of the safety zone. *(Ramboll 2014b)*

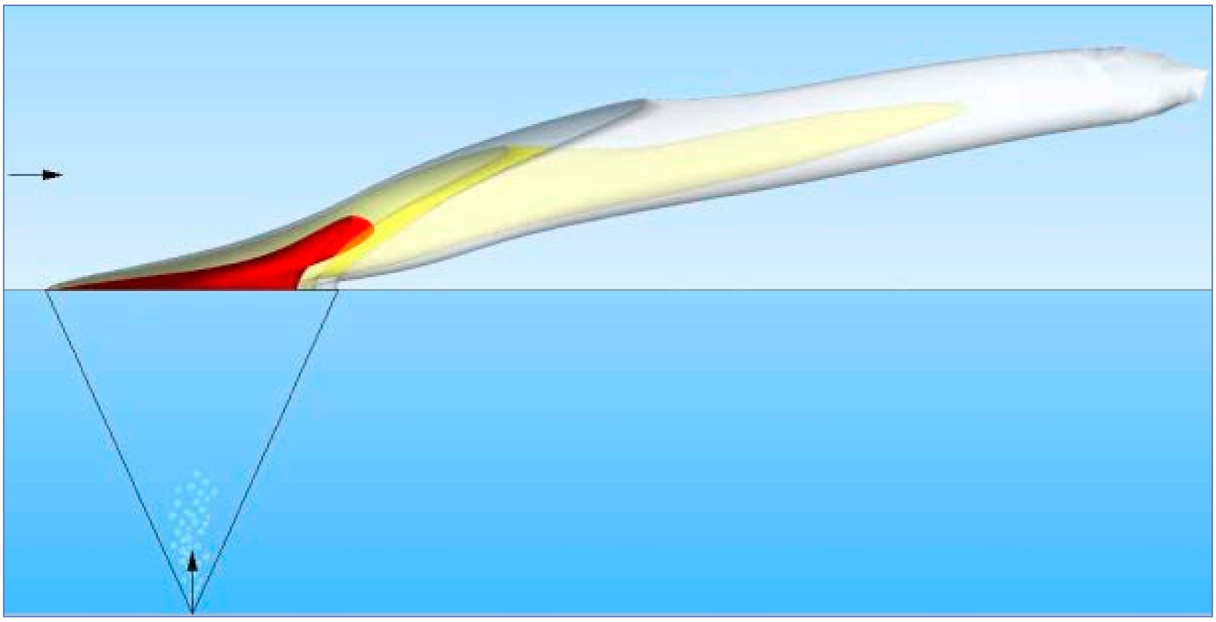


Figure 8-31. Release of gas from a damaged offshore pipeline (Ramboll 2014b).

In the risk assessment the distance of the hazardous area was calculated at four different wind speeds and for four different sizes of gas leak. The extent of the hazardous gas cloud is shown in the table below (Table 8-24) *(Ramboll 2014b)*. The extent of the hazardous gas cloud depends on the size of the leak and wind speed. With small leaks the hazardous area is at its shortest some tens of meters, while in the unlikely event of a pipeline rupture the hazardous area will in favorable weather conditions extend to a distance exceeding 700 m (Figure 8-32).

Table 8-25. Extent of hazardous gas cloud. *(Ramboll 2014b)*

| Leak size | Wind speed, m/s | Distance of flammable area, m |
|---|---|---|
| Small | 3 | 100 |
| | 8 | 60 |
| | 13 | 35 |
| | 18 | 20 |
| Medium | 3 | 170 |
| | 8 | 235 |
| | 13 | 215 |
| | 18 | 160 |
| High | 3 | 270 |
| | 8 | 265 |
| | 13 | 350 |
| | 18 | 345 |
| Rupture | 3 | 725 |
| | 8 | 680 |
| | 13 | 530 |
| | 18 | 630 |

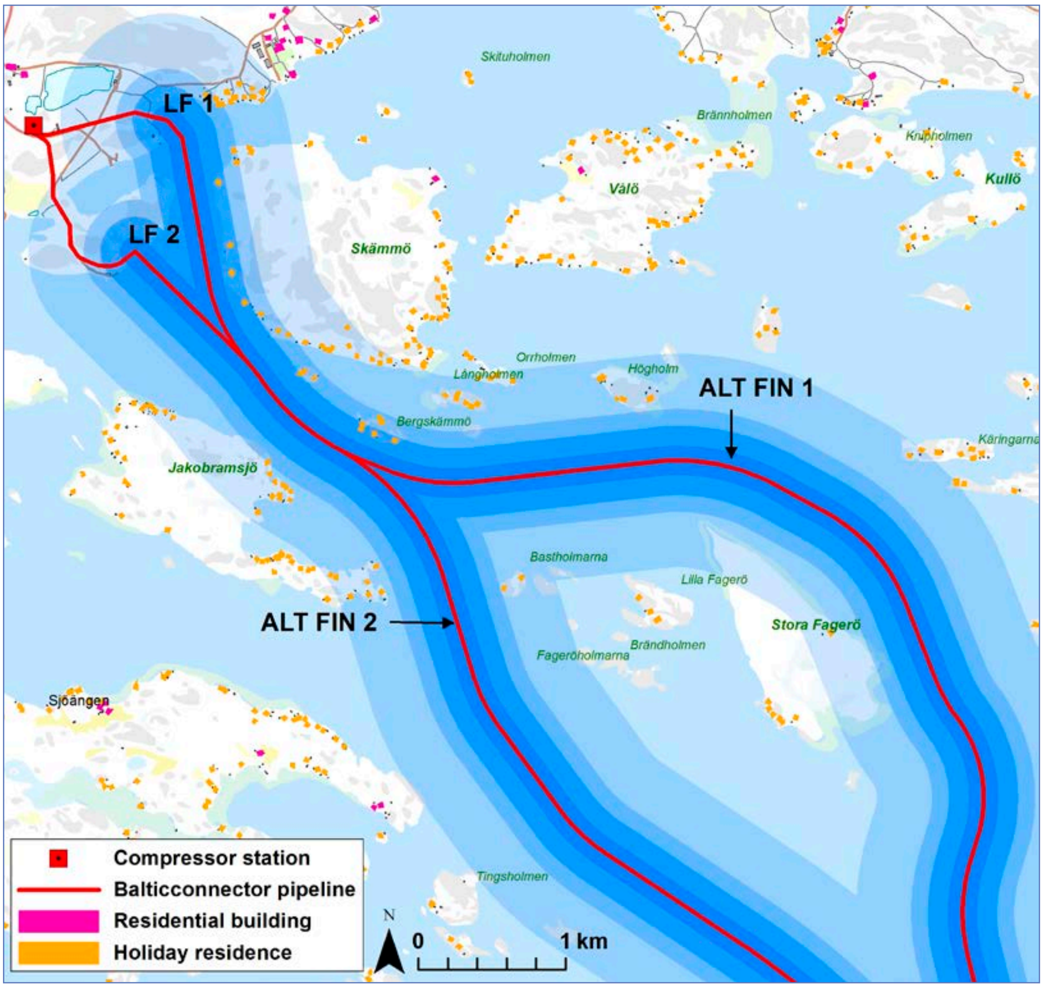



Figure 8-32. Extent of hazardous gas cloud. The extent of the hazardous area is shown in shades of blue, with the darkest blue indicating the hazardous zone of a small leak and the blue color becoming paler as the leak size increases. The palest blue area indicates the hazardous area caused by a pipeline rupture.

There are no permanent residences in the hazardous area. There are no holiday residences either in the hazardous area caused by a small leak. As regards a medium leak, depending on the alternative the maximum number of holiday residences in the hazardous area is 9, as regards a large leak 23 and as regards a rupture 92 (Table 8-25). The number of holiday homes in the hazardous zone for the ALT FIN 1 and ALT FIN 2 alternatives is as high or almost as high when the leak is small, medium or large, but in the event of a pipeline rupture in ALT FIN 1 there will be 12–21 more holiday residences within the hazardous area, depending on the landfall alternative selected. Regardless of the leak size, with LF1 there will be more holiday residences in the hazardous zone than with LF2. There will be no holiday residences within the hazardous area in areas south of the island of Stora Fagerö on the Finnish side. The ignition of natural gas and a resulting fire is possible in the hazardous area.

### 8.16.3.3 Risks of offshore natural gas pipeline leak to people

A gas leak into the sea and the resulting formation of a gas cloud is a highly unlikely event. Should this, however, happen, the gas cloud could lead into a flash fire of the gas cloud and damage to people caught in the fire *(Nord Stream 2009b)*. Such a risk to individuals is assessed to be the highest among those working on board vessels sailing the Stockholm–Helsinki route. For example, M/S Mariella will cross the natural gas pipeline around 350 times a year *(Ramboll 2014b)*.

It is assumed in the quantitative risk assessment that 50% of the crew will be on the deck when the ship enters the gas cloud. The risk assessment was calculated for a ship in the Stockholm–Helsinki service that crosses the pipeline 350 times a year. It was assumed in the risk assessment that the period between the start of the gas leak and the issue of a warning about it is two hours. The leak size distribution used in the assessment is shown in the table below 6). It was assumed in the risk assessment that the probability of a vessel igniting the gas cloud depends on the size of the cloud, not the size of the vessel. The assumed probability of a fire caused by a vessel is shown in the table below (Table 8-27). *(Ramboll 2014b)*

Table 8-27. Leak size distribution used in the calculations. *(Ramboll 2014b)*

| Leak size | Probability (%) |
|---|---|
| Small | 74 |
| Medium | 16 |
| Large | 2 |
| Rupture | 8 |

Table 8-28. Estimated ignition probability. *(Ramboll 2014b)*

| Leak size | Probability (%) |
|---|---|
| Small | 0.25 |
| Medium | 0.25 |
| Large | 1.0 |
| Rupture | 1.0 |

The annual risk to individuals obtained is $9.08 * 10^{-7}$–$9.36 * 10^{-7}$ depending on the reason for pipeline damage. This risk corresponds to one accident in more than a million years. The result obtained is lower than $1 * 10^{-5}$ (one accident once in 100,000 years), which is a commonly used value for an acceptable risk to an individual.

The risk to groups was calculated for the most critical pipeline section, which is KP 37–46. In the most critical 10 km section of the pipeline the risk to groups is at an acceptable level according to the calculations carried out in the risk assessment. *(Ramboll 2014b)*

The risk of ignition of leaking gas even in the most extreme case is within 700 m from the point of natural gas pipeline rupture or breakage. A gas leak into the sea and the resulting formation of a gas cloud is a highly unlikely event.

### 8.16.3.4 Other risks posed by offshore natural gas pipeline leaks

#### Loss of water buoyancy

A possible pipeline leak may result in the loss of water buoyancy above the rupture. At worst a situation like this could cause instability in or the capsizing of a vessel above the rupture. The radius of the gas column on the surface of the sea would depend on the depth of the rupture, with the radius being the larger the deeper the gas leak takes place. For this reason the safety zone for vessels varies depending on the depth of the gas leak site. According to calculations carried out for other pipeline projects, only small vessels face the risk of sinking due to loss of buoyancy *(Nord Stream 2009b)*.

Table 8-26. Number of holiday residences in the hazardous area in the event of a gas pipeline leak.

| Size of leak and hazardous area (max.) | Number of holiday residences | Alternative |
|---|---|---|
| Small, hazardous area 100 m | 0 | All alternatives |
| Medium, hazardous area 235 m | 9 | LF1, ALT FIN 1 |
| | 5 | LF2, ALT FIN 2 |
| | 8 | LF1, ALT FIN 2 |
| | 4 | LF2, ALT FIN 2 |
| Large, hazardous area 350 m | 23 | LF1, ALT FIN 1 |
| | 15 | LF2, ALT FIN 2 |
| | 23 | LF1, ALT FIN 2 |
| | 15 | LF2, ALT FIN 2 |
| Rupture, hazardous area 725 m | 92 | LF1, ALT FIN 1 |
| | 67 | LF2, ALT FIN 2 |
| | 71 | LF1, ALT FIN 2 |
| | 55 | LF2, ALT FIN 2 |

### Greenhouse gas emissions

In the highly unlikely but theoretically possible event of a natural gas pipeline rupture, the inlet valve to the damaged pipeline will be closed and as much gas as possible released from the pipeline via the outlet valve. Natural gas from the pipeline could be released into the air. In the event of a rupture, the amount of gas released could at a maximum be up to the volume of the entire pipeline, i.e. around 16,000 $m^3$. With the pipeline design pressure being 80 bar and the Baltic Sea bottom temperature around 4–6 °C, the volume of gas in the pipeline will correspond to a mass of 900 tonnes. Natural gas consists primarily of methane. The global warming potential of methane is 25 times greater than that of carbon dioxide. This means that 900 tonnes of natural gas released into the atmosphere corresponds to 22,000 tonnes of carbon dioxide equivalent *(Nord Stream 2009b)*.

By way of comparison, according to preliminary data, Finland's total emissions of greenhouse gases in 2013 corresponded to 60.6 million tonnes of carbon dioxide *(Statistics Finland 2014a)* and carbon dioxide emissions from Baltic Sea shipping totaled 18.9 million tonnes in 2011 *(SPC 2013)*. Greenhouse gas emissions from a possible pipeline rupture correspond to less than 0.1% of Finland's annual greenhouse gas emissions and around 0.1% of carbon dioxide emissions from Baltic Sea shipping. The accelerating impact on global warming would be very small.

### Water quality

Natural gas dissolves poorly into water, whereby the impacts of an offshore natural pipeline leak on water quality would be very low. Natural gas will rise to the surface and be released into the atmosphere. The dispersal of gas will depend on weather conditions (*Nord Stream 2009b*).

There may be a brief temperature impact in the air as the expansion of natural gas results in a fall in temperature below the freezing point. Another possible phenomenon affecting water quality is the rise of bottom water. This may result in the mixing of bottom water with surface water, which may further affect salinity, temperature and oxygen conditions (*Nord Stream 2009b*).

### Impact on fish, marine mammals and birds

In the event of a natural gas leak from the pipeline, the fish, marine mammals and birds in the water column and in the gas cloud above the surface will die or escape. The affected area will be limited and so will be the duration of the impact.

### 8.16.3.5 Risks involved in the operation of the onshore natural gas pipeline

According to statistics, the biggest threat to natural gas pipeline safety is posed by unauthorized and unsupervised excavation work in the immediate vicinity of a natural gas pipeline. In this there is a risk of damage to pipeline structures resulting from excavation. Any gas leak in a pipeline will be detected immediately and the pipeline section will be isolated by closing the nearest shut-off valves and emptying the pipeline of gas. Once unpressurized, the pipeline can be safely repaired. Lighter than air, natural gas released due to a leak will rise.

#### 8.16.3.6 Fire at the compressor station

Releases of pressurized natural gas and gas ignition at the compressor station are possible in the event of natural gas pipeline or compressor damage which could, in the extreme situation, result in a fire. The compressor station will be equipped with fire and gas detectors as well as fire-extinguishing systems. The fire would most likely be restricted to the immediate vicinity of the compressor station. The planned Ingå compressor station corresponds to three compressor stations already in corresponding use in Finland (Imatra, Kouvola, Mäntsälä). The compressor station safety distance to, for example, detached houses is 100 m. In Ingå the nearest permanent dwellings to the compressor station are located further than the safety distance at around 400 m north of the compressor station.

### 8.16.4 Prevention and mitigation of adverse impacts

Ensuring safety is the basic requirement for natural gas use. Safety of usage can be promoted through ways such as careful planning, professional construction and assurance of work quality through inspections, expert and correct operation, and regular maintenance.

The legislation and regulations relating to natural gas provide the minimum level for safety that must be complied with in construction and operation.

#### Safety during construction

Construction will take place in compliance with existing legislation and regulations relating to construction. In addition, the safety and operational guidelines issued by the authorities, Gasum and the contractors will be taken into consideration. Particular attention will be paid to the safe movement of installation vessels. A safety zone will be established around vessels participating in construction, and the safe movement of other vessels will be ensured (see section 8.8). More detailed seabed surveys will be carried out before pipeline construction, with more detailed mapping of munitions and barrels also taking place in that context. These will be cleared from the natural gas pipeline corridor in a manner accepted by the authorities.

In the event of exceptional situations during construction, the procedure applied to the discontinuation of pipelaying due to poor weather conditions will be followed (see section 3.4.4). Movement caused by weather or errors in the steering of the pipelaying vessel may cause the excessive buckling of the pipeline and result in a rupture in the pipeline wall. To prevent this, the pipelaying vessel may be equipped with a buckle detector that will set off an alarm if the pipeline inner diameter measurement becomes smaller. The buckle detector will be inserted in the pipeline, which is where it will monitor the bending point. If buckling is detected, the pipelaying vessel will reverse and any damaged connections will be removed. The same procedure will be followed if x-ray or ultrasound measurements reveal any non-acceptable weld circumferences. Delays in the schedule relating to situations described above will not result in any major problems in pipelaying.

If buckling leads into a wet buckle, i.e. water entering the pipeline, the situation will be more difficult. In such cases the pipeline must be quickly lowered onto the seabed or it may break under its own weight. The recovery of a pipeline filled with water may be difficult and result in further buckling, whereby the water will first have to be removed from the damaged pipeline section. This will involve measures including underwater installation work. The plan for underwater buckling is as follows:

- cutting off and removing the damaged pipe section;
- attaching water-pumping equipment to the landfall or vessel;
- removing sediment from the pipeline;
- installing the pipe recovery tool;
- emptying water from the pipeline using compressed air; and
- depressurizing the pipeline and recommencing pipelaying.

#### Safety during operation

To prevent natural gas pipeline damage, the following methods will be used to protect the offshore pipeline:

- pipeline trenching;
- covering the pipeline with rock;
- increasing pipeline wall thickness or size.

A more detailed description of the methods is provided in chapter 3. Around 85% of the length of the offshore natural gas pipeline will be protected using some method.

Maintenance management of the natural gas pipeline will be carried out to ensure the pipeline will be kept in good working order and will not pose a risk to the environment.

## 8.17 Decommissioning

### 8.17.1 Assessment methods and assessment uncertainties

The environmental impacts of decommissioning were assessed on the basis of impacts during construction and experiences from the impacts of the decommissioning of corresponding projects. The impacts of the discontinuation of operation are described to the extent possible at this stage.

The time of decommissioning is difficult to estimate. The possible decommissioning will take place in several decades' time, and there is no certainty today on the construction technologies available then. Issues such as water quality and status of the natural environment cannot be assessed specifically at this point either. For reasons including these there are uncertainties in the assessment. Post-decommissioning measures will be determined in accordance with the legislation in force at any given time. The assessment was conducted by an experienced environmental expert.

### 8.17.2 Environmental impacts assessed

The natural gas pipeline will be an energy transmission system designed for continuous use, with its condition maintained continuously. The Balticconnector pipeline's operational life is expected to be 50 years. A decommissioned pipeline is typically left in place. Decommissioning will take place using methods available at that point in time and in compliance with international regulations and recommendations as well as the legislation in force in Finland and in Estonia at that time.

#### 8.17.2.1 Isolation and cleaning

In the initial phase of decommissioning, pipeline isolation and cleaning will take place. A mechanical plug device may be applied for actual isolation from onshore gas grids. The main options for pipeline isolation and cleaning is in the selection of the isolation pig train drive medium, which may be inhibited seawaters.

By performing a pre-decommissioning cleaning operation, any loose material such as corrosion products, magnetite or soft scale can be removed together with the residual condensate.

#### 8.17.2.2 Alternative methods for decommissioning

**Leaving the offshore pipeline on the seabed**

The natural gas pipeline can be left on the seabed. Activities required for this decommissioning method involve:
- filling the pipeline with seawater or inhibited seawater;
- sealing off the pipeline ends; and
- performing regular inspections of the pipeline.

In addition to the above-mentioned activities, the pipeline may be trenched and/or rock-covered to protect shipping, fishing and navy activities against disturbance caused by the pipeline. Leaving the offshore pipeline on the seabed is not estimated to have significant impacts on water quality, the marine environment or safety.

**Recovering the offshore pipeline from the seabed**

Another alternative for decommissioning is to recover the pipeline from the seabed. Activities required for this decommissioning method involve:
- dredging, jetting and removal of rock to expose the pipeline;
- cutting the pipeline in suitable sections for recovery;
- removing coating;
- onshore disposal;
- weight and anti-corrosion coating removal;
- recycling steels; and
- using coatings as landfill.

The recovery of the natural gas pipeline from the seabed will result in a significantly larger amount of adverse environmental impacts than leaving it on the seabed. The environmental impacts of recovery will be almost equal in type and extent to those arising from the construction of the offshore pipeline described in this EIA report.

**Decommissioning of the onshore pipeline**

As regards onshore pipes, the environmental impacts of decommissioning will depend on whether only the above-ground structures of the natural gas transmission pipeline (such as signposts and equipment at stations) or both the above- and underground structures (including transmission pipeline) will be removed. In the latter case the removal of the underground transmission pipeline will result in a significantly higher level of adverse environmental impacts.

The removal of the above-ground structures of the pipeline would require the disconnection of the pipeline section from the rest of the network. This will call for excavation work. Decommissioned transmission pipelines can, however, be reused for purposes such as protective piping for various municipal engineering pipes or cables. The impacts of decommissioned underground transmission pipelines on soil as well as groundwater and surface waters will be similar to those of transmission pipelines in operation. Perforation corrosion in transmission pipelines left underground is highly unlikely. If this was, however, to take place, the worst consequence would be a small local indentation. The impacts of this would be low and not necessarily visible to the eye. If the transmission pipeline is left underground, it may need to be dug up at a later date in the section in question due to other construction.

If the above-ground structures as well as the underground transmission pipeline are removed after decommissioning, the impacts of the earthworks and demolition work will be almost as large as those during the construction of a new natural gas transmission pipeline.

The removal of the offshore and onshore pipeline sections as well as related structures will be decided specifically for each case and in compliance with the statutory obligations in force at that time. The statutory obligations in force 50 years from now cannot, however, be assessed specifically at the moment. There is no significant difference between the routing alternatives as regards decommissioning.

### 8.17.3 Prevention and mitigation of adverse impacts

If the offshore pipeline is left on the seabed, it can be trenched and/or covered with rock so that it will not disturb vessel traffic (anchors), fishing (trawls) or navy operations.

As a general rule, the environmental impacts of the decommissioning of the offshore and onshore pipeline sections can be prevented and mitigated using the same methods as can be used during their construction.

## 8.18 Impacts on river basin management and marine strategy objectives

The EU-wide objective for water and marine resource management is to achieve at least good environmental status for surface waters and groundwaters. At the same time the status of waters with good environmental status must not deteriorate.

According to the statement issued by the Uusimaa Centre for Economic Development, Transport and the Environment (May 7, 2014), the EIA report must include an assessment of the project's impacts on the achievement of the objectives set for the status of waters and, as regards river basin management, concerning coastal water bodies and, as regards marine strategy, concerning the marine waters in the entire territory of Finland.

### 8.18.1 Kymijoki-Gulf of Finland river basin management plan

The objective set for water resources management is to maintain or achieve good environmental status by 2015. The deadline can be extended to 2021 or 2027. The first river basin management plans and programs of measures were adopted in 2009, and the management plans are currently being updated for 2016–2021. In the new proposal for the Kymijoki-Gulf of Finland River Basin District for 2016–2021 (Uusimaa Centre for Economic Development, Transport and the Environment 2014) published in October 2014, the Balticconnector natural gas pipeline project is presented as a new PCI project affecting waters (section 5.5.1 of the river basin management plan proposal). The special characteristics of the body of water, such as special susceptibility to pressures, or conservation values, create grounds for the examination of the project's impacts in the river basin management plan. On further examination, however, the project was not regarded as such the implementation of which would result in a deviation from the environmental objectives. To be adopted in late 2015 by the Finnish Government, section 11.3 on new projects of the final river basin management plan will contain a more detailed assessment of project impacts from the perspective of the achievement of, and any need for deviation from, the environmental objectives, provided that this is enabled by the information presented in the project's environmental impact assessment report.

The assessment of the ecological status of coastal areas in accordance with the river basin management plan is based on various physico-chemical and biological quality elements. Total nutrient concentrations and transparency are used as the physico-chemical classification criteria. Biological status is determined on the basis of chlorophyll *a*, occurrence of bladderwrack (*Fucus vesiculosus)* and zoobenthic communities. In the project area the current ecological status of coastal water bodies is classified as poor in the southwestern inner archipelago of Fagerviken, Ingå, and in the outer archipelago in Upinniemenselkä and Porkkala-Jussarö.

The temporary and mainly minor turbidity, minor increase in vessel traffic and possible short-term load from pipeline flooding resulting from natural gas pipeline construction work will not significantly reduce the physico-chemical water quality or ecological status of the coastal water bodies of the area. The nutrient load may to some extent accelerate phytoplankton production, but this will, on the other hand, be restricted by increased turbidity. Turbidity affects transparency, but the short-term change will not have a significant impact on bladderwrack populations. Changes in zoobenthos caused by seabed intervention are mainly assessed as reversible, with benthic status mainly being linked with the oxygen situation. On the whole some deterioration of water quality and minor biological changes may be observed in the marine area during the construction of the Balticconnector pipeline project in 2019–2020. The possible minor flow changes and low levels of load caused by the pipeline during operation are not assessed to have a significant impact on water quality in the marine area or on aquatic fauna or zoobenthos in the littoral zone. Therefore the Balticconnector natural gas pipeline project is not assessed to jeopardize or delay the achievement of good environmental status in the marine area in any of the implementation alternatives.

### 8.18.2 Marine strategy

The general aim of the Finnish marine strategy is to achieve good environmental status of the Baltic Sea by 2020. The development of the marine strategy takes place in three steps. A resolution on the first part was issued by the Government in 2012: assessment of the current state of the marine environment, definitions of good environmental status, and environmental targets and indicators. The second step – the monitoring program – of the marine strategy was adopted in August 2014. Due for completion by the end of 2015 and undergoing consultations in early 2015, the final stage of the marine strategy is the program of measures.

In the marine strategy, good environmental status of the marine environment is assessed using 11 descriptors and related indicators. The descriptors of good environmental status are combating eutrophication, reduction of hazardous substances, conservation of biodiversity, prevention of the spread of invasive alien species, sustainable use and management of marine resources, reducing human impacts on the sea-floor, prevention of hydrographic changes, and reducing marine and coastal littering and underwater noise. The table below covers the status of the marine environment and the impacts of the Balticconnector pipeline project by descriptor.

Table 8-29. Project impact on the descriptors of good environmental status (GES) of the marine environment defined in the marine strategy.

| Descriptors of good environmental status (GES) of the marine environment | | | |
|---|---|---|---|
| **Descriptor** | **Definition** | **Current status in 2012 and assessment of achievement of good environmental status (GES)** | **Impacts of the Balticconnector project** |
| Biodiversity | The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions. | GES has not been achieved. If existing and new measures are implemented, it is possible to achieve GES in 2020. | There are no species in accordance with Annexes II and IV of the Habitats Directive or threatened species along the pipeline routings. In the area affected by ALT FIN 2, eelgrass (Zostera marina) occurs. The IUCN classification of eelgrass is Near Threatened (NT). The impacts on the natural environment in the archipelago and marine area will be the highest during construction in the coastal area. Impacts during construction will mainly be targeted at birds, fish, zoobenthos and possibly also seals. The project will not have a significant impact on red algal communities in the project area. Zoobenthic biodiversity is in places very poor along the pipeline route due to poor oxygen conditions. The project is not assessed to reduce the biodiversity of the Ingå coastal area as a whole (excluding the adverse impacts on breeding potential of the construction of the LF1 landfall alternative) -any impacts will be short-term and reversible at the population level. The impacts will be due to disturbance, noise and turbidity caused by seabed intervention. |
| Non-indigenous species | Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems. | Status in 2012 was mainly good, and it is possible to maintain GES by implementing existing measures. | The risk of introduction of non-indigenous species is low in conjunction with the project as transport will take place locally. The locations of the storage facilities established will be determined with a view to minimizing land and marine transport needs. Efforts will also be made to source the rock material required for seabed intervention from sites close to the pipeline route. |
| Commercial fish species | Populations are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock. | Comprehensive status assessment was not possible in 2012 due to data deficiencies. | The most significant impacts will be targeted during construction on the archipelago zone due to underwater noise generated by marine works and increased rates of suspended solids. Permanent impacts on fish breeding are possible in the landfall areas (landfall LF 1) due to the destruction of spawning and nursery habitats. In the offshore areas any adverse effects will in practice be targeted at mature individuals and the overall significance is assessed as low. |

| Descriptors of good environmental status (GES) of the marine environment | | | |
|---|---|---|---|
| **Descriptor** | **Definition** | **Current status in 2012 and assessment of achievement of good environmental status (GES)** | **Impacts of the Balticconnector project** |
| Food webs | All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity. | GES has not been achieved. If existing and new measures are implemented, it is possible to achieve GES in 2020. | Seabed intervention and sediment grain size changes may affect zoobenthic community structures in the vicinity of the pipeline. Temporary reductions in fish reproductive capacity may take place in the archipelago zone. Temporary, short-term changes in food webs may also be caused by the deterring of aquatic birds and seals. |
| Eutrophication | Human-induced eutrophication is minimized, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters. | GES has not been achieved. It is not possible to achieve GES throughout the Finnish marine waters in 2020. | The suspended solids load and turbidity arising during construction will be relatively low, with the focus being close to the bottom. The biggest impacts will be seen close to the coast. Increased nutrient load and, on the other hand, decreased transparency, will be short-term and are not assessed to have significant impacts on algal blooms, oxygen situation, macroalgae or littoral flora. |
| Sea-floor integrity | Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected. | Status in 2012 was mainly good, and it is possible to maintain GES by implementing existing and some new measures. | According to preliminary conservative estimates, the construction of the offshore pipeline will call for seabed blasting and dredging over a section than is almost 20 km in length. The overall impacts on the seabed will, however, be low due to the restricted area required by the pipeline. The most significant impacts will be restricted to the pipeline construction stage. The magnitude of impacts will be the highest close to the coast off Ingå. Cumulative impacts on the seabed may also arise with other projects. Zoobenthos recovery can be assessed to mainly take place in a few years if other environmental conditions are favorable. The pipeline and the subsea rock berms protecting it will in many places create a protrusion from the seabed, which will have some impact on local near-bottom flows of water. |
| Hydrographical conditions | Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems. | Status in 2012 was mainly good, and it is possible to maintain GES by implementing existing and some new measures. | Pipeline structures may during operation cause minor bottom flows and resulting erosion impacts in the local environment. |
| Concentrations of contaminants | Contaminants are at a level not giving rise to pollution effects. | GES has not been achieved. It is not possible to achieve GES throughout the Finnish waters in 2020. | On the basis of surface sediment concentrations determined for the pipeline routing, contamination concentrations will not have a significant impact on the environment around the pipeline. Any biocides used during pipeline testing may have adverse impacts. The more specific implementation of the pressure test will be decided at a later date. The amounts of metal dissolving from pipeline structures during operation will be very small. |

| Descriptors of good environmental status (GES) of the marine environment | | | |
|---|---|---|---|
| **Descriptor** | **Definition** | **Current status in 2012 and assessment of achievement of good environmental status (GES)** | **Impacts of the Balticconnector project** |
| Contaminants in seafood | Contaminants do not exceed levels established by legislation or other relevant standards. | GES has not been achieved. It is not possible to achieve GES throughout the Finnish waters in 2020. | Concentrations of contaminants in the project area are low. The project is not assessed to increase the concentration of contaminants in seafood. |
| Marine litter | Properties and quantities of marine litter do not cause harm to the coastal and marine environment. | Status assessment was not possible in 2012 due to data deficiencies. | All non-hazardous and hazardous waste generated during construction and operation will be disposed of at licensed and approved facilities and will not end up in water. Waste transport will be carried out by a licensed contractor. The project will not increase coastal or marine littering. |

| Descriptors of good environmental status (GES) of the marine environment | | | |
|---|---|---|---|
| **Descriptor** | **Definition** | **Current status in 2012 and assessment of achievement of good environmental status (GES)** | **Impacts of the Balticconnector project** |
| Energy, incl. underwater noise | Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment. | Status assessment was not possible in 2012 due to data deficiencies. | Underwater explosions during construction may cause significant adverse effects in the marine area close to the pipeline on any seals and aquatic birds found in the area. The adverse effects will, however, be very short-term and are not assessed to have permanent adverse effects at the species level. Noise disturbance caused by blasting and other construction work will be mitigated using a variety of mitigation methods. Noise impacts during operation will be very low. |

The proposal for the program of measures for 2016–2020 to implement the Finnish marine strategy was published in 2015 *(Joint website of Finland's environmental administration 2015)*. The existing measures were not considered sufficient for the maintenance of, or the achievement in all respects of, good environmental status in the marine environment, and 35 marine resource management measures were proposed by experts for the program. The proposals for management measures for 2016–2021 were included in the assessment of the sufficiency of existing measures. A new measure proposed for the reduction of nutrient loads is the promotion of the use of liquefied natural gas (LNG) as a shipping fuel and taking care of the construction of the necessary infrastructure. Other measures closely related to the Balticconnector project include the reduction of underwater noise and the reduction of the adverse effects of dredging.

Efforts will be made to minimize any adverse effects of the Balticconnector natural gas pipeline project on the marine environment primarily through pipeline design and route optimization. The strongest impacts will be seen during the construction phase, and efforts will be made during construction in particular to take the possible mitigation measures into account. The implementation of the project is not regarded to jeopardize the achievement of the objective of good environmental status of the marine environment.

## 8.19 Transboundary impacts across the borders of Finland

The Balticconnector project is not estimated to cause significant transboundary impacts across the borders of Finland. The pipeline will extend across western Gulf of Finland to Estonia, whereby construction work in Finnish waters may result in low impacts in Estonia's territorial waters in addition to Finnish waters. No impacts are estimated to occur on other Baltic states.

Seabed intervention will take place almost throughout the pipeline route, whereby there will be impacts in Finnish as well as Estonian waters. Construction work closer to the border of the Exclusive Economic Zones (EEZ) of the countries may result in minor transboundary impacts on both sides.

The deterioration of water quality arising from seabed interventions relating to the construction of the natural gas pipeline will be restricted in terms of area and duration. Offshore impacts on western Gulf of Finland will be low due to the large volumes of water and, on the other hand, the smaller scale of the marine works carried out. Due to the large water depth and the stratification of the water column in this area, the impacts will not in practice reach the surface layer. According to preliminary plans, there will be low levels of construction carried out in Finland's EEZ south of KP 34. The marine works carried out in Finland's EEZ and turbidity arising from these will not cause any significant adverse effects in Estonian EEZ or territorial waters.

Construction work relating to the Nord Stream gas pipeline project (*2009–2012*) as well as the technical characteristics of the natural gas pipeline and the methods relating to its construction and testing are essentially similar to those in the Balticconnector project, especially in offshore areas close to the borders of the countries' EEZs. In the Nord Stream gas pipeline project, environmental impacts during construction were monitored, with the results obtained providing measured empirical data, particularly concerning offshore areas. It was stated on the basis of the monitoring that sediment displacement due to construction work was low. No significant changes in concentrations of heavy metals, organic compounds or nutrients were detected in sediments. The changes in sediment chemistry were better explained by natural changes in concentration than by pipeline construction work. *(Nord Stream 2010, 2013)* The contaminant contents found in sediment samples obtained from the Balticconnector pipeline route were also low, and their distribution with solids during construction is not likely to pose a risk to the marine environment in Estonian EEZ or territorial waters.

In general the impacts of the construction of the Nord Stream pipeline on water quality were temporary, local and low. The diameter and capacity of the Nord Stream pipeline are, however, around twice those of the planned Balticconnector pipeline, whereby as a general rule the impacts relating to trench size and water flows in the nearby area will be slightly smaller in this project. Based on these observations it can be assessed that the Balticconnector project will not have significant transboundary impacts on water quality regardless of whether construction work takes place in the Finnish or Estonian waters. Any low impacts taking place will be short-term and local.

Gas pipeline project activities taking place within Finnish waters during construction or operation are not estimated to have significant transboundary impacts on flora, birds, marine mammals or fish in Estonian waters either. Underwater blasting causes brief and high levels of sound pressure transported over distances of tens of kilometers. Underwater blasting will take place in Finnish as well as Estonian waters. The number of blasting sites will, however, be higher on the Finnish side. The nearest blasting site is located around 3 km from the border of Estonia's EEZ. As the distance from the blasting site increases, the impacts are reduced as the intensity of the sound decreases. Underwater noise from seabed dredging and possible blasting explosions may be carried from Finnish waters to Estonian waters, whereby seals or harbor porpoises in the area may hear sounds caused by blasts. Due to the distance, however, there will not be significant noise impacts on the behavior of marine mammals.

As regards above-water noise, noise propagation will be in the same range as the modeling results for onshore noise for the ALT FIN 1 and ALT FIN 2 routing alternatives, with the equivalent sound level of 45 dB(A) propagating over a day to an estimated 500 m from the pipelaying vessel. All in all, above-water noise impacts will be low and short-term, and no significant transboundary impacts across the Finnish borders are estimated to occur during project construction or operation.

The nearest Natura 2000 site in Finland's neighboring states is Naissaare, Estonia (EE0010127, SCI), located around 30 km from the limit of Finland's territorial waters. Balticconnector project activities on the Finnish side will not result in impacts on the protection principles of the Natura site.

Seabed intervention will mainly result in brief local impacts on other vessel traffic with a maximum duration of few days for each area. In the offshore areas between Finland and Estonia where the pipeline will cross busy fairways, the safety zone will result in impacts on other vessel traffic as the diversion of the safety zone of the installation vessel will required. This is not estimated to have a significant impact on the safety of vessel traffic considering the existing navigation and traffic control measures. Emissions from the vessels participating in pipelaying will have an impact on air quality in the Estonian territory when the vessels are close to the Estonian territory. The impacts will be very low and remain close to the route taken by the vessels.

The transboundary impacts of the project on people and society will be low. There will be a temporary increase in technological and economic activity in Estonia and well as Finland during construction. During operation, there will be an emphasis in transboundary impacts on the territory of the two states on the role of the natural gas pipeline as an energy transport channel reducing dependency on Russian natural gas supply. The Balticconnector pipeline will not cause restrictions on bottom trawling, whereby there will be no impact on those who work in fisheries.

In the possible worst-case scenario accident in Finnish waters (gas pipeline rupture), the size of the dangerous flammable gas cloud would be slightly over 700 m, whereby the impact would also extend to waters on the Estonian side. The extent of the hazardous gas cloud depends on the size of the leak and wind speed. A gas leak into the sea and the resulting formation of a gas cloud is a highly unlikely event. Should this, however, happen, the gas cloud could lead into a flash fire of the gas cloud and damage to ship passengers caught in the fire in Estonian waters. According to the quantitative risk assessment carried out for the Balticconnector project, this risk corresponds to one accident in more than a million years.

Following the pressure test conducted in the pre-commissioning phase, the seawater used to flood the pipeline will be filtered and treated with oxygen scavengers (e.g. sodium bisulfite, $NaHSO_3$) and/or biocides (e.g. glutaraldehyde). Flooding can also be carried out using clean water without any additives. Sodium bisulfite and sodium hydroxide are natural substances already present in seawater, and the treatment poses no risk to the marine environment. Glutaraldehyde is rapidly biodegradable but highly toxic to aquatic organisms, whereby special care must be taken in its dosage. When using oxygen scavengers or biocides, the water removed is led into a basin for the settlement of solids and any impurities in them. Following the settlement process, the water is pumped into a marine area where mixing will take place rapidly. If the flooding is carried out using filtered water, there is no need for settling and the water can be led in a controlled manner into the sea. If the flooding water is discharged on the Estonian side, any resulting environmental impacts in Estonia will be transboundary impacts.

The impacts of flooding water were monitored in Portovaya Bay, Vyborg, Russia, in conjunction with the Nord Stream gas pipeline project. The impacts concerning the levels of oxygen, salinity and solids in water were low and may also have been caused by natural variation due to weather conditions. No harmful substances were detected in conjunction with pressure testing and flooding. The substances used for flooding water treatment were sodium bisulfite and sodium hydroxide. Due to the small volume of water and the short duration of discharge, the impact of flooding water in the Balticconnector project can be assessed as low on the basis of the experiences gained from the Nord Stream project.

During operation following pipeline installation, there may the possible impact of changes in water flows. If occurring, flow changes may cause erosion in new areas, but their extent and impacts will be small. Pipeline anodes may also release very small quantities of metals (Zn, Al) in the immediate vicinity of the pipeline.

## 8.20 Zero alternative

### 8.20.1 Assessment methods and assessment uncertainties

The zero alternative examined is the non-implementation of the Balticconnector project, i.e. a situation where the natural gas pipeline and the related functions will not be constructed. The environmental impacts of the zero alternative were assessed on the basis of the assumption that in the zero alternative the LNG terminal to be connected to the natural gas network and serving Finland and the Baltics will not be realized either. In addition, to assess the environmental impacts of the zero alternative, natural gas consumption was presumed to decrease if the natural gas pipeline and terminal will not be implemented. In other words, the realization of the Balticconnector and LNG terminal projects would result in the level of natural gas consumption remaining at least at the current level due to the improved price competitiveness of natural gas. The gas consumption assessments are based on assessments conducted by experienced energy experts.

The most significant uncertainties in the assessment of the environmental impacts of the zero alternative are related to natural gas consumption forecasts. Competitiveness between fuels and production forms depends on many issues, including the development of fuels, emission allowances and electricity prices as well as taxation. International and national energy and climate policies and national energy and climate strategies can also steer the fuel choices made by energy produces. The assessments conducted in this context are based on the best current view of future development. The assessment was conducted by an experienced environmental expert.

### 8.20.2 Environmental impacts assessed

In the zero alternative the adverse environmental impacts of the Balticconnector natural gas pipeline during construction and operation will not be realized, but the project's positive impacts will not be achieved either.

If the Balticconnector project is implemented and the volume of natural gas consumption remains unchanged, the natural gas transmitted via the Balticconnector or the liquefied natural gas (LNG) delivered to the current natural gas transmission network will not cause changes in emissions from energy production, industry or transport as these will replace the natural gas imported from Russia via a natural gas pipeline of corresponding characteristics. Furthermore, the development of the natural gas infrastructure facilitates the use of biogas via the natural gas network by current users of natural gas and therefore biogas as a renewable energy source will generate positive environmental impact.

In the zero alternative natural gas is replaced by other fuels (coal, peat, wood, oil) with higher combustion emissions and environmental impacts than natural gas. The overall consumption of other fuels is also higher than that of natural gas because with natural gas the efficiency of energy produced is on the whole higher than with other fuels.

Combined heat and power (CHP) production facilities, which is where the majority of natural gas is consumed, for technical reasons natural gas is in conjunction with heat production used to produce up to twice as much high-efficiency CHP electricity compared with solid fuels (coal, peat and wood). Consequently, in the zero alternative the rate of CHP electricity production will be lower and, because the consumption, i.e. demand, of electricity will remain the same, in the zero alternative electricity would also need to be generated at separate electricity production plants. A considerable share of separate electricity production consists, particularly in the winter, of low-efficiency condensing power mainly produced from coal somewhere in the electricity market area, mainly in Finland, Denmark, Germany or Poland. This condensing power production increases fuel consumption in the zero alternative since the efficiency of condensing power production is around 40% and that of natural gas-fuelled CHP around 90%. Coal accounts for around one-half of the fuels replacing natural gas, wood for a little under one-fourth and peat and oil for the rest.

Around half of natural gas currently consumed in Finland is used by industry, with one of the important industrial uses being the production of hydrogen from natural gas for the diesel production process. If natural gas was not competitive in hydrogen production, producers might opt for oil in the process, whereby the use of the replacement fuel would cause higher environmental impacts.

The zero alternative would result in a clear increase in carbon dioxide, sulfur dioxide, nitrogen oxide and particulate emissions. The impact on air quality in Finland would be low, however. On the other hand, the imports of LNG could compensate against the impacts of the zero alternative to some extent.

In Estonia the impacts of the zero alternative of the Balticconnector project will not be along the same lines as in Finland due the difference of the Estonian energy market. In Estonia the role played by natural gas in electricity production in particular is small. The competitive setting between natural gas and other fuels is not as sensitive as in Finland either.

## 8.21 Cumulative impacts

The following provides an assessment of the potential cumulative impacts of the Balticconnector project with other known projects. The assessment only covers those projects that have been assessed to potentially have cumulative impacts with the Balticconnector project (Figure 8–33 and Figure 8–34). For each project, only those cumulative impacts that are assessed to arise from the activities are mentioned.

Existing activities other than seabed cables and Nord Stream natural gas pipelines are not described or included in the cumulative impact assessments. Existing activities were taken into account in chapters 7 (Current status of the environment) and 8 (Assessment methods and environmental impacts assessed) of this EIA report.

### 8.21.1 Gulf of Finland marine area

Other projects planned for the Gulf of Finland marine area and potentially causing cumulative impacts with the Balticconnector project comprise the Nord Stream extension project and the Ingå-Raseborg offshore wind farm (Figure 8–33). The Balticconnector natural gas pipeline route will also cross several existing electric and telecommunications cables as well as the two existing Nord Stream natural gas pipelines (Figure 8–33).

#### 8.21.1.1 Nord Stream natural gas pipelines and extension project

The Nord Stream is a 1,224 km offshore natural gas pipeline system across the Baltic Sea from Portovaya, Russia, to Greifswalder Bodden, Germany. The route passes through the Exclusive Economic Zones (EEZ) of Russia, Finland, Sweden, Denmark and Germany and through the territorial waters of Russia, Denmark and Germany. The gas pipeline was constructed and is operated by Nord Stream AG. Constructed in 2009–2012, the Nord Stream consists of two pipelines, each with an annual throughput capacity of around 27.5 bcm. The first pipeline was opened in November 2011 and the second in October 2012. The Nord Stream pipelines will intersect with the Balticconnector pipeline.

The Nord Stream extension project comprises the construction of two offshore natural gas pipelines across the Baltic Sea from Russia to Germany. The routing alternatives extend from the Russian landfall via Finnish, Swedish and Danish waters to the German landfall. In the EEZ of Finland the route follows the routes of the existing Nord Stream gas pipelines 1 and 2. The total length of the routing alternatives is around 1,250 km.

The project's EIA procedure for Finland began in March 2013, and the coordinating authority issued its statement on the EIA program on July 4, 2013. According to the preliminary project schedule, pipeline construction will take place in 2016–2018. *(Ramboll 2013)*

If the Nord Stream extension project is implemented within the planned schedule (*Ramboll 2013*), the construction of natural gas pipelines under the project will take place during a period different from the construction of the Balticconnector natural gas pipeline. Therefore there will be no cumulative impacts during construction. When crossing the Nord Stream pipelines at the southern edge of the EEZ of Finland, pipeline protection measures will result in water turbidity during construction in areas close to the crossing point. During pipeline operation, the cumulative impact of the Balticconnector and Nord Stream pipelines may cause slight local changes in bottom flows as well as erosion or sediment accumulation in new areas. These impacts are not, however, anticipated to be significant. Correspondingly, the planned Nord Stream extension project will result in cumulative impacts with the Balticconnector to the same extent as is described above concerning

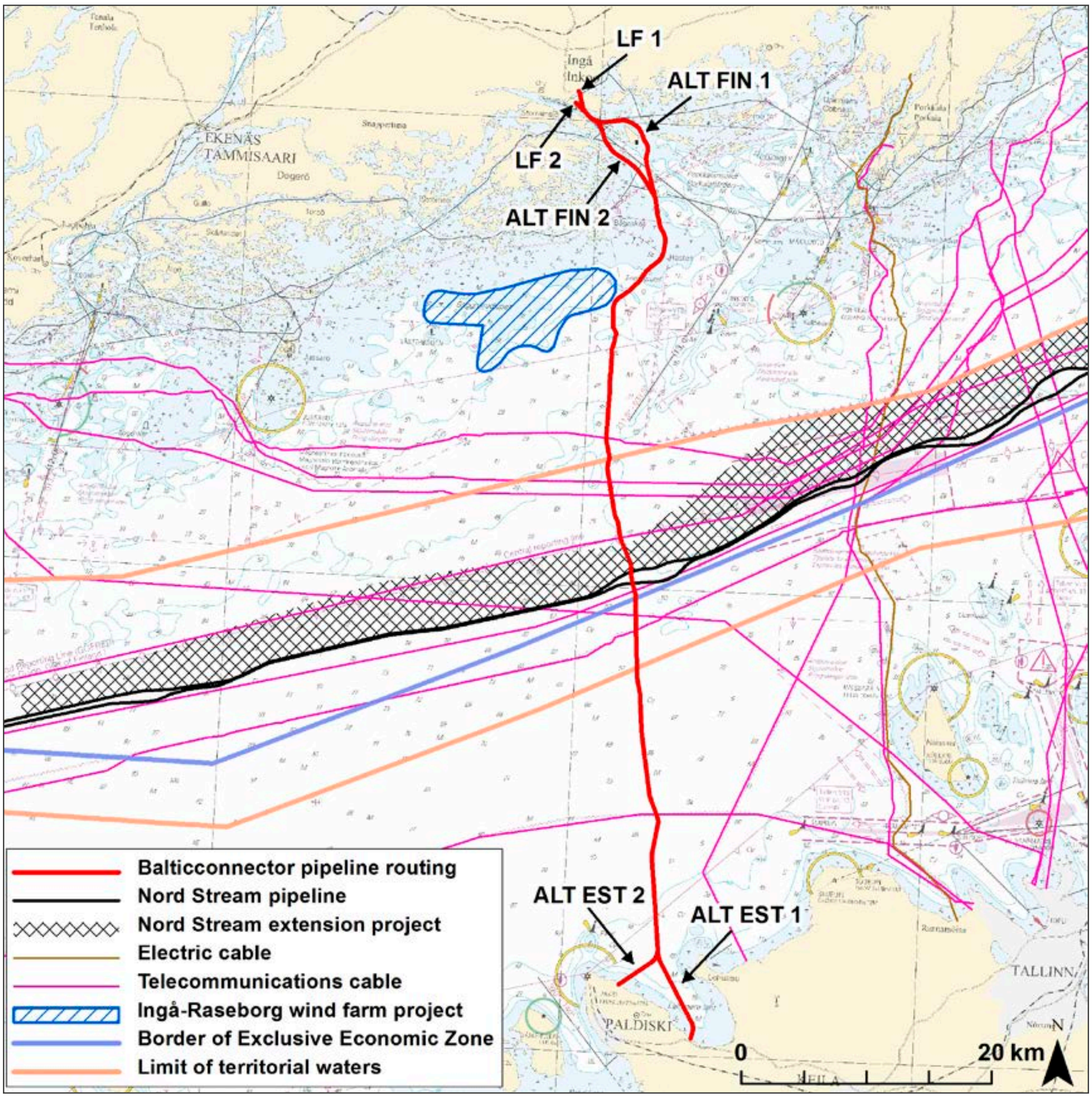



Figure 8–33. Projects planned for the Gulf of Finland marine area with potential cumulative impacts and the existing Nord Stream natural gas pipelines and electric and telecommunications cables.

the cumulative impacts of the Balticconnector and the current Nord Stream pipelines.

If the construction of the two natural gas pipeline projects will take place over the same period of time, the projects may have low adverse cumulative impacts on birds and marine mammals (increased turbidity, disturbances). As the construction of the Nord Stream extension project will take place in offshore areas, its impacts will not extend significantly to the coastal area where the impacts of the Balticconnector on the natural environment during construction will be at their most significant.

If the construction of the Nord Stream extension project takes place before that of the Balticconnector project, vessel traffic during the construction of the latter may increase the accident risk of the Nord Stream project during operation to some extent. The risk posed by vessel traffic during construction to the Nord Stream extension project will, however, be low.

#### 8.21.1.2 Ingå-Raseborg offshore wind farm

Suomen Merituuli Oy is planning an offshore wind farm west of the Balticconnector pipeline route off Ingå and Raseborg, Finland. The project covers offshore wind turbines, cabling required for the wind farm as well as power lines for connection to the national grid.

The wind farm will comprise a marine area that is approximately 5 * 20 km in size where around 60 wind turbines will be constructed. The turbines will have a hub height of around 100 m and capacity of 3–5 MW. The distance between the turbines will be around 700 m. The total capacity of the wind farm will be 180–300 MW.

The project's EIA procedure has been completed and the project is currently awaiting municipal land use planning. If completed according to the plans, the wind farm is due to be operational by 2020. According to a rough estimate, the wind farm can be constructed in 2–4 years. *(Suomen Merituuli 2014 & 2010)*

The wind farm project in the offshore area west of the Balticconnector pipeline route will involve large-scale dredging and deposition work which may, if coinciding with the construction of the natural gas pipeline, have local cumulative impacts on water quality and the aquatic environment that will be significant in the short term. The impacts on fish stocks and fishing will be similar to those of the impacts of the construction of the Balticconnector natural gas pipeline. As the projects will be located close to each other, simultaneous construction work would increase the adverse impacts on birds, marine mammals, fish and fishing in the area. The cumulative impact would, however, overall be low as seabed intervention and gas pipeline installation will only take place for a short period of time in the area affected by the wind farm.

The planned offshore wind farm and the Balticconnector project will also have low cumulative impacts arising from air emissions from vessels during construction. There will be a temporary increase in emissions into the air, but the impact will be short-term. The simultaneous construction of the projects would also increase the accident risk relating to vessels to some extent during the construction of the projects.

The wind farm will generate some above-water noise during operation within an area with a radius of around 1–2 km. The noise generated by the pipelaying vessel during pipeline construction will, however, be slightly different in nature than wind farm noise and be temporary. The largest noise emissions from the wind farm will take place during high wind speeds, which is when it is likely that pipelaying cannot take place. On the whole the change in noise situation would be small.

The wind farm planned for Ingå-Raseborg is not likely to have cumulative impacts related to land use with the Balticconnector project. If the wind farm and the power line connection required for it are included in the local master plan, the reservation for the Balticconnector natural gas pipeline must be taken into account in the plan.

#### 8.21.1.3 Cables

There are many subsea telecommunications cables in the Gulf of Finland. According to preliminary studies, many of the identified telecommunications cables and a number of unidentified cables will intersect with the planned Balticconnector natural gas pipeline. These comprise both cables in operation as well as abandoned cables. The crossings will need to be agreed upon with the cable owners. Unidentified items such as cables detected in studies conducted during the Balticconnector project will be examined in the detailed design phase of the project.

At the moment there are two known new cable construction projects that would intersect with the Balticconnector natural gas pipeline in the marine area. The Sea Lion submarine cable system planned by C-Lion1 Ltd is a subsea fiber optic cable connection under the Baltic Sea. Connecting Finland and Germany and with a total marine cable length of around 1,150 km, the cable system would intersect with the Balticconnector pipeline in Finland's Exclusive Economic Zone south of Ingå. The project's EIA screening is currently underway, and construction is planned to begin in 2015. The other possible intersecting project is the Baltic Sea Optical Expressway marine cable system of the Swedish company Eastern Light from Rostock to Finland. There are no details available concerning the schedule of the project.

The technical construction method description for infrastructure crossings is presented in section 3.4.2. When crossing cables that are in operation, the measures to protect the cable and the Balticconnector pipeline will cause turbidity of water during construction work in the area close to the crossing point. The impacts are not, however, anticipated to be significant.

Any future telecommunications and electric cables as well as fairway projects may have cumulative impacts with the Balticconnector project. It is, however, difficult to assess the cumulative impacts in advance. In general terms the cumulative impacts with other seabed cables will be low and mainly relate to increased local bottom flow changes.

### 8.21.2 Finnish area in Ingå

The projects causing potential cumulative impacts planned for the Ingå area are presented in the figure (Figure 8–34).

#### 8.21.2.1 Gasum Corporation, LNG terminal project

Gasum Corporation is planning a liquefied natural gas (LNG) terminal for the Fjusö area in Ingå. An alternative to a full-scale LNG terminal is the placement of a floating storage and regasification unit (FSRU) either in Ingå outside Fjusö or in the Fortum power plant harbor area.

In addition to storage tanks on land, the construction of a full-scale LNG will involve filling of sections a water body, quay structures, service buildings, road tanker loading facility, other infrastructure required by the facility as well as the connection of the facility to the natural gas network. The construction of the FSRU alternative will comprise the quay structures and road tanker loading facility as well as the connection of the facility to the natural gas network. In addition, both of these project alternatives will involve dredging of the water body and blasting as well as the construction of a natural gas pipeline between Ingå and Siuntio.

The realization of the LNG terminal will increase traffic volumes in the area. It is estimated that an annual

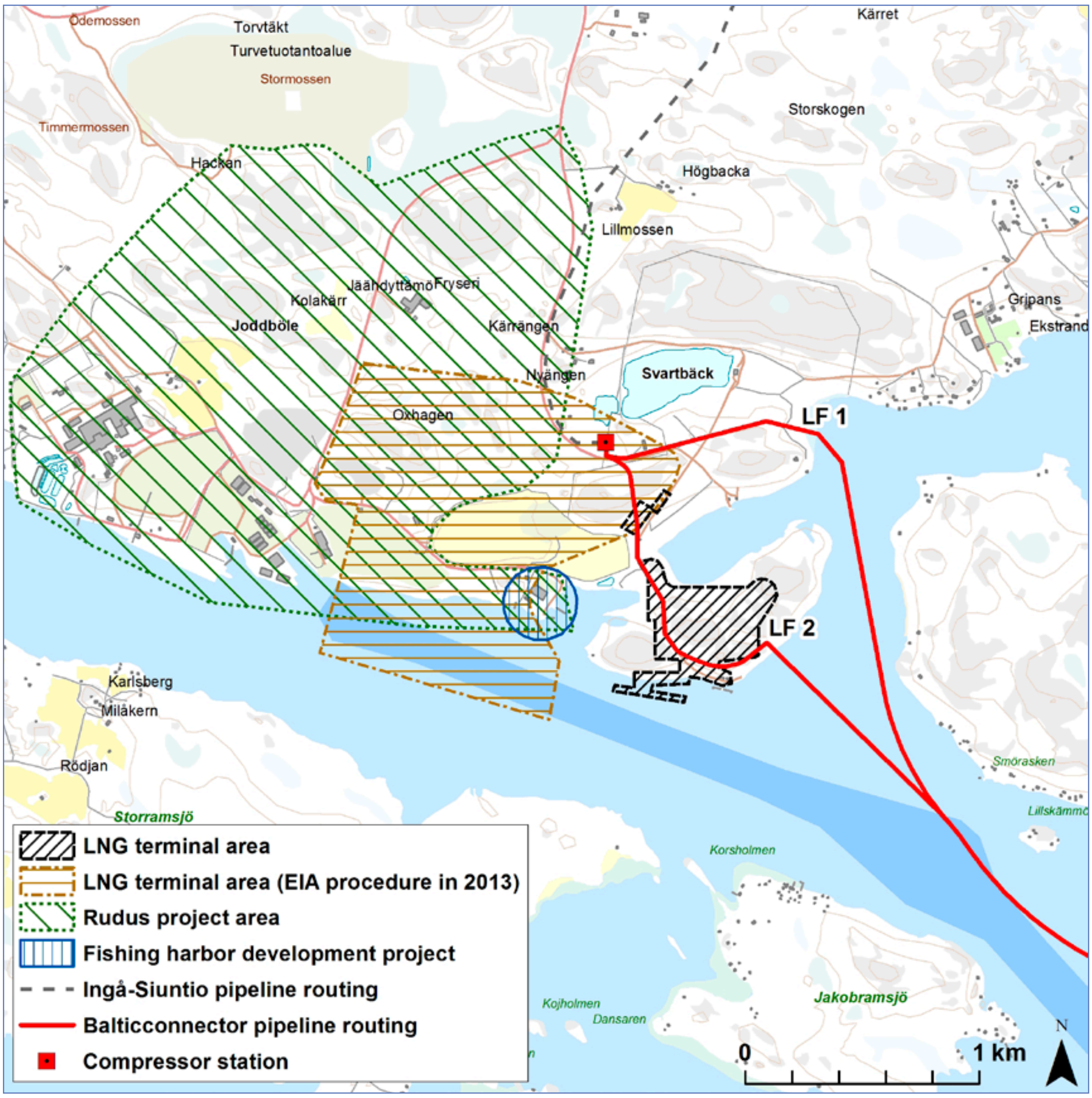



Figure 8-34. Projects causing potential cumulative impacts in the Ingå area. The location of the LNG terminal examined in the 2013 EIA procedure is also shown on the map (Inkoo Shipping area).

total of 400–650 bunkering vessels and around 16–21 LNG carriers will visit the LNG terminal. The volume of heavy-duty road traffic would increase on Hamnvägen road by 30–60 vehicles a year. According to preliminary project schedule, construction will begin in 2016 and gas deliveries in 2019. *(Gasum Corporation 2014)*

The construction phases of the Balticconnector project and the LNG terminal will coincide to some extent. Once the construction of the Ingå sections of the Balticconnector is due to begin, most of the blasting relating to the construction of the LNG will already have been completed. Once the construction of the Balticconnector project is underway, terminal construction is likely to have progressed to the construction of tanks and other corresponding structures.

Harbor dredging relating to the LNG terminal planned for Ingå will cause cumulative impacts with the Balticconnector gas pipeline constructed in Ingå. These impacts will be local and limited to the construction phase. The amount and extent of impacts will depend on the LNG construction site selected and the quality of seabed at the site. The impacts on the natural gas pipeline landfall site and the marine works (mainly dredging) carried out for the LNG terminal will be targeted at the same areas in the inner archipelago of Ingå: Fagerviken, the area off Fjusö, and Barkarsundet and occasionally also Kyrkfjärden. The significance of the cumulative impacts will be affected by the timing of the work; if the marine works are carried out simultaneously, the level and duration of the load of suspended solids in the inner archipelago will increase clearly. Correspondingly, if implemented in different years, the significant adverse impacts in the area will be repeated.

Cumulative impacts on aquatic plants and zoobenthos are assessed as low. As regards resedimentation of suspended material, the impacts may persist until the following year but are likely to be reversible. The aquatic plants found in the impact areas of the projects are typical of the Finnish coast, and no species protected under the Habitats Directive were found. It should also be noted that the project area is located in areas strongly shaped by human activities and the underwater nature values of the area are therefore unlikely to deteriorate significantly due to the environmental impacts of the projects. The impacts of dredging will extend to the environment with a gradually reduced effect. The strongest impact will be seen in the Barkarsundet and Kyrkfjärden areas. The zoobenthos of the dredged area is likely to be restored over time.

As regards fish stocks, the most significant adverse impact of both projects on fisheries will be targeted at the breeding of spring-spawning fish species and disturbance to commercial fishing in the area.

The LNG terminal project will change the natural environment of the Fjusö Peninsula and deteriorate its nature values significantly more than the Balticconnector project, especially if a full-scale LNG terminal will be constructed on the peninsula. Noise and turbidity generated during construction will be higher or last longer if both projects are implemented. There may be cumulative impacts on the Stor-Ramsiö nature reserve. No significant cumulative impacts are likely to be caused on the Ingå archipelago Natura site.

The cumulative noise impacts of the LNG terminal planned for the Fjusö Peninsula and the Balticconnector natural gas pipeline would be at their highest during construction (if blasting was to take place simultaneously), particularly toward the end of the construction period by when the rock outcrops of the Fjusö Peninsula protecting against noise dispersal would mostly have been lowered. At that point the calculated additional impacts of noise from the LF1 landfall alternative to the noise impacts of terminal construction would be around +2– +5 dB, while the corresponding impacts with the LF2 alternative would be +1–+3 dB. Because the assessment of both impacts at this point is purely based on calculations, the impacts may involve rather large uncertainties. Nevertheless, according to a preliminary comparison, the LF2 alternative will cause a slightly smaller added noise impact than LF1 at the nearest holiday residences susceptible to disturbance (Skämmö, Bastubacka) due to the landfall route. As regards holiday residences on Jakobramsjö, however, the change would be the opposite as for them the calculated added noise impact would be around +3 dB with LF2 and 2 dB higher than with LF1. The added noise impact during operation due to the LNG terminal would be very small close to the compressor station. If construction of both projects takes place at the same time, some vibrations and dust generation in the local environment will occur as a cumulative impact.

Dredging of the seabed will need to be carried out for the LNG project. If seabed intervention, pipelaying or pipeline protection work takes place simultaneously, these may have cumulative underwater noise impacts. The level of impacts will depend on the timing and overall duration of the work, but some adverse cumulative impacts may occur on nearby protected areas.

If the LNG terminal is constructed on the Fjusö Peninsula, the nature of the environment, its status in the overall landscape and views towards the area will change significantly. If the terminal is constructed, the natural gas pipeline will become part of a large-scale complex of industrial facilities. With the exception of the Fjusö project area proper, the terminal would only cause a small increase in cumulative impacts as regards land use.

The LNG terminal and the construction of the Balticconnector project may have low cumulative impacts on local air quality during pipeline construction. From the economic impact perspective, the cumulative impact of the natural gas pipeline project with other local development projects will be significant, particularly in combination with the LNG terminal.

In the unlikely but possible event of an accident involving the Balticconnector project, any gas leaks may be flammable and/or toxic and hazardous to humans. The LNG terminal alternatives located on the Fjusö Peninsula will be in the hazardous area of a Balticconnector gas leak in the vicinity of the landfall sites. LNG terminal equipment, such as the flare, may act as an ignition source for the gas cloud in the event of a natural gas pipeline leak. Any risks posed by the LNG terminal must be taken into consideration in the more detailed design of the Balticconnector project, particularly regarding the LF2 landfall alternative. LF1 is better than LF2 from the safety perspective because LF2 is located in the vicinity of the LNG terminal project and vessels entering and exiting the LNG terminal will move very close to the natural gas pipeline in the LF2 alternative. The planning and design of the LNG terminal and LF2 must be coordinated with a view to maintaining a high level of safety in the area and ensuring the maintenance of the fairway and the dredging of the vessel turning circle.

Vessel traffic to and from the LNG terminal will increase traffic in the fairway in the vicinity of the Balticconnector gas pipeline in sections including between the islands of Skämmö and Jakobramsjö where the fairway runs close to the planned route of the Balticconnector. Increased vessel traffic will result in a small increase in the risk of accident during the operation of the Balticconnector pipeline. The risk will be low, however.

In addition to the terminal, the LNG terminal project comprises a natural gas transmission pipeline in the areas of the municipalities of Ingå and Siuntio. The Balticconnector project's landfall sites are of no relevance to the location of the Ingå–Siuntio pipeline routing. There will be no cumulative impacts from the construction of the connecting pipeline and the Balticconnector project.

#### 8.21.2.2 Rudus Oy, Ingå production area project for increased production capacity and material efficiency

Rudus Oy is planning the extension of the Ingå production area and increased production capacity and material efficiency through increased rock extraction and recycling activities. The planned project area is located in Joddböle, Municipality of Ingå, next to the Port of Ingå.

According to the plans, operations will be expanded to increase the rock extraction site area to 164 ha, recycling activities area to 30 ha and intermediate storage and end disposal area of surplus material to around 17 ha. The annual volume of rock extracted varies in the 1–6 milj.m$^{3\text{-theor}}$ range. In the EIA procedure currently underway, the construction of a new harbor basin possibly in two stages will also be examined, with the basin covering up to around 10 ha. The planned depth for the basin is 20 m. The need to expand the harbor basin depends on rock production volumes.

Depending on the alternative assessed, the rock extraction layers will be in the +3–-30 m range. Rock extracted from the area will be crushed and placed in intermediate storage in the area. Sales shipments will mainly take place by sea via the Port of Ingå. According to the preliminary project schedule, the EIA procedure is due for completion in spring 2015, after which the necessary licenses and permits can be applied for the project.

If coinciding with the construction of the Balticconnector pipeline, the dredging relating to the construction of the new harbor basin included in the rock extraction extension project may cause minor cumulative impacts in near-shore waters. Cumulative impacts (turbidity and noise) may be caused on the Stor-Ramsiö nature reserve. No significant cumulative impacts are likely to be caused on the Ingå archipelago Natura site. Impacts on fish and fishing will be targeted at the Ingå inner archipelago: Fagerviken and off Fjusö. The impact areas will in part overlap with the landfall area of the Balticconnector natural gas pipeline and the LNG terminal project. The significance of the cumulative impacts will be affected by the scheduling of the work, i.e. whether marine works will be carried out simultaneously or in different years. If carried out simultaneously, the magnitude and duration of the suspended solids load on the inner archipelago will increase clearly. Correspondingly, if implemented in different years, the adverse impact will be repeated. The most significant adverse impact on fisheries caused by the extension of the harbor basin will also affect the breeding of spring-spawning fish and disturb fishing in the area.

The expansion of the Rudus Oy production area will transform the area west of the Fjusö Peninsula into a rock extraction area and change the area's natural environment to a larger extent and for longer than the Balticconnector project.

Rock extraction will cause some noise impacts in the local environment. During the highest noise pollution load seen during dredging (project alternative A1) the noise level at the Balticconnector project's compressor station is estimated to be around 50 dB(A). On the basis of this, the cumulative impacts would be non-existent at the nearest residential property northeast of the project areas during the operation of the Balticconnector pipeline. Rudus rock extraction and the Balticconnector pipeline may also have short-term and fairly low impacts on air quality.

The projects are not mutually exclusive from the land use planning perspective. If the Rudus Oy project in Joddböle is realized, the industrial nature of the coastal zone will be strengthened further, which will further reduce the landscape impacts of the structures required by the Balticconnector project in relationship with the nature of the Fjusö-Joddböle area.

Local residents in Ingå perceive the Rudus Oy project as having adverse impacts on residential comfort and amenity, with the impacts also mentally associated with the Balticconnector and other planned projects. A survey among residents and resident consultation events have been implemented concerning the Rudus expansion project. As regards technical and environmental impacts, the projects are separate, but in terms of image, their impacts are associated with each other. It is important to maintain an open dialog with those involved and local residents regarding the projects aimed at the same area in order to keep the residents continuously informed about the current status of the projects, their potential impacts and the methods available to mitigate their adverse impacts.

#### 8.21.2.3 Ingå fishing harbor development project

A project to develop the fishing harbor located to the west from Fjusö is currently underway in the Municipality of Ingå. The harbor is a small port of landing where trawlers bring their catch. The development covers the renewal of quays and dredging and filling waters. *(Regional State Administrative Agency for Southern Finland 2014b)*

If coinciding with construction work of the Balticconnector gas pipeline, dredging relating to the Ingå fishing harbor may have a low cumulative impact on near-shore waters. The construction phase of the Balticconnector project may restrict waterborne traffic to and from the fishing harbor. The impact will be short-term, however.

# 9 COMPARISON BETWEEN ALTERNATIVES

## 9.1 Principles applied in the comparison between alternatives

The characteristics as well as the factors essential from the environmental impact perspective of the project assessed were examined on the basis of preliminary design data. A study of the current status of the environment and factors affecting it was conducted for the environmental impact assessment on the basis of existing data and studies and surveys conducted for the EIA procedure.

The project's environmental impacts were examined by comparing the changes brought about by the implementation of the project with the current situation. Efforts were made to pay particular attention to the examination and description of impacts found important on the basis of feedback received from various stakeholders during the EIA procedure.

The significance of environmental impacts was assessed on the basis of the cumulative impact of the sensitivity of the current state of the area or site affected and the magnitude of change caused by the project. Also taken into consideration in the assessment of the significance of the environmental impacts were the monitoring group opinions on the quality and sufficiency of the assessment work received during the drafting period. The significance of the impacts was examined on the basis of the assessment matrix developed in the IMPERIA project (see chapter 6).

Factors essential to the assessment of the significance of impacts are:

- the receptor of the impact and its sensitivity to changes;
  - the legislation relating to the receptor;
  - the societal significance of the receptor;
  - the susceptibility of the receptor to changes;
- the magnitude of the change caused by the project;
  - the intensity of the change;
  - the geographical extent of the impact;
  - the duration as well as reversibility and permanence of the impact;
- the fears and uncertainties relating to the impact;
- differing opinions on the significance of the impacts.

## 9.2 Comparison between alternatives

The impacts of the assessed alternatives and their significance are presented in the table below (Table 9-2). The table provides a uniform presentation of the key environmental impacts arising from the alternatives. The most significant impacts will arise during construction. The feasibility of the alternatives from the environmental perspective is assessed at the end of the section.

Table 9-1. Assessment scale employed in the assessment of significance.

| | |
|---|---|
| **Significance of impacts** | Very high ++++ |
| | High +++ |
| | Moderate ++ |
| | Low + |
| | No impact |
| | Low - |
| | Moderate -- |
| | High --- |
| | Very high ---- |

Table 9-2. The most significant environmental impacts of the implementation alternatives of the Balticconnector project assessed (ALT FIN 1, ALT FIN 2, LF1 and LF2) and their significance in comparison with the current situation and the non-implementation of the project (zero alternative). The most significant impacts will arise during construction.

<table>
<tr><th>Project's environ-mental impacts</th><th>Zero alternative</th><th>ALT FIN 1</th><th>ALT FIN 2</th><th>LF1</th><th>LF2</th></tr>
<tr><td>Seabed</td><td>No impacts.</td><td colspan="4">The impacts of construction on the seabed will be low in terms of magnitude and extent considering the limited area of the pipeline. The duration of the impact will be short and the magnitude of change can in all be regarded as low.<br><br>The magnitude of the physical impacts of seabed intervention will overall be low in the Gulf of Finland, but in near-coast areas, particularly the Ingå area, which is surrounded by archipelago, the impacts will be higher for a limited period of time. The overall impact in that area will still, however, be low. No permanent changes with environmental significance will take place on the Finnish side.<br><br>There is variation in the types of seabed in the areas covered by the different alternatives. The differences between the routing alternatives are, however, overall so small the difference between their impacts is assessed as insignificant.</td></tr>
<tr><td rowspan="3">Water quality</td><td rowspan="3">No impacts.</td><td colspan="4">The magnitude of impacts during construction on the whole is assessed as moderate. The increase in turbidity arising from seabed interventions relating to the construction of the gas pipeline will be restricted in terms of area and duration. On the basis of sediment results, the risk of the dissolution of harmful substances into water is low. The risk of harmful substances is slightly increased by the flooding water discharged after the pipeline pressure test if biocides are used.</td></tr>
<tr><td colspan="4">During pipeline operation there will only be very low impacts in the form of bottom flows and resulting erosion impacts in the immediate vicinity of the pipeline. The magnitude and overall significance of the impacts is assessed as low.</td></tr>
<tr><td>The impacts during construction will be higher than in the ALT FIN 2 alternative. In the overall scale of the coastal areas off Ingå, however, the difference between the alternatives cannot be regarded as significant.</td><td>The impacts during construction will be lower than in the ALT FIN 1 alternative. In the overall scale of the coastal areas off Ingå, however, the difference between the alternatives cannot be regarded as significant.</td><td>Both the magnitude of the impacts and the size of the affected area will on the basis of the modeling be locally larger than with LF2.</td><td>Both the magnitude of the impacts and the size of the affected area will on the basis of the modeling be locally smaller than with LF1.</td></tr>
</table>

| Project's environmental impacts | Zero alternative | ALT FIN 1 | ALT FIN 2 | LF1 | LF2 |
|---|---|---|---|---|---|
| Benthic fauna and aquatic flora | No impacts. | The duration of the reduction in transparency caused by turbidity is assessed to be so short in relation to the lifecycles of macroalgae and vascular plants that it will not have a significant impact during construction or operation. The resedimentation of suspended solids may have a low impact in the vicinity of the dredging site during construction but not during operation. The resedimentation of suspended solids will deteriorate the viability of zoobenthos. The impacts will, however, be local and temporally restricted in conjunction with dredging operations. | | | |
| | | The impacts during construction will be higher than with ALT FIN 2 because suspended solids will be dispersed over a larger area and in higher concentrations than with ALT FIN 1. The differences will not be significant, however. | The impacts of the alternative on aquatic plants and zoobenthos will be less detrimental than with ALT FIN 1. | The impacts during construction will be higher than with LF2 because suspended solids will be dispersed over a larger area and in higher concentrations than with LF1. Kyrkfjärden is a bay with restricted exchange of water, whereby the resedimentation of suspended solids may be long-term while not serious. | The impacts of the alternative on aquatic plants and zoobenthos will be less detrimental than with LF1. |
| Fish and fisheries | No impacts. | Moderate impacts may arise as a result of destruction of spawning and nursery habitats in the landfall areas and, due to suspended solids and underwater noise impact throughout the archipelago zone. As regards offshore areas, high noise pressure levels caused by blasting were also regarded as of moderate significance due to the large impact area.<br><br>During construction, moderate impacts will be caused on fishing throughout the archipelago zone as fish will be deterred due to an increase in the concentration of suspended solids caused by seabed intervention work as well as underwater noise caused by blasting. Any impacts on fish breeding areas will result in permanent adverse effects. In offshore areas disturbance will be caused to trawling as restrictions will need to be in place on the movement of vessels not included in the pipelaying fleet. Fish may also be deterred by blasts. The impacts during construction will be temporary and of short-term local duration, however. There will be no adverse effects on fish or fisheries during operation. | | | |
| | | The adverse impacts of the alternative on fisheries regarding fish stocks as well as fishing will be higher than those of ALT FIN 2 due to the higher suspended solids load. The routing alternative is also closer to its natural state and more susceptible to changes as there is a fairway in the vicinity of ALT FIN 2. More commercial fishing also takes place in the vicinity of ALT FIN 1. | The adverse impacts of the alternative on fisheries regarding fish stocks as well as fishing will be lower than those of ALT FIN 1. | The impacts of the alternative on fish and fishing will be higher than those of LF2. This is due to the destruction of a significant reedbed area, higher suspended solids load and larger impact area than with LF2. The sensitivity of LF1 and its surrounding environment to changes can be regarded as clearly higher than that of LF2. The magnitude of adverse impact on commercial fishing will also be greater and the affected area larger than with LF2. | The impacts of the alternative on fish and fishing will be lower than those of LF1. The sensitivity of LF2 and its surrounding environment to changes can be regarded as clearly lower than that of LF1. The magnitude of adverse impact on commercial fishing will also be lower and the affected area smaller than with LF1. |

| Project's environmental impacts | Zero alternative | ALT FIN 1 | ALT FIN 2 | LF1 | LF2 |
|---|---|---|---|---|---|
| Conservation areas | No impacts. | Deteriorating impacts on the Ingå archipelago Natura site are possible during the construction phase, but these will be low and transient. There will be no impacts on habitat types or other Natura sites. The impacts will be higher than with ALT FIN 2. | Deteriorating impacts on the Ingå archipelago Natura site are possible during the construction phase, but these will be low and transient. There will be no impacts on habitat types or other Natura sites. The impacts will be higher than with ALT FIN 1. | The impacts will not extend to conservation areas. The impact on locally valuable nature sites will be low. There is no difference between the alternatives. | |
| Flora | No impacts. | At most a very low and local impact changing littoral vegetation during construction. The impacts will be higher than with ALT FIN 2. | At most a very low and local impact changing littoral vegetation during construction. The impacts will be lower than with ALT FIN 1. | Minor disappearance and change of flora along the pipeline route and at the compressor station. The impacts are slightly lower than with LF2. | Minor disappearance and change of flora along the pipeline route and at the compressor station. The impacts are slightly higher than with LF1. |
| Bird fauna | No impacts. | Noise, disturbance and turbidity during construction may cause a significant adverse impact on birds breeding on the nearest islands and islets. Birds feeding in the waters will be adversely affected by turbidity and underwater noise. The impacts will be higher than with ALT FIN 2 because the planned pipeline route will pass closer to significant bird areas and a nesting site of a species under strict protection. | Noise, disturbance and turbidity during construction may cause an adverse impact on birds breeding on the nearest islands and islets. Birds feeding in the waters will be adversely affected by turbidity and underwater noise. The impacts will be lower than with ALT FIN 1 because the planned pipeline route will run further away from significant bird areas. | There will be minor disturbance to birds and minor loss/fragmentation of habitats during construction. There is no difference between the alternatives. | |
| Other fauna | No impacts. | A low adverse impact on seals may be caused by underwater noise and turbidity during construction. There is no difference between the alternatives. | | There will be no impacts on species listed in Annex IV(a) to the Habitats Directive. There is no difference between the alternatives. | |
| Soil, bedrock and groundwater | No impacts. | The impacts on soil, bedrock and groundwater will be very low during construction and operation. Both alternatives will require some blasting of bedrock, but the explosions will be small in scale and focus on areas not classified as valuable rock outcrops. The impacts on soil will be limited to the construction period. Following pipeline installation, soil will be used for the landscaping of the trench. There is no significant difference between the onshore pipeline routings. | | | |

<table>
<tr><th>Project's environ-mental impacts</th><th>Zero alternative</th><th>ALT FIN 1</th><th>ALT FIN 2</th><th>LF1</th><th>LF2</th></tr>
<tr><td rowspan="2">Noise</td><td rowspan="2">No impacts.</td><td colspan="2">As regards above-water and above-ground noise impacts during construction, in both of the routing alternatives, ALT FIN 1 and ALT FIN 2, the daily guideline value for noise may be exceeded temporarily at the nearest holiday residences close to Fjusö. The differences between the alternatives are not significant.</td><td rowspan="2">The noise impacts of LF1 regarding the land-fall site and onshore blasting would be slightly higher than those of LF2. As regards the landfall site, LF1 may result in the daily guideline value of 45 dB(A) being exceeded over the short term at the nearest holiday resi-dences.</td><td rowspan="2">The noise impacts of LF2 regarding the landfall site and onshore blasting would be slightly lower than those of LF1.</td></tr>
<tr><td>As regards under-water noise, slightly higher noise levels will be generated in the nearest nature reserves by ALT FIN 1 than by ALT FIN 2.</td><td>As regards under-water noise, slightly lower noise levels will be generated in the nearest nature reserves by ALT FIN 2 than by ALT FIN 1.</td></tr>
<tr><td>Vibrations</td><td>No impacts.</td><td colspan="4">Vibrations during construction will mainly be caused by blasting explosions. Vibrations from underwater explosions may have a temporary impact on the residential comfort of the nearest residents. Vibrations will be detectable in the nearest buildings for a short period of time, but according to the assessment there will no impacts on the buildings. There will be no vibration impacts from the project during operation.</td></tr>
<tr><td>Waterborne traffic</td><td>No impacts.</td><td colspan="4">Seabed intervention will mainly result in momentary local impacts on other vessel traffic with a maximum duration of few days for each area as the avoidance of the area will needed during intervention. The impacts on vessel traffic and traffic safety are, however, assessed to be low in terms of their significance considering the duration of the impact and existing navigation and traffic control measures. There is no significant difference between the alternatives. The impacts during operation will be very low.</td></tr>
<tr><td>Land transport</td><td>No impacts.</td><td colspan="4">The impacts on other traffic and traffic safety will be low and short-term. There are no differences between the alternatives. The impacts during operation will be very low.</td></tr>
</table>

| Project's environ-mental impacts | Zero alternative | ALT FIN 1 | ALT FIN 2 | LF1 | LF2 |
|---|---|---|---|---|---|
| Air emissions | The zero alternative will have no local impacts on air quality. In the zero alternative natural gas will be replaced by other fuels (coal, peat, wood, oil). The zero alternative would result in a clear increase in carbon dioxide, sulfur dioxide, nitrogen oxide and particulate emissions. The impact on air quality in Finland would be low, however. | Emissions and impacts on air quality and the climate of the ALT FIN 1 and ALT FIN 2 routing alternatives and the LF1 and LF2 landfall alternatives during construction will be quite low, with no significant differences between the alternatives. The impacts of the implementation alternatives on air quality during construction will last for two years and focus on the vicinity of the vessels participating in construction, i.e. mainly on areas further out at sea where there are few people. The extent of temporary construction-related blasting on the mainland will be considerably smaller than existing aggregate operations near the compressor station.<br>The impacts on air quality and climate during the operation of the natural gas pipeline will be low, with no difference seen between the alternatives. Emissions into the air will mainly be generated at the compressor station, where the amount of emissions from natural gas combustion will be small and focus on an area that until 2014 was subjected to a considerably higher load from the nearby power station. | | | |
| Land use and built environment | No impacts. | The overall significance of the impacts on land use is low. The impacts will mainly be local, targeted at a fenced area. The need to amend the local detailed plan due to the project can be regarded as the most significant impact. There will be hardly any impacts on the built environment. | | | |
| | | A small section of ALT FIN 1 will cross an important landscape entity. | ALT FIN 2 will be located close to an ancient underwater monument. If the route can run far enough from the monument , the difference between the alternatives is not significant. | There are no differ-ences between the alternatives in terms of land use. Landfall LF1 is located on a site that is in accordance with the local detailed plan while LF2 is not. On the other hand, changes to the detailed plan are likely to be required in any case. | With LF2 it is likely that an amendment to the local detailed plan is required.<br>LF2 is located further from existing holiday residences and perma-nent residences than LF1. On the other hand, new building sites for holiday residences are designated close to LF2 in the draft amendment to the local master plan. |

<table>
<tr><th>Project's environmental impacts</th><th>Zero alternative</th><th>ALT FIN 1</th><th>ALT FIN 2</th><th>LF1</th><th>LF2</th></tr>
<tr><td rowspan="3">Landscape and cultural environment</td><td rowspan="3">No impacts.</td><td colspan="4">The project's landscape impacts will be low in the onshore sections. The project will not cause impacts on valuable landscape or cultural environment items in the land area. Further studies will be required for the assessment of the significance of the impacts concerning underwater cultural heritage. Once progress in made in project design, further studies must be conducted concerning any fixed ancient underwater monuments.</td></tr>
<tr><td colspan="2" rowspan="2">ALT FIN 2 will be located close to an ancient underwater monument. If the route can run far enough from the monument , the difference between the alternatives is not significant. Further studies will be required for the assessment of the significance of the impacts concerning underwater cultural heritage.</td><td>LF2 will be located in the innermost section of a bay to which vistas only open from the east.</td><td>LF2 will be located on a site visible from the sea.</td></tr>
<tr><td colspan="2">In other respects the alternatives will be located in part in current natural areas and in part in areas modified by human activity. There is no significant difference between the landscape impacts.</td></tr>
<tr><td rowspan="2">People and society</td><td rowspan="2">No impacts.</td><td colspan="4">There will be short-term adverse impacts on amenity, recreational use, fishing and boating during construction. Human perception of adverse effects or their impacts on amenity and living conditions depends on the individual. There is no significant difference between the alternatives.</td></tr>
<tr><td colspan="4">There will be a low positive overall impact on the Ingå area due to increased industrial activity. This is to do with a slight increase in employment opportunities as well as direct and indirect employment generation.</td></tr>
<tr><td>Natural resources</td><td>No impacts.</td><td colspan="4">There is no current or planned onshore or marine extraction activity in the vicinity of the natural gas pipeline. The route may, however, in part be located in such areas where extraction might take place later on. Extraction will not, however, be possible along or in the immediate vicinity of the natural gas pipeline route during pipeline operation (around 50 years). The significance of this impact is, however, assessed as low as the impact will be very local (as the area is narrow). There is no significant difference between the alternatives.</td></tr>
<tr><td>Waste</td><td>No impacts.</td><td colspan="4">The overall significance of the waste generated from the project will be low when internationally acknowledged standards and methods as well as local legislation are complied with in waste handling. There is no significant difference between the alternatives.</td></tr>
<tr><td rowspan="2">Exceptional and accident situations</td><td rowspan="2">No impacts.</td><td colspan="4">Provided that more detailed seabed surveys will be conducted to map out any munitions and barrels and the recommended pipeline protection measures will be taken, the risk of a serious accident is very low.</td></tr>
<tr><td colspan="2">There is no significance difference between the ALT FIN 1 and ALT FIN 2 alternatives.</td><td>In the event of a possible leak from the natural gas pipeline, there are more holiday residences in the hazardous area of the LF1 alternative near Ingå than there are in the LF2 alternative.</td><td>In the event of a possible leak from the natural gas pipeline, there are fewer holiday residences in the hazardous area of the LF2 alternative near Ingå than there are in the LF1 alternative.</td></tr>
<tr><td rowspan="2">Decommissioning</td><td rowspan="2">No impacts.</td><td colspan="4">If the offshore pipeline is left on the seabed, the resulting impacts will be of low significance or of no significance.</td></tr>
<tr><td colspan="4">If the offshore pipeline has to be recovered from the seabed due to national legislation in force at that time, the societal and environmental significance of the impacts will be high. The environmental impacts of the offshore and onshore pipeline would correspond to the environmental impacts arising from construction.</td></tr>
</table>

## 9.3 Summary of key impacts

The most significant environmental impacts of the project will arise during the construction of the natural gas pipeline. Adverse impacts during pipeline operation will be lower. Impacts identified as the most significant impacts during construction are impacts on seabed, water quality, the marine environment, flora and fauna.

According to preliminary calculations and plans, a significant amount of seabed intervention measures (dredging, ploughing or jetting, blasting and subsea rock installation) will be required for pipeline protection and freespan rectification. The actual need for seabed intervention will be specified further once progress is made in technical project design, with the need for intervention for each pipeline section likely to be reduced below the level presented in this EIA report. The environmental impact assessments conducted are based on conservative assessments concerning project measures, and efforts have been made to conduct them on the basis of the worst-case scenarios.

## Impacts during construction

### Offshore areas

For the purpose of environmental impact assessment, the suspended solids load caused by natural gas pipeline construction work was modeled using a mathematical model on water movements and the migration of substances. The amount of seabed intervention required during construction will be relatively small in the offshore areas of western Gulf of Finland, with the impacts on water quality in these areas being very low due to the large volumes of water, efficient exchange of water and lesser nature values. The affected area is estimated to extend approximately to a maximum of 1 km from the pipeline. Turbidity and accumulation areas as well as impacts on marine environment will be clearly lower than in near-shore areas. Harmful substances are likely to be dispersed with suspended matter along the flow directions but to be eventually resedimented with the solids.

Impacts on water bodies were also found to be temporary, local and low in the environmental monitoring carried out during the construction of the Nord Stream gas pipeline project. In offshore areas the duration of noise and other disturbances will also be shorter than in archipelago areas as construction work will progress faster further off the shore.

Where permitted by the ice situation, some birds, seals and occasionally also harbor porpoises are found in the open sea areas of the Gulf of Finland. No particularly important feeding areas attracting large numbers of individuals are known in the area covered by the natural gas pipeline project. Among birds, Anseriformes in particular prefer feeding in shallow areas very rarely found in open sea areas. The impacts of offshore turbidity on bird fauna are likely to be low since the impacts on fish, bivalves and other small fauna that they feed on are estimated to be very local and short-term. Deep-bottom zoobenthos will be destroyed almost all the way underneath the pipeline, but on the whole the natural gas pipeline is not estimated to pose a major risk to offshore soft-bottom benthic communities which, due to the poor oxygen situation, are quite non-diverse and have good recovery potential.

Fish populations are impacted particularly by underwater blasting, which results in behavioral changes over several kilometers and risk of injury up to hundreds of meters from the blasting site. Demersal fish will also be affected by changes in the benthos, which may have either negative or positive impacts depending on the species of fish. No significant fish spawning areas can be found in the offshore zone of the project area. The impact on fisheries is reduced by the fact that the impact focus will be on mature fish.

Adverse effects on fishing in the offshore areas of the Gulf of Finland will mainly be caused by the prevention of trawling in the project area during construction. Fishing vessels operating in the area will be disturbed by increased vessel traffic, seabed intervention work, pipelaying as well as pipeline protection measures. In the Gulf of Finland however, where fairway crossings take place in the open sea, the impacts on other vessel traffic will be low as there will be plenty of space around the safety zone of the pipelaying vessel for diversionary routes, resulting in only short detours.

The most significant risks relating to the construction of the natural gas pipeline comprise the collision of installation vessels participating in pipelaying with other vessels as well as any munitions and barrels containing hazardous substances found in the seabed in the construction area. The prevention of safety incidents is the primary goal set for planning. Planning will take place in compliance with legislation as well as safety and occupational health and safety rules. Efforts will be made to prevent vessel collisions and groundings through traffic control. The disposal of munitions and barrels will be negotiated with the relevant national authorities.

### Coastal areas

According to assessments made on the basis of the results of water system modeling carried out on the area off Ingå, turbidity caused by the various phases in the construction of the natural gas pipeline will be relatively low. The biggest impacts will be seen near the coast where flow rates are lower and turnover of water slower than in offshore areas. Ploughing is the method causing the highest levels of turbidity. Changes in wind direction will create a potential impact area around the construction site, the extent of which as well as the dispersal direction of turbidity will vary depending on the wind and flow situation. The division of the work into stages will result in repeated turbidity bursts varying in locations occurring throughout the construction period. Sediment accumulation will increase during the work but will remain small in quantity due to the short duration.

According to preliminary construction method plans, blasting through explosions will take place in several locations. An explosion generates a rapid increase in pressure, a blast, which is followed by a rapid decrease in pressure. The turbidity cloud created will move with currents. The material is mostly minerals, whereby it will settle quite quickly. Due to their very brief duration, the water quality impacts of turbidity clouds are assessed to be low in comparison with impacts including those of dredging and ploughing. The impacts of blasts are the highest on aquatic organisms.

Sediment mixing may result in the release of harmful substances into seawater and their entry into organisms and food chains. According to the results of sediment sampling, however, the concentrations are low. Pollutants will be dispersed with turbidity but are likely to be eventually resedimented with the solids.

Birds nesting on islets near the pipeline alternatives may experience significant temporary disturbance to food sourcing if turbidity is high and occurs during their breeding season. Overall the impact is, however, likely to be low because the turbidity is assessed as short-term and will only be seen in a small area at a time. As regards fish, significant impacts during construction were assessed to occur in situations where there are adverse effects on fish spawning areas, spawning or fry. In these respects the most significant impacts will be targeted at the Ingå inner archipelago (spring-spawning fish species, possibly some species seeking to spawn in rivers) as well as middle and outer archipelago (Baltic herring and the sea-spawning European whitefish). The adverse effect caused by the deterral of fish will be temporary and can be addressed through compensations to commercial fishers. Any impacts on fish breeding areas will, however, result in permanent adverse effects.

Vessel traffic during the construction of the Balticconnector pipeline will contribute to the impacts of vessel traffic near the islands by the pipeline and the areas close to the Ingå fairway. Bird populations in the archipelago of the Stora Fagerö area in particular will be subjected to the impacts of noise and other disturbances as the planned routing alternatives run close to nesting islets. A threatened bird species under strict protection also breeds in the area. The impacts of above-water noise on birds will, however, overall be low. Any damaging impact of underwater noise is likely to affect a small number of individuals (such as birds, harbor porpoises and seals), and therefore the impacts of underwater noise are also assessed as low concerning animals in the area. In the worst cases, however, underwater noise may injure individual marine mammals. Therefore measures mitigating the impacts of pressure waves must be employed in blasting to prevent injuries in marine mammals.

Vessel transport involves the regular vessel transport risks, such as the risk of oil spill or introduction of non-indigenous species. The risk of introduction of non-indigenous species is low in conjunction with the project as transport takes place locally. Vessel traffic also causes nitrogen oxide, sulfur dioxide, particulate and carbon dioxide emissions, but their impact in the project will be low in comparison with other waterborne transport. Considering the volumes transported by the vessels, the impacts of increased vessel traffic are estimated to be low on the whole.

The impacts on people and society will focus almost entirely on the period of natural gas pipeline construction. The adverse effects caused by the construction of the natural gas pipeline will, however, be non-persistent by nature, whereby their impact will not last for a long time. Compared with the current situation, some work conducted during construction may to some extent cause annoyance. Human perception of adverse effects or their impacts on amenity and living conditions depends on the individual. The most significant impacts will be related to temporary noise disturbance in marine and land areas and increases in vessel traffic during construction. Short-term turbidity in water areas close to the offshore pipeline may cause minor adverse effects on the recreational use of the areas during construction.

#### Impacts during operation

The Balticconnector natural gas pipeline will cover a strip of the seabed in the Gulf of Finland. The pipeline and the subsea rock berms protecting it will form a protrusion from the seabed in many places. In normal situations there will be no impact on water quality during the operation of the natural gas pipeline. During operation, the impacts of the pipeline on the marine environment will mainly be limited to minor flow amendments due to morphometric changes caused by the pipeline itself and its construction (covering and protection) in areas near the pipeline, such as increased turbulence around the pipeline at faster bottom flow velocities. Changes in flow velocities and directions may affect the transport and accumulation of materials in the close vicinity of the pipeline. According to measurements carried out for the Nord Stream project, the impacts only extend up to tens of meters from the pipeline.

The overall impacts during the operation of the natural gas pipeline in the archipelago and marine area will be low. Periodic inspections and servicing and maintenance tasks may cause minor disturbances to birds and marine mammals, but these will not differ from the disturbance caused by other movement in the area. Pipeline maintenance measures will include the addition of soil around the pipeline wherever necessary. Such measures may contribute toward changes in near-bottom flows as well, whereby changes in flows may cause changes in erosion or sediment accumulation in nearby areas.

Potential impacts of pipeline anti-corrosion measures, coating and protective anodes on water quality are to do with substances, mainly metal ions, released from materials during pipeline lifecycles. The zinc/aluminum anodes installed in the pipeline may cause a slight increase in the concentrations of zinc and aluminum in the immediate vicinity of the pipeline, but the concentrations will rapidly become smaller in the sea due to currents and exchange of water. Most metals will settle and accumulate in the bottom sediment. The impacts of anodes on metal concentrations in seawater were monitored in conjunction with the construction of the Nord Stream gas pipeline. The metal concentrations were generally in the same magnitude near the pipeline and in the reference areas.

Flora in the onshore gas pipeline work area will be allowed to restore naturally following pipeline construction. An area along the line of the pipe that is approximately 5 m in width will be kept treeless and cleared of shrubbery. Impacts during operation on flora and fauna will be restricted to the cleared zone and areas near it, with changes taking place in species composition from the current situation. An increase in flora such as grasses and sedges and a decrease in herb-rich forest plants are likely to be seen in the cleared zone. The edge effect will not extend very far into the environment, and the zone that is kept clear of trees and shrubbery will not restrict the movement of animals or cause significant habitat changes for breeding birds.

The compressor station can be fueled by electricity or natural gas. If fueled by electricity, there will be no local flue gas emissions from the compressor station. A natural gas-fueled compressor station will generate small amounts of carbon dioxide ($CO_2$), nitrogen oxides ($NO_x$) and water vapor. The combustion of natural gas does not in practice result in any sulfur dioxide of particulate emissions. According to calculation results, noise impacts during compressor station operation will be low and very local. There will be low noise impacts on the Svartbäck pond, which is a valuable bird area.

Possible damage to the gas pipeline and resulting pipeline malfunction could have consequences to human safety. The risk assessment conducted for the Balticconnector project (*Ramboll 2014b*) identified the sections where the pipeline must be protected to prevent pipeline damage. Maintenance management of the natural gas pipeline will be carried out to ensure the pipeline will be kept in good working order and will not pose a risk to the environment.

## 9.4 Feasibility of alternatives and summary of comparison

As regards environmental impacts, the alternatives examined are feasible when a special focus in project design is placed on the prevention and mitigation of adverse impacts from construction. No adverse environmental impacts that are unacceptable or that could not be mitigated to an acceptable level were found during the environmental impact assessments of the project alternatives.

Due to the higher levels of solids resulting from construction, the impacts on water quality, marine environment, fish, fisheries, and birds will be higher in the ALT FIN 1 alternative than in ALT FIN 2. The ALT FIN 1 routing alternative is also closer to its natural state and more susceptible to changes, and more commercial fishing is carried out in its vicinity than that of the ALT FIN 2 alternative. The ALT FIN 1 alternative is also closer to significant bird areas and a nesting ground of a species under strict protection than ALT FIN 2. Water quality impacts during construction will be larger with LF1 than LF2 due to a higher solids concentration. The adverse effects on fish and fisheries caused by LF1 will be larger than those of LF2 due to the destruction of a significant reedbed area. The magnitude of adverse effect on commercial fishing will also be greater and the affected area larger with LF1.

The route taken by ALT FIN 2 east of Jakobramsjö passes closer to holiday residences than ALT FIN 1, whereby ALT FIN 2 may affect the recreational conditions of a larger number of holiday residents. LF1 is closer to holiday and permanent residences than LF2, whereby temporary adverse effects may be caused at a slightly higher level on the amenity of coastal residents and swimming beach users. Human perception of adverse effects or their impacts on amenity and living conditions depends on the individual. The noise impacts of LF1 regarding the landfall site and onshore blasting would be slightly higher than those of LF2. As regards the landfall site, LF1 may result in the daily guideline value of 45 dB(A) being exceeded over the short term at the nearest holiday residences. Furthermore, in the event of a possible (but highly unlikely) leak from the natural gas pipeline, there are more holiday residences in the danger zone of the LF1 alternative near Ingå than there are in the LF2 alternative. None of the adverse effects are assessed to result in a permanent change in the living conditions of local residents or holiday residents. Landfall LF1 is located on a site that is in accordance with the local detailed plan while LF2 is not. On the other hand, changes to the detailed plan are likely to be required in any case.

In addition to adverse impacts, the implementation of the project will also have positive environmental impacts. The long-term objective of the development of the Finnish energy market is to increase natural gas sourcing alternatives to ensure supply security and the functioning of the natural gas market. At the moment natural gas for Finland is only sourced from Russia. The construction of the LNG terminal and the Balticconnector natural gas pipeline would contribute to the development of the natural gas market and supply security in Finland. The positive impacts on employment and livelihoods will also not be realized if the project is not implemented. If the project is not implemented, neither the adverse nor the positive impacts of the project will be realized.

# 10 ENVIRONMENTAL IMPACT MONITORING

According to the Environmental Protection Act, operators must be aware of the environmental impacts of their activities.

Environmental impact monitoring aims to:

- produce information about the project's impacts;
- find out which impacts result from the implementation of the project;
- find out how well the results of the impact assessment correspond to reality;
- find out how well the measures to mitigate adverse impacts have succeeded; and
- launch the necessary measures in case of any unforeseen, significant adverse impacts occurring.

The proposals presented in the following sections for the principles of an environmental impact monitoring program were drawn up in conjunction with the environmental impact assessment of Gasum's Balticconnector project. The proposals presented in this EIA report differ in some respects from those presented in the EIA report for Estonia due to differences in environmental conditions and legislation. In Finland a detailed monitoring program is drawn up in conjunction with the environmental permit application and approved by the permitting authority as part of the environmental permit decision. Under the Estonian Environmental Impact Assessment and Environmental Management System Act, the proposal for a detailed monitoring program must already be provided in the EIA report phase.

### 10.1.1 Water quality and marine environment

The monitoring will take place in accordance with the provisions of the permit required for the project under the Water Act and the Environmental Protection Act. During pipeline construction, the extent of turbidity, water quality and biological factors will be monitored.

Water quality monitoring will focus on the areas affected by those measure that cause the highest adverse impacts on the marine environment, which will be specified further at later stages of the project once progress is made in pipeline design. Automated continuous measuring instruments can be utilized in the monitoring, providing comprehensive data about turbidity impacts and their duration. Components such as oxygen, solids, nutrients and harmful substances such as heavy metals and organic compounds will be analyzed from water samples. HELCOM or national standards will be complied with in the monitoring. A separate monitoring program will be drawn up for munitions clearance, in which marine and other environmental impacts will also be taken into consideration.

As regards macrophytes, the impact monitoring can be along the same lines as with the studies of current status conducted for the project *(Leppänen and Leinikki 2013)*. The monitoring will cover changes taking place in and between lines and cumulative impacts between and within all lines as well as diversity. Soft-bottom benthic fauna can also be monitored by repeating the sampling on the same sites as in the survey of the current status. The Before-After-Control-Impact (BACI) approach is a generally accepted method for the assessment of conditions before and after construction work. The overall purpose of the monitoring is to assess the situation before/after construction and natural variation between years in the biota.

Where possible, monitoring in coastal areas off Ingå can also be carried out in conjunction with the joint monitoring of Fagerviken. The joint monitoring has involved measures including water quality monitoring and studies on zoobenthos and aquatic flora. Very little bladderwrack was found off Ingå but, to avoid additional turbidity, dredging can be scheduled not to coincide with the bladderwrack reproduction period.

### 10.1.2 Fish, birds and marine mammals

The fisheries impacts will be monitored during project implementation on the basis of a fisheries monitoring program determined under the water permit. According to the assessment, there is no need for fisheries monitoring during operation.

The monitoring program implemented during construction will be employed to monitor fish breeding, changes in the structure of fish stocks, and commercial and recreational fishing in the area. Suitable monitoring methods for the Ingå archipelago may include Coastal survey net sampling; Gulf Olympia juvenile sampling throughout the archipelago zone; juvenile seine sampling; where necessary, spawn sampling or breeding monitoring by seine sampling for sea-spawning European whitefish; and surveys among fishers. For the offshore areas the monitoring focus will be on commercial fishing surveys and the monitoring of catches per statistical rectangle (register of the Ministry of Agriculture and Forestry). Where necessary, impacts during blasting explosions can also be monitored using methods such as echo-sounding.

The Before-After-Control-Impact (BACI) design is proposed as the monitoring setup. Clear monitoring hypotheses and statistical methods to test these hypotheses will be presented in the monitoring program.

Impacts on birds and marine mammals in the marine area can be monitored during intervention measures and pipelaying. If signs of disturbance among animals are observed in the monitoring carried on-board vessels, the work can be discontinued temporarily, mitigation measures can be increased, or work methods can be changed.

### 10.1.3 Noise

If necessary, noise during construction can be monitored through noise measurements near sound sources and recipients subject to disturbance. Correspondingly, the situation during operation can be monitored through sound source and environmental noise measurements as well as a noise model.

The monitoring of underwater noise can, for example, be carried out using hydrophones measuring and recording underwater noise at sites regarded as important during the noisiest period of the entire construction process (including explosions, largest-scale excavation).

### 10.1.4 Shipping, people and society

The Gulf Finland Reporting System (GOFREP) is a mandatory reporting system for ships of 300 gross tonnage or over. Vessel traffic is controlled by Vessel Traffic Service (VTS) centers in Helsinki, Tallinn and St. Petersburg, which provide vessels with shipping information for the Gulf of Finland. The aim of the system is to increase maritime safety in the area, improve the protection of the marine environment, and monitor compliance with the International Regulations for Preventing Collisions at Sea (COLREGs) as well as national rules of the road at sea. The GOFREP area covers the international waters in the Gulf of Finland east of the Western Reporting Line as well as national rules of the road at sea. Finland and Estonia have also introduced mandatory reporting systems in their national waters outside their VTS areas. During project construction, the pipelaying vessel will be monitored using the GOFREP system like all other vessel traffic in the Gulf of Finland.

Information about construction work and schedules will be provided locally through advance notifications as well as notifications while work is in progress. Efforts will be made to include permanent residents, holiday residents as well as boaters in those who will receive the notifications. The municipality and health surveillance authorities will be informed in advance of any work that may have an adverse impact on water quality to prevent any additional adverse effects on the monitoring of bathing water quality or bathing water assessment. It is important for local residents to be informed of the status of the project's environmental monitoring. Monitoring findings should be published regularly in conjunction with the Project Developer's normal communications. The project itself is not going to cause environmental impacts resulting in any special need for monitoring from the perspective of people and society.

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# APPENDIX

# ANNEX 1: COORDINATING AUTHORITY'S STATEMENT ON ENVIRONMENTAL IMPACT ASSESSMENT PROGRAM

May 7, 2014

Gasum Corporation
PO Box 21
FI-02151 Espoo, Finland

Reference
Environmental Impact Assessment Program received on January 27, 2014

**STATEMENT ON ENVIRONMENTAL IMPACT ASSESSMENT PROGRAM, BALTICCONNECTOR, NATURAL GAS PIPELINE BETWEEN FINLAND AND ESTONIA**

## 1. PROJECT INFORMATION AND ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCEDURE

On January 27, 2014 the environmental impact assessment (EIA) procedure for the Balticconnector natural gas pipeline project between Finland and Estonia was initiated by Gasum Corporation by submitting the environmental impact assessment program concerning the project to the Uusimaa Centre for Economic Development, Transport and the Environment.

### Environmental impact assessment (EIA) program and EIA report

The environmental impact assessment (EIA) program is the Project Developer's plan concerning the studies that will be needed to assess the environmental impacts and the ways in which the EIA procedure will be conducted.

The Project Developer will draw up the EIA program and, on the basis of the statement issued by the Coordinating Authority on the program, the EIA report.

### Project Developer and Coordinating Authority

The Project Developer is Gasum Corporation, with Eero Isoranta acting as the project contact person. The EIA program was drawn up as a consultancy assignment by Ramboll, with Tommi Marjamäki acting as the contact person.

The Coordinating Authority under the Act on Environmental Impact Assessment Procedure for the project is the Uusimaa Centre for Economic Development, Transport and the Environment. The Coordinating Authority's representative is Leena Eerola (section 3(1) of the Act on the Centres for Economic Development, Transport and the Environment and section 2(1)3 and 3(1)1 of the Decree on the Centres for Economic Development, Transport and the Environment . ).

### Project background and project description

Invoice to Project Developer €24,960.00. The criteria for the charge are enclosed with this statement.

Gasum Corporation is planning the construction of an offshore natural gas pipeline from Ingå, Finland, to Paldiski, Estonia. The aim is to interconnect the Finnish and Estonian gas distribution networks and improve regional access to and supply security of gas in Finland and the Baltic states. The Balticconnector natural gas pipeline project is classified as an EU priority project and has been granted financial assistance by EU. The project is also part of the trans-European energy networks funded by the EU.
The Balticconnector natural gas pipeline will be connected with the existing gas network in Finland and Estonia. The project also includes reception stations in Finland and Estonia, the onshore gas pipelines from the Finnish point of landfall to the Ingå compressor station and from the Estonian point of landfall to Paldiski, Kersalu, and the compressor station in Ingå.

The offshore gas pipeline will have a diameter of approximately DN 500 mm and length of approximately 81 km. The annual gas throughput capacity is estimated to be around 5 TWh and the planned annual transmission capacity is 2 bcm. The natural gas pipelines and Ingå compressor station will be controlled and monitored from the Kouvola central control room, which is staffed around the clock. Pipeline inspections will be carried out regularly. The operational life of the pipeline is around 50 years.

The gas pipeline will be installed using either an anchored or a dynamically positioned pipelaying vessel. Installation on the seabed will require dredging, blasting, filling and subsea rock installation. Route optimization will be carried out in conjunction with detailed route design on the basis of geotechnical and environmental studies.

The gas pipeline will be installed on the seabed, but in some sections the pipeline will need to be protected against impacts such as anchor dragging. The protection will involve either trenching or covering with rock. To ensure pipeline stability, the pipeline will either be trenched or covered by rock near the landfall. Rock cover will also be used at the intersection points with existing pipelines and cables. The gas pipeline will be laid exposed on the seabed in the deep sections of the Gulf of Finland.

The planned landfall site of the Balticconnector natural gas pipeline in Finland is on the Fjusö Peninsula around 2 km east of the Port of Ingå. There is a port, a decommissioned power plant, rock extraction site, Natural Emergency Supply Agency operations, fishing harbor and boat winter storage facility in the vicinity of the project area.

In addition to permanent homes, there is a large number of holiday residences in the Ingå archipelago. The volume of boat traffic is high, and there are also several commercial fishers operating in the archipelago. The pipeline will pass through the Natura 2000 site of the Ingå archipelago, and there are several other protected areas near the project area.

**Project alternatives**

**Alternative ALT 0:** The Balticconnector natural gas pipeline project will not be implemented.
**Alternative ALT FIN 1:** Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Ingå, Finland, to Paldiski, Estonia, route north of Stora Fagerö.
**Alternative ALT FIN 2:** Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Ingå, Finland, to Paldiski, Estonia, route south of Stora Fagerö.
**Alternative ALT EST 1:** Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Ingå, Finland, to Paldiski, Estonia, with the point of landfall in Kersalu, Estonia.
**Alternative ALT EST 2:** Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Ingå, Finland, to Paldiski, Estonia, with the point of landfall in Pakrineeme, Estonia.

**Need to apply the EIA procedure on the project**

The need to apply the EIA procedure on the project is based on sections 4 a and 4(2) of the EIA Act (468/1994 as amended). Under section 4 a of the EIA Act, the Act applies in the Finnish Exclusive Economic Zone. Section 4(2) lays down provisions on the application of the EIA procedure in individual cases.

The project is not included in the list of projects given in section 6 of the EIA Decree, under subsection 8 b of which the EIA procedure is applied to gas pipelines with a diameter of more than DN 800 mm and a length of more than 40 km. Under section 4(2) of the EIA Act, the assessment procedure is also applied in individual cases to a project other than one referred to in the list of projects that will probably have significant adverse environmental impacts comparable in type and extent to those of the projects included in the list.

Pursuant to decision YM1/5521/2006 issued on February 17, 2006 by the Ministry of the Environment, the environmental impact assessment procedure is applied to the Balticconnector natural gas pipeline project. According to the justifications of the decision, the project's environmental impacts will be targeted particularly at the littoral zones of Finland and Estonia, where pipeline installation will require seabed dredging and filling along the pipeline routing. Around DN 500 mm in diameter and around 80 km in length, the environmental impacts of the gas pipeline are likely to correspond to those of a pipeline with a diameter of 800 mm and length of 40 km set as the limit in the list of projects given in section 6 of the EIA Decree (subsection 8 b). The project is also covered by section 8 of the list of projects provided in Appendix 1 to the bilateral agreement on EIA between Finland and Estonia (large-diameter oil and gas pipelines, underwater pipelines in the Baltic Sea).

Furthermore, the Uusimaa Centre for Economic Development, Transport and the Environment states that the EIA procedure will promote the assessment and harmonized consideration of environmental impacts in planning, design and decision-making and increase citizens' access to information and opportunities for participation.

**Relationship with other projects and plans**

Planned LNG terminals in Ingå and Paldiski.

The Balticconnector natural gas pipeline will cross fairways with regular traffic almost throughout the entire length of the pipeline.

There are several telecommunications cables crossing the Balticconnector natural gas pipeline in the Gulf of Finland.

The Nord Stream natural gas pipelines 1 and 2 as well as the two new pipeline routings planned under the Nord Stream extension project will cross the Balticconnector natural gas pipeline project.

The Ingå-Raseborg wind farm is planned west of the Balticconnector pipeline. The planned electric cables and other possible needs of the wind farm project will be taken into account in the plans for the Balticconnector pipeline.

There are several other operations and projects not directly connected with the Balticconnector project in the area affected by the gas pipeline project. These will be taken into account in the assessment if they may have cumulative impacts with the Balticconnector project.

**Integration of the EIA procedure with procedures under other legislation**

The construction of the Balticconnector natural gas pipeline in Finland's territorial waters and Exclusive Economic Zone requires a permit under the Water Act issued by the Regional State Administrative Agency for Southern Finland for pipeline construction, operation and maintenance.

Consent of the Government of Finland to environmental studies and the right to use the pipeline route is required under the Act on the Finnish Exclusive Economic Zone.

A project license issued by the Ministry of Employment and the Economy under the Natural Gas Market Act is required for the construction of a natural gas transmission pipeline crossing the national border.

A construction license issued by the Finnish Safety and Chemicals Agency is also required for the safe construction of the natural gas pipeline and the storage of natural gas.

The construction of a low-pressure natural gas pipeline requires a permit under the Land Use and Building Act issued by the local building control authority. The right to use an area under water is granted in conjunction with the processing of the water permit application.

The purpose of use of the area and land use plan regulations concerning the area must be taken into account in the placement of the activities. An amendment to the local detailed plan of Joddböle may be required.

A building permit issued by the local building control authority under the Land Use and Building Act will be required for the compressor station.

In addition to the building permit, an environmental permit may also be required for the compressor station.

Guidelines provided by the Finnish Transport Agency must be followed in natural gas pipeline installation and signposting (*Liikenneviraston ohjeet ilmajohtojen, kaapeleiden ja muiden johtojen asettamisesta ja merkitsemisestä*, Reg. No: 6155/040/2010).

Restrictions laid down in section 17 of the Territorial Surveillance Act must be complied with in restricted areas. Permission from territorial surveillance authorities is required for activities such as construction, extraction, deposition and examination of soil materials. Under section 20 of the Territorial Surveillance Act, the permitting authority is the Gulf of Finland Naval Command until December 31, 2014 and Navy Command Finland as of January 1, 2015.

The National Board of Antiquities must be contacted if signs of any ancient monuments in accordance with the Antiquities Act (295/1963) are detected.

The Act on Water Resources Management (272/2011) and Decree on the Management of the Marine Environment (980/2011) as well as environmental objectives, plans and action plans under these must be taken into account in decisions relating to the project.

## 2. COMMUNICATIONS AND CONSULTATIONS ABOUT THE EIA PROGRAM

The initiation of the EIA program was published in the *Kirkkonummen Sanomat* and *Västra Nyland* newspapers.

The public display of EIA program was notified and conducted from February 10, 2014 to April 7, 2014 in the following locations:

Ingå library, Ola Westmans allé 1, 10210 Ingå
Ingå municipal hall, Ola Westmans allé 3, 10210 Ingå
Siuntio municipal library, Asematie 2, 02580 Siuntio
On the internet: www.ymparisto.fi/balticconnectorYVA

A public event on the EIA program was organized on Tuesday March 25, 2014 at 18:00–20:00 at Kyrkfjärden school, Museivägen 7, 10210 Ingå.

A meeting for the authorities took place on March 14, 2014 at the Uusimaa Centre for Economic Development, Transport and the Environment.

The Balticconnector natural gas pipeline project is also likely to have significant and adverse transboundary environmental impacts. Therefore the UNECE Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention, Finnish Treaty Series 67/1997) is applied to the project. Under the Convention, Finns also have the opportunity to express their opinions on environmental impacts from Estonia affecting Finland. Correspondingly, other citizens, organizations and authorities of the Baltic Sea region have been able to express their opinions on the EIA program to the extent where the impacts of the Finnish section of the project affect other countries.

The project is planned in Finland and Estonia and the impacts will be targeted at the territories of both countries. Therefore the bilateral Agreement between Finland and Estonia on Environmental Impact Assessment in a Transboundary Context (Finnish Treaty Series 51/2002) is also applied to the project. The environmental impact assessment will be carried out as a joint environmental impact assessment under Article 14 of the bilateral agreement wherever possible under national legislation.

The Ministry of the Environment will convey the information as regards the international consultation to the Parties under the Espoo Convention about feedback received in Finland, while comments received from other Baltic Sea countries will be conveyed to the Coordinating Authority, the Uusimaa Centre for Economic Development, Transport and the Environment.

## 3. SUMMARY OF STATEMENTS AND OPINIONS PRESENTED

The Uusimaa Centre for Economic Development, Transport and the Environment has requested statements on the EIA program from the Municipality of Ingå, Municipality of Siuntio, City of Raseborg, Municipality of Kirkkonummi, Regional State Administrative Agency for Southern Finland, Uusimaa Regional Council, National Board of Antiquities, Provincial Museum of Western Uusimaa, Environmental Health Care of Hanko, Ingå and Raseborg, Western Uusimaa Rescue Department, Ministry of Employment and the Economy, Energy Authority, Finnish Safety and Chemicals Agency (Tukes), Finnish Transport Safety Agency (Trafi), Metsähallitus (the state enterprise administering state-owned land and waters), Finnish Transport Agency, Defence Command, Finnish Game and Fisheries Institute, Finnish Environment Institute (SYKE), Fortum Corporation, Fingrid Oyj, Rudus Oy, National Emergency Supply Agency, Inkoo Shipping Oy Ab, Ingå Marina, and Ingå Fishing Region.

A total of 14 statements and 4 opinions on the EIA program were submitted to the Coordinating Authority. The full statements and opinions (in Finnish or Swedish) can be found online at www.ymparisto.fi/balticconnectorYVA.

The following is a summary of the main content of the statements and opinions.

### Summary of statements

Project

The Balticconnector project is closely connected with the Finngulf LNG terminal project, and the division of the projects into two separate EIA procedures is in part artificial.

In practice, only one alternative with slight differences in nuances has been selected for the EIA. More routing alternatives that differ from each other than those presented in the program should be examined. The justifications of the alternative selected and the alternatives that were studied earlier must also be presented. In addition, more landfall site alternatives must be assessed for Ingå. Fjusö is not in accordance with the local detailed plan in which there are two area reservations for a landfall site. These sites should also be assessed as alternative landfall sites.

The scoping of the project's impact area and the justifications of the scoping must be presented.

All environmental agreements, programs and policies currently in force or under preparation as well as the EU Maritime Spatial Planning Directive under preparation must be taken into account in the EIA.

Impacts on marine area and natural environment

From the environmental conservation perspective the starting point must be a solution that will not change the natural water flow conditions or have a significant impact on the structure and functioning of the marine ecosystem.

The most significant underwater environmental impacts of the project are likely to take place during construction and mainly consist of local impacts on water quality and zoobenthos. No permanent changes in water quality are expected. The project's impacts on fish, aquatic birds and marine mammals are likely to be low.

The program presents environmental studies to be carried out but, on the other hand, also states that existing data and data from possible further studies will be utilized. Consequently, the program does not provide a clear picture of the implementation of the impact assessment.

Seabed intervention will involve blasting of bedrock peaks and exposed sections, dredging and filling of depressions. These operations will release nutrients and suspended solids into the water mass. Turbidity may remain visible locally for a longer period of time depending on the currents in the area. The dispersal and retention of sediment solids in the water, nutrient concentrations and concentrations of harmful substances must be monitored and a plan for the prevention of adverse impacts must be drawn up before pipeline installation.

Measurements have been carried out in the area, but the data provided concerning currents in the area is rather non-specific, and there is no proper research program. The impacts of the pipeline on currents should be studied for different types of seabed area, and the current surveys should include three-dimensional flow measurements. The impacts of resuspension on nature reserves and Natura 2000 sites, fish spawning areas and known underwater Natura 2000
habitat types must be studied on the basis of flow measurements of a sufficiently long duration.

The locations of the most important fish breeding areas must be studied and the risks of their destruction during construction and operation must be assessed. The gas pipeline is planned to be operational for decades, whereby the impacts on fishing should be examined over a longer term.

If any important seal occurrence areas are detected in the assessment, pipeline construction must be scheduled in a manner minimizing adverse impacts on seals.

Seawater treated with chemicals will be used and discharged into the sea in the pipeline pressure test carried out in the pre-commissioning phase. The substances used in the test as well as their environmental impacts must be assessed.

The nature surveys conducted previously on the area must be taken into account and supplemented by surveys including those on the occurrence of the moor frog. A breeding birds survey should be conducted on the Fjusö area. There are two significant resting sites of Long-tailed Duck, a globally Vulnerable (VU) species, in the marine area close to the gas pipeline routing. To establish the more specific area boundaries and significance of the resting sites, a survey of migrating birds resting in the Ingå archipelago Natura site should conducted.

In addition to Paldiski, a Natura 2000 assessment screening under section 65 of the Nature Conservation Act must also be conducted for Ingå. The screening must be based on the overall impacts of the Balticconnector/LNG project and the overall environmental impacts of pipelaying, dredging, dredging materials deposition and increased vessel traffic.

Noise

The project will generate underwater noise during gas pipeline installation as well as pipeline operation. The size of the noise impact area will be affected by factors including water depth, seabed type and season. The noise caused by installation work is presumed not to cause any significant increase from existing noise levels. Explosions and other work generating impulsive noise will result in significant changes in the physical environment. The sound pressure level caused by gas flow during operation is presumed to be low, but noise levels in the vicinity of compressor stations may be comparable to ship source levels.

Underwater noise has been found to cause serious adverse impacts on marine mammals and fish. The superficial report on the project's underwater noise impacts provided in the EIA program is insufficient and the program must be supplemented in this respect. Because there is no precise data about adverse noise impacts caused by work relating to the gas pipeline, the precautionary principle must be followed in project design and implementation. The environmental impacts of the project must also be monitored.

The impacts of noise on fish must be monitored using methods such as echo-sounding, and the pipeline's impacts on fish must be assessed on the basis of this. To reduce the impacts of blasting during construction, blasting must be scheduled on specific dates.

Land use

The land use planning situation of the project and the area affected by it must be presented in the report in more detail than in the program regarding regional and well as local master planning.

The onshore section of the planned natural gas pipeline in Joddböle runs through an area designated as an industrial area in the regional land use plan. In this area there are rock resources designated with a feature notation in the first-phase Helsinki-Uusimaa regional land use plan. The reconciliation of the project and the use of the area’s rock resources as well as the cumulative impacts with known projects must be examined in the EIA report.

Both pipeline alternatives will run through a marine area designated as a Natura site in the regional land use plan. Other regional land use plan notations of key relevance to the impact assessment are the site notation for the LNG terminal designated in the Helsinki-Uusimaa regional land use plan on the Fjusö Peninsula and the need for the power transmission connection between the Ingå-Raseborg offshore wind farm and the main grid.

The local detailed land use plan in effect in Joddböle is not mentioned in the program. The Joddböle local detailed plan may need to be amended and this, as a general rule, is the condition for a permission to be granted for a pipelaying and compressor station in the detailed land use plan area. In addition to the building permit, an environmental permit may also be required for the compressor station.

Traffic

The impacts on waterborne traffic have been covered in an appropriate manner.

The pipeline will enable the delivery of some of the natural gas to the destination country without shipping. This affects the risks involved in shipping as those volumes of gas that are pumped via the pipeline will not need to be transported by ship.

The project will have impacts on waterborne traffic in the area, especially during pipeline installation, as the pipeline routing will cross several shipping routes. The Project Developer must contact the Finnish Transport Agency about the plans relating to crossing and the pipeline routing in Barösundsfjärden.

The Project Developer must contact the Finnish Transport Agency and agree on the studies required for detailed design. Vessels used for exploration and installation work must maintain continuous contact with Finnish and Estonian traffic control centers and comply with instructions provided by the centers as well as International Regulations for Preventing Collisions at Sea (COLREGs) as well as national rules of the road at sea. The Project Developer must submit the coordinates of the pipeline to be implemented in good time to the Finnish Transport Agency for inclusion on nautical charts to inform other seafarers. Guidelines provided by the Finnish Transport Agency must be followed in pipeline installation and signposting.

Safety and risks

The Ministry of Employment and the Economy stated in its decision on the study permit that the impacts of the alternative pipeline routings as well as the risks involved will be assessed later on during the EIA procedure on the basis of the study findings. Therefore the impacts of the project and the risks involved should be presented clearly in the EIA report.

The permit procedures in compliance with the Act on safety in the handling of dangerous chemicals (390/2005) and the provisions laid down pursuant to the Act have been taken into consideration in the EIA program.

Archaeological cultural heritage, cultural environment and landscape

The valuable sites of the built cultural environment and landscape have been presented sufficiently. The methods presented for the assessment of the impacts on landscape and cultural heritage appear to be sufficient.

The project may have an impact on archaeological cultural heritage. The destruction and damaging of ancient monuments is against the Antiquities Act. There is no map of known ancient on-land monuments in and close to the project area, and shipwreck sites are presented insufficiently on the map. The National Board of Antiquities does not have comprehensive data about ancient monuments in the area affected by the project. If any ancient monuments are detected, the mitigation of adverse impacts and the procedure under the Antiquities Act must be agreed upon with the National Board of Antiquities. It is important to determine reliably in conjunction with project design whether there are any underwater cultural heritage and ancient monument sites in the area covered by the marine works relating to the project. Various types of scanning often form a necessary part of underwater archaeological inventories, but these alone are not sufficient as inventories. The Antiquities Act does not apply to the Exclusive Economic Zone (EEZ), but it must also be ensured in the EEZ as well that an inventory is conducted on the pipeline routing to detect any cultural heritage sites and it must be ensured in project design that cultural heritage are not destroyed or damaged in conjunction with the project.

Impacts on scientific heritage

There are stations for the monitoring of the status of the marine environment maintained by the Finnish Environment Institute and the Uusimaa Centre for Economic Development, Transport and the Environment in the area potentially affected by the project. There are seven monitoring stations along the planned route, each located no further than 3 km from the pipeline routing. Any irreversible impacts on the monitoring stations will destroy long time series that are important scientifically as well as for marine resource management, and therefore it is important to move the pipeline routing further away.

Cumulative impacts

The environmental impacts of the natural gas pipeline between the landfall site and the compressor station must be studied. In the preliminary routing, the on-shore section of the gas pipeline will cross an emergency supply storage facility oil pipeline, municipal water and sewage pipes and a road planned for the fishing harbor. The routing and implementation of the pipeline between the island of Stora Fagerö and the landfall site must be presented on clear maps, and the impacts must be assessed taking into account facts such as the open-water section between Fjusö and Jakob Ramsjö being intended for use as a turning area for LNG carriers and some dredging work being planned. The EIA report must present clearly how and what kinds of cumulative impacts with the LNG
terminal project have been assessed.

The Fingrid Oyj Estlink 1 HVDC submarine power cable runs around 20 km east of the planned natural gas pipeline routing. On the basis of current information, the project will have no impact on the Estlink 1 submarine cable.

Offshore wind farm projects are not mentioned in section 8.6 of the EIA program concerning cumulative impacts of projects. The status of these projects should be examined, and the projects' cumulative impacts should be assessed.

There are several fiber and copper cables of the Defence Forces on the planned pipelaying route. The constructor must enter into an agreement with the owners of existing cables on the seabed concerning the crossings.

Other comments

The construction of the natural gas pipeline must not in any circumstances result in the prevention of the operational use of the military route.

The pipelaying route cuts across the northwestern perimeter of the Porsö restricted area. Provisions on restrictions and permissions relating to restricted areas are laid down in the Territorial Surveillance Act.

The gas pipeline to be constructed must be implemented in a manner not preventing firing or other activities of the Defence Forces in the area.

The clearance of mines and explosives on the seabed in the Exclusive Economic Zone does not fall directly within the duties of the Navy without a separate order and without a separate agreement on the costs arising thereof.

Impacts on issues such as people’s living conditions, safety, as well as air quality and noise impacts and cumulative impacts with other projects in the area have been taken into account in the EIA program, whereby there is no need for comments from the health protection perspective.

Any impacts on the utilization of fish for human consumption must be taken into account in the impact assessment. The impacts of increased turbidity will need to be assessed also as regards impacts on bathing water in the area affected by the project.

The Kallbådan seal conservation area is not included in the description of the current status. The Kallbådan Natura site is located in the municipalities of Kirkkonummi and Ingå.

There are imprecisions and irrelevant information from the environmental impact perspective in the EIA program. It is claimed erroneously in the text that demersal trawling is banned in the Gulf of Finland.
Sufficient time must be allocated for the language checking of the texts.

**Responses to the notification in accordance with the Espoo Convention and the bilateral agreement between Finland and Estonia**

The Ministry of the Environment has notified Estonia, Latvia, Lithuania and Russia of the initiation of the EIA procedure. The countries were requested to respond whether or not they intend to participate in the project’s assessment procedure and in this context also submit any comments on the EIA program. Estonia responded that it will participate in the procedure. The Russian Ministry of Natural Resources responded that Russia will participate but the country’s official response will be provided via the Russian Ministry for Foreign Affairs. Lithuania responded that the country will not participate in the assessment procedure but provided comments in its statement. Latvia responded that it will not participate in the assessment procedure but requested access to the EIA report for information.

The EIA program was also submitted for information to Sweden, Denmark, Germany and Poland.

In its statement, Estonia required, e.g. that the studies of underwater cultural heritage and the methods employed to assess the project’s impacts must be presented clearly and that an expert must be employed in the preparation of the impact assessment. The EIA procedure must also cover the assessment of the impacts of explosions, maintenance measures and decommissioning. The planned Nord Stream gas pipeline must be included in the cumulative impacts studied. Attention was also paid in the statement to the need to provide more recent data about the number of gray seals. The assessments of the impacts on fish and fisheries must also be made more specific and supplemented. The Natura assessment screening must be presented as a separate section of the report. The EIA must present up-to-date information about the possible LNG terminal in Finland and Estonia.

In its comments Lithuania pointed out that the project may, particularly during construction, have negative impacts on seal and fish populations and Natura sites and species living on the sites. Recommendations made by researchers concerning the scheduling of construction work and gas pipeline routing choices should be taken into account.

The full international statements can be found online at www.ymparisto.fi/balticconnectorYVA.

**Summary of opinions**

Project

The Balticconnector project should be required to involve an EIA program and monitoring plan as extensive as those of the Nord Stream project.

There is only one routing for the long offshore section in the comparison of alternatives. As regards the offshore pipeline, an alternative passing east of the Ingå Natura site should also be considered or justifications should be provided for why it was not taken into consideration.

The ALT FIN 2 alternative would not require intervention with untouched seabed sections. The need for dredging and blasting would be smaller than with the opening of a new channel. The compatibility and the appropriateness of the reconciliation of simultaneous projects affecting the area should be considered seriously, first of all from the perspective of the natural environment but also from the perspective of impacts on municipal economy and society. The alternative that is the least damaging, polluting and burdening during operation on the natural environment must naturally be selected.

It would be good to obtain comparative data for the report about other corresponding
gas pipeline projects to ensure the utilization of experience gained in them. In addition to the volume of rock required, rock sourcing and the impacts of rock transport to and from the port should be studied. In this lessons could be learned from the Nord Stream phase 2 program.

Impacts on marine area and natural environment

The impacts of seabed intervention on sediments and their eutrophicating impact in the aquatic ecosystem must be studied, with the Marine Strategy Framework Directive also taken into account.

Seabed blasting, dredging and other intervention may have major local impacts on the archipelago ecosystem. Environmental studies must be employed to obtain data for the optimization of the opportunities to find a route through the archipelago with the lowest adverse impacts from the environmental perspective. The studies of the impacts of the pipeline on the seabed and surrounding coastal areas must be conducted in considerably greater detail than presented in the program.

Sacrificing Fjusö, which is mostly in its natural state, to the natural gas pipeline and LNG terminal is questioned because there are already industrial areas in its vicinity. There is an area notation in the Joddböle land use plan for a possible gas pipeline, but in the EIA the landfall site is given in a different location than in the land use plan. It would be detrimental to the natural environment of the archipelago to destroy a new site on Fjusö.

As regards land areas of Ingå, a key site to be assessed concerning impacts is the regionally valuable Oxhagen forest area with considerable nature values due to its diverse biotopes and the large size of the area.

The Finnish and HELCOM Red Lists of species must also be taken into account as regards the species and habitat types of the marine area. The Natura assessment screening should also be conducted concerning the Ingå archipelago, taking the integrity of the site also into consideration.

Land use

The land use planning and activities of the Joddböle industrial area must be developed in a sustainable manner. Included in land use plans for a long time, the construction of the railway line would serve the Port of Ingå, the freezing facility, fishing harbor, potentially the LNG terminal as well as new industrial enterprises that are hoped for the area.

Cultural environment and landscape

The impacts of the gas pipeline on landscape and cultural heritage will be the highest during pipeline construction. Therefore the pipeline routing must avoid and conserve valuable areas.

Cumulative impacts

The program does not take all projects in the Joddböle area into account, such as the decommissioning of the power plant, the extension of the Port of Ingå and the Rudus Oy coastal rock crushing facility project. In addition to the above-mentioned projects, the possibility of Joddböle railway line arrangements must also be taken into account in the cumulative impacts.

## 4. COORDINATING AUTHORITY'S STATEMENT

The Balticconnector natural gas pipeline project will cover the territories and territorial waters of the states of Finland and Estonia and the Finnish and Estonian Exclusive Economic Zones.

The environmental impact assessment (EIA) program covers the content requirements specified in section 9 of the EIA Decree, and the EIA program has been processed in the manner required by EIA legislation.

In addition to those presented in the EIA program, attention should be paid to the following issues in the performance of the studies and the drawing up of the EIA report.

The Gulf of Finland is sensitive and has unique natural conditions, and it suffers from excessive burdening. Therefore the natural gas pipeline must be designed and implemented with care to minimize any adverse environmental impacts. The project's environmental impacts must be assessed for the project's entire lifecycle.

### Project description

The purpose, background and Developer of the project are presented clearly in the EIA program. The description of the project and the current status of its environment are, however, non-specific and some of the information provided in the EIA program is out of date or insufficient. This information must be supplemented and made more specific to be able to conduct a specific assessment.

Sufficiently detailed map data is necessary for the assessment of the suitability of the proposed routing alternatives and any need for further studies. In addition, the project's land use needs and the need for seabed intervention, as well as the construction phases and methods, including munitions clearance, pipelaying, pipelaying fleet and equipment, subsea rock installation and crossing structures, must be presented and assessed clearly and in detail. The report must also present the type of rock material to be used and the source and transport method of the rock material. The environmental impacts of the pressure test conducted during the pre-commissioning phase must be studied and assessed more specifically.

It is stated in the EIA program that, to avoid and mitigate adverse environmental effects, the best and most environmentally friendly techniques will be selected for all phases of the project.

### Examination of alternatives

More routing alternatives must be presented in the EIA report. The EIA program only examines two offshore routing alternatives, which only differ from each other in a short section. The precautionary principle must be followed in project design and implementation, and the best alternative from the environmental perspective must be proposed for the gas pipeline in the EIA report. Any need to supplement Natura 2000 sites must also be taken into consideration in the route selection.

Furthermore, the coordinating authority finds that the previously examined routing alternatives of the project must be presented in greater detail, and their exclusion from the shortlist and the inclusion of the current alternatives must be justified.

The EIA program only presents one natural gas pipeline landfall site, and this site is not in compliance with the local detailed plan currently in effect. More landfall alternatives must be presented and the inclusion of the alternatives must be justified in the EIA report.

### Strategies, programs and plans concerning the project and project area

All acts, decrees, environmental agreements, programs and policies as well as the EU maritime spatial planning directive currently under preparation relevant to the project or project area must be presented and taken into consideration in the EIA report.

The EIA report must also contain a description of how the strategic objectives and measures of the Finnish marine strategy will be taken into account in project design, implementation and operation.

**Investigation of impacts and assessment of significance**

The assessment of impacts in the EIA program focuses on key impacts from the project perspective, and the issues assessed are, as a general rule, presented clearly. The most significant project impacts are assessed to be caused by the measures taken to install the pipeline on the seabed. Impacts during pipeline operation are presumed to be low and mainly affecting fisheries and vessel traffic. The planned assessment must be specified further regarding the following issues.

The methods used to assess the project's impacts are presented insufficiently and must be presented in greater detail in the report.

The Coordinating Authority finds that the most important issue in the examination and mitigation of the pipeline's environmental impacts is pipeline route optimization. Route investigations and optimization must be carried out with a view to minimizing seabed intervention. The aim of route optimization for sections outside near-shore shallows must be to avoid blasting, dredging or other heavy seabed intervention methods.

The Coordinating Authority states that the use of a dynamically positioned pipelaying vessel in pipelaying is a better option from the environmental perspective than the use of an anchored vessel. The negative impacts caused by the protection of the pipeline are higher than those caused by pipelaying onto the seabed. Therefore efforts must be made to minimize the length of the pipeline section the protection of which is found necessary. In coastal shallows where the pipeline must be protected for reasons including safety aspects, it must be determined whether burying the pipeline the seabed or covering it with rock is the preferred option from the environmental perspective. The impacts of the alternative methods must be assessed and the adverse impacts of measures must be minimized.

The area affected by the project depends on the nature of the impact examined. The scopings of the various affected areas must be presented and justified in the EIA report.

**Impacts on the Gulf of Finland**

A diverse description of the status of the Gulf of Finland is provided, but the description must be supplemented in the EIA report using existing data, such as monitoring results, as well as data obtained from further studies. The figures provided for issues such as the oxygen situation of the Gulf of Finland illustrate the oxygen situation in the deep sections of the Gulf of Finland but do not illustrate the situation in areas off Ingå or in coastal areas in general.

The coastal water body in which the landfall site will be located is the Ingå Fagervik water body of the western inner archipelago, the ecological status of which is classified as bad (River basin management plan until 2015). It borders on the Upinniemenselkä water body of the southwestern outer archipelago, which is classified as poor, and the Orslandet water body of the southwestern inner archipelago, which is classified as bad. Outside these, the Porkkala-Jussarö water body of the southwestern outer archipelago is classified as moderate. Published in October 2013, the new classification proposal classified the above-mentioned water bodies as poor, with the exception of Orslandet, which is still classified as bad. These classification changes are not regarded as being due to changes in the status of the water bodies but due to more data being available and changes having been made to classification criteria.

The nature of impacts on water bodies is identified well in the EIA program, with the principles of impact assessment and the need for studies presented clearly on the basis of this. However, the description of existing data and planned studies is very non-specific, which makes it difficult to assess their sufficiency. Impacts must be assessed in all respects with such level of detail that the differences between the alternatives can be assessed reliably. Impacts on all long-term stations monitoring the status of the marine environment in the project area must also be assessed.

Work methods and measures including those on the seabed are presented at a very general level, and more specific data must be obtained for the impact assessment on issues such as excavation, dredging and subsea rock installation as regards both quantities of materials and the location of measures.

The Project Developer must assess the project's impacts on the achievement of the objectives set for the status of waters and, as regards river basin management, concerning coastal water bodies, and, as regards marine strategy, concerning marine waters in the entire territory of Finland.

**Impacts on the natural environment**

Nature surveys produced previously for the area must be taken into account in the preparation of the report. Moor frog and breeding bird surveys must also be conducted concerning the Fjusö area. Up-to-date information must be provided about the numbers of seals in the area affected by the project.

Impacts during natural gas pipeline construction and operation on the Kallbådan Natura 2000 site, which is significant for the protection of the gray seal,
and on other areas where seals occur must be studied. Pipeline construction must be implemented and scheduled in a manner minimizing adverse impacts on seals.

The motivation for the establishment of the Ingå archipelago Natura 2000 site is primarily based on the bird values of the area. There are two significant resting sites of Long-tailed Duck, a globally Vulnerable (VU) species, in the marine area close to the gas pipeline routing. To establish the more specific area boundaries and significance of the resting sites, a survey of migrating birds resting in the Ingå archipelago Natura 2000 site must conducted.

It is proposed in the EIA program that the screening to establish the need for a Natura 2000 assessment be conducted during the EIA procedure. The Coordinating Authority states that there is a need to supplement the Natura 2000 network for underwater habitat types, mainly reefs and sandbanks. These habitat types may be found in the area affected by the planned gas pipeline, whereby the assessment must cover the impacts of the alternatives on any areas to be included in Natura 2000 sites.

**Impacts on fish and fisheries**

The description of the fisheries impacts assessment methods is non-specific. The EIA program does not provide a sufficient amount of information about existing research data that can be utilized, new studies to be conducted or methods to be employed in them. The program does not specify the areas in which studies will be conducted either.

The description of the fisheries impacts assessment methods must also be specified further by describing the potential impacts on fisheries during construction and operation. As regards impacts during construction, the report must also specify which existing research data has been utilized, which new studies have been conducted and which methods have been employed in the sourcing of research data.

The EIA report must present the current fishing areas in areas around the pipeline routing on a map to facilitate the assessment of the pipeline and pipelaying measures on fishing.

**Noise impacts**

Under the Act on Water Resources Management and the Decree on the Management of the Marine Environment, the impacts to be assessed concerning the project also include underwater noise. Underwater noise may not occur at levels with adverse impacts on the marine environment. Assessments of noise during construction and operation must be conducted in compliance with the following decisions and limit values: Commission decision on criteria and methodological standards on good environmental status of marine waters (2010/477/EU) and Government resolution on Finland’s marine strategy (first part).

The studies presented in the EIA program concerning noise generated by the activities are, as a general rule, sufficient. However, the EIA report must present as well as possible the various noise-generating activities or processes as regards durations, locations and the commonness of any recurring noise events as well as the propagation of noise generated by these into the environment. If an activity may cause temporary high-noise events, these and the noise generated must be described separately, with the calculations presenting equivalent continuous sound level during such activity as well as maximum sound level caused by the activity in the surrounding area. The EIA report must also provide a clear presentation of the noise abatement measures or best available technologies that will be used to mitigate noise propagation in the environment.

As regards noise relating to construction, the report must present how adverse impacts caused by activities generating high noise and pressure levels, such as blasting and other excavation, on organisms in the area can be reduced. In addition, the potential impacts of these activities on humans and any restrictions on use of areas during the construction phase (such as duration and location of activities) must be presented.

**Impacts on land use**

The EIA report must present the up-to-date statutory land use planning situation and clearer land use plan maps. The plan notations given in plans concerning the area must also be elaborated in the report.

The Helsinki-Uusimaa regional land use plan and first-phase Helsinki-Uusimaa regional land use plan are in effect for the area. The onshore section of the planned natural gas pipeline in Joddböle runs through an area designated as an industrial area with rock resources in the regional land use plan. The reconciliation of the project and the use of the area's rock resources as well as the cumulative impacts with known projects must be examined in the EIA report. In the marine area the pipeline alternatives run through an area designated as a Natura site in the regional land use plan.

Any need for amendments to the local detailed plan of Joddböle must be examined.

**Impacts on archaeological cultural heritage, cultural environment and landscape**

As regards onshore cultural heritage, the valuable items and sites of built cultural environment and landscape are presented sufficiently in the EIA program.

Regionally valuable cultural environments must be updated to the report in accordance with the latest surveys. These can be found appended to the second-phase Helsinki-Uusimaa regional land use plan and are based on a study conducted on the topic (Uusimaa Regional Council 2012).

The project may have impacts on underwater as well as onshore archaeological cultural heritage, particularly during the construction phase. A clear map must be provided on the known ancient monuments in and close to the project area. The map of shipwreck sites must be supplemented. If any ancient monuments are detected, the mitigation of adverse impacts and the procedure under the Antiquities Act must be agreed upon with the National Board of Antiquities. It is important to determine reliably in conjunction with the preparation and design of the Balticconnector project whether there are any underwater cultural heritage and ancient monument sites in the area covered by the marine works relating to the project. This must be examined through an underwater archaeological inventory carried out by an expert, with an inventory report also produced. The Antiquities Act does not apply to the Exclusive Economic Zone (EEZ), but it must also be ensured in the EEZ as well that an inventory is conducted on the pipeline routing to detect any cultural heritage sites and it must be ensured in project design that cultural heritage items and sites are not destroyed or damaged in conjunction with the project.

**Traffic impacts**

The project will have impacts on waterborne traffic in the area, especially during pipeline installation, as the pipeline routing will cross several shipping routes.
The Project Developer must contact the Finnish Transport Agency and agree on the studies required for detailed design. Vessels used for exploration and installation work must maintain continuous contact with Finnish and Estonian traffic control centers and comply with instructions provided by the centers as well as International Regulations for Preventing Collisions at Sea (COLREGs) as well as national rules of the road at sea. The Project Developer must submit the coordinates of the pipeline to be implemented in good time to the Finnish Transport Agency for inclusion on nautical charts to inform other seafarers. Guidelines provided by the Finnish Transport Agency must be followed in pipeline installation and signposting.

As regards impact on road traffic, the scale of deliveries, routes and sufficiency of the local road network for these must be studied in particular. In addition, any traffic safety risks relating to land transport must be investigated.

**Cumulative impacts with other projects and activities**

Other projects, including relevant rights, located in or planned for the area affected by the project must be taken into account in all activities and the precautionary principle must be followed in the project. The routing, construction and operation of the natural gas pipeline must be planned and implemented in a manner not preventing current or future scientific research or commercial exploitation projects in the EEZ and ensuring that the adverse impacts caused by the project on such projects will be as low as possible.

The information provided in the EIA program concerning other projects is insufficient (e.g. the expanding operations of Rudus and the Ingå power plant ash deposition site were not mentioned and the location given for the planned LNG terminal is incorrect). **According to feedback received, the planned gas pipeline will also intersect with onshore items (oil pipeline, water and sewage pipe, planned road to the fishing harbor).** The Coordinating Authority finds that the appropriate assessment of the cumulative impacts will require updates to the information provided in the EIA report.

**Impacts on safety and people’s living conditions**

The permit procedures in compliance with the Act on safety in the handling of dangerous chemicals (390/2005) and the provisions laid down pursuant to the Act have been taken into consideration in the EIA program.

Risks posed by accidents and incidents to local residents and environment must be presented clearly in the EIA report. Furthermore, the procedures to prevent and control damage must be described.

Any impacts on the utilization of fish for human consumption must be taken into account in the impact assessment.

The impacts of increased turbidity will need to be assessed also as regards impacts on bathing water in the area affected by the project.

**Monitoring**

A proposal for a monitoring program concerning the project's impacts must be presented in the EIA report. Monitoring must take place before and during construction as well as during operation. The aim of monitoring is to obtain information about the project's impacts on the environment and the success of the mitigation measures and to identify any unexpected impacts caused by the project.

**Other points**

- Section 3.4.4 does not specify Kallbådan as a seal conservation area.
- Section 3.4.4 states erroneously that the gray seal and ringed seal and listed in Annexes II and IV to the Habitats Directive. They are listed in Annexes II and V to the Habitats Directive. According to the Red List of Finnish Species, the ringed seal is classified as Near Threatened (NT) while the gray seal classification is Least Concern (LC).
- Section 4.3.2.5 states erroneously that half of the Kallbådan Natura 2000 site is located outside Finland's territorial waters. The site is located in the municipalities of Kirkkonummi and Ingå.
- Section 3.5.2 states erroneously that demersal trawling is prohibited in the Gulf of Finland.

**Participation and reporting**

During the public display of the EIA program, a presentation event was organized at the Kyrkfjärden school on March 25, 2014, attended in addition to the representatives of the Project Developer, consultant and Coordinating Authority by around 20 persons. Matters discussed at the event included the project location, alternatives, impacts and restrictions during construction, landscape and noise impacts, land use planning, LNG terminal, economic impacts, impacts on wells of water intended for human consumption, and compensations. It was also brought up that notifications of the project must also be published in Helsinki Metropolitan Area newspapers because some of the people are holiday residents.

A presentation and discussion event for the authorities was organized at the Uusimaa Centre for Economic Development, Transport and the Environment on March 14, 2014.
The participation arrangements are presented clearly in the EIA program. The project has had a steering group. Material relating to the assessment has also been available online on the EIA site of the Uusimaa Centre for Economic Development, Transport and the Environment.

**International procedure**

International procedure under sections 14, 15 and 22 of the EIA Act is applied to this EIA procedure. The matters agreed under the Espoo Convention and the bilateral agreement between Finland and Estonia must be taken into account in the assessment procedure and the drawing up of the EIA report.

Consequently, the Project Developer must ensure that the EIA report contains the supplementation needs brought up by in the statement of Estonia dated April 25, 2014. The Ministry of the Environment attends to the notification and negotiation duties relating to the Espoo Convention.

## 5. PUBLIC DISPLAY OF THE STATEMENT

We will send the Coordinating Authority's statement for information to the statement providers and inform those submitting an opinion about the statement. The statement is available online at www.ymparisto.fi/balticconnectorYVA.

We will send copies of the statements and opinions received on the EIA program to the Project Developer. The original documents will be stored at the Uusimaa Centre for Economic Development, Transport and the Environment.

Director Satu Pääkkönen

Senior Officer Leena Eerola

APPENDIX 1) Charge determination and appeal

The statements and opinions (in Finnish or Swedish) received can be found online at www.ymparisto.fi/balticconnectorYVA.

CC The Finnish Environment Institute (statement + 2 copies of EIA program)
Providers of statements
Providers of opinions

## APPENDIX 1

## CHARGE DETERMINATION AND APPEAL

### Applicable law

Section 8 of the Act on Criteria for Charges Payable to the State (150/1992)
The Act on amendments to sections 1 and 8 of the Act on Criteria for Charges Payable to the State

Government Decree of January 9, 2014 on chargeable performances of Centres for Economic Development, Transport and the Environment as well as Employment and Economic Development Offices in 2014.

The charge payable for the consideration of an environmental impact assessment program is €80 for each hour taken to process the matter. A total of 312 hours were taken to consider this EIA program.

### Appeals against a charge

A party required to pay a charge that considers that an error has been made in setting the charge for the statement can ask the Centre for Economic Development, Transport and the Environment for a rectification within six months of the date of issue of this statement.

# ANNEX 2: NATURA 2000 ASSESSMENT SCREENING

Recipient
**Gasum**

Document type
**Natura 2000 assessment screening**

Date
**October 15, 2013**

# BALTICCONNECTOR

## NATURAL GAS PIPELINE CONNECTION

## ESTONIA-FINLAND

## NATURA 2000 ASSESSMENT SCREENING

# NATURAL GAS PIPELINE CONNECTION ESTONIA-FINLAND
# NATURA 2000 ASSESSMENT SCREENING

| | |
|---|---|
| Date | **October 15, 2013** |
| Authors | **Juha Kiiski, Tarja Ojala** |
| Reviewed by | **Riina Känkänen, Lauri Erävuori** |
| Accepted by | **Tommi Marjamäki** |
| Description | **Natura 2000 assessment screening for the Balticconnector natural gas pipeline project** |

| | |
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## CONTENTS

# 1. INTRODUCTION

Gasum Corporation is planning a natural gas pipeline connection (Balticconnector) between Finland and Estonia. If implemented, the project would interconnect the Finnish and Estonian natural gas distribution networks. In Finland's territorial waters the routing alternatives would run from offshore areas to the Ingo archipelago area and further to the Fjusö Peninsula. On the Fjusö Peninsula the gas pipeline would make landfall and the onshore section would run further to a compressor station planned for Joddböle.

As part of the project's environmental impact assessment (EIA) procedure, the potential impacts of the project alternatives on Natura sites near the project area were studied regarding the section of the gas pipeline passing through Finnish waters. It was assessed regarding both of the alternatives whether an appropriate Natura assessment referred to in section 65 of the Nature Conservation Act should be conducted in the further planning and design phase of the project. The work was commissioned by Gasum Corporation, and the Natura 2000 assessment screening was conducted by Ramboll Finland Oy.

# 2. PROTECTION OF NATURA SITES AND OBLIGATION TO CONDUCT IMPACT ASSESSMENTS

## 2.1 Natura protection

The Natura network was established to protect habitat types, species and their habitats referred to in the EU Habitats Directive (892/43/EEC) and Birds Directive (79/409/EEC) occurring in areas classified or proposed for inclusion in the Natura network by Member States. The network seeks to achieve the long-term maintenance of Europe's endangered species and habitat types. Member States are tasked with ensuring that the Natura assessment is, where necessary, conducted in conjunction with the preparation and decision-making relating to projects and plans to make sure the nature values due to which the area was included or proposed for inclusion in the Natura network *are not significantly deteriorated*. Activities deteriorating conservation values are prohibited within and outside the boundaries of sites.

Conservation measures corresponding to the conservation objectives must be taken on sites included in the Natura network. Conservation is implemented on the Natura sites off Ingå, Finland, through measures including those under the Nature Conservation Act, Building Act and Water Act. The method employed affects issues such as the types of activity possible on each Natura site. The protection of those Natura sites on which the strongest restrictions are in place on ordinary land use is implemented under the Nature Conservation Act. On those sites most measures modifying the environment are prohibited. The conservation implementation method usually employed for areas protected under the Building Act is a legally binding land use plan. The Water Act lays down provisions on water quality and measures affecting the seabed.

## 2.2 Determination of assessment obligation

Areas included in the Natura network are selected on the basis of the EU Habitats Directive (Sites of Community Importance, SCI) and/or the Birds Directive (Special Protection Areas, SPA).

Under section 65 of the Nature Conservation Act, *"If a project or plan, either individually or in combination with other projects and plans, is likely to have a significant adverse effect on the ecological value of a site included in, or proposed by the Government for inclusion in, the Natura 2000 network, and the site has been included in, or is intended for inclusion in, the Natura 2000 network for the purpose of protecting this ecological value, the planner or implementer of the project is required to conduct an appropriate assessment of its impact. The same shall correspondingly apply to any project or plan outside the site which is liable to have a significantly harmful impact on the site."*

Sections 65 and 66 of the Nature Conservation Act entail that planned projects or the cumulative impacts of different projects may not significantly deteriorate those nature values due to which the site was classified, proposed for inclusion or included in the Natura network. On the other hand, activities changing the natural environment can also take place within a Natura site if their impacts do not significantly deteriorate features motivating the protection of the Natura site or the coherence of the site.

The permitting authority is tasked with ensuring that the assessment is appropriate and the conclusions justified. The assessment obligation applies to areas listed in Government decisions that are included as SCIs and SPAs in accordance with the Habitats and Birds Directives. The assessment obligation arises if the project's impacts:

- affect nature values motivating the protection of the Natura site;
- may be deteriorating by nature;
- may be significant;
- cannot be ruled out on the basis of objective facts.

The nature values from the perspective of which the impacts must be examined are specified in the Standard Data Forms specific to each Natura site found in the Natura 2000 database. Depending on the site, the nature values to be assessed are:

- habitat types listed in Annex I to the Habitats Directive (Sites of Community Importance, SCI);
- species listed in Annex II to the Habitats Directive (Sites of Community Importance, SCI);
- bird species listed in Annex I to the Birds Directive (Special Protection Areas, SPA); and
- migratory bird species regularly resting in the area not listed in Annex I to the Birds Directive (Special Protection Areas, SPA).

Consequently, for SCIs the assessment is based on conservation values (habitat types and species) in accordance with the Habitats Directive, for SPAs on species listed in the Birds Directive and migratory bird species, and for SCI/SPAs both.

The deterioration of nature values in practice means the destruction and/or degradation of the habitat type. In species examinations, deterioration means the deterioration of the quality of the habitat or a disturbance impact on individuals of the species. Other issues to be taken into account in assessments of deterioration of nature values include changes affecting the favorable conservative status of the habitat type or species as well as the impact of the site on the coherence of the Natura 2000 network. The criteria for deterioration derived from the definitions of a favorable conservation status for habitat types are the reduction of the area of the habitat type or the deterioration of ecosystem structure and functioning necessary for the habitat type's typical species. At the species level, deterioration means deterioration of the quality of the habitat of the species, reduction in distribution, reduction in population size or disappearance of population.

The assessment of the significance of the impacts is affected by factors such as the extent of the changes and the significance and location of the nature values. The decisive factor is the significance of the deteriorating impacts to the site's habitat types and/or species. The precautionary principle must be applied in assessments of impact significance: the assessment must be conducted if significant deteriorating impacts cannot be ruled out on the basis of objective facts.

Five aspects are included in the screening: 1) description of the project or plan, 2) description of the Natura site and the impacts on it, 3) assessment of the significance of the impacts, 4) examination of mitigation measures and alternatives as well as cumulative impacts, and 5) conclusions and evaluation of impacts. The conclusion of the screening can be:

1) Will not deteriorate Natura values; Natura assessment not required.
2a) Will deteriorate Natura values; Natura assessment must be conducted.
2b) Occurrence of impacts uncertain; Natural assessment must be conducted.

# 3. BASELINE DATA AND ASSESSMENT METHODS

The Natura 2000 assessment screening was conducted primarily on the basis of existing data. The data on the conservation values of Natura sites in the vicinity of the project area was obtained from the Standard Data Forms for the Natura sites. Other sources of information about the natural conditions of the site were the Metsähallitus biotope data for the Ingå archipelago Natura site (database extraction April 9, 2013) and field observations made for bird surveys conducted in the project area in 2013. With studies conducted on the area yet to be completed, environmental monitoring reports of the Vuosaari harbor project (Vatanen et al. 2012) and Nord Stream gas pipeline project (Hanski et al. 2010) were utilized in the assessment of potential project impacts on Natura sites.. The descriptions of the project's work phases and technical data are mainly based on the draft EIA program of the project.

# 4. PROJECT DESCRIPTION

## 4.1 Location of the project area

The project area is located in archipelago areas of Ingå and in part in offshore areas of Raseborg (Figure 4-1). The total length of the offshore section of the gas pipeline is 81 km, of which the section passing through Finland's territorial waters is around 33–36 km depending on the alternative.

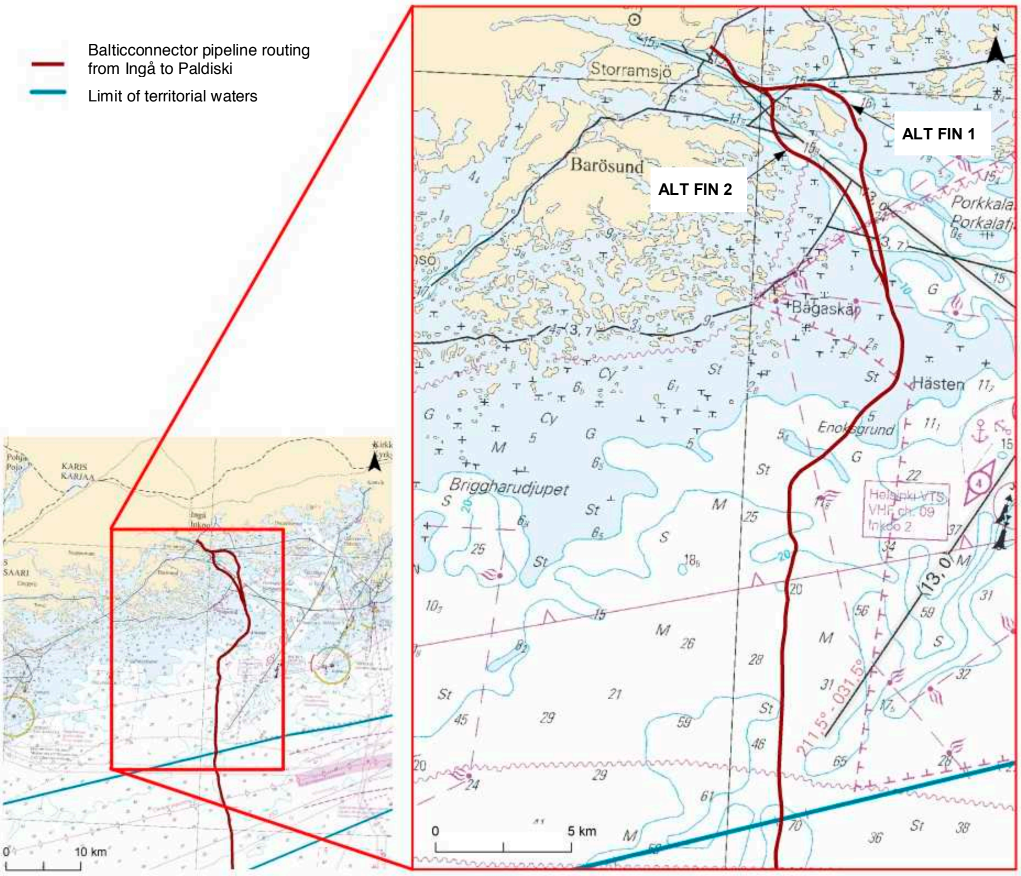


**Figure 4-1 Locations of the gas pipeline routing alternatives in Finland's territorial waters.**

## 4.2 Project alternatives

The planned offshore natural gas pipeline will run between Paldiski, Estonia, and Ingå, Finland. Two alternatives are examined for the Ingå middle and outer archipelago areas. In alternative 1 the gas pipeline would pass north and east of the island of Stora Fagerö and cross a fairway southeast of Stora Fagerö. In alternative 2 the gas pipeline would pass between Stora Fagerö and Älgsjö and cross a fairway northwest of Stora Fagerö. In both alternatives the pipeline route would pass through the Ingå archipelago Natura site (FI0100017). The pipeline section coinciding with the Natura site is 12 km long in both alternatives. Neither of the alternatives examined will pass through other Natura sites.

Three different alternatives have been proposed for examination in the project’s environmental impact assessment concerning Finland’s territorial waters:

- Alternative 0: The Balticconnector natural gas pipeline will not be implemented. The natural gas pipeline from Paldiski to Ingå will not be constructed.
- Alternative ALT FIN 1: Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Paldiski, Estonia, to Ingå, Finland, route north of Stora Fagerö.
- Alternative ALT FIN 2: Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Paldiski, Estonia, to Ingå, Finland, route west of Stora Fagerö.


**Figure 4-2 Planned routes for Alternatives ALT FIN 1 and ALT FIN 2.**

The landfall site of the offshore section of the natural gas pipeline will be located in Fjusö, Ingå, with the ALT FIN 1 as well as ALT FIN 2 alternative (Figure 4-2). The routing alternatives ALT FIN 1 and ALT FIN 2 of the natural gas pipeline differ from each other in the sections passing through the Ingå middle and outer archipelagos. Moving from the mainland towards the open sea, ALT FIN 1 and ALT FIN 2 split northeast of Jakobramsjö and continue as separate routings until Bågaskär. With both alternatives the route would then pass west of the island of Hästen into the offshore area and further to Paldiski, Estonia.

## 4.3 Description of the construction phase

**Pipelaying**

According to the preliminary plans, the diameter of the gas pipeline laid on the seabed will be 20 inches (508 mm). The pipeline will consist of several layers; the innermost layer will be coated with an epoxy-based material, while polypropylene will be used for the more external layer and concrete for the outermost weight coating. The offshore gas pipeline will be installed using either an anchored or dynamically positioned pipelaying vessel. Depending on the type of pipelaying vessel employed, anchor tugboats, pipe supply vessels and monitoring vessels will be required for the pipelaying process in addition to the actual pipelaying vessel. The primary principle in the construction of the offshore section is to construct the gas pipeline by welding together line pipes that are 12 m in length on board the pipelaying vessel and lower the completed pipe string onto the seabed. A safety zone that may not be accessed by other vessels without a separate permission will be established around the pipelaying vessel during pipeline construction.

**Pipelaying and anchoring**

The pipelaying and anchoring on the seabed during the construction of the gas pipeline will vary depending on factors such as the geophysical properties of seabed sediments, the depth of the sea, and the location of telecommunications cables. Seabed intervention measures carried out include trenching, subsea rock installation, bedrock peak removal, and filling. Subsea rock installation is necessary to ensure the stability of the pipeline.

**Seabed intervention**

The pipeline will be laid in a trench that is around 2 m deep and 5 m wide. Trenching will take place at least in sections close to the shore and shallows as well as on fairways. Depending on the water depth, trenching can take place using excavating, suction dredging or jetting. The trench will be backfilled using seabed sediments or crushed rock after pipelaying. In deeper sections the gas pipeline will mainly remain exposed. Blasting will take place for sections that have boulders and/or bedrock where filling is not a feasible option. In blasting, explosives are used to break the bedrock and/or boulders.

At crossings of the gas pipeline and telecommunications cables, telecommunications cables are usually buried deeper than the gas pipeline. Crushed rock will be used to cover the cables. At crossings of high-voltage cables and the gas pipeline, support structures protecting the cables will be installed between the cable and the pipeline (rock/bitumen cover or concrete cover).

The progress made in gas pipeline construction will depend on seabed topography and type. In shallow areas (coast and shallows) more seabed intervention will take place than in sections with depths exceeding 20 m. In deep-water areas the daily pipelaying rate will be around 2–3 km. Close to the coast and in shallows progress in construction is estimated to be made at 300–1,000 m/day.

**Pipeline testing**

The pre-commissioning measures will include pipeline inspections to ensure pipeline integrity and compliance with requirements. These include a pressure test using seawater. The seawater led into the pipeline will be treated with oxygen scavengers, dyes and microbiocides. The purpose of oxygen scavengers is to prevent internal corrosion of the line pipes. Biocides are used to prevent the growth of bacteria that might facilitate internal corrosion. Dyes are used to detect any leaks in the gas pipeline. After the pressure test the pipeline will be de-watered using methods such as dried compressed air. After this the pipeline will be cleaned by running a pig propelled by compressed air or the gas flow. The leak-tightness of the pipeline will also be tested in this context.

### 4.4 Operation

Natural gas will flow in the gas pipeline during operation. The operation of the natural gas pipeline will be controlled and monitored from the central control room located at the Kouvola Natural Gas Centre and staffed around the clock. Central control room staff monitor gas pipeline and compressor station process data and control the processes whenever necessary.

The pipeline will be subjected to regular internal and external inspections throughout its operational life. External inspections include inspections of pipeline location and condition as well as corrosion protection. Internal inspections will be carried out using pigs.

### 4.5 Decommissioning

The gas pipeline will be an energy transmission system designed for continuous use, with its condition maintained continuously. Towards the end of their technical operational life, gas pipelines are normally replaced with a new parallel pipeline (diversion) and the decommissioned pipeline is left in place. The proposed lifecycle of the pipeline is 50 years. Pipeline decommissioning will take place at that point in the manner required by the legislation in force at that time.

## 5. NATURA SITES IN THE VICINITY OF THE PROJECT AREA

### 5.1 Location

There are several sites included in the Natura network in the vicinity of the sections of the natural gas pipeline project passing through Finland’s territorial waters. There are a total of 10 Natura sites located within around 15 km from the pipeline routing alternatives, with five of these in marine areas (Figure 5-1). Four of these represent marine areas proper, while the Älgsjölandet-Rövass herb-rich forests Natura site covers mineral soils in part bordering on Ingå marine areas. The assessment includes the Natura sites presented in Table 5-1, while the other Natura sites within 15 km are located on mineral soils on the mainland or islands and are not assessed to be impacted by the implementation of the project.

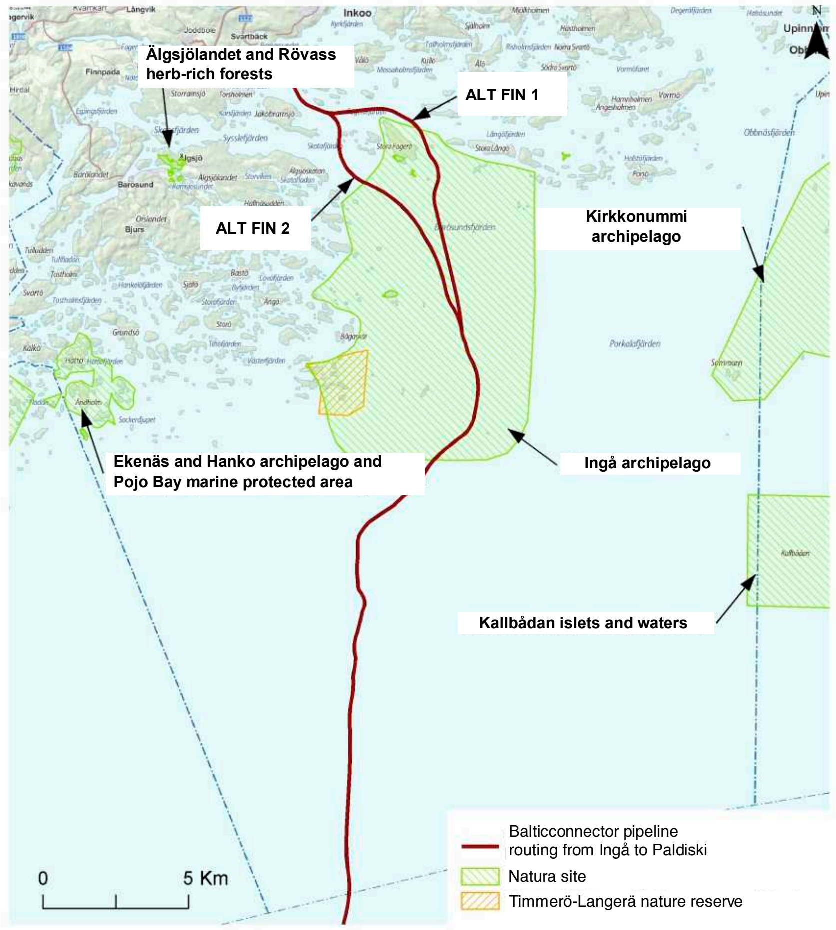


**Figure 5-1 Gas pipeline routing alternatives and Natura sites located in the vicinity of the project area.**

**Table 5-1 Natura sites in the vicinity of the project area.**

| Code | Title | Area (ha) | Site type | Shortest distance from gas pipeline (km) |
|---|---|---|---|---|
| FI0100017 | Ingå archipelago | 203 | SCI, SPA | 0 |
| FI0100016 | Älgsjölandet and Rövass herb-rich forests | 23 | SCI | 4,5 |
| FI0100026 (SCI) FI0100105 (SPA) | Kirkkonummi archipelago | 1 750 | SCI | 8 |
| FI0100005 | Ekenäs and Hanko archipelago and Pojo Bay marine protected area | 5 2630 | SCI, SPA | 9 |
| FI0100089 | Kallbådan islets and waters | 1 520 | SCI | 10 |

## 5.2 Ingå archipelago Natura site (FI0100017)

### Location and general description

The Ingå archipelago Natura site (FI0100017) is located in the interior of the Ingå archipelago area. The Natura site covers all of the terrestrial areas within the site boundaries excluding Hovskär, Fagerögrund and a small southwestern section of Stora Fagerö. The only aquatic area included in the Natura site is the aquatic area of the Timmerö nature reserve. The total area of the Natura site is 203 ha; the site comprises 135 ha of terrestrial areas and an aquatic area of 68 ha belonging to a previously established nature reserve. The conservation is implemented using measures under the Nature Conservation Act and the Building Act. The conservation of the Natura site has been implemented by setting up protected areas on privately owned land (Timmerö nature reserve YSA014152, Barö offshore nature reserve YSA010484 and Ådgrund-Rönngrundet nature reserves YSA011646). The conservation implementation for areas not designated as protected areas is based on local master plans.

The most significant conservation values of the Ingå archipelago Natura site comprise the habitat types of the Habitats Directive and the valuable bird species occurring in the area. The site is protected under the Habitats Directive (Sites of Community Importance, SCI) as well as the Birds Directive (Special Protection Areas, SPA). Islands on the site are rocky, excluding Stora Fagerö, the northern parts of which consist of an esker formation. The islets on the site are treeless and rocky.

The pipeline routing alternatives do not pass through any terrestrial or aquatic areas included in the Natura site. At its closest, the gas pipeline would run around 160 m from islets included in the Natura site and around 3.3 km from the Timmerö aquatic area included in the Natura site.

**Habitat types of Annex I to the Habitats Directive**

According to the Standard Data Form for the Ingå archipelago Natura site, a total of 12 habitat types of the Habitats Directive occur on the site (Table 5-2). Those of the habitat types of the Ingå archipelago Natura site that are classified as priority habitat types comprise Boreal Baltic coastal meadows, Fennoscandian lowland species-rich dry to mesic grasslands, Western taiga, and Fennoscandian deciduous swamp woods. The priority habitat types represent habitat types that are in danger of disappearance and for the conservation of which the Community has particular responsibility.

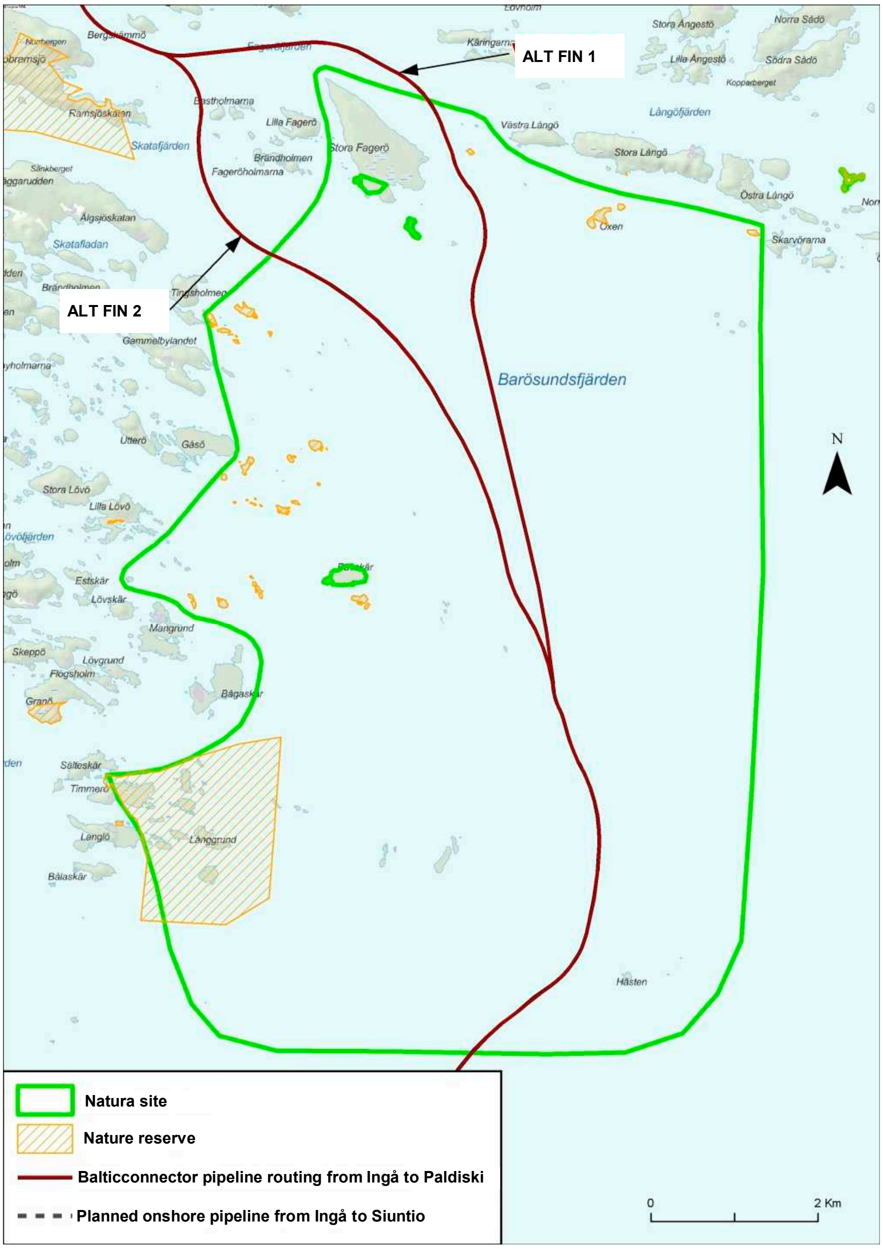


**Figure 5-2 Ingå archipelago Natura site; the lined area at the bottom of the map is the aquatic area protected as a private nature reserve.**

Habitat type data on most of the small islets and islands of the site is available in the Metsähallitus geographical information system. The material does not, however, cover the Natura site's underwater habitat types or, for example, the majority of the island of Stora Fagerö. The most common habitat type of the site is Boreal Baltic islets and small islands. The following habitat types reported on the Natura Standard Data Form were not detected in the habitat type inventory: annual vegetation of drift lines, Boreal Baltic sandy beaches, dry to mesic grasslands, and deciduous swamp woods. The habitat types of sandbanks which are slightly covered by sea water all the time, and reefs, can only occur in the aquatic area in the southern part of the Natura site.

**Table 5-2 Habitat types of Annex I to the Habitats Directive occurring in the Ingå archipelago Natura site according to data provided in the Standard Data Form and the habitat type inventory conducted by Metsähallitus, * = priority habitat type. The habitat types highlighted in green are not mentioned in the Standard Data Form but have been detected in the habitat type inventory.**

| Habitat type | Code | Area, ha, Metsähallitus data |
|---|---|---|
| Sandbanks which are slightly covered by sea water all the time | 1110 | - |
| Reefs | 1170 | - |
| Annual vegetation of drift lines | 1210 | - |
| Perennial vegetation of stony banks | 1220 | 0.2 |
| Vegetated sea cliffs of the Atlantic and Baltic coasts | 1230 | 4.2 |
| **Baltic esker islands** | **1610** | **2.7** |
| Boreal Baltic islets and small islands | 1620 | 15.2 |
| *Boreal Baltic coastal meadows | 1630 | <0.1 |
| Boreal Baltic sandy beaches with perennial vegetation | 1640 | - |
| *Fennoscandian lowland species-rich dry to mesic grasslands | 6270 | - |
| **Transition mires and quaking bogs** | **7140** | **<0.1** |
| **Siliceous rocky slopes** | **8220** | **0.8** |
| *Western taiga | 9010 | 3.0 |
| **Fennoscandian herb-rich forests** | **9050** | **0.2** |
| *Fennoscandian deciduous swamp woods | 9080 | **-** |
| ***Bog woodland** | **91D0** | **<0.1** |
| No habitat type | | 20.9 |
| **Total** | | **47.2** |

### Species of Annex II to the Habitats Directive

No species listed in Annex II to the Habitats Directive are mentioned in the Standard Data Form. Gray seal (*Halichoerus grypus)* is, however, known to occur occasionally in the Hästen area. The only gray seal sighting in the 2013 fieldwork season was made in September east of Stora Fagerö (1 individual).

### Bird species of Annex I to the Birds Directive

Species listed in Annex I to the Birds Directive nesting or regularly occurring in the area are Common Tern (*Sterna hirundo)*, Arctic Tern (*Sterna paradisea)*, Red-backed Shrike (*Lanius collurio)* and Caspian Tern (*Hydroprogne caspia)*. Species listed in Annex I to the Birds Directive also sighted in field surveys of 2013 as nesting in the area were Barnacle Goose (*Branta* *leucopsis)* and one threatened species. On the basis of breeding birds inventories carried out in May and June 2013, the best bird islets on the site are Stengrundet and Fagerögrundet located close to the island of Stora Fagerö, Storoxen located south of Jakobramsjö, and the islet east of Långholmen. Nesting on Fagerögrundet are species including a total of 70 pairs of Common and Arctic Tern; Ruddy Turnstone (*Arenaria interpres)*, Common Redshank (*Tringa totanus),* Barnacle Goose, and Tufted Duck (*Aythya fuligula)*. Birds breeding on Stengrundet include 30 pairs of Common and Arctic Tern; Caspian Tern, Tufted Duck and Common Redshank, while on Storoxen there are a total of almost 70 pairs of Common and Arctic Tern, 26 pairs of Common Eider; Tufted Duck, Barnacle Goose, Common Redshank and Eurasian Oystercatcher. On the small islet east of Långholmen the breeding species include Mute Swan (*Cygnus olor)*, Barnacle Goose, Tufted Duck, Velvet Scoter (*Melanitta fusca)* and around 20 pairs of Common Eider. Other species include Black Guillemot (*Cepphus grylle)* (around 5 pairs) and Caspian Tern (1 pair) occurring on Hästen and Greylag Goose nesting on Gåsoklobben and Lilla Fagerö (4 and 6 pairs, respectively).

**Migratory birds**

Migratory bird species not listed in Annex I to the Birds Directive regularly resting on the site comprise Gray Heron (*Ardea cinerea)*, Gadwall (*Anas strepera)*, Ruddy Turnstone, Eurasean Hobby (*Falco subbuteo)*, Velvet Scoter and Common Redshank. Other bird species found on the site are Black Guillemot, Lesser Black-backed Gull (*Larus fuscus)* and Ringed Plover (*Charadrius hiaticula)*.

Species sighted May in resting birds inventories during the 2013 fieldwork season include Long-tailed Duck (*Clangula hyemalis)*, Common Eider, Common Scoter (*Melanitta nigra)* and Velvet Scoter. The largest numbers of Long-tailed Duck in the area in May totaled around 1,500 individuals. The maximum numbers of Common Eider in the summer months totaled around 2,000. The occurrence of these species focuses on offshore areas and, for Common Eider, particularly in the Hästen, Sadeln areas and areas east of Bågaskär. In July around 350 Greylag Geese were sighted in the Bärö offshore area.

## 5.3 Älgsjölandet and Rövass herb-rich forests (FI0100016)

**Location and general description**

The Natura site is located in the sheltered inner archipelago of Ingå at the northeastern end of Älgsjölandet and the northern part of Orslandet. The Natura site is protected as a SCI under the Habitats Directive. The sections of the Natura site mainly border on surrounding mineral soils but in part also on shores of the inner archipelago. The total area of the Natura site is 23 ha. Herb-rich forests with oak trees and wooded pastures are found on the site.

At its nearest the planned gas pipeline would pass 4.6 km from the Älgsjölandet and Rövass herb-rich forests Natura site.

**Habitat types of Annex I to the Habitats Directive**

The habitat types listed in Annex I to the Habitats Directive occurring on the site are presented in Table 5-3.

**Table 5-3 Habitat types of Annex I to the Habitats Directive occurring on the Älgsjölandet and Rövass herb-rich forests Natura site according to data provided in the Standard Data Form, * = priority habitat type.**

| Habitat type of Habitats Directive | Code | Coverage (%) | Coverage (ha) |
|---|---|---|---|
| * Fennoscandian old broad-leaved deciduous forests | 9020 | 5 | 1 |
| Fennoscandian herb-rich forests | 9050 | 85 | 20 |
| Fennoscandian wooded pastures | 9070 | 1 | <1 |

**Species of Annex II to the Habitats Directive**

Of species listed in Annex II to the Habitats Directive, Siberian flying squirrel (*Pteromys volans)* occurs on the Natura site.

**Bird species of Annex I to the Birds Directive**

Of species listed in Annex I to the Birds Directive, Red-backed Shrike occurs on the Natura site.

## 5.4 Kirkkonummi archipelago Natura site (FI0100026)

**Location and general description**

The Kirkkonummi archipelago Natura site is an extensive area spanning from the eastern marine areas of Ingå to the easternmost marine areas of Kirkkonummi. The area is included in the Natura network as two entities: SCI and SPA.

The SCI contains the islands inside the Natura site boundaries and, of aquatic areas inside the boundaries, the waters close to Sommarn and waters included in the established nature reserves. The total area of the SCI is 1,750 ha. The SPA comprises those aquatic areas that are within the Natura site boundaries but not included in the SCI The total area of the SPA is 14,234 ha. Areas inside the Natura site boundaries not included in the Natura site comprise the tip of the Porkkala Peninsula, a small area on the western shore, Låga Segelkobben and Rönnskär.

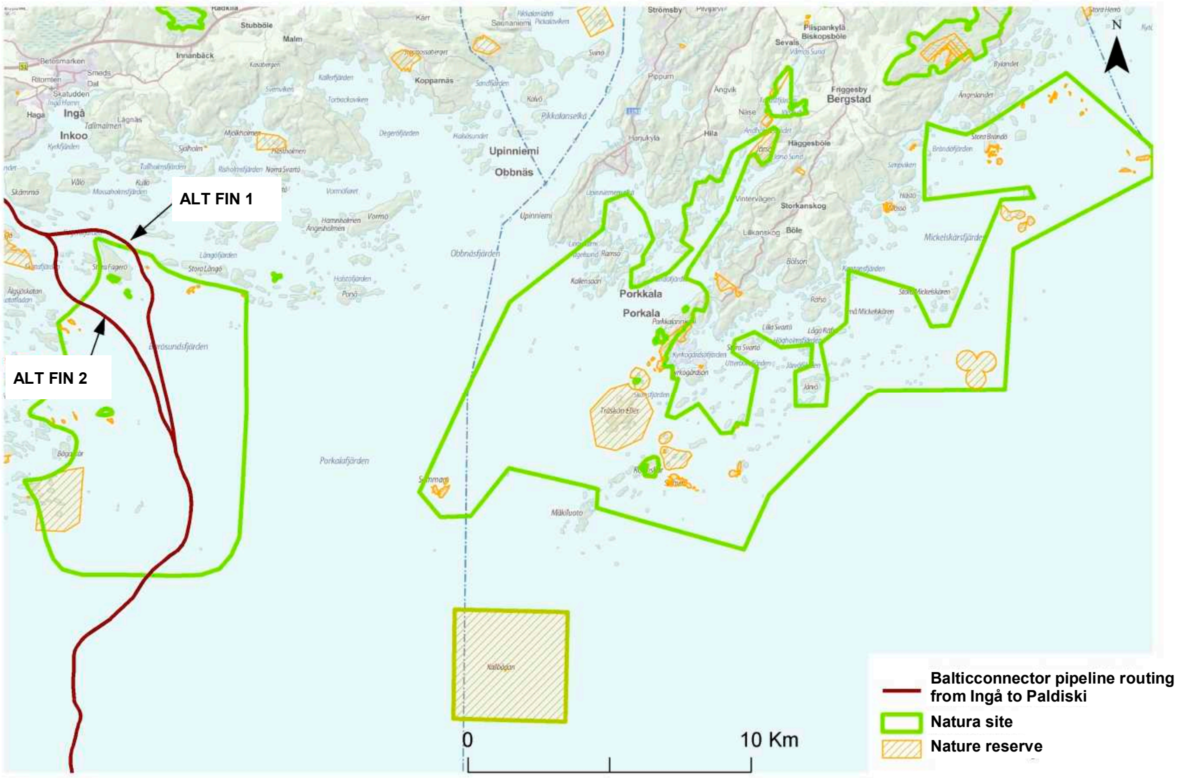


Figure 5-3 Kirkkonummi archipelago Natura site.

The Kirkkonummi archipelago Natura site has been found to be representative in terms of its archipelago nature and diverse in terms of its conditions. An extensive archipelago and coastal area, the Kirkkonummi archipelago is highly important for the protection of archipelago habitat types and several bird species. Islands on the site mainly have rocky shores and are barren. Apart from a few exceptions, the islands are unbuilt. Sandy beaches are mainly found on Sommarn and in places also in the Upinniemi archipelago. There are representative herb-rich forests in places on the largest islands of the inner archipelago.

With the exception of the Upinniemi archipelago and Sommarn, the entire Natura site is covered by the partial local master plan of Kirkkonummi coast and archipelago. The western half of the land use plan area from the Porkkala Peninsula to the islands of Salgrunden belong to the national Shore Conservation Program. There are also protected areas already established previously under the Nature Conservation Act in the area, with the largest of these being the Träskö and local waters area managed by the Finnish Forest Research Institute. Protection on the SCI is implemented in part through nature reserves in accordance with the Nature Conservation Act. In those areas covered by the land use plan that are not protected under the Nature Conservation Act, the Natura site implementation takes place under the Building Act. In the waters surrounding Sommarn the Natura site is implemented under the Water Act. Habitats important for birds in waters belonging to the SPA are protected under provisions laid down in the Water Act as well as the Nature Conservation Act.

The distance from the Kirkkonummi archipelago Natura site to the pipeline routing alternatives is 8.5 km.

### Habitat types of the Habitats Directive

The habitat types listed in Annex I to the Habitats Directive occurring on the Kirkkonummi archipelago Natura site are presented in Table 5-4.

**Table 5-4 Habitat types of Annex I to the Habitats Directive occurring on the Kirkkonummi archipelago Natura site according to data provided in the Standard Data Form, * = priority habitat type.**

| Habitat type of Habitats Directive | Code | Coverage (%) |
|---|---|---|
| Sandbanks which are slightly covered by sea water all the time | 1110 | 16 |
| Coastal lagoons | 1150 | < 1 |
| Reefs | 1170 | 12 |
| Annual vegetation of drift lines | 1210 | < 1 |
| Perennial vegetation of stony banks | 1220 | 5 |
| Vegetated sea cliffs of the Atlantic and Baltic coasts | 1230 | 5 |
| Boreal Baltic islets and small islands | 1620 | 10 |
| *Boreal Baltic coastal meadows | 1630 | < 1 |
| Boreal Baltic sandy beaches with perennial vegetation | 1640 | < 1 |
| Natural dystrophic lakes and ponds | 3160 | < 2 |
| Hydrophilous tall herb fringe | 6430 | < 1 |
| Siliceous rocky slopes with chasmophytic vegetation | 8220 | 30 |
| *Western taiga | 9010 | 1 |
| Fennoscandian herb-rich forests | 9050 | < 1 |
| *Bog woodland | 91D0 | 1 |

### Species of Annex II to the Habitats Directive

No species listed in Annex II to the Habitats Directive are mentioned in the Standard Data Form.

### Bird species of Annex I to the Birds Directive

Species listed in Annex I to the Birds Directive mentioned in the Standard Data Forms for the SCI and SPA comprise Steller's Eider (*Polysticta stelleri)*, Gray-faced woodpecker (*Picus canus)*, Boreal Owl (*Aegolius funereus),* Eurasian Eagle-owl *(Bubo bubo)*, Red-throated Diver (*Gavia stellata)*, Common Tern (*Sterna hirundo)*, Wood Lark (*Lullula arborea*), European Nightjar (*Caprimulgus europaeus*), Black-throated Diver (*Gavia arctica),* Arctic Tern, Wood Sandpiper (*Tringa glareola*), Horned Grebe (*Podiceps auritus),* Black Woodpecker (*Dryocopus martius)*, Red-backed Shrike, Red-breasted Flycatcher (*Ficedula parva)*, Hazel Grouse (*Tetrastes bonasia)*, Caspian Tern, Black Grouse (*Lyrurus tetrix*), Smew (*Mergellus albellus*) and Barnacle Goose.

### Migratory bird species resting regularly on the site

Migratory bird species resting regularly on the site include Long-tailed Duck, Red-necked Grebe (*Podiceps grisegena*), Gray Heron, Gadwall, Greenish Warbler (*Phylloscopus trochiloides*), Northern Pintail (*Anas acuta*), Ruddy Turnstone, Curlew Sandpiper (*Calidris ferruginea*), Purple Sandpiper (*Calidris maritima*), Northern Shoveller (*Anas clypeata*), Scaup (*Aythya marila)*, Temminck's Stint (*Calidris temminckii*), Common Scoter, Eurasean Hobby, Little Stint (*Calidris minuta*), Velvet Scoter, Sanderling (*Calidris alba*), Common Redshank, Black Guillemot, Common Shelduck (*Tadorna tadorna)*, Razorbill (*Alca torda)*, Dunlin (*Calidris alpina*), Lesser Black-backed Gull and Common Kestrel (*Falco tinnunculus*).

## 5.5 Ekenäs and Hanko archipelago and Pojo Bay marine protected area (FI0100005)

### Location and general description

The Natura site covers very extensive areas of the inner, middle and outer archipelago from Hanko to Pojo and further to western parts of the Ingå archipelago. The site is a marine area of around 52,000 ha covering the Pojo Bay waters, Hanko southern bay waters and Ekenäs archipelago waters starting from the Nothamn-Strömsö-Hättö protected area in the east all the way to the seaward limit of the internal waters in the south. The total area of the Natura site is 52,630 ha. The features of the site include complete series of inner, middle and outer archipelago zones, brackish water inlets, a diverse range of coastal habitat types and significant forest areas. The special values of the site include series developing from brackish to seawater as well as littoral development series with fladas and glo-lakes. In addition to extensive marine areas, the Natura site has several special sites of conservation value, such as protected areas and conservation program sites.

The Natura site is protected as a site under the Habitats as well as the Birds Directive (SCI and SPA). In the aquatic areas of the Natura site, the seabed, underwater natural environment and water quality are protected under the Water Act. Construction and extraction in the area is regulated on the basis of the recommendations of the Environment Committee of the Baltic Marine Environment Protection Commission (HELCOM). The site is included in the Baltic Sea Protected Areas (BSPA) proposed by HELCOM and is also a marine area requiring special protection measures proposed by the working group on special protection of waters.

The distance from the Natura site to the pipeline routing alternatives is 9.5 km.

### Habitat types of the Habitats Directive

The habitat types of the Habitats Directive occurring in the Ekenäs and Hanko archipelago and Pojo Bay marine protected area Natura site are presented in Table 5.

**Table 5-5 Habitat types of Annex I to the Habitats Directive occurring in the Ekenäs and Hanko archipelago and Pojo Bay marine protected area Natura site, * = priority habitat type.**

| Habitat type of Habitats Directive | Code | Coverage (%) | Coverage (ha) |
|---|---|---|---|
| Sandbanks which are slightly covered by sea water all the time | 1110 | 2 | 1 040 |
| Coastal lagoons | 1150 | 1 | 520 |

| | | | |
|---|---|---|---|
| Large shallow inlets and bays | 1160 | 2 | 1 040 |
| Reefs | 1170 | 1 | 520 |
| Annual vegetation of drift lines | 1210 | < 1 | < 520 |
| Perennial vegetation of stony banks | 1220 | < 1 | < 520 |
| Vegetated sea cliffs of the Atlantic and Baltic coasts | 1230 | < 1 | < 520 |
| Boreal Baltic islets and small islands | 1620 | 1 | 520 |
| *Boreal Baltic coastal meadows | 1630 | < 1 | < 520 |
| Boreal Baltic sandy beaches with perennial vegetation | 1640 | < 1 | < 520 |
| Boreal-Baltic narrow inlets | 1650 | 4 | 2 080 |
| Embryonic shifting dunes | 2110 | < 1 | < 520 |
| Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes') | 2120 | < 1 | < 520 |
| * Fixed dunes with herbaceous vegetation ('grey dunes') | 2130 | < 1 | < 520 |
| * Decalcified fixed dunes with *Empetrum nigrum* | 2140 | < 1 | < 520 |
| Wooded dunes of the Atlantic, Continental and Boreal region | 2180 | < 1 | < 520 |
| Humid dune slacks | 2190 | < 1 | < 520 |
| Natural dystrophic lakes and ponds | 3160 | < 1 | < 520 |
| * Species-rich Nardus grassland on siliceous substrates in mountain areas | 6230 | < 1 | < 520 |
| *Fennoscandian lowland species-rich dry to mesic grasslands | 6270 | < 1 | < 520 |
| Hydrophilous tall herb fringe | 6430 | < 1 | < 520 |
| Lowland hay meadows | 6510 | < 1 | < 520 |
| Siliceous rocky slopes with chasmophytic vegetation | 8220 | < 1 | < 520 |
| Siliceous rock with pioneer vegetation | 8230 | < 1 | < 520 |
| *Western taiga | 9010 | 1 | 520 |
| * Fennoscandian old broad-leaved deciduous forests | 9020 | < 1 | < 520 |
| Fennoscandian herb-rich forests | 9050 | < 1 | < 520 |
| * Fennoscandian deciduous swamp woods | 9080 | < 1 | < 520 |
| *Bog woodland | 91D0 | < 1 | < 520 |

**Species of Annex II to the Habitats Directive**

Of species listed in Annex II to the Habitats Directive, gray seal, yellow-spotted whiteface (*Leucorrhinia pectoralis*) and narrow-mouthed whorl snail (*Vertigo angustior*) have been found on the site.

**Bird species of Annex I to the Birds Directive**

Species listed in Annex I to the Birds Directive mentioned on the Natura Standard Data Form include Gray-faced Woodpecker, Boreal Owl, Eurasian Eagle Owl, Common Tern, Wood Lark, Eurasian Bottern (*Botaurus stellaris*), European Nightjar, Barred Warbler, Black-throated Diver, Common Crane, Arctic Tern, Whooper Swan (*Cygnus cygnus*), Wood Sandpiper, Spotted Crake (*Porzana porzana*), European Honey-buzzard (*Pernis apivorus*), Western Capercaillie (*Tetrao urogallus*), Black Woodpecker, Tundra Swan (*Cygnus columbianus*), Red-backed Shrike, Red-breasted Flycatcher, Hazel Grouse, Caspian Tern, Ruff (*Philomachus pugnax*), Smew, Eurasian Pygmy-owl (*Glaucidium passerinum*) and Red-necked Phalarope (*Phalaropus lobatus*).

**Migratory bird species resting regularly on the site**

Migratory bird species resting regularly on the site include Gray Heron, Gadwall, Garganey (*Anas querquedula*), Red Knot (*Calidris canutus*), Jack Snipe (*Lymnocryptes minimus*), Northern Pintail (*Anas acuta*), Ruddy Turnstone, Curlew Sandpiper, Spotted Redshank (*Tringa erythropus*), Eurasean Hobby, Little Stint, Velvet Scoter, Common Redshank, Dunlin and Stock Dove (*Columba oenas*).

### 5.6 Kallbådan islets and waters (FI0100089)

The Kallbådan islets and waters Natura site is located in an offshore area southwest of the Porkkala Peninsula in the municipalities of Kirkkonummi and Ingå. The total area of the site consisting mainly of offshore areas is 1,520 ha. The site is protected as a SCI under the Habitats Directive. The largest terrestrial area on the Natura site is the 0.7-ha Kallbådan lighthouse islet. The site also includes smaller islets and rocks around Kallbådan. The boundary of the Natura site extends at least 1.8 km from the islets in all directions. In the 1996 gray seal inventory Kallbådan was found to be the most important occurrence area of the species in the Gulf of Finland area from Vehkalahti to Ingå. A seal conservation area (HYL010002) has been stablished to protect the species in the area. The distance from the Natura site to the pipeline routing alternatives is 9.5 km.

**Habitat types of the Habitats Directive**

The Boreal Baltic islets and small islands (1620) habitat type is the only habitat type of the Habitats Directive occurring on the Kallbådan Natura Site. The habitat type's coverage on the Natura site is less than 1%.

**Species of Annex II to the Habitats Directive**

The primary motivation for the inclusion of the Kallbådan area into the Natura 2000 network was the occurrence of the gray seal, a species listed in Annex II to the Habitats Directive, in the area.

## 6. POTENTIAL IMPACTS OF THE PROJECT

The potential impacts of the project can be divided into impacts during **construction**, impacts during **operation and maintenance** and impacts during **decommissioning**. The most significant activities and their impacts during the various phases of the project are presented in Table 6-1. Light pollution, flow impacts of vessels participating in construction work etc. are regarded as insignificant in terms of their impacts in this context.

**Table 6-1 The most significant activities and impacts from the environmental impact perspective in various project phases.**

| Project phase | Activity | Impact |
|---|---|---|
| Construction | Munitions clearance, blasting, seabed filling, subsea rock installation, dredging | Destruction of seabed and benthic organisms |

| | | |
|---|---|---|
| | Munitions clearance, pipelaying, anchoring, blasting, dredging. | Mixing of sediments and any harmful substances contained by sediments with seawater. |
| | Munitions clearance, pipelaying, blasting, dredging, seabed filling, subsea rock installation, vessel traffic, pipeline testing. | Noise and direct disturbance |
| Operation | Flow of natural gas in the pipeline, maintenance measures and monitoring | Noise |
| | Maintenance and monitoring | Direct disturbance |
| Decommissioning | Parallel pipeline installation (pipelaying, vessel anchoring, subsea rock installation) | Mixing of sediments and any harmful substances contained by sediments |
| | Parallel pipeline installation (pipelaying, vessel anchoring, subsea rock installation) | Noise and direct disturbance |

## 6.1 Impacts during construction

There will be several factors with potential impacts on the natural environmental environment during the construction of the gas pipeline. Impacts during marine construction include:

- destruction of seabed flora and other organisms along the pipeline route;
- destruction of seabed structures along the pipeline route;
- mixing and dispersal of seabed sediments into the environment (e.g. dredging);
- release of any harmful substances contained by seabed sediments;
- noise and direct disturbance from construction work (pipelaying, dredging, etc.);
- disturbance from construction vessel traffic (noise impact and direct disturbance);
- diversion of any other vessel traffic due to the safety zone maintained during construction (direct disturbance to other vessel traffic on diverted routes);
- introduction of non-indigenous species in ballast waters of vessels participating in construction.

Impacts on water bodies caused by the construction of the gas pipeline have been assessed as the most potential adverse impacts of the project. Seabed intervention is mainly anticipated in sections from the pipeline landfall site to the Oxgrund area southwest of the island of Stora Fagerö. In the deeper sections south of Oxgrund, the need for seabed intervention will be considerably lower. Other significant impacts of construction work will include noise and direct disturbance. Noise and direct disturbance may have impacts on birds, marine mammals and fish in the area.

### Seabed destruction/alteration

The seabed, including its flora and in part other organisms, will be destroyed along those sections of the natural gas pipeline routing that will require:

a) dredging/blasting/filling of the seabed for pipelaying;
b) subsea rock installation and anchoring to attach the pipeline onto the seabed;
c) crossings of the gas pipeline routing and cables (support structures and subsea rock installation).

Seabed intervention work will be carried out in a zone that is around 5–10 m wide along the pipeline route. As time passes, however, benthic rock substrate species are likely to appear on sites such as subsea rock installation sites.

### Seabed sediment mixing

Seabed sediments will mix with seawater during gas pipeline construction and seabed intervention. When mixing with seawater, nutrients and suspended solids will be released from sediments into the seawater. Increases in nutrient levels result in issues such as the eutrophication of aquatic environments, while increases in suspended solids result in increased water turbidity. Turbidity decreases the depth of penetration of sunlight and reduces the rate of photosynthesis in deeper water layers. Long-term high levels of turbidity have consequences such as the disappearance of benthic flora in the deeper layers. Resedimentation may also cause sediment accumulation. Sediment accumulation makes it more difficult for aquatic organisms to attach to substrates on the seabed. Turbidity may also have an adverse impact on food sourcing among bird species in important feeding areas.

Locally the intensity of sediment mixing will depend on the duration of the activity and the type of seabed. During gas pipeline construction work sediment mixing will take place locally over a very brief period. In bedrock/rocky seabed sections the release of nutrients and solids will be considerably lower than in soft-bottom areas.

The size of the area affected by sediment mixing depends not only on the extent and duration of the activity but also on prevailing currents and weather. For example, it was found in the environmental monitoring carried out during the construction of the Vuosaari harbor in Helsinki that sediments were dispersed further during windy periods than during low-wind periods. In the Gulf of Finland the spring and early summer feature considerably lower winds than the autumn.

Environmental monitoring in the project area was conducted during the construction of the Nord Stream gas pipeline project (Hanski et al. 2010) concerning the environmental impacts of the various work stages. Construction activities included rock placement, mattress installation, pipelaying, munitions clearance, and dredging in Russian waters. The monitoring findings included the following:

- During munitions clearance the highest rates of turbidity just above the bottom were 5–6 NTU and above that layer 1–3 NTU. Turbidity plumes extended 200–300 m from the detonation point, and the maximum duration of concentration of suspended solids above 10 mg/l was 18 hours.
- Turbidity caused by rock installation (with 10 mg/l as the limit value) extended to less than 1 km. The total duration of suspended solids in seawater over 10 mg/l during the activity varied from 16 to 60 hours. The extent of turbidity plumes was at its maximum 600 m from the installation site.
- The dynamically positioned pipelaying vessel used for pipelaying was not found to cause sediment mixing. A minor increase in turbidity (1–4 NTU) during pipelay by the anchored lay barge was recorded 1.5–2 m above the seabed at a distance of 50 m from the pipeline routing.

The construction work plans for the LNG terminal planned for Joddböle, Ingå, include the deposition of dredging materials (mainly sand). The planned deposition site is located around 7 km south of the Ingå archipelago Natura site. According to the dispersal model produced for the deposition of dredging materials, the suspended solids concentrations would decrease quite strongly as the distance from the deposition site increases. According to the model, bottom-layer turbidity around 2 km from the site would typically be a maximum of 2–4 mg/l. The extent of the area with increased turbidity is estimated to be a few square kilometers. The volumes of materials involved in the construction of the gas pipeline routing alternatives currently under examination will be locally considerably lower than in the construction of the LNG terminal, whereby the impacts on water quality are also assessed to be low.

The water body of the Ingå archipelago Natura site protected as a private nature reserve is at its nearest located 3.2 km from the pipeline routing. According to the results of the above-mentioned modeling and monitoring of the Nord Stream gas pipeline project, the turbidity generated during construction will not extend to waters of the Natura site protected under the Habitats Directive.

**Release of harmful substances and nutrients**

Sediment mixing also results in the release of any harmful substances contained by the sediments into seawater. Harmful substances include metals (As, Cd, Cr, Cu, Pb, Ni, Zn, Hg), PCBs, organotin compounds (such as TBT), PAHs, dioxins and furans. Any significant quantities of harmful substances found in sediments are mainly caused by human activity. Metals are found in areas including those close to old shipyards and smelters, while dioxins are created as impurities in combustion and chlorination processes. Organotin compounds used to be used in vessel anti-fouling paints. TBTs have ended up in seawater directly through dissolution from ship hulls and particularly in conjunction with hull maintenance work (cleaning and re-application). Harmful substances and pesticides have also ended up in waters through littering where various types of chemicals and pesticide containers have been dumped directly into the sea.

Elevated concentrations of harmful substances are most likely to occur in the waters close to the Port of Ingå and in the vicinity of the fairway.

Nitrate used to be a growth-limiting factor in the Baltic Sea, but in many areas the situation has changed or is changing because, on one hand, the removal of phosphorus from wastewater and, on the other hand, oxidizing conditions have resulted in reductions in phosphorus concentrations. Phosphorus released into water in conjunction with seabed excavation is, however, usually attached to particles and therefore eventually resedimented onto the bottom. Only nutrients already dissolved in interstitial water are released in conjunction with intervention work and are in a form usable by plankton and other organisms. However, the quantity of phosphorus or other nutrients released from interstitial water will be so low that it is not assessed to have an impact on primary production in the marine area.

**Noise and direct disturbance**

Noise and direct (visual) disturbance will be caused by pipeline construction work. The duration of the noise and disturbance impacts will be shorter in the offshore sections than in the inner and middle archipelagos where the rate of progress made in construction work will be slower. The duration of disturbance will be short-term, with progress made at 0.3–3 km/day in the construction work. It should be taken into account in the assessments of disturbance impacts that the volume of waterborne traffic in the area is also high during non-construction periods as well (vessel and recreational traffic).

Noise and direct disturbance are anticipated to have impacts on birds, marine mammals and possibly also fish in the area. Direct disturbance causes the flight response in birds, which during the nesting season will in extreme cases lead into birds abandoning their nests. Even parents merely leaving the nest for a brief period may result in breeding failure (nest predators). Similarly, direct disturbance during nestling period may, if broods scatter, result in the loss of offspring (increased risk of predation). The flight initiation distance (FID) of moving vessels has been studied on various species (Ruddock & Whitfield 2007). The FID (the distance between the bird and the source of disturbance) has been found to depend not only on the species of bird but also on the speed and direction of the approaching vessel (direct, tangential, etc.). The FID has been found to become longer as the speed of the vessel increases. As a general rule FIDs are some hundreds of meters.

## 6.2 Impacts during operation and maintenance

The operation of the actual gas pipeline (onshore and offshore sections) will only result in low impacts on the natural environment. Impacts during operation mainly include:

- noise generated by gas flowing in the pipeline;
- gas pipeline maintenance measures may mainly cause minor noise impacts and direct disturbance.

**Noise and direct disturbance**

During operation, noise impacts will be caused by the gas flowing in the pipeline. The noise impact of flowing gas is, however, assessed as insignificant. Noise and disturbance caused by maintenance measures will be low and short-term.

## 6.3 Impacts of decommissioning

Consisting of concrete, polypropylene and epoxy coating, the offshore sections of the gas pipeline, including installation structures, will be left on the seabed once the end of its operational life is reached (around 50 years). Even when subjected to weathering, the offshore pipeline structures, including installation elements, will not contain significant quantities of substances that are harmful to the environment.

## 6.4 Mitigation measures

The following presents measures for each project phase that can be employed to mitigate the project's impacts on the environment in the area.

**Construction**

The breeding season from early May to late July is the most sensitive period for the birds in the area. Significant bird islets and islands in the vicinity of pipeline routing alternatives ALT FIN 1 and ALT FIN 2 are Storoxen, Lilla Fagerö, Stengrundet, Fagerögrundet, Hästen and the islet east of Långholmen. It is recommended for the Stengrundet area that construction work be scheduled outside the breeding period. Due to the larger distance, the impact of construction on birds breeding on the other islands and islets is regarded as lower.

If high concentrations of harmful substances are detected in sediment studies conducted in the project area, enclosed buckets or corresponding technologies must be used in the dredging of contaminated sediments.

A safety zone is planned around the pipelaying vessel during construction, with access prohibited for all unauthorized traffic within the zone. The Ingå archipelago bird islets and islands must be taken into account in any diversion of other vessel traffic if construction takes place in the period from May to July (breeding and nestling period). If possible, other traffic should be diverted to routes as far away from islets and islands as possible. This perspective must be taken into account at least in those areas near Stora Fagerö where there are several valuable sites in terms of bird populations.

**Operation**

If long-term noise and direct disturbance is caused by maintenance measures during pipeline operation in the immediate vicinity of valuable bird areas during the breeding season, it is recommended that the maintenance measures be carried out, where possible, outside the breeding season.

**Decommissioning**

The impacts of the laying of a parallel pipeline will be the same as those of the first pipeline.

# 7. IMPACTS ON NATURA SITES

## 7.1 Ingå archipelago (FI0100017)

### Location

Both project alternatives, ALT FIN 1 and ALT FIN 2, pass across the boundaries of the Ingå archipelago Natura site. The majority of the islands and islets within the site boundaries are included in the Natura site, while the only aquatic area included in the Natura site is the aquatic area of the Timmerö nature reserve At their nearest the proposed gas pipeline routing alternatives pass 3.3 km from the aquatic areas of the Natura site. As a general rule the distance to the nearest islets and islands is 700–1,500 m. However, the ALT FIN 1 alternative is routed close to Stora Fagerö (280 m) and the bird islets east of Stora Fagerö (160 m).

### Impacts on habitat types of Annex I to the Habitats Directive

The underwater habitat types of the Ingå archipelago Natura site are sandbanks which are slightly covered by sea water all the time, and reefs. These habitat types can only be found in the aquatic area of the Natura site protected under the Habitats Directive in the southern part of the Natura site in the Timmerö-Langerö nature reserve located at least 3.3 km from the project alternative areas. Disturbance caused by turbidity or construction will in no circumstances extend to the nature reserve; this assessment is based on observations of the size and dispersal of turbidity plumes (Hanski et al. 2010, Pöyry Finland Oy 2013). Consequently, the impact of pipeline construction on the reefs and sandbanks which are slightly covered by sea water all the time habitat types is assessed as insignificant.

The annual vegetation of drift lines habitat type is mentioned in the Natura Standard Data Form. The habitat type was not, however, found in the habitat type inventory conducted by Metsähallitus. This is likely to be due to the fact that both of the planned pipeline routings are located in a marine area with depths of at least 10 m and mainly more than 20 m. Annual vegetation of drift lines mainly consists of bladderwrack (*Fucus vesiculosus)*, the maximum growth depth of which is 4–5 m. Because both of the pipeline routing alternatives are located outside the bladderwrack zone, the project will have no impact on the growth conditions of bladderwrack or on whether or not drift lines can be formed on island shores by bladderwrack rising from the bottom. The non-detection of the habitat type in the habitat types inventory also implies that there are no viable bladderwrack populations occurring in the shallows in the vicinity of the pipeline routing. Another reason for the non-occurrence of drift lines may be the lack of suitable shallow-sloping shore areas in which bladderwrack can accumulate. Therefore the temporary adverse turbidity impact is not assessed to affect the growth conditions of bladderwrack and, consequently, the occurrence of the habitat type.

The other Directive habitat types occurring in the Ingå archipelago area are habitat types of coastal areas and of mineral soils of inner sections of islands on which seabed intervention or disturbance will have no impact.

### Impacts on species of Annex II to the Habitats Directive

The impacts on gray seals found in the Hästen area will mainly comprise direct disturbance and noise. The impact of noise on marine mammals has not been studied. The disturbance impact will, however, be temporary and short-term, whereby the impact is assessed as low.

### Impact on bird species of Annex I to the Birds Directive

Potential impacts will mainly affect Common Tern, Arctic Tern and Caspian Tern nesting on the islets of the Stora Fagerö area and the threatened species of the area. Noise and direct disturbance during the breeding season may have a reducing impact on bird breeding success during pipeline construction. There will be no long-term reduction because the disturbance will be restricted to a maximum of one breeding season. The majority of the bird islets and islands of the Natura site are located more than 600 m from the pipeline routing alternatives, whereby the project's impacts on birds are regarded as low and temporary and therefore the project will not result in the deterioration of the features motivating the protection of the area.

**Species-specific examination:**

Common Tern (*Sterna hirundo)*
The most significant breeding sites of the species are Fagerögrundet, Stengrundet and Storoxen. Of these, Stengrundet is located closest to the proposed pipeline routing alternatives (less than 200 m), while the distance to the other islands and islets is more than 500 m. The potential adverse impact of the project on the breeding success of the species can be prevented by scheduling construction work around the Stengrundet area outside the breeding season.

Arctic Tern (*Sterna paradisea)*
As Common Tern (see above).

Red-backed Shrike (*Lanius collurio)*
The species was not sighted in the area in the 2013 fieldwork season. A land bird nesting on the mainland and potentially on the largest islands, the species is not anticipated to be affected by the project.

Caspian Tern (*Hydroprogne caspia)*
Individual pairs of Caspian Tern nest on Hästen, Sadeln, Stengrundet and the islet south of the Bastholmarn islands. Of these, Stengrundet is less than 500 m from the proposed pipeline routing alternatives. The potential adverse impact of the project on the breeding success of the species can be mitigated by scheduling construction work around the Stengrundet area outside the breeding season.

Barnacle Goose (*Branta leucopsis)*
The species breeds on sites including Storoxen, Hjortonklobben area, Lilla Fagerö and Fagerögrundet (a total of around 20 pairs). The species is not particularly timid and will often only flee from e.g. approaching people at a distance of only a few meters. The population of the species in the Gulf of Finland is still growing. On the basis of the short flight initiation distance of the species, the number of pairs in the area and the general development of the population, the project's impacts on the species will be low.

Threatened species
A threatened species with the nearest nesting site located around 1 km from the proposed pipeline routing alternatives nests in the area. The most sensitive period for the nesting of the species is the period between March and June. To minimize the project's disturbance impact, construction work east of Stora Fagerö should be restricted to periods outside the most sensitive period from the nesting perspective.

## 7.2 Älgsjölandet and Rövass herb-rich forests (FI0100016)

The conservation values of the site represent mineral soil habitat types and fauna. In addition, the site is located more than 5 km from the project area. The project is not regarded to have any deteriorating impacts on the nature values of the Natura site because the construction carried out in the marine area will not have impacts on the habitat types or species of the terrestrial area.

## 7.3 Kirkkonummi archipelago (FI0100026, FI0100105)

At its nearest the site is located 8.5 km from the planned pipeline routing. The impacts of construction work are assessed to be limited mainly to underwater noise and possible traffic relating to construction work along nearby fairways. Construction-related traffic will not, however, significantly increase the volume of waterborne traffic in the area. The potential disturbance impacts caused by construction work are regarded as very low due to the distance. The impacts on water bodies are not assessed to extend to the Natura site.

## 7.4 Ekenäs and Hanko archipelago and Pojo Bay marine protected area (FI0100005)

The site is located 9.5 km from the planned pipeline routing, and no traffic on or in the immediate vicinity of the site will be generated by construction work. Underwater noise impact is assessed as the highest impact of the project. Due to the distance between the Natura site and the project area and the short duration of the construction period the impacts are, however, assessed as insignificant. The project's impacts on water bodies are not assessed to extend to the Natura site.

## 7.5 Kallbådan islets and waters (FI0100089)

The site is located 9.5 km from the project area. The impacts of construction work are assessed to be limited mainly to underwater noise and possible traffic relating to construction work along nearby fairways. Construction-related traffic will not, however, significantly increase the volume of waterborne traffic in the area. The potential disturbance impacts caused by construction work are regarded as very low. The impacts on water bodies are not assessed to extend to the Natura site. The project is not assessed to affect the conservation values motivating the protection of the site.

## 7.6 Cumulative impacts

Projects significant for the examination of cumulative impacts near the Balticconnector project area include the Raseborg–Ingå offshore wind farm.
The offshore wind farm has been planned for the offshore area south of the Ingå and Raseborg archipelagos. There are no other known projects significant for cumulative impacts. The planned gas pipeline routing would pass a few hundred meters from the offshore wind farm project area (Figure 7-1). The distance from the wind farm area to the Natura site is around 1.5 km.

The project's potential impacts on nearby Natura sites were also assessed as part of the environmental impact assessment of the Ingå-Raseborg offshore wind farm project (Ramboll Oy, 2010). The construction phase of the offshore wind farm is not assessed to have impacts on nearby Natura sites or their conservation values. Turbidity impacts during construction are assessed as very low and not affecting the underwater habitat types of the Natura sites according to the assessment conducted. Impacts on birds breeding on Natura sites have been mentioned as potential impacts during project operation.

If a decision is made to construct the Raseborg-Ingå offshore wind farm, an essential role from the environmental impacts perspective will be played by the scheduling of the projects' construction work in relation to each other. Project construction will result in changes in water quality and, according to the precautionary principle, to avoid cumulative impacts on water quality, project construction work should not be carried out simultaneously in the vicinity of aquatic areas of Natura sites.

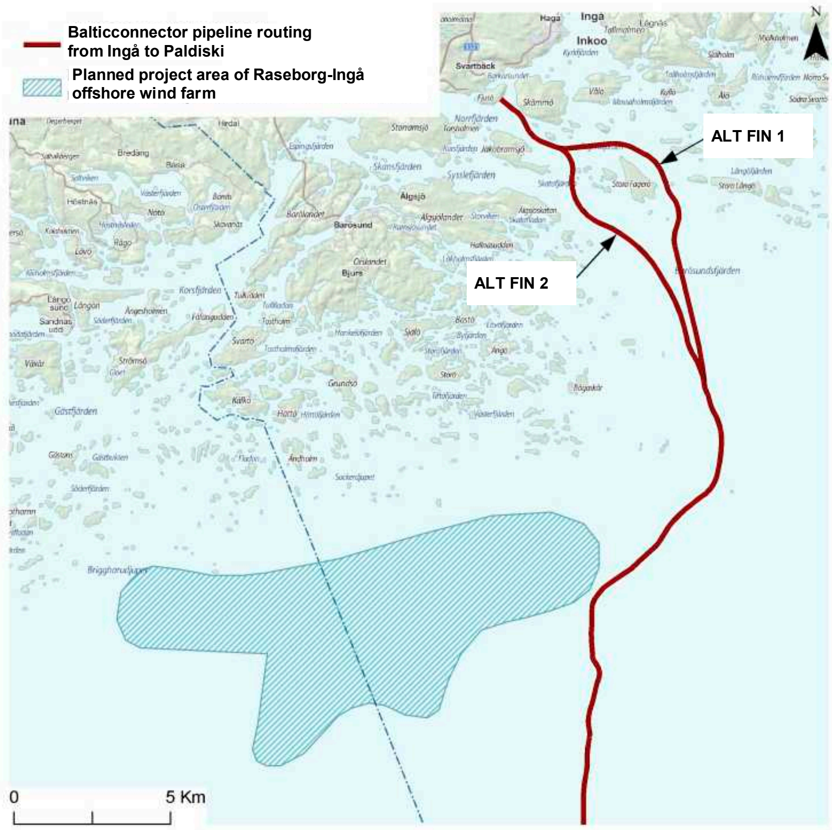


**Figure 7-1 Locations of the Raseborg-Ingå offshore wind farm and the Balticconnector gas pipeline project in Ingå and Raseborg.**

# 8. CONCLUSIONS

The gas pipeline routing alternatives ALT FIN 1 and ALT FIN 2 are located at least 4 km from the Natura sites of Älgsjölandet and Rövass herb-rich forests, Kirkkonummi archipelago, Ekenäs and Hanko archipelago and Pojo Bay marine conservation site, and Kallbådan islets and waters. Due to the long distance, no adverse impacts are assessed to be caused on these Natura sites.

There are no such Directive habitat types or Directive species on the Ingå archipelago Natura site on which the implementation of the project might have negative impacts. Impacts on Birds Directive species and bird species regularly resting in the area are possible, but they are assessed to be low and temporary. Adverse impacts on birds can be mitigated significantly or eliminated fully by scheduling construction work close to the most important bird islets and islands outside the breeding season.

It can be concluded on the basis of the above that, if executed in the appropriate manner, pipeline construction and operation will not deteriorate the nature values due to which the Natura sites located close to the project area were included in the Natura network. The assessment did not bring up issues necessitating a Natura 2000 assessment (Appropriate Assessment) under section 65 of the Nature Conservation Act.

Espoo, October 15, 2013

**RAMBOLL FINLAND OY**

| | |
|---|---|
| Tarja Ojala | Juha Kiiski |
| MSc, Biologist | Graduate student in Biology |

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# ANNEX 3: IMPERIA: CLASSIFICATION OF IMPACTS AND RECIPIENTS

# Imperia: Classification of impact components

The multi-criteria decision analysis (MCDA) practices and tools developed in the EU LIFE+ IMPERIA project (*https:www.imperia.jyu.fi*) were employed as appropriate in the assessment of the significance of the environmental impacts reported in the EIA report of the Balticconnector project. The following classification criteria for the components of impact significance were utilized in the impact assessment work.

# 1 SEABED

### Sensitivity of the receptor

Legislative steering, societal significance, susceptibility to change

| | |
|---|---|
| Very high | The receptor is determined in legislation as valuable or protected, or the sediment contaminant contents exceed the limit values. The area is totally untouched and its recovery capacity is poor. The receptor has high recreational and/or economic value. |
| High | The receptor is determined in legislation as valuable or there are contaminants in the sediments. No extensive seabed intervention measures have been carried out in the area. The recovery capacity of the area is poor or moderate. The receptor has recreational and/or economic value. |
| Moderate | The receptor is determined as geologically quite valuable or there are low contaminant concentrations in the sediments. Minor seabed intervention measures have been carried out in the area. The recovery capacity of the area is moderate. The receptor has no significant recreational and/or economic value. |
| Low | The receptor has not been determined as geologically valuable. There are very low contaminant concentrations in the sediments. Seabed intervention measures have been carried out in the area. The recovery capacity of the area is good. The receptor has no significant recreational and/or economic value. |

### Magnitude of change

| | |
|---|---|
| Very high ---- | The quantities of material handled are very large.<br>High adverse impacts on the seabed or environment are caused by the activity. |
| High --- | The quantities of material handled are large.<br>Adverse impacts on the seabed or environment are caused by the activity. |
| Moderate-- | The quantities of material handled are moderate.<br>Some adverse impacts on the seabed or environment are caused by the activity. |
| Low - | The quantities of material handled are small.<br>Only minor adverse impacts on the seabed or environment are caused by the activity. |
| No impact | No impact on soil or bedrock and no adverse impacts on the seabed or environment. |
| Low + | Nr = not relevant |
| Moderate ++ | Nr |
| High +++ | Nr |
| Very high ++++ | Nr |

# 2 SOIL, BEDROCK AND GROUNDWATER

### Sensitivity of the receptor

Legislative steering, societal significance, susceptibility to change

| | |
|---|---|
| Very high | Soil and bedrock: The receptor is determined as geologically very or exceptionally valuable. In addition, the area is in its natural state. It has |

| | |
|---|---|
| | high landscape value.<br><br>Groundwater: Classified as a Class I and important groundwater area used extensively for water supply. Built-up area or settlement with receptors that are very sensitive to changes in groundwater level. |
| High | Soil and bedrock: The receptor is determined as geologically valuable. In addition, the area is quite close to its natural state. It has clear landscape value.<br><br>Groundwater: Classified Class I groundwater area where there is possibly also a water intake structure. Settlement or area with residents with receptors that are sensitive to changes in groundwater level. |
| Moderate | Soil and bedrock: The receptor is determined as geologically quite valuable. In addition, the area is partly in or close to its natural state. It has only minor landscape value.<br><br>Groundwater: Class II groundwater area. An area with individual wells of water intended for human consumption or a few structures and buildings sensitive to changes in groundwater level. |
| Low | Soil and bedrock: The receptor's soil or bedrock does not have particular value on the basis of its geological characteristics. In addition, the area is not in its natural state. It has no landscape value.<br><br>Groundwater: A glacial till area with no classified groundwater area. Groundwater is not used for human consumption. There are no structures or buildings sensitive to subsidence. |

**Magnitude of change**

| | |
|---|---|
| Very high ---- | The quantities of material handled are very large. High adverse impacts on soil and bedrock or the environment are caused by the activity. A clear and large change in the quantity and/or quality of groundwater clearly exceeding the limit values set for water intended for human consumption. Current use is prevented. |
| High --- | The quantities of material handled are large. Adverse impacts on soil and bedrock or the environment are caused by the activity. A change in the quality and/or quantity of groundwater restricting its current use and/or exceeding limit values. |
| Moderate-- | The quantities of material handled are moderate. Some adverse impacts on soil and bedrock or the environment are caused by the activity. An impact on groundwater quality that remains within the limit values set for water intended for human consumption and/or impact on groundwater quantity restricting groundwater sourcing to some extent. |
| Low - | The quantities of material handled are small. Only minor adverse impacts on soil and bedrock or the environment are caused by the activity. There are no impacts on current water supply use. A change in quality and quantity of groundwater that remains within the limit values. |
| No impact | No impact on soil or bedrock and no adverse impacts on soil or bedrock or the environment. No impact on groundwater. |
| Low + | Nr = not relevant |
| Moderate ++ | Nr |
| High +++ | Nr |
| Very high ++++ | Nr |

# 3 HYDROLOGY AND WATER QUALITY

**Sensitivity of the receptor**

Legislative steering, societal significance, susceptibility to change

| | |
|---|---|
| Very high | There is an extensive or there are several Natura 2000 site(s) or other protected area(s) that also include aquatic areas in the affected area.<br>Exchange of water restricted and flow velocities low (<2 cm/s)<br>Excellent water quality (physico-chemical quality elements of the ecological status and chlorophyll *a* of coastal water bodies).<br>There is significant bathing water and/or raw water use in the aquatic areas. |
| High | There is a Natura 2000 site or other protected area, including aquatic area, in the affected area.<br>Exchange of water quite restricted and flow velocities quite low (2–5 cm/s).<br>Excellent or good water quality (physico-chemical quality elements of the ecological status and chlorophyll *a* of coastal water bodies).<br>There is some bathing water and/or raw water use in the aquatic areas. |
| Moderate | There is a protected aquatic area in the affected area.<br>Exchange of water quite efficient and flow velocities quite high (5–10 cm/s).<br>Good water quality (physico-chemical quality elements of the ecological status and chlorophyll *a* of coastal water bodies).<br>There is little bathing water and/or raw water use in the aquatic areas. |
| Low | There are no protected aquatic areas in the affected area.<br>Exchange of water efficient and flow velocities high (>10 cm/s)<br>Moderate or poorer water quality (physico-chemical quality elements of the ecological status and chlorophyll *a* of coastal water bodies).<br>There is no bathing water and/or raw water use in the aquatic areas. |

**Magnitude of change**

| | |
|---|---|
| Very high ---- | The activity has a very significant impact on water quality and hydrology.<br>Model calculations show a very clear increase in the suspended solids concentration of water (>20-fold compared with current status).<br>Model calculations show an increase in turbidity in a very large area (>5 km from the pipeline). Model calculations show a very long-term increase in turbidity (year).<br>A very clear impact on the elements of the ecological status classification of coastal water bodies (transparency, nutrient and chlorophyll *a* concentrations).<br>A very significant risk of an increase in harmful substances in the water column.<br>A very clear impact on bottom flows. |
| High --- | The activity has a significant impact on water quality and hydrology.<br>Model calculations show a clear increase in the suspended solids concentration of water (10–20-fold compared with current status).<br>Model calculations show an increase in turbidity in a large area (2–5 km from the pipeline).<br>Model calculations show a long-term increase in turbidity (months).<br>A clear impact on the elements of the ecological status classification of coastal water bodies (transparency, nutrient and chlorophyll *a* concentrations).<br>A significant risk of an increase in harmful substances in the water column. |

| | |
|---|---|
| | A clear impact on bottom flows. |
| Moderate-- | The activity has a moderate impact on water quality and hydrology.<br>Model calculations show a moderate increase in the suspended solids concentration of water (5-10-fold compared with current status).<br>Model calculations show an increase in turbidity in quite a small area (0.5–2 km from the pipeline).<br>Model calculations show quite a short-term increase in turbidity (weeks).<br>A moderate impact on the elements of the ecological status classification of coastal water bodies (transparency, nutrient and chlorophyll *a* concentrations).<br>A moderate risk of an increase in harmful substances in the water column.<br>A moderate impact on bottom flows. |
| Low- | The activity has a low impact on water quality and hydrology.<br>Model calculations show a low increase in the suspended solids concentration of water (>2-5-fold compared with current status).<br>Model calculations show an increase in turbidity in a small area (<0.5 km from the pipeline).<br>Model calculations show quite a short-term increase in turbidity (days).<br>A low impact on the elements of the ecological status classification of coastal water bodies (transparency, nutrient and chlorophyll *a* concentrations).<br>A low risk of an increase in harmful substances in the water column.<br>A low impact on bottom flows. |
| No impact | The activity has no impact on water quality and hydrology. |
| Low + | Nr = not relevant |
| Moderate ++ | Nr |
| High +++ | Nr |
| Very high ++++ | Nr |

# 4 MARINE ENVIRONMENT

**Sensitivity of the receptor**

Legislative steering, societal significance, susceptibility to change

| | |
|---|---|
| Very high | Several species listed in the Nature Conservation Decree as under strict protection and/or threatened species and/or species listed in Annex II or IV to the Habitats Directive occur in the area. There are underwater Natura habitat types and/or habitat types protected under the Nature Conservation Act and/or habitat types assessed as threatened in Finland in the area. The area consists entirely or in part of a Natura site, national conservation program site, nature reserve or has other nationally significant nature values.<br>The area is important for the recreational use of nature and/or regarded as significant in terms of its nature values.<br>In the event of a disturbance, the species composition or characteristics of the area may be destroyed or changed very clearly. The restoration of the original species and habitat types in the area is unlikely or very slow. |
| High | Species listed in the Nature Conservation Decree as under strict protection and/or threatened species and/or species listed in Annex II or IV to the Habitats Directive. There are underwater Natura habitat types and/or habitat types protected under the Nature Conservation Act and/or habitat types assessed as threatened in Finland in the area. The area consists in part of a Natura site, national conservation program site, nature reserve or has other nationally significant nature values.<br>The area is important for the recreational use of nature and/or regarded as significant in terms of its nature values.<br>In the event of a disturbance the species or characteristics of the area may change clearly and their restoration in the area is slow. |
| Moderate | Species red-listed in Finland as Near Threatened (NT) and/or Regionally |

| | |
|---|---|
| | Threatened (RT) species or significant populations of non-threatened species occur in the area. There are underwater habitat types assessed as valuable in Finland and/or habitat types protected under the Water Act in the area. There may be regionally or locally valuable natural sites in the area.<br>The area is quite important for the recreational use of nature and/or regarded as quite significant in terms of its nature values.<br>In the event of a disturbance, the restoration of the species and characteristics of the area is possible. |
| Low | No threatened or otherwise noteworthy species or significant underwater habitat type nature values occur in the area. There are no protected areas or regionally or locally valuable natural sites in the area.<br>The area is not important for recreational use and not regarded as particularly significant in terms of its nature values. In the event of a disturbance, the area is rapidly restored. |

**Magnitude of change**

| | |
|---|---|
| Very high ---- | The project causes the disappearance of threatened or otherwise noteworthy species and/or habitat types from the area. The project destroys or very significantly reduces the nature values motivating the designation of the sites as nature reserves. |
| High --- | The project significantly reduces populations of threatened or otherwise noteworthy species and/or significantly reduces the area of threatened or otherwise noteworthy habitat types or changes their characteristics. The project significantly reduces the nature values motivating the designation of the sites as nature reserves. |
| Moderate-- | The project reduces populations of threatened or otherwise noteworthy species and/or reduces the area of threatened or otherwise noteworthy habitat types or changes their characteristics. The project reduces the nature values motivating the designation of the sites as nature reserves. |
| Low - | The project's impacts on threatened or otherwise noteworthy species and habitat types are low. The project's impacts on nature reserves do not jeopardize the nature values motivating their designation as nature reserves. |
| No impact | The project does not have impacts on species or habitat types or nature reserves. |
| Low + | The project's impacts on threatened or otherwise noteworthy species and habitat types are low. The project has a low increasing impact on the nature values motivating the designation of the sites as nature reserves. |
| Moderate ++ | The project improves the viability of populations of threatened or otherwise noteworthy species and/or increases the area of threatened or otherwise noteworthy habitat types. The project increases the nature values of nature reserves. |
| High +++ | The project significantly improves the viability of populations of threatened or otherwise noteworthy species and/or significantly increases the area of threatened or otherwise noteworthy habitat types. The project significantly increases the nature values of nature reserves. |

| | |
|---|---|
| Very high ++++ | The project very significantly improves the viability of populations of threatened or otherwise noteworthy species and/or very significantly increases the area of threatened or otherwise noteworthy habitat types. The project promotes the dispersal of new threatened and otherwise noteworthy species to the area or creates new valuable habitats. The project very significantly increases the nature values of nature reserves. |

# 5 FISH AND FISHERIES

**Sensitivity of the receptor**

Legislative steering, societal significance, susceptibility to change

| | |
|---|---|
| Very high | Threatened fish species and their spawning and nursery areas occur in the area. There are underwater Natura habitat types, nature reserves (aquatic areas), closed areas or a fish passage designated by a Centre for Economic Development, Transport and the Environment in the area. The area has nationally significant fisheries values.<br>The area is very important for the exploitation of natural resources (commercial fishing) and recreational use (such as recreational fishing) and/or it is regarded as very significant in terms of its fish stock values.<br>In the event of a disturbance, fish species and their spawning areas may be destroyed or changed very clearly. The restoration of the original species in the area is unlikely or very slow. |
| High | Threatened fish species and/or their spawning and nursery areas occur in the area. There are underwater Natura habitat types, nature reserves (aquatic areas), closed areas or a fish passage designated by a Centre for Economic Development, Transport and the Environment in the area or its immediate vicinity. The area has locally significant fisheries values.<br>The area is important for the exploitation of natural resources (commercial fishing) and recreational use (such as recreational fishing) and/or it is regarded as significant in terms of its fish stock values.<br>In the event of a disturbance, fish species and/or their spawning areas may change clearly and their restoration in the area is slow. |
| Moderate | Threatened fish species but no spawning or nursery areas of these species occur in the area. There may be a nature reserve (aquatic areas) or closed area in the affected area. There is no fish passage designated by a Centre for Economic Development, Transport and the Environment passing through the area. The area may, however, have other fisheries values.<br>The area is quite important for the exploitation of natural resources (commercial fishing) and recreational use (such as recreational fishing) and/or it is regarded as quite significant in terms of its fish stock values.<br>In the event of a disturbance, the restoration of the fish stocks of the area is likely. |
| Low | No threatened fish species or their spawning areas occur in the area. There are no nature reserves (aquatic areas), closed areas or fish passages designated by a Centre for Economic Development, Transport and the Environment in the area. The area does not have significant fisheries values.<br>The area is not important for the exploitation of natural resources (commercial fishing) and recreational use (such as recreational fishing) and it is not regarded as particularly significant in terms of its fish stock values.<br>In the event of a disturbance, the fish species of the area will be rapidly restored. |

**Magnitude of change**

| | |
|---|---|
| Very high ---- | The project causes the permanent disappearance of threatened species and/or species otherwise significant from the fisheries or ecosystem perspective from the area. The project destroys or very significantly reduces spawning areas of fish species that are threatened or otherwise significant from the fisheries or ecosystem perspective. The project prevents the migration of fish to important spawning areas. |
| High --- | The project significantly reduces populations of threatened species and/or species important from the fisheries or ecosystem perspective. The project significantly reduces the area/breeding volume of spawning areas of fish species that are threatened and/or otherwise important from the fisheries or ecosystem perspective. The project significantly disturbs migration to important spawning areas. |
| Moderate-- | The project reduces populations of threatened species or species otherwise important from the fisheries/ecosystem perspective. The project reduces the area/breeding volume of spawning areas of fish species that are threatened or otherwise important from the fisheries or ecosystem perspective. The project causes minor disturbance to fish migration to important spawning areas. |
| Low - | The project's impacts on threatened or otherwise noteworthy species and their spawning areas are low. The project's impacts do not jeopardize the status of fish populations, breeding or disturb fish migrations. |
| No impact | The project does not have impacts on fish species/their living conditions, spawning areas or migrations. |
| Low + | The project's impacts on threatened or otherwise noteworthy species and their spawning areas are low. The project causes a minor improvement in the status of fish populations, breeding or fish migration opportunities. |
| Moderate ++ | The project increases populations of threatened species or species otherwise important from the fisheries or ecosystem perspective. The project increases the area and/or breeding volume of spawning areas of fish species that are threatened or otherwise important from the fisheries or ecosystem perspective. The project causes a minor improvement in the opportunities of fish to migrate to their spawning areas. |
| High +++ | The project significantly increases populations of threatened species or species otherwise important from the fisheries or ecosystem perspective. The project significantly increases the area and/or breeding volume of spawning areas of fish species that are threatened or otherwise important from the fisheries or ecosystem perspective. The project causes a significant improvement in the opportunities of fish to migrate to their spawning areas. |
| Very high ++++ | The project very significantly increases populations of threatened species and species otherwise important from the fisheries or ecosystem perspective. The project very significantly increases the area and/or breeding volume of spawning areas of fish species that are threatened or otherwise important from the fisheries or ecosystem perspective. The project causes a very significant improvement in the opportunities of fish to migrate to their spawning areas. |

# 6 NOISE

## Onshore/above-water noise

**Sensitivity of the receptor**

Legislative steering, societal significance, susceptibility to change

| | |
|---|---|
| Very high | Settlement without industrial, traffic or other noise-generating activities. No anthropogenic ambient noise. A very large number of sensitive disturbable receptors, such as holiday residences, schools and day care centers. |
| High | No industrial, traffic or other noise-generating activities. Very little or no anthropogenic ambient noise. A large number of sensitive disturbable receptors, such as holiday residences, schools and day care centers. |
| Moderate | Some industrial or other noise-generating activity, some traffic, moderate ambient noise level. Quite a large number of sensitive disturbable receptors, such as holiday residences, schools and day care centers. |
| Low | An area with industry or other noise-generating activity, large volumes of traffic and high level of ambient noise. No sensitive disturbable receptors, such as holiday residences, schools and day care centers. |

**Magnitude of change**

| | |
|---|---|
| Very high ---- | Noise levels caused by the activity are very high (exceed the planning guideline values very often at the nearest receptors). The use of the area may become impossible due to noise. |
| High --- | Noise levels caused by the activity are high (exceed the planning guideline values often at the nearest disturbable receptors). The sound insulation of residential buildings may need to be increased due to noise. |
| Moderate-- | Noise levels caused by the activity are moderate (exceed the planning guideline values occasionally at the nearest disturbable receptors). |
| Low - | Noise levels caused by the activity are low (do not exceed the planning guideline values in any circumstances at the nearest disturbable receptors |
| No impact | The activity has no impact on the noise level. |
| Low + | Nr = not relevant |
| Moderate ++ | Nr |
| High +++ | Nr |
| Very high ++++ | Nr |

## Underwater noise

**Sensitivity of the receptor**

Legislative steering, societal significance, susceptibility to change

| | |
|---|---|
| Very high | A nature reserve where populations of marine animals that are sensitive to noise have been detected. A very large number of animals or animal species that are sensitive to noise and disturbable. |
| High | A nature reserve or other marine area free of ambient noise where marine animals that are sensitive to noise have been detected. A large number of animals or animal species that are sensitive to noise and disturbable. |
| Moderate | A normal marine area, with some marine animals sensitive to noise detected, moderate ambient noise level. Quite a large number of sensitive disturbable marine animals. |
| Low | An area with a lot of noise-generating activity, high volumes of |

| | |
|---|---|
| | waterborne traffic and a high level of ambient noise. Only few sensitive and disturbable marine animals (occasional individuals). |

**Magnitude of change**

| | |
|---|---|
| Very high ---- | Noise levels caused by the activity are very high (exceed the biological dangerous zone very often). It may be impossible for marine animals to stay in the area due to noise. |
| High --- | Noise levels caused by the activity are high (exceed the biological dangerous zone often and mostly mask other noise, making the communication of marine animals difficult). It may be difficult for marine animals to stay in the area due to noise. |
| Moderate-- | Noise levels caused by the activity are moderate (may mask other noise and make the communication of marine animals more difficult). The noise causes behavioral changes in marine animals. |
| Low - | Noise levels caused by the activity are low (do not cause significant behavioral changes in marine animals). |
| No impact | The activity has no impact on the noise level. |
| Low + | Nr = not relevant |
| Moderate ++ | Nr |
| High +++ | Nr |
| Very high ++++ | Nr |

# 7 VIBRATIONS

**Sensitivity of the receptor**

Legislative steering, societal significance, susceptibility to change

| | |
|---|---|
| Very high | A lot of residences and/or holiday residences, no industrial activity, very low traffic volumes. No anthropogenic vibrations. A lot of sensitive or disturbable receptors in the scope of impact. |
| High | Residences and holiday residences, only little industrial activity, low volumes of traffic and low current vibration impacts. Quite a lot of sensitive or disturbable receptors in the scope of impact. |
| Moderate | Residences and some industrial activity, quite high volumes of traffic. Some disturbable or sensitive receptors in the scope of impact. |
| Low | Settlement that may have industrial activity, high volumes of traffic. No sensitive or disturbable receptors in the scope of impact |

**Magnitude of change**

| | |
|---|---|
| Very high ---- | As regards blasting vibrations, peak particle velocities caused by the activity are very high (regularly or considerably exceed the guideline values set for buildings at disturbable or sensitive receptors). As regards traffic vibrations, the vibrations significantly disturb residents and are suspected to cause structural damage. |
| High --- | As regards blasting vibrations, peak particle velocities caused by the activity are high (often exceed the guideline values set for vibration impact on buildings at disturbable or sensitive receptors). As regards traffic vibrations, the vibrations occasionally disturb residents and may cause structural damage. |
| Moderate-- | As regards blasting vibrations, peak particle velocities caused by the activity are moderate (may exceed the guideline values set for human amenity in literature at disturbable or sensitive receptors). Traffic vibrations occasionally observable but not disturbing. |

| | |
|---|---|
| Low - | As regards blasting vibrations, peak particle velocities caused by the activity are low (do not exceed the guideline values set for buildings or human amenity in literature at disturbable or sensitive receptors). As regards traffic vibrations, the impacts are targeted at unpopulated areas or the vibrations cannot be detected in residential buildings. |
| No impact | The activity does not cause vibrations. |
| Low + | Nr = not relevant |
| Moderate ++ | Nr |
| High+ | Nr |
| Very high + | Nr |

## 8 TRAFFIC

**Sensitivity of the receptor**

Legislative steering, societal significance, susceptibility to change

| | |
|---|---|
| Very high | Current traffic volumes very low. A large number of sensitive disturbable receptors nearby, such as holiday residences, schools and day care centers. |
| High | Current traffic volumes quite low. Quite a large number of sensitive disturbable receptors, such as holiday residences, schools and day care centers. |
| Moderate | Current traffic volumes moderate. Some disturbable receptors, such as holiday residences, schools and day care centers. |
| Low | Current traffic volumes high. No sensitive disturbable receptors, such as holiday residences, schools or day care centers. |

**Magnitude of change**

| | |
|---|---|
| Very high ---- | The increase in traffic volumes caused by the project is very high. Traffic safety and perceived traffic safety are clearly reduced. Smoothness of traffic flow is considerably reduced around the clock. Long-term traffic restrictions are caused on other traffic. |
| High --- | The increase in traffic volumes caused by the project is high. Traffic safety and perceived traffic safety are reduced. Smoothness of traffic flow is reduced around the clock. Traffic restrictions are caused on other traffic. |
| Moderate-- | The increase in traffic volumes caused by the project is moderate. Traffic safety and perceived safety are moderately reduced. Any traffic restrictions on other traffic are short-term, but smoothness of traffic flow is reduced in places or journey times are slightly increased. |
| Low - | The increase in traffic volumes caused by the project is low. Traffic safety, perceived safety and smoothness of traffic flow are reduced to a small extent or not at all. |
| No impact | The project has no impact on traffic. |
| Low + | Nr = not relevant |
| Moderate ++ | Nr |
| High+ | Nr |
| Very high + | Nr |

## 9 CLIMATE AND AIR QUALITY

**Sensitivity of the receptor**

Legislative steering, societal significance, susceptibility to change

| | |
|---|---|
| Very high | No activities generating emissions affecting climate change in the current status. Air in the area is clean and air quality is not reduced by human activity. The new activity may have a very high impact on the achievement or maintenance of the targeted emission level. There are highly sensitive receptors such as hospitals in the affected area. |
| High | Little activity generating emissions affecting climate change in the current status. Hardly any activity reducing air quality near the area. The new activity may have a high impact on the achievement or maintenance of the targeted emission level. There are sensitive receptors such as schools and day care centers or densely built permanent or holiday residences in the affected area. |
| Moderate | Some activity generating emissions affecting climate change in the current status. The area is bordered on an area reducing air quality to some extent. There may be protective vegetation zones between the emission source and the receptor. The new activity may have some impact on the achievement or maintenance of the targeted emission level. There are commercial or office premises or sparsely built residences nearby. |
| Low | A lot of activity generating emissions affecting climate change in the current status. The receptor borders on another area reducing air quality, such as a road area with high traffic volumes or there is an industrial facility affecting air quality nearby (< 1 km). The new activity has hardly any impact on the achievement or maintenance of the targeted emission level. There are no residences or other sensitive receptors such as schools or day care centers nearby. |

**Magnitude of change**

| | |
|---|---|
| Very high ---- | The quantity of greenhouse gas emissions accelerating climate change caused directly or indirectly by the project increases very much. The relative contribution of the project's emissions to the overall emissions in the area examined increases significantly. Concentrations affecting air quality are very high. Emissions continuously or almost continuously exceed limit and guideline values. |
| High --- | The quantity of greenhouse gas emissions accelerating climate change caused directly or indirectly by the project increases a lot. The relative contribution of the project's emissions to the overall emissions in the area examined increases clearly. Concentrations affecting air quality are quite high. The emissions do not exceed the limit or guideline values but account for more than 40% of the limit and guideline values. |
| Moderate-- | The quantity of greenhouse gas emissions accelerating climate change caused directly or indirectly by the project increases. The relative contribution of the project's emissions to the overall emissions in the area examined increases to some extent. Concentrations affecting air quality are moderate. The emissions do not exceed the limit or guideline values but account for more than 25% of the limit and guideline values. |
| Low - | The quantity of greenhouse gas emissions accelerating climate change caused directly or indirectly by the project increases a little. The relative contribution of the project's emissions to the overall emissions in the area examined remains unchanged. Concentrations of emissions affecting air quality are low. |
| No impact | The project has no impact on greenhouse gas emissions. No impact on air quality. |
| Low + | The quantity of greenhouse gas emissions accelerating climate change caused directly or indirectly by the project takes a downturn. The relative contribution of the project's emissions to the overall emissions |

| | |
|---|---|
| | in the area examined takes a downturn. Emissions affecting air quality are reduced a little. |
| Moderate ++ | The quantity of greenhouse gas emissions accelerating climate change caused directly or indirectly by the project decreases. The relative contribution of the project's emissions to the overall emissions in the area examined decreases. Emissions affecting air quality are reduced moderately. |
| High +++ | The quantity of greenhouse gas emissions accelerating climate change caused directly or indirectly by the project decreases a lot. The relative contribution of the project's emissions to the overall emissions in the area examined decreases significantly. Emissions affecting air quality are reduced quite a lot. |
| Very high ++++ | The quantity of greenhouse gas emissions accelerating climate change caused directly or indirectly by the project decreases very much. The relative contribution of the project's emissions to the overall emissions in the area examined decreases very significantly. Emissions affecting air quality are reduced very much. |

## 10 FLORA, FAUNA AND PROTECTED SITES

**Sensitivity of the receptor**

Legislative steering, societal significance, susceptibility to change

| | |
|---|---|
| Very high | Several species listed in the Nature Conservation Decree as under strict protection and/or threatened species and/or species listed in Annex II or IV to the Habitats Directive and/or species listed in Annex I to the Birds Directive occur in the area. There are Natura habitat types and/or habitat types protected under the Nature Conservation Act and/or habitat types assessed as threatened in Finland in the area. The area consists entirely or in part of a Natura site, national conservation program site, nature reserve or IBA/FINIBA or has other nationally significant nature values.<br>The area is important for the recreational use of nature and/or regarded as significant in terms of its nature values.<br>In the event of a disturbance, the species composition or characteristics of the area may be destroyed or changed very clearly. The restoration of the original species and habitat types is unlikely or very slow. |
| High | Species listed in the Nature Conservation Decree as under strict protection and/or threatened species and/or species listed in Annex II or IV to the Habitats Directive and/or species listed in Annex I to the Birds Directive occur in the area. There are Natura habitat types and/or habitat types protected under the Nature Conservation Act and/or habitat types assessed as threatened in Finland in the area. The area consists in part of a Natura site, national conservation program site, nature reserve or IBA/FINIBA or has other nationally significant nature values.<br>The area is important for the recreational use of nature and/or regarded as significant in terms of its nature values. In the event of a disturbance the species or characteristics of the area may change clearly and their restoration in the area is slow. |
| Moderate | Species red-listed in Finland as Near Threatened (NT) and/or Regionally Threatened (RT) species and/or species listed in Annex I to the Birds Directive and/or significant populations of non-threatened species occur in the area. There are habitat types classified as Near Threatened (NT) in Finland, protected under the Water Act, or |

| | |
|---|---|
| | specified as of special importance under the Forest Act in the area. There may be regionally or locally valuable nature sites in the area. The area is quite important for the recreational use of nature and/or regarded as quite significant in terms of its nature values. In the event of a disturbance, the restoration of the species and characteristics of the area is possible. |
| Low | No threatened or otherwise noteworthy species or habitat types occur in the area. There are no protected areas or regionally or locally valuable natural sites in the area. The area is not important for recreational use and not regarded as particularly significant in terms of its nature values. In the event of a disturbance, the area is rapidly restored. |

**Magnitude of change**

| | |
|---|---|
| Very high negative impact | The project causes the disappearance of threatened or otherwise noteworthy species and/or habitat types from the area. The project destroys or very significantly reduces the nature values motivating the designation of the sites as nature reserves. |
| High negative impact | The project significantly reduces populations of threatened or otherwise noteworthy species and/or significantly reduces the area or threatened or otherwise noteworthy habitat types or changes their characteristics. The project significantly reduces the nature values motivating the designation of the sites as nature reserves. |
| Moderate negative impact | The project reduces populations of threatened or otherwise noteworthy species and/or reduces the area of threatened or otherwise noteworthy habitat types or changes their characteristics. The project reduces the nature values motivating the designation of the sites as nature reserves. |
| Low negative impact | The project's impacts on threatened or otherwise noteworthy species and habitat types are low. The project's impacts on nature reserves do not jeopardize the nature values motivating their designation as nature reserves. |
| No impact | The project does not have impacts on species or habitat types or nature reserves. |
| Low positive impact | The project's impacts on threatened or otherwise noteworthy species and habitat types are low. The project has a low increasing impact on the nature values motivating the designation of the sites as nature reserves. |
| Moderate positive impact | The project improves the viability of populations of threatened or otherwise noteworthy species and/or increases the area of threatened or otherwise noteworthy habitat types. The project increases the nature values of nature reserves. |
| High positive impact | The project significantly improves the viability of populations of threatened and otherwise noteworthy species and/or significantly increases the area of threatened or otherwise noteworthy habitat types. The project significantly increases the nature values of nature reserves. |
| Very high positive impact | The project very significantly improves the viability of populations of threatened and otherwise noteworthy species and/or very significantly increases the area of threatened or otherwise noteworthy habitat types. The project promotes the dispersal of new threatened and otherwise to the area or creates new valuable habitats. The project very significantly increases the nature values of nature reserves. |

# 11 LAND USE AND BUILT ENVIRONMENT

**Sensitivity of the receptor**

Legislative steering, societal significance, susceptibility to change

| | |
|---|---|
| Very high | Wilderness-like or open natural-status environment or significant tourism-related land use.<br>Permanent residences throughout the area or nationally important societal activity.<br>Non-appealable local detailed plan or local master plan directly guiding construction in effect on the area.<br>Included in area entities intended in national land use objectives as special nature and cultural environments. The affected area is designated in land use plans for permanent or holiday residences or recreational use, or a nationally significant area or site is designated in a land use plan. |
| High | An area in its natural state or area used for tourism or in part an area with permanent and/or holiday residences.<br>Regionally significant societal activity.<br>Non-appealable local detailed plan or local master plan in effect on the area. The affected area is designated in land use plans in part for permanent or holiday residences or recreational use, or a regionally significant area or site is designated in a land use plan. |
| Moderate | The purpose of use of the area is e.g. boating, forestry, recreation, mushroom picking, hunting, berry picking. In part an area of holiday residences, a sparsely populated area.<br>Locally significant societal activity.<br>A non-appealable local master plan but no local detailed plan in effect on the area. The project is not designated in the plan. |
| Low | The area is an industrial area.<br>Some or no societal activity.<br>A regional land use plan or non-binding local master plan but no local detailed plan in effect on the area.<br>The land use planning of the project area is fully or almost fully in accordance with the planned project. |

**Magnitude of change**

| | |
|---|---|
| Very high<br>- - - - | Has a very adverse impact on community structure.<br>Current land use in and/or in the immediate vicinity of the project area is no longer possible or has a significant adverse impact on its development conditions.<br>The current built environment will be permanently removed.<br>The project is in significant conflict with land use plans that are in effect and/or pending.<br>The project is mostly in conflict with national land use objectives. |
| High<br>- - - | Has an adverse impact on community structure.<br>Significant adverse impact on current land use in and/or in the immediate vicinity of the project area or on its development conditions.<br>The current built environment is altered.<br>The activity deviates clearly from non-appealable and/or pending land use plans.<br>The project is mostly in conflict with national land use objectives. |
| Moderate<br>- - | Some adverse impact on current land use in and/or in the immediate vicinity of the project area or on its development conditions.<br>The current built environment is altered to some extent.<br>The activity deviates to some extent from non-appealable and/or pending land use plans.<br>The project is mostly in conflict with national land use objectives. |
| Low - | Only a low adverse impact on current land use in the area and its development conditions. |

| | |
|---|---|
| | The current built environment is altered slightly.<br>The activity is in line with or deviates to some extent from non-appealable and/or pending land use plans.<br>The project is in part in conflict with national land use objectives. |
| No impact | No impacts on community structure, land use or built environment and does not result in the need to amend any land use plans in effect. |
| Low * | A positive impact on community structure.<br>The project supports the implementation of a land use solution designated in land use plans that are in effect or is not in conflict with land use plans.<br>The project is mostly in line with national land use objectives. |
| Moderate ** | A positive impact on community structure.<br>The project significantly supports the implementation of a land use solution designated in land use plans that are in effect.<br>The project is mostly in line with national land use objectives. |
| High *** | A significant positive impact on community structure.<br>The project significantly supports the implementation of a land use solution designated in land use plans that are in effect and also is of significance to development in accordance with another land use plan of the affected area.<br>The project is mostly in line with national land use objectives. |
| Very high<br>* * * * | A very significant positive impact on community structure.<br>The implementation of the project is a prerequisite for the implementation of a land use solution designated in land use plans that are in effect and also enables other development of the affected area in accordance with land use plans.<br>The project is in line with national land use objectives. |

## 12 LANDSCAPE AND CULTURAL ENVIRONMENT

**Sensitivity of the receptor**

Legislative steering, societal significance, susceptibility to change

| | |
|---|---|
| Very high | In the area affected by the most significant impacts there are lots of nationally valuable landscape areas or nationally significant built cultural environments.<br>In the area affected by landscape intervention measures there are a lot of fixed ancient monuments.<br>The area affected by the most significant impacts is a zone beyond human activity by nature.<br>The area affected by the changes is traditional or stagnant by temporal nature. The landscape is by nature and scale coherent and established.<br>The area is used by a large group of people for recreation/holiday residence/nature tourism. |
| High | In the area affected by the most significant impacts there are nationally valuable landscape areas or nationally significant built cultural environments.<br>In the area affected by landscape intervention measures there are fixed ancient monuments.<br>The area affected by the most significant impacts is mostly a zone beyond human activity by nature.<br>The area affected by the changes is to a large extent traditional or stagnant by temporal nature. The landscape is by nature and scale to a large extent coherent and established.<br>The area is used for recreation/holiday residence/nature tourism. |
| Moderate | There are nationally valuable landscape areas or nationally significant built cultural environments in the area surrounding the area.<br>The landscape is by nature and scale relatively coherent and established.<br>The area is used to some extent for recreation/holiday |

| | |
|---|---|
| | residence/nature tourism. |
| Low | There are no valuable landscape and/or cultural environment sites in or near the area.<br>The area is not coherent temporally, stylistically, by scale and/or structure, the area does not have a clear individual nature.<br>There are already activities or landscape damage significantly modifying the terrain.<br>The area is not used for recreation/holiday residence. |

**Magnitude of change**

| | |
|---|---|
| Very high ---- | The change causes significant landscape damage in relation to the nature of the landscape entity.<br>The coherence of the landscape is significantly reduced in the area.<br>Significant adverse impacts are caused on view axes that are the most important for landscape perception or the identity of the area.<br>Significant adverse impacts are caused in relation to valuable sites. |
| High --- | The change causes landscape damage in relation to the nature of the landscape entity.<br>The coherence of the landscape is reduced in the area.<br>Adverse impacts are caused on view axes that are the most important for landscape perception or the identity of the area.<br>Adverse impacts are caused in relation to valuable sites. |
| Moderate-- | The change causes some landscape damage in relation to the nature of the landscape entity.<br>The coherence of the landscape is reduced to some extent in the area.<br>Some adverse impacts caused on view axes that are the most important for landscape perception or the identity of the area.<br>Some adverse impacts caused in relation to valuable sites. |
| Low - | The change causes minor landscape damage in relation to the nature of the landscape entity.<br>The coherence of the landscape is reduced to a small extent in the area.<br>Minor adverse impacts are caused on view axes that are the most important for landscape perception or the identity of the area. Minor adverse impacts are caused in relation to valuable sites. |
| No impact | No impact on the nature of the landscape entity.<br>No impact on the coherence of the landscape.<br>No impact on the most important view axes for landscape perception.<br>No impacts on valuable sites. |
| Low + | The change increases the integrity of the landscape to a small extent.<br>The coherence of the landscape is improved in the area to a small extent.<br>Some positive impacts are caused on view axes that are the most important for landscape perception or the identity of the area.<br>The change improves the visibility of valuable sites. |
| Moderate ++ | The change increases the integrity of the landscape to some extent.<br>The coherence of the landscape is improved to some extent in the area.<br>Some positive impacts are caused on view axes that are the most important for landscape perception or the identity of the area.<br>The change emphasizes the status of valuable sites in the landscape to some extent. |
| High +++ | The change increases the integrity of the landscape.<br>The coherence of the landscape is improved in the area.<br>Positive impacts are caused on view axes that are the most important for landscape perception or the identity of the area.<br>The change emphasizes the status of valuable sites in the landscape. |

| | |
|---|---|
| Very high ++++ | The change significantly increases the integrity of the landscape.<br>The coherence of the landscape is significantly improved in the area.<br>Significant positive impacts are caused on view axes that are the most important for landscape perception or the identity of the area.<br>The change significantly emphasizes the status of valuable sites in the landscape. |

## 13 PEOPLE AND SOCIETY

**Sensitivity of the receptor**

Legislative steering, societal significance, susceptibility to change

| | |
|---|---|
| Very high | A lot of permanent and holiday residences. A lot of sensitive receptors. Very high recreational use value.<br>Nationally significant societal activity.<br>Very high recreational use value. Very much disturbance-prone nature-based business activity.<br>The affected area is designated in land use plans for permanent or holiday residences or recreational use, or a nationally significant area or site is designated in a land use plan. |
| High | Several permanent and holiday residences.<br>Several sensitive receptors. High recreational use value.<br>Regionally significant societal activity. A lot of disturbance-prone nature-based business activity.<br>The affected area is designated in land use plans in part for permanent or holiday residences or recreational use, or a regionally significant area or site is designated in a land use plan. |
| Moderate | Some permanent and holiday residences. Moderate recreational use value.<br>Some sensitive receptors.<br>Locally significant societal activity. A moderate level of disturbance-prone nature-based business activity. |
| Low | Few permanent and holiday residences. Low recreational use value. No sensitive receptors.<br>Some or no societal activity. Not much disturbance-prone nature-based business activity. |

**Magnitude of change**

| | |
|---|---|
| Very high<br>- - - - | A highly adverse impact on the wellbeing, living conditions, amenity or recreational use opportunities of people, residents and holiday residents of the area affected by the project.<br>Current land use in and/or in the immediate vicinity of the project area is no longer possible or there is a significant adverse impact on its development conditions.<br>The project has a highly adverse impact on technical or commercial value or usage value of properties.<br>The project is in significant conflict with land use plans that are in effect and/or pending.<br>A very high negative change in the local area's livelihoods, employment and economy. |
| High<br>- - - | An adverse impact on the wellbeing, living conditions, amenity or recreational use opportunities of people, residents and holiday residents of the area affected by the project.<br>A significant adverse impact on current land use in and/or in the immediate vicinity of the project area or on its development conditions.<br>The project causes a major change in the value or usage value of residential or |

| | |
|---|---|
| | holiday properties.<br>A significant negative change in the local area's livelihoods, employment and economy.<br>The activity deviates clearly from non-appealable and/or pending land use plans. |
| Moderate<br>- - | Some adverse impact on the wellbeing, living conditions, amenity or recreational use opportunities of people, residents and holiday residents of the area affected by the project.<br>A moderate impact on the value or usage value of residential and holiday properties.<br>A moderate negative change in the local area's livelihoods, employment and economy.<br>The activity deviates to some extent from non-appealable and/or pending land use plans. |
| Low - | Only a minor adverse impact on the wellbeing, living conditions, amenity or recreational use opportunities of people, residents and holiday residents of the area affected by the project.<br>The current built environment is altered slightly.<br>The activity is in line with or deviates to some extent from non-appealable and/or pending land use plans.<br>Only a minor change in the value or usage value of residential and holiday properties.<br>A minor negative change in the local area's livelihoods, employment and economy. |
| No impact | No impact on the wellbeing, living conditions, amenity or recreational use opportunities of people, residents and holiday residents of the area affected by the project. No impact on the value or usage value of residential and holiday properties.<br>No impact on the local area's livelihoods, employment or economy. |
| Low * | A positive impact on people and society in the local area of the project.<br>A minor improvement in the wellbeing, living conditions, amenity or recreational use opportunities of people, residents and holiday residents of the area affected by the project.<br>The project supports the implementation of a land use solution designated in plans that are in effect or is not in conflict with land use plans.<br>A minor positive change in the local area's livelihoods, employment and economy.<br>A minor positive value change or improvement of usage value of residential and holiday properties in the area affected by the project. |
| Moderate ** | A moderate positive impact on people and society in the local area of the project.<br>A moderate improvement in the wellbeing, living conditions, amenity or recreational use opportunities of people, residents and holiday residents of the area affected by the project.<br>The project moderately supports the implementation of a land use solution designated in land use plans that are in effect.<br>A moderate change in direct or indirect employment in the local area.<br>A moderate positive value change or improvement of usage value of residential and holiday properties in the area affected by the project.<br>A moderate positive change in the local area's livelihoods, employment and economy. |
| High *** | A significant positive impact on people and society in the local area of the project.<br>The project significantly supports the implementation of a land use solution designated in land use plans that are in effect and also is of significance to development in accordance with another land use plan of the affected area.<br>A major improvement in the wellbeing, living conditions, amenity or recreational use opportunities of people, residents and holiday residents of the area affected by the project.<br>A considerable positive change in the local area's livelihoods, employment and economy.<br>A significant positive value change or improvement of usage value of residential and holiday properties in the area affected by the project. |

| | |
|---|---|
| Very high<br>* * * * | A very significant positive impact on people and society in the local area of the project.<br>A very considerable improvement in the wellbeing, living conditions, amenity or recreational use opportunities of people, residents and holiday residents of the area affected by the project.<br>The direct and indirect employment impacts of the project are very high.<br>A very significant positive value change or improvement of usage value of residential and holiday properties in the area affected by the project.<br>A very considerable positive change in the local area’s livelihoods, employment and economy. |

# ANNEX 4: SUMMARY OF THE ESTONIAN EIA REPORT

## SUMMARY OF THE ESTONIAN EIA REPORT

The environmental impact assessment (EIA) procedure for the Balticconnector project has been conducted in Finland and in Estonia in compliance with national legislation. The procedure has involved the production of separate environmental impact assessment reports (EIA reports) in both countries.

This summary is a brief description of the project's alternatives and main impacts in Estonia. The full Estonian EIA report is available on the Gasum website in Estonian and in English (*http://www.balticconnector.fi*).

The contents of the Estonian EIA report by chapter are shown in the table below.

| EIA report chapter | Chapter contents in brief |
|---|---|
| 1. **Summary** | The chapter provides a brief description and summary of the Balticconnector EIA procedure and its results. |
| 2. **Project** | The purpose of the chapter is to present the project. A brief description of the parties responsible for the project, their business activities and position from the project perspective as well as backgrounds and purpose of the project is provided. The chapter also presents the project schedule and the relationship of the project with other projects.<br>The chapter covers the previously studied routing alternatives, the selection of the current route, and the alternatives assessed in the EIA procedure. |
| **3. Technical description** | The chapter further describes the phases, procedures and technical data relating to project design, construction and operation. |
| 4. **Environmental impact assessment procedure** | The chapter describes the EIA procedures carried out for Estonia as well as Finland taking the requirements of international consultations and the bilateral agreement between the countries into consideration.<br>The chapter covers the content and schedule of, parties to as well as communications and participation relating to the EIA procedure.<br>The licenses, permits, plans and decisions required for the project are also described in the chapter. |
| 5. **Current state of the environment** | The chapter describes the current state of the environment as regards the Gulf of Finland and the Pakri area of Estonia. |
| 6. **Starting points of the environmental impact assessment and the environmental impacts assessed** | The chapter describes the starting points of the EIA and covers the scoping, significance and extent of the environmental impacts in general.<br>In the assessment work, the multi-criteria decision analysis (MCDA) practices and tools developed in the EU LIFE+ IMPERIA project were employed as appropriate in the assess- |

| | |
|---|---|
| | ment of the significance of the environmental impacts.<br>The chapter presents the results if the impact assessment by environmental impact, including cumulative impacts with other known projects, impacts of project decommissioning and transboundary effects. A summary of the significance of the impacts and comparison between alternatives is also provided in conjunction with assessment results. |
| 7. **Comparison between alternatives** | The chapter describes the principles, phases and results of the comparison carried out between the alternatives. The chapter aims to also provide the reader with a clear idea of the feasibility of the alternatives and of how the comparison between the alternatives was carried out and what its results are based on. |
| 8. **Uncertainties relating to the impact assessment** | The chapter presents the uncertainties relating to the impact assessments carried out. |
| 9. **Prevention and mitigation of adverse impacts** | The chapter describes the means and ways that can be employed by the parties responsible for the project in subsequent project phases to prevent or mitigate any adverse impacts caused by the project and assessed in the EIA report. |
| 10. **Environmental impact monitoring program** | The chapter describes the plans made by the parties responsible for the project for environmental impact monitoring during and after the project. |

***Application and stages of the EIA procedure***

The offshore natural gas pipeline will enable the transmission of natural gas between Finland and Estonia. Due to the international dimension of the Balticconnector project, two main international procedures are applied to the project: the UNECE Convention on Environmental Impact Assessment in Transboundary Context (Espoo Convention) and the bilateral Agreement between Finland and Estonia on Environmental Impact Assessment in a Transboundary Context.

The need for the assessment of the project's environmental impacts for Estonia is based on the Environmental Impact Assessment and Environmental Management System Act. The Balticconnector project is included in the list of projects provided in chapter 6 of the Estonian EIA decree under which it is classified as a project with essential environmental impacts. According to this (*Environmental Impact Assessment and Environmental Management System Act § 6 section 1 clause 11)* marine dredging, starting from the soil volume of 10 000 cubic metres, sinking of solid substances into the seabed, starting from the soil volume of 10 000 cubic metres, are listed as activities with significant environmental impact and therefore EIA process is compulsory (*RT III, 17.12.2013, 6 Hoonestusloa menetlemise algatamine*). Gasum Oy submitted superficies license application to burden public water body and installation of natural gas pipeline to seabed to the Estonian Ministry of Economic Affairs and Communications (MEAC) on 14.05.2013. Based on Estonain Government order (12.12.2013 No

555) on initiation of superficies license proceedings, it was decided to initiate EIA process.

The EIA procedure for Estonia comprises two stages. Firstly, an environmental impact assessment program was prepared. This is a plan specifying which impacts will be assessed and how they will be assessed. The party responsible for the project submitted the EIA program to the permitting authority, which gave notification of the public display of the EIA program on February 2, 2014. The EIA program was displayed for statements and opinions from February 10 to April 7, 2014. The public consultations concerning the program took place on April 15, 2014 in Paldiski and April 16, 2014 in Tallinn. The opinions and statements provided were included in the program, and on May 23, 2014 the EIA program of the Balticconnector project was submitted for approval to the Ministry of the Environment, which issued its statement for the supplementation of the program on June 20, 2014. The supplemented EIA program was submitted on June 30, 2014 to the Ministry of the Environment, which approved of it by letter No 11-2/14/1093-9 dated July 15, 2014.

The report concerning the project's environmental impacts – the EIA report – was produced in the second stage of the EIA procedure. The EIA report was prepared on the basis of the EIA program and the opinions and statements provided concerning the program. Investigations for this EIA report commenced in spring 2014, and the report was submitted to the coordinating authority in April 2015. The work was guided by the statements and opinions received during the program stage as well as comments provided at public consultations.

Citizens and various stakeholders may express their opinion about the EIA report within the period of time specified by the permitting authority. The EIA procedure will be completed once the EIA report is approved by the supervising authority. The EIA report as well as the stakeholder interaction carried out and the material acquired during the EIA procedure will provide important support to more specific planning and design concerning the project, as well essential information for the permitting authorities.

***Project description and alternatives assessed***

In addition to the entire pipeline route, the following alternatives were examined in the environmental impact assessments conducted in Estonia:

**Alternative EST 1 (ALT EST 1):** Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Inkoo, Finland, to Paldiski, Estonia, with the point of landfall in Kersalu, Estonia.

**Alternative EST 2 (ALT EST 2):** Construction of the Balticconnector natural gas pipeline across the Gulf of Finland from Inkoo, Finland, to Paldiski, Estonia, with the point of landfall in Pakrineeme, Estonia.

A situation where the Balticconnector natural gas pipeline will not be constructed was assessed as the zero alternative.

Two route alternatives were studied in Lahepere Bay and on the Pakri Peninsula. Both alternatives run through the shallow Lahepere Bay and the landfalls are located on the Pakri Peninsula (Figure 1).

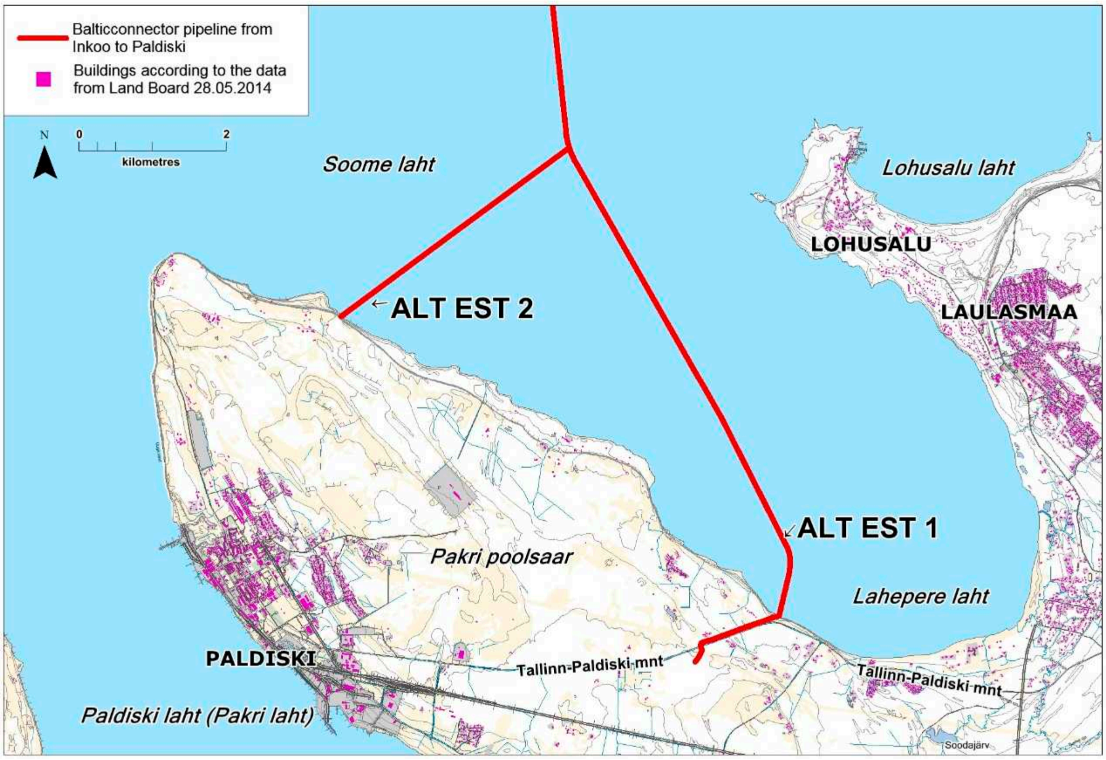


**Figure 1. The routing alternatives of the Balticconnector natural gas pipeline in Estonia – Paldiski area.**

The landfall in ALT EST 1 is in Kersalu. **At the Kersalu landfall,** the main scarp of the North Estonian Klint, up to 9 m high here, rises from a narrow high-water shore. According to the comprehensive plan of the City of Paldiski, Kersalu is a promising residential area by Lahepere Bay. The ALT EST 1 alternative also features an onshore gas pipeline around 1.3 km in length running from the landfall to the planned compressor station.

The ALT EST 2 point of entry from the sea to the land area on Pakrineeme is located on Pakri landscape reserve area, away from human settlements – no existing or planned residential areas are located in the proximity of the landfall. The region is developing into an area with industrial land use, containing the Paldiski wind farm, and a detailed plan has been approved for the construction of the Paldiski LNG terminal's onshore facilities. **At the Pakrineeme landfall**, the scarp of the North Estonian Klint, up to 23 m high, rises sharply upward approximately 17 m from the shore.

***The most significant environmental impacts***

The most significant environmental impacts of the project will arise during the construction of the natural gas pipeline. Adverse impacts during pipeline operation will be of lower significance. Impacts identified as the most significant impacts during construction are impacts on seabed, water quality, the marine environment, flora and fauna as well as nature reserves.

According to preliminary calculations and plans, a significant amount of seabed intervention measures (dredging, ploughing or jetting, blasting and subsea rock installation) will be required for pipeline protection and free-span rectification. The actual need for seabed intervention will be specified further once progress is made in technical project design, with the need for intervention for each pipeline section likely to be reduced below the level presented in the EIA report. The environmental impact assessments conducted are based on conservative assessments concerning project measures and efforts have been made to conduct them on the basis of the worst-case scenarios.

Impacts during construction

*Offshore areas*

For the purpose of environmental impact assessment, the suspended solids load caused by natural gas pipeline construction work was modeled using a mathematical model on water movements and the migration of substances. The amount of seabed intervention required during construction will be relatively small in the offshore areas of western Gulf of Finland, with the impacts on water quality in these areas being very low due to the large volumes of water, efficient turnover of water and lesser natural values. The impact area is estimated to extend to approximately 1 km from the pipeline. Turbidity and accumulation areas as well as impacts on marine environment will be clearly lower than in near-shore areas. Harmful substances are likely to be dispersed with suspended matter along the flow directions but to be ultimately resedimented with the solids.

Impacts on water bodies were also found to be temporary, local and low in the environmental monitoring carried out during the construction of the Nord Stream gas pipeline project. In offshore areas the duration of noise and other disturbances will also be shorter than in near-shore areas as construction work will progress faster further off the shore.

Where permitted by the ice situation, some birds, seals and occasionally also harbor porpoises are found in the open sea areas of the Gulf of Finland. No particularly important feeding areas attracting large numbers of individuals are known in the area covered by the natural gas pipeline project. Among birds, Anseriformes in particular prefer feeding in shallow areas very rarely found in open sea areas. The impacts of offshore turbidity on bird fauna are likely to be low as the impacts on fish, bivalves and other small fauna that they feed on are estimated to be very local and short-term. Deep-bottom zoobenthos will be destroyed almost all the way underneath the pipeline, but on the whole the natural gas pipeline is not estimated to pose a major risk to offshore soft-bottom benthic communities which, due to the poor oxygen situation, are quite non-diverse and have good recovery potential.

Fish populations are impacted particularly by underwater explosions, which result in behavioral changes over several kilometers and risk of injury up to hundreds of meters from the blasting site. Benthic fish are also affected by changes in the benthos, which may have either negative or positive impacts depending on the species of fish. No significant fish spawning areas can be found in the offshore zone of the project area. The impact on fisheries is reduced by the fact that the impact focus will be on mature fish.

Adverse effects on fishing in the offshore areas of the Gulf of Finland will mainly be caused by the prevention of trawling in the project area during construction. Fishing vessels operating in the area will be disturbed by increased vessel traffic, seabed intervention work, pipelaying as well as pipeline protection measures. In the Gulf of Finland however, where fairway crossings take place in the open sea, the impacts on other vessel traffic will be low as there will be plenty of space around the protection zone of the pipelaying vessel for diversionary routes, resulting in only short detours.

The most significant risks relating to the construction of the natural gas pipeline comprise the collision of installation vessels participating in pipelaying with other vessels as well as any munitions and barrels containing hazardous substances found in the seabed in the construction area. The prevention of safety incidents is the primary goal set for planning. Planning will take place in compliance with legislation as well as safety and occupational health and safety rules. Efforts will be made to prevent vessel collisions and groundings through traffic control. The disposal of munitions and barrels will be negotiated with the relevant national authorities.

*Coastal areas*

Both alternatives (ALT EST 1 and ALT EST 2) are running in shallow Lahepere Bay and landfalls are situating in Pakri peninsula.

The damage to the coastal sea benthic fauna can be expected to be greater when compared to the open sea. There is a chance of the benthic fauna ecosystem restoration, the recovery will depend greatly on the surrounding environmental conditions and will take 2-5 years. Since the negative impact is temporary and limited in scope, it can be classified as moderate.

The impact of noise on fish generated due to construction work can be assessed as moderate to small, depending on the amount of blasting. On an individual level the impact can be irreversible if a fish is injured or killed. However, on population level the impact is reversible, and concludes with the conclusion of construction work. The impact on fishing deriving from fish fauna during the construction period is assessed as moderate and reversible.

The impact of noise and visual disturbance on birds is direct, negative and intensive, but due to its short duration it is evaluated to be moderate. Highest risks are expected in the Pakri Natura 2000 area where Sound Pressure Levels will be highest during construction phase (pipelaying and trenching). In the Natura 2000 MPAs the Catecean's and the Pinnipeds' acoustic thresholds should not be exceeded during the pipeline construction.

Both alternative routes of the Balticconnector gaspipe run through the Pakri habitat directive and birds directive areas. Significant impacts without implementation of mitigation measures cannot be excluded to concern habitat 1110 in both alternatives. This is not a priority habitat, and mitigation measures will reduce the impact to insignificant.

In ALT EST 2, significant impact cannot be excluded for the priority habitat 9180*, because it cannot be predicted how the microtunneling will affect the soil structure, roots of plants or water regime. The significant impact to priority habitats 6210* and 6280* (situating outside of Natura 2000 area) in the ALT EST 2 area can be avoided by making sure the construction activities do not take place in the immediate vicinity of these sites.

The impact of planned construction work on the bird species defined as the protection aim of the Natura 2000 birds area is insignificant to moderate. In order to limit moderate impact it is necessary to apply mitigation measures. It is important to avoid negative impact on black guillemot whose only known nesting location in Estonia is located on Pakri cape that is whithin impact area of ALT EST 2.

The project is estimated to have insignificant impact to the integrity of the Natura 2000 area.

In the Kersalu landfall location (ALT EST 1), where the plan is for the route make landfall in a trench, the impact on the soil in the land section of the affected area will be significant. The microtunnel option (as planned for Pakrineeme in ALT EST 2) will cause minimum damage to the main feature in the Pakri landscape reserve, the Cambrian / Ordovician scarp of the Baltic Klint.

The mainland section of Balticconnector will cover areas of very different sizes for the two alternative routes. ALT EST 1 with its 32 meters wide area directly under construction will cover around 3 hectares whereas ALT EST 2 with its direct construction zone (jacking shaft) will take up around 0.1 hectares. The alternatives also differ from each other regarding the protected species involved. While the ALT EST 1 route in Kersalu does not cross any protected objects of an area included in the preservation regime in force according to the environmental register, the ALT EST 2 landfall site is situated in the Pakri landscape reserve. However, it cannot be said that the Kersalu route alternative does not actually cross any protected objects – the seaward section of the route is situated within the planned Pakri nature reserve that has also been entered into the environmental register. The ALT EST 1 area covers sites of 5 protected plant species (category III) and 17 animal species and the ALT EST 2 area covers sites of 4 protected animal species.

Onwards from the landfall the construction activities will have an impact on the habitats of protected species.

The impact of the mainland section of the pipeline on the natural environment can be divided according to the alternative construction methods – whether the pipeline will be taken to the mainland in a trench (ALT EST 1) or in a microtunnel (ALT EST 2). The construction of an open trench will have a greater impact than a closed construction method, which allows bringing the pipeline to the mainland without touching the surface formations. It is important to plan ahead concerning various construction techniques so that the pipeline can be constructed with less impact on natural formations. Mitigation measures can be employed to minimize impacts. For this, the protected plants species growing on the route (ALT EST 1) should be transplanted and also the conditions should be improved for the species in the area of bushy alvar grassland bordered by the current site, improving its light conditions by cutting the brushwood.

Implementation of the Balticconnector project implements land use objectives provided in prior plans regarding both alternatives.

Impacts during operation

The impacts during the operation of the natural gas pipeline in coastal and sea area will be low. Periodic inspections and servicing and maintenance tasks may cause minor disturbances to birds and marine mammals, but these will not differ from the disturbance caused by other movement in the area.

The Balticconnector gas pipeline will cover a strip of the seabed in the Gulf of Finland. The pipeline and the subsea rock installations protecting it will form a protrusion from the seabed in many places.

In normal situations there will be no impact on water quality during the operation of the natural gas pipeline. During operation, the impacts of the pipeline on the marine environment will mainly be restricted to minor flow amendments due to morphometric changes caused by the pipeline itself and its construction (covering and protection) in areas near the pipeline, such as increased turbulence around the pipeline at faster bottom flow velocities. Changes in flow velocities and directions may affect the transport and accumulation of materials in the close vicinity of the pipeline. According to measurements carried out for the Nord Stream project, impacts only extend up to tens of meters from the pipeline.

The flow of pressurized gas in the pipeline will increase the temperature of the pipeline, which will affect the bottom sediment up to a few meters from the gas pipeline. This change in temperature will not play any practical role as regards sediment characteristics. Pipeline maintenance measures will include the addition of soil around the pipeline wherever necessary. Such measures may contribute toward changes in near-bottom flows, whereby changes in flows may cause changes in erosion or sediment accumulation in nearby areas.

During pre-commissioning, underwater noise will be generated from water intake and discharge, in which pigging will also be used. Pipeline operation noise sources can be classified as either continuous or intermittent. During operation, noise will be generated by 1) gas-borne noise from pipeline and 2) maintenance works, such as the use of vessels and helicopters. Based on data from similar reports, the noise impact from these actions will, however, be insignificant.

After the construction of the pipeline and the subsequent soil restoration is complete, the gaspipe corridor will be kept open by removing trees and bushes along the gas pipeline protection zone. This is the only impact element during operation and maintenance. Consequently, only herbs and shrub can grow on the gas pipeline. It should also be noted that the construction of the route corridor will create new open habitat, and therefore the construction may help open-habitat plants to distribute. The edge effect will not extend very far into the environment, and the zone that is kept clear of trees and shrubbery will not restrict the movement of animals or cause significant habitat changes for breeding birds.

Possible damage to the gas pipeline and resulting pipeline malfunction could have consequences to human safety. The risk assessment conducted for the Balticconnector project (*Ramboll 2014b*) identified the sections where the pipeline must be protected to prevent pipeline damage. Maintenance management of the gas pipeline will be carried out to ensure the pipeline will be kept in good working order and will not pose a risk to the environment.

<u>Transboundary impacts across the borders of Estonia</u>

The Balticconnector project is not estimated to cause significant transboundary impacts across the borders of Estonia. The pipeline will extend across western Gulf of Finland to Finland, whereby construction work in Estonian waters may result in low impacts in Finland’s territorial waters. No impacts are estimated to occur on other Baltic Sea region states.

The deterioration of water quality arising from seabed interventions relating to the construction of the gas pipeline will be restricted in terms of area and duration. Offshore impacts in western Gulf of Finland will be low due to the large volumes of water and, on the other hand, the smaller scale of the marine works carried out. Due to the large water depth and the stratification of the water column in this area, the impacts will not in practice reach the surface layer. According to preliminary plans, the type of construction carried out near the limit of territorial waters, north of KP 53, will either be dredging or ploughing. Water works carried out in Estonian waters may cause some turbidity carried across the state borders. The contaminant contents found in sediment samples obtained from the Balticconnector pipeline route were, however, low, and their distribution with solids during construction is not likely to pose a risk to the marine environment. The Balticconnector project will not have significant transboundary impacts on water quality regardless of whether construction is carried out in Finnish or Estonian waters. Any low impacts taking place will be short-term and local.

Following the pressure test, the seawater used to flood the pipeline will be filtered and treated with oxygen scavengers and/or biocides. Flooding can also be carried out using clean water without any additives. When using oxygen scavengers or biocides, the water removed is led into a basin for the settlement of solids and any impurities in them. Following the settlement process, the water is pumped into a marine area where mixing will take place rapidly. If the flooding is carried out using filtered water, there is no need for settling and the water can be led in a controlled manner into the sea. If the flooding water of the Balticconnector pipeline is pumped into the marine area in Finland can possible adverse impacts to the water quality be considered as transboundary impacts. However, due to the small volume of water and the short duration of discharge, the impact of flooding water can be assessed as low on the basis of the experiences gained from the Nord Stream project.

Gas pipeline project activities taking place within the borders of Estonia during construction or operation are not estimated to have significant transboundary impacts on flora, birds, marine mammals or fish. Underwater blasting will take place in Estonian as well as Finnish territorial waters. The number of blasting sites will, however, be smaller on the Estonian side. Underwater noise from seabed dredging and possible blasting explosions may be carried from the limit of the Estonian territorial waters to Finnish territorial waters, whereby seals or porpoises in the area may hear sounds caused by blasts. Underwater blasting causes brief and high levels of sound pressure transported over distances of tens of kilometers. As the distance from the blasting site increases, the impacts are reduced as the intensity of the sound decreases. Due to the large distance, however, there will not be significant noise impacts on the behavior of marine mammals. Above-water noise impacts will be low and short-term, and no significant transboundary impacts across the Estonian borders are estimated to occur during project construction or operation.

The nearest Natura 2000 sites to the limit of Estonian territorial waters are the Kallbådan islets and waters and the Natura site of the Inkoo archipelago, both on the distance of approximately 30 km. Balticconnector project activities on the Estonian side will not result in impacts on the protection principles of the Natura sites.

Seabed intervention will mainly result in momentary local impacts on other vessel traffic with a maximum duration of a few days for each area. In the offshore areas between Finland and Estonia where the pipeline will cross busy fairways, the safety zone will result in impacts on other vessel traffic as the diversion of the safety zone of the installation vessel will required during intervention measures. This is not estimated to have a significant impact on the safety of vessel traffic considering the existing navigation and traffic control measures. Emissions from vessels participating in pipelaying will have an impact on air quality in the Finnish territory when the vessels are close to the Finnish territory. The impacts will be very low and remain close to the route taken by the vessels.

The transboundary impacts of the project on people and society will be low. There will be a temporary increase in technological and economic activity in Estonia and well as Finland during construction. During operation, there will be an emphasis in transboundary impacts on the territory of the two states on the role of the gas pipeline as an energy transport channel reducing dependency on Russian gas supply. The Balticconnector pipeline will not cause restrictions on bottom trawling, whereby there will be no impact on those who work in fisheries.

In a possible worst-case scenario accident in Estonian waters (gas pipeline rupture), the size of the dangerous flammable gas cloud would be slightly over 700 m and could lead into a flash fire of the gas cloud and damage to people caught in the fire in the Finnish territory. However, a gas leak into the sea and the resulting formation of a gas cloud is a highly unlikely event.

***Feasibility of alternatives and summary of comparison***

As regards environmental impacts, the alternatives examined are feasible when a special focus in project design is placed on the prevention and mitigation of adverse impacts from construction during construction. No adverse environmental impacts that are unacceptable or that could not be mitigated to an acceptable level were found during the environmental impact assessments of the project alternatives.

ALT EST 1 and ALT EST 2 are both running in shallow Lahepere Bay. There are no significant differences between alternatives regarding the impact on seabed. ALT EST 1 burdens the seabed in the length of approximately seven kilometres when ALT EST 2 burdens the seabed in the length of approximately four kilometres.

Although the results of resuspended particles spread modelling indicated that floating material can spread quite far towards both shorelines in the bay, most of the material would settle in the immediate vicinity of the work area. A certain amount of sediment can be transported and settled outside Lahepere Bay towards the open sea from the tip of Ihasalu peninsula only for ALT EST 2 in case of strong NW winds.

In the area of ALT EST 1 soft and sandy sediment dominate on the sea bottom. The phytobenthic communities in this area are mainly formed by higher plants and have a high biomass value. In the shallow coastal sea area of ALT EST 2 a rocky type of seabed with characteristic communities of phytobenthos dominate. At the depth of 6-7 meters rocky seabed is replaced by sandy sediments with a lower biodiversity of seabed flora. In view of this it can be assumed that by implementing this alternative there will be a lesser impact for phytobenthic communities because after finishing construction works the rock filling enables the recovery of seabed flora characteristic to the region.

In the case of the alternative ALT EST 2 in Lahepere Bay, zoobenthos on both soft and hard compact substrata will be damaged. Alternative ALT EST 1 will see the damaging of benthic fauna communities on only the soft seabed, but the rock fill is planned to be deposited on a larger area. The zoobenthos is expected to recover after the completion of construction works in both alternative construction areas.

Changed seabed on the pipeline route can have a negative impact on the spawning grounds. Based on the spread of most important species in Lahepere Bay, the smaller impact would be ensured by alternative ALT EST 1, which goes through an area where the number of species is lower than on the route of alternative ALT EST 2. In general the area of the planned gas pipeline is small when compared to the area of the bay, and it is probable that the impact caused by changes on the seabed on the spawning areas of Baltic herring as well as other fish is insignificant for both alternatives.

Both onland alternative routes have an impact on the protected natural object. ALT EST 1 area covers sites of five protected plant species (category III) and 17 animal species and ALT EST 2 area covers sites of four protected animal species.

The impact of the mainland section of the pipeline on natural environment can in turn be divided according to alternative construction methods – whether the pipeline will be taken to the mainland in a trench (ALT EST 1) or by penetrating a microtunnel (ALT EST 2). Construction methods that damage natural environments the least have a lesser impact on natural communities and biotopes.

ALT EST 1 is in line with the thematic plan of the comprehensive plan of Paldiski titled "Location of the category D natural gas pipeline" and ALT EST 2 with Paldiski LNG terminal detail land use plan. Still there exists uncertaincy regarding connection of ALT EST 2 with Paldiski-Kiili category D natural gas pipeline. In order to greate this connection, approximately 8,5 kilometers long natural gas pipeline must be constructed from ALT EST 2 until planned compressor station in Kersalu.

The project is estimated to have insignificant impact to the integrity of the Natura 2000 area.

The ALT EST 1 is assessed as alternative with less impact on Pakri habitats directive site compared with ALT EST 2.

The overall significance of the implementation alternatives assessed is shown in the table below (Table 1).

**Table 1. Assessment scale for the assessment of the significance of impacts and the significance of the environmental impacts of the implementation alternatives of the Balticconnector project assessed (ALT EST 1 and ALT EST 2) in comparison with the current situation and the non-implementation of the project (zero alternative).**

| | |
|---|---|
| **Significance of impacts** | Very high ++++ |
| | High +++ |
| | Moderate ++ |
| | Low + |
| | No impact |
| | Low - |
| | Moderate -- |
| | High --- |
| | Very high ---- |

| PROJECT'S ENVIRONMENTAL IMPACTS | ALT 0 | CONSTRUCTION | | OPERATION | |
|---|---|---|---|---|---|
| | | ALT EST 1 | ALT EST 2 | ALT EST 1 | ALT EST 2 |
| **Seabed** | 0 | – | – | – | – |
| **Water quality** | 0 | – – | – – | – | – |
| **Benthic fauna and aquatic flora** | 0 | – | – | 0 | 0 |
| **Fish fauna** | 0 | – – | – – | 0 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| **Fishing** | 0 | – – | – – | 0 | 0 |
| **Conservation areas** | – | – – | – – – | 0 | 0 |
| **Flora** | 0 | – – | – – – | – | – |
| **Bird fauna** | 0 | – – | – – | 0 | 0 |
| **Other fauna** | 0 | – – | – – | 0 | 0 |
| **Soil, bedrock and groundwater** | 0 | – – | – | 0 | 0 |
| **Noise** | 0 | – | – | 0 | 0 |
| **Vibrations** | 0 | – | – | 0 | 0 |
| **Waterborne transport** | 0 | – | – | – | – |
| **Land transport** | 0 | – | – | – | – |
| **Air emissions** | 0 | – | – | 0 | 0 |
| **Land use and built environment** | 0 | – | – | 0 | 0 |
| **Landscape and cultural environment** | 0 | – | – | – | – |
| **People and society** | 0 | – | – | + | + |
| **Natural resources** | 0 | 0 | 0 | – | – |
| **Waste** | 0 | 0 | 0 | 0 | 0 |

In addition to adverse impacts, the implementation of the project will also have positive environmental impacts. At the moment natural gas for Estonia is sourced only from Russia and Latvia. The construction of the Balticconnector natural gas pipeline would contribute to the development of the natural gas market and supply security in Estonia. If the project is not implemented, neither the adverse nor the positive impacts of the project will be realized.