CHAPTER 5 INITIAL ENVIRONMENTAL EXAMINATION

CHAPTER 5 INITIAL ENVIRONMENTAL EXAMINATION (IEE)

5.1 General

An Initial Environmental Examination (IEE) is normally conducted early in the life of a project. In general there are two main aims, of:

- Screening the project to determine the type of environmental analysis that is appropriate. This depends on the type of development and its likely environmental impacts;
- Scoping the environmental analysis, that is defining the nature of the work required.

If the IEE shows that a project is likely to have small-scale environmental impacts, no further environmental analysis may be required. If the IEE shows that the project could have significant negative impacts, then a more detailed analysis, such as Environmental Impact Assessment, may be necessary so that mitigation measures can be devised.

An IEE can also assist in the process of developing alternative approaches to a project. In this case the IEE includes work to:

- Evaluate the environmental impacts of each project option, and indicate which are preferred on environmental grounds.

The work of an IEE therefore involves the following main activities:

- Review of environmental conditions in the area that could be affected by the project, normally from an analysis of existing data;
- Identification of any features that are sensitive or valuable, so that project options can be developed that avoid unnecessary environmental damage;
- Preliminary assessment of the impacts of project options, their significance and the potential for reducing negative impacts by mitigation measures;
- Determining preferences between options based on the significance of their impacts and the ease with which mitigation can be provided;
- Determining the type of further environmental analysis required, considering legal requirements and the scale of likely impacts;
- Devising the scope of future environmental analysis, on the basis of legal requirements, likely sensitive issues, and any deficiencies in the data available.

IEE is carried out in the early stages of a project before designs are prepared, when the detailed nature of the project has not been determined. It is therefore a preliminary analysis, and existing conditions, environmental impacts and mitigation measures are described in broad terms only. These are all considered in more detail in the subsequent EIA, if this is shown to be necessary.

5.2 The Existing Environment

5.2.1 Sources of Existing Data

There are four main sources of existing data describing the environment of Klaipeda Port and the surrounding area. These are:

- Results of routine environmental monitoring conducted in and around the Port by Government agencies (KSSA, Ministry of Environment Klaipeda Region, MoE Centre of Marine Research);
- Reports of EIA studies produced for various engineering projects in the Port (such as dredging, realignment of the Port entrance, etc);
- Scientific papers published by university and research institute staff, collected in journals, books and other publications;
- Information on the human environment, obtained from Klaipeda Public Health Centre, Government-produced statistics and data, and other sources.

Most reports and data were only available in Lithuanian, so relevant tables, graphs and sections of text were translated into English. These data, and information already available in English were reviewed and used to produce the account of existing environmental conditions given below. The sources of data are quoted in the text and the references are listed in the bibliography at the end of the report.

Data collected by the Government agencies is generally presented in annual reports, and where possible the most recent reports were obtained, together with those from the previous few years. Where such reports contain summaries of results only, the raw data was sought from the agencies concerned and used to produce Figures presented below.

5.2.2 Surveys

Additional surveys were carried out for this Study to collect data on physical and chemical parameters in the water and sediments of the coast, channel and lagoon, required for the coastal engineering and numerical modelling aspects. These are described in the previous chapters. Certain elements were relevant to the environmental study, and in summary these involved the following:

- Bathymetric surveys by echo-sounding in areas of 4 x 2 km outside the Port entrance and 3 x 1 km in the channel west of the International Ferry Terminal, producing maps showing contours at 1 m intervals;
- Topographic surveys of the beach north of the Port entrance, and bathymetric surveys across the channel at approximately 500 m intervals;
- Sampling of bottom sediment at 40 locations and analysis of grain size, organic content, total oil and heavy metals (Cd, Cr, Cu, Pb, Ni, Zn, Hg);
- Continuous recording (for 7 months) of wave height and direction, water level, and current speed and direction by meters located 3 km from the port entrance;
- Continuous recording (for 2.5 months) of current speed and direction, water level and turbidity by meters at the mouth of the channel, west of the Ferry Terminal and at two stations in the lagoon;

- Measurements of current speed and direction, turbidity and salinity at several stations in the lagoon in April and May 2003, using portable meters.

Data from these surveys is used in the following description of the existing environment, to supplement information that was already available in these fields.

5.2.3 Physical Environment

(1) Climate

Lithuania is located on the European mainland in the eastern Baltic, between latitudes 54º and 56º North (Figure I.1.1-1 of Volume I). The climate is temperate, and continental over most of the country, where there are long cold winters and short hot summers. In the coastal belt the climate is more maritime, modified by the sea, which reduces temperature extremes and increases rainfall.

There are four seasons, with a long autumn and winter (September – March), and a shorter spring and summer. Data collected between 1961 and 1990 by the Lithuanian Hydrometeorological Service shows that the monthly average air temperature in Klaipeda is below freezing in January and February (<-2 ºC) and around 17 ºC in July and August (Figure III.5.2-1). The maximum recorded temperature was 34 ºC in August 1896, 1917 and 1954, and the minimum was –33.4 ºC in February 1956, giving an overall temperature range of almost 70 ºC.

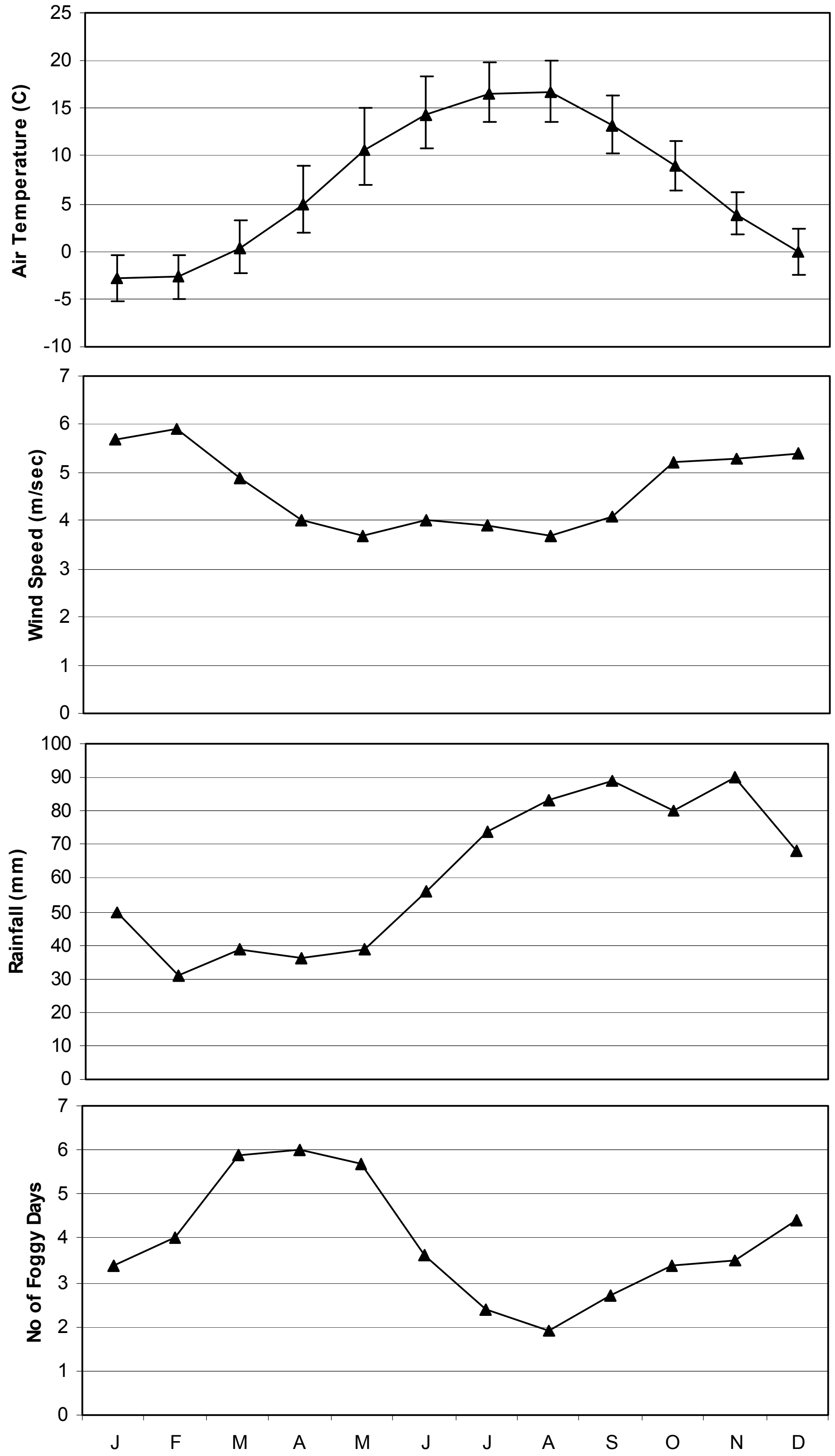
Rainfall is lowest in spring and highest in autumn, and the monthly average is around 30 mm in February and 90 mm in September (Figure III.5.2-1). Winds blow mainly from the southeast in winter, west to north in spring, west in summer and west to southeast in autumn. Average speed is 5 - 6 m/sec in winter and 4 m/sec in summer, and gusts of up to 40 m/sec are frequent in winter. Fogs occur throughout the year, for between two and six days each month, and are most frequent when the wind blows from the west across the sea in winter and spring (Figure III.5.2-1).

The cold air and shallow water depths cause the Curonian Lagoon to freeze for several months each winter, but the Port remains ice-free in all but the coldest years. In mild winters and as temperatures rise in spring, ice drifts from the lagoon into the Port channel and can cause a hazard to shipping.

(2) Topography and Bathymetry

The Port and Klaipeda City to the east are flat and low-lying (Photo III.5.2-1), with an elevation of only a few metres above Baltic Sea Level (BSL). The land rises gradually to 20-30 m to the east of the city, where there are areas of higher ground, bisected by the valleys of the Dane and Minija rivers, running roughly north-south. The main high ground near the Port is on the Curonian Spit to the west, where movement of air- and water-borne sand along the coast over the centuries has created a narrow sandy peninsula of coastal dune and forest, which rises to 30-40 m in places.

The Curonian Lagoon is a shallow, flat depression, with an average depth of 3.8 m, reaching 5.8 m in places towards the centre. The bed becomes deeper to the north, where the Port Channel is dredged to provide access for shipping. Figure III.5.2-2 shows that the channel is currently 9-11 m deep in the south, 12 m in the centre, and 14-14.5 m at the entrance. These depths are maintained by dredging, which removes an average of 400,000 m^3 of silt each year. This is dumped at sea 20 km southwest of



Source: Lithuanian Hydrometeorological Service

Figure III.5.2-1 Average climatic conditions in Klaipeda (1961-1990). Figures = monthly average; vertical bars = monthly average maximum and minimum temperature

Photo III.5.2-1 General view of Klaipeda Port and the surrounding area (looking south)

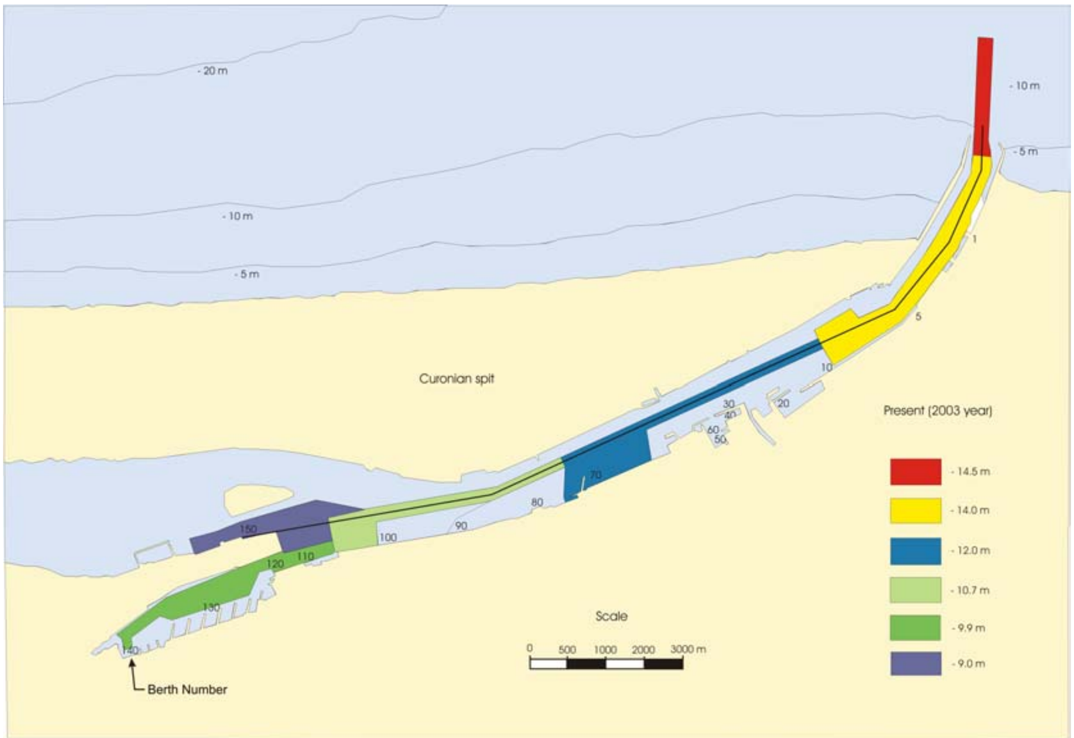
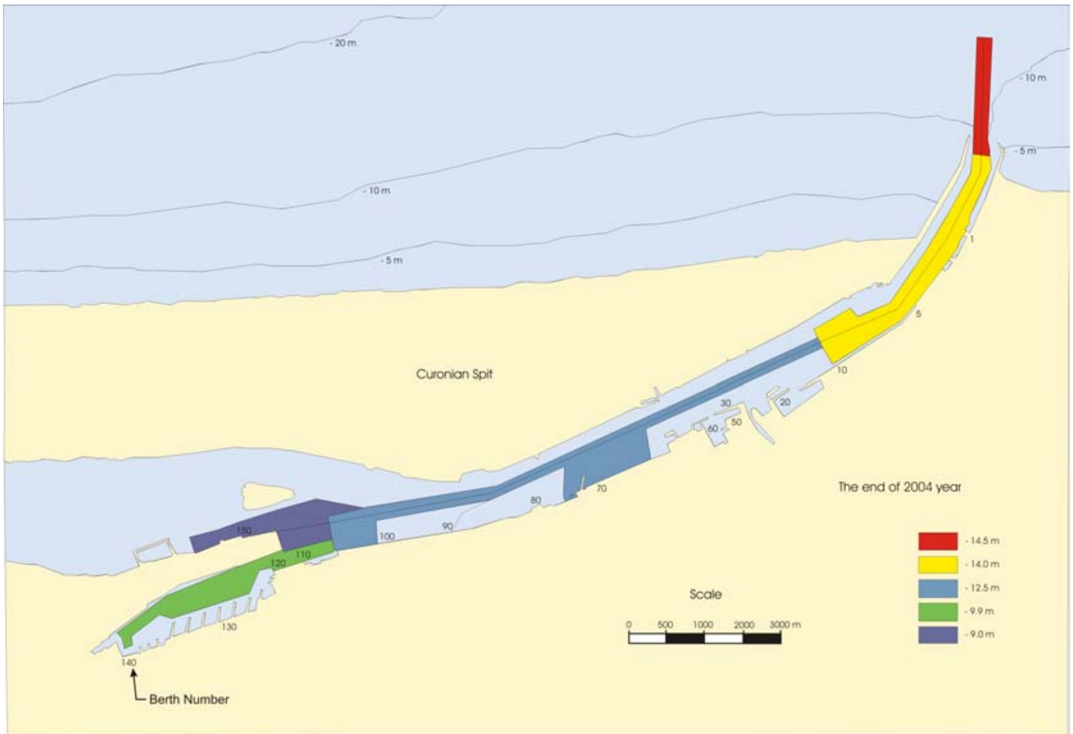


Figure III.5.2-2.a Present Water Depth of Klaipeda Port Channel (2003)



Source: KSSA

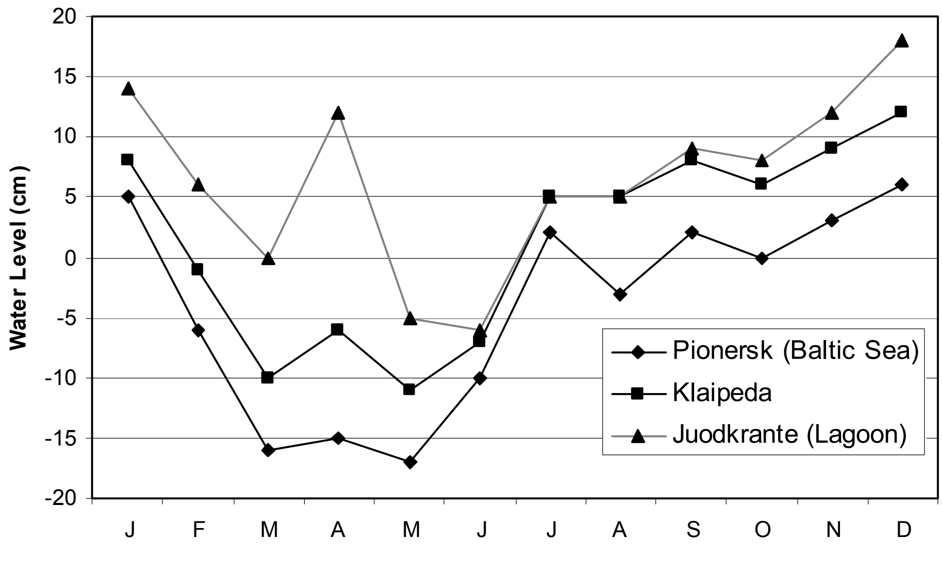
Figure III.5.2-2.b Future Water Depth of Klaipeda Port Channel (2004) after completion of capital dredging

the Port in depths of 45-50 m, and small quantities of clean sand from the access channel are dumped in 25-30 m, 11 km northwest of the Port. In July 2003 a programme of capital dredging began, to deepen the central part of the channel to 12.5 m over the next 1.5 years (Figure III.5.2-2).

To the north and south of the port the coast is fringed by a belt of sand dunes rising to 5-10 m in height, beyond which the natural sand beach slopes gradually down to the sea (Photo III.5.2-2). The Baltic is a shallow sea and the bed also slopes gently, reaching a depth of 15 m two kilometres offshore (Figure III.5.2-2), and 50 m around 30 km offshore.

(3) Tides, Waves and Currents

There is very little tidal movement in the Baltic, and variations in water level are small, and mainly caused by changes in wind direction and freshwater run-off. Water levels are generally slightly above Baltic Sea Level in autumn and winter (when rainfall and winds are high), and below BSL in spring, with sudden temporary increases in April being caused by melting ice and snow in the catchment (Figure III.5.2-3). The lagoon receives discharges from several rivers, so the water is generally a few centimetres higher than in the Port channel, which in turn is slightly higher than the sea. There is therefore a net outflow from the lagoon, of 22-26 km^3 per year (Pustelnikovas 1998). Water levels of more than 0.5 m above or below BSL occur on average only once per year, mainly during storms, and conditions generally return to normal within a few days (Harris 2000).



