Maritime Institute in Gdańsk

Department of Maritime Hydrotechnics

Environmental Impact Assessment of the investment:

"Disposal of the dredge spoil from the dredging works to the sea from the water bodies constituting water areas of the harbor of Szczecin and Świnoujście Seaport Authority S.A."

Investor: Szczecin and Świnoujście Seaport Authority S.A. (ZMPSiŚ S.A.)

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1. INTRODUCTION

1.1. Subject and scope of EIA

The subject of the report is environmental impact assessment for the project involving removal of the dredge spoil to the sea from dredging of the water bodies constituting water areas of the harbor of Seaports Authority S.A. connected with construction of the quay for reloading LNG in the external port in Świnoujście.

The project under this EIA is located offshore the Pomeranian Bay to the east of the estuary of the Świna River and existing east breakwater.

The scope of the designing works covers the following:

- dredging works on the water body from the port turntable to shielding breakwater on the length of the LNG cargo handling position and the position of the water intake. The depth of the water body is -14.5 m (the position of mooring the vessel) and -12.5 m (other areas);
- designation of potential sites for spoil excavated from dredging works.

The purpose of this EIA is to identify significant environmental impacts associated with construction and operation of the proposed project and identify actions minimizing negative impacts on the environment and historical monuments.

This said EIA has been drawn up fully in compliance with art. 66 of the Act as of 3rd October 2008 on providing information on the environment and its protection, participation of the public opinion in environmental protection and environmental impact assessments (Journal of Laws of 2008 No. 199, item. 1227):

- - investment impact on the environment,
- - investment impact of projects on Natura 2000 sites.

1.2. Project classification

According to the Regulation of the Minister of Transport and Construction of 26th January 2006 on the procedures for issuing permits for disposal at sea of dredged spoil and the dumping at sea of waste or other substances (Journal of Laws of 2006, No. 22, item 166), it is required to assess the impacts of the project involving the disposal of dredged spoil at sea from dredging of the bottom on the marine environment.

Furthermore, investment consisting of the construction of quay in the external port in Świnoujście was classified in accordance with § 2. 1 pt. 32 of the Regulation of Council of Ministers on the types of enterprises that, may significantly affect the environment and specific conditions for qualifying projects to draw up the environmental impact assessment (Journal of Laws, No. 257, 2004, item 2573, as amended) as a project likely to significantly affect the environment for which it is required to draw up environmental impact assessment.

Regional Director of Environmental Protection in Szczecin with their decision of 18th June 2009, No. RDOŚ-32-WOOŚ-6613-5-7/08/at corrected with decision of 10th December 2009 No. RDOŚ WOOŚ.T.Ś-6613/5-12/08/at defined environmental constraints of approval for the implementation of a project entitled "Construction of the quay in the outer port of Świnoujście."

1.3. Formal-legal bases

- Council Directive 1976/160/EEC of 8th December 1975 on the water quality at public beaches (Journal of Laws, EC L 31, of 05.02.1976);
- Council Directive 79/409/EEC of 2nd April 1979 on the conservation of wild birds (Journal of Laws EC L 103 of 25.04.1979);
- Council Directive 91/244/EEC of 06.03.1991 amending Directive 79/409 EEC of 2nd April 1979 on the conservation of wild birds (Journal of Laws EC L 115 of 08.05.1991);
- Council Directive 91/689/EEC of 12th December 1991 on hazardous waste (Journal of Laws EC L 377 of 31.12.1991; L168 of 02.07.1994);
- Council Directive 92/43/EEC of 21st May 1992 on the conservation of natural habitats and of wild fauna and flora (Journal of Laws, EU Environment section, protection of consumers and health, Volume 02, page 102) Appendix II, IV and V;
- Council Directive 97/11/EC of 3rd March 1997 amending Directive 85/337/EEC on assessment of the effects of certain public and private projects on the environment (Journal of Laws EC L 73 of 14.03.1997; Journal of Laws EC L156 of 25.06.2003);
- Council Directive 1999/31/EC of 26th April 1999 on waste storage;
- European Parliament and Council Directive 2000/60/EC of 23rd October 2000 establishing framework for community activities in the field of water policy (Journal of Laws EC 327 of 22.12.2000);
- European Parliament and Council Directive 2004/35/EC of 21st April 2004 on liability for environment with regard to the prevention and remedying damage to environment (Journal of Laws EC L 143/56 of 30.04.2004);
- European Parliament and Council Directive 2006/12/EC of 5th April 2006 on waste.

- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Substances as of 29th December 1972;
- Convention on the Protection of World Cultural and Natural Heritage (Paris Convention), ratified in 1976 (Journal of Laws of 1976 L No. 32, p. 190);
- Convention on the Conservation of European Wildlife and Natural Habitats ("Bern Convention"), as of 19th September 1979 (Journal of Laws as of 1996, No. 58, p. 263);

- Convention on Environmental Impact Assessment in a Transboundary Context prepared in Espoo (Finland) on 25th February 1991. Governmental Statement on the ratification of the Convention by the Republic of Poland of 24th September 1999 (Journal of Laws, No. 96 of 1999, p. 1111);

- Convention for the Protection of the Marine Environment of the Baltic Sea, prepared in Helsinki on 9th April 1992 (Journal of Laws of 2000, No. 28 p. 346) (Helsinki Convention);

- Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhaus Convention), ratified by Act of 21st June 2001 (Journal of Laws of 2001, No. 89, p. 970);

- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), ratified in 1996 (Journal of Laws of 2003 No. 2, p. 17);

- Stockholm Convention on permanent organic pollutants (ratified: Journal of Laws of 2008, No. 138, item 864);

- HELCOM Guidelines for the Disposal of Dredged Material at Sea – adopted in June 2007 and Form and Reporting on Disposal of Dredged Material at Sea – approved by Helcom Monas 9 in October 2006;

- International convention on preventing the sea pollution by vessels (Marpol 1978, 1997) (Journal of Laws, No. 17, item 101);

- Agreement on the Conservation of Small Cetaceans of the Baltic and North Sea, done at New York on March 17, 1992 (Journal of Laws of 1999, No. 96, item 1108);

- Act on marine areas of the Republic of Poland and the maritime administration as of 21st March 1991 (consolidated text, Journal of Laws of 2003 No. 153, p. 1502 as amended);

- Act on Building Law of 7th July 1994 (consolidated text, Journal of Laws of 2006 No. 156, p. 1118, as amended);

- Act of 16th March 1995 on the Prevention of Pollution from Ships (consolidated text, Journal of Laws of 2006, No. 99, item 692);

- Act on the state of the natural disaster as of 18th April 2000 (Journal of Laws as of 22nd May 2002);

- Act on Environmental Protection Law as of 27th April 2001 (consolidated text, Journal of Laws of 2008 No. 25, p. 150);

- Act on waste as of 27th April 2001 (consolidated text, Journal of Laws of 2007, No. 39 p. 251);

- Act on water law as of 18th July 2001 (consolidated text, Journal of Laws of 2005, No. 239 p. 2019, as amended);

- Act of 27 July 2001 on implementation of the Act - Environmental Protection Law, the Act on waste and amending certain acts (Journal of Laws of 2001, No. 100 item. 1085, as amended);
- Act on planning and spatial development of 27th March 2003 (Journal of Laws of 2003, No. 80 p. 717, as amended);
- Act of 27th March 2003 amending the Act on Building Law and other acts (Journal of Laws of 2003, No. 80, item 718);
- Act as of 28th March 2003 on establishing long-term programme "Sea shores protection programme" (Journal of Laws of 2003, No.67, item 621);
- Act on the protection of historic monuments of 23rd July 2003 (Journal of Laws of 2003, No.162 p. 1568, as amended);
- The Act on Nature Conservation as of 16th April 2004 (Journal of Laws of 2004 No. 92, p. 880 as amended);
- Act on the prevention of environmental damage and its repair of 13th April 2007 (Journal of Laws of 2007 No. 75, p. 493);
- Act on emergency management as of 26th April 2007 (Journal of Laws of 21st May 2007);
- Act on Access to Environmental Information and its protection, society participation in environment protection and environmental impact assessments as of 3rd October 2008 (Journal of Laws of 2008 No. 199 p. 1227);
- Act amending the act on the nature conservation and some other acts as of 3rd October 2008 (Journal of Laws as of 13th November 2008);
- Act on investments involving the LNG terminal in Świnoujście of 24th April 2009 (Journal of Laws of 2009, No. 84 item 700);

- Regulation of the Minister of Transport and Maritime Economy of 1st June 1998 on technical conditions to be met by hydro-engineering structures and their location (Journal of Laws, No. 101, item 645, as amended);
- Regulation of the Minister of Environment on determining the types of habitats to be protected as of 14th August 2001 (Journal of Laws, No. 92 of 2001, p. 1029);
- Regulation of the Ministry of the Environment of 27th September 2001 on the directory of waste (Journal of Laws, No. 112, item 1206);
- Regulation of the Minister of Environment on the types and concentrations of substances that cause the spoil contamination of 16 April 2002 (Journal of Laws of 2002, No. 55, item 498);

- Regulation of the Minister of the Environment as of 27th June 2002 on permissible levels of some substances in the air, emergency levels of some substances in the air and tolerance limits for permisdsible levels of some substances (Journal of Laws of 2002, No. 87, item 796);

- Regulation of the Minister of the Environment as of 26th July 2002 on types of systems which may cause significant contamination of the individual elements of nature or environment, as whole (Journal of Laws of 2002, No. 122, item 1055, as amended);

- Regulation of the Minister of the Environment on the requirements to be met by marine internal waters and coastal environment which are living environment for crustaceans and mollusks of 4th October 2002 (Journal of Laws, No. 176, item 1454)

- Regulation of the Minister of Health on the requirements which should correspond to the bathing water of 16th October 2002 (journal of Laws of 2002, No. 186, item 1530);

- Regulation of the Minister of Environment on reference values for certain substances in the air as of 5th December 2002 (Journal of Laws of 2003, No. 1, p. 12);

- Regulation of Council of Ministers on the border between surface water and internal sea waters and territorial sea waters of 28th December 2002 (Journal of Laws, No. 239, item 2035).

- Regulation of Council of Ministers on the organization and how to combat threats and marine pollution (Journal of Laws of 2002, No.239, item 2026);

- Regulation of the Minister of the Environment as of 9th July 2004 on wild species of plants under protection (Journal of Laws of 2004 No 168, item 1764);

- Regulation of the Minister of Environment on special protection areas Natura 2000 as of 21st July 2004 (Journal of Laws, No. 229, p. 2313);

- Regulation of the Minister of Environment on the species of wild animals under protection as of 28th September 2004 (Journal of Laws No. 220, p. 2237);

- Regulation of the Council of Ministers on types of investments which might significantly impact the environment and detailed conditions connected with qualifying the investment for preparation of environmental impact assessment as of 9th November 2004 (Journal of Laws, No. 257, item 2573);

- Regulation of the Minister of the Environment on procedure and scope of drawing up a project of protection plan for Natura 2000 as of 30th September 2005 (Journal of Laws of 2005, No 61, item 549);

- Regulation of the Minister of the Environment as of 16th May 2005 on types of habitats and species of animals and plants which require protection in the form of Natura 2000 (Journal of Laws of 2005, No. 94, item 795);

- Regulation of the Minister of Transport and Maritime Economy on the procedures for issuing permits for disposal at sea of dredged spoil and dumping at sea of waste or other substances of 26th January 2006 (Journal of Laws, No 22, item166);

- Regulation of the Minister of the Environment on conditions, which have to be met when discharging wastewater into water or soil and on substances particularly harmful for water environment of 24th July 2006 (Journal of Laws of 2006, No. 137, item 984);

- Regulation of the Minister of Maritime Affairs on the technical conditions of use and the detailed scope of control of marine hydro-engineering structures of 23rd October 2006 (Journal of Laws, No. 206, of 2006, item 1516);

- Regulation of the Minister of the Environment of 14th June 2007 on permissible levels of noise in the environment (Journal of Laws of 2007, No. 120, item 826, with appendixes)

- Regulation of the Minister of Environment of 5th September 2007 amending the regulation on special protection areas Natura 2000 (Journal of Laws of 2007, No. 179 item 1275);

- Regulation of the Minister of Environment on the levels of certain substances in the air as of 3rd March 2008 (Journal of Laws of 2008, No. 47, item 281);

- Council Regulation EC No. 1041/2006 of 11th December 2006;

- Regulation of the Minister of Maritime Economy of on the dimensions and protection seasons of marine organisms and the detailed conditions of implementation of marine fisheries of 22nd March 2007 (Journal of Laws, No. 56, item 384);

- Regulation of the Minister of Environment of 20th August 2008 on the classification of the condition of bodies of surface water (Journal of Laws of 2008, No 162, item 1008);

- Regulation of the Minister of Environment amending the regulation on special protection areas Natura 2000 as of 27th September 2008 (Journal of Laws, No. 198 item 1226);

Local acts:

- Regulation No. 4 of the Director of Maritime Office in Szczecin as of 17th September 2002 (as amended) Port regulations.

- Amendment to the Local Spatial Development Plan of Świnoujście unit area V-region of the Ku Morzu street, approved with Resolution No. XXIV/203/2007 of Świnoujście Town Council of 13th September 2007

2. DESCRIPTION OF THE PLANNED INVESTMENT

2.1. Characteristics of the Investment

As a part of Project involving construction of LNG reloading waterfront in the water body of external port of Świnoujście, dredging works which are necessary to obtain required technical depth shall be executed:

- within the reloading position and water intake from the port side, by the breakwater and to the distance of approx. 47 m from it: - 12,5 m UMSL
- on the port water body between port turntable and planned LNG reloading station (vessel mooring position): - 14,5 m UMSL.

The project includes disposal of excavated spoil at the sea to a designated marine dump site located in the Pomeranian Bay covering an area of approximately 3 km^2.

At the stage of applying for environmental decision for the construction of waterfront project in the external port of Świnoujście, Seaports Authority did not have more precise bill of quantities for dredging works and the team preparing EIA have adopted that, it shall be about 1.5 million m^3 of dredged spoil on the basis of own estimates, and this amount is in the environmental decision. At present, Seaports Authority have a building permit design and the more accurate calculation within the dredging works, which show that, the volume of dredged spoil will be at the level of 2.4 million m^3 and this volume is binding and indicated in building permit design and technical specifications for contractors.

Schedule provides that the dredging works shall be phased in two stages:

- **stage I** – before commencement of the works connected with pile driving and waterfront construction, assuming extraction of approx. 30% of the spoil i.e. 720 000 m3 within 4 months in the period (07.–10.2010),
- **stage II** – upon completion of waterfront construction, assuming extraction of approx. 70% of the spoil i.e. 1 680 000 m3 within 6 months in the period (06-11.2012 r.).

Schedule provides for a 30% reserve time for unforeseen circumstances during implementation e.g. technical, weather, etc. Dredging works shall be carried out round the clock, even at night.

Environmental Decision of 18th June 2009 No. RDOŚ-32-WOOŚ-6613-5-7/08/at, in the grounds, sets Ostrów Grabowski as a place for disposal of spoil from dredging works, but also in section IV, paragraph 2, the decision speaks of the management of the excavated spoil as required by Seaports Authority. Therefore, bearing in mind the time and quantity of dredged spoil, Seaports Authority have attempted to acquire additional dump site in the sea, which is the subject of this EIA.

2.1. Location of the dredging works and spoil disposal

The planned construction area of the waterfront for unloading LNG and dredging works and spoil disposal associated with that investment includes a coastal zone of the Pomeranian Bay to the east of the estuary of Świna River and existing east breakwater (Fig. 1).

Dredging works shall be located in the water body of external port in Świnoujście which is being built between the port turntable and the future shielding breakwater, at the length of the LNG reloading position and the position of the water intake. Shielding breakwater with a length of 2,980 meters will be located approximately 1050 meters east of the existing breakwater shielding eastern entrance to the inner port of the Pomeranian Bay. From the south, project area is separated from the Szczecin Lagoon with the islands of Uznam and Wolin in the shape of an irregular square and an area of about 924 km^2.

This part of the bay is adjacent to the estuary of the Odra River and is under the influence of fresh water. Environmental conditions are formed depending on the difference in water levels between the Szczecin Lagoon and the bay, and on the winds direction, the hydrological conditions of coastal waters, particularly salinity, which changes shape. The waters of the south-east part of bay have mainly marine character (saltwater). Pomeranian Bay is a shallow basin with a rich fish fauna and is one of two most important sea bird habitats in the Baltic Sea. It is adjacent to the Bornholm Basin from the northeast, and Arkoński Basin from the north-west. This water body itself covers an area of approximately 6000 km^2. The volume of the bay waters is relatively small and amounts to 73 km^3 (Majewski, 1974). The average depth is just over 13 m. There is a major shallowing – Ławica Odrzana in the central part of the bay, where the sea depth reaches 8 m. It is a special refuge for wintering and migratory birds due to the abundance and availability of food.

Wolin, the largest island located entirely in Poland, closes the Szczecin Lagoon from the north-east, is separated from the mainland (east) with a narrow Dziwna strait, and with Świna strait from the Uznam island. The coastline from the north (seaward) is levelled, strongly diversified from the other sides, with peninsulas and numerous smaller islands offshore. The area consists mainly of moraine, alluvial and marine sands forms. There are high clusters of moraine, sloping toward the coast with steep cliffs and with areas with small dunes. The central part of the island includes Wolin National Park. The location of the waterfront for unloading LNG at the outer port of Świnoujście and the dump sites for dredge spoil adopted for the analysis of choice of option is shown on the map (Fig. 1).

2.1. Estimated time for works execution

Implementation of the project has been planned for 2010-2012. The dredging works and disposal of dredged spoil at the seabed according to the variant 2a shall be carried out in stages for 10 months. In case of interruptions and periodic lesser capacity, execution time can be extended. Commencement and completion dates of works have been identified by the Investor in the schedule.

2.1. Planned technology of dredging works and disposal

Description of planned works

The planned dredging works, as a part of project Construction of waterfront in the external port of Świnoujście, in a total volume of about 2.4 million m^3, are located between the proposed ships turntable and the proposed shielding breakwater. The scope of works is divided into two main

components: bringing a depth of the basin adjacent to the turntable to -14.50 level and preparation of the body of water adjacent to the berch to the level -12.50.

Tolerance of the works execution:

– Vertical tolerance of the works execution: -0,30 m

– Horizontal tolerance of the works execution on crest and underwater slope bottom on the inside of the dredged area by the mooring position: -0,50 m

– Horizontal tolerance on the remaining area of works execution: +/-0,50 m

– Slope tolerance of the underwater slopes: 1:4,5 to 1:5,5

The order of carrying out the works and equipment used for the implementation

In accordance with the works schedule set by the Investor and a building permit design, it is recommended to execute works in the following order:

1. First, it is recommended to execute dredging of the basin located between the planned turntable and proposed breakwater to the level -14.50 m. These works should be carried out on the breakwater sections - sections 99-111 at the minimum distance of 50 meters from structure under construction, and on the section from section 112 to the base of the breakwater at a minimum distance of 55 m from the breakwater structure under construction. Given the low depth prevailing on the water body, works should be divided into two parts:

    - preparation of basin with a floating dredger to the level allowing safe operation of the suction hopper dredgers. The minimum depth which should be provided with a floating dredger is -8.0 m. Spoil from works to be exported to a dump site designated by the Investor.

    - collecting remaining volume with suction hopper dredgers. The remaining volume from the level -8.0 to -14.5 + vertical tolerance should be collected and exported to a dump site with silting up bucket-ladder dredger. Investor also provides for the export of excavated spoil and its disposal at Ostrów Grabowski.

2. The next stage, conducted simultaneously with the first one, shall be execution of only necessary dredging works to ensure the access of vessels and dredging the bottom under the loading bridge and fire water intake bridge. Therefore, excavations to the level of -12.50 should be executed under two loading platforms: the first on sections 107-111, the other on sections 126-131. Excavations must be carried out only after the basin is sheltered with anchored sheet piling. Because of close proximity to newly constructed breakwater structure, works should be executed with a small grab dredger, or bucket-ladder dredger. Spoil must be placed on self-propelled hopper barge with a maximum draft of up to -3.5 m. If it is necessary to execute access gutter for dredger team, it should be also executed with grab dredger or bucket-ladder dredger. Depth of gutter - minimum 4 m.

3. The final stage of works is dredging the spoil to the level of -12.50 in the lane of 30 meters from the newly constructed breakwater structure. These works should be done after construction of the breakwater and waterfront structure. Because of the need to execute works by the very

sheet pile, grab dredger or bucket-ladder dredger should be used, which might dredge spoil to the depth of -13.0 m

Spoil disposal technology on a dump site

During the execution of dredging works, the water body should be marked with yellow buoys to accommodate the schedule of works and the least obstruct the navigation of water body. Dredge spoil shall be gradually placed on the dredgers with own hold or on the hopper barges and exported to the place of disposal of excavated spoil specified in the permit to execute dredging works. Hopper barges and dredgers are opened hydraulically. The maintenance of the slow movement of dredging equipment (dredger, hopper barge) (approximately one node) allows for even distribution of spoil on bottom of the dump site. The measurement system installed on floating equipment shall allow to control the discharge area. It is not recommended to dispose the dredge spoil with "Rainbowing" technology or otherwise, by bow connection. Dredging works and disposal technologies are dependent on the technical specifications required by the Investor.

Spoil shall be disposed on the area of three quarters, each with an area of about 1 km^2 and volume of approximately 1 million m^3 of sediment within a disposal field according to the variant 2a. Disposal of excavated spoil in motion should be carried out taking into account the currents and vessel traffic, for the suspension to concentrate in the disposal fields.

During spawning season in autumn (IX-XI), spoil should be disposed on the northern quarter most offshore in the belt with a width of 1 km. This quarter should be reserved for the spoil excavated during the autumn spawning

Equipment used for dredging works

For execution of the dredging works, in compliance with the technology assumed in the Design Documentation, it is anticipated to apply following, technically fit and approved by the Engineer equipment:

- dredgers, grab dredgers,

- Hopper barges,

- seagoing tug-boats and port tug-boats,

- pontoons,

- vessels to survey the body of water.

The Contractor should provide a sufficient amount of equipment intended to transport excavated spoil from the dredging works and dredging equipment. The above-mentioned means of transport must comply with the technical and formal regulations, resulting from the rules of communication in the port waters and the Pomeranian Bay.

2.1. Expected type of emissions resulting from the operation of the investment

Emissions of gas or dust into the air

Both construction and dredging equipment are powered by diesel engines. During their working, gases are emitted in proportion to the spent fuel. Average fuel consumption by the propulsion system is estimated at 40 dm^3 per moto-hours (according to literature data). Working time of dredgers and emissions will depend on the equipment employed by the contractor for such works. Pollution emitted in the construction phase is: CO_2, carbon dioxide, carbon monoxide CO, nitrogen oxides NOx, SO2, sulfur dioxide, hydrocarbons, particulate matter (soot).

Overall, emissions of air pollutants will be disorganized, with a range limited to the area of construction (for both dredging site and dump site). Emissions from floating vessels, using dredges with appropriate operational efficiency will not affect the air quality in the relevant area.

In addition, due to very good ventilation of this area of works, as a consequence of favorable winds, there will not be stagnation of polluted air in any season.

It is not expected to discharge other waste and sewage into the marine environment from vessels (dredgers, tugs, motor boats, floating cranes, etc). Units executing works must hand over oily materials, waste oil and sewage, garbage and household waste into port reception facilities at the port of Świnoujście.

Noise emission to the environment

Acoustic conditions in the given area is the sum of sounds from different sources, determined in dB (A) as averaging the sound level during a certain period of time.

The planned project shall be a sound source due to its operation, work of machines, etc. The following are details on expected noise, and set out conditions which must be met for the noise not to exceed the permissible limit values

There shell be following noise sources during the dredging works:

– work of the main engines of units approx. 65-70 dB (A)
- pump units approx. 1972 to 1975 dB (A)
- Conveyor belt drive and work approx. 80 dB (A)
- Unloading pump units approx. 1965 to 1957 dB (A).

Most activities shall take place on open space thus shielding the noise will be negligible.

In the literature, one can find information on the methods for determining the nuisances and range of industrial noises together with the available computer programs. The results of these calculations indicate that, during the normal course of business, an equivalent noise level will be from 55 to 60 dB (A). Permissible level, in principle, shall not exceed the contour of port areas. It is therefore concluded that, the noise emissions caused by carried out works shall not threat sites subject to the protection against noise, i.e., sites subject to the protection of residential development by Barlickiego street and the nearest holiday areas.

2.1. Accidents, break-downs and fortuitous events

Any investment implemented, both at sea and on land, can cause failure events. It cannot be excluded that during the dredging works and dumping spoil on the indicated dump site, there will be no emergency events associated with, on the one hand, the aspect of shipping, and on the other, and on the other with hydro-meteorological conditions influencing directly floating vessels. In addition, unforeseen events and accidents can occur due to a significant intensification of hydro-technical works on the water body of the planned outer port.

Literature mentions 4 basic causes of accidents at sea:

- human error,
- technical break-down,
- force majeure (external factor),
- terrorism.

Human error is the dominant factor in the classification of the causes of accidents and disasters at sea. Depending on the type of accident and the water bodies, percentage in the reasons ranges from about 60 to 80%. This is due to insufficient training (lack of skills) - which reveals an erroneous assessment of the situation and making the wrong decisions, inadequate level of organization and inability to work as a team, the fatigue causing slow reactions, improper assessment of the situation and failure to make a decision or wrong decisions as a result, and mental limitations manifested with lack of ability to work in stress, with a large flow of information and the necessity of making many decisions in short periods of time. In this case, it can have an effect, both on hitting the breakwater by a vessel, and to be understood as structural or execution error committed during the construction of the breakwater.

At the operation stage of breakwater, the spillage of petroleum substances from vehicles on the road on the breakwater may also happen. This is the technology road, so the vehicles using it will ride with a minimum speed. The danger of spilling oil-derived substances will therefore be negligible, but such cases cannot be excluded. Breakwater will consist of oil separators (drainage) to secure such cases.

Technical break-downs, classified as a cause of a maritime accident, except for cases of incorrect exploitation by human, constitute about 10 - 30% of the causes of accidents. Technical reasons related to the vessel traffic are not dangerous in themselves (jammed rudder, black out, the main engine failure), but in the limited water bodies, in this case, they can lead to hitting into hydro-engineering facility. Other technical break-downs may lead, in this case, the breach of the structure, and extremely to its collapse (defects in material).

"Force majeure" event is usually equated with extreme hydro-meteorological conditions. On the limited water bodies, such as the area of Świnoujście, in case of intensification of extreme weather events, moorings can come off or the anchor can break and as a result the vessel can hit the breakwater and the direct impact of wind and waves on the breakwater structure, especially when during the construction phase partial/total landslides of structure can happen.

Terrorism is the deliberate action of a man who wants to cause the greatest losses of human / economic as possible. Given the twenty-first century threats, all the port facilities (including shielding

breakwater structure) should be well defended and meet the requirements of International Ships and Port Facility Security Code – according to Mejszelis and others 2008.

3. OTHER INVESTMENTS PLANNED FOR IMPLEMENTATION IN THE VICINITY OF THE BREAKWATER

Following investments are planned in the vicinity of the investment under this EIA:

- Construction of LNG Terminal – Investor: PLNG Sp z o.o.;
- Construction of a shielding breakwater and a groin for the planned outer port in Świnoujście – Investor: The Maritime Office in Szczecin;
- On the area of Morska Stocznia Remontowa (Marine Shipyard), works connected with refurbishment and construction of facilities are planned, as well as dock installation;
- Reconstruction of the existing eastern breakwater – Investor: Maritime Office;
- Construction of parking lot with 75 places for heavy vehicles at the crossing of Jana Sołtana & Ludzi Morza Streets, area of Euro-Terminal;

4. DESCRIPTION OF THE NATURAL ELEMENTS OF THE ENVIRONMENT COVERED WITH THE SCOPE OF THE ASSUMED IMPACT OF THE PLANNED INVESTMENT

The first hydrological research in the area of the Pomeranian Bay was conducted in the 19th century. In 1888, relationship of current with the wind in the south-western part of the Baltic Sea was presented. In a study conducted in the next century, the focus was mainly on the hydrology and dynamics of the coastal waters of the Pomeranian Bay. Measurements of temperature, salinity and oxygen content in the area Ławica Odrzana were conducted from 1925 to 1938. In the period 1955-1958 a systematic study on the Pomeranian Bay and Ławica Odrzana was conducted by Marine Division of MIR (Sea Fisheries Institute) in Świnoujście. During 1960-1967, survey in the Ławica was carried out by: Obserwatorium Ujściowe PIHM (Observatory) and MIR (Sea Fisheries Institute). From the 70's to the mid-90's, a systematic research in this area was conducted by Institute of Meteorology and Water Management as a part of the oceanographic service and monitoring of the Baltic Sea.

The research results were published in the hydrological annals (IMGW 1957-1970), and since 1961 data from the cruise measurements have been published. The most complete picture of the region was presented in a monograph of the Pomeranian Bay (Majewski, 1974). Also oceanographic database was used from the years 1976-2010 for the area of the Pomeranian Bay within the scope: temperature and salinity, oxygen concentration, and biogenic salt, and materials of WIOŚ in Szczecin gathered as part of the monitoring of the Baltic coastal zone from four positions in the Pomeranian Bay (years 1985-2005) . In addition, materials developed by Nature Conservation Office in Szczecin were used, outlining the expected impact of the construction of waterfront at the external port of Świnoujście on the natural environment (Borówka and others, 2007, Mejszelis and others, 2008), the results of environmental research of the Pomeranian Bay from the period 2001-2003 conducted by the Agriculture Academy in Szczecin and research results from the period 2007-2008 conducted in the area of planned construction of a shielding breakwater for external port (Mejszelis and others, 2008).

4.1. Geological and morpho-dynamical conditions

4.1.1. Geology and geo-morphology of the area

The bottom of the southern Baltic Sea with its vast depths, less extensive shoals and coastal shallows is entirely covered with the Quaternary sedimentary cover. It was created in the last ice age, and during developmental stages of the Baltic Sea after the withdrawal of the glacier. Two complexes of the Quaternary - the upper and lower are distinguished in the sedimentary cover.

Higher complex, directly forming the surface of the sea bottom, is very simple at the bottom of the southern Baltic and central and north, so its range covers the whole Baltic Sea, but as far as age is concerned, it does cover a very short period of time - the later Pleistocene and Holocene. Lower

sedimentary complex is more complex in terms of lithological-facies and includes several different horizons and levels of chronostratigraphy of Pleistocene and opposed to the first, has a very limited spatial range (Kramarska, 1995, Mojski, 1995).

Both of these complexes are clearly separated with the surface of sedimentation discontinuity. This is the thill area from the late Pleistocene moraine clay in the Baltic Sea area. Higher sedimentary Quaternary complex of the bottom of the southern Baltic covers glacial forms and sediments of underwater sedimentation, directly building bottom area. These forms and sediments, formed in the late Pleistocene and Holocene period, were created during a relatively short time period, covering only approximately the past 12 000 years. However, they were formed in a substantially different conditions, which over time, were subject to further significant changes associated with the developmental phases of the Baltic Sea during the late Pleistocene.

Then, they were the result of rapid transgression of the southern Baltic in the first half of the Holocene, including the Littorina transgression, which maximum could fell on the first decades of the optimum climate of post glacial. These palaeogeographic transformations involved not only changes within the conditions of sedimentation in the bottom of the sea and the coastal zone, but also affected the hydrogeological relationships on the neighboring land, influenced the development of peatlands.

Part of these early Holocene bogs and the lowest parts of river valleys of Pomerania, the latter - filled with potamogenic sediments, after some time were also found on the today's seabed. It had already been the consequence of the sea transgression, which actually lasts until the present day, slowed down significantly after a Littorina period. Shoals build and their surfaces cover up mainly sandy forms, to a lesser extent, gravel and rocky, and clay. They are mainly coarse-grained fractional forms. On this basis, those forms are included with the shallow water variety.

Shallow water varieties of forms developed in the late Pleistocene and Holocene, although initially on land, then in the coastal zone of transgrading sea and finally on the shallow seabed. Here, moraine clay is the oldest form, which was melted from the ice during the deglaciation of the area in the subaeral conditions.

The most important event in the shallow waters, and in fact one big sequence of events, was the Holocene transgression of the southern Baltic. Then, sea took a large area of former land and forms and land surface structures were destroyed, and formed from the material of these structures, extensive gravel - sand littoral cover of the today's bottom, underlain with marine pavement transgression and covered with very poorly or not covered at all with marine sedimentary deposits. At the bottom, under water frontal moraine islands remained almost unchanged in the depth range from about 20 to about 10 m. Today, they form generally central parts of some schools of the South Baltic.

Basic pavement of a marine transgression put the deposits in the vertical ordering on a large area of shallow water. These deposits, which it covers and partially cuts, are older than the marine transgression, and those that it underlays, usually belong to the sandy littoral bottom cover.

From the bottom of the southern Baltic, bog deposits and partly lime deposits are also known, early Holocene. They occupy the largest area at the bottom of the Pomeranian Bay, on the south side of

Ławica Odrzana, covered with a thick sand cover. The cover has been genetically linked to the processes of forming the Świna River Gate. Proposed locations of disposal fields are located on the vast abrasion-accumulation plains of marine origin (Fig. 2).

Sea sand coverage that, occurs at the bottom of the coastal region is characterized by large granulometric homogeneity of deposits. These are fine-grained sands (Fig. 3), almost mono-fractional, predominantly composed of grains with a diameter of 0.25 to 0.10 mm, well and very well sorted. Sandy cover has the greatest thickness, of approximately 10 m, in the southern part of the relict of the spit bank near the edge. Shell deposits are mainly represented by Cardium glaucum & Macoma baltica, Mytilius edulis, Mya arenaria, Hydrobia ulvae. Shells of Cardium are generally well preserved, with a strong construction and clear ornamentation and sizes of up to l cm. Levels of shell rock sometimes are repeated several times in a single profile, but the most clear and commonly found is the level at a depth of about 20 to 25 cm below the bottom (Kramarska, 1995, 1999; Kramarska, Jurowska, 1991). The sands are mainly dominated with quartz grains (approximately 90%) (Borówka & others, 2003). The content of heavy minerals represented mainly by ilmenite, grenades, zircon and rutile (2%) is the result of sand mineralogical selection under the influence of multiple redeposition of components induced with surge and currents.

The depth of the Pomeranian Bay in the projected area of works fluctuates around 13 m. The entire area on the surface of the bottom is dominated with deposits of fine-grained sand, medium sand occur in places, coarse-grained, gravel. Deeper below the surface of the bottom in addition to marine sand and gravel, there are deposits of silts and lacustrine sand and glacial till (Fig. 3).

Sedimentary Environment

Bottom sediments of bottom areas (W1, W2 and W2A) for spoil disposal have been examined in terms of their use as a living environment for benthic animals. As the main characteristics of sediments following is concerned: grain size distribution (average grain diameter), the depth of oxygen availability in the sediment and organic matter content and other substances, including pollutants. The bottom of the discussed area is in a zone of fine-grained sand redeposition. On the eastern side of the ship lane to Świnoujście, sands with an average grain diameter of 0,15-0,18 mm on average occur in the surface sediment layer with thickness of at least 1 m. The seabed is flat and the depth of the sea reaches 10-13m.

Geological drilling done in 2008 for investment confirm the existence of interbedding of silty clay, a concise, humus, interbedded with sand dust and organic silt. There are under a layer of fine-grained sand, locally medium-grained with an admixture of shells, gravel with thickness exceeding 1.5 m. Shell detritus consists mainly of Cerastoderma glaucum and Mya arenaria. Macoma baltica clams are rare. Below a depth of 11.5 m prevails fine-grained sand, with gray color mixed with shells, some gravel.

On the eastern side of the ship lane, conditions favoring sedimentation of small fraction of deposits prevail. The advantage of the disposal process increases due to shield of the inner part of the Pomeranian Bay by land against extreme hydro-meteorological phenomena. These conditions are also favorable to deposition of partial organic matter and retention of the smallest fraction in deposit: silts and clays. In the surface layer of sediment on the eastern side of the ship lane, in its close vicinity, participation of fraction <0.063 reached about 20%. The further to the east, this value

strongly decreased. The sediment on the western side of the lane is dominated with the smallest fraction of sand, contains, bigger than on the east side, content of muddy-clay fraction, the organic matter (Masłowski, Dworczak, 2004).

Pomeranian Bay sediments have low moisture content and loss on ignition (LOI). The highest moisture content and LOI values were recorded in surface sediments in the north-west part of the bay and estuary of Świna River (humidity> 60%, LOI> 7.5% during the 1996/1997 study.) Both these parameters were lowest for sediments in the middle part of the bay. Organic matter content in sediment samples taken from waters associated with the construction of the shielding breakwater and external port of Świnoujście is low. Organic matter content in the area of the proposed port has not exceeded 1%. The highest concentrations of organic matter were in the samples taken from the ship lane Szczecin-Świnoujście (3,44-5,07%) and in its vicinity (> 1%). This is due to the presence of loamy-silty interbedding in sediments (Test results of ..., 2008). The content of organic matter in the vicinity of the planned waterfront in 20 core samples did not exceed 1.7%.

Fig. 2 Morphogenesis of bottom in the area of the proposed disposal sites of spoil in the sea

Fig. 3 Bottom surface sediments in the area of the proposed disposal sites of spoil in the sea

This low content of organic matter in the sediment, particularly its parts of plant origin (of phytoplankton blooms) on the east side of the lane suggests a relatively low sediment pollutant load. This assumption is based on the outcome of research on the load spatial diversity of substances such as PCBs in the sediment deposited Pomeranian Bay. The data for the Pomeranian Bay areas with similar sedimentological conditions show the presence of these substances, but at concentrations much lower than, the recorded for example in the sediments of the Szczecin Lagoon and Gulf areas characterized by more deposition than erosion type of sedimentological conditions.

Total phosphorus content (Ptot.)in the surface layer of the bay sediments ranged from 0.050 to 0.700 $mg.g^{-1}$ s.m. The sediment collected from the region of the Świna River estuary, level (Ptot.) was about 0.400 mg. g^{-1} s.m. Relatively high values were recorded in the north-east of the bay (> 0.300 $mg.g^{-1}$ s.m.). The lowest values of phosphorus occurred in the central part of the bay (<0.150 $mg.g^{-1}$ s.m.) (Frankowski, Bolałek, 1999). Pomeranian Bay surface sediments are relatively uniform because of their chemical composition and source of organic matter. Sediments from Sassnitz Depth and mouth area of Świna River are significantly different.

Oxygen content in the sediment pore waters, its change with depth in sediment and in particular the location of the oxidation-reduction discontinuity level, is a function of grain composition of the sediment, sorting, and organic matter content. The thickness of the oxygenated layer of sediment is a crucial determinant of the depth of benthic fauna in the sediment, especially the smallest multicellular invertebrates - the so-called meiobenthos. To the west of the mouth of Świna River 75-90% of meiobenthos is concentrated in the upper 3 cm of sediment, while to the east of the mouth of the bottom meiofauna distribution in the sediment is more even and its representatives can be found up to 10 cm in the sediment (lower boundary of layer covered by the sampling) – Borówka & others, 2007.

Bottom sediments collected on ZP3 position located in the area of the planned project concerning the dredging works connected with the construction LNG waterfront characterized with the presence

of the surface layer of detritus in the period December-July 2008. Redox discontinuity level in the sediment occurred in the range of 2 to 4.5 cm. The concentrations of PAHs and PCBs in bottom sediments on ZP3 position did not exceed the permissible limit values specified in the Regulation of the Minister of Environment of 16.04.2002 on the types of concentrations of substances which cause the spoil contamination.

4.1.2. Debris transport

The movement of sediment in the coastal zone is the consequence of movements and currents of water with wave origin. In general, along the Polish Baltic coast, two large zones of convergence and divergence of along-the-shore stream deposits are distinguished. Abelian variability of sediment movement is conditioned by several factors, including: geological structure, geomorphological features and the regime of wave-current.

In the Pomeranian Bay, there is in a convergence zone of debris flows, moving from the east and west, to the area of the mouth of the Piana River. In addition to converging in this region of two main along-the-shore streams of debris and their high local diversity (qualitative and quantitative), the phenomenon of aggrandizement of large quantities of sediment (Q. 105 m^3/year) through mouth of the Odra river is observed, which affect the overall balance of stream sediments.

Although the resultant debris stream is oriented from east to west (the area from Kołobrzeg to Świnoujście), locally there might be strong disorders causing different-scale cell circulation associated with local direction changes, which was observed by Furmańczyka and Musielak (Dressing & others, 1998) in the form of spatially irregular, from-the-shore currents and sediment runoff.

On the section of coast belonging to the Pomeranian Bay, about 14 drain streams was found. Along-the-shore deposits streams meeting in the Pomeranian Bay (near Świnoujście) provide approximately 5,104 m^3/year (Dressing & others, 1998) material from the west and 4,104 m^3/year from the east.

Despite the extremely complex along-the-shore movement of deposits, the analogy to the studies carried out on the multiple-shoal shore (Lubiatowo) it can be assumed that the maximum transport is observed mostly in the vicinity of I and II stable shoal, disappearing into the sea. During a heavy storm, value of transport becomes negligible at a distance of about 1000 meters from the coastline (Pruszak & others, 1999).

Dynamic effects of the wave on the sea bottom is associated with sea H_D depth, variable in time and space, closing part of transverse profile of the bank, active for a given wave motion. For Polish multiple-shoal banks, H_D depth at medium many-year storm conditions vary from 5-7 m in the scale of the season, to 7-9 m in annual scales (Rożyński & others, 1998).

According to the concept developed by Cieślak (1985), there is a cell nature of debris transport, with different trends depending on the area and depth of the bottom. To the west of Dziwnów, the movement of debris towards the west begins to dominate. The largest sediment transport takes place within a depth of 0-2 m. It practically disappears at a depth of 6 m.

A changes simulation on the profile bottom during a heavy storm, which occurred on the Baltic Sea in the period 01-10.12.1999 (wind speed exceeded 26 m/s SW to W direction) allowed for the observation of scope changes and definition of the depth closing the active part of the profile.

For such meteorological conditions calculated wave parameters on the high seas reached values close to the extreme (wave height significantly exceeded 7 m and wave period exceeded 10 s). In such conditions, wave energy mainly underwent dissipation on shoals, then the slope of the shore, and even on the beach-dunes lane.

Simulation of level change of sea bottom for shallow sea areas near Świnoujście (Fig. 4) indicates the areas of erosion and sediment accumulation on the bottom at a distance of between 300 and 1100 m from the coastline. Changes in bottom depth may exceed 1 m. The largest deepening occurred within 500 meters - more than 1 m, 650 m - 0.7 and 900 m - about 0.7 m. At a distance of about 1100 meters from the shore (which corresponds to a depth of 6 m BMSL) sediment movement is slowly fading. Appointment of spoil disposal sites at depths below 10 m BMSL, significantly reduces the sediment transport during extreme storms.

As a part of pre-investment works for the construction of the external port IBW PAN (report t. VIIIb) performed an analysis of debris transport in the vicinity of the planned buildings. The results obtained from the calculation model UNIBEST-LT confirmed previous conclusions on two-direction of debris transport in the area of Świnoujście. The intensity distributions along-the-shore sediment transport indicate that, even with intense wind wave, regardless of wind direction, the movement of sediment occurs in the coastal zone and disappears at a distance of 1000-1200 m from the shoreline (at depths of around 7-10 m). The resultant annual sediment transport in the area of Świnoujście is small and the resultant direction is variable.

Fig. 4 Simulation of bottom level near the cable route in extreme storm conditions for Świnoujście (Gajewski and others, 2001)

On the east side of Świna River estuary, resultant annual sediment transport varies from about 13 000 m^3 in an easterly direction to approximately 3 000 m^3 in a westerly direction. On the western side of Świna River estuary, the resultant size of the annual sediment transport are smaller and are as follows: to the east 9 000 m^3/year, and to the west 2 000 m^3/year.

It has been assumed that, for the sediments of coastal zone of the Pomeranian Bay, debris transport occurs when the orbital velocity of bottom water exceed the speed of 0.40 m/s. This phenomenon may occur in the medium statistical year for about 6.4 days, leading to a dilution of the bottom in the vicinity of the proposed breakwater (Final report …., 2008).

Designated as variants spoil disposal sites at a depth of less than 10 m BMSL limit processes of redeposition of fine-grained sands, which dominate on the seabed. The processes of erosion and sediment transport occurring during the average hydrodynamic conditions will be small. Only during major storm surges, redeposition of fine-grained sand may occur. Sandy fractions 0,063-0,25 mm diameter migrate on the bottom surface in the form of fields and sandy ribbons and after repeated redeposition escape outside the zone of storm waves influence, where at the depth of 1925-1930 m is their deposition (Kramarska & others, 2006 .) Thicker material> 0.25 mm transported only at high speeds, is directed towards the shore. From the point of view of protection of sea coasts, sediment moving towards shallow areas on profile is the preferred phenomenon.

4.1.3. Morphodynamic processes on the shore and bottom of the Pomeranian Bay

The consequence of wave-current conditions, particularly conditions of litho-and morphodynamic changes, are changes within the coastline. Within the Pomeranian Bay, several types of changes in dune and cliff edges are distinguished.

In this discussed region, due to the existence of converging sediment streams (Racinowski, 1974) resulting in sediment transport along the coast from both the islands of Wolin and Uznam, we observe both clear, long-term process of accumulation (km 412-428) as well as dynamic abrasion-accumulation changes (km 394-412).

Based on a detailed analysis of existing cartographic materials, Zawadzka (1999) found that, for the period of over one hundred years (1875-1979) in the coastal belt of 413-428 km, there is a constant trend of beach over-building and moving toward the north shoreline at an average speed of +1.15 m /year and the increase of the surface of 17 200 m2/year.

In the area of the planned dredging works, accumulation during the researched period amounted to 0,9-2,1 m / year. Short-term changes in the foot of the dunes in the years 1971-1983 occurred at a speed of 2-3 m / year (Table 1).

Tab. 1 Changes of shoreline and the foot of the dunes in the area of Świnoujście (Zawadzka, 1999)

Region	Mileage	Changes of the shoreline		Changes of the foot of dunes
		1875-1979	1971-1983	1971-1983
		m/year		
Świnoujście	421,0	1,5	0,1	2,43
	421,5	2,1		
	422,0	1,9	0,39	2,0
	422,5	0,8		
	423,0	0,9	1,25	3,07
	424,0	1,9	1,31	

On the adjacent from the east abrasive section of coast including cliffs of the island of Wolin (km 406,5-411,5) in the century, the speed of movement of the shoreline was -0.42 m / year (Zawadzka, 1999).

Morphology of the shore to the east of Świnoujście is associated with a wide zone of dunes. Area of Świna River Gate (km 411,5-428,0) belongs to the largest areas of aeolian accumulation in the southern Baltic coast. Contemporary white dunes are composed of two generations. Internal white dunes are just 400-800 (1000 meters) from the coastline. White dunes cover the area of 400 meters from the coastline (Osadczuk, 2004, 2005). Lowest dunes are to the east of the estuary of Świna River. The average height of dunes of this region in 2006 was 4.5 m (2-5 m). Beaches had a width of 30-94 m, an average of 55 m. The height of the beach at the foot of the dunes was 2.5 meters (Elements of monitoring ..., 2008).

Bordering from the east, section of the cliff edge of Wolin Island (km 406,5-411,5) is characterized by the highest cliffs (20-80 m). Beaches are wide ranging from 11 to 75 m (2006) and are subject to the erosion with cliff foothills. Segment with a high risk of erosion is a section of 412-413 km.

Section of coast where there is an estuary of Świna River is not subject to special treatment for the protection against erosion and sea flooding. According to the long-term program "The protection of sea coasts" (Act of 28 March 2003, Journal of Laws, No. 67 of 18 April 2003) in area of the proposed project, it is not planned to construct or upgrade of coastal fortifications and artificial shore feeding. An analysis of changes in coastline and dunes foot show that, the existing breakwaters, built in the nineteenth century, did not affect the severity of the erosion processes in their vicinity. The status of balance in the coastal zone was created there.

Construction of the external port of Świnoujście and permanent changes in the bottom shall not cause greater interference of along-the-shore sediment movement from the present. One can expect a slight changes in a short time after its construction. The proposed location of spoil disposition sites are located at a height of 409-414 km. In this region, there are sections of coast with a predominance of erosion processes. The a/m Act provides for artificial feeding of bank with sand in the region of Międzyzdroje (km 411,8-413,5).

4.2. Hydrodynamic and hydrological conditions

4.2.1. Wind regime

The closest meteorological station for the discussed area is Świnoujście. We analyzed observations of the velocity and direction of winds from the period 1961-1990 against 1951-1980. Data from 1951-1980 well characterize trends in changes of hydro-meteorological parameters and preclude an analysis of periodic processes, which may lead to erroneous inference. Newer available, partial data have not allowed to conduct inference about the parameters of the wind trends in recent decades.

The direction of the wind

In the southern Polish Baltic coast, tendency with advantage of winds from the western sector dominates, which is consistent with the conditions prevailing in moderate latitudes. For thirty years 1961-1990, existence of dominance of the western sector is confirmed.

From the sector SW, W and NW occurred 47% of winds. For the whole coast, this frequency fluctuates around the value of 50 .10%. Approximately 32% of the winds is from the sector E to S. The lowest winds are recorded from the sector north-east (N and NE). Their frequency does not exceed 20% (Table 2). The frequency of northern winds and the north-east is growing strongly in the first half year.

Tab. 2 The series of discrete distribution schedules for the direction of the wind for Świnoujście station in years 1961–1990.

Station	Number sets of the discrete distributions frequency of wind direction								
	silence	N	NE	E	SE	S	SW	W	NW
Świnoujście	0,034	0,690	0,1120	0,0750	0,0980	0,1450	0,2060	0,1840	0,0760

Both in the ten-year periods of observation and in 1961-1990, shape of wind rose indicates the dominant trend of superiority of south-western winds. Differences in the frequency of direction of the winds in the analyzed periods do not exceed 10%.

Particular significance in the evaluation of hydro-meteorological conditions has frequency of winds from sea directions, including in Świnoujście due to course of the coastline near the station, sector NW, N, NE. These winds in connection with large extent of action and generating maximum wind waves cause the greatest changes in the coastal zone. In 1961-1990, only 26% of these winds occurred there, which differs substantially from their frequency on the remaining stations, which always exceeds 40% (Kołobrzeg - 42.2%).

Amplitude of frequency changes of the sea winds at different observation times is practically unchanged and amounts to .1%. This demonstrates the well-established trends in the distribution of wind directions occurring in the southern Baltic region.

Wind speed

The course and an outline of the Pomeranian Bay shoreline affect local climate distinguish features. The wind speed in the area throughout the Pomeranian Bay is characterized by small values. Average wind speed in the 30-year period in Świnoujście 1961-1990 reached 4.0 m/s (Fig. 5). In 1951-1980, average wind speed in Świnoujście was VSR = 3,8 m/s.

Fig. 5 Curve of the average annual wind speeds at Świnoujście station during 1961-1990, indicating the regression line

Analyzing the data compiled in the form of empirical correlation tables, clearance function of wind speed and direction, and direction frequency histograms according to the directions of the wind speed at 1 m / s for 1961-1990, we can draw the following conclusions:

–in the area of Świnoujście, about 80% of wind speed does not exceed 5 m/s in all analyzed periods of measurement;

– over 90% of winds does not exceed 8 m/s;

– for Świnoujście, winds from the section 1–3 m/s exceed 70% of frequency occurrence;

– participation of winds with speed v ≥8 m/s is small and does not exceed 2.5%. Their lowest frequency was observed in the spring and summer 1981-1990 - 0.1%, the largest of up to 2.1% in autumn and winter 1971-1980;

– during the year, average wind speed reached its maximum in January, February, March and November (average 4,2-4,6 m/s). The lowest average speeds are recorded, as on the other stations on the Polish coast, from June to August, when monthly average could fall up to 2.5 m/s. This is the best time to carry out dredging works. Spoil from the dredging works disposed on the dump site will then be subject to the smallest dynamics;

– strong winds and storms are rare here. In the period 1956-1985 in Świnoujście 39.1 days a year were recorded on average with wind speeds ≥ 10 m/s. In 1961-1990, the number of days with wind ≥ 11 m/s was an annual average of 25.4 day. In Świnoujście, these winds usually come up in November

- 4.7 day; December and March - 4.4 days. The least number of winds with this speed occurred in August - 1.5 days (tab. 3);

– maximum number of days with wind ≥ 10 m/s, which over 30 years occurred within one month in Świnoujście, ranged from 3 September to 16 in November. There are two groups of months with varying frequency of strong winds. Months from October to May are characterized with a high frequency and low- from June to September;

– there is big similarity on the section of coast from Świnoujście through Dziwnów to Kołobrzeg for direction of strong winds. These winds are mostly from three directions: west, north-west and south-west, and their aggregate frequency fluctuates around 70% of the total number (Trzeciak & others, 1992).

On the basis of fragmentary data contained in the materials from IMGW (Environmental conditions ..., 2004), it results that, in each year from 1991 to 2000 period, the monthly average wind speeds in Świnoujście were lower, especially than average of the years 1970-1990. It can be concluded that, in the last decade of the twentieth century, upward trend of wind speed slowed down. In the coastal zone of the sea, wind has usually greater speed than the wind speed measured near the shore.

The average long-term wind speed estimated on the basis of empirical data from the sea (according to the Climate of the Baltic Sea Basin) in the area of interest to us is between 12 to 14 nodes, which corresponds to 6-7 m/s. The percentage of strong winds> 11 m/s is within 10-15%. For the storm winds> 17 m/s this study provides 1-2%

These data confirm that, over the maritime areas average wind speed exceeds by far the average speed obtained from coastal stations. It is expected that, the wind conditions prevailing in the coastal zone are less favorable for the conduct of the dredging works at the sea, than those presented on the basis of measurement data from the shore stations.

Tab. 3 Number of days with wind with speed of v ≥ 10 m/s in the period 1956-1985 in the area of Świnoujście(Trzeciak i in., 1992).

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Świnoujście													
Month average	4,1	3,8	4,4	3,2	2,2	2,3	2,0	1,5	2,2	4,2	4,7	4,4	39,1
Part % in the general number of days per month	13,2	13,4	15,5	10,7	10,7	7,7	6,4	5,2	7,3	13,5	15,7	14,2	-
Part in the general annual % number of days	10,5	9,7	11,2	8,2	8,2	5,9	5,1	4,1	5,6	10,7	12,0	11,2	-
Maximum per year	11	6	7	7	7	6	5	8	3	7	16	8	56
Minimum per year	0	0	0	0	0	0	0	0	0	0	0	0	37

4.2.2. Fluctuations in sea level

Changes in sea level are important factor shaping the reconstruction of the coastal zone. In the Baltic Sea, they are generated primarily by wind damming up activities. An important factor is the difference between the tributaries of the river waters, the sum of evaporation and precipitation and water exchange through the Danish Straits, namely the Baltic Sea water balance, which causes large fluctuations around the average level of the sea. Secondary importance have own vibration and astronomical tides. The nearest mareographical station is Świnoujście, which has a unique series of measurement, where the first observations come from 1811.

Mean sea level calculated from the measurement series from the years 1811-1985 for Świnoujście amounted to H_M = 491.1 cm ± 0.3 cm, while the long-term variability of mean sea level as the trend of vertical average annual change, set for the same period, amounted to v ± 0.7 mm / year ±0.1 (Dziadziuszko, Jednorał 1988). We also observe a positive variability trend for the other stations along the Polish Baltic coast of v 1.1 mm/year for the Kołobrzeg to ± 1.2 mm/year for Gdańsk Nowy Port. In recent decades, the average sea level rise has further accelerated to about 4.2 mm/year for the period 1971-1990 (Rotnicki, Borzyszkowska, 1999, Zeidler & others, 1995).

For the selected three decades 1961-1990, as well as for the period 1951-2000, the mean sea level in Świnoujście was 499.0 cm. The average and extreme sea level, recorded in this period, are referenced to the zero level N.N. in Amsterdam (Fig. 6). The highest average sea levels occur from July to January. In the remaining months, the mean sea level is lower than the long-term average. The clearance function of water level for Świnoujście station (Fig. 7) shows that, the water conditions in the range 470-540 cm mostly occur there. The frequency of average conditions 450 <H_M <550 oscillates around 98%. The frequency of high and very high states does not exceed 2% (Boniecka & others, 2007).

Analyzing the spread of sea-level fluctuations on a monthly basis there are two distinctive seasons: autumn/winter from October to March, with the largest span of the fluctuations, reaching 2.55 m (November) and spring/summer (April-September) with span of less than 1, 69 m (September) (Fig. 7). For the west coast, the changes amplitude in extreme conditions can reach a level of 3.5 m. With the land winds (mainly SW), sea level could be lowered by 1.3 m below the average. In stormy weather conditions fluctuations of water table are usually ±0,7 m, and the average daily fluctuations are ±0,25 m.

Fig. 6 Curves of annual mean sea levels with the trend line during periods of 1961–1990 & 1951–2000

Fig. 7 Clearance function of sea level for Świnoujście, period 1961–1990

Fig. 8 The mean and extreme water levels recorded in Świnoujście in period 1961-1990

Fig.9 Characteristic monthly sea levels in the period in Świnoujście in period 1948-2006 (Wiśniewski, Wolski, 2009)

In the design practice, it is necessary to know the characteristic sea levels (Table 4).

Tab. 4 Characteristic sea levels for shore station neighboring with the research area (Boniecka i in., 1998, Wiśniewski, Wolski, 2009)

Status (cm) for the station Świnoujście						
WWW	SWW	SW	SNW	NNW	WWW-NNW	SWW-SNW
Period 1961-1990						
639	591	496	421	366	273	170
Period 1948-2006						
669	546	499	456	366	303	90

For Świnoujście station historically highest water level was recorded in 1874, when sea level reached 696 cm. Highest water conditions are associated with storm surges in years 1913 - 693 cm, 1904 and 1995 - 669 cm, 1968 - 639 cm. Minimum sea levels occurred in the year 1967 - 366 cm, 1939 - 381 cm and 1999 - 379 cm. The probability of annual maximum sea levels (Table 5) was estimated with Gumbel distribution (Wróblewski, 1992) based on data from Świnoujście station from the period 1901-1990.

Tab. 5 Probability of occurrence of maximum sea levels at the Świnoujście station (Wróblewski, 1992)

P%	99	90	50	30	20	10	5	2	1	0,5	0,2	0,1
$T_{(years)}$	1,01	1,11	2,0	3,33	5	10	20	50	100	200	500	1000
M_{max}	548	561	568	597	605	620	633	652	665	678	695	708

Probability of 1% for Świnoujście has been set at 665 cm, and 0.1% (thousands of years water) represents the water level of 708 cm (Wróblewski, 1992). The probability ignores trend of mean sea level rise. In the region of the southern Baltic sea, sea level rise scenario in the best-case variant was estimated at 30 cm, 60 cm in the likely, and pessimistic as much as 100 cm per 100 years (Cieslak, 2001). According to the IPCC sea level rise reaches 47 cm over the next 100 years.

Storm surges are relevant to the deposit of excavated material from the dredging works in the sea. Monographs of storm foods by Majewski & others (1983) and the works by Wiśniewska (1979, 1981) and Dziadziuszko & Malicki (1994) contain the meteorological conditions of storm surges in the second half of the twentieth century. Storm surges in the southern Baltic coast are usually generated by a center of low pressure associated with weather fronts. The most dangerous surges, which were observed along the southern Baltic coast in the twentieth century, usually accompanied low pressure system moving towards the south-west of the Norwegian Sea, through Scandinavia and the Baltic Sea. Storm surges are response of the sea to extremely strong winds from sectors of the north-west to north-east, formed after the passage of the front. Storm surges of this type can last for a few hours. In the case of the imposition of an increase in sea levels during the surges already on already occurring high sea levels, caused by large inflows from the North Sea, observed sea levels can be very high, reaching even the extreme values (Sztobryn & others, 2005).

Analyzing storm situations (H> 565 cm) in the period 1985-1995 (Basiński & others, 1996) 53 storm surges with varying duration were recorded at Świnoujście. The storm from November 1995 which lasted 32 hours was the storm with the longest time of exceeding the emergency levels H> 569 cm, when the maximum level reached the value of 669 cm, one of the highest in this century. Storms of February 1987 and December 1989S had the shortest period, for which the duration was only 1 hour. During storms, the highest frequency was recorded in the range of 571-580 cm - frequency of 52.5%, 20.7% of levels ranged 581-590 cm. During this period, 14 big storm surges were recorded (level H> 600 cm), of which 3 took place in 1995.

During the period 1996-2000 12 storm surges (H> 570 cm) had place, of which two reached the maximum levels of 600 cm (April 1997, January 2000). The longest surge lasting 57 hours with the maximum level in Świnoujście, amounting to 588 cm, occurred in February 1999 and in that April 1997 (45 + 72 hrs.) as one surge with two peaks separated by a drop (Sztobryn & others, 2005). In the period 1995-2000 prolongation of storm surges was observed. The first flood occurred in August and the season ended only in April.

In the seasonal distribution most of the great storm surges took place in January, November and December. This also applies to sea levels higher and equal to emergency levels. Surges did not occur in the period from May to July (Fig. 10).

It should be noted that, the station in Świnoujście is characterized with the largest number of the storm situations and the great storm surges at considerably shorter period of their existence, which is connected with the sea journey of storm low pressure systems along with weather fronts, developing from the west coast to the east. The threat of storm floods in the area of Świnoujście has doubled at the end of the twentieth century (34) compared with the half century (15) (Sztobryn & others, 2005).

Large number of storm surges was also registered in the period 2001-2007. At Świnoujście station 35 cases of exceeding the level of 570 cm were reported. In February 2002, the maximum water level reached 648 cm. Big storm surges (≥600 cm) occurred during this period up to 10 time (Wiśniewski, Wolski, 2009).

Fig. 10 Frequency of storm surges (Świnoujście) in each month – comparison of periods (1950-1975, 1976-2000 & 2001-2007) (Sztobryn & others, 2005)

4.2.3. Waving and sea currents

Waving

In the analyzed area, seashore is in the form sinus. Smaller depth occurring in this part of the coastal zone affect the maximum wave parameters, which are not as high here as in other sections of the Polish coast.

In the absence of long strings of observation of waves at sea, numerical spectral wave models are used more and more often to forecast waves. On the basis of one of them WAM4 model (WAVE Moddeling) forecasts of waves at the Baltic Sea are made. The analysis of regional variability in the Baltic waves in the area of the Polish coast (1998-1999) was developed by Paplińska and Reda (2001). As a result of wave calculations using this model, along the Polish Baltic coast, four distinct areas where surge occurs were separated. One of the areas is the Pomeranian Bay, where

the significant wave height obtained from the model is the lowest. For the Pomeranian Bay, the simulation of wave conditions for the model grid node with coordinates 54.01 'N 14.19' E was carried out.

Significant (90% of the time)wave with height of below 0.13 m are most often. The significant wave, exceeding 1 m in height, occurred there by 10% of the time. The highest annual average height of significant wave did not exceed of 0.6 m in this region. The average wave period was 3.4 s. The predominant mean direction of the wave direction is south-east, southwest and east. The highest maximum height value of significant wave is in February - 4.22 m (direction E).

Gajewski and others (2001) obtained similar results for a point farther to the north (54.09 'N 14.18' E). Archived data on wave forecasts is based on wind field data from the period 20.09.1997-27.01.2001. Directional distributions of significant wave heights as well as wave periods and distribution were established.

Fig. 11 Directional distribution for the height of significant wave and waving period for the point with coordinates 54°09'N, 14°18'E (Gajewski & others, 2001)

In the discussed period, there were mostly waves from sectors of south-west and south-east with the heights from 0.8 to 1.5 m. From the sea sectors , the biggest waves did not exceed 1.5 m in height. The most frequent waves have a period of about 3 seconds, and the largest 6 s (Fig. 11). The obtained characteristics are in good agreement with data obtained from observations at sea, coming from ships and buoys (The Climate of the Baltic Sea Basin).

As a part of the hydrodynamic research of the designed shielding breakwater for the outer port of Świnoujście, IBW PAN carried out calculations of the wave filed with WAM4 model for 3 prognostic points (Final Report ..., 2008). They examined sets of wave forecasting points located within the Pomeranian Bay in the area of Świnoujście obtained from the reconstruction of the wave on the Baltic Sea during the 44 years (1958-2001). Points 1 and 2 were located on the north-east from the Świna River mouth, first at a distance of about 10 km, the second about 5 km from the coast. Point 3 was located on the western side of the approach fairway.

The obtained results show that, in the Świnoujście region waves from NE and then NW and NNW directions occur most likely. For the NE and NNE directions, for which were the largest extent of the wind, significant wave height reached maximum values (Hs = 3.71 m) - Figure 12.

Fig. 12 Significant wave height with the time period not exceeding one day in the forecast points 1, 2 and 3 with winds from the NNE direction in the statistical average year.

To illustrate the impact of waves height on the safety of the dredging works connected with the deepening of the basin and placing the dredge spoil on the dump sites, the number of storm days during the year, when the works can be difficult is presented. Taking as representative the waves set for 2 forecast point (14°20,340 'E, 53°58,716' N, depth h ~ 10 m) on the basis of 44-year calculations for the statistical year, following was received (Final Report ..., 2008):

– for approx. 33 hours in total wave height in the vicinity of the region of dredging will exceed the height of 2.0 m,

– for approx. 108 hours in total waves height will exceed 1,6 m,

– for approx. 304 hours in total waves height will exceed 1,2 m.

Currents

In the coastal zone of the Baltic Sea, the determining factor of currents forming is the wind waves and energy carried with it. The most important are along-the-shore currents and return currents. These two systems decide on the size of sediment transport, changes and phenomena occurring in the coastal zone.

For the sea areas of the Southern Baltic Sea, measurements of instantaneous currents conducted in the years 1978-1996 (Fig. 13 and 14) allowed for statistical analysis of trends for selected squares of the Baltic and the development of the horizontal distribution of the frequency of the current directions in the surface layer of the southern Baltic. Analysis of the probability distributions of occurrence of the current direction revealed the existence of asymmetric and two-model distributions and corresponding to dominant flow directions. To obtain the horizontal distribution, currents roses were determined for each of the squares of Baltic, thanks to which one can extract the characteristic distributions of direction in the surface layer and the bottom (Krzymiński, 1999).

Fig. 13 Percentage distribution of currents observed in the surface layer (5-10 m) in the Polish zone of southern Baltic in the years 1978–1996 (Krzymiński, 1999)

Fig. 14 Percentage distribution of currents observed in the bottom layer in the Polish zone of southern Baltic in the years 1978–1996 (Krzymiński, 1999)

In general, currents associated with the direction and strength of the wind occurring over this area. Deviation of the current direction from wind direction was found, especially for weak winds (up to about 15^{o}), whereas with winds greater than 5^{o}B this direction diverged less - to about 2^{o}. In G02, square including part of the Pomeranian Bay with the area of dredging and spoil disposal, both on the surface and at the bottom, we observe similar distribution characteristic of current trends, where the strong and moderate west and south west currents prevail (over 50% of cases). With strong winds, flow in the whole water column (0 to about 18 m) has practically the same direction. Due to the seasonal variation of anemobaric conditions, affecting the flow, one can separate the different systems of currents, depending on the season:

- I quarter – currents in the West direction dominate – over 50% of cases,
- II quarter – almost exclusively dominated by the western currents,
- III quarter – eastern currents,
- IV quarter – almost exclusively dominated by north-western and north-eastern currents.

Seasonality of speed changes of currents is also in their vertical distribution. In the spring and summer, range of variability of the speed is around 10 $cm.s^{-1}$ on practically all depths (mean values ranging from 5 $cm.s^{-1}$), while in the autumn and winter the speed of the current in the middle tier rise

substantially. At depths of 5 m (average value of about 11 cm.s^{-1}) and 7 m, we observe bigger speeds than on the others, often exceeding 30 cm.s^{-1}.

The intensity of dynamic phenomena is well illustrated by the depth of vertical mixing of water. The average value of this parameter in the years 1988-1998, measured on an expedition cruises, was 6 m and the maximum values were recorded at 13 m, which was the result of wind mixing reaching the bottom of the basin.

4.2.4. Ice phenomena

The studied area is located in relatively shallow southern part of the Pomeranian Bay, bounded on the north by a very shallow basin of Ławica Odrzana. The proximity of the Szczecin Lagoon has significant influence. Ice phenomena (especially during harsh winters) cause difficulties in shipping, restrict fishing activities and carrying out the dredging works. There is a destructive activity of ice in the coastal zone. The beginnings of research on ice conditions of the Pomeranian Bay go back to the nineteenth century. Detailed mapping studies of freezing conditions of the Pomeranian Bay were carried out by Girjatowicz (1999a, 1999b, 2001, 2005), Majewski (1974) and Sztobryn & others (2005). The observation material from the period 1945/47 - 1999/2000 was subject to statistical analysis (Girjatowicz, 2005).

As a result of variability of thermal conditions, the dynamics of water and ice flows, especially from the Szczecin Lagoon, on the Pomeranian Bay, we observe the high variability of ice conditions. There is an ice cover on the Bay, for the most period of time, formed from floating and then compressed and joined forms of ice, i.e. ice, ice floes and ice debris. As a result of wind activities, there is a drift of ice fields, dangerous for ships, banks and water engineering facilities. The first ice along the southern coast of the Pomeranian Bay appears in the second decade of January, the latest in open waters of the Bay - the first decade of February (Table 6).

The earliest, ice disappears in the open waters of the Pomeranian Bay is in the second decade of February. The ice disappears in the third week of February along the Bay coast , and in estuaries of Dzwina and Świna River - in the first decade of March (Table 6).

Table 6 The average characteristics of freezing of the Pomeranian Bay during 1946/47-1999/2000 (according to Girjatowicz, 2005)

Observation region	First ice	Last ice	Length of ice period	Number of days with ice
Świnoujście sea	12.01	7.03	42	27
Świnoujście port	1.01	5.03	60	39
Międzyzdroje sea	19.01	23.02	27	15
Dziwnów sea	7.01	1.03	44	19
Dziwnów port	27.12	2.03	54	28

Ice season (time in days, between the date of first ice and the date of the last ice) for the Pomeranian Bay is much shorter than in the Szczecin Lagoon. The longest ice seasons are over 50 and 40 days respectively in the estuary areas of rivers – Świna and Dziwna. Along the southern shore of the Bay this season is 30-40 days. On the open waters of the Bay, ice season is getting shorter and amounts to less than 10 days (Girjatowicz, 1999b, 2005). Also the number of days with ice on the Pomeranian

Bay, i.e. the sum of days on which ice occurred in the winter season is much smaller than in the Szczecin Lagoon. At the costs of the Bay, the figure is 10-20 days. On the open waters of the Bay, number of days with ice does not exceed 10 days. In the mouth of Świna River, as a result of inflow of ice from the lagoon to the sea, we observe the greatest number of days with ice (39 days). The greatest thickness of ice on open water of the Polish Baltic Sea Coast is 0.5 m ahead Świnoujście and Międzyzdroje.

Taking into account the freezing conditions of the Pomeranian Bay, dredging works and dredge spoil disposal in the ice season are difficulty. As a result of climate change, especially warming, disappearing of harsh winter, the length of the ice season is reduced and the period for execution of dredging works is extended. Long-term hydro meteorological forecasts and historical data from observation series of freezing allow for their optimal design. Schedule for the project provides that, dredging works and the spoil disposal, divided into two stages, will be performed during the months of June-November, when the probability of occurrence of days with ice is negligible.

4.2.5. Water circulation

Coastal waters in the area of the planned project of construction of a berth in the external port of Świnoujście are under the influence of the freshwater of Świna River (Majewski, 1974). Świna River is artificially regulated by the shipping channel (depth 15 m) leading to the Szczecin Lagoon. Of the three major freshwater tributaries (Świna, Dziwna and Piana Rivers) to the Pomeranian Bay, Świna River introduces up to 75% of the total freshwater inflow. The remaining rivers account for respectively 15% and 10% of the total freshwater inflow to the bay (Majewski, 1974). River water transported in the direction of the open sea with the surface currents moving in the direction which is in compliance with the impact of winds. Southeast winds intensify the movement of river water in a northerly direction, with winds from the south-west freshwater of Świna River is transported towards the north-east part of the bay. However, in the bottom layer a system of currents is often distinguished, moving in the opposite direction to the transport of surface waters.

The low tide of Świna River and water circulation have a significant influence on other physical and chemical parameters of water in this area including temperature, salinity, amount of load of metals and nutrient salts.

4.2.6. Temperature and salinity

Temperature

The vertical variation of temperature is dependent on the depth of the basin and the intensity of outflow of river water (Beszczyńska-Möller, 1999). The small depth in the coastal waters of the Pomeranian Bay allow complete mixing of water and lack of thermal stratification within the water column. Research conducted in 1993-1997 showed that, the levels of temperature gradient usually does not exceed 2°C throughout the Pomeranian Bay (Beszczyńska-Möller, 1999). Only during the early spring warming of surface waters and cool autumn, a significant horizontal variation of water temperature of region ranging from -5 ^{o}C to 6^{o}C was reported.

Horizontal sea water temperature changes depend on time of year, sea currents and the volume of river inflows and dynamics of outflows of freshwater to the sea. Seasonal changes in water temperature were investigated in the Pomeranian Bay in 2000-2003, as part of annual monitoring of coastal waters operated by the Maritime Branch of the Institute of Meteorology and Water

Management in Gdynia. Given the scope of dredging works planned in the coastal zone and spoil disposal on the proposed dump site, the variability of water temperature was examined on the part of the Pomeranian Bay located between the sea stations in Świnoujście and Międzyzdroje. Comparison of data from these two stations over the years 2000-2003 showed that, the variations in water temperature in this section are small. It is supported by the close proximity of the two measuring points and the low variability of meteorological conditions in the area of 15 km.

In spring (April, May, June), the mean temperature values at Świnoujście station are higher than in Międzyzdroje on average by about 1^{o}C. This difference is most likely due to the inflow of warmer river water of Świna River to the Pomeranian Bay, while in the immediate vicinity of Międzyzdroje there is no similar feeding. Based on the analysis of water temperature data from the years 2000-2003, in late autumn and winter (November, December, January), the reverse situation occurred when the mean temperatures in the region Międzyzdroje are higher by about 1^{o}C than the waters in the area of the Świna River mouth (Table 7 .) Maximum temperatures in the range 18,0-22,5°C were observed during the summer months from June to October. The lowest temperature on the western Polish coast was recorded from December to March and ranged from -0.4° to 3.0°.

Table 7 Average monthly water temperature (°C) in the Polish coastal area of Świnoujście and Międzyzdroje 2000-2003 (Environmental conditions ..., 2004; Southern Baltic in 2003)

Town	Year	Parameter	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Świnoujście	2000	$T_{śr}$	1,2	2,7	4,5	9,4	15,7	17,1	16,8	18,6	15,8	12,5	7,4	4,7
	2001	$T_{śr}$	1,0	1,1	1,9	6,0	13,3	16,1	19,9	20,0	15,9	12,6	6,7	1,9
	2002	$T_{śr}$	1,0	4,1	4,0	8,4	14,4	18,6	18,8	20,6	18,1	10,2	5,2	1,1
	2003	$T_{śr}$	0,5	0,4	1,9	6,8	13,6	18,0	19,7	20,5	16,6	10,8	5,2	4,1
Międzyzdroje	2000	$T_{śr}$	1,1	2,6	4,2	8,3	14,4	17,5	16,9	18,5	15,0	11,6	7,3	4,6
	2001	$T_{śr}$	2,0	1,7	2,5	6,5	13,0	15,6	20,9	20,5	15,9	12,8	6,8	2,0
	2002	$T_{śr}$	0,9	3,8	4,8	7,6	13,3	17,5	18,6	20,3	18,1	10,4	5,7	1,6
	2003	$T_{śr}$	0,8	0,0	2,9	6,2	13,0	17,8	19,3	20,2	16,6	10,3	6,5	3,9

Recent, detailed studies on water quality and biological elements in the area of planned dredging work in the outer port which is being built were carried out as a part of "Environmental impact assessment of a project consisting of construction of a shielding breakwater for the planned outer port in Świnoujście."

For the area covered by the planned works (the area designated for the construction of the breakwater, its proximity and water lane), research was carried out at 5 positions (ZP1, ZP2, ZP3, ZP4 and ZP5.) ZP3 position is located in the area of planned dredging works for the construction of the waterfront by the Seaports Authority and corresponds to the location of the berth. The research of physico-chemical parameters and biological elements quality in these positions was analyzed for three consecutive seasons: from late autumn 2007 through spring 2008 and summer 2008.

Fig. 15 Location of proposed sites (W1, W2 and W2A) for disposal of the excavated spoil from dredging works planned by the Seaports Authority and location of research stations in the Pomeranian Bay in 1996-1997 (Renk & others, 1999) and 2001-2003 (Chojnacki & others, 2007).

In December, there was no vertical temperature changes at the position ZP3 in the surface and bottom layer. The value of water temperature in this season remained at 4.7^{o}C. The largest vertical gradient with a value of 2°C was recorded at this position in summer, when the water temperature in the surface layer was 19.7 ° and 17.6° in the bottom layer. In spring, water temperature, gradually warming in the surface layer, was 6.25°C, whilst in the layer near bottom was around 1^{o}C.

Salinity

Seasonal distribution of salinity in the Pomeranian Bay depends, as in the case of temperature, on the extent and direction of spread of the freshwater of Świna River and the intensity of the inflow of marine waters from the open sea areas. Regular monitoring research conducted by IMGW showed that, the lowest gradient of salinity value in the Pomeranian Bay occurs in late spring and summer (May, June, July). Daily measurements of salinity at the station in Międzyzdroje showed that, the greatest changes in salinity values occur throughout the winter and early spring (January to April). During the cruise in April 2003 at the station SW3at the Świna River mouth, the lowest value of salinity of about 3.7 PSU (Southern Baltic in 2003)was recorded this year. A year earlier in June, the salinity at this station was 3.2 PSU (Southern Baltic in 2002).

During the cruises of r/v Navigator XXI in 2001-2003, a significant influence of water of the Odra and Świna Rivers on salinity in the surface layer was observed. Research conducted at the positions (SI, SII, SIII, MI, MII, MIII, LO) - figure 15, located in closer or further vicinity of the planned dredging works and the proposed location for the disposal of excavated spoil, show a decrease in the average values of salinity in the north direction. The lowest average values of salinity for the years 2001-2003 were recorded at stations located in the area of the estuary: at the station SI - 5.7 PSU in the surface layer, 6.13 PSU near bottom and at the station SII - respectively 6.24 and 6.56 PSU. At the research stations in the immediate vicinity of the storage of sediment, no significant effect of freshwater was recorded (Chojnacki & others, 2007).

Especially in the coastal waters of the Pomeranian Bay, seasonal occurrence of vertical and horizontal salinity gradient is observed. In the autumn, at the position ZP3 in the region of planned dredging works, there was no vertical changes in salinity values sustained at 7 PSU. In spring and summer, salinity values (up to 5.2 PSU) in surface water were significantly lower than the salinity of more than 7 PSU in near bottom water. In the summer, vertical variation in salinity was less than 0.85 PSU, while in the spring salinity gradient was about 2.5 PSU, and pointed to the increased inflow of freshwater from the mainland to the Pomeranian Bay (Mejszelis & others, 2008).

4.2.7. Oxygenation

Oxygen dissolved in sea water, in addition to salinity and temperature, is an important parameter characterizing the conditions of the marine environment. Oxygen content in water depends mainly on the intensity of occurring of biological processes and the inflow volume of sea and land water (on the amount of nutrients N and P and the temperature of water). The concentration of oxygen in water is subject to temporal and spatial changes. Oxygenation status of waters is generally correlated with phytoplankton blooms. During the blooms, the over-saturation of water with oxygen is observed, and after blooms stopping and starting the processes of mineralization of dead organic matter - oxygen deficits are observed.

Shallow waters of the western Polish coast, under continuous mixing process, are well saturated with oxygen and it is difficult to distinguish the presence of the vertical gradient of oxygen concentration in the water in the area of the proposed sites for spoil disposal from the dredging works for the construction of waterfront at the outer port of Świnoujście. Annual monitoring of IMGW showed that, average, winter concentrations of dissolved oxygen in the surface layer of the Pomeranian Bay waters ranged from about 9 to 10.5 $cm^3 \bullet dm^{-3}$. Maximum values of oxygen saturation, associated with spring air temperature rise and the beginning of the vegetation period, was recorded from May to June at the level of 130-140%. According to the seasonal cycle of changes in physico-chemical parameters of sea water, in late summer in August and September, there is decrease of oxygen concentration in the layer near bottom, associated with the final stage of the growing season and start the mineralization processes. Minimum concentration of dissolved oxygen in the Pomeranian Bay water fluctuated even around 3 $cm^3 \bullet dm^{-3}$, which lies within the range 2-4 $cm^3\ dm^{-3}$ defined as oxygen deficit (Southern Baltic in 2003).

Studies of surface waters of the Pomeranian Bay, carried out during cruises of r/v Navigator XXI showed that, the average concentrations of dissolved oxygen, of all seasons in 2001-2003 at stations: SI, SII, SIII, MI, MII, MIII and LO, changed in very limited scope: 10,45-10,832 $O_2 \bullet$ mg dm^{-3}. The average concentrations in water near bottom in the area of the planned dump site were only slightly lower than the average concentration of oxygen in the surface layer and the biggest vertical changes gradient in oxygen concentration occurred at the station MIII and was 0.33 mg $O_2 \bullet dm^{-3}$ (Chojnacki & others, 2007).

Monitoring studies conducted by the Regional Inspectorate for Environment Protection in Szczecin in 2008 showed generally good oxygenation of water in the area of the planned dredging works. Horizontal changes in the oxygenation of water in the area of the Pomeranian Bay were observed resulting from the periodic decrease in oxygenation of water in the area of the estuary during the inflows of Świna River. The average value of oxygen dissolved in water at monitoring site SW (near the Świna river mouth) was 8.1 mg $O_2 \bullet l^{-1}$. The most oxygenated waters at this station • 12.6 mg $O_2\ l^{-1}$ were recorded at the beginning of spring on 27/03/2008, and the lowest $O_2 \bullet$ 3.6 mg l^{-1} during the growing season, on 12/05/2008. Whereas on the seagoing Station No IV, located about 6 nm to the west from the proposed location of the spoil dump site, the minimum concentration of oxygen dissolved in water with a volume of 8.5 mg $O_2 \bullet l^{-1}$ is equivalent to the averaged value of all measurements at a station SW located in the vicinity of planned dredging works in the coastal zone. Oxygen saturation at both stations remained at a high level of 91.5% at SW to 129.7% at IV (Landsberg-Uczciwek & others, 2009).

Oxygenation in the coastal zone of the Pomeranian Bay is homogeneous and significant vertical changes in the value of dissolved oxygen in the water is not observed. In addition, at the position ZP3 in seasons: late fall, winter and spring, there was a high concentration of oxygen dissolved in water, both in the surface layer and near bottom, located in the range of 11.5 mg $\bullet\ dm^{-3}$ to 14.37 mg $\bullet\ ^{dm\ -3}$. Only in the summer and late autumn during the growing season and immediately after it, sudden drop in dissolved oxygen in the entire water column is observed. In the summer of 2008, at the position ZP3 concentration of oxygen dissolved in the layer near bottom was 7.16 mg $\bullet\ dm^{-3}$ and was by 2 mg $\bullet\ dm^{-3}$ less than the concentration of oxygen dissolved in surface water at the same time (Mejszelis & others, 2008 .)

4.2.8. Biogenic salts

The term biogenic salts defines element compounds of nitrogen (N), phosphorus (P) and silicon (Si) present in sea water. In other terms, they are called nutrients, since they are involved in the biochemical cycle in the marine environment. Sources of compounds of nitrogen, phosphorus and silicon can be divided into area and point sources (Bogdanowicz, 2004).

Biogenic elements from the source area may be of natural or anthropogenic origin (Kowal, 1997). The natural area sources providing nutrients to the marine waters are as follows: river flow rich with elements washed from the base, rocks and soil erosion, and decomposition of organic matter in the outflow area (Kajak, 1998). River flow from agricultural areas is a source of nutrient salts in sea water resulting from human activities. The main point sources of nutrients are channels of municipal waste water discharges, uncontrolled landfills and industrial waste water (Kajak, 1998). Large amounts of nitrogen and phosphorus are in wastewater from the food and cellulose industry. Detergents are the primary source of phosphorus in the waste (Kowal, 1997).

The form and the load of nutrients delivered to the marine waters depend on the conditions in the river bed and the area of the estuary, and thus on the speed of flow of river water, sedimentation dispersions velocity, velocity of sediments transported by river, the trophic status of waters and the associated presence of macrophytes and algae and the water temperature (Bogdanowicz, 2004). The concentration of elements entering into the sea also depend on the season, which is linked to, low - in the winter (with the loss of vegetation) or very high - in the spring and summer (fertilizing agricultural land, land drainage and collection of crops), level of human impact. Seasonal variability of river transport of nitrogen and phosphorus compounds affect the seasonal variability of concentrations of these elements in the coastal waters of the Baltic Sea. In the Photic layer of the sea, concentrations of nonorganic biogenic salts vary according to season, assuming the highest values in winter and lowest in spring and summer, during intense phytoplankton blooms using the available oxygen in the water, and after its exhaustion, oxidized nutrients to vital processes. Generally, for the whole Baltic Sea, the minimum concentration of nutrients within the period of spring and autumn blooms of algae are observed (Falkowska & others, 1999).

Monitoring studies conducted in 2001 by the Maritime Branch in Gdynia of Institute of Meteorology and Water Management in central Pomeranian Bay (the station B13) confirm the seasonal trend of changes of nitrogen, phosphorus and silicon compounds for the Baltic Sea. The highest concentrations of nitrogen and silicon were reported in winter and spring with heavy outflow of river water into the bay and at a very low primary production (Fig. 16)

Fig. 16 Long-term (1991-2000) seasonal changes in biogenic salt content (N, P and Si) in the surface layer (0-5 m) of the central Pomeranian Bay (station B13).

The opposite situation, seasonal changes in concentrations in 2001, was observed for phosphorus. In late spring, the concentration of dissolved phosphate reached a value close to zero, which indicates their rapid wear off. Therefore, phosphorus is considered to be a factor which limits the primary production in the Pomeranian Bay (Environmental conditions ..., 2004).

Spatial distribution of biogenic salt concentrations in the Polish economic zone has a horizontal trend (Łysiak-Pastuszak and Dragas, 2002). Because of the predominance of exports of nutrients into the sea from land-based sources (river) over the deposition from the atmosphere, higher nutrient

concentrations are quoted in the coastal zone than in open waters. This phenomenon determines the intensification of biological processes in estuaries and their immediate vicinity.

The results obtained from testing the waters of the Pomeranian Bay in 2001-2003 demonstrated high level of eutrophication in the coastal zone subject to the direct influence of river water (Machula & others, 2006). The biggest changes gradient of the concentration of total nitrogen (0.13 mg $N.dm^{-3}$) between water surface and near bottom occurred at the station SI located in the immediate vicinity of the planned dredging works. The maximum concentration with value of 0.777 mg $N.dm^{-3}$ at this station was recorded in the surface layer. At the other stations (SIII and LO) located at a distance of about 2 km from the designated field for spoil disposal, no significant changes in concentrations Ntot were observed. The homogeneous distribution of nitrogen concentrations in this region is supported with the presence of small depth and associated with this good mixing of water masses in the whole column from the bottom to the surface. The largest concentration Ntot recorded at stations SIII and LO in the surface layer were respectively 0.45 mg N.dm-3 and 0.32 mg $N.dm^{-3}$ and were comparable to levels of Ntot in the bottom layer of water. The lowest concentration of Ntot recorded at stations SI, SIII and LO did not differ significantly and fluctuated in the range 0,082-0,154 mg N.dm-3 in the entire water column.

A similar situation in these measuring points occurred in the case of reported concentrations of total phosphorus. The highest concentrations of Ptot (0.269 mg $P.dm^{-3}$ and 0.237 mg $P.dm^{-3}$) was recorded in near bottom layer and the surface layer at station SI near the estuary. At the offshore stations and SIII & LO maximum concentrations of Ptot ranged from 0.124 mg $P.dm^{-3}$ to 0.174 mg $P.dm^{-3}$. The smallest concentration of Ptot on the study area throughout the water column changed to 0,030-0,084 mg $P.dm^{-3}$. Only in contrast to the concentrations of Ntot, in the case of Ptot, generally higher concentrations in water near bottom, than in the surface layer, were reported. This phenomenon is characteristic of phosphorus - precipitating element in the sediments in the form of metal complexes with phosphates, and then secondarily released to the near bottom water in the environmental conditions of increased demand for oxygen.

Monitoring studies in 2008 performed by WIOŚ in Szczecin revealed high concentrations of total nitrogen for both SW station and station IV - far away from the coast. Ntot concentrations at the station SW changed from 0.4 mg $N \bullet l^{-1}$ (17 September) to 2.3 mg $N \bullet l^{-1}$ (16 April). Ntot concentrations on seagoing measuring point IV ranged from 0.4 mg $N \bullet l^{-1}$ (16 July) to 1.7 mg $N \bullet l^{-1}$ (16 April). Based on these ranges of Ntot concentrations, an assessment of the status of marine waters west of the Pomeranian Bay was carried out. The reported Ntot concentrations qualify coastal waters of the Pomeranian Bay on the basis of the Regulation of the Minister of Environment of 20 August 2008 on the classification of the surface water bodies to the category "less than good condition." Seasonal variability of Ntot confirms the phenomenon of interdependence of the concentration values on the intensity of river water inflows. Ptot concentrations at SW stations and IV station compared to other points on the Pomeranian Bay were low and fluctuated within the range 0,01-0,07 mg $P \bullet l^{-1}$.

4.2.9. Water Transparency

The development of phytoplankton and chlorophyll *a* concentrations have an impact on changes in water transparency. The decrease in visibility in the water was recorded in periods of high concentrations of chlorophyll *a* with strong algae blooming. Annual average visibility obtained in

2004 and 2005 remained at a level similar to that in the years 1985 to 2005 and amounted to 1.9 and 2.3 m respectively. In October 2005, at a position located about 4 nautical miles from shore the highest maximum value of transparency of 6,8 m for the past decades was recorded.

The smallest transparency in the above mentioned long-term fluctuated around 1 m was observed at the positions closest to the coast (Report on the state of the environment ..., 2006).

In June 2008, at the monitoring point of the coastal waters of the SW station (in the region of dredging works) transparency was 2 m. The average transparency was 1.7 m (Landsberg-Uczciwek & others, 2009). At station IV, away from the shore about 12 nm and located west of the proposed dump site for spoil disposal, water transparency ranged from 2 m to 4 m and the average transparency for this station was 2.4 m.

4.3. Biological quality elements

4.3.1. Phytoplankton and chlorophyll *a*

Phytoplankton

Phytoplankton creates a community of plants floating passively in the water column. Latest available data on the occurrence of phytoplankton in the coastal zone of the Pomeranian Bay are in a special edition of Oceanology of 1999 (studies: Renk & others, Gromisz & others), and also concern monitoring research of the Baltic coastal zone published by the Regional Inspectorate for Environmental Protection in Szczecin (2008) and the Maritime Branch of the Institute of Meteorology and Water Management in Gdynia (2000-2003). Generally, in coastal waters of the Baltic Sea in the Pomeranian Bay, taxa characteristic of brackish water such as green algae and cyanobacteria are observed in the composition of phytoplankton (Zembrzuska, 1973).

The characteristics of phytoplankton in the area of the proposed spoil dump site W2A was based on the research conducted in 1993-1997 from the deck of the vessel r/v Oceania of the waters of the Pomeranian Bay in the coastal zone. During the research, the occurrence of seasonal changes in phytoplankton species composition was found. The results of analysis of samples taken from the research station No. 27 located at a distance of about 1 km from the proposed spoil dump site showed that, in summer (July 1996) the composition of the phytoplankton was dominated by cyanobacteria (Aphanizomenon flos-aquae, and Microcystis sp. Aphanothaece sp.) Katodinium roturdatum and cryptomonads. On the neighboring stations: No. 33 and No. 25 respectively located to the west and east of the measuring point 27, the same species dominated during the same period (Renk & others, 1999). In spring (March 1996) there was a significant share of diatoms (Thallasiosira spp - 51-100%, Melosira arctica - 10%) and Dinoflagellate (Mesodinum rubrum and Heterocapsa rotundata - a total of about 30%) in the composition of phytoplankton, at these stations. Late spring (May 1997) was dominated by cyanobacteria Gomphosphaeria sp, Microcystis sp. and Aphanizomenon sp. In autumn, (October 1997) all stations were dominated by diatoms (Cosinodiscus sp. and Cosinodiscus granii - 51-100%) and cryptomonads (11 -25%). Biomass of phytoplankton in the open waters of the Pomeranian Bay ranged 1,3-3,2 mg • m^{-3} (Gromisz & others, 1999). Slight variations in the species composition of phytoplankton over a distance of 11 km covering stations Nos. 33, 27 and 25 points to the homogeneity of the environment in the area of the proposed place of disposal of sediments from dredging the basins for the waterfront in the external port in Świnoujście. Hydrological and hydrochemical conditions changing gradually from the mouth of

the Świna River towards the open sea affected the quantity and diversity of phytoplankton species accumulated in each of the studied seasons.

Phytoplankton in the area of the estuary of Świna River was more varied with regard to time and space. On the section of the coastal zone in the Pomeranian Bay (stations SW3 and SK), during the monitoring studies carried out by Marine Department of the Institute of Meteorology and Water Management in Gdynia, domination of flagellates, cryptomonads and diatoms was discovered. The greatest abundance of phytoplankton at both stations was recorded in spring (April), some 180 million units • m-3. At the SW3 station situated at a distance of about 2 km from the area of the dredging works in successive seasons: summer and autumn of 2001, the decrease in phytoplankton abundance from 100 million units • m^{-3} (June) to 5 million units • m^{-3} (November) was recorded with a simultaneous increase in phytoplankton biomass in the autumn months (IX / X) to a value of 45 mg C • m^{-3} (Environmental conditions…, 2004).

The presence of a dominant group and the taxonomic composition of phytoplankton in the area of dredging works in the external port of Świnoujście varies depending on the season. In the spring of 2008, the highest total concentration of phytoplankton was recorded resulting from the heavy inflows of river waters rich in salts, biogenic into the Pomeranian Bay and commencement of primary production processes. In winter (December), at the station ZP3 dominance of green algae (Chlorophyceae) was reported in an amount of 42,6-91,5% of the total density of phytoplankton and with the dominant taxa Oocystis sp, Scenedesmus sp. In the spring season, this station and the adjacent research positions (ZP2, ZP4) were dominated with diatoms (36,6-86,5% of the total phytoplankton density)with the most numerous represented taxa Asterionella formosa (35,4-95,8% the concentration of diatoms), Frangilaria sp. and Thallassiosira nordensllioeldi. In summer, cyanobacteria (Cyanophyceae) were the dominant group in the phytoplankton from 51% to 72.3% of the total density.

Chlorophyll a

Chlorophyll *a* values, which is an indicator of phytoplankton biomass in surface and the near bottom water in the area of the planned dredging works (the position ZP3), changed in all studied seasons 1,16-3,31 µg • dm^{-3}. Only the highest value of 11.79 µg • dm^{-3}, proving a clear diatoms blooming (Bacillariophyceae), was recorded in the surface layer in April 2008.

Study conducted in 2002 by IMGW in the Pomeranian Bay, at the station SW3, located in the vicinity of the planned dredging works and spoil dump site, revealed a very high average concentration of chlorophyll *a* amounting to 12.05 mg • m^{-3}. Scope of changes of chlorophyll *a* concentrations in all seasons was 4,89-18,82 mg • m^{-3} and these were among the highest values recorded during the monitoring study on the Polish coast. This resulted from high biomass of phytoplankton, which is the result of green algae bloom in the area.

Recent studies of chlorophyll *a* as a parameter of primary production in the Pomeranian Bay were carried out by WIOŚ Szczecin as a part of assessing the quality of surface water. At the SW station in the area of the Świna River mouth, much higher values of chlorophyll *a* concentration (from 10.5 mg m^{-3} • - 16 July to 43.4 mg m^{-3} • - 16 April) than at the offshore station IV (2, 6-30,8 mg • m^{-3}) was reported.

Chlorophyll *a* together with transparency are key parameters in assessing the intensity and degree of water eutrophication (Ochocki & others, 1999). Maximum values of chlorophyll concentrations in the Pomeranian Bay in 1985-2005 showed frequent exceeding of normative border (25 mg • m^{-3}) and fluctuated in the range 30-230 mg • m^{-3}. Assessment of the Pomeranian Bay waters on the basis of chlorophyll *a* indicates strong waters eutrophication. The average values of chlorophyll *a* concentrations fluctuated around 20 mg • m^{-3} (Protection Program ..., 2008).

4.3.2. Zooplankton

Zooplankton are animal organisms floating freely in the water column. In the Baltic Sea, the spatial and seasonal changes in abundance and species diversity of zooplankton are distinguished. Many animal species included in the zooplankton show a high environmental tolerance, both to salinity and water temperature. In general, trend of the high density and diversity of species is observed in the summer. In winter, the composition of zooplankton is relatively poor (almost homogenous). Spatial distribution is characterized by a decrease in density of organisms with increasing distance from the coastline. The zooplankton in the Baltic Sea also includes small crustaceans: marine Cladocera (Bosmina coregoni maritime, Evadne Normanni, Podon polyphemoides) and freshwater species Cladocera, such as Daphnia cucullata - mainly at the mouths of Świna and Dziwna rivers.

Studies of zooplankton in the region of the planned dredging works have shown that, the predominant share had taxa characteristic of the fresh and brackish waters: Freshwater Copepod Acanthocyclops viridis (Cyclopoida) (especially in the spring) and Copepod Acartia species (Calanoida). However, in studies by Machuła (2004), zooplankton was dominated, almost any time of year, by a typical Baltic species of Acartia bifilosa, which in some seasons was accompanied by an increased abundance of Cladocerans Evadne nordmanni, Podon intermedius, Podon leuckarti, Copepoda Acartia longiremis and Eudiaptomus gracilis, and rotifers (Rotifer).

In 2001-2003, research was carried out on seasonal changes and horizontal distribution of zooplankton in the region of the planned dredging works and the proposed spoil dump site. The greatest species diversity was observed among Cladocerans, which are the dominant taxon in each research season. Maximum density of Cladocerans was 213 493 specimen/m^3, including, inter alia, species: Pseudocalanus elonatus, Temora longicornis, Acartia bifilosa, Acartia longiremis, Acartia tonsa, Centropages hamatus, Cyclopina gracilis, Megacyclops virdis. Among the dominant species of Cladocerans was Acartia bifilosa with maximum density of 210 443 specimen/m^3. Periodically Cladocerans abundance and biomass can reach up to 90% of the total zooplankton (Chojnacki & others, 2007).

In the structure of zooplankton in the research by Mejszelis & others, 2008, distinct ecological succession is visible, which is characterized by changes in the dominance of taxa in successive seasons. In December, the largest share had of adult specimen of Cladocerans Acartia bifilosa, Temora longicornis & Acanthocyclops viridis. In April, larval forms of Cylopoida - Naupliuses and species Acanthocyclops viridis strongly dominated. However, during the summer, the dominance of the species Acartia bifilosa, represented by adult and larval forms was again manifested. In summer, the presence of zooplankton in a juvenile form of bivalve Bivalvia is also marked. At the station ZP3, in December 2007, the total abundance of zooplankton was approximately 1.7 • 103 specimen/m^3 and was the lowest compared to neighboring research positions (ZP4, ZP2).

4.3.3. Underwater vegetation – macrophytes

Macrophytes are benthic vegetation, submerged in water. It is composed of Angiosperms plants rooted in the soft bottom and macro-algea (Thallophyte with sizes of at least several millimeters) attached to hard substrates such as stones and non-attached, lying at the bottom in the form of clusters or algal mats. In the coastal zone in Świnoujście region, macrophyte researches have not been conducted yet.

Nevertheless, the potential occurrence of benthic vegetation in a given area may be discussed, based on available environmental data, such as sediment type, hydrological conditions and the bathymetry of the area.

Shallow basin selected for dredging is deprived of clusters of underwater vegetation (macrophytes), only the coastal zone and single stones may be covered with algae of the species Cladophora glomerata (seaweed).

Locally, the occurrence of patches of underwater vegetation is possible, as one can periodically meet accumulation of sea-grass on a section of beach between Świnoujście and Międzyzdroje. Probably, they are from the regions of central and northern parts of Ławica Odrzana and not from the coastal zone. Information provided by divers performing diagnosis of the seabed in the southern part Ławica Odrzana exclude the presence of sea-grass meadows in this region.

There is no rooted vegetation underwater at the designated area W2A of spoil dump site from dredging works for the construction of waterfront at the outer port of Świnoujście. A considerable depth of the bottom (about 13 m) and large distance from the shore and associated physical and geological conditions are not conducive to the development of macrophytes in the area. Phenomena of the so-called algal mats on the surface sediments has not been observed.

4.3.4. Associations of benthic fauna

Essentially, two groups of organisms are distinguished in associations of benthic fauna:

- meiobenthos composed of invertebrates with sizes not exceeding 1 mm,

- macrobenthos i.e. bottom organisms larger than 1 mm.

Meiobentos

Species composition of the marine meiobenthos of the Pomeranian Bay is poorly recognized (Borówka & others, 2007). This group in the bay is represented by a few to a dozen of so called higher taxa, among which freely living nematodes (Nematoda) are dominant in terms of abundance and biomass; other distinctive and fairly representative and numerous clusters of taxa, coming from crustaceans (Crustacea), are Copepod (Copepoda) and among them suborder (Harpacticoida) and ostracods (Ostracoda) , Gastrotricha (Gastrotricha) and Turbellaria. Nematodes and the Copepod of the suborder Harpacticoida are subject to detailed identification analysis (Rokicka-Praxmajer and Radziejewska, 2002). Analysis results confirm the high biodiversity of meiobenthos, especially of nematodes. In the sediment at the mouth of Świna River (in the region of dredging works for the construction of the berth in the outer port of Świnoujście), nematodes were the major component of meiobenthos, composing from 60% to 90% of its total size (Mejszelis & others, 2008).

The spatial distribution of the Pomeranian Bay meiobenthos shows a strong dependence on sediment type and degree of its enrichment with organic matter (Jończyk and Radziejewska, 1984; Rokicka-Praxmajer & others, 1998). Therefore, the highest density (of the order of several million individuals per 1 m2 of bottom) and biomass values of benthic meiofauna is observed in the estuarine areas, particularly at the mouth of Świna River (on the west side of the ship lane). Whereas, in areas of sandy bottom, with low organic matter content, abundance of this benthic fauna group is significantly lower. The occurrence of meiobenthos has not been studied yet in the area of proposed spoil dump site. However, it can be expected that - in the face of big dynamics of sedimentary environment and poor in organic matter (sheer sand) – number of bottom meiofauna will not be particularly high, but biodiversity may be significant.

The study of sediments in the area of the planned dredging works (ZP3) as a part of "Environmental impact assessment for the Project of Construction of the shielding breakwater for the external port in Świnoujście" showed that, nematodes (Nematoda) were the dominants in meiobenthos, constituting approximately 70 to 99% of all organisms in taken core sample. Among other taxa, with a significant percentage, Gastrotricha (Gastrotricha) and Turbellaria were distinguished. The average number of meiobenthos at the station ZP3 ranged from approximately 1 500 specimen/10 cm2 in summer to about 1 700 cm2 specimen/10 in other seasons. Taxonomic structure of meiobenthos and its dominance structure are consistent with the results of previously published researches on the meiobenthos associations in the coastal region of Pomeranian Bay (Praxmajer-Rokicka & others, 1998).

Macrobenthos

Macrozoobenthos (bottom macrofauna) is defined as a group of bottom invertebrates remaining in a sieve with a mesh size of 1 mm (HELCOM 1988) during sifting bottom sediment samples. It includes both organisms living on the surface of bottom sediment (epifauna) and in the sediment (infauna). It is formed by numerous, taxonomically diverse group of invertebrate organisms inhabiting almost all aquatic ecosystems. The majority are sedentary species with a long (at least annual) life cycle. Macrozoobenthos is considered as a good indicator of biological quality of waters (Diaz and Rosenberg, 1995, Gray & others, 2002, Rosenberg & others, 2002, Karlson & others, 2002). It reacts with changes in abundance, biomass and species composition to deterioration of ecological status, for example, as a result of progressive eutrophication (Cederwall and Elmgren, 1990, Rumohr & others, 1996).

Studies of Pomeranian Bay macrobenthos have a long tradition dating back to the thirties of the previous century, and therefore it is quite well recognized in terms of overall accuracy of the distribution in the Bay (Demel and Mańkowski 1951, Demel and Mulicki, 1954, and Nawodzińska Drzycimski, 1965, Żmudziński, 1982, Powilleit & others, 1995, Warzocha, 1995, Kube & others, 1996, 1997, Wawrzyniak-Wydrowska, 1996, Osowiecki, 1993-2000, Woźniczka, 2004).

The literature data show that, the Pomeranian Bay, not only in terms of numbers but the biomass, is dominated by mussels. The shallower areas of the bay are dominated by mussels Mya arenaria (68-85% of biomass), while deeper - mollusc Macoma balthica (69-73% of biomass) and Marenzelleria

neglecta and Hediste diversicolor, and mussels Cardium glaucum, whose participation in the macrobenthos biomass ranges from 1% to 8% (Powilleit & others, 1995).

During the monitoring research, at the station, B13, located approximately 16 km from the shore and closest to the designated spoil dump site from dredging works, the largest number of taxa (14 species) was found in comparison to other stations in the area of the Pomeranian Bay. Recent published data from the annual monitoring cruise by IMGW does not allow for analysis of seasonal changes in species and abundance structure at station B13 in the Pomeranian Bay. In 2003, macrobenthos research at station B13 was performed once in July, while in 2002 a research was conducted several times - hence the average value for all the analysis and range of abundance and biomass (Table 8). However, the results allow for the selection of the species most frequently occurring at the station B13 which include: Hydrobidae nd., Pygospio elegans and Macoma baltica (dominant species). In summer 2003, following were also numerous: Corophoum voluntator (15.2%), Marenzelleria viridis (12.9%), Oligochaeta nd. (9.8%) and Hediste diversicolor (4.1%) - tab.8. Percentage abundance of other species did not exceed 2%. In 2002, a significant share in the total numbers had also following species: Mytilus edulis, Gammarus Gammarus zaddach and Gammarus salinus (Southern Baltic in 2002 & 2003).

The highest rates of biomass: 68.9, 62.48 and 6.983 g • m^{-2} m.m. at the station B13 in July 2003 were recorded for the species: Macoma baltica (47.6%), Mya arenaria (43.1%) and Cardium glaucum (4.8%). For species Corophium volutator, Hydrobidae nd., Marenzelleria virdis biomass was recorded at level approx. 1.5 g • m^{-2} m.m. The biomass of other taxa occurring at station B13 did not exceed 1 g • m^{-2} m.m. In 2002, at the station B13, the total biomass of macrobenthos was dominated by molluscs: Macoma baltica (47%) and Mytilus edulis (38%).

This phenomenon, where the species composition of macrobenthos is dominated by mussels, was also found in previous studies: Powilleit & others, 1995; Calder, 2004a, b).

Macrozoobenthos in the area of the planned dredging works was characterized by a moderate taxonomic diversity. Research positions ZP1 (3.2 m) and ZP3 (5.8 m) located in the shallow zone of the basin were characterized by relatively low numbers of macrobenthos. The dominant species were: Mya arenaria and Cardium glaucum, snails belonging to the genus Hydrobia, Polychaete: Marenzelleria neglecta and Pygospio eleganas and crustaceans Balanus improvisus. There were no seasonal changes in the structure of dominance, only in December 2007 an increased percentage of Mytilus edulis and Balanus improvisus at the station ZP3 was found. Generally, in the case of the Pomeranian Bay macrobenthos, seasonal variability is much weaker than the spatial variability. Based on these studies and literature data, it can be concluded that the region, where the investment shall be located, is not distinguish with a particular species richness or high abundance of macrobenthos organisms. It is a generally shallow zone subjected to high waves energy, which does not form particularly favorable conditions for the existence of most species of macrofauna.

Table 8 The numbers and biomass of macrobenthos in the Pomeranian Bay in 2002 and 2003

Species	2002								2003 (July)			
	Number				Biomass (g/m^2 m.m.)				Number		Biomass (g/m^2 m.m.)	
	(%)	Aver.	Min.	Max.	(%)	aver	Min.	Max.	(%)		(%)	

Bylgides sarsi	-	-	-	-	-	-	-	-	0,5	10		0,011
Hediste diversicolor	2	80	50	110	0,2	0,1	0,11	0,18	4,1	83		0,975
Pygospio elegant	11	530	410	630	0,1	0,04	0,04	0,05	18,3	373		0,167
Merenzelleria viridis	2	97	50	140	0,04	0,04	0,02	0,06	12,9	263		1,657
Oligochaeta nd.	3	180	50	250	0,03	0,03	0,01	0,04	9,8	200		0,097
Hydrobidae nd.	61	2987	1830	4130	5	3	2,03	4,48	28,4	580		1,677
Cardium glaucum	0,2	10	10	10	4,9	3	2,12	5,39	1,8	37	4,8	6,983
Macoma baltica	5	250	190	290	47	33	28,8	36,3	6,5	133	47,6	68,900
Mya arenaria	0,3	13	10	20	5,1	4	2,73	4,97	1,3	27	43,1	62,480
Mytilus edulis	10	570	80	1260	38	37	10,7	81	0,5	10		0,011
Cyathura carinata	0,3	17	10	20	0,02	0,01	0,01	0,02	0,6	13		0,081
Jaera albifrons	0,1	3	0	10	0,01	0,003	0	0,01	-	-		-
Gammarus zaddachi	2	120	40	280	0,1	0,1	0,03	0,25	-	-		-
Gammarus salinus	2	130	40	300	0,1	0,1	0,02	0,33	0,1	3		0,083
Corophium volutator	0,1	3	0	10	0,01	0,003	0	0,01	15,2	310		1,753

4.3.5. Ichtiofauna

Coastal and estuaries waters play a characteristic role as a habitat for ichtiofauna. They create life space for both the adult forms of many fish species (migration, spawning grounds, feeding grounds) and juvenile forms (feeding ground, a hiding place, a place for intensive growth). Because estuaries are a zone separating fresh water environment and marine areas, we note the presence of fish fauna in the waters linking the two different environments. Unfortunately, due to the proximity of the coast and estuaries, these areas were always vulnerable to the largest anthropopressure usually being in conflict with the natural functions of bodies of this type.

Species composition

Fish is an biocenosis element, which is extremely difficult to assign to the observed area proposed as a place for spoil disposal. The reason is that, the majority of fish occurring in the Pomeranian Bay, in different parts of their life is linked to different parts of the area. Many species live in the Bay throughout the year, some swim here only during certain periods of their life, e.g. looking for a suitable places to spawn, or in search of rich feeding grounds. These migrations are mainly caused by the specificity of fish life cycle (spawning, feeding, wintering) and the variation of environmental conditions present in reservoirs.

Estuary nature of the Bay results in a rich taxonomic diversity of fish fauna, where typically marine species occur (connected with stronger salted open waters of the Baltic Sea) as well as fresh and berkish water species connected with freshly coastal water and waters of the Szczecin Lagoon. Based on the hydrological conditions prevailing in the basin affecting the living conditions of fish fauna, the Pomeranian Bay can conventionally be divided into two parts:

- south-west part located under the strong influence of freshwater of the Odra River by three straits flowing into it with three straits,

- south-east part with more marine character where the influence of fresh water is much smaller.

In the west part, we note much greater diversity of species composition of fish fauna because there are far more numerous freshwater fish migrating from Szczecin Lagoon water. East "sea" part of the bay is an area with less species diversity, dominated by marine fish. Water body part selected for

the discharge of sediment from dredging works is located in its western part, and species found in other areas of the Pomeranian Bay can occur there.

The presence of at least 31 taxa of fish are recorded in the waters of the discussed region of dredging works and sediment discharge. Constantly, there are 11 species of freshwater fish, 5 species of migratory fish and 15 marine (Wolnomiejski, 1997, Garbacik-Wesołowska and Boberski, 2000):

- Sea fish:
    - Herring (Clupea harengus)
    - Sprat (Sprattus sprattus)
    - Alosa fallax
    - Cod (Gadus morhua calarias)
    - Flounder (Platichtys flesus)
    - Plaice (Pleuronectes platessa)
    - Turbot (Psetta maxima),
    - Myoxocephalus Scorpius
    - Cyclopterus lumpus
    - Lesser sand eel (Ammodytes tobianus)
    - Greater sand eel (Hyperoplus lanceolatus)
    - Nerophis ophidion
    - Zoarces viviparus
    - Trachurus trachurus
    - Gobidae;

- Two-environment fish:
    - Brown trout (Salmo trutta)
    - Salmon (Salmo salar)
    - Rainbow trout (Oncorhynchus mykiss)
    - Eel (Anguilla anguilla)
    - Lampetra fluviatilis;

- Freshwater fish:
    - Whitefish (Coregonus lavaretus)
    - European smelt (Osmerus eperlanus)
    - Zarte (Vimba Vimba)
    - Carp bream (Abramis brama),
    - Roach (Rutilus rutilus)
    - Perch (Perca fluviatilis)
    - Pike-perch (Stizostedion lucioperca),
    - Ruffe (Gymnocephalus cernuus)
    - Pike (Esox lucius)
    - Burbot (Lota lota),
    - Stickleback (Gasterosteus aculeatus).

commercial species which occur in mass include: herring, sprat, flounder, perch, pike, roach and bream. Mass, non-commercial group include: Ammodytidae and Goby occurring mostly in the coastal belt to a depth of 10m (Psuty-Lipska and Garbacik-Wesołowska, 1998).

Fishing

Polish Maritime Areas (POM) are considered to be rich in fish resources. The productivity of fishing is an average of 35.9 kilograms per hectare, with an average for the Baltic 18.5 kg per hectare (Development strategy ..., 2008). It can be assumed that, waters constituting approx. 55% of POM are adjacent to West Pomeranian voivodship.

It is difficult to separate the resources of the Pomeranian Bay, as fishing boats stationed in the ports of West Pomeranian voivodship fish in the whole area of POM. The main species exploited by the Polish Baltic fisheries are cod, herring, sprat, flounder, salmon and trout. Polish fishing in the Baltic in subarea ICES 24 (west coast) in 1999-2001 averaged 10 600 tons. Overall, Baltic fishing during this period averaged to 142 000 tons. The project in question is within the territorial sea of the Republic of Poland (up to 12 nm from the coastline), where coastal fishing is carried out using deck motor boats with a length of 13 m. The zone with a width of 3 nm from the coast is an area of water prohibited for cutter and spawning fishing. On the discussed area, fishermen from five bases fish: Świnoujście, Ognica, Karsibór, Międzyzdroje and Przytór. The basic gear is bag nets and cod and eel hooks.

Fishing in the coastal belt was evaluated based on the years 1998 and 2001 (Table 9). The size of boat fishing decreased from 3 000 tons in 1998 to 2 100 tons in 2001. In the past few years, the tendency of decreasing fishing effort in boat fishing in the Pomeranian Bay (including the discussed water body) has been maintained in relation to compensation received from the European Union for the scrapping of vessels. Boat fishing in the Pomeranian Bay is over 70% of the coastal belt fishing and the two bays. Over 75% of the fishing constitute herring and cod, and the rest are freshwater fish or two-environment fish. (Table 9).

Table 9 Size of boat fishing by species and regions in 1998 and 2001 in tons Source: Sea Fisheries Institute, 2002.

Fish species	1998		2001	
	Pomeranian Bay	Total Boat fishing	Pomeranian Bay	Total Boat fishing
Cod	220,5	1448,4	482,1	1490,2
Herring	2479,0	3934,8	1147,1	3048,3
Flat fish	84,0	1734,9	214,4	1591,1
Other	232,5	3867,8	280,6	3806,1
Including roach	-	-	88,7	1324,6
Total	**3016,0**	**10 985,9**	**2124,2**	**9936,7**

The basic species present in the catches are cod, herring, flat fish, sea trout, pike, perch, eel, bream and roach (Garbacik-Wesolowska and Boberski, 2000).

Dominant species in the fishery is herring fished mainly in the coastal zone "Herring harvest" take place in the Bay in the months of March-May (Kaczewiak, 1995). In those months, the fishermen use spawning concentrations of fish swimming in mass into shallow coastal areas to spawn. After spawning in June, herring leave the water of the Pomeranian Bay (Kaczewiak, 1997).

Flounder is the second most important sea species of fishing conducted in the coastal waters of the Bay, which fishing constitutes from 0.2 to 2.6% of the overall fishing (Garbacik-Wesołowska and Boberski, 2000).

Fishing for freshwater fish is focused on pikeperch and perch. Most productive perch fishing is recorded in the spring during the post protection season, when the fish return to the feeding grounds of the Pomeranian Bay (Garbacik-Wesołowska and Boberski, 2000). In the most shallow coastal waters strip, fishing of the freshwater fish is dominated by roach, bream and pike.

In the area of the proposed spoil dump site, fishing boats catch fish. There are productive fisheries of flounder and herring, and less efficient of cod and sprat only on Ławica Odrzana and adjacent waters to the east in the Pomeranian Bay. Migratory and freshwater fish constitute a relatively small component of the fishing. Statistics show only fishing of salmon, pike and perch, but also following fish are caught: pike, bream, roach, and others, but they are not reflected in official statistics because of the high attractiveness and connected with that sales from the boat.

On the fisheries in the area of dredging works and spoil disposal in a variant of 1, fishing of cod in 2003 amounted to 2 tons, herring 25 tons (Baltic square D1). For locations – variant 2, fishing was much higher and amounted to: cod - 16 tons, herring - 467 tons, flatfish - 9 tons (Baltic square D2). The most abundant fishery of herring and sprat are located north of the studied areas, and of flatfish like cod in the vicinity of Kołobrzeg (Fig. 17 and 18).

Fig. 17 Summary of results of fishing in 2002 - fishery adjacent to the coast of West Pomeranian voivodship (Szostak, Kuzebski, Pieńkowska, 2004 - Source: Strategy for the economy ..., 2006)

Fig. 18 Quantitative and qualitative summary of fishing in 2002 in 106 squares (fishery-Kołobrzesko Darłowo) and 107 (fishery Ławica Odrzanej) (Szostak, Kuzebski, Pieńkowska, 2004 - Source: as above)

Protected species

On the list of species occurring in the Pomeranian Bay, there are also species subject to the total species protection, currently protected by national or international law [1,2,3,4] (Garbacik-Wesołowska and Boberski, 2000):

- Alosa Alosa and including Alosa fallax,

- Pelecus cultratus,

- Spinachia spinachia,

- Sygnathus typhle,

- Liparis Liparis,

- Pomatoschistus minutus,

- Pomatoschistus microps,

- Myoxocephalus quadricornis,

- Petromyzon marinus,

- Lampetra fluviatilis,

- Gobio kessleri,

- Rhodeus sericeus amarus,

- Noemacheilus barbatulus,

- Cobitis taenia,

- Cobitis aurata,

- Misgurnus fossilis,

- Acipenser sturio - considered extinct,

[1] - Regulation of the Minister of Environment of 28 September 2004 on the species of wild Animals under protection (Journal of Laws No. 220, item 2237).

[2] - Convention of 19 September 1979 on the conservation of European wild flora and fauna and their habitats (Journal of Laws of 1996, No. 58, item 263) - Bern Convention.

[3] - Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora - the Habitats Directive.

[4] - Act on marine fishing of 18.01.1996 (Journal of Laws of 1996 No. 34 item 145).

Among the mentioned species, only occurrence of small number of fish taxa is confirmed in recent years in the Bay (Wysokiński, 1998). Most freshwater fish is linked to the inland waterways and areas overgrown with vegetation. It is unlikely that, these fish would live on sandy bottom areas, which are planned as a place for the sediment deposition (depth> 10m). Sygnathus typhle, Liparis Liparis and Spinachia spinachia are marine species and are also associated with bottom overgrown with vegetation but not found in the analyzed region.

Pomatoschistus minutus is associated with the sandy bottom of the analyzed area for spoil disposal - (Horackiewicz and Skóra, 1996). It is quite frequently occurring species on the Polish coast, whose presence on the list of protected animals seems to be debatable (Skóra, 1996).

Fish protection

On the waters of the Pomeranian Bay, fishing is banned on fish spawning migration routes and spawning grounds. Reproductive associations of flounder, plaice, turbot, salmon and pre-spawning associations of zander are protected. For this reason, certain areas of the Pomeranian Bay are permanently or temporarily excluded from fishing. Anchoring and ship lanes are also closed for fishing, as well as certain parts of water bodies are temporarily closed for the Navy.

Regulation of the Minister of Maritime Economy of 22 March 2007 on the dimensions and protection seasons of marine organisms and the detailed conditions of implementation of marine fishing (Journal of Laws, No. 56/2007, item 384) and Council Regulation EC No 1041/2006 of 11 December 2006 fixing the sizes of permitted fishing sizes and associated conditions for certain fish stocks and groups of stocks applicable to the Baltic Sea for 2007 (Journal of Laws EU of 22 December 2006) establish the protection periods for the following species of fish :

- Turbots and brills- in the period from 1 June to 31 July,

- Plaice and flounder - in the period from 1 February to 30 April,

- Cod - in the period from 10 June to 20 August,

- Salmon and sea trout - in the period from 15 June to 30 September outside the four-mile lane of coastal waters,

- Sea trout - in the period from 15 September to 15 November in the four-mile lane of coastal waters, excluding the waters within the territorial jurisdiction of the Maritime Office in Gdynia.

Besides, on Ławica Odrzana in places limited with isobath 10 m and four-mile lane of coastal waters following is valid:

- prohibition of fishing using all towed gear,

- use of appropriate mesh size in nets.

Important areas of the basin for the local fish fauna and costal fishing

In coastal waters of the Pomeranian Bay, there are not actually such species of fish that could be attributed only to this area, because they occur periodically, coming there for spawn or for feeding, and at the end of their life processes (feeding or spawning) leave the area. There is a correlation of fish fauna occurrence (connected with biological rhythms of fish from those waters) with the waters of the Bornholm Depth (plaice, cod and sprat) with adjacent estuaries and the Szczecin Lagoon (pike-perch, bream, perch, roach, salmon, whitefish and eel).

Spring herring spawning

The analyzed region of the planned discharge of sediment is a very important area for local fishing. The basin itself is one of the most important breeding grounds for spring herring occurring in the Bay in March and moving toward traditional spawning grounds in the coastal zone. Spawning grounds of the herd are located in shallow coastal waters (3-12m), in the lane to 3 NM from shore. Spawning begins in late March and early April and ends in the second half of May (Porębski, 1995). Fishing for herring in the area of Pomeranian Bay are based on the spawning concentrations.

Areas where young flatfish mature and habitats of their adult forms

The analyzed area of the Pomeranian Bay is a feeding region for flounder and sprat (Elwertowski, 1954; Popiel, 1955) – Fig. 21. Flounder is one of the most important species in the southern Baltic coastal fishing. It spends the winter in deeper, warmer waters, where early in spring it spawns. After spawning, flounder moves towards the shore in search of feeding places. It stays in the shallow coastal zone to winter. In the boat fishing, flounder begins to appear in May and is exploited to late autumn (Garbacik-Wesołowska and Boberski 2000). Sandy coastal zone of the Pomeranian Bay is also the area where youth flounder stays. From the deep spawning grounds, few-millimeter larvae swim to the shores, where they stay in the shallower waters to winter. Sandy bottom of coastal waters is also a spawning grounds for turbot – fish valuable in terms of fishing. This species is breed near shores in the summer.

Habitat and spawning grounds of gobies and Ammodytidae

Sandy nature of bottom is the typical habitat of protected Pomatoschistus minutus and Ammodytidae occurring in the Pomeranian Bay. In addition to the ecological role that, these taxa have in the ecosystem (e.g. food for predatory fish), Ammodytidae are an important element in coastal fishing. They are caught to be used as bait in hooked fishing.

Occurrence areas of freshwater fish

Pomeranian Bay, and particularly its fresh part which is strongly influenced by the fresh waters of the Odra River, is a traditional feeding water body for many species of freshwater fish. These fish which occur in the Pomeranian Bay belong to the stocks inhabiting between the Szczecin Lagoon and Bay. These flocks constantly migrate between the Lagoon and the Bay. Roach, bream and pike can be encountered closest to the shore. The range of zander and perch occurrence is more extensive and reaches several nautical miles (Garbacik-Wesołowska and Boberski 2000). The main spawning grounds of cod according to ICES are located outside the planned area of the spoil disposal. Feeding areas of cod and herring mainly cover the eastern part of the proper Baltic and the Gulf: Finland and Bothnia (Fig. 20).

Monitoring results of fishing of fish occurring in the coastal zone of the Pomeranian Bay

During the period from April 2007 to August 2008, under the Sectoral Operational Programme for Fisheries and Fish Processing 2004-2006 under the direction of S. Dudko, monitoring of fishing was carried out in the coastal zone of the Pomeranian Bay in relation to the species structure of the stocks and longitude structures of some fish populations of commercial use (Dudko & others, 2008). In the vicinity of the analyzed location of the spoil dump sites, there are three research cruises route: E, H and R, where a total of 19 one-hour hauls were performed using a research vessel of SMB-AR-1.

In the control fishing, fish belonging to 22 species were caught, of which only 14 fish species on the listed routes. Among them, regardless of the location of routes, the biggest role was played by flounder - on average in two years of the study they constituted 42% and perch (29%). Turbot and plaice were represented in the composition of fishing at the level of 3.9% and 3.4%. Participation of zander and roach in the fishing was similar and amounted to approximately 25%. Cod was about 1.1%. Fish belonging to the species: Cyclopterus lumpus, bream, ruffe, European smelt occurred in single specimen. Relatively, Myoxocephalus Scorpius was in large quantities. Analyzing the number of fish caught in control towed gear, it can be concluded that, going further from the shore, smaller number of them was caught, with invariable dominance of flounder and perch. A relatively small proportion of pelagic fish resulted from the survey methodology aimed at catching bottom fish.

Figure 19 Location of main spawning grounds of Baltic fish species,
Figure 20 Location of the main feeding areas of cod and herring
Figure 21 Location of the main feeding areas for flounder and sprat

4.3.6. Avifauna

Pomeranian Bay is considered one of the most important Baltic waterbird concentration areas. Shallow areas of the basin, as Ławica Odrzana and estuary area of Świna River draining into the bay

Odra River waters rich in organic matter and nutritive salts, are among the main sites of birds wintering in the southern Baltic Sea. The importance of this area increases during severe winters, when water bodies located in the northern and eastern parts of the Baltic Sea freeze. Then, birds staying there move to areas richer in food resources in the milder climate on the south coast. In addition, Pomeranian Bay lies on the route of the main migratory routes of the avifauna from north-east to south-west. Therefore, due to the natural importance of Pomeranian Bay for migratory and wintering birds, this area was included in the Natura 2000 network. Report assessing the impact of the proposed project is limited to a group of aquatic birds, because of the likelihood of violations of their natural living and feeding habitat. Presented characteristics of birdlife is based on literature sources.

In terms of occurrence, birds in coastal marine waters in the area of Świnoujście can be divided into: sedentary birds - the species or populations remaining throughout the year on a given territory and closing there their reproduction cycle and migratory birds - which can be divided into three groups: breeding birds (species or populations flying to Poland for the breeding season only, migrating to the countries of south-western Europe or to the depths of Africa for wintering), wintering birds (species or populations of birds arriving from the north-east to Poland on the wintering grounds), migrating birds (species or populations of birds staying in Poland in order to get food during the journey from breeding grounds to their wintering grounds, or vice versa, they are primarily birds of the wetlands) - by Brichetti (2005). Strongly developed migration of birds makes that, their effective protection is discussed in an international context, a fundamental criterion valuing a given area is consideration of not only the occurrence of breeding birds, but also not-breeding birds (Gromadzka and Gromadzki, 2003).

Birds frequently occurring in the area of Świnoujście are listed in most international conventions and the Polish law on protection of wild animals. The criterion of qualifying the Pomeranian Bay to the Natura 2000 sites was the gathering of over 1% of the European population of 10 species of birds in this region. Morphological constraints of basin were also important, in which shallow water area, which is favorable for feeding, is about 1 500 km^2 (Table 10).

Table 10 General characteristics of marine habitat in the Pomeranian Bay (Osowiecki, 2004)

The shallow areas (<10 m depth)	1 500 km^2
Average number of wintering sea ducks	around 1 250 000
Number of species for which the Pomeranian Bay is a mainstay of international importance	10 (Black-throated Loon, Red-throated Loon, Great Crested Grebe, Red-necked Grebe, Horned Grebe, Long-tailed duck, Common Scoter, Velvet Scoter, Red-brested Mergnaser, Black Guillemont)
Number of species for which the Pomeranian Bay brings together more than 30% of the population wintering in Europe	2 (Horned Grebe, Red-brested Mergnaser)
Number of species for which the Pomeranian Bay brings together more than 20% of the population wintering in the Baltic Sea	5 (Great Crested Grebe, Red-throated Loon, Horned Grebe, Red-brested Mergnaser, Black Guillemont)

According to the Regulation of the Minister of Environment dated 09/28/2004, all water birds found in the Pomeranian Bay with the exception of cormorant (Phalacrocorax carbo) are under strict protection, including three species: Red-breasted Merganser (Mergus serrator), merganser (Mergus

merganser) and Shelduck (Tadorna Tadorna) and require active protection. Three bird species occurring in the Pomeranian Bay are on the red list of endangered and threatened animals in Poland (Głowaciński, 2002) and they are: Red-breasted Merganser (Mergus serrator), Shelduck (Tadorna Tadorna) and Black-throated Diver (Gavia arctica).

In general, the risk status of loons in Europe is unfavorable, because in the absence of active protection it is a species vulnerable to extinction. Following species have similar status: Aythya (Mergus Albellus), merganser (Mergus merganser) and plunger (Cepphus Gryll). Four species of birds occurring in the bay are listed in first annex to the Birds Directive. The standard data form for the Pomeranian Bay also lists seven species of migratory birds regularly and quite frequently occurring in the area.

Various species of sea birds show a variable degree of focusing within their preferred environment. As a result of a short distance of the central part of the planned investment area from the coast (Variant 1 - approximately 14 km variant 2a - about 19 km) and taking into account the mobility of birds, when assessing the number, birds found in open waters of the southern part of the Pomeranian Bay and the coastal zone avifauna were taken into account . Wintering ducks - Clangula hyemalis - largest, Scoter (Melanitta nigra), Red-breasted Merganser (Mergus serrator) and Uhl (Melanitta fusca) are dominant in the Baltic avifauna.

The climatic conditions in that season have major impact on the density of divers (Gavia sp) in different areas of the bay. There is a significant increase in the number of divers in the coastal area in autumn and winter during heavy storms on the open waters of the Pomeranian Bay. In general, in the coastal zone a few individuals of this species are reported, what results from the fact that, these birds usually migrate away from the coast. The total number of Black-throated and Red-throated Loon on the Pomeranian Bay is estimated at over 6 000 birds (Durinck & others, 1994).

In February 1995, in the coastal zone in the region of Świnoujście, the concentration of grebe (Podiceps sp) in the number of 2 000-4 000 birds was recorded (Tomiałojć & Stawarczyk, 2003). Among these, crested grebe (Podiceps cristatus) was the most numerous (4 200 individuals), however occurring in the majority on the German coast. Within the Polish territorial waters, its size was probably approx. 1 000 birds (Manuals of protection of habitats and species, Natura 2000), but also more numerous concentrations were recorded.

In October 2003 (Kejzer and Jasinski, 2005), observation and counting of bird species were conducted on the Baltic coast, including the Świnoujście-Przytór section (km 423-418). The most numerous species in this section are: crane (Grus grus) - 261 individuals, Mallard (Anas platyrhynchos) - 97 individuals from the family Anatidae, goose (Anser fabalis) - 95 birds and great crested grebe (Podiceps cristatus) -in the number of 88 individuals from grebe family. High concentration of these species during the counting in October is subject to their life cycle. The presence of numerous crane and geese in the autumn in the region of Świnoujście is the result of flights from breeding areas in northern Europe to wintering grounds in south-western part of Europe. On the other hand, grebe is a species wintering on the southern coast of the Baltic Sea, and therefore its concentration in the Polish coastal zone is increasing during the winter months. Lack of certain birds popular on the Polish coast, such as *Melanitta nigra*, *Melanitta fusca* and Clangula Hyemalis, during observations in 2003, can result from the habitat preferences of these species. These birds gather in large numbers on areas rich in food resources located far away from the shore, which in turn makes it impossible to

accurately test their numbers. On 5-km section Świnoujście-Przytór, 689 birds of different species were observed. Summing up the birds belong to the individual orders, their percentage in the total number of birds of this region was determined (Table 11). In autumn 2003, the cranes were most numerous (38% of all recorded birds during this period). Common dominants of south Baltic avifauna are ducks, classified in the order Anseriformes - 35% of all birds counted during research in 2003. Species belonging to the orders: grebes (Podicipediformes) - 13% and the Charadriidae (Caradariiformes) - 8% have also significant participation. Percentage of birds from order Pelecaniformes was about 6% - presence of 40 cormorants (Phalacrocorax carbo) was reported. Of all observed birds at that time, the smallest share of less than 1% had birds of the order passerine (Passeriformes).

Table 11 Spring and autumn migration and number of wetland birds in the two sections of the Polish sea shore in October 2003 (Kejzer and Jasinski, 2005) and January 2007 (Meissner, 2007)

Order/Family	Species	Birds migration (non-hatching)		Section Przytór-Świnoujście (km 423,0-418,0) October 2003	Section Międzyzdroje-Świnoujście (km 412,0-424,1 January 2007	Section Świnoujście-border (km 424,1-428,4) January 2007
		Spring passage (months)	Autumn passage (months)			
Gaviiformes / Gaviidae	*Gavia arctica*	III-VI	IX-XII			
	Gavia stellata	III-V	IX-XI			
Podicipediformes / Podicipedidae	*Podiceps cristatus*	III-IV	VIII-XII	88	6	2
	Podiceps auritus	III-V	IX-XII			
Pelecaniformes / Phalacrocoracidae	*Phalacrocorax carbo*	II-VI	VI-XI	40	70	30
Ciconiiformes / Ardeidae	*Botaurus stellari*	III-IV	VIII-XI			
	Ixobrychus minutus	IV-V	VIII-X			
	Ardea cinerea	II-III	IX-X			
Anseriformes/ Anatidae	*Cygnus olor*	-	-	4	16	18
	Cygnus cygnus	II-IV	X-XII			
	Anser fabalis	III-V/	IX-XI	95		
	Anser albifrons	III-V/VI	IX-XII			
	Anser anser	II-III	XI/XII			
	Anas penelope	III-V	IX-XII	6		
	Anas strepera	III-V	IX-XI			
	Anas crecca	III-V	IX-XI	18		
	Anas platyrhynchos	II-IV	IX-XII	97		2
	Anas acuta	III-IV/V	VII/VIII-X/XII			
	Aythya ferina	III/IV	X			
	Aythya fuligula	II/III-IV	VI-XII	15	5	
	Aythya marila	II/III-IV	VIII-X			
	Mergus merganser	III-IV	X-XI	3	34	
	Clangula hyemalis	III-IV	IX-XI		2	
	Melanitta fusca	III-IV	X-XI			
	Melanitta nigra	III-IV	VIII-X	1	46	18
	Bucephala clangula	II/III-IV	IX-XII	5	3	2
	Mergus serrator	IV-V	IX-XI			
Charadriiformes / Charadriidae	*Charadrius hiaticula*	II-III	VII/VIII	5		
	Pluvialis squatarola	IV-V	VII-XI	4		
Charadriiformes / Haematopodidae	*Haematopus ostralegus*	III-IV	VIII-IX	2		
Charadriiformes / Scolopacidae	*Calidris alba*	III/IV-V/VI	VII-X			
	Calldris alpina	III	VII/VIII	31		
Charadriiformes / Laridae	*Larus fuscus*	II-V	VII-XI			
	Larus argentatus	-	-		200	50
	Larus radibundus	III-IV	VII-XI		70	100
	Larus canus	III	IX-XI		50	50
	Larus marinus	II-III	IX-XI		10	5
	Sterna sandvicensis			4		

Charadriiformes / Sternidae	*Sterna hirundo*	III/IV-V	VII-X	7		
Gruiformes / Gruidae	Grus grus	II-IV	IX-XI	261		
Passeriformes / Motacillidae	*Anthus petrosus*	III-IV	IX-XI	3		
Total				689	512	789

As a part of project "Development of documentation to establish a system of marine protected areas critical for biodiversity conservation in the most valuable areas of the Baltic Sea" in January 2007, ornithological field research was conducted, covering, inter alia, Special Protection Area PLB 990003 “Pomeranian Bay". Birds were counted from the shore using binoculars and spotting scopes in good weather conditions. Observation area was divided into 13 regions, including two sections of the coastal belt covering an area of the planned investment: Międzyzdroje-Świnoujście, Świnoujście-border. The most numerous species in both regions were: herring gull (Larus argentatus) -250 individuals, Gull (Larus radibundus) -170 individuals, Common Gull (Larus canus) -100 bird and cormorant (Phalacocorax carbo) -100 birds. Melanitta nigra was the most common species (64 individuals) in the study area among the birds subject to strict protection. In the section Międzyzdroje-Świnoujście, merganser (Mergus merganser) was quite numerous (34 individuals), whose distribution was uneven – no individuals at a section of Świnoujście-border. In total, over a distance of Międzyzdroje-Świnoujście, 512 specimens of all species of birds were reported, and in the adjacent section of Świnoujście-border, twice less (277 birds). The density of birds on both of the a/m sections was moderate compared to other tested coastal sections of the Pomeranian Bay, for which the density has changed in the scope 14-51 individuals/km^2. It amounted to 28 individuals/km^2 on the section Świnoujście-border and to 19 individuals/km^2 on the section Międzyzdroje-Świnoujście (Meissner, 2007). Summing up the number of birds belonging to different orders, it was found that ducks constitute 68% of all birds counted at that time. Subsequently, there are gulls from family Charadriidae (18%). Percentage participation of Pelecaniformes and grebes in the total number of birds in January 2007 was respectively 13% and 1%.

Birds as a last or one but last trophic chain are very sensitive indicator of environmental changes and react quickly to any disturbance to their regular life cycle. The biggest threat to avifauna is the loss of habitat, which is often a result of intensive anthropogenization of the areas as a result of construction of ports, strengthening of sea coasts and shores of lakes (Gromadzki & others, 2002). Food was the criterion determining assessment of the impact of the proposed project on birds in the area of planned dredging works and spoil disposal on a designated dump site. Birds of the wetlands in this region were divided into five morphological and ecological groups: benthos-eating - birds feeding mainly on mussels, which they catch from the bottom of the basin while diving: Aythya fuligula, Bucephala clangula, Aythya Marila; fish-eating – fish eating species: cormorants (Phalacrocorax carbo), great crested grebe (Podiceps cristatus), Horned Grebe (Podiceps auritus), Red-breasted Merganser (Mergus serrator), Black-throated Diver (Gavia arctica), common tern (Sterna hirundo), phytophages - herbivore species: mallard (Anas platyrhynchos), mute swan (Cygnus olor), insectivorous - insectivorous. species: lesser spotted eagle (Aquila pomarina) and omnivorous species: little gull (Larus miniutus).

Polish zone of territorial waters in the region of south-west coast on a section Świnoujście-Dziwnów is characterized with the highest average density of ducks (Clangula hyemalis and Melanitta fusca) amounting to 95 individuals per km^2 (Meissner, presentation) on the Polish coast. Depth of basin is

a factor determining distribution of ducks, collecting food from the bottom of water bodies. Among others, Melanitta nigra is present in the zone to a depth of 20 m, especially in winter. Clangula hyemalis occurs in high density in the shallow areas, and Melanitta fusca occurs most often in deeper areas. Mussels are the basic component of food during the winter (September to April) for diving ducks. It was estimated that, during the winter ducks in the number of 40 000-90 000 individuals consume more than 25 000 tons of marine organisms, of which about 20 000 tonnes of mussels (Stempniewicz, Meissner, 1999). Density of divers (Gavia sp) is influenced by climatic conditions in that season. There is a significant increase in the number of divers in the coastal area in autumn and winter during heavy storms in the Baltic Sea. In general, in the coastal zone, a few individuals of this species are reported, what results from the fact that, these birds usually migrate away from the coast. The most numerous and most frequent grebes (Podiceps sp) are found outside the breeding period during the flight. In winter, this species prefers shallow inland and marine waters, well protected from wind and waves. South-west coast is a popular wintering grounds, mainly during the harsh winters, when the birds move inland from frozen reservoirs of the Baltic coast. However, there are no accurate data on the number of long-term changes in the number of grebe in the area of Świnoujście.

4.3.7. Marine mammals

Mammalian fauna of the Baltic Sea is poorly diversified. Only four species are the permanent residents, including three species of seals and a small whale - the porpoise. The presence of marine mammals in the Pomeranian Bay is observed extremely rare.

Grey Seal (Halichoerus grypus), visiting Polish shores, most often banks, occurs from north of the Baltic Sea to the Gulf of Riga. It is the largest of the Baltic seals. To the first half of the twentieth century, it inhabited numerously southern Baltic. Currently, mostly young individuals appear in this region coming to us primarily from Estonia. The size of its population in the Baltic is about 17 000 individuals. In the years 1980-1997 in the coastal area of Wolin National Park, one gray seal was observed. Also three unidentified individuals were observed.

Common Seal (Phoca vitulina) usually lives in shallow waters, near sandy or rocky beaches. In water, the animals are usually seen singly or in small groups, grouped on land, however not staying too close together. It is a resident of the Danish Straits and west of the Baltic Sea, roughly following the line of islands: Wolin - Bornholm - Gotland, where it exists in small population. However, this species is observed extremely rare along the Polish coast - on average less than one individual per year.

Ringed seal (Phoca hispida) is the smallest of the Baltic seals. It lives mainly on the eastern part of the Baltic Sea and the Gulf of Finland. It occurs usually singularly. In 1991-1996 along the Polish coast of the Baltic, ringed seal was recorded nine times, including five times in the region of Slowinski National Park, the other times in the Pucka Bay and the southern part of the Gulf of Gdansk. The probability of its occurrence throughout the Pomeranian Bay is negligible.

Porpoise (phocaena phocaena) is the only representative of cetaceans in the Baltic Sea. This species is protected. In the Baltic sea, numerous from the 30's of the 20th c., now occurs sporadically and is threatened with extinction. Porpoises are protected in Poland since 1984. They are also protected with the Bonn Convention and subsequent Agreement on the Conservation of Small Cetaceans of

the Baltic and North Sea (ASCOBANS), which Poland ratified at the end of 1995. It is the only species of cetacean permanently habiting in the Baltic Sea. The occurrence of porpoises is restricted to the coastal cold waters and moderate waters of northern hemisphere. It occurs regularly in the Baltic Sea, off the coast of Denmark, Germany, southern Sweden and Poland. It occurs irregularly and very rarely in other areas. In Poland, porpoises, however, are usually recorded in the Gulf of Gdansk and Pucka. A small number of Baltic porpoises makes that, the reports of their occurrence are extremely rare. The main indicator of porpoises stay in our waters are reports on dead fish found in nets or on shore. Most of the data can be obtained during the winter and spring. In 1990-1997, in the coastal zone of Wolin National Park, information was collected about 6 porpoises. In the Polish database from the years 1986-2005, there are 104 descriptions of recorded porpoises, of which 71 are reports on by-catch, 23 - bodies of stranded porpoises, and only 10 reports concern the observation of live animals. Over 40% of all reports are from the Pucka Bay (Kulik, 2007).

Developed "National Species Management Plan. Porpoise "(Kulik, 2007) and other works and reports do not specify the precise data on the size and characteristics of populations in different basins, including the Pomeranian Bay.

4.4. The occurrence of mineral deposits

The area of the planned investment is not the place of occurrence of any mineral deposits.

4.5. Landscape and cultural heritage

The area under the question is located in the Pomeranian Bay basin adjacent to the physico-geographical microregion of Mierzeja Świny divided into Mierzeja Przytorska on the north and the delta of Świna River from the south. The area of Mierzeja Przytorska is elongated flat part of the Wolin Island, extending along the sea shore, with characteristic, strips parallel to the shore, terrain. On the west of Mierzeja and at the mouth of the Świna River, harbor district of Świnoujście was established; on the east, there is Międzyzdroje resort. The essential landscape and recreational values of areas adjacent to the discussed investment are:

- wide sandy beach,

- forest area spreading from the street Ku Morzu to Międzyzdroje,

- existing eastern breakwater of the Świna River mouth

- existing western breakwater of the Świna River mouth with a characteristic "windmill,

- a lighthouse and port infrastructure.

The main important components of the cultural landscape of Mierzeja Przytorska are as follows: complex of historic military architecture, historic lighthouse, pier in Międzyzdroje and development units of port in Świnoujście.

Historical architecture

In the immediate area of the proposed project (water body connected with the LNG waterfront and spoil dump site), there are no modern historical buildings subject to legal protection. There are no located and recorded archaeological sites on the areas of this said investment. During

the examination of purity of dredge spoil from dredging works and of bottom sediments for the presence of underwater navigation obstacles on the area of the future external port, no elements of historical value were found. It should, however be borne in mind that, the Baltic Sea area is not yet subject to systematic archaeological exploration. Archeological and cultural assets associated with the medieval settlement may be placed under the bottom layer of sand, which is in redeposition phase, so it may not lead to positive results. Historical elements in the sea have been discovered by accident, mostly by fishermen and in the coastal zone around the ports by Maritime Offices, for example, during the dredging of the fairway or cleaning moorings - in recent years, the Maritime Office in Szczecin during maintenance of approach fairway to the port of Świnoujście accidentally discovered a wreck of a wooden sailing ship possibly from the 19th c in the western edge of the fairway (Mejszelis & others, 2008).

4.6. Condition of atmospheric air

Analysis of the meteorological data clearly indicates a favorable position in reference to the location of the project against "compass rose". During the year, the prevailing winds blow from directions 180 - 270°, i.e. the south and west, and intermediate directions in this sector. Beneficial consequence of such a system of the direction of winds is the fact, that pollution generated within the designed external port (during its construction and operation) will be significantly - particularly in the winter (heating season) scattered and moved towards north and north-easterly direction towards the open sea.

The current status of air quality in the area of the planned investment (Division Port of Świnoujście) was determined by the Voivodship Inspector for Environmental Protection in Szczecin letter No WM 6750/1-85/08 (Mejszelis & others, 2008 - Appendix 7) as average concentrations as follows:

- nitrogen dioxide (NO_2): 14 µg/m^3,

- Sulfur dioxide (SO_2): 4,0 µg/m^3,

- Carbon monoxide (CO): 200,0 µg/m^3,

- Particulate matter PM-10: 18,0 µg/m^3.

Therefore, the reference value of pollutants, background and disposition concentrations for these pollutants and the ones planned to be introduced into the air during the construction and operation (mainly from transport and construction) are as presented in Table No. 12

Table 12. Reference values and disposition concentration

Contamination	Reference value		Background µg/m^3		disposition concentration µg/m^3	
	D_1	D_a	%	S_a	S_1	S_{da}
Nitrogen dioxide	200	40		14,0	186,0	26,0
Sulfur dioxide	350	30		4,0	346,0	26,0
Carbon monoxide	30000			200,0	29800,0	

Particulate matter	280	40		18,0	262,0	22,0
Aliphatic hydrocarbons	3000	1000	10	100,0	2900,0	900,0
Aromatic hydrocarbons	1000	43	10	4,3	995,7	38,7

4.7. Acoustic climate

Area of the planned dredging works is located adjacent to the sites of Commercial Port of Świnoujście. These areas are under the influence of noise impacts related to the port operations (reloading equipment) and its functioning (including rail traffic). From the port areas, except for noise associated with traffic and work of rotary work dumper, in principle, there is no emission of high levels of noise. In summer, the beach, where there is a natural acoustic climate, is often used by vacationers.

Acoustic climate in these areas will change only during the construction of the breakwater and dredging of the external harbor basin. In the area of the designated spoil dump site, there is a natural acoustic climate associated with the natural sounds of nature (e.g. the sound of the sea). It will be changed only slightly at the moment of discharging spoil onto dump site after then, it will return to the natural level.

4.8. Sites protected by Polish law

The area of the planned investment in the Pomeranian Bay is located within the following legal forms of nature protection within the meaning of the Act of 16 April 2004 on the Nature Conservation:

- In the Special Areas of Conservation of Natura 2000 PLH 990002 “Ostoja na Zatoce Pomorskiej”;
- In the Special Protection Areas of Natura 2000 PLB 990003 “Zatoka Pomorska”

In the vicinity of the planned investment following protected areas are located:

- Wolinski National Park;
- Special Areas of Conservation PLH320019 “Wolin and Uznam”;
- Special Protection Areas of Natura 2000 PLB320002 "Delta Świny";
- Special Protection Areas of Natura 2000 PLB 320011 “Zalew Kamieński I Dzwina”;
- ecological site " Wydmy na Warszowie " (Dunes of Warszów) and "Przytorskie Wydmy” (Przytorskie Dunes) planned to be subject to projection.

Description of Natura 2000 area is in Chapter 11.1.

Woliński National Park

Woliński National Park, established in 1960, is located in the vicinity of the location of the external port of Świnoujście and spoil disposal sites. It covers the following: the Baltic cliff coast, Delta Wsteczna Świny, border of Mierzeja Przymorska, a fragment of Międzyzdrojski Forest, coastal waters

of the Baltic Sea, incorporated in 1996, with a width of 1 nautical mile (BSPA – distant for more than 12 km from the site W2A) bordering with the Wolinski National Park, as well as the coastal waters of the Szczecin Lagoon. Total area of sea waters and inland waters is 4,700 hectares. These areas are located at a considerable distance from the planned port area and planned soil dump sites in the sea (approximately 13 km). This investment should not threaten the populations of protected animals in the park and the marine environment of the coastal zone subject to protection.

„Wydmy na Warszowie" & „Przytorskie Wydmy"

Ecological site "Dunes of Warszów" and "Przytorskie Dunes" is an area intended to be protected, but relevant legislation has not been issued yet. This site is to be established in order to protect valuable coastal and dune beach, as a valuable landscape elements and habitats of valuable plant species. The western end of ecological site is adjacent to investments. Dredging works and spoil disposal executed within the area of future external port will not interfere in areas planned for protection.

5. CONDITION OF SEDIMENTS PURITY

5.1. Scope of research

The study included sediments from the basin associated with the construction of the waterfront for unloading LNG at the external port of Świnoujście. The paper presents results of laboratory tests of 20 averaged soil samples from 20 sediment cores taken as a part of work: "Disposal of the dredge spoil from the dredging works to the sea from the water bodies constituting water areas of the harbor of Szczecin and Świnoujście Seaport Authority S.A. (Report on tests No. 51/10, 2010) involving:

1) determination of heavy metal content in 20 averaged soil samples from 20 bottom sediment cores: arsenic (As), chromium (Cr), zinc (Zn), cadmium (Cd), copper (Cu), nickel (Ni), lead (Pb), mercury (Hg);

2) marking in 20 averaged soil samples from 20 bottom sediment cores of contents of polycyclic aromatic hydrocarbons (PAHs): benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(Ghi)perylen, benzo (a) pyrene , dibenzo (a, h) anthracene, indeno(1,2,3-c,d)pyrene;

3) marking in 20 averaged soil samples from 20 bottom sediment cores, the contents of polychlorinated biphenyls (PCBs) - the sum of PCB congeners: 28, 52, 101, 118, 138, 153 and 180;

4) The determination of grain composition in 20 averaged soil samples collected from 20 bottom sediment cores and to determine the type and name of the test soil.

The study also used the results of 16 averaged soil samples collected from 16 bottom sediments made available by the Maritime Office in Szczecin, carried out in 2008, as part of the purity assessment of the bottom sediments in the area of the proposed external port in Świnoujście (letter from the Maritime Office in Szczecin of 13/10/2009, sign: TI-220/5/995/2009, Results of ..., 2008).

Collection, preparation and determination of concentrations of substances in the sediments was performed in accordance with the Regulation of the Minister of Environment of 16 April 2002 on the types and concentrations of substances that cause spoil contamination (Journal of Laws of 2002, No. 55, item 498). If these critical values given in the annex to the regulation are exceeded the spoil is considered contaminated. (Table 13).

Table 13 Types and concentrations of substances that cause that, spoil from dredging works of dredging the sea basins is contaminated (Regulation of the Minister of Environment of 16 April 2002 on the types and concentrations of substances that cause spoil contamination (Journal of Laws of 2002, No. 55, item 498)

SUBSTANCE TYPE	BORDERLINE CONCENTRATION DEFINING CONTAMINATED SPOIL [mg/kg s.m]
Heavy metals	

As (Arsenic)	≥30
Cd (Cadmium)	≥7,5
Cr (Chromium)	≥200
Cu (Copper)	≥150
Hg (Mercury)	≥1,0
Zn (Zinc)	≥1000
Pb (Lead)	≥200
Ni (Nickel)	≥75
Polycyclic Aromatic Hydrocarbons (PAHs)	
benzo(a)anthracene	≥1,5
benzo(b)fluoranthene	≥1,5
benzo(k)fluoranthene	≥1,5
Benzo(ghi)perylen	≥1,0
benzo(a)pyrene	≥1,0
dibenzo(a,h)anthracene	≥1,0
indeno(1,2,3-c, d)pyrene	≥1,0
Polychlorinated biphenyls (PCBs)	
Cogenerates PCBs in total 28, 52, 101, 118, 138, 153, 180	≥0,3

Material for testing

In accordance with the guidelines contained in the Regulation of the Minister of the Environment (Journal of Laws No. 55, item 498) for the planned quantity of dredging works amounting to approx. 2.4 million m^3, there were 36 sediment samples for chemical analysis required. Samples of 20 sediment cores were collected with VIBRO probe from the research vessel "IMOR 2"of Maritime Institute in Gdansk, on 20-21.03.2010, from the waters associated with the construction of waterfront at the external port of Świnoujście. Then, sediment cores were delivered to the Laboratory of the Department of Environmental Protection IM in Gdansk.

Core samples of bottom sediments were collected from locations agreed with the Employer and shown on the attached map (Appendix 1), while the coordinates of the sampling sites are presented in the Report on tests No. 51/10, 2010. The results of the remaining 16 averaged samples taken from 16 bottom sediment cores were provided by the Maritime Office in Szczecin.

5.2. Methodology of deposits testing

Representative sample of the spoil in quantity of 1 kg was dried at room temperature to constant mass, sieved through a sieve with a mesh diameter of 2 mm. The concentration of tested substances was determined in the fraction of soil with grain size <2 mm. From the sieved spoil fraction <2 mm, analytical sample of 100 g was collected, which was grated in an agate mortar into particles <0.063 mm.

Determination of metals

After dissolution of analytical samples with hydrochloric acid solution (1 ÷ 4) contents of arsenic, chromium, zinc, cadmium, copper, nickel and lead were determined with atomic spectrometry emission method with inductively coupled plasma (ICP-AES) on a spectrometer OPTIMA 2000 DV by Perkin ELMER. Whereas, the mercury content was determined with atomic absorption method with a

concentration on the gold collector on the mercury analyzer MA-Z by Nippon Instrument Corporation after the dissolution of fragmented samples with hydrochloric acid solution (1 ÷ 4).

Determination of organic compounds

In the analytical sample of bottom sediment organic matter was determined as follows:

- polycyclic aromatic hydrocarbons (PAHs) were determined by GC - MSD method (gas chromatography with mass spectrometry detector) in the dicholoromethane extracts after extraction of samples with dichloromethane, using a gas chromatograph type HP 6890 with mass spectrometer type HP 5973 by Hewlett Packard. Obtained extracts were purified with solid phase extraction technique (SPE) before the final analysis,

- polychlorinated biphenyls (PCBs) were determined with GC - MSD method (gas chromatography with mass spectrometry detector) in the acetone extracts obtained after the extraction of samples with a mixture of hexane / acetone using a gas chromatograph type HP 6890 with mass spectrometer type HP 5973 by Hewlett Packard.

Granulometric analysis

Sediment sample were dried at 105^{o}C. Sieving was performed on a standard set of sieves: <0.063, 0.063, 0.125, 0.250, 0.500, 1.0, 2.0, 4.0 and 8.0 mm. Screening time was 30 minutes, at an amplitude of vibration 1 second.

5.3. Test results

Heavy metals

The concentrations of heavy metals in 20 averaged soil samples of 20 sediment cores collected as a part of work: "Disposal of the dredge spoil from the dredging works to the sea from the water bodies constituting water areas of the harbor of Szczecin and Świnoujście Seaport Authority S.A." and in 16 averaged soil samples from 16 cores delivered by the Maritime Office in Szczecin, executed in 2008, as part of the purity assessment of the bottom sediments in the area of the planned external port of Świnoujście were within the limits for:

- Arsenic (As) - below than 1.25 mg As/kg c.m. (for all analyzed samples),

- Chromium (Cr) - 0.88 ÷ 6.59 mg Cr/kg c.m.,

- Zinc (Zn) - 1.75 ÷ 3.69 mg Zn/kg c.m.,

- Cadmium (Cd) – below than 0.05 mg Cd/kg c.m., (for all samples analyzed)

- Copper (Cu) - 0.25 ÷ 0.63 mg Cu/kg c.m.,

- Nickel (Ni) - 0.57 ÷ 3.67 mg Ni/kg c.m.,

- Lead (Pb) - 0.60 ÷ 2.98 mg Pb/kg c.m.,

- Mercury (Hg) - below 0.01 ÷ 0.07 mg Hg/kg c.m.,

On the basis of obtained results, it was stated that, that content of heavy metals in 36 averaged soil samples from 36 sediment cores taken from waters associated with the construction of waterfront at the external port of Świnoujście is **lower** than the values which cause that, spoil is contaminated in accordance with Regulation of the Minister of Environment of 16 April 2002 on the types and concentrations of substances which cause that spoil is contaminated (J.o L. No. 55, item 498).

Polycyclic Aromatic Hydrocarbons (PAHs)

The concentrations of polycyclic aromatic hydrocarbons in 20 averaged soil samples 20 sediment cores collected as a part of work: "Disposal of the dredge spoil from the dredging works to the sea from the water bodies constituting water areas of the harbor of Szczecin and Świnoujście Seaport Authority S.A." and in 16 averaged soil samples from 16 cores delivered by the Maritime Office in Szczecin, executed in 2008, as part of the purity assessment of the bottom sediments in the area of the planned external port of Świnoujście were within the limits for:

benzo(a)anthracene - below than 0.001 ÷ 0.001 mg / kg dm,

benzo(b)fluoranthene - below than 0.001 ÷ 0.002 mg / kg dm,

benzo(k)fluoranthene - below than 0.001 mg / kg dm,

benzo(Ghi)perylen - below than 0,001 mg / kg fresh matter,

benzo(a)pyrene - below than 0.001 ÷ 0.001 mg / kg dm,

dibenzo(a,h)anthracene - below than 0.001 mg / kg dm,

indeno(1,2,3-c, d)pyrene - below than 0.001 mg / kg dm

On the basis of obtained results, it can be concluded that, that content of individual PAHs in 36 averaged soil samples from 36 sediment cores taken from waters associated with the construction of waterfront at the external port of Świnoujście is **lower** than the values which cause that, spoil is contaminated in accordance with Regulation of the Minister of Environment of 16 April 2002 on the types and concentrations of substances which cause that spoil is contaminated (J.o L. No. 55, item 498).

Polychlorinated biphenyls (PCBs)

Concentrations of polychlorinated biphenyls (PCBs) in 20 averaged soil samples 20 sediment cores collected as a part of work: "Disposal of the dredge spoil from the dredging works to the sea from the water bodies constituting water areas of the harbor of Szczecin and Świnoujście Seaport Authority S.A." and in 16 averaged soil samples from 16 cores delivered by the Maritime Office in Szczecin, executed in 2008, as part of the purity assessment of the bottom sediments in the area of the planned external port of Świnoujście were below 0.0001 mg / kg dm.

On the basis of obtained results, it can be concluded that, the total content of PCBs congeners 28, 52, 101, 118, 138, 153 and 180 in 36 averaged soil samples from 36 sediment cores taken from waters associated with the construction of waterfront at the external port of Świnoujście is **lower** than the

values which cause that, spoil is contaminated in accordance with Regulation of the Minister of Environment of 16 April 2002 on the types and concentrations of substances which cause that spoil is contaminated (J.o L. No. 55, item 498). In Table 14 average concentrations of substances in 36 sediments samples taken from the area of waters connected with the construction of waterfront at the port of external Świnoujście are shown.

Table 14 Types and concentrations of tested substances in sediments taken from the area of waters connected with the construction of waterfront at the port of external Świnoujście

Item	Test type	Unit	Mean concentration	Concentration /1/, which cause that spoil is contaminated
1	Organic matter (loss on ignition)	% s.m.		-
Metals				
1	Arsenic (As)	mg/kg s.m.	p. 1,25	≥30
2	Chromium (Cr)	mg/kg s.m.	1,47	≥200
3	Zink (Zn)	mg/kg s.m.	2,68	≥1000
4	Cadmium (Cd)	mg/kg s.m.	p.0,05	≥7,5
5	Copper(Cu)	mg/kg s.m.	0,44	≥150
6	Nickel (Ni)	mg/kg s.m.	0,90	≥75
7	Lead (Pb)	mg/kg s.m.	1,10	≥200
8	Mercury (Hg)	mg/kg s.m.	0,02	≥1
Polycyclic Aromatic Hydrocarbons (PAHs)				
1	benzo(a)anthracene	mg/kg s.m.	p.0,001	≥1,5
2	benzo(b)fluoranthene	mg/kg s.m.	p.0,001	≥1,5
3	benzo(k)fluoranthene	mg/kg s.m.	p.0,001	≥1,5
4	Benzo(ghi)perylen	mg/kg s.m.	p.0,001	≥1,0
5	benzo(a)pyrene	mg/kg s.m.	p.0,001	≥1,0
6	dibenzo(a,h)anthracene	mg/kg s.m.	p.0,001	≥1,0
7	indeno(1,2,3-c, d)pyrene	mg/kg s.m.	p.0,001	≥1,0
1	Cogenerates PