

St. Petersburg Flood Protection Barrier Environmental Impact Assessment Study¹ Executive Summary

1 Preface

This is the Executive Summary of the study to assess the environmental impacts of the completion of the St. Petersburg Flood Protection Barrier - it presents a summary and major findings. A comprehensive study report - Saint Petersburg Flood Protection Barrier, Environmental Impact Assessment Report, NEDECO, June 2002 – can be consulted at various public locations and after contacting the **Project Client**². The study will be completed with a three day Exposition to present the results, to take place 17 – 19 July 2002, and a Final Public Consultation on the last day of the Exposition.

The European Bank for Reconstruction and Development (EBRD) has been requested by the Ministry of Finance of the Russian Federation to participate in the funding of the completion of the partially constructed St Petersburg Flood Protection Barrier. As the implementation of the project may result in environmental impacts, the EBRD has required an Environmental Impact Assessment to be undertaken as part of the feasibility study of the project.

The Environmental Impact Assessment study reported here is one of four studies that together form the feasibility study for the Project:

- Technical Feasibility Study (TFS) – financed from the Netherlands' Trust Fund;
- Environmental Study (EIA) – financed from the Japanese Trust Fund (JECF);
- Cost Recovery Study (CRS) – financed from the Netherlands' Trust Fund; and
- Economic Analysis (EA) – financed from the Taiwanese Trust Fund.

Each of these studies is reported separately.

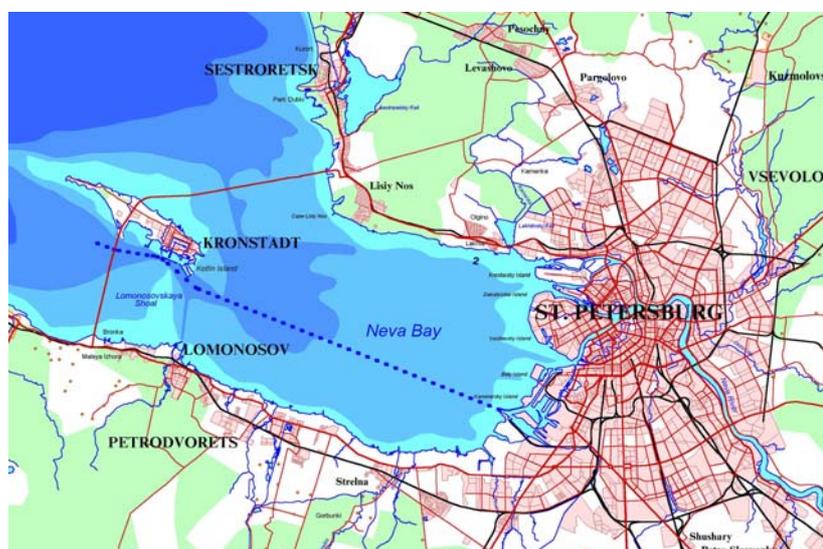


Figure 1: Map of St. Petersburg and the location of the Barrier in Neva Bay.

Following international tendering, the environmental impact assessment study was commissioned by Gosstroy to the Netherlands consortium NEDECO. Both foreign and

¹ The present study was conducted by a NEDECO consortium with WL | Delft Hydraulics as leading partner. The Finnish Environmental Institute was second partner. It was funded by the Japan- Europe Cooperation Fund (JECF) at the EBRD and conducted in the period January – July 2002

² The Project Client and Coordinator is the State Committee of the Russian Federation on Construction and Housing Complexes (Gosstroy of Russia). The EIA Report can be viewed at Gosstroy's offices in Moscow and Saint Petersburg during normal opening hours. Please contact Mr. G.S. Markosov (095-930-4806), Mr. V.M. Zotov (095-930-3046), or Mr. V.I. Shchekachikhin (812-319-9063).

Russian experts from St. Petersburg have contributed to the study with data, analysis and background documentation. The contribution of all participants is gratefully acknowledged. The responsibility for this report rests with NEDECO.

2 Does St. Petersburg need a Flood Protection Barrier?

Czar Peter the Great founded the city of St. Petersburg in 1703 in a low-lying area, where the delta of the river Neva meets the waters of the Gulf of Finland. And with these three elements – low-lying city, river delta and Gulf – the present problem of St. Petersburg is defined. High water in the Gulf causes frequent flooding of the low areas of the city, while the river outflow carries the effluent of the population and industry of the city of five million people to the shallow eastern part of the Gulf and Neva Bay.

The flooding of the city has been a concern since its foundation. Between 1703 and now, a total of 295 floods or water level rises with peaks higher than 160 cm BS³ have been recorded, that is about 1 per year. The most recent one occurred on 10 March 2002. When the water level reaches 160 cm BS, streets and basements in the low lying parts of the city centre start to flood, and a flood is officially recorded. The five largest floods occurred in 1824 (421 cm), 1924 (380 cm), 1777 (321 cm), 1955 (293 cm) and 1975 (281 cm BS). There are indications that the flood frequency is increasing: in the 22 years since 1980, 46 floods have occurred, which is about 2 per year. A new analysis of all flood data till 2002 was conducted and the probability of flooding was determined by statistical analysis, see Table 1.

Table 1: Vulnerability of St. Petersburg (Gornii Institute) to floods

Return period (in years)	1	5	10	25	50	100	250	500	1000	2500	5000	10000
Flood level in cm BS	160	222	246	277	300	323	353	376	398	428	451	473

The concept of 'return period' is a statistical value - a return period of 5 years and a flood level of 222 cm indicate that, on average, the level of 222 cm is exceeded once every five years.



Figure 2: Flooding of streets and embankments during the flood of 1967 (244 cm BS)

The damage incurred by floods increases with flood level and duration of the high water and is not restricted to material damage alone. For example, in 1824 over 300 people lost their lives due to the flood. With the present population, a flood of 300 cm, which has a return period of 50 years, could already be catastrophic. It will lead to damage to public infrastructure such as roads, bridges, embankments (see Figure 2), flooding of the metro system, overflow of sewerage systems and to serious flooding of buildings. This notably

³ BS (Baltic System) is the reference datum for water levels in the Baltic Sea. 0 cm BS roughly corresponds to the long-term mean sea level at Kronstadt.

includes buildings of historic and cultural value, which largely are located in the low lying city centre, such as the Hermitage and many other museums.

An outline economic assessment using the above vulnerability data indicates that the total average damage due to flooding is US \$ 69 million/year. A more detailed analysis will precise this further.

Conclusions:

The City of St. Petersburg is extremely vulnerable to flooding - and the risk of major floods is increasing. Flood protection is needed.

3 The Flood Protection Barrier

Planning of the present flood defences started in the 1960s, driven by the serious flood of 1955.

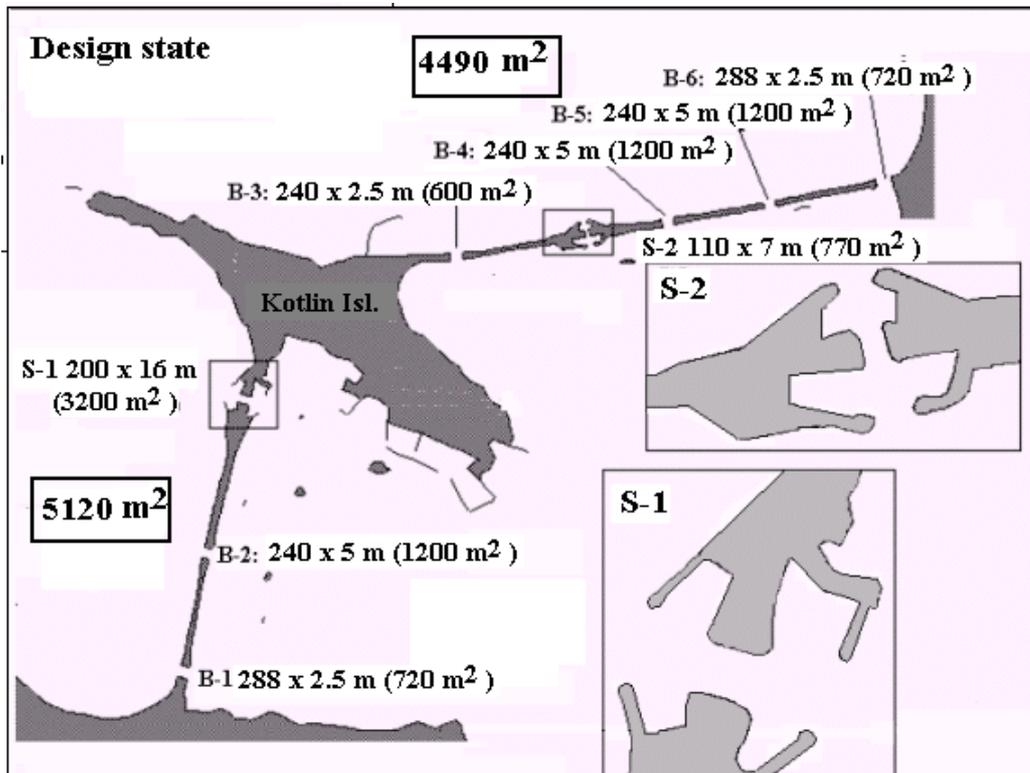


Figure 3: Design of the St. Petersburg Flood Protection Barrier (approved western variant)

A number of alternatives was considered, among them a so-called eastern variant with defence works very close to the city shores and in the various branches of the Neva Delta, and a western variant across the island of Kotlin. An extensive and thorough feasibility study addressed technical issues, environmental impacts, economic aspects and many more.

Based on the studies, the Government of the Soviet Union in 1979 approved the construction of the western variant, consisting of a 25.4 km long Flood Protection Barrier across the island of Kotlin, west of the city of Kronstadt– see Figure 1. The Barrier is composed of 11 dam sections D1 - D11, 6 water exchange complexes B1 - B6 distributed along the Barrier to allow free passage of water and 2 navigation passages S1 and S2. Figure 3 shows the concept of the Barrier, including the width and depth of each opening.

Construction started in 1980 and by December 1984 Kotlin was connected to the northern coast via the Barrier. In the autumn of 1987 concerned citizens appealed to Secretary

General Gorbachev. They felt that the observed pollution of Neva Bay was caused and aggravated by the construction of the Barrier and they protested against its completion. As a result, the construction was temporarily halted. In short succession, three commissions of Soviet experts were nominated to investigate the environmental state of Neva Bay and the possible role of the Barrier in this. The reports of the commissions disagreed on the influence of the Barrier, however. In 1990, an International Commission of experts was subsequently invited to study and evaluate the issue. In its report, this Commission confirmed the serious environmental state of Neva Bay, and made clear that the impact of the completed Barrier on the environmental state would be minimal. It recommended that completion should proceed as planned. In parallel, measures to improve wastewater treatment should be implemented as discharge of untreated or partially treated sewerage was the main cause for the deteriorated environmental state of the Bay. Although these results were generally accepted during the years that followed, the work continued at only a minimal pace. Due to the break-up of the Soviet Union shortly thereafter, work between 1987 and 2002 was largely limited to maintenance of works already completed.

4 The existing Barrier does not provide sufficient safety

The present state of the Barrier is given in Figure 4.

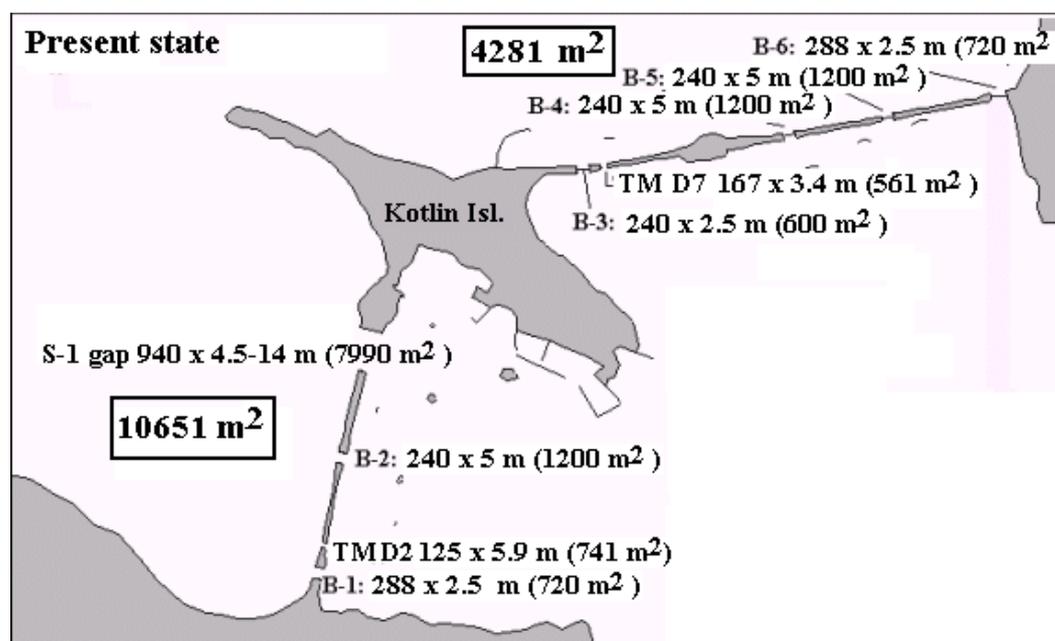


Figure 4: Present situation of the Barrier

At present the Barrier is about 60-70% completed. The dam sections are largely in place and the water passage openings B1-B6 are fitted with steel gates that will be lowered in case of floods. The electrical and mechanical equipment necessary for lowering the gates at the complexes B1 and B2 have not yet been placed, though. In order to allow sufficient flow of water through the Barrier during the construction stage, temporary openings were made in dam sections D2 and D7, while near the planned navigation passage S1 a large part of dam section D3 – the temporary navigation gap – was left open. These temporary openings S1, TM-D2 and TM-D7 have no provisions to be closed in case of flood threats.

As a result, the present Barrier already dampens floods that threaten the city and flood levels in the city are lower than before. However, model simulations have shown that for a flood case similar to the historic one of 1824 (peak level 421 cm BS) the present Barrier reduces the peak flood level in the city by only 40 to 80 cm. So, for these really high flood levels, the remaining peak level in the city is still in the category 'catastrophic flood' and such that major damage will occur. Furthermore, serious floods will be likely to damage the Barrier itself, as

final protection layers have not yet been applied and the existing navigation opening is vulnerable due to strong currents occurring during extreme floods.

Conclusion:

To provide full flood protection to the city of St. Petersburg, the Flood Protection Barrier must be completed.

5 The Project to complete the Barrier

Within the framework of the Environmental Impact Assessment Study, the Project is defined as “the completion of the St. Petersburg Flood Protection Barrier”. The study addresses three alternatives for completion:

1. **‘Do minimum’;**
2. **Completion of the Barrier only; and**
3. **Completion of the Barrier with provisions for a future highway.**

The Project explicitly does not address the highway function of the Barrier.

Alternative 1 - Do minimum

A ‘do minimum’ alternative is included in the study as a reference scenario. It provides insight in the situation that would exist (or develop) if the flood protection Barrier is not completed.

Alternative 2 - Barrier only

This alternative comprises the realisation of the works needed to attain the full flood protection function of the Barrier.

Alternative 3 - Barrier with provisions for a future highway

Alternative 3 is an extension of Alternative 2 - Barrier only. For Alternative 3, some additional construction works are included, which facilitate the possible future construction of the highway or reduce higher construction costs in the future, at limited extra costs at this point in time.

Construction works

For the ‘do minimum’ alternative, hardly any construction activities are foreseen, apart from maintenance work.

The other two scenarios are largely similar in terms of the works to be completed, the volumes of construction materials and the construction methods to be applied. The 940 m of the present navigation gap south of Kotlin Island and the two temporary openings have to be closed. Rip- rap (breakstone) covering of the exposed faces of the embankment still has to be put in place. Four of the six sluice complexes are largely completed and operational. The structures for the two navigation passages S1 and S2 are partly complete, but the gates still need to be completed.

The outstanding works for the second and third alternative can be summarised as follows:

- Finalising of navigation openings and related gate structures at S1 and S2;
- Closure of the present 940 m wide navigation opening in D3;
- Closure of the 2 temporary ‘technical openings’ TM D2 and TM D7;
- Heightening of the embankments;
- Application of rip-rap protection on the exposed faces of the embankment;
- Finalising of the road bridge at S2; and
- Additional works for the tunnel section near S1 (alternative 3 only).

6 The Environmental Impact Assessment Study

The main objective of the Environmental Impact Assessment Study (EIA) was to assist Gosstroy and the EBRD to assess and provide a platform for a public discussion on the

environmental impacts of the Project and to be consistent with Russian environmental and permitting requirements and EBRD's environmental policy and procedures.

The activities were grouped into six stages:

- Conducting a Scoping Study;
- Conducting a Scoping Meeting or First Public Consultation;
- Definition of the environmental baseline;
- Assessment of environmental impacts of the Project, both positive and negative;
- Conducting a Final Public Consultation; and
- Reporting.

Scoping Study

In the Scoping Study, the Project was described, plus the characteristics of the environment in which the Project is located: Neva Bay and the Eastern Gulf of Finland. An overview was given of environmental norms and standards and Russian water quality standards. The relevance to the Project of international aspects including the HELCOM recommendations (Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area) and the Espoo Convention on EIA in a Transboundary Context were reviewed. A comparison was made of EIA requirements according to Russian law, EBRD Environmental Procedures and European Union (EU) regulations. Based on existing literature, the key environmental issues and the potential environmental impacts to be studied in more detail in the actual impact assessment were identified. Potential impacts were identified via cause - effect networks for the relevant sources of impact (processes in Neva Bay and the Gulf of Finland). Starting from general long lists of potential impacts, priority short lists of potential impacts were made for both the completed Barrier (Table 2) and the construction phase (Table 3). The Scoping Study⁴ was conducted during the first month of the study (January 2002).

Conclusion:

Completion of the barrier will not likely result in significant transboundary impacts as per the provision of the Espoo Convention. The present EIA study, carried out in accordance with EBRD's environmental requirements, can serve as a basis for an EIA in accordance with the applicable Russian requirements.

Further procedural steps as per the Russian environmental, health and safety regulations will be defined and undertaken by the Implementing Agency (Gosstroy) to ensure the project is in line with the applicable national environmental, health and safety legislation.

Table 2: Potential environmental impacts of the Completed stage of the Flood Protection Barrier

1. Changes in hydrodynamics: <ul style="list-style-type: none"> • Flow patterns • Flow velocities • Exchange/ residence times
2. Changes in erosion and sedimentation patterns and the release of hazardous pollutants from sediments
3. Changes in surface water quality <ul style="list-style-type: none"> • Pollutants (heavy metals, hydrocarbons, phenols, DO, BOD5) • Nutrients (N and P) • Bacteria (coli, salmonella, saprophytes) • Suspended sediments • Ice cover
4. Changes in hydro-biology <ul style="list-style-type: none"> • Phytoplankton and zooplankton • Benthos • Fishes
5. Impact on recreation

⁴ The Scoping Study is reported in the Scoping Report. This report is available to the general public in both Russian and English through internet, see www.morzashita.spb.ru under EBRD project

6. Impact on fisheries
7. Impacts on public health and safety
8. Changes in possibilities for industrial and drinking water intake
9. Encroachment/change of precious ecological zones <ul style="list-style-type: none"> • Impact on rare and endangered species, habitat and biodiversity • Loss of fisheries reproduction zones and migratory paths
10. Changes in landscape, loss of monuments
11. Interference with navigation

Table 3: Potential environmental impacts of the Construction activities for the completion of the Flood Protection Barrier

1. Impacts of sand mining
2. Hazardous materials handling <ul style="list-style-type: none"> • risk of spills • risk of fires, explosions • health risks of workers
3. Water and soil pollution
4. Air pollution (dust, odours, fumes)
5. Noise/vibration hazards
6. Pollution resulting from construction waste disposal
7. Worker accidents
8. Traffic congestion/accidents
9. Erosion by runoff and wave action

First Public Consultation

The results of the Scoping Study were presented and discussed at a First Public Consultation, which was held in St. Petersburg on 31 January 2002. Representatives of government departments, research institutes, NGOs, municipalities and the press, as well as interested individuals attended this public meeting. The emphasis of the meeting lay on identifying the concerns of the public regarding the Project and further prioritisation of the aspects that would be analysed in the EIA study. Eleven participants made use of the opportunity to give a short presentation of their views and 30 participants provided written comments.

The general view was that the Barrier needs to be completed, and that leaving it in its present state is an environmental risk because of the continued risk of flooding. In order of importance, the participants identified the following key subjects for further analysis in the Environmental Impact Assessment: impacts related to sedimentation and displacement of polluted sediments, changes in water quality, and the possible resulting impacts on recreation and fish stock / fish migration routes. A key outcome of the meeting was the recommendation to make optimal use of existing expertise on the Barrier and the environment resting with the local scientific community, as many studies on the Barrier had already been done.

In line with this recommendation, two teams of Russian experts with broad experience with the study issues were formed, one for the assessment of the impacts of the Barrier after completion, and one for the assessment of the impact of the construction activities.

Conclusion:

The participants of the Public Consultation largely agreed in their views regarding the completion of the Barrier. They expressed the overall opinion that the Barrier needs to be completed as soon as possible. Leaving it in its present state is considered to be an environmental risk. A prioritisation of the environmental assessment was derived from the key environmental items of concern expressed by the participants. Participants strongly recommended making optimal use of existing knowledge resting with local Russian experts.

7 Neva Bay today

Neva Bay is part of the Ladoga Lake, Neva River, Neva Bay and Eastern Gulf of Finland water system. Figure 5 presents the main characteristics of this water system. The discharge

of the Neva River, which has a long term average value of 2500 m³/s, determines the mean flow system in Neva Bay. Flow velocities range from a few to some 10 cm/s in the main part of the Bay, with higher velocities in the navigation channels and areas of velocities <2 cm/s directly along the northern and southern coasts. Superimposed on this basic flow is the effect of wind and pressure induced flows, which at times of westerly storms leads to floods coming into Neva Bay from the central Gulf of Finland.

The present Barrier allows for exchange of flow between Neva Bay and the Gulf. Outflow from the Bay occurs on average 84% of the time. The residence time of Neva river water is about 7 days. On average, Neva Bay is covered with ice for 150 days per year.

Water quality

The water quality situation in Neva Bay is determined by the quality of the upstream Ladoga Lake and the discharge of untreated and partially treated domestic and industrial wastewater. Human activities create a considerable pollution load to the Neva Bay and the Eastern Gulf of Finland. The main water quality problems in the region include:

- High levels of bacteriological pollution (especially coliforms), caused by waste water discharges. In summer, the beaches inside Neva Bay and in some parts of the Eastern Gulf of Finland are frequently closed due to high levels of bacterial pollution;
- Heavy metal and oil pollution of surface water, caused by industrial and domestic waste water discharges, navigation and resuspension of polluted sediments;
- Eutrophication of water, especially along the southern shore of the Neva Bay and in the shallow area of the eastern Gulf of Finland. Overgrowth of coastal areas with reeds and algae blooms are typical phenomena in eutrophied areas. Blue-green algae blooms occur, especially in the resort zone of the Eastern Gulf of Finland, where many beaches are located.

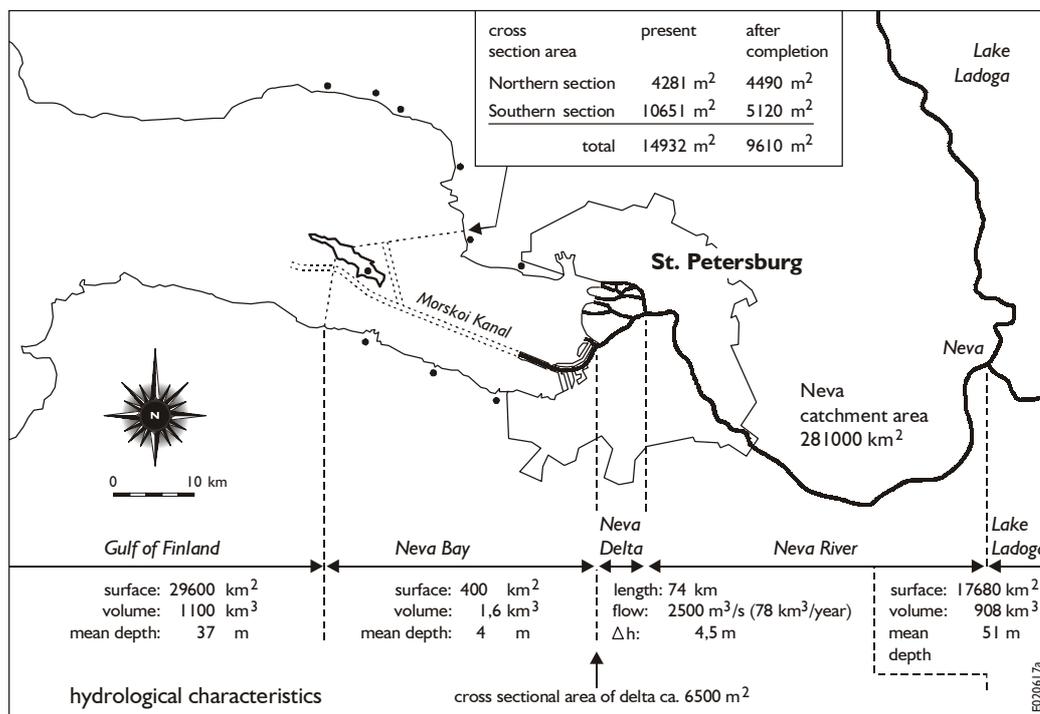


Figure 5: Overview of Lake Ladoga, Neva River, Neva Bay and Eastern Gulf of Finland system

Floods have a negative impact on water quality. Within the boundaries of St. Petersburg there are many sources of chemical and microbial contaminants, which may create environmental hazards during a flood. The most important areas within the city from this environmental point of view are industrial enterprises, hospitals, boiler houses, vehicle garages and depots, oil and fuel storage areas, and storage facilities for industrial and other hazardous waste.

Polluted bottom sediments

The heavy metal pollution of bottom sediments in Neva Bay and the Eastern Gulf of Finland exceeds regional background levels, and for some substances also international standards. The same applies for organic pollutants. There are some local hot spot areas with exceptionally high pollution concentrations. These include the southern coast of Neva Bay, ports, roadsteads / anchor places, navigation channels and sand mining pits. Contaminated sediments accumulated in these areas can cause water pollution, if the pollutants are released from the bottom due to physical disturbance or chemical processes.

Fish

The eastern part of the Gulf of Finland and Neva Bay are the most important fishing grounds in the Leningrad Oblast. Total fish catches in the area have decreased by more than 40% in the last 20 years, and totalled some 10,000 tonnes in 2000. The main reasons for the decrease are the variation in natural hydro-climatic conditions and the transition to a market oriented economy.

Neva Bay is an important area for reproduction of a number of migratory fish species, which use the Bay and the Neva River as a spawning and hatching area. The most important are lamprey and the fish species smelt and salmon. The latter is currently exploited mainly for reproduction purposes.

Nature reserves

There is a number of protected nature reserves of shallow water areas located in Neva Bay and Eastern Gulf of Finland. These areas have been created to conserve coastal forests, valuable landscapes, and rare and endangered species. Some 63 rare and endangered plant species, 39 rare and endangered lichens and fungi and 104 rare and endangered animals exist in the Neva Bay and surrounding area. The areas are also important as a resting place for migratory birds (e.g. the Lebyazyi Reserve, which is subject to the Ramsar convention).

Effects of Barrier construction to date

The construction of the Barrier so far has had limited effects on the environment. The outflow from the Bay through the section south of Kotlin has increased at the cost of that north of Kotlin. Locally along the Barrier, varying patches of low velocities occur. The changes in water quality as a result of the Barrier construction so far are minimal. Increase of areas of macrophytes is observed in the shallow coastal areas where flow velocities have decreased. The reduction of high water levels due to the presence of the incomplete Barrier has not affected the low-lying wetlands. The change in fisheries is a direct consequence of the variation in natural hydro-climatic conditions and the transition to a market oriented economy.

Impacts due to autonomous developments such as wastewater discharges, navigation and port and industrial activities have dominated the change in the environment of the Bay and the adjacent part of the Gulf during the last twenty years.

Conclusions:

There are at present serious environmental problems in Neva Bay. These are associated with the activities occurring in and around the city of St. Petersburg, with its 5 million inhabitants and many industries.

Discharge of untreated and partially treated domestic and industrial waste water is one of the main sources of pollutants affecting the water and sediment quality and ecological status of the Bay and the adjacent part of the Gulf of Finland.

The impact of the construction of the Barrier to date on the deterioration of the environmental state of the Bay and the adjacent part of the Gulf is negligible compared to the impacts of unrelated developments such as wastewater and industrial discharges, heavy metal and oil pollution.

8 Impact of the completed Barrier on the environment

The “Do minimum” alternative

The “Do minimum” alternative has no environmental impacts as compared to the baseline situation. This alternative implies continuation of the Barrier maintenance works that are ongoing at the present time. Specifically, there will be no change to the Barrier that can influence the existing hydro-dynamic conditions, which are the driving force to all other environmental changes in the Neva Bay and Gulf of Finland. If the Barrier is not completed and the “Do minimum” alternative is followed, then any changes taking place in Neva Bay and the Gulf of Finland will be due only to autonomous developments in St. Petersburg and the surrounding region.

Completion alternatives 2 and 3

Alternatives 2 and 3 differ with respect to the work on the access ramps to the tunnel under navigation opening S1. For the potential environmental impact of the Barrier after completion, these alternatives are the same and no distinction is made in the present assessment.

The evaluation of the existing situation in Neva Bay and the adjacent eastern part of the Gulf of Finland was followed by an assessment of the possible environmental impacts related to the completion of the Flood Protection Barrier. This was based on expert judgement, using literature and data and taking into account the (monitored) changes that occurred in the project area as a result of the existing Barrier construction, as well as numerical modelling of flow and water quality parameters. The latter allowed for comparison of alternatives and variants in terms of flow distribution, currents, flushing and residence time, and water quality indicators.

The changes in hydrodynamics resulting from the new distribution of the openings and their size form the driving force for all other completion related impacts in Neva Bay and the Eastern Gulf of Finland. Table 4 presents the net openings in the Barrier for the cases of completion of the Barrier according to alternatives 2 or 3.

Table 4: Original, present and future exchange openings between Neva Bay and the Gulf of Finland

	Original (m ²)	Present (m ²)	Future (m ²)	Present as % of original	Future as % of original	Future as % of present
Total	33,700	14,932	9,610	44	29	64
Total South	11,000	10,651	5,120	97	46	48
Total North	22,700	4,281	4,490	19	20	105
Ratio North/South	67/33	29/71	47/53			

Impacts on water exchange through the Barrier

The changes in water velocities, circulation patterns, and water levels caused by the completion of the Barrier are inherent to its design and operation. With open gates, the reduction of the openings in the southern section and the slight increase of the openings in the northern section will lead to an increased outflow through the Northern Section of approximately 10% and a decrease of outflow through the Southern Section of the same size. In fact this implies a partial return to pre-Barrier flow conditions.

It is expected that velocities through the openings B1-B6 will increase up to 50%, with somewhat larger increases in the navigation channels. The occurrence and intensity of inflow of more brackish water from the Gulf into the Bay in non-flood situations will be reduced from the present ~16% to about ~9%. As periods of inflow from the Gulf into Neva Bay are generally followed by much longer periods of outflow, the effect on net mixing is negligible.

In case of flood threats, all Barrier gates will be closed for the duration of the flood. The key

impact is the prevention of potentially serious economic and ecological damage caused by flooding (stirring and flushing with polluted sediments, potential overflow of sewerage systems).

Conclusions:

Prevention of water exchange in flood situations and the associated economic and ecological damage is the key positive impact of Barrier completion.

There will be a shift of outflow from the southern section of the Barrier to outflow through the northern section of some 10%. In fact this implies a partial return to pre-Barrier flow conditions.

The changes in related flow velocities and local mixing have no significant effect on the overall aquatic environment.

Impacts on general circulation

With completion of the Barrier, there will be a slight increase (<5%) in the already existing areas of low velocity (defined as <2 cm/sec) along the northern and southern shores of Neva Bay and near the Barrier. Examples are the area between the Barrier and the Lomonosov shoal (located just inside the Barrier attached to the southern shore) and the corner between the north side of Kotlin Island and the Barrier. Such areas in general enhance growth of macrophytes and so are advantageous for fish spawning and bird resting and nesting. Locally, contamination is less easily flushed out of these regions. The circulation in the western part of the Bay reflects the increased flow northward, more in line with the pre-Barrier situation. The circulation in the eastern part of the Bay is only marginally affected by Barrier completion.

The deepening of the navigation openings will enhance penetration along the sea-bed of brackish Gulf of Finland water further into Neva Bay. This influx of brackish water has a positive effect on species composition.

There is little to no impact regarding ice cover.

Conclusions:

The impact on the general circulation is small and tends to a partial restoration of the pre-Barrier situation.

There is an increase in the low velocity areas along the northern and southern shores of Neva Bay and near the Barrier but these are local and small. These areas enhance growth of macrophytes, which is beneficial for fish spawning and birds.

Impacts on water and sediment quality, habitats, ecology

The identified changes in water circulation will have some, but limited effect on the existing water quality and ecological conditions in Neva Bay and the Gulf of Finland, such as bacterial pollution and eutrophication, notably near the southern Barrier section and the shallow eastern Gulf of Finland near Sestroretsk. Occurrence of blue-green algae is well known here, but it is not expected that the Barrier will strongly affect this. Other human influences, such as waste discharges from untreated and partially treated domestic and industrial effluents, have a far larger influence on the environmental quality of Neva Bay. The completion of the Barrier will have a positive effect (will stop) pollution caused by flooding of St. Petersburg (e.g. release of chemicals and oils due to inundation of storage areas, industrial areas and overflow of the sewerage system). There is little to no impact on sediment behaviour (sedimentation, erosion) and sediment pollution. There will be no change to the necessary maintenance dredging of the shipping channel (Morskoi Kanal).

Conclusion:

Given the small changes in water circulation, the impacts on water quality and ecological conditions will be limited.

Impacts on species composition and bio-diversity

Periodic inflow of Gulf water under normal circumstances – already small – will be further reduced. Mixing in the Bay is dominated by the outflow of Neva River water, which takes place over much longer periods. Hence no harmful impacts on species composition and bio-diversity is expected. The expected increase of more saline water along the bottom of the deeper navigation opening S1 and the Morskoi Kanal may even be beneficial to species composition.

Flow velocities in the Barrier openings will increase, but maximum velocities remain below critical levels for migrating fish.

Conclusions:

There is no harmful impact on species composition and biodiversity.

Increased influx of more brackish water along the Morskoi Kanal may be a positive impact.

Fish migration will not be affected, as the cruising speed of fish is still above the velocities in the Barrier openings.

Impacts on coastal wetlands

Coastal wetlands in Neva Bay that are located above 150 cm BS are flooded about once per year or less. Closure of the Barrier will retain floods below this level. It is expected that the local biotope will adjust to the new situation.

There is no negative impact on the important Black alder swamps along the northern and southern Neva Bay shoreline as these are at or even below mean sea level and continue to be flooded. This also largely holds for the wetlands and habitats of the Lakhtinsky Rails, as these for over 90% are located below 150 cm BS and as such continue to be flooded regularly.

The important Lebyaziy Reserve – a Ramsar site – is located west of the Barrier and is not negatively affected by the completion of the Barrier.

Conclusions:

There is no impact on coastal areas lying below 150 cm BS as these will continue to be regularly flooded. This holds for example for the important black alder swamps as they lie at about mean sea level, and the Lakhtinskiy Rails, part of the Yuntolovskiy Reserve.

There is no (negative) impact for any of the wetlands west of the Barrier, such as the Lebyaziy Reserve (a Ramsar site).

Impacts on navigation

The impact on safety of navigation is considered to be positive, due to the possibility of traffic separation between navigation openings S1 and S2 and the fact that the width of S1 is larger than the navigational part of the present gap in D3.

Increased velocities will change navigation conditions and a programme of familiarisation for pilots is recommended, but they are not considered a serious safety issue.

Conclusions:

The impact on navigation is positive. Some familiarisation of the pilots to the new situation is recommended.

Impacts on recreation, water intakes and public health

Sedimentation and macrophyte growth (water plants and reeds) can increase in the identified shallow, sheltered coastal zones where flow velocities will decrease. This is a continuation of an existing trend. In regions used for recreation this may be considered a negative impact and macrophyte harvesting can be considered as mitigation. For fish spawning and water fowl increased macrophyte and algae growth is a positive impact. Bacterial pollution resulting in beach closures is not expected to change. Algal blooms and the occurrence of blue-green algae causing unpleasant beach conditions are observed in the shallow and recreational areas of the Eastern Gulf of Finland (Zelenogorsk and Sestroretsk), but completion of the Barrier is not expected to affect the nutrient conditions causing this.

There are no expected impacts to water intakes or public health.

Conclusions:

The impact on recreation mainly concerns growth of macrophytes.

Bacterial pollution resulting in beach closures, and occurrence of blue-green algae are not expected to change.

There are no expected impacts on water intakes or public health.

Summarising the assessment above, it is noted that both positive and (small) negative impacts of the Barrier after completion have been identified. A recurring issue in the analysis is the fact that other developments, not related to the Barrier or its completion, continue to have a much larger negative impact on the present environmental state of the Neva Bay and the adjacent part of the Eastern Gulf of Finland.

These conclusions agree with those of earlier studies, notably the Report of the International Commission (1990) and the St. Petersburg Flood Protection Barrier Pre-feasibility Report (GIBB, 1997).

Overall conclusions on environmental impacts:

The completion and the operation of the Barrier are designed to meet relevant Russian and EU environmental and health and safety standards.

The completion of the Barrier has no significant negative impacts on the environment of Neva Bay and the Gulf of Finland compared to the existing situation.

There will be a partial return to Pre-Barrier conditions in water flows north and south of Kotlin and in the general circulation pattern.

Safety of navigation to and from the ports will be increased because effective opening will increase and smaller and larger vessel traffic will be separated.

While many environmental problems in Neva Bay and the Gulf of Finland are identified in the existing situation (e.g. water and sediment quality) they are primarily associated with other activities occurring in and around the city of St. Petersburg. The completion of the Barrier will have no direct effect on these.

9 Impacts of the construction activities

The potential environmental impacts of the two construction alternatives 2 and 3 ('without' and 'with' provision for a future highway) are considered to be the same due to the limited difference between the construction activities of these alternatives.

During the environmental impact assessment, an overview was made of the existing regulations and norms that are applicable to large-scale hydrotechnical works. Based on this,

it is concluded that environmental effects during the construction period can largely be avoided by adjusting work materials, work procedures and adequate scheduling and timing of activities. This is especially true with regard to potential impacts due to: hazardous materials, air pollution, water pollution from wastewater and chemicals, and construction waste disposal. The appropriate work procedures are already sufficiently specified in existing Russian legislation and regulations.

Sand mining for construction material, and dredging and disposal of dredged material for the navigation channels will create localised impacts due to: damage to bottom fauna, increase of water turbidity, and resuspension of pollutants from the bottom sediment. Although, these can have a sequential influence on benthic species, phytoplankton production, zooplankton and fish, the area, duration and magnitude of impacts are low and are not considered significant, except for fish (see below). The procedures and locations for disposal of the dredged material will be dependent on the pollutant concentrations of the material, and the corresponding sediment pollution class (0-4). The regulations for sediment disposal are specified according to class. Measurement of the quality of the dredge material will be required (monitoring). Regulations regarding fisheries strongly reduce the available time per year for construction. Specifically, construction activities in water are not allowed during fish migrations (spawning runs), especially during the 1-month salmon migration period at some time in autumn (falling between August 20 and November 15). This implies that no sand mining, dredging or disposal activities, or closure of the present navigation opening may occur during this time. Existing regulations may potentially allow for continuation of certain construction related activities in the water during the spring migration period (lasting 4-6 weeks at some time during the period of April 10-June 25) if the damages to fish stocks are compensated financially.

Navigation through the existing shipping channel(s) and the ones to be completed will not be impacted by dredging barges during the construction phase if scheduling and locations of dredging operations is optimised.

Noise levels at the work places and at the residential areas in northern Kronstadt caused by expected use of construction vehicles and machinery will be above the permissible levels. The noise impact can be mitigated to meet permissible limits by implementing a number of measures, including use of modern equipment with less noise emissions, optimising scheduling and location of equipment use, applying noise control enclosures, providing workers with ear protection, etc.

Conclusions:

Good planning of work procedures and adequate scheduling of the activities can largely mitigate the potential impacts of the construction activities.

For noise and navigation, specific mitigating measures and scheduling actions must be taken to avoid negative impacts.

In order that this is effective, procedures should be monitored and regulations enforced.

Special consideration must be given to construction activities during spawning runs in spring, and damages to fish stocks, if allowed, must be financially compensated.

Construction related activities in water will have to be fully suspended during the salmon spawning run in autumn.

10 Summary of mitigation measures

No significant impacts related to the completion of the Barrier are identified, and therefore only minor mitigating measures related to the completed Barrier are required:

- Harvesting of macrophytes, specifically at recreation areas; and
- Training to familiarise pilots with the new navigation conditions.

A number of (potential) impacts during the construction phase are identified, but these can either be mitigated or are considered to be insignificant, in terms of their area of impact, magnitude or duration. Monitoring and enforcing the adherence to regulations during construction is considered the key issue in avoiding (potential) impacts of the construction phase.

Further specific mitigating measures are required for:

- Noise abatement; and
- Protection of fish migrations.

According to regulations, construction activities in water will have to be halted during the autumn salmon migration, lasting about one month.

Additionally, one main measure has been identified to improve the environmental conditions in the Neva Bay and Eastern Gulf of Finland (although this is independent of the presence of the Barrier):

- *Improvement of level of wastewater treatment:* The capacity and the level of wastewater treatment in the St. Petersburg region should be increased, for both domestic and industrial effluents. This will play a major role in improving the water quality and ecology in Neva Bay and the Gulf of Finland, with respect to bacterial pollution, elevated BOD concentrations, heavy metals, and eutrophication problems (including blue-green algae) caused by elevated nutrient concentrations. Sensitive coastal regions such as protected nature areas and beach/resort areas will especially benefit.

It is concluded that this measure is so important for the improvement of the environmental conditions in Neva Bay and the Gulf of Finland, that it should be urgently conducted.

Conclusions:

No significant impacts / mitigation measures related to the completed Barrier are identified.

Only two minor mitigation measures are identified:

- Harvesting of macrophytes;
- Training (familiarisation) of pilots for changed navigation conditions.

Construction related potential impacts can largely be mitigated by adhering to existing regulations; adequate enforcement is a key issue.

Noise abatement and protection of spawning runs require special attention.

A measure for improvement of the environment – not related to Barrier completion – is the improvement of wastewater treatment.

11 Summary of Monitoring

A limited amount of monitoring with direct relationship to the Barrier is recommended.

Priorities for this monitoring are given to:

- Effects that have a cause-effect relationship with the completed Barrier and / or construction activities;
- Effects that can and should be mitigated;
- Effects of the completed Barrier and / or construction that have a high uncertainty; and
- Effects that are related to public concerns.

During the construction phase, the most important monitoring will be the checks for compliance with applicable procedures and regulations. These should occur frequently, with the frequency and time depending on the work scheduling, and should take place at unannounced times. Monitoring of noise will be necessary to check effectiveness of mitigation measures and compliance with standards. Monitoring quality of the sediment to be dredged near S1 and S2 will be required to identify the sediment pollution class (if any), and therefore,

the locations for disposal.

In the past decades, general and systematic environmental monitoring in Neva Bay and the Eastern Gulf of Finland has been conducted on different spatial and temporal scales. This monitoring is presently under serious financial pressure. For the management of the Neva Bay and Gulf of Finland water system as such, this monitoring is vital and should be continued, preferably based on a reassessment of the actual information needs.

In direct relation to the latter, the realisation of an open information system regarding the water quality and ecological status is strongly recommended, to bring together data from operational and other monitoring, collected by many different institutes on behalf of the stakeholders. Important environmental changes and trends can so be detected and be integrated in water management decisions for the Neva River-Neva Bay-Gulf of Finland system. The data in this system should be readily accessible to all stakeholders and institutes involved.

Conclusions:

Monitoring related to the completion of the Barrier must focus on the effects that have a cause-effect relationship with the Barrier completion, those that need to be mitigated and those that have a high uncertainty.

Tailored monitoring to ensure compliance with regulations is a key requirement for the construction phase.

12 Overview of Public information activities so far

The public information activities so far have consisted of the following:

- Inviting representatives of government, institutes, municipalities, NGO's and press to the Public Consultation on 31 January 2002
- Publishing an announcement of and invitation to the Public Consultation in the St. Petersburg Information Bulletin for 28 January - 3 February 2002
- Announcing the Project and the Public Consultation in a 15 minute radio interview on Radio Russia on 29.1.2002
- Preparation of a 12 page brochure on the Project and the approach to the Environmental Impact Assessment, distributed to participants of the Consultation on 31.1.2002
- Arranging for a poster exposition on flood threats and the Flood Protection Barrier, in combination with the Public Consultation
- Conducting the Public Consultation on 31.1.2002. The outcome is summarised in the Scoping Report, accessible through www.morzashita.spb.ru.
- Publishing a small report in the St. Petersburg Information Bulletin for 18-24 February 2002, on the start of the EBRD funded Feasibility Study and the Public Consultation
- Making the Brochure and the Scoping Report freely accessible through the web site www.morzashita.spb.ru (see under: EBRD project)
- Publishing a small report in the St. Petersburg Information Bulletin for 25-31 March 2002, on the Public Consultation and announcing that all scoping materials can be viewed on the web site www.morzashita.spb.ru
- Publishing an article in the paper: "Youth, Ecology and Culture", April 2002, on the Project and Public Consultation, including the announcement that all scoping material can be viewed on the web site www.morzashita.spb.ru

A Final Public Consultation on the Project will take place on Friday, July 19, 2002 in the House of Scientists, Dvortsovaya Naberezhna 26, St. Petersburg, starting 13:00 hrs. In addition, an exposition will present the results of the Environmental Impact Assessment.

On 17 July and 18 July this exposition will be open to the public during office hours in the Hall of Investments, Ostrovsky Square 11, St. Petersburg.

Conclusion:

A series of Public Information activities has been realised, related to and in follow up of the First Public Consultation.

The Final Public Consultation on the Project will take place on Friday, July 19, 2002 in the House of Scientists, Dvortsovaya Naberezhna 26, St. Petersburg, starting 13:00 hrs.

13 Summary of the Environmental Impact Assessment

Considering the findings and conclusions described above, NEDECO presents the following overall summary of the present Environmental Impact Assessment.

The completion and the operation of the Barrier are designed to meet relevant Russian and EU environmental and health and safety standards.

Completion of the Barrier will have no significant negative impacts on the environment of the Neva Bay and adjacent Gulf of Finland, particularly relating to water quality.

There are at present serious environmental problems in Neva Bay and the adjacent part of the Gulf of Finland, but these are related to other activities in and around the City of St. Petersburg.

There will be a partial return to Pre-Barrier conditions in water flows north and south of Kotlin and general circulation and the safety of navigation to and from the ports will increase.

These conclusions agree with those of earlier studies, notably the Report of the International Commission (1990) and the St. Petersburg Flood Protection Barrier Pre-feasibility Report (GIBB, 1997).

The overall impacts of the completion of the Barrier for the city of St. Petersburg in a general sense can be summarised as:

No further risk of human and economic losses incurring from flooding.

Full protection of the extensive cultural heritage of the city against floods and damage.

Creation of a more beneficial situation for making investments in the city territory.

Possibilities of creating recreational areas along the reclaimed territories.

(Partly temporary:) The construction itself and related activities will lead to increase of employment in St. Petersburg and especially in Kotlin.