Source: LEI (2002)

Figure III.5.2-3 Average water levels in the Study Area (1955-1996)

The rivers discharge an average of 22 km^3 of water into the lagoon each year (LEI 2002), of which around 40% enters in spring and 20% in winter. Almost 80% comes from the Nemunas at the southern border of Lithuania, and the remainder mainly from the Matrosovka and Deima rivers in Russia. Seawater enters the lagoon from the Baltic only around 40 times per year, for 70 days in total, mostly during storms,

Photo III.5.2-2 Dunes on the Curonian Spit (bottom) and near Palanga (top)

producing an inflow of 5.4 km^3/year (Harris 2000). LEI (2002) suggest that inflow has increased in recent years as the Port channel has been deepened by dredging.

The main current in the lagoon is produced by the discharge from the Nemunas, which flows northward at around 0.5 m/sec, increasing to 1-2 m/sec during the spring and autumn floods. This water flows through the Port channel and out to sea to the north of the entrance, forming a surface layer down to 10-14m, up to 15 km offshore. When seawater flows into the lagoon it travels along the bed, at 0.8-1.1 m/sec (Pustelnikovas 1998), below the lighter outflowing freshwater. In the centre of the lagoon there is a weak surface current, mainly to the south, and a northward flow near the bed.

At sea waves are mainly driven by wind, and in the Baltic they tend to be low in height because of the limited distances over which the wind acts on the water surface. At Klaipeda 75% of offshore waves are less than 2 m high, and 50% originate from the south and west (Harris 1998, LEI 2000). Heights increase to 6-7 m in storms and 9 m in extreme conditions, but such events are rare. Heights decrease close to the shore, where 45% of waves are 0.5-1 m. Northwesterly winds generate waves perpendicular to the Port entrance, causing navigational problems in the past when strong waves penetrated into the channel. This was improved by the angular extension to the northern breakwater, which restricts the width of the entrance, and waves over 1 m are now rarely seen in the channel.

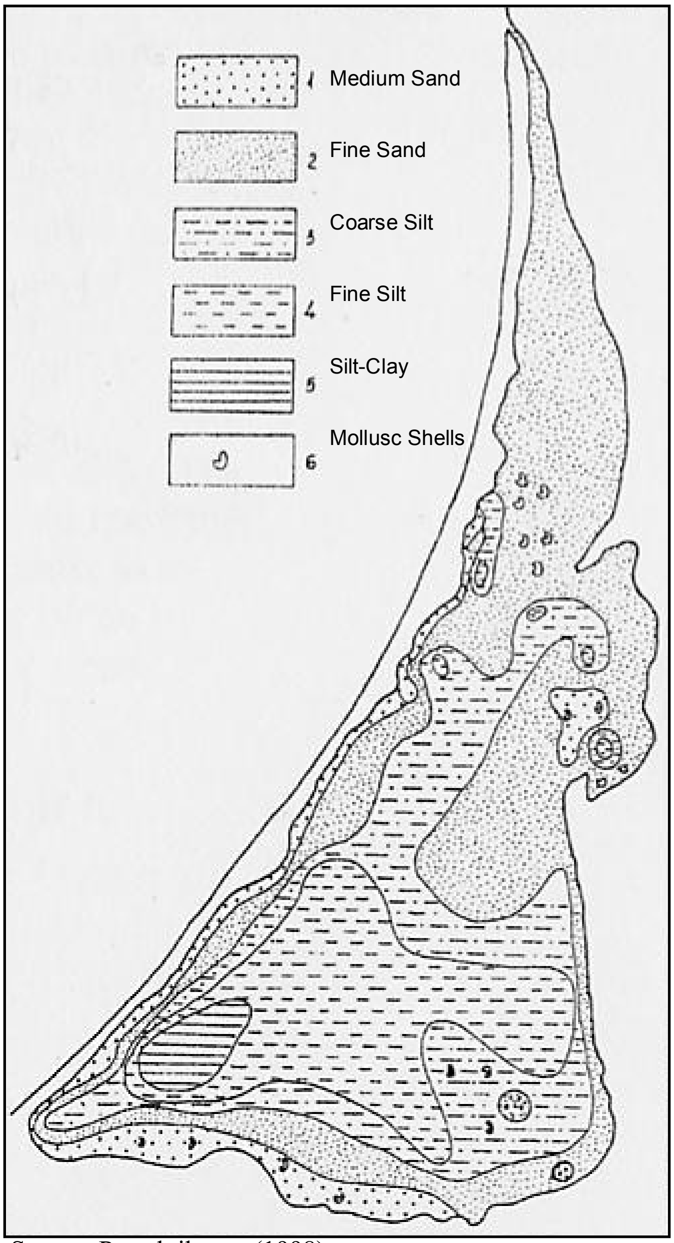
(4) Geology and Sediments

The main geological influences in the Baltic region have been the various ice ages, intervening periods of sea level rise, and changes in land elevation. The Baltic Sea developed 18-20,000 years ago as the last glacier retreated from the north European mainland, leaving a depression that gradually filled with water forming a glacial lake. Salinity fluctuated as connections with the sea were established by melting ice and rising sea level, and severed by the rising land. The Ancylus Lake became the Littorina Sea in the early Holocene period, and this developed the configuration of the present day Baltic Sea around 4,000 years ago.

Given the influence of ice in the past and rivers and the sea in recent times, the geology of the coast is dominated by glacial, fluvial and marine deposits. Morainic till was deposited by the ice flows of the Pleistocene, and remains as a 40-60 m thick belt of grey, dense loam, containing gravel, pebble and boulders. This is located 10-16 m below the surface, and dips from east to west towards the Curonian Spit. Above this is a 5-8 m thick surface layer laid down in the Littorina period, comprising sand, peat and other organic matter (Kunskas 1996).

More recent sediments in the lagoon consist of fine material deposited by the rivers, coarser sand blown across the Spit in the west, and biological material, including shell fragments and decomposing organic matter. Surface sediments are generally fine grained in the south and towards the centre of the lagoon where current speeds are low, and sandier in the north and near the land (Figure III.5.2-4).

Deposits in the Port are unevenly spread, as sedimentation is modified by currents, waves and the activities of man. In the centre of the channel deposits are less than 20-30 cm deep and consist mainly of coarse mud or fine sand, as water flow is relatively strong and the bed is dredged in most years. In enclosed harbours and near the berths,

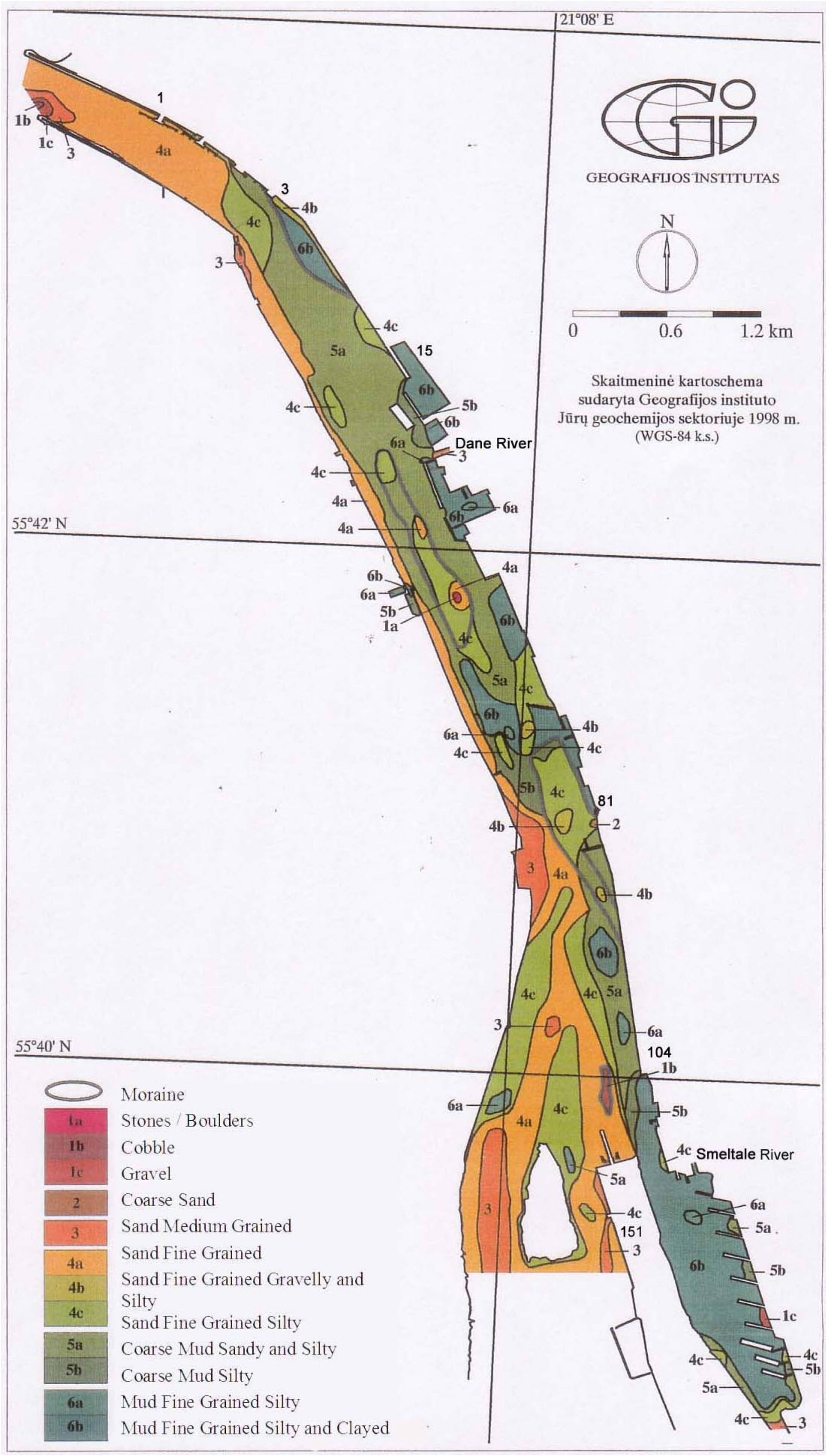


Source: Pustelnikovas (1998)

Figure III.5.2-4 Distribution of surface sediments in the Curonian Lagoon

reduced currents allow fine-grained mud to settle, in depths of a metre or more (Figure III.5.2-5). Sediments at the mouth of the channel are more sandy and marine in origin, and are generally less than 5 cm deep, although this can increase considerably after storms.

The coastal beaches consist of medium grained sand down to around mean sea level, below which currents and wave action are reduced, allowing finer sand to settle. Currents are also slow in deeper water and around the breakwaters, where the bed contains mainly fine-grained sandy silt (LEI 1998).



Source: KSSA (1998)

Figure III.5.2-5 Distribution of surface sediments in Klaipeda Port Channel.

(5) Geomorphology and Coastal Processes

The Curonian Spit was formed after the last Ice Age as the retreating glaciers left a chain of moraine islands, which became joined through sand deposition. Wind and waves then moved the spit gradually north and east, isolating the lagoon from the sea around 5,000 years ago. Dunes were formed in the west, which became larger and parabolic in the east, where large forests developed, stabilising the sand. This prevailed until the middle of the 16th century when tree felling caused widespread sand movement, burying 14 villages. This was rectified by reforestation in the next century, forming the present landscape and morphology.

Water began to flow from the lagoon to the sea around 2,000 years ago, since when the outlet has migrated gradually northwards as a result of sand deposition near the mouth and coastal retreat on the northern side. Breakwaters were built in the 19th century and extended in the mid-20th century (Figure III.5.2-6), and dredging began in 1960. The outer channel was initially lowered to 10-10.5 m below chart datum (BSL), and the inner channel to 9-9.5 m. The outer channel was deepened to 12-12.5 m in 1982-83, and Figure III.5.2-3a shows present depths.

Figure III.5.2-6 shows how the coastline has changed over the past two centuries. This indicates that there have been periods of coastal advance and retreat, but that overall the coastline has moved seaward on both sides of the entrance. The advance has been much greater to the north, where the largest change was in the 19th century following construction of the breakwaters (Photo III.5.2-3). The southern coast now appears stable, and the breakwater prevents significant sand from entering the channel. In the north the beach is closer to the end of the breakwater and sand enters the channel. Dredged material dumped offshore does not re-enter the coastal system, so there is a net sediment imbalance on the northern side, which is presently causing erosion north of Melnrage.

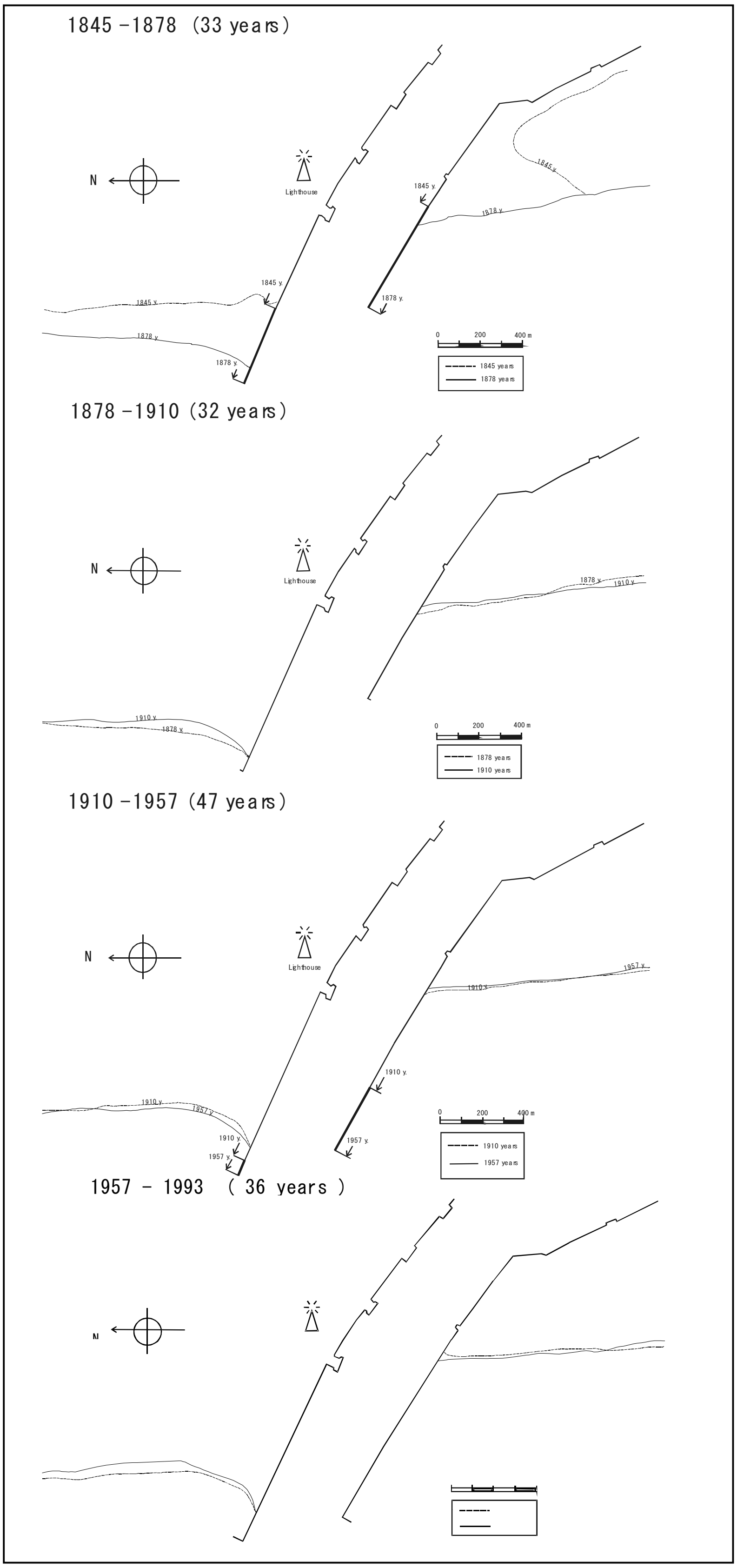
There have been disagreements in the past as to the direction of littoral drift along the coast, and the direction may have changed in different periods. The present drift appears strongly northward in the southern part of the spit, but weaker near the channel mouth, and in the north the drift is mainly from north to south. It may be that the channel marks the boundary between two sediment cells, between which there is no net transport of material.

5.2.4 Chemical Environment

(1) Water Quality

Water quality in and around the Port is monitored regularly by KSSA and the MoE Centre of Marine Research, and data has also been collected for EIAs and other studies. Given that the Port is located in a coastal area subject to significant river discharges, water quality is determined mainly by the quality and quantity of inputs from rivers and the sea, and the wastewater discharges from ships, industry and municipal drainage.

The Lagoon and the Baltic Sea are both shallow, so in general water temperature does not differ greatly between the surface and the bed. In winter cold winds blow from the east, and the temperature of the Lagoon falls to zero Celsius, and the surface freezes down to around 70 cm in the south and 30 cm in the north (Harris 2000). In the Port,



Source: Zilinskas and Jarmalavicius (2000)

Figure III.5.2-6 Changes in the coastline around Klaipeda Port, 1845-1993

Photo III.5.2-3 Morphology of the coast at the mouth of the Port Channel, showing the difference between the northern and southern sides

warmer seawater maintains the temperature at 1-2 ºC and the water freezes only rarely. KSSA data shows that water temperatures begin to rise in April as air temperatures reach 8-10 ºC, and are highest in July-September, when the surface of the Lagoon and the channel reach 19-21 ºC (Figure III.5.2-7), and the sea is 1-2 degrees cooler.

Salinity is low in the Baltic Sea because of the high river inputs and limited exchange with high saline water in the open sea west of Denmark. Salinity decreases from west to east and south to north, and at Klaipeda is around 7 ‰ in summer and 3 ‰ in winter. Salinity in the Port is dependent on the direction and velocity of water flow and wind, but is generally intermediate between the low saline sea and the freshwater lagoon. Seawater intrudes into the Lagoon for short periods only (1-2 days at most), and inflow is normally greater in the autumn, when salinity at the Port is around 4 ‰. Salinities of 5-6 ‰ have been recorded at Juodkrante 20 km south of the Port, and 0.06 ‰ at Nida 50 km south, but such events are rare and short-lived (Harris 2000).

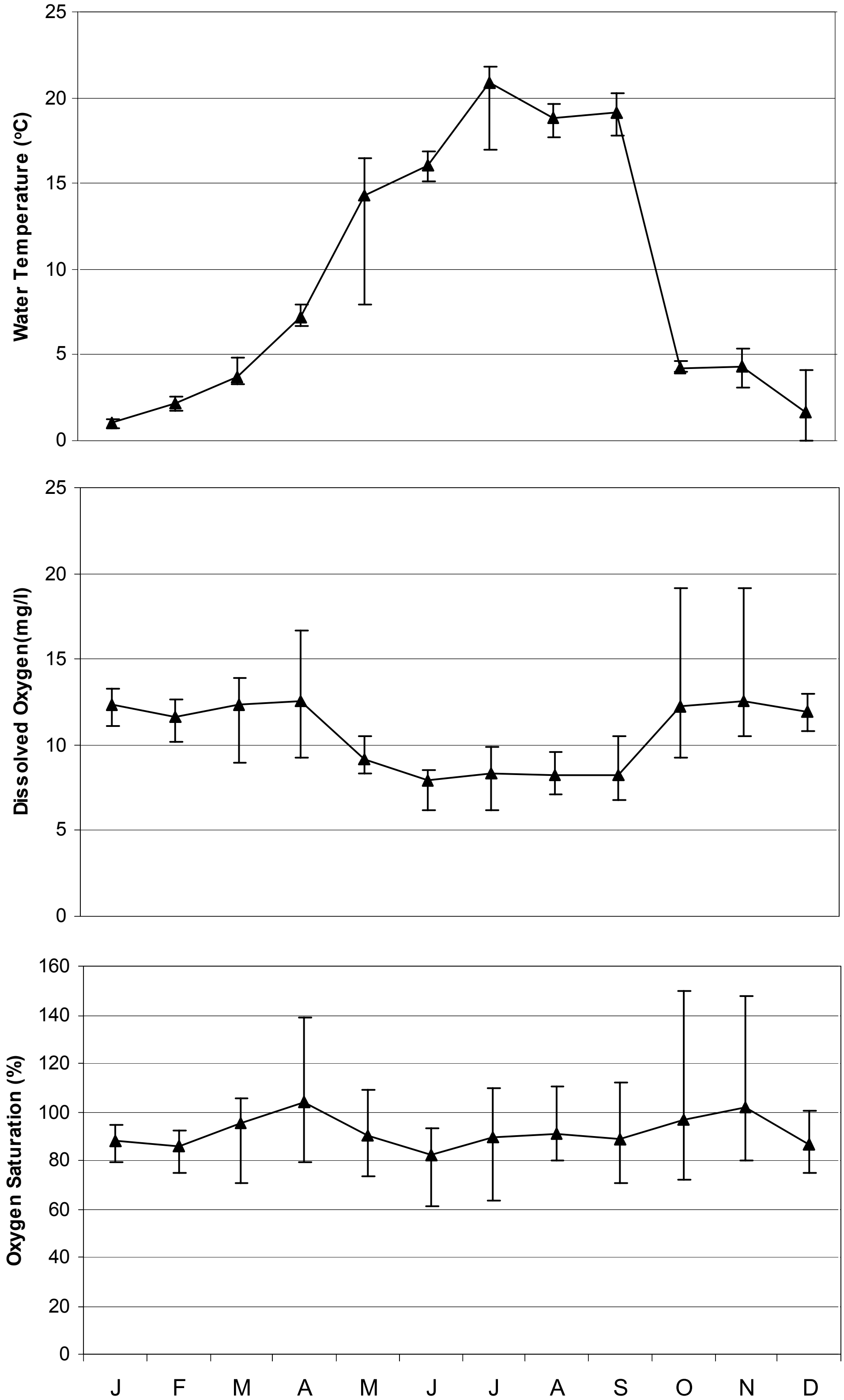
Dissolved oxygen varies seasonally, being generally higher in spring when water temperature is low and photosynthesis by phytoplankton and aquatic plants is high. At this time the water is frequently up to 170% saturated in the centre of the Lagoon, and 90-100% in the Port (Figure III.5.2-7), but lower in areas with limited circulation, such as the enclosed harbours. Oxygen decreases in the summer as temperatures rise, and although KSSA data indicate that levels rarely fall below 6 mg/l or 60% saturation, considerably lower concentrations occur at times. In August 2001 for example levels of 1.85 mg/l and 21.5 % were recorded in the south of Malku Bay (KSSA 2001), which could have killed some animals. In contrast the surface of the sea remains well oxygenated throughout the year, although breakdown of organic matter can deplete levels near the bed.

The water of the Lagoon and Port is naturally eutrophic (high in plant nutrients), because of runoff and river discharges from areas rich in vegetation and minerals. Levels are increased by a variety of organic and inorganic pollutants, mainly derived from sewage, fertilizers, and industrial and domestic discharges. The main source of these materials is the Nemunas River, which has a catchment of over a million km^2 and flows through farmland and inhabited areas in Belarus, and along the Lithuania-Russia border before discharging into the Lagoon. Another significant source of organic matter is the outfall from the city sewage works, which discharges into the channel south of the Smelte yard, although the quality of the effluent has improved since provision of biological treatment in 1998.

Because of these inputs water in the Lagoon and Port is high in phosphorus and nitrogen (Figure III.5.2-7), and according to Lithuanian quality criteria for lakes, at times the water is classed as “bad” in terms of these parameters (>0.09 and >2.0 mg/l respectively, Table III.5.2-1). Because of the organic loading Biochemical Oxygen Demand (BOD) is also high, and often exceeds the Lithuanian limit for cyprinid waters (freshwater fish) in summer (6 mg/l O_2, Table III.5.2-2), when levels can be even higher (>10 mg/l) in the Lagoon.

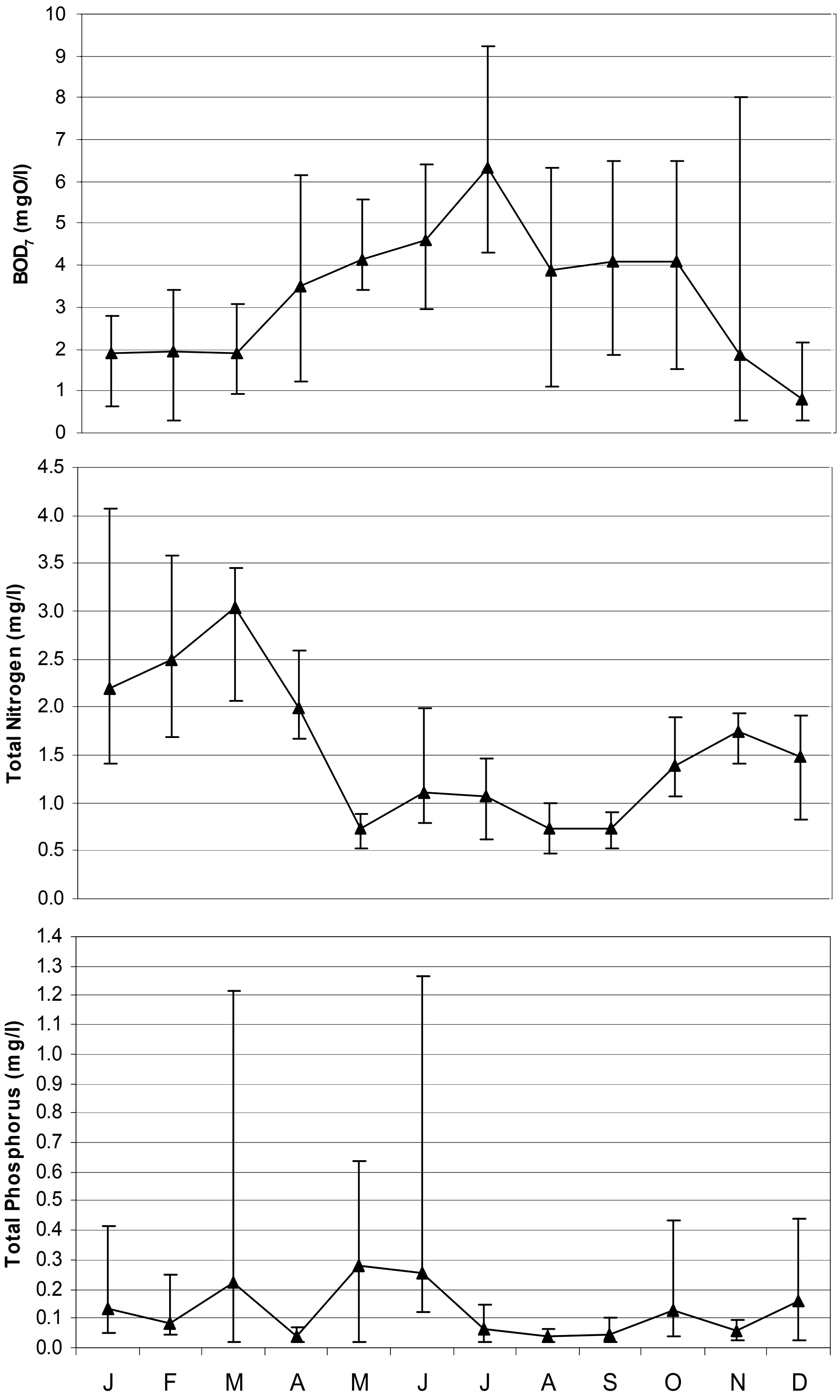
Other sources of pollution in and around the Port include:

- Wastewater discharges and rainwater runoff from shipyards, ships, industrial sites, and the surrounding urban area;
- Accidental spillages during cargo handling and other activities;



Source: KSSA (2002)

Figure III.5.2-7 Water Quality in Klaipeda Port in 2002. Figures = monthly average of 11 stations monitored each month at the surface and above the bed; vertical bars = monthly maximum and minimum



Source: KSSA (2002)

Figure III.5.2-7 (Continued) Water Quality in Klaipeda Port in 2002. Figures = monthly average of 11 stations monitored each month at the surface and above the bed; vertical bars = monthly maximum and minimum

Table III.5.2-1 Water quality criteria for Lithuanian lakes (<3 m depth)

Quality class / Parameters	Very Good	Good	Sufficient	Bad	Very Bad
Total Phosphorus mg/l	<0.02	>0.02 - <0.04	>0.04 - <0.09	>0.09 - <0.15	>0.15
Chlorophyll a	<10	>10 - <20	>20 - <40	>40 - <60	>60
Transparency (m)	>Mid Depth (MD)	>1.6 - <2.2 or >MD	>1.2 - <1.6 or >MD	>0.9 - <1.2 or >MD	<0.9
pH	>6.5	>6.3 - <6.5	>6.0 - <6.3	>5.3 - <6.0	<5.3
Total Nitrogen mg/l	<0.6	>0.6 - <0.9	>0.9 - <2.0	>2.0 - <3.0	>3.0

Table III.5.2-2 Lithuanian quality standards for *Cyprinid* waters

Parameter	Quality Standard	Analysis method	Sampling Frequency (minimum)	Notes
Dissolved Oxygen (mg/l)	50% of samples >8mg/l 100% of samples >5mg/l When minimal concentration is <4mg/l, measures should be taken to eliminate the causes	Winkler method or Electrochemical method	Once a month One sample must be taken when oxygen concentration is lowest (before sunrise)	
PH	6 - 9	Electrometrical method	Once a month	
BOD_7 (mg/l O_2)	<6	Measuring concentration of dissolved oxygen		
Phenol (mg/l)	Concentration in surface waters should be low so as not to be tasted in fish meat	Judgement by taste		Presence of phenol compounds is determined by taste only when they are suspected in the water
Petroleum hydrocarbons	Concentration should be low so as not to develop a visually observable film on the water surface and not to be tasted in fish meat	Visually and by taste	Once a month	Visual evaluation is performed once a month. Taste determination is only performed when hydrocarbons are suspected in water
Unionised Ammonium (mg/l NH_3)	<0.025	Spectrophotometry using indophenol blue or by Nessler's method	Once a month	These values may be exceeded for a short time, during sunshine
Ammonium Ions (mg/l NH_4)	<1 (Especially where water temperature is low and nitrification does not take place, ie <5ºC)	Spectrophotometry using indophenol blue or by Nessler's method	Once a month	

- Port sediments contaminated from past and present activities, which release chemicals when they become disturbed.

KSSA data show that levels of Lead, Copper and Chromium consistently exceed Lithuanian standards in water in the harbours adjacent to shipbuilding and repair yards near the Dane River and in Malku Bay in the south (Figure III.5.2-8).

Hydrocarbon levels are also high throughout the port, and other studies have reported elevated levels of pesticides, detergents and phenols (Harris 2000). Most of these substances become adsorbed onto fine material, and are thus generally present in higher concentrations in the sediments, as discussed below.

(2) Sediment Quality

Port sediments have been contaminated for many years, mainly from the heavy engineering and other polluting activities conducted in the past without adequate environmental controls, and the discharge of wastewater from the municipal sewerage system that provided only primary treatment until 1998. The situation has improved over the past ten years as port organisation and operation has improved, and many operators have begun to take conscious steps to limit their impacts on the environment. The municipal wastewater plant has also been upgraded and now provides secondary biological treatment, which reduces the organic and bacterial content of the effluent. However, although the port has been dredged annually since 1960, this is mainly at the centre of the waterway (Figure III.5.2-2), and contaminated sediments remain near certain berths and in enclosed harbours, where they continue to be a potential source of contamination, liberating chemicals into the water if disturbed.

The Ministry of Environment operates a method of classifying sediments in terms of their contamination with the seven most common heavy metals and hydrocarbons, which then determines how the sediment may be used or disposed of after dredging. This is shown in Table III.5.2-3, and the classes are interpreted as:

Class 1: Clean: may be dumped at sea or used for land levelling, road building, etc;

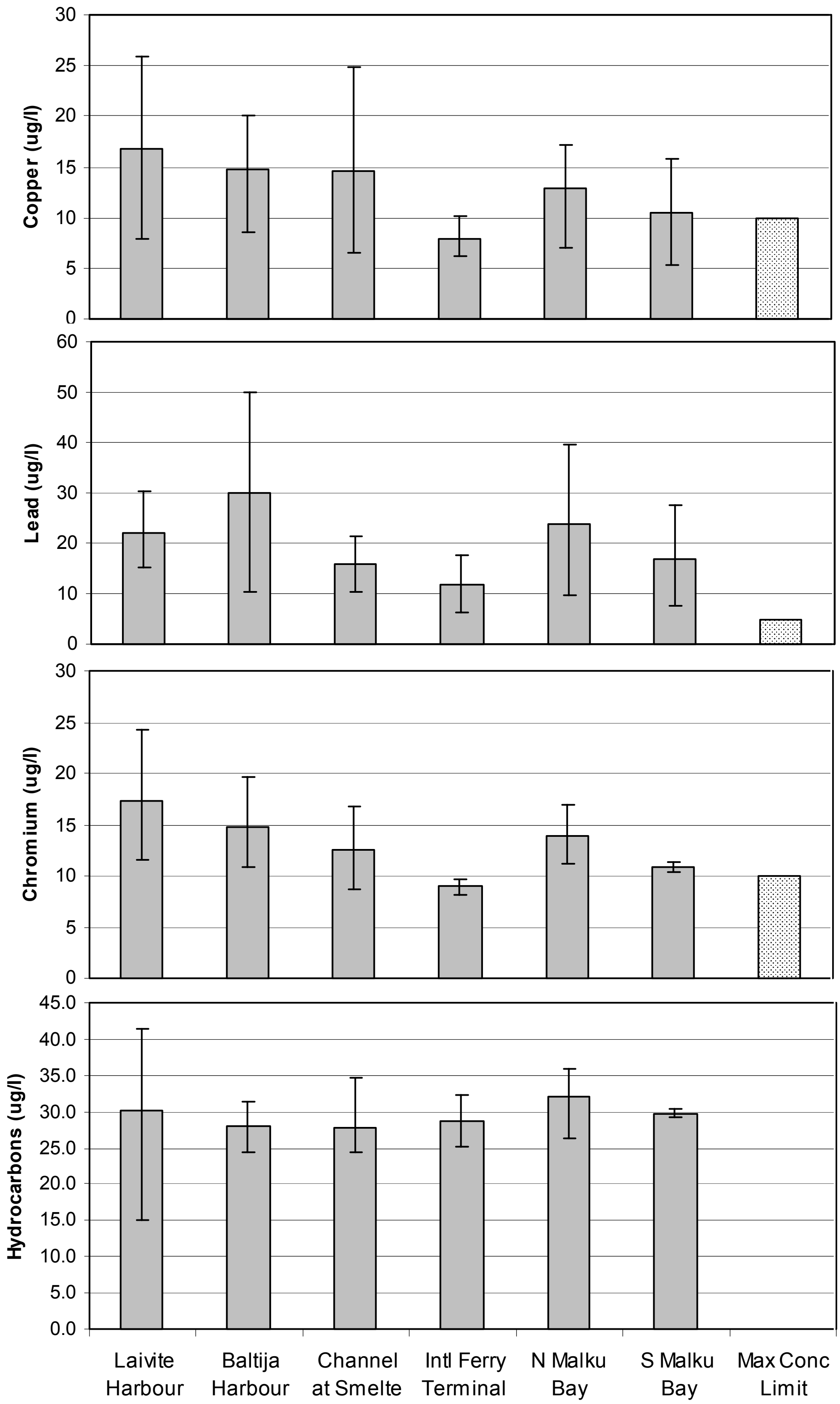
Class 2: Little Polluted: may be dumped or used in the same way as Class 1;

Class 3: Polluted: may be dumped at sea only in exceptional cases when the content of mobile forms of heavy metals, pesticides, phenols, polychlorbiphenyls, benz(a)pyrene and radionuclides has been determined, their environmental effects identified and other methods of sediment detoxification considered and rejected. This sediment must be landfilled if sea dumping is prohibited by MoE;

Class 4: Highly polluted: may only be disposed of as described for Class 3.

There is no similar system in operation throughout the European Union, so Table III.5.2-4 shows sediment quality standards used by the Dutch government, which are frequently used for reference worldwide. The interpretation of the contamination classes is broadly similar to those used in Lithuania and the comparison shows that Lithuanian standards are significantly more strict.

Contamination of Port sediments has been investigated by EIAs and other studies, and is monitored several times each year by both KSSA and the MoE Centre of Marine Research. Figure III.5.2-9 shows data collected by KSSA in 2001 and 2002, together.



Source: KSSA (2002)

Figure III.5.2-8 Concentration of heavy metals and hydrocarbons in water of Klaipeda Port in 2002. Figures = average of two samples (surface and sea bed) in June and October; vertical bars = max and min. Speckled bar = Maximum Concentration Level (Lithuanian Hazardous Substances legislation)

Table III.5.2-3 Classification of Klaipeda sediments according to the Lithuanian Ministry of Environment

Class	Name	Concentration, mg/kg (less than)							
		Cu	Pb	Zn	Ni	Cr	Hg	Cd	Hydro-carbons
1	Clean	20	20	100	30	75	0.1	1	20
2	Little Polluted	100	100	200	50	100	0.5	3	100
3	Polluted	200	200	400	100	200	1.0	5	1500
4	Highly Polluted	>200	>200	>400	>100	>200	>1.0	>5	>1500

Source: DEP (1994)

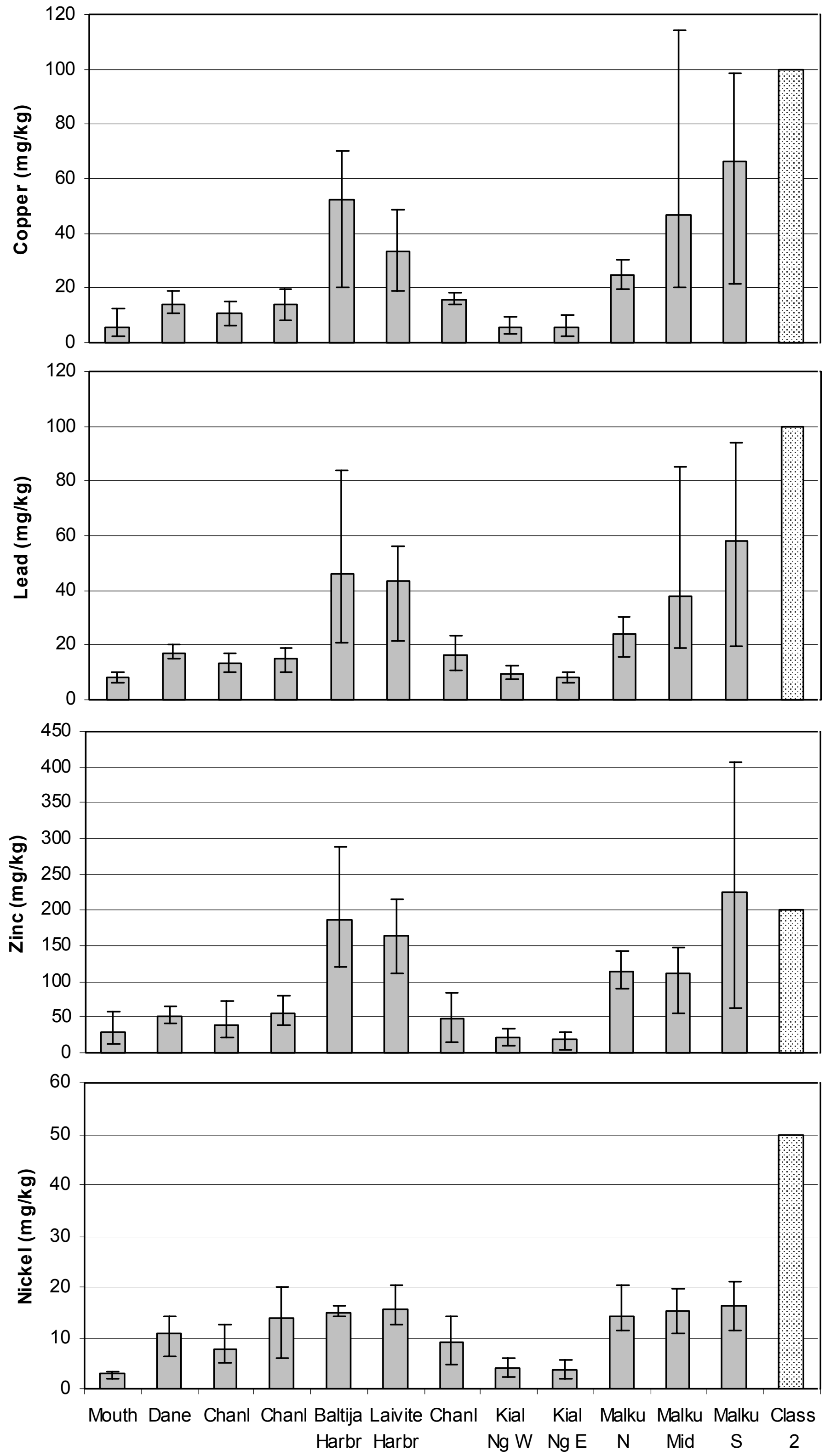
Table III.5.2-4 Sediment Quality Standards used in the Netherlands

Class	Name	Concentration, mg/kg (less than)							
		Cu	Pb	Zn	Ni	Cr	Hg	Cd	Hydro-carbons
1	Target	35	85	140	35	100	0.3	0.8	50
2	Limit	35	530	480	35	380	0.5	2	100
3	Test	90	530	720	45	380	1.6	7.5	3000
4	Intervention	190	530	720	210	380	10	12	5000
5	Signal	400	1000	2500	200	1000	15	30	

Source: IADC/CEDA (1997)

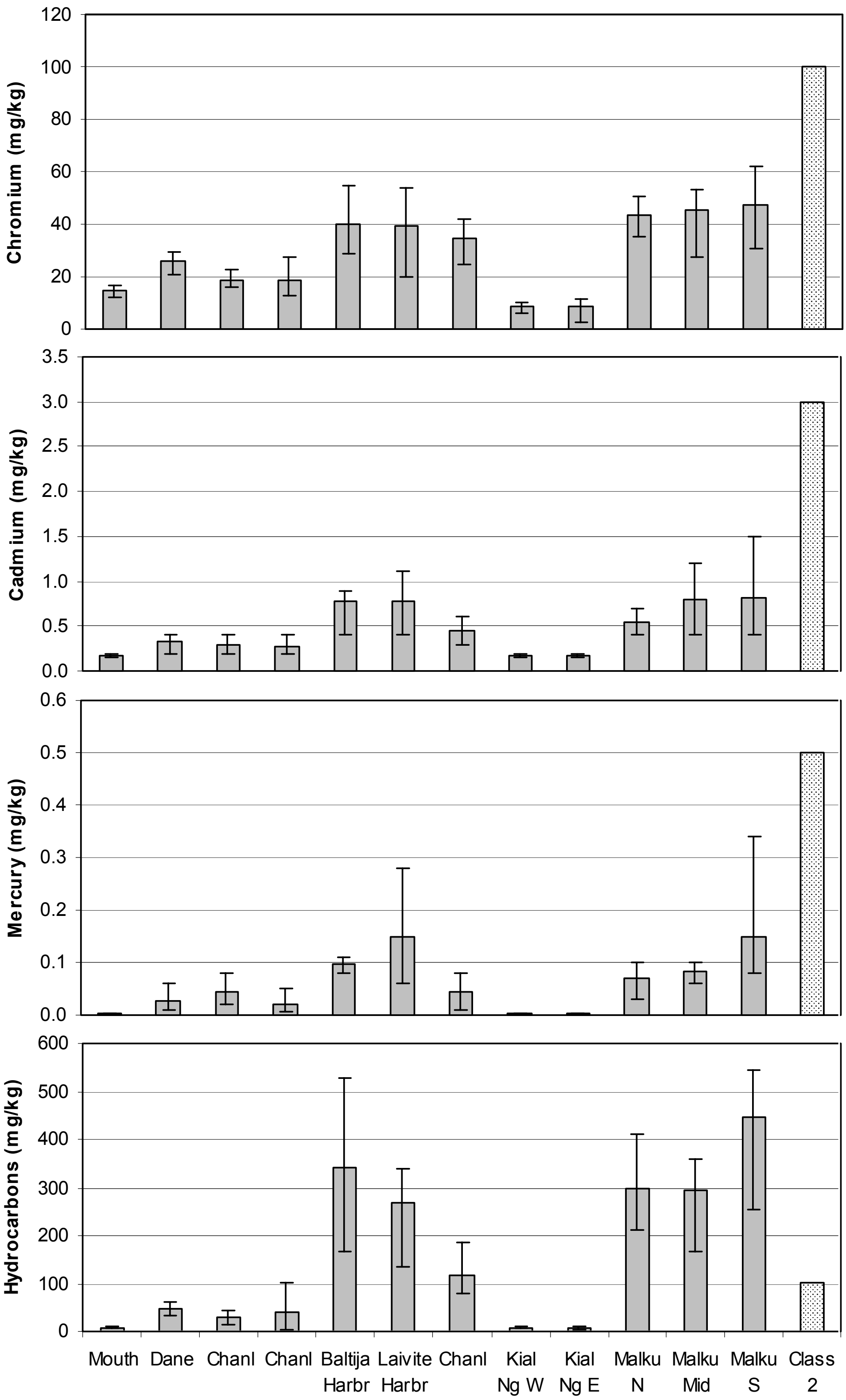
with the limit values for Class 2 sediment, which is considered little polluted and safe for sea dumping. This indicates that most pollutants are in low concentrations near the port entrance and in other parts of the main channel, but much higher in the enclosed harbours around the Dane River and in Malku Bay, adjacent to the shipbuilding and repair yards. Oil seems to be the main pollutant, being present at concentrations significantly above Class 2 in the harbours. In contrast most metals are below Class 2 levels at all stations, with the exception of Copper and Zinc, which were above Class 2 in some parts of the harbours.

KSSA data suggests therefore that surface sediments are not heavily polluted by metals, but that material from the harbours should not be dumped at sea because of the content of oil and certain metals. It should be noted that these figures are for the surface of the sediment, and that lower layers could be more polluted because the material would have been deposited in the past. Higher pollution levels have been reported by certain other studies, including LEI (1998) who sampled 54 stations north of the Dane River in 1997 and found Class 3 hydrocarbon concentrations in 72% of samples, and Class 3 Nickel in 18.5%. KSSA/ECOLAS (2003) also reported high concentrations of tributyl tin (used in antifouling paints in the past, and highly toxic to marine organisms) in the three harbours.



Source: KSSA (2001, 2002)

Figure III.5.2-9 Concentration of metals and hydrocarbons in surface sediment of Klaipeda Port, 2001-2002. Figures = average of two samples per station each year (spring and autumn); vertical bars = maximum and minimum values. Speckled bar = upper limit for sea disposal without further analysis



Source: KSSA (2001, 2002)

Figure III.5.2-9 (cont) Concentration of metals and hydrocarbons in surface sediment of Klaipeda Port, 2001-2002. Figures = average of two samples per station each year (spring and autumn); vertical bars = maximum and minimum values. Speckled bar = upper limit for sea disposal without further analysis

(3) Air Quality

Air Quality in Klaipeda is monitored by the Regional Environment Ministry, and the data is published in the annual yearbook. The most recent data obtained relates to the year 2000, when air quality was monitored at three locations: in the Port near the Bega site, in the centre of the city, and in a recreational area at Melnrage. Table III.5.2-5 shows the results, together with the limit values established by the Lithuanian air quality standards, established in 2002 to comply with the relevant EC Directives (1999/30/EC and 2000/69/EC).

There were 906 observations at the first two locations, and 146 in the city centre where the equipment operated in January and February only. The data show that in general air quality is reasonably good, despite the industrial character of the port and its proximity to the city. Annual average levels of sulphur dioxide, carbon monoxide and lead were all well below the legal limits, and none of the individual readings exceeded short-term permitted maxima. In the case of SO_2, concentrations have declined in recent years because the Lithuanian energy industry has changed from coal to natural gas as the main fuel. Lead levels have also declined because of the greater usage of lead free petrol and liquid propane gas as fuel for cars.

The main concern relates to Nitrogen Dioxide, which exceeded the maximum permitted concentration at all three sites, between 1 and 4% of the time, presumably as a result of pollution by traffic. Dust levels also appear high, although the readings are not directly comparable to the standards as these relate to PM_{10} (particulate matter of 10µm or less). Potential sources of dust include the handling of dry bulk materials in the port, and sand blown from the beaches and dunes, although their relative significance cannot be evaluated from the data available at present.

Table III.5.2-5 Air Quality in Klaipeda in 2000, as monitored by the Ministry of Environment, Klaipeda Region

Pollutant	Location	C_{ave}	C_{max}	Lithuanian/EC Limit Values				% Exceedence
				1 hr	8 hr	24 hr	Year	
Dust (µg/m^3)	Port	61	350			50 (PM_{10})	40 (PM_{10})	0
	Melnrage	40	170					0
	City	-	200					0
SO_2 (µg/m^3)	Port	2	29	350		125	20	0
	Melnrage	2	34					0
	City	-	29					0
CO (mg/m^3)	Port	1	2		10			0
	Melnrage	1	4					0
	City	-	4					0
NO_2 (µg/m^3)	Port	33	140	200			40	3.4
	Melnrage	35	140					3.4
	City	-	130					1.4
H_2S (µg/m^3)	Port	<1	2					
	City	-	2					
NH_3 (µg/m^3)	Melnrage	9	70					
	City	-	30					
Pb (µg/m^3)	City	.011	.02				0.5	0

Source: KSSA/ECOLAS (2003)

5.2.5 Ecology and Nature Conservation

(1) The Curonian Spit National Park

Although industry and the Port dominate the life and landscape of the city, and these activities and others in the river catchments have caused environmental degradation, Klaipeda is nevertheless a very significant location in terms of ecology and nature conservation. The most important area is the Curonian Spit (see Photo III.5.2-1).

The Spit was designated as a Landscape Reserve in 1961, a State Forest Park in 1976, and a National Park in 1991 "to preserve the most valuable complex of Lithuanian seaside, its unique landscape and the dune ridge, and the natural and ethno-cultural heritage, for its sustainable use and care." The National Park covers 18,000 ha and includes the entire spit between Klaipeda and the Russian border, and extends into the sea in the west and the Curonian Lagoon in the east, to the south of the Port (Fiugre III.5.2-10). The Park is protected under the Law of Protected Areas in the Republic of Lithuania, and is managed by a Park Administration, via management plans implemented under local planning laws.

As the designation suggests, the Park is important for landscape, culture and nature. This is also recognised internationally, by the World Conservation Union IUCN who have classified the Spit as a Category II Protected Area (managed mainly for ecosystem protection), and UNESCO who have designated the Spit as one of only 754 World Heritage Sites, because it is "an outstanding example of a landscape and sand dunes that is under constant threat from natural forces (wind and tide)" (UNESCO 2000).

Forest covers 70% of the land of the spit, coastal and inland sand dunes cover 25%, and the remainder comprises six villages, roads, infrastructure and farmland. There are major differences in landscape and ecology across the spit, produced by the prevailing west and southwesterly winds, moving the sand and shaping the dunes as shown in Fiugre III.5.2-11. The top of the beach in the west is inhabited by isolated halophytic (salt-loving) plants including the sea sandwort and Baltic rocket (*Cakile baltica*). There is then a belt of sand dunes (the fore-dune ridge) rising to around 15 m, the front of which has been planted with long-rooted marram and lyme-grass to stabilise the dune. Other plants grow here, including sea vetch, sea violet and Baltic toadflax (*Linaria loeselii*). The eastern slopes of the dunes are colonised by coastal gypsophilia and the rare sea-holly (*Eryngium maritimum*), a few small trees, and thickets of ramanas roses (*Rosa rugosa*).

East of the fore-dunes is a flat plain of blown sand, vegetated with grey hair-grass, rush-leaved fescue, sheep's-bit (*Jasione montana*) and other grasses. The land then rises gradually for a kilometre or more in the central part of the spit where there are extensive forests of pine and birch, with alders on more marshy ground. The eastern area then rises steeply to form the Great Dune Ridge, which varies in height from 10 m to 67 m (Photo III.5.2-4). Here the dunes have been planted with trees over the years to limit sand movement, and large areas are covered with mountain pine, Scots pine and grasses. Older forests near Nida and Juodkrante contain pine, spruce and oak, some of which are up to 100-150 years old. The ground flora includes several rare plants, such as the creeping twinflower (*Linnaea borealis*).

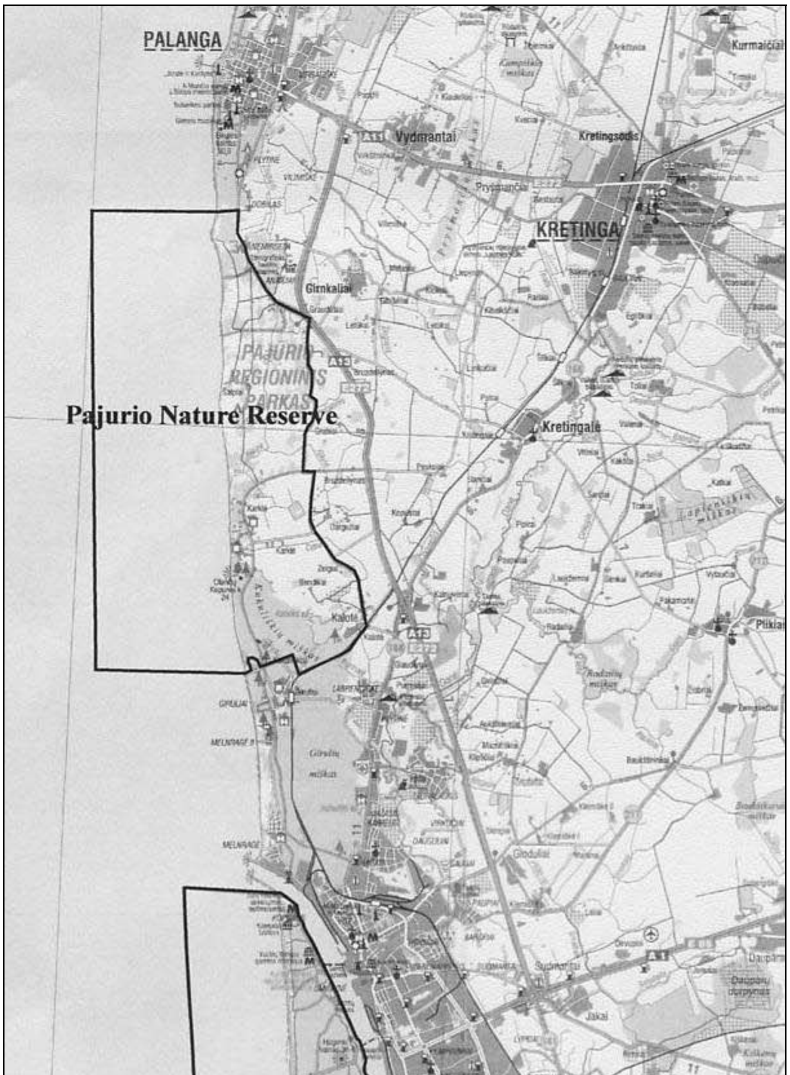


Figure III.5.2-10 Areas protected for nature conservation near Klaipeda Port

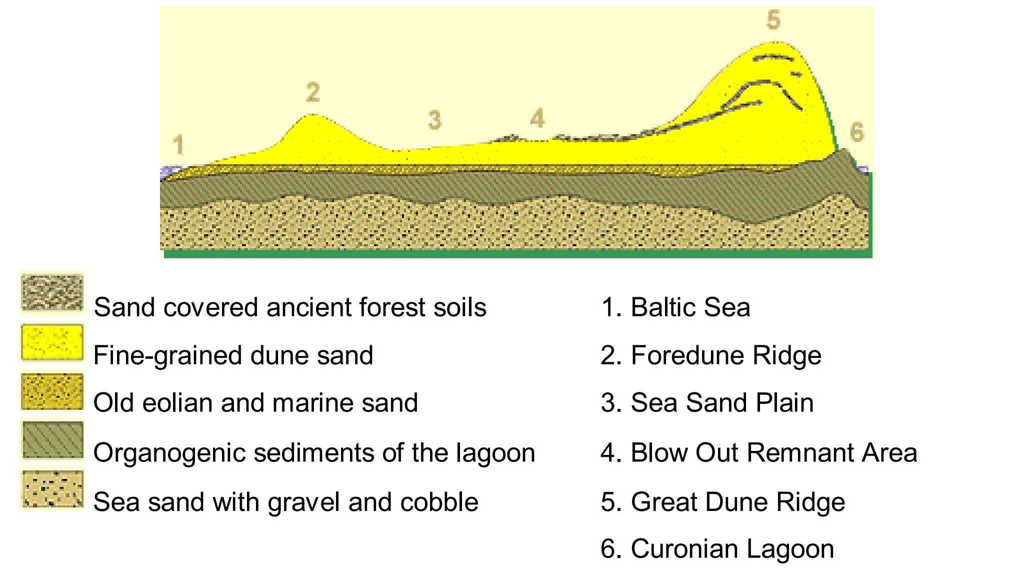


Figure III.5.2-11 Diagrammatic cross section through the Curonian Spit

The dunes then plunge steeply down towards the Lagoon and sand flows into the water in places. Elsewhere the narrow eastern coastal plain is covered with birch forests and grasses, with reed beds at the edge of the water, including common reed (*Phragmites australis*), grey club-rush, common spike-rush and the lesser pond-sedge (Photo III.5.2-5). In all there are almost 1,000 plant species on the Spit, of which 31 are rare and included in the Red Data Book of Lithuania (EPD 1992).

The variety of plant associations and environmental conditions on the Spit provide many types of habitat, which support a high diversity of animals. For example there are 37 species of mammal, ten of which are rare. The largest is the elk, and there arecurrently 30 individuals living and breeding in the depths of the forest where they feed on young pine seedlings. Roe deer venture out to feed on scrub and young deciduous trees at the dune/forest boundary, and wild boar live in pine thickets in such numbers that some starve in winter. Brown hare, red fox, badger, stoat, pine marten and weasel are all found in forest and scrub, and otters and beavers live in the lagoon and on adjacent banks. There are also bats and small mammals, including yellow-necked mouse and shrew.

The Spit is also very important for birds, both resident and visitors. Large flocks of finches and tits pass through in spring and autumn, followed by several types of raptor including sparrowhawks, ospreys and harriers. More than a hundred species breed on the Spit in summer, including skylarks in the dunes, chaffinches, thrushes and tits in the woods, and mallards, mute swans, great crested grebes and shelduck in the Lagoon. One of Lithuania’s largest and oldest colonies of grey herons and cormorants lives near Joudkrante, currently comprising around 2000 pairs. Several rare birds breed on the Spit, including white-tailed eagles, black kites, hobbies and tawny pipits. There are also many thousands of water birds that overwinter on the Spit, including common and velvet scoters, long-tailed ducks, goosanders and goldeneyes.

Photo III.5.2-4 The Great Dune Ridge at the south-east of the Curonian Spit

Photo III.5.2-5 Reedbeds and pine and birch forest at the edge of the Curonian Lagoon

There is also a very diverse insect fauna, which includes 300 species of beetle and 470 species of butterfly, of which at least 10 are rare. There are also good numbers of amphibians, comprising four types of frog, one species of newt and three toads, including the natterjack, which is rare in Lithuania and elsewhere in Europe, but quite common on the Spit. There are three species of lizard, and grass snakes have been seen recently, suggesting that they may have been introduced.

The National Park is managed within 5 functional zones (nature, buffer, recreation, urban and economic), and its 16 conservation areas comprise over 75% of the land. Conservation measures include the prohibition of many potentially damaging activities, including camping, lighting fires, walking on dunes except in designated areas, driving off the road, damaging the flora, and making noise that disturbs nesting birds. The planning laws prohibit “economic activity” within the park boundary, which is the term used for construction projects.

The Spit will soon be protected further as it is within an area proposed as a candidate Natura 2000 site under the EU Wild Birds and Habitats Directives, which have been incorporated into Lithuanian law prior to EU accession. Natura 2000 is a network of major conservation sites across the EU, protected because they contain fragile and vulnerable natural habitats and species of particular importance for biodiversity. The boundary of the “Northern Curonian Lagoon Special Protection Area” has not yet been finalised, but it is likely to include most of the Spit, plus possibly the northern part of the Lagoon and areas on the eastern bank. Activities within and near such areas are limited to those that do not harm the natural values that are the reason for the site being designated, which in this case are likely to include birds, rare habitats and flora and fauna.

(2) Other Designated Nature Conservation Areas

There are three other areas in the vicinity of the Port (shown on Fiugre III.5.2-10) designated because of their importance for nature conservation and landscape.

Pajurio Regional Park is the most important, covering 5033 ha of coastal land, beach and sea north of Klaipeda, between the Klaipeda Municipality boundary and Old Palanga. It was established in 1992 to preserve the landscape, ecology and cultural heritage of the coast, and contains several locations given specific protection. These are:

- Lake Placis Nature Reserve, near the coast in the centre of the Park, comprising the lake, swamps, dunes and vegetation, and the landscape of the beach lowland. Rare plants found here include thistle and western marsh orchid, and rare animals include field harrier and reed toad;
- Karkle Botanical Reserve and Kalote Botanical-Zoological Reserves cover areas of lake and forest in the south where several rare plants are found, including early coral root, ivy-leaved speedwell and sessile oak, plus bats, otters, grass snakes, and several species of migrating birds;
- Olandu Kepures Landscape Reserve occupies a small area of coast and includes Ice-Age boulders and ancient and replanted forest. The Olandu Kepures escarpment (Photo III.5.2-6, “Dutch Cap” in English) is a landmark used by seamen;
- Nemirseta and Saipiai Landscape Reserves are a complex of dunes, meadows and forest and inhabiting flora and fauna;
- Karkle Marine Reserve includes the beach and subtidal area where rocks and boulders are fish spawning grounds;

Photo III.5.2-6 Olandu Kepures in February 2004

- Karkle Ethno-Cultural Reserve includes old fishermen's houses, an old cemetery and the ancient village street structure.

The second area is Smelte Botanical Reserve, which is 2ha of land within the port, on the eastern side of the ferry terminal peninsula. It was established to protect terrestrial halophytic plant communities including the nationally rare *Juncetum gerardii*, found on part of the site.

The third area is Luzijos Botanical Reserve on the east bank of the lagoon, 2-3 km south of the ferry terminal peninsula. This is a narrow strip of coastal land, 78 ha in total, established in 1997 to preserve the network of sand beaches with rare halophytic plants and flooded meadows adjacent to the lagoon.

These sites are less important than the internationally designated Curonian Spit, but they are established under Lithuanian law so it is unlikely that activities would be permitted that would damage or reduce the value of the protected assets.

(3) The Curonian Lagoon

The Curonian Lagoon is shallow, polluted, and subject to sometimes-abrupt changes in salinity, so it provides a harsh and variable environment. It is however protected from wind and wave action, with good supplies of food for certain organisms, and a variety of habitats that support a number of important species.

Three main animal communities have been recognised on the bed of the lagoon, distributed according to the type of substrate and their tolerance of saline intrusions (Olenin 1996, Harris 2000). In the north the burrowing worm *Marenzelleria viridis* dominates in the east, and the freshwater snail *Valvata piscinalis* in the west. Farther south in the centre of the Lagoon there are large populations of the freshwater zebra mussel (*Dreissena polymorpha*), growing attached to stony ground. These communities all include other organisms typical of freshwater and slightly brackish conditions, including oligochate worms, chironomids and insect larvae.

The water is rich in plankton, which varies greatly in numbers, species and distribution, seasonally and from year to year. Zooplankton consists mainly of limnetic (freshwater) forms in the south and near the rivers, where *Daphnia longispina* and *Cyclops strenuus* are common. Marine species such as *Acartia bifilosa* occur when seawater intrudes in the north, and in the centre is a transition zone containing a mixture of species. Phytoplankton is dominated by species that live in both the lagoon and the sea, such as the diatom *Stephanodiscus hantzschii* and the blue-green alga *Aphanizomenon flos-aquae*. High nutrient levels often cause phytoplankton blooms in summer when certain species reproduce rapidly, reaching such high densities that the water takes on the colour of the plant pigment (frequently green or red, so the phenomenon is known as a "red tide"). These can be irritating and even toxic to aquatic animals, and can cause adverse reactions in people eating affected fish.

There are over 50 fish species in the Lagoon, including several that are captured commercially (such as pike-perch, bream, roach, eel and perch) by mainly small-scale operators. The fishery is small, totalling 1000-3000 tonnes annually, and lower catches have occurred in more recent years (Pustelnikovas 1998). A more important feature of the lagoon is that it serves as a spawning ground for several commercially important marine fish that migrate from the sea in large numbers to breed at various times of the year (Figure III.5.2-12). There are also a number of rare fish, including Twaite shad (*Alosa fallax fallax*) and sea lamprey (*Petromyzon marinus*), which are included in the Lithuanian Red Data Book. Others are protected under the Bern Convention and EU Habitats Directive, such as river and brook lampreys (*Lampetra fluviatilis* and *L planeri*), asp (*Aspius aspius*), chekhon (*Pelecus cultratus*), European bitterling (*Rhodeus sericeus amarus*) and pond loach (*Misgurnus fossilis*) (KSSA/ECOLAS 2003).

The Lagoon and surrounding land lies within a small but very important corridor through which millions of birds, mostly passerines like finches and tits, migrate annually from Euro-Asia to Central and Western Europe or Africa. The Lagoon is also important for migrating water birds, including Great Cormorant, Whooper Swan, Tundra Swan, Northern Pintail, Common Pochard, Common Goldeneye, Smew, Goosander, White-tailed Eagle and Little Gull. Many of these rest and forage in the Lagoon and along the water's edge, and on Kiaules Nugara, the reed-covered island west of the ferry terminal (Photo III.5.2.7). Other species overwinter in the Lagoon, including Red- and Black-throated Diver, Steller's Eider, Long-tailed Duck, Velvet Scoter and Red-breasted Merganser. Many of the species and populations are internationally important, so this is a major bird site (KSSA/ECOLAS 2003).

(4) The Port Channel

There are three main aquatic habitats in the Port area: the soft sediment bed of the channel; artificial hard substrates provided by breakwaters, quay walls and hulls of vessels; and the water itself.

The richest community is found on the breakwaters at the Port entrance (Photo III.5.2-8), where the rocks, concrete blocks and tetrapods are covered by dense growths of the brown seaweed *Pilayella* down to 2 m depth, and the green seaweed *Cladophora* from 2-4 m. Sessile mussels and barnacles encrust inner, more sheltered areas, and motile whelks and crabs forage on the surface. The most important aspect of the ecology of the breakwaters is the fact that they are used as a spawning area by Baltic herring, which are the major component of the sea fishery. Studies in April 1995 recorded herring roe (fertilized eggs) on most breakwater surfaces between 1-4 m depth, containing up to 14 million individuals per m^2 (Harris 2000).

Other hard substrates in the Port are much less densely colonised, because they are exposed to more variable water conditions and closer to pollution sources in the sediments and wastewater discharges. The barnacle *Balanus improvisus* dominates the fauna here, being tolerant of low salinities and able to close its body plates to withstand short periods of adverse conditions. Many surfaces become covered by green algae as temperature and light increase in spring and summer, and the species are again those that are tolerant of low salinity, such as *Cladophora*, *Enteromorpha* and *Chaetomorpha*.

Photo III.5.2-7 Kiaules Nugara

Photo III.5.2-8 Breakwaters at the mouth of the Port Channel

The bed of the channel consists of coarse-grained sand near the mouth, which is inhabited by marine species found in soft sediments offshore, such as the worms *Pygospio elegans* and *Nereis diversicolor* and the burrowing molluscs *Macoma balthica* and *Mya arenaria*. Farther south in the main part of the channel the sediment is finer and contains more organic matter, and the community is dominated by Oligochaete worms, which are well known indicators of organic pollution. Other inhabitants include the rag-worm *Nereis diversicolor* and the burrowing shrimp.*Corophium volutator* (LEI 2002), again species common in organically enriched areas. The community becomes sparse near the quaysides, and in some of the more polluted areas (such as the Laivite and Baltija harbours and parts of Malku Bay) there is no fauna at all (KSSA 2002).

The main ecological importance of the channel is because it is the route through which several commercially exploited and other rare fish migrate each year to reach their spawning grounds in the Lagoon. Migrations occur in all seasons and the patterns are complex and not fully known, and can vary from year to year. Figure III.5.2-12 shows the patterns reported by the most recent studies (Harris 2000, LEI 2002), which indicate that April-July and October-December are the most important periods. The Ministry of Environment often limit potentially damaging activities (such as dredging) in April-May, and August-October, although Figure.5.2-12 suggests that there is no time in the year when there are no fish migrating.

(5) Coastal Zone

Pollution levels are lower at the coast because chemicals are diluted in a large volume of water, and the surface of the sea is well oxygenated by photosynthesis and wave action. The beaches are composed of mainly fine to medium grade sand, which is moved around by waves, preventing colonisation by soft-bodied animals. The small areas uncovered by the tide are therefore sparsely inhabited, and the air breathing amphipod *Talorchestia deshayesii*, is one of the few species found.

In the subtidal zone, waves often create a narrow depression close to the shore, in which mats of seaweed collect and decay, attracting the sand hoppers *Gammarus* and *Bathyporeia*. Sand is more stable at 1-5 m depth, and is colonised by more species (up to 4 per m^2) and individuals (300-6,000 per m^2). These include burrowing amphipods (*Corophium*), shrimps (*Crangon*), tube-dwelling worms (*Pygospio elegans*), rag-worms (*Nereis diversicolor*), and young fish. In deeper water the sand community is richer (8-10 species and 1000-7000 individuals per m^2), and includes burrowing bivalve molluscs such as *Macoma balthica* and *Mya arenaria* (Harris 2000).

Monitoring by the MoE Centre of Marine Research (2002) shows that stony areas found at depths of 10-25 m support the richest marine communities. Rock surfaces are encrusted with sedentary mussels (*Mytilus edulis*), barnacles (*Balanus improvisus*), hydrozoans (*Cordylophora caspia*) and the red seaweed *Ceramium rubrum*, and surrounding sand is inhabited by many of the burrowers described above. In total there are up to 50 species per m^2 and 50,000 individuals.

Coastal fish include many that are important in commercial catches, including the bottom-dwelling turbot and flounder, and the smaller pelagic herring and sprat. As well as species that migrate from the sea to the lagoon to spawn, others like bream and perch migrate from the lagoon to the sea to feed, so the coastal community can include freshwater species. Young fish tend to be found closer inshore, and most fish migrate into deeper water in winter to avoid the cold. As fish are highly mobile there are few other consistent patterns to their distribution.

	J	F	M	A	M	J	J	A	S	O	N	D	Not known
Spawning (sea to Lagoon)													
[1]Salmon *Salmo salar* adults						■	■	■	■	■	■	■	
[1]Salmon *Salmo salar* juveniles				■	■	■							
[1]Sea Trout *Salmo trutta* adults							■	■	■	■	■	■	
[1]Sea Trout *Salmo trutta* juveniles				■	■	■							
[1]Twaite shad *Alosa falax* adults			■	■	■	■	■						
Whitefish *Coregonus lavaretus* adults	■									■	■	■	
Vimba *Vimba vimba* adults	■	■	■	■	■				■	■	■	■	
[2]Smelt *Osmerus eperlanus* adults	■	■	■	■						■	■	■	
[2]Eel *Anguilla anguilla* adults					■	■	■						
[2]Lamprey *Lampetra fluviatilis* adults	■	■	■	■						■	■	■	
Lavaret										■	■	■	
[1]Sea Lamprey *Petromyzon marinus*													■
Feeding (lagoon to sea)													
[2]Bream *Abramis brama*						■	■						
Perch *Perca fluviatilis*						■	■						
[2]Pike - perch *Stizostedion lucioperca*						■	■						

Source: LEI (2002), Harris (2000). [1] Lithuanian Red Data Book species; [2] Fished commercially

Figure III.5.2-12 Times of migration of fish species through Klaipeda Channel

5.2.6 Human Environment

(1) Population and Demographics

Klaipeda is Lithuania's third largest city, and data from the Lithuanian Health Information Centre shows that in January 2003 there were 191,635 inhabitants, that is over 5% of the population of the country. Almost 54% of the Klaipeda population is male, higher than the natural average, presumably because the port attracts male workers into the area.

As in most other parts of Lithuania, the average age of Klaipeda's population is increasing, and in 2001, 12% of the people were 65 and over. This is due to two main factors, which are:

- A falling birth rate, which in 2002 was 8.1 births per 1000 people; and
- An increasing life expectancy (currently 68 years for men and 78 years for women);

The decline in birth rate is related to many factors, including the radical changes in Lithuanian society in the post-Soviet era, and uncertainty about the future in certain sectors, in the absence of state control and support. The increase in life expectancy will be a result of the general improvements in social conditions and public health care.

Current trends in Klaipeda and elsewhere in Lithuania are of a moderate decline in population numbers, as mortality exceeds the birth rate (Table III.5.2-6). As in the other Baltic States this is compounded by negative migration as people, mainly in the younger age groups, leave the country to seek higher salaries and better conditions, mainly in western Europe. In Klaipeda the population declined by 2,300 between 2001 and 2002, 20% of the decline in the country as a whole (Table III.5.2-6).

Table III.5.2-6 Mortality, birth rate and population density in Klaipeda and Lithuania in 2001 and 2002

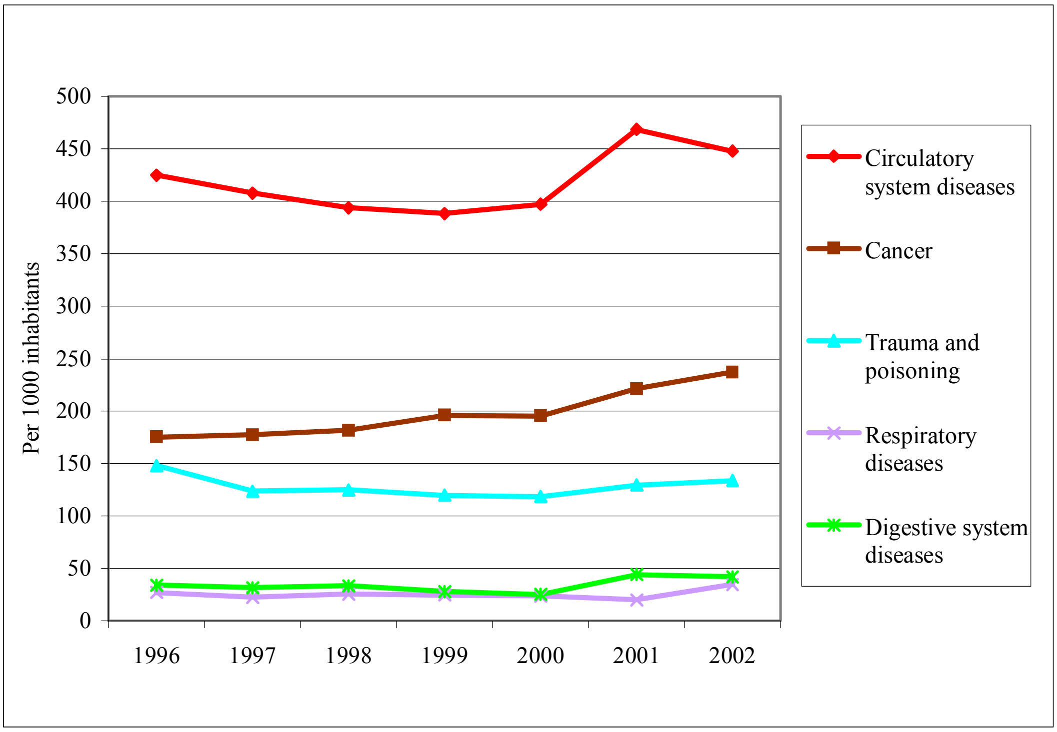
Year	Lithuania				Klaipeda			
	Births	Deaths	Difference	Population	Births	Deaths	Difference	Population
	Per 1000 inhabitants			Total	Per 1000 inhabitants			Total
2001	9.1	11.6	-2.5	3,481,292	8.6	9.5	-0.9	194,400
2002	8.7	11.9	-3.2	3,469,100	8.1	9.4	-1.3	192,100
Change	-0.4	+0.3	-0.7	-12,192	-0.5	-0.1	-0.4	-2,300

Source: Lithuanian Health Information Centre

(2) Public Health

Data from the Lithuanian Health Information Centre shows that 1799 people died in Klaipeda in 2002, 60% of them aged 65 or above. Heart and other vascular diseases were the single biggest cause (47%), followed by cancer (25%, Figure III.5.2-13). These are characteristic diseases of the developed world, reflecting the increasing affluence in Lithuania over the past decade, and the continuing trend of smoking, alcohol consumption, a high fat diet, and insufficient exercise. Infant mortality (in the first year of life) fell steadily in Lithuania from 1% in 1997 to 0.79% in 2002, in line with the overall improvement in living standards and health care. In Klaipeda the picture is more complex and variable, with the rate being 1.1% in 1996, 0.8% in 1998 and 0.96% in 2002. Mortality is generally greater when the mother and baby return home than in the pre-natal period when there is more care from doctors.

In 2002 there were on average 2.2 visits to a health centre per person per year in Klaipeda, higher than the national average of 1.7, possibly because more people are involved in industrial activities than elsewhere in the country. This figure has increased dramatically over the past six years when there was less than one visit per person in both Klaipeda and Lithuania. Respiratory problems and heart disease are the main public health problems, causing half the deaths, one third of the disablements, and 15-20% of the visits to health centres. High blood pressure (53%) and coronary heart disease (22%) are the main reasons, presumably resulting from the social changes of the 1990's, which have brought a more affluent lifestyle, but increased personal responsibility compared with past times, and a degree of uncertainty about the future.



Source: Lithuanian Health Information Centre

Figure III.5.2-13 Causes of mortality in Klaipeda residents, 1996-2002

As in most societies morbidity (illness) in children is higher than adults, and in Lithuania this has increased steadily over the past ten years, reaching 2.7 visits to a health centre per child per year in 2002. In Klaipeda the figure is considerably higher, at 3.4. These figures are against the trend of improving health and social conditions, and are likely to be a result of parents taking advantage of the increased availability and quality of health care. Respiratory disease is by far the main health problem in children, accounting for 59% of the cases.

5.3 Options for Port Development

5.3.1 Environmental Sensitivity

From the above account of existing environmental conditions it is clear that, as well as being very important in the economy of the country and a major influence on the life of the city, Klaipeda Port is also located in an area of considerable environmental importance and sensitivity. Key features include:

- The Curonian Spit in the west, which has internationally important landscapes, culture and ecology, and is a designated National Park and a UNESCO World Heritage Site;
- The Channel between the Spit and the Port, through which commercially exploited and rare fish, and large numbers of internationally important birds migrate each year;
- The Curonian Lagoon in the south, which is a fish spawning ground, a resting and over-wintering site for migrating birds, a tourist attraction and supports a commercial fishery;
- The Baltic Coast in the north, which is used for recreation and tourism by local people and visitors, and the adjacent village of Melnrage where there are traditional residences and new housing, and business developments aimed at the recreational market;
- Klaipeda City in the east, where commercial and residential areas are located close to the port with little or no buffer in places, and where houses and business premises have been built on land designated in City Plans as reserved for port use in the future;
- Land immediately south of the port, which is a groundwater protection zone as it contains boreholes from which water is extracted to supply the southern half of the city.

The port is therefore surrounded on all sides by areas and features that are of local, national and international importance, which are sensitive in different ways and to varying degrees to damage and disturbance. Proposals to expand the operation of the port need therefore to be developed and implemented with a great deal of sensitivity to environmental considerations, to prevent damage and disturbance to important natural and man-made assets.

Resolution of apparent conflicts between the needs of development and a desire to protect environmental assets is the function of Environmental Assessment, which is a tool intended to enable development to proceed without causing unacceptable impacts. If environmental considerations are taken into account early in the project cycle (when alternative methods of achieving a proposed development are devised), actions that could cause significant negative impacts can be identified and avoided, or measures can be included in the design to reduce the impacts to acceptable levels.

5.3.2 Formulation of Port Development Options

An important stage in the EIA process is the identification of environmental constraints and opportunities, so that these can be taken into account in devising the alternative approaches to the development (options). Constraints and opportunities are defined as follows:

- Environmental Constraints are areas or features of the environment that are important and need to be preserved, or where the proposed development could produce significant negative impacts;
- Environmental Opportunities are areas or features of the environment that could be significantly improved by the proposed development, or where the development could proceed without having negative impacts.

Table III.5.3-1 shows the main sensitive features and environmental constraints and opportunities in the study area, identified from the detailed analysis of existing conditions presented above.

A similar list of key features, identified from a preliminary analysis earlier in the Study, was discussed with the port planning and engineering experts of the JICA Study Team when the options for port expansion were being devised. As a result it was proposed to focus as much of the future development as possible within the existing Port boundary, to minimise adverse impacts and take advantage of the main environmental opportunities (see Table III.5.3-1).

However, early results from the demand forecasts and economic analyses suggested that it was unlikely that all of the required increase in capacity could be accommodated within the existing Port. Potential areas for expansion outside the boundary were therefore investigated. Because the National Park legislation prohibits large-scale development on the Curonian Spit, there are only two areas outside the Port where further development could be feasible. These are:

- On the western side of the Ferry Terminal peninsula, south of the existing Port (Area A: see Figure III.5.3-1);
- On the coast at Melnrage, north of the Port entrance (Area B on Figure III.5.3-1).

5.3.3 Environmental Sensitivity of Potential Development Sites

To assist in the process of developing the options for Port expansion, and to ensure that environmental factors were properly taken into account, a preliminary analysis was carried out of the environmental sensitivity of the main potential development sites considered by the Study. These are shown on Figure III.5.3-1 and Photos III.5.3-1~III.5.3-5 (below), and included the two areas outside the Port, the two most polluted sites within the Port (where the benefits of environmental cleanup would be greatest), and a third area near the Smeltale River where land currently unoccupied by the Port is designated in the Klaipeda City Plan for future Port use.

The analysis reviewed the existing environmental conditions at each site and the constraints and opportunities shown in Table III.5.3-1, and considered the environmental implications of port construction in each area. The main conclusions were that:

Table III.5.3-1 Main Environmental Sensitivity, Constraints and Opportunities in relation to further development of Klaipeda Port

	Main Sensitive Features	Main Constraints	Opportunities
PHYSICAL	• Curonian Spit and lagoon is internationally important and protected for landscape and ecology	• Development which involves dredging or water-based construction should be designed to ensure that patterns of erosion and sedimentation are not changed at the coast or in the lagoon, and that the supply of sand to the dunes is maintained	A port development at a coastal location could improve the physical environment in the vicinity by enhancing the supply of sand to dune areas and increasing the planting of sand-retaining vegetation
	• Coast and landscape to north and south of port is important for recreation and tourism		
	• Beaches and dunes protect land from wind, waves, flooding, and are being damaged & lost worldwide		
	• Muddy edge of lagoon provides important habitat, landscape and flood protection		
	• Navigation can be difficult at port entrance in storms, and accidents have caused oilspills in past	• A port development should be designed to ensure that it does not increase wave action in the channel or restrict the size of the port entrance	A port development could improve navigation safety by providing a wider entrance and more protection from waves
CHEMICAL	• Port is sensitive to chemical pollution on all sides:	• Facilities for handling/storage of hazardous cargo should be located away from sensitive areas (housing, channel, spit, beach) • Modern facilities and strict operational procedures should be provided to reduce the risk of pollution from accidents	A new port development could significantly improve environmental quality in port, city and channel if it: • Focused on areas occupied by polluting industry • Removed these industries (eg ship repair) • Removed areas of contaminated sediments • Provided modern organisation and cargo handling • Required operators to achieve ISO 14001
	• West: fish migrate through channel; ecology of lagoon and spit is internationally important		
	• East: people live and work in Klaipeda City		
	• North: beaches are used for recreation and tourism		
	• South: city water is extracted from boreholes		
	• Port with inadequate facilities can cause pollution by cargo handling/storage, fuel loading, accidents		
	• Contaminated sediments in harbours at Malku Bay and near R Dane could cause pollution if disturbed	• Dredging and construction should not disturb polluted sediments	
	• Port land is probably contaminated from past uses	• Construction on port land should remove and dispose of contaminated soil in approved manner	
ECOLOGY	• Curonian Spit and lagoon is a National Park and one of Lithuania's most important nature conservation sites	• Construction or dredging within the National Park boundary would not be permitted • Construction or dredging near the protected areas should be avoided	Ecology of channel and lagoon would benefit from development that improved environmental quality of port as suggested above, because: • Flora and fauna would re-colonise areas where they are absent at present • More fish may migrate to lagoon to spawn • Fishery may improve • Environment near Nature Reserve would improve
	• Northern Curonian Lagoon is in an area proposed as EU Natura 2000 site (boundary not yet decided)		
	• Habitats and species must not be damaged or disturbed in or near the designated areas		
	• Many important fish migrate from sea to lagoon to spawn or from lagoon to sea to feed	• MoE may require dredging to cease during peak fish migration periods	

	Main Sensitive Features	Main Constraints	Opportunities
	• Pajurio Regional Park is located on coast north of port, 4 km from Melnrage	• Construction within the boundaries of Pajurio Regional Park would not be permitted	
	• Smelte Botanical Reserve is 2ha within port along east of ferry terminal peninsula	• Construction within Smelte Botanical Reserve boundary should be avoided	
HUMAN	• Inhabited areas are very close to east of port and some housing and business premises are on land reserved for port expansion	• Development should avoid relocation of people where possible (even from illegal settlements) to avoid public opposition	Enhancements of the human environment could be included in a port development, such as providing improved waterfront access and landscape
	• Melnrage has a well established community and the beach and landscape are important for recreation and tourism	• Port expansion at Melnrage would be highly visible, would reduce the value of the landscape, and make the area less attractive to visitors	Human environment within and outside port would benefit from development that improved port environmental quality as suggested above, because of • Reduced emissions and improved air quality • Reduced noise • Improved water quality and ecology in channel
	• Melnrage beach and coast is a greenfield site as it has not previously been developed,	• Lithuania should follow EU practice, which avoids development on greenfield sites and prefers to develop previous industrial areas (eg the port)	
	• The port is an important human environment as many people live and work there	• Port operations and worker health and safety must be maintained during and after construction	• Can improve local socio-economic conditions by employing local people long-term in the new port
	• Some port buildings are historically important	• Historically important buildings must be retained	• Can develop a port museum and history trail to raise public interest in the port

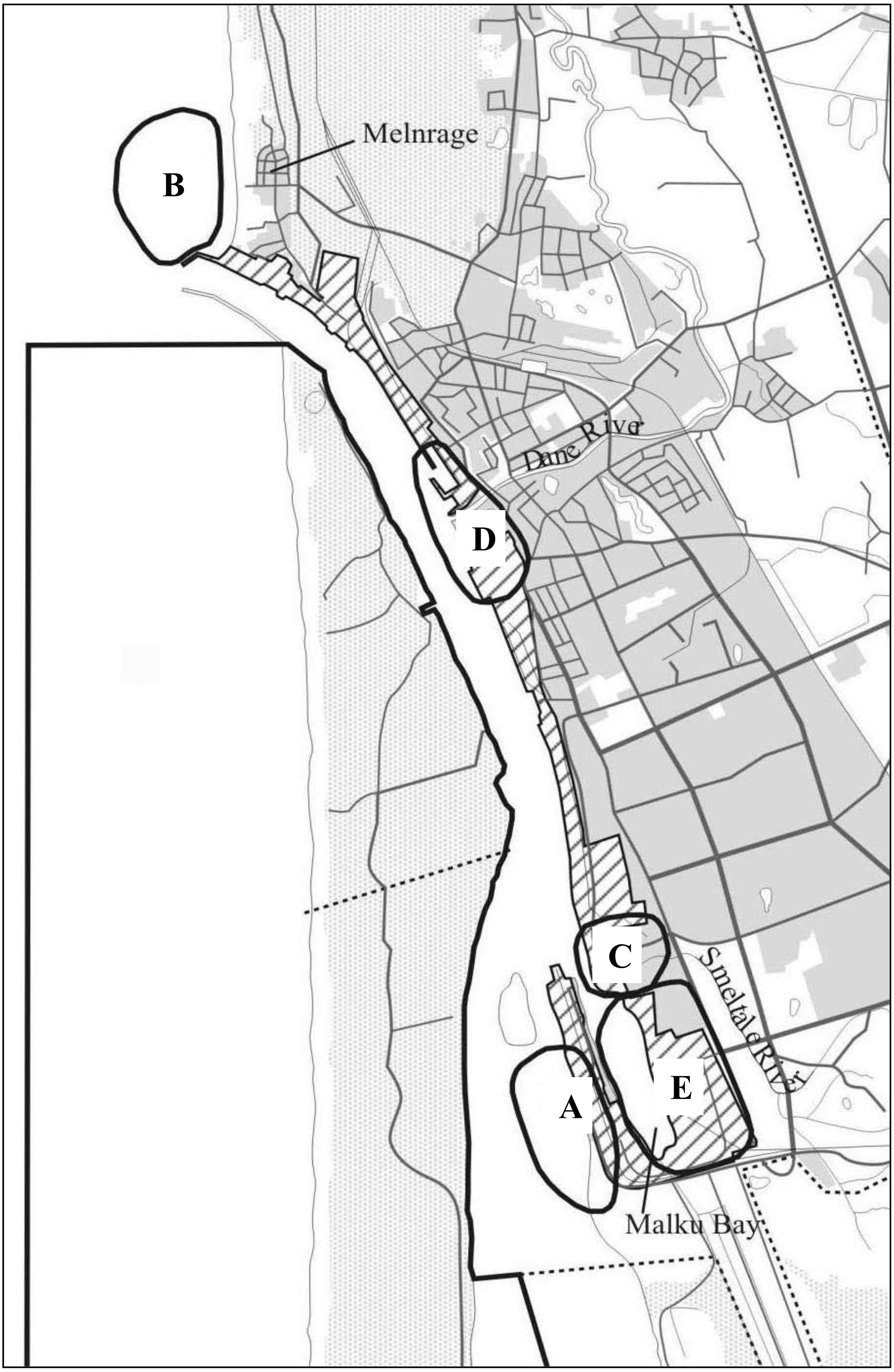


Figure III.5.3-1 Areas considered for potential future port expansion in the initial stages of the Study

- Construction is not possible on the Curonian Spit, or in the west of the Lagoon south of the existing port territory, as this is within the National Park;
- Proposed construction elsewhere must not damage or disturb species and habitats in the National Park;
- It would be preferable for as much new construction as possible to be located within the existing Port boundary as this is on brownfield[1] land mainly owned by the government;
- Construction within the Port presents the opportunity to clean up polluted sediments and polluting industry around the River Dane Mouth and in Malku Bay, which would be a major environmental benefit;
- If construction is proposed outside the Port, this should minimise the need to relocate residents as far as possible; and
- Large-scale construction on the coast at Melnrage would be visible over large distances, which is likely to be considered as a significant negative impact as the coastal strip is important for recreation and tourism.

5.3.4 Preliminary Option Preferences

Table III.5.3-2 was then prepared, to provide guidance to the planning and engineering experts as to the development potential of each of the above sites from an environmental perspective. This indicates that at this early stage there were preferences between sites, and also potential difficulties at certain locations in terms of the likely impacts of port development. The main conclusions from this preliminary exercise were that:

- Site E (Malku Bay and land immediately east, Photo III.5.3-1) would seem to be the preferred site for future port development on environmental grounds. It is within the existing port boundary, includes areas reserved for port use that are currently unoccupied, and contains the most polluted sediment (in Malku Bay) and one of the most polluting industries (ship repair), both of which could be cleaned and/or removed as part of the new expansion plans;
- Development at the two other sites within the port would not be feasible. There is insufficient space for provision of extensive new land-based facilities at the Dane River site (D, Photo III.5.3-2) and there could be adverse impacts on the human environment as there are houses and other buildings located very close to the Port. Although land around the Smeltale River (Site C, Photo III.5.3-3) is reserved for Port use, some of it has already been developed for housing and the remainder has been earmarked for recreational development, so there would be difficulties in reclaiming the area for Port expansion;
- Outside the Port, development at Site A (Photo III.5.3-4) would be difficult because it is very close to the boundary of the National Park and the likely boundary of the Natura 2000 site. In Western Europe development is prohibited close to such sites to avoid disturbing species and habitats in the protected areas and because locations nearby often function in the ecology of the protected site. The MoE are also concerned that further dredging in the south of the port could

[1] Greenfield site: an area where there has not previously been any industrial development
Brownfield site: an area that has previously been developed

increase the ingress of saline water into the Lagoon and damage its fragile ecology;

- Development at Site B (Photo III.5.3-5) would also be difficult as the coast at Melnrage is used for recreation by local people and visitors, attracted by the beach and landscape, and residents of the village of Melnrage have invested in supporting infrastructure and new housing. A large industrial development here would be visible for long distances and would detract from the beauty of the landscape to the north towards the resort of Palanga and in the south on the popular beaches of the Curonian Spit.

Table III.5.3-2 Preliminary assessment of the suitability of areas in and near Klaipeda Port as potential sites for future port development

Zone	Development Potential (Preliminary Evaluation)	Reasons
A **West side of Ferry Terminal** **(Photo III.5.3-4)**	Difficult	Close to boundary of National Park, and proposed EU Natura 2000 site. In western Europe development can be prohibited close to the protected area if the location functions in the ecology of the protected site. If development was proposed here it would need to show clearly that species and habitats within the protected areas would not be damaged or disturbed during or after construction.
B **Coast off Melnrage** **(Photo III.5.3-5)**	Difficult	Not a protected area, but important for recreation and tourism because of the beach and landscape, and with a significant housing settlement at Melnrage. A large-scale development here would be visible over long distances, and would detract from the natural landscape, so this is likely to be considered a significant negative impact. Depending on what is proposed, it is not clear how visual and other impacts could be mitigated.
C **Adjacent to River Smeltale** **(Photo III.5.3-3)**	Not Feasible	On existing Port land and land reserved for Port development. However the City land use plan shows low-rise housing and planned recreational development south of Smeltale River, so it would be difficult to re-claim the area for Port use.
D **Adjacent to Dane River** **(Photo III.5.3-2)**	Not Feasible for large-scale new construction	Initially a preferred site because it presents an opportunity to clean up polluted sediments and polluting industry in the course of developing new Port facilities. However it was subsequently found to be not suitable for large-scale new construction because there is insufficient land, and there would be negative human impacts as city housing and other infrastructure is very close to the Port here.
E **Malku Bay** **(Photo III.5.3-1)**	Preferred (Positive Impact)	On existing Port land and land reserved for Port expansion. Presents an opportunity to clean up the most polluted sediments and polluting industry (ship repair). The extent of sediment contamination would need to be examined to determine whether it can be dumped at sea, or whether landfill may be needed.

Photo III.5.3-1 Potential Port Development Site E: Malku Bay and land on the eastern side, within the port boundary

Photo III.5.3-2 Potential Port Development Site D: Harbours and land around the Dane River

Photo III.5.3-3 Potential Port Development Site C: Reserved Port Territory around the Smeltale River, east of the Fishing Harbour

Photo III.5.3-4 Potential Port Development Site A: on the Western Side of the Ferry Terminal Peninsula

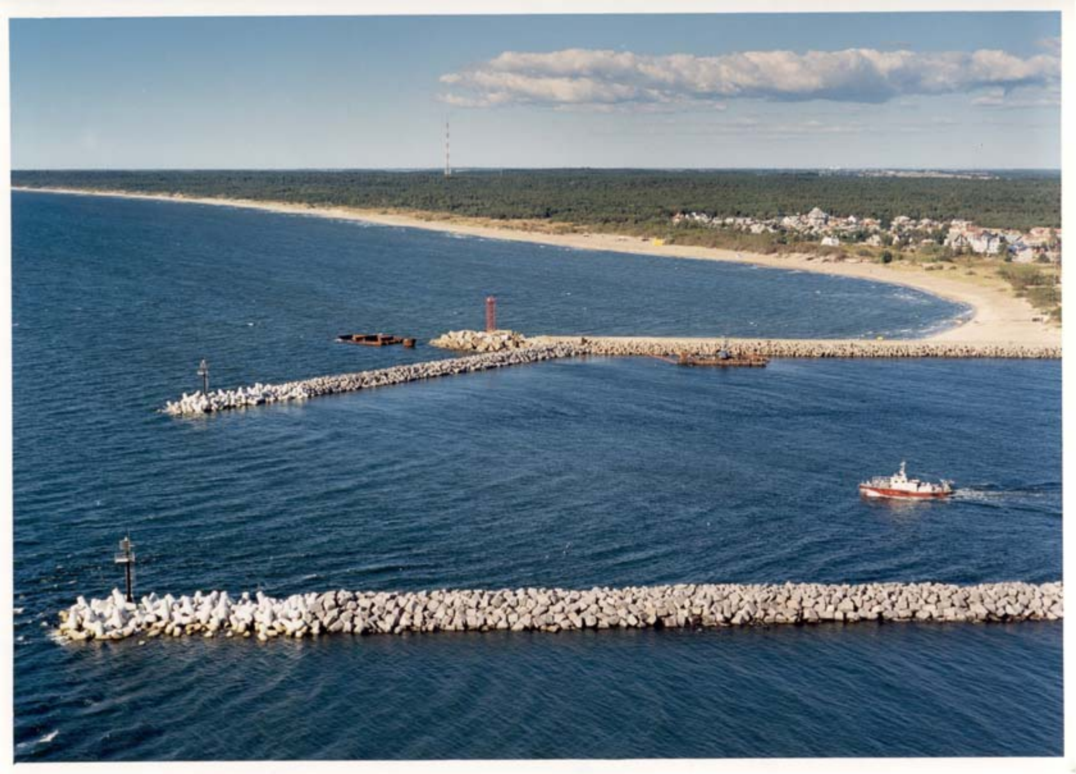


Photo III.5.3-5 Potential Port Development Site B: on the coast at Melnrage I

5.3.5 Selected Port Development Options

The above factors, and issues relating to the various other fields involved in a study of this type (economics, financial, engineering, planning, legal, etc) were taken into account in formulating the alternative approaches to developing the port. Seven options were proposed at three locations, and two others were included as possible future development zones because of their potential for providing significant environmental improvements. The options are summarised in Table III.5.3-3, which shows that they fall into four basic groups in terms of their location, purpose and the nature of the changes involved. Their main features are as follows:

Table III.5.3-3 Proposed Port Development Options

No	Name	Location	Main Features (approx dimensions)
A	Inner-Port New	West of Ferry Terminal	0.8 km^2 reclaimed area; 0.9 km^2 basin dredged to –14 m; 125 m wide approach channel west of Kiaules Nugara, dredged to –14 m; 5 or 6 berths at front of reclaimed area
B1	Outer-Port Alt. 1	Melnrage 1	1 km^2 reclaimed area; 2 km^2 basin dredged to –15 and –17 m, protected by breakwaters; approach channel dredged to –17.5 m; 6 berths. Options differ in dimensions of reclaimed area and layout of structures and facilities
B2	Outer-Port Alt. 2	Melnrage 1	
B3	Outer-Port Alt. 3	Melnrage 1	
D	Potential Future Development 1	Adjacent to Dane River	Removal of contaminated sediments in enclosed harbours; clean up of on-land contamination and facilities; removal of polluting industry; reallocation of land for cleaner uses
E	Potential Future Development 2	Western Ship Repair	
F	Inner-Port Rehab	Selected areas	Refurbishment of existing facilities; provision of new cargo handling and storage; may include extension of certain quay areas by reclamation

(1) Inner-Port New

- A single option, providing new Port facilities on new land to the west of the Ferry Terminal peninsula;
- A rectangular area of reclaimed land, approximately 0.8 km^2, with a 0.9 km^2 basin, dredged to –14 m BSL on its western side;
- A 125 m wide access channel west of Kiaules Nugara, dredged to –14 m, connecting the basin with the Port channel north of the ferry terminal;
- Road and rail access via extensions from facilities in the Port nearby;
- Five or six berths on the main frontage, for vessels of 12 m draught.

(2) Outer-Port

- Three options, providing new Port facilities on new land offshore of the beach at Melnrage 1;
- A rectangular area of reclaimed land, approximately 1 km^2, with a 2 km^2 basin to the north, dredged to –17 and –15 m;

- Approximately 3 km of rock or concrete breakwaters around the basin, opening into the existing Port access channel at the south-western corner;
- The 300 m wide access channel will be deepened to –17 and –17.5 m (offshore);
- Road and rail access via new routes, with bridges across nearshore areas if necessary;
- Six berths, for vessels of – 13 m and –15 m draught;
- Quayside facilities would include cranes, suction unloaders, conveyors, storage sheds, silos, rail marshalling yard and storage areas for containers;
- The three options differ in the dimensions and layout of the reclamation areas and quayside facilities.

(3) Inner-Port Rehabilitation

- Options to re-organise and rehabilitate where necessary existing stevedoring operations, in areas to be selected later in the Study;
- Will involve re-organisation of operations, provision of new handling and storage facilities where necessary, re-siting of structures, and provision of new road and rail access;
- May also involve removal of contaminated land and polluted channel sediment;
- Certain quayside areas may be extended into the channel by reclamation;
- The channel would also be deepened by dredging from –12.5 to –14.5 m between the KLASCO and Bega berths.

(4) Potential Future Development

- Two options, to clean-up and rehabilitate the two most polluted parts of the Port (Malku Bay and the harbours near the Dane River) and remove the most polluting industry (ship repair);
- Would involve dredged removal of contaminated sediment, followed by disposal at sea or landfill depending on degree of contamination;
- On-land action includes investigation and removal of contaminated land, and facilities, and operations that release significant pollutants;
- On completion new facilities would be provided and land would be re-allocated for cleaner uses.

5.3.6 Construction of Port Development Options

Precise details of the approach to constructing each option are not known at this early stage of development. However certain assumptions can be made, from a knowledge of how similar port expansion and refurbishment has been carried out elsewhere. This is described below, and the information is used in comparing potential environmental impacts of each option in the next section.

(1) New-Port Options

- Reclaimed areas will be delimited by bunds of rock brought by road from local quarries;

- Infill material will be sand, stone and aggregate from local quarries, although dredgings may be used if suitable; excess water will overflow back into the channel as the area is filled;
- Edges of the reclaimed area will be finished with reinforced concrete, or steel sheet-piles driven by hydraulic pile driver;
- After dewatering and compaction, the surface of the reclaimed area will be finished with concrete;
- Breakwaters will be of local or imported stone, or locally produced concrete tetrapods, tipped from trucks or barges and positioned by crane;
- Dredging will probably be by cutter suction, with material pumped into barges which overflow to increase the retained silt, prior to sea dumping.

(2) Rehabilitation Options

- The main channel and areas near the berths will be suction-dredged, and material will be dumped at sea;
- Any on-land contamination will be removed, and defunct buildings will be demolished, and waste material will be transported to a licensed landfill;
- New buildings and facilities, including rail access, will be built using local and imported materials, brought by road, rail and sea;
- At locations where the quayside is to be extended into the channel, steel sheet-piles will be driven into the bed by hydraulic pile driver to form the new berth frontage;
- Sand and aggregate will then be brought by road from local quarries and used for infill, after which the upper surface will be concreted.

(3) Potential Future Development Options

- Polluted harbours would be dredged by suction methods, or harbours may be closed off, dewatered and sediment pumped out from on land;
- Sediment will be dumped at the approved ground at sea, or transported by tanker to a purpose-built landfill if permitted pollution levels are exceeded;
- Contaminated land will be removed, buildings and facilities will be demolished, and material and refuse will be transported to landfill;
- Buildings and facilities for the new uses of the areas will be constructed, using local and imported materials, transported by road, rail and sea.

5.4 Environmental Impacts of Port Development Options

Before the options can be compared on the basis of their likely impacts on the environment, the types of impact that port developments can have needs to be established. The following account therefore describes the most common impacts associated with port developments at coastal and estuarine sites elsewhere, in the construction phase and when new facilities are operating.

This does not mean that these impacts will be produced by all or any of the options being considered by this Study. The actual impacts produced by a development depend on a variety of factors, in particular the specific nature, size and location of the development, and the nature of the environment in the vicinity. Impacts likely to be produced by each of the options are discussed in Section 5.4.3 below.

5.4.1 Potential Impacts of Port Developments: Construction

(1) Physical Environment

Creation of a large area of new land by reclamation at a coastal site or near the mouth of a river can have profound physical impacts. The new structure can change the natural processes of erosion, accretion and sediment transport, which create and maintain the natural morphology of the bed and the land/water interface. Structures built perpendicular to strong currents often interrupt sediment transport processes causing silt to collect on the upstream side, where the bed or intertidal area becomes wider and muddy from the accumulation of fine particles. In contrast on the downstream side the lack of sediment can cause severe erosion.

These impacts can be increased if reclamation is coupled with construction of large breakwaters, and particularly where there is extensive dredging, as this affects bed topography and alters currents. Changes in sedimentation patterns generally begin in the construction phase, when bunds are built around the reclamation area. They increase as dredging progresses and breakwaters are built, and may continue long after construction has finished.

Removal of materials used in construction (rock, sand, aggregate, etc) can have major negative impacts on the physical environment at the extraction sites, particularly if licensed quarries are not used. These are non-renewable materials, so amounts removed should be kept to a minimum by using dredged material for reclamation where possible. This has the further benefit of reducing sea dumping and providing a positive use for a waste material.

Port construction can also cause major changes in the physical appearance of the landscape, initially from the presence of site vehicles, vessels and machinery, which disturb views, and subsequently from the new permanent structures as they begin to develop. The main effect of these changes is on people and the enjoyment they gain from views of the landscape, so this is discussed with other aspects of the human environment below.

(2) Chemical Environment

Dredging can have major negative impacts on water quality, because the normal practice is to pump the extracted material into the hold of the dredger or a hopper barge, which is allowed to overflow to reduce the water content and increase the retained sediment, before the vessel travels to the dumpsite. Overflow water is normally very high in suspended solids, which reduces light penetration, irritates fish and other marine organisms, which then avoid the area, and makes water unattractive for swimming and watersports. It can also increase pollution levels if the dredged sediment is contaminated, as the chemicals re-enter the water column.

Reclamation can have similar effects because water is normally allowed to overflow from the bunded area into the water body as infill is added. This creates plumes of turbid water, which can contain chemicals if fill material is polluted. Reclamation can also increase pollution levels if the new structures cause areas of contaminated sediment to erode.

Another potential source of chemical pollution at construction sites is from spillage of site materials, such as fuel, oil and detergents, if these are not properly used and stored. This can be avoided relatively easily by storage in closed drums in bunded areas, and by implementing routine controls on their usage.

(3) Ecology and Nature Conservation

Reclamation and the creation of breakwaters and other structures can have significant ecological effects if large numbers of benthic organisms (living in or on the bottom sediment), are covered and destroyed. Such impacts are more significant if any of the affected species are rare, or if they are important for other reasons, such as being used as food by commercially exploited fish. Dredging can have similar impacts, as few organisms are able to survive being pumped into the dredger with the extracted sand. Dredged areas therefore become devoid of organisms, although this is temporary as the benthos normally re-colonises by settlement of larvae from the plankton in a few years.

Fish can be affected by dredging and aquatic construction if they, or organisms they feed on, avoid turbid water because of the irritation caused by suspended sediment. They can also avoid areas because of the disturbance caused by noise, vibration or movement in the water, although conversely some fish can be attracted to marine structures by the cover they provide. Dredging and construction in rivers or marine channels can impede migration in those fish that have to travel between rivers and the sea at different stages in their life cycle. This can be critical if the migration is related to breeding, as it can affect the overall stock of rare or commercially important species. Stocks can also decline if dredging or reclamation destroys areas used as spawning, feeding or nursery grounds and the fish have to move to less suitable areas.

Aquatic and terrestrial birds living near a construction site can be disturbed by the noise and visibility of vehicles, workers and other activities, and this can be very significant if it occurs during breeding periods, at critical feeding times in winter, or if it causes birds to leave an area. Birds can also be affected if the construction covers important feeding or nesting habitat, which for aquatic species is often in intertidal areas or at the edges of lakes and rivers.

Areas that are important for nature conservation are normally designated by law, which confers protection, the scale of which depends on the importance of the area and the species and habitats it contains. The protection defines activities that are permitted and/or prohibited within the boundary, and the latter often includes construction projects. Designations associated with areas of national and international importance can also prohibit development close to protected sites, if it could damage species and habitats in the designated area. Impacts can include destruction of habitats and species, or indirect loss, such as could arise from changes in erosion and accretion patterns. Animals can also be disturbed by site activities and noise, which can affect breeding success or alter distribution patterns.

(4) Human Environment

A large construction project can have a variety of impacts on people who live and work nearby, and these can include:

- Disturbance by noise from the construction site, by dust produced during dry weather, and by the visual impacts of lorries, machinery and the structures that change the landscape as they are built;
- Disruption of normal activities by the presence of increased traffic on local roads, and by loss of access to areas in and around the site;
- Loss of land if this has to be purchased at the site, or where access roads are constructed.

Land acquisition is generally not a key issue for port projects as the bed of aquatic areas and existing port land are normally owned by the State. If privately owned land does have to be obtained, this should be achieved amicably through negotiation and payment of fair prices, to avoid generating public opposition to the scheme. Acquisition of land and property can become a highly emotive issue if land required for a port development is inhabited, and residents or even communities have to be relocated. The best practice is to avoid this situation by careful site selection, but if relocation is necessary then this should be achieved through extensive open consultation with those affected, and development and implementation of a mutually agreed resettlement plan that involves relocation to an acceptable area, provided with improved housing and infrastructure.

Although construction phase impacts are temporary and therefore of generally less significance than the permanent impacts of completed structures, port projects are often large, and if construction takes several years then even temporary impacts can become highly significant. One of these is the transportation of material used in reclamation and to construct extensive breakwaters, if it is carried by road. Communities living alongside the route can be repeatedly exposed to increased noise, dust and air pollution from heavy lorries, delicate buildings can be damaged by vibration, and traffic and normal activities are disrupted by large increases in heavy traffic over long periods.

The presence of a construction site can also mean that people are unable to visit areas to conduct their normal activities, and at coastal and estuarine sites this often relates to leisure pursuits such as swimming, sunbathing, boating and fishing. This is a temporary impact and is generally not greatly significant as these activities can be carried on nearby, or in aquatic areas elsewhere. If construction is in or near an existing port, then careful planning is required to ensure that vessel movements and other port operations are not impeded by activities at and around the site, and that safety is maintained at all times.

Many site activities can produce noise and dust, but the main sources are pile driving and reclamation respectively. Although both are temporary and normally occur for a period of months only, impacts could be significant if the site is located close to areas where people live or work, or areas important for nature conservation. In such situations noise barriers can be erected around the site, dusty areas can be sprayed with water in dry weather, and other precautions can be taken, such as prohibiting pile driving during the night and at weekends.

Visual impacts of construction activities are both temporary and permanent. Views of the landscape are disturbed by construction lorries, vessels, cranes and heavy machinery, but these impacts cease when building work finishes. However the landscape begins to change permanently as structures are built, and the changes increase as the scheme progresses.

Where a new development is built at an existing port site, impacts of construction activities on the landscape are not normally significant because they occur against a backdrop of busy industrial activity, where any additional visual disturbance would not be noticed. However if construction is at a greenfield site, visual impacts can be highly negative, particularly if they occur in an area of scenic beauty, which coasts and estuaries frequently are. If the development is prominent at such a location it may be difficult or impossible to make the site appear less obtrusive, as visual screens can impede natural views, and artificial barriers or even natural screening by earth banks or trees are out of place in an aquatic landscape.

Port construction can also have positive impacts on the human environment by providing opportunities for local people to be employed in the construction workforce, and for local businesses to supply goods and services. This provides at least temporary improvements in socio-economic conditions and may stimulate the economy, and these benefits can increase if greater opportunities develop when the port begins to operate.

5.4.2 Potential Impacts of Port Developments: Operation

(1) Physical Environment

The operational phase of a new port development extends over a much longer period than construction, so there is a greater likelihood that the morphological changes described in Section 5.4.1 may occur. Over time silt can gradually build up on one side of port structures, and adjacent beaches or mudbanks can become wider. The nature of the bed can change as well, as the settling particles tend to be fine and high in organic content, so at coastal sites beaches can become muddier. Areas elsewhere can erode if the retention of material by the new structures significantly decreases sediment supply downstream.

The presence of the port structures can also cause major changes in the landscape, and again this is discussed with other impacts on the human environment below.

(2) Chemical Environment

Many of the activities carried out in an operating port can affect chemical conditions in the environment. These include:

- Cargo handling: hazardous materials can be spilled onto land and water and released into the air;
- Fuel loading: oil can be spilled on land and into the water;

- Cargo storage: dry bulk materials can create dust, and liquids can leak onto land and water;
- Ship manoeuvring: collisions and other accidents can release fuel and cargo.

These can have significant impacts on water, air and aesthetic quality within the port and in areas nearby, which would be highly negative if they affected nature conservation sites, inhabited areas, or locations used for recreation, fish farming or other purposes. However modern ports normally minimise such incidents by using state-of-the-art cargo handling and storage facilities (suction unloaders, enclosed conveyors, silos with dust extraction), applying strict operational procedures designed to reduce environmental impacts, and developing oilspill contingency plans and other pollution treatment measures.

(3) Ecology and Nature Conservation

Operating ports can have negative ecological impacts if they release pollutants into the air or water as noted above, but this is normally avoided by the various preventative measures, so these impacts are relatively rare.

As ports are mainly located on coasts or estuaries, they are often near nature conservation sites, particularly those that are important for waterbirds. Disturbance by noise and movement of vessels, vehicles and machinery is therefore an issue, as if birds are disturbed during winter feeding times they can have difficulty surviving cold periods, and excessive disturbance can also cause birds to leave an area permanently. This needs to be avoided by careful siting of operations within the port, and inclusion of screening measures in the design if necessary.

Ports frequently have to be dredged to maintain the depth of access channels and basins, and this can then produce the temporary impacts described in Section 5.4.1 above. These include the following:

- Benthic organisms inhabiting dredged areas are removed and destroyed;
- Fish, or species they feed on may avoid areas affected by plumes of turbid water, so distribution patterns can be changed;
- Fish may be prevented from migrating between rivers and the sea by the presence of the dredger and turbidity plumes;
- Areas affected by turbidity plumes can become low in productivity because reduced light penetration inhibits plant photosynthesis;
- Aquatic organisms can be exposed to pollution if dredged areas are contaminated;
- Birds in areas nearby can be disturbed during key times, such as winter feeding, breeding or nesting.

Given that dredging is rarely an urgent activity, many of these impacts can be avoided by careful planning to ensure that the operation is not carried out at critical times of fish migration, bird breeding, etc. Other impacts like the loss of benthic organisms and changes in the distribution of fish are normally temporary, and the ecosystem recovers within a relatively short time after the dredging ceases. Impacts can be significant however if they cause changes in the stocks of rare or commercially exploited fish, species that are eaten by fish or birds, or organisms that are important for other reasons.

Ports can also confer certain ecological benefits, by providing:

- Increased habitat diversity in the form of concrete quaysides and rock breakwaters, which will be colonised by different species than the soft sediments that normally dominate aquatic areas;
- Protected water in the harbours and enclosed basins, which can be used as nursery areas where young fish grow into adults, if the water is unpolluted.

These benefits can be significant if they result in increases in stocks of fish or other important species.

(4) The Human Environment

The purpose of expanding a port is normally to bring economic benefits at national level by attracting increased trade, which provides improved income for the Government. This might then confer benefits on people throughout the country, if new revenues are spent on social projects, providing improved healthcare, public education, transport, etc, or used to encourage business expansion and other investment that generates employment.

There can also be improvements in the human environment in the vicinity of a new port, as it provides increased employment, which improves socio-economic conditions and can stimulate the local economy. Where the new port is large and successful, or if it is located in a socially disadvantaged area, the long-term economic benefits can be very significant at a local level.

There can also be negative impacts, of which changes in land use and landscape can be the most important. As with impacts of the construction process, long-term changes in these features are not normally significant when the development is sited within an existing port, as the new activities are absorbed into the overall industrial character of the area. However if the development is located at a greenfield site, particularly an area regarded for its scenery, these changes can be very negative indeed.

A new port development can be very visible and obtrusive in an otherwise natural and unspoilt coastal or estuarine landscape, as the eye is inevitably drawn to the unnatural feature. It can be difficult or impossible to make the structure less obvious, as screening by even natural materials such as trees, can be out of keeping in a seascape. Changes in land use can also be very negative if an area that was heavily used for recreational pursuits is no longer suitable or attractive for such purposes because of the presence of the new industrial site.

In determining the significance of such impacts, important considerations should be:

- Whether the area is recognised for the beauty or importance of its landscape by being subject to national or international designation or protection;
- The number of visitors the area receives, whose enjoyment of the landscape would be decreased by the presence of a new port;
- The distance over which the changes can be seen, which can be considerable at coastal sites because of the lack of natural barriers;
- Impacts on the local economy if visitor numbers were to decline.

Such considerations need to be evaluated against the benefits to the human environment that a new port development can bring, by generating trade, employment, and social and economic improvements.

5.4.3 Environmental Impacts of Proposed Port Development Options

This section assesses the broad environmental impacts that each of the four main options proposed in this Study (shown in Table III.5.3-3) could have, based on the information about each that is currently available. Selected options will be developed further in subsequent stages of the Study and this could alter certain details of the assessment. However the options are unlikely to change radically, so the major impacts and overall conclusions presented below should remain valid.

Table III.5.4-1 lists the main impacts that port developments at coastal and estuarine sites can have, as discussed above. It then considers whether the impacts would occur during construction and operation of each of the four types of option proposed in this Study, and whether the impact would be significant. This is explained in words in the table, and indicated via a coloured key. This assessment is explained further in the following section.

(1) Inner-Port

Creation of a 0.8 km^2 area of new land, with associated breakwaters and rock protection would require large quantities of sand, stone and aggregate. There could therefore be major physical impacts at the extraction site, which should be avoided by obtaining material from several locations, ensuring that all are licensed quarries, and considering importation of material from other countries where feasible and cost-effective. The construction process would produce major physical changes at the site itself because the reclaimed area is perpendicular to the main currents, a great deal of dredging would be required to lower the bed from 2-5 m below BSL to -14 m in the basin area, and the edges of the channel and Kiaules Nugara are natural mud and reedbeds, with no stone protection. These areas might therefore erode, which could be very significant in time because of their ecological and aesthetic importance.

The large dredging and reclamation operations would create substantial plumes of turbid water, which would affect large parts of the channel and lagoon, and this could be significant given potential impacts on migrating fish and the appearance of the water. A deep basin relative to the surrounding area will require regular subsequent dredging when the port is operating, but this will involve less material than the original work, so plumes will be smaller and less significant. Given the importance of the surrounding area for both ecology and recreation, strict procedures to prevent spillage of chemicals will be required during both construction and operation.

The benthos of the area does not include rare species, so direct losses from dredging and reclamation should not be significant. The completed port would deliver some ecological benefit by increasing the amount of hard substrate and associated species, and providing an area of protected water that may be used by fish as a nursery. Table III.5.4-1 shows however that other ecological impacts could be very negative:

- The amount of dredging and the fact that it will extend into the narrow channel west of Kiaules Nugara, may discourage fish from migrating, which would be significant if it affected stocks;

Table III.5.4-1 Main potential environmental impacts of proposed port development options

	IMPACT	INNER-PORT		OUTER-PORT		POTENTIAL FUTURE		REHABILITATION	
		CONSTRUCTION	OPERATION	CONSTRUCTION	OPERATION	CONSTRUCTION	OPERATION	CONSTRUCTION	OPERATION
PHYS	Changes in erosion and sedimentation patterns	May occur: channel is narrow, muddy	Could affect Spit and Kiaules Nugara	Weak drift currents. Changes not likely	Changes could occur over time	Small changes from harbour dredging	Small change: silt settles in harbours	Small reclamation and dredging	Small changes from channel dredging
PHYS	Physical changes at materials extraction site	Needs large amount of rock and infill	Not Relevant	Needs large amount of rock and infill	Not Relevant	Small amounts of building materials	Not Relevant	Small amounts of building materials	Not Relevant
CHEMICAL	Dredging: Turbidity plumes, re-suspended pollutants	Large quantity, mud, strong current	Will need frequent dredging	Significant if plume affects beaches	Avoid dredging in summer	Highly polluted. Must contain plume	Removes polluted sediment, industry	Channel is not heavily polluted	Small maintenance dredging in future
CHEMICAL	Reclamation: Turbid plumes, re-suspended pollutants	Overflow from large reclamation	Not Relevant	Large area. Plume must avoid beaches	Not Relevant	Not Relevant	Not Relevant	Small reclamation	Not Relevant
CHEMICAL	Pollution from spillage of fuel, chemicals or cargo	Must avoid. Spit & lagoon vulnerable	Must avoid. Spit & lagoon vulnerable	Must avoid damage to beaches and Spit	Must avoid damage to beaches and Spit	No vulnerable areas nearby	Must avoid future pollution	No vulnerable areas nearby	Improved facilities: reduced pollution
ECOLOGY	Benthos: removal by dredging and reclamation	Large areas, but no known rare species	Frequent dredging, but no rare species	Large areas, but no known rare species	No known rare or important species	Few inhabitants in polluted harbours	Little dredging in future	No rare/important species in channel	No rare/important species in channel
ECOLOGY	Fish: impeded migration, loss of breeding or feeding grounds	Large construction in a narrow channel	No known effect of present port activity	Dredging avoids key migration times	Operational area is outside channel	No major works in channel	No known effect of normal port activity	Dredging will avoid key periods	No known effect of normal port activity
ECOLOGY	Birds: decreases from disturbed breeding or feeding	Kiaul Nugara, Spit reedbeds very close	Kiaul Nugara, Spit reedbeds very close	No important bird sites nearby	No important bird sites nearby	No important bird sites nearby	No important bird sites nearby	No important bird sites nearby	No important bird sites nearby
ECOLOGY	Damage of habitats or species in or near protected areas	More saline water will enter lagoon	Edge of spit and island could erode	Unlikely to affect protected areas	Unlikely to affect protected areas	No important habitats nearby	No important habitats nearby	No important habitats nearby	No important habitats nearby
ECOLOGY	Increased habitat/biodiversity; fish nursery in protected water	Disturbance will deter colonisation	Should increase fish and benthos	Disturbance will deter colonisation	Should increase fish and benthos	Dredging will deter colonisation	Should increase fish and benthos	No new aquatic habitat	No new aquatic habitat
HUMAN	Need to acquire land, property and/or relocate residents	Some land needed for facilities	Not Relevant	Some land needed for road & railway	Not Relevant	No new land required	Not Relevant	No new land required	Not Relevant
HUMAN	Disruption and disturbance by transport of materials & cargo	No major settlement nearby	No major settlement nearby	Major disturbance at Melnrage	Ongoing Melnrage disturbance	Avoid disturbing port, landfill route	Normal operation, so no disturbance	Avoid disturbing port, landfill route	Normal operation, so no disturbance
HUMAN	Disruption of normal activity through loss of access to site	Site is not used at present	Site is not used at present	Temporary loss of recreation area	Permanent loss of recreation area	Present operators removed amicably	New non-polluting operations installed	Planning will avoid disrupting port	Improved operation and environment
HUMAN	Disturbance by noise and dust	No inhabitants nearby	No inhabitants nearby	Likely to disturb Melnrage residents	Some noise will be heard at Melnrage	Increases not noticeable in port	Should not increase above normal level	Increases not noticeable in port	Improved operation will reduce levels
HUMAN	Visual disturbance, permanent changes to landscape	Activities blend into port landscape	Port landscape moves into lagoon	Site visible along coast and Melnrage	Site visible along coast and Melnrage	Activities blend into port landscape	New facilities will improve port scene	Activities blend into port landscape	New facilities will improve port scene
HUMAN	Increased employment and improved socio-economics	Jobs available in local workforce	Improve trade, jobs national economy	Jobs available in local workforce	Improve trade, jobs national economy	Jobs available in local workforce	Little change in numbers of jobs	Jobs available in local workforce	Little change in numbers of jobs
	MITIGATION	Significant economic and social benefits but difficult to avoid negative effects on Kiaules Nugara, National Park & Lagoon		Significant economic and social benefits but changes in landscape and disturbance in Melnrage will be highly detrimental		Major environmental benefits from removal of polluted sediment and industry		Few impacts. Some environmental benefits from improving operations and facilities	
	CONCLUSION	Not acceptable because of potential impacts in and near protected area		Not recommended, but economic benefits may outweigh negative landscape impacts		Recommended because of major improvements in port environment		Acceptable. No major benefits or adverse impacts	

KEY: Highly Negative (red) · Negative (yellow) · Not Significant (white) · Positive (green) · Highly Positive (blue)

- Birds in nearby shallows and reedbeds could be disturbed during both construction and operation, which could be significant if it occurred in critical breeding or feeding periods;
- If the edges of the waterway erode, this would affect reedbeds, fish nurseries and bird feeding areas in and near the National Park;
- Dredging would allow more saline water into the lagoon, causing highly negative changes to its fragile and important ecology by removing present inhabitants and allowing marine species to colonise from the Baltic.

In terms of the human environment this scheme will have few negative impacts during construction or operation, because the site is not close to inhabited areas or parts of the port where there are large numbers of workers, so few people will be disturbed by site activities. The change in appearance of the area may be considered to be negative as it brings the industrial port landscape farther into the lagoon, where the scenery is remote and natural. Like the other large-scale option (outer-port), this scheme should have major benefits by increasing national trade and Government income, and providing increased employment and improved social conditions locally.

(2) Outer-Port

The outer-port development involves a similar amount of reclamation and dredging to the inner port option, but will create much larger breakwaters to provide protection from the strong wave action. Multiple sourcing from licensed quarries and importation of material where feasible will therefore again be required. The mouth of the channel is at the boundary between two sediment cells and there are no strong currents transporting material. It is unlikely therefore that even the substantial dredging or structures would cause significant changes in coastal morphology.

The dredging would create large plumes of sediment, but these would only be significant if they affected recreational beaches in the summer, and simple planning can avoid working during this period. Similar action would ensure that overflow from the reclaimed area also did not have significant impacts. As with other options spillage of chemicals will be prevented by strict operational practices, and this will be very important when the port is functioning, to prevent pollutants affecting the popular beaches to the north and south.

Table III.5.4-1 shows that there should also be no major ecological impacts, because:

- The benthos includes no rare or particularly important species;
- The main port area will be located to the north of the channel, so providing dredging avoids key periods, fish migration should not be affected;
- Although the National Park boundary is 1 km to the south, this is mainly a tourist area and is not important for birds or other species.

Like the inner-port this option will provide hard surfaces that will be colonised by new species, and fish may use the protected basin as a nursery.

Although the outer-port could be built and operated without major impacts on ecology or physical and chemical conditions, Table III.5.4-1 shows that there would be major negative impacts on the human environment. These include:

- Disturbance of Melnrage residents if construction materials are transported by road, and exposure to noise in the long-term from the operating port;
- Loss of a recreation area used mainly by local people, as even if the beach is not developed, visitors would be deterred by the presence of the port;
- Severe deterioration of the coastal landscape, visible over a long coastline, which includes Lithuania's most popular beaches on the Curonian Spit;
- Impacts on the local economy if visitor numbers decrease.

This option would however provide significant economic benefits at both a local and national level, because it is the largest facility, with the greatest potential to attract new trade and generate increased Government revenue, and to produce new employment opportunities locally.

(3) Inner-Port Rehabilitation

The inner-port rehabilitation options involve mainly reorganisation and refurbishment of yards that are currently in operation. Although these have not yet been identified it is likely that the improvements will involve some demolition of existing on-land facilities, and some new building. Plans could also include small-scale reclamation to extend certain berths a few metres into the channel, and dredging to increase the depth of the main channel from –12.5 to –14 m between KLASCO and Bega.

The dredging and reclamation should not cause major physical impacts because they are much smaller in scale than the operations involved in the inner- and outer-port developments, and will occur in the main port area where the channel is protected by hard surfaces on both banks. Extraction of material for new building and reclamation should also not have major impacts, providing licensed quarries are used.

The reclamation and dredging should not produce significant chemical impacts because of the small scale of the operations and the fact that sediment in the main channel is not heavily polluted. On completion the refurbishment should improve chemical conditions in and around the port by providing up-to-date facilities and equipment for cargo handling and storage, with modern and effective pollution prevention and control mechanisms.

There should also not be significant ecological impacts. Dredging will be planned to avoid key fish migration periods, as required by the MoE, and as these locations are in the main port area there are no important or protected sites nearby where birds or other animals could be disturbed, during construction or operation of the facilities. Unlike other options, refurbishment will not provide ecological benefits, because no new harbours will be created, and the new edge of any reclaimed areas will be colonised by similar species as are currently attached to the existing quayside.

Table III.5.4-1 shows that there should also not be any negative impacts on the human environment. The refurbishment will be planned to ensure that it does not impede normal port operations or disturb those parts of the city in the vicinity, and the limited amount of demolition and new building should ensure that dust and noise levels are not raised above background. Visual disturbance should also not be significant when viewed from the port, channel or even the city, because construction activities and the new facilities will be seen against the normal port background.

These options will produce positive impacts on the human environment, by providing a cleaner, more modern port and working environment, and generating new employment opportunities. However as the changes are less extensive than those of the other options, both types of benefit will be less significant.

(4) Potential Future Development

These options would involve no major construction in the channel, although there would be physical changes in the enclosed harbours which will be dredged to remove polluted sediment. The harbours should be sealed to prevent escape of pollutants, after which fine material will re-settle over time when the entrances are re-opened. On-land refurbishment will include removal of contaminated land and replacement with clean soil, but these will be small quantities, so physical changes will not be significant.

If the harbours were not sealed there would be major chemical impacts from escape of contaminated material, so effective closure during the dredging operation is a priority. Industries that have produced the contamination should also be removed, and together these actions will deliver a much cleaner, significantly improved port environment. It will be very important to maintain these conditions with effective pollution prevention measures and strict controls on operations in the future.

If no contaminated material enters the channel then the only impacts on ecology from these options should be beneficial. Dredging will not destroy significant aquatic organisms as the harbours are largely devoid of life. Fish migration will not be impeded as there will be no major construction in the channel and little future dredging, and the harbours are in the heart of the port, so there are no sites or protected areas nearby where birds or other animals can be disturbed. Cleaning the harbours will provide ecological benefits as they will be re-colonised by invertebrates and may also be used as nursery areas by fish.

As far as the human environment is concerned it would be important to negotiate the amicable departure of companies presently occupying these sites, well before the termination date of their current agreements. Careful planning would also be needed to ensure that port operations are not disrupted by the refurbishment activities, and that people living nearby are not disturbed by lorries carrying demolition material to landfill. The refurbishment will produce noise, dust and visual disturbance for short periods, but this will not be significant in the normal port environment. On completion these areas will be unpolluted, with modern equipment and facilities, providing a significantly improved working environment and landscape. These options will not bring the economic improvements at national level expected of the larger port developments, but there should still be increased employment opportunities locally.

5.4.4 Conclusions

The above assessment shows that there are clear preferences between the four main types of option based on the environmental impacts they are likely to produce. These preferences and their reasons are summarised below.

- The Inner-Port Rehabilitation options would be acceptable on environmental grounds;

- They will not have major adverse impacts when the facilities are reorganised and refurbished, and the upgraded equipment and operations will provide a cleaner, more modern port and working environment;
- Potential Future Development is the option that is preferred on environmental grounds;
- This is because it would remove the three most heavily polluted areas of sediment in the port (in the Laivite, Baltija and Malku Bay harbours), and the industries responsible for producing much of the contamination in the past (shipbuilding and repair);
- This will remove the main sources of pollution in the port and substitute new operations that are less environmentally damaging, equipped with modern facilities and pollution prevention methods, which will significantly improve the port environment;
- If this option is selected it will be essential to seal the harbour entrances when the sediment is removed, to prevent contaminated water or sediment escaping and polluting the main channel;
- The Inner-Port New option would not be acceptable on environmental grounds because of the negative ecological impacts it is likely to produce;
- The large amount of dredging south of the existing port area would allow more saline water to enter the lagoon, causing highly negative changes to its fragile and important ecology by removing present inhabitants and allowing marine species to colonise from the Baltic;
- Major dredging and reclamation in a narrow channel could also cause erosion of adjacent banks and the muddy channel bed, which could affect important habitats in and near the Curonian Spit National Park, including reedbeds, fish nurseries and bird feeding areas;
- The Outer-Port option would not be recommended on environmental grounds, mainly because of the highly negative impacts it would have on the landscape by converting an area of natural Baltic coast used for recreation by local residents, into a large, industrial port;
- A new port at this location would be highly visible in the nearby village of Melnrage, on beaches to the north, and on the very important beaches on the Curonian Spit, an area which has been designated as a National Park and UNESCO World Heritage Site because of the beauty of its landscape;
- It is difficult to envisage how such a development could be made less obtrusive, as screening would impede sea views, and even use of natural materials such as trees would not be in keeping with a coastal landscape;
- Visitors to the Curonian Spit make a significant contribution to the local economy, so there could be further negative impacts if numbers were to decline;
- Decisions as to whether to propose this option should also consider the benefits that a major new port could bring, by increasing trade and Government revenue, which could provide improvements in social and economic conditions throughout the country;

- A new port would also generate employment opportunities locally, which could improve social conditions and stimulate the economy of Klaipeda.

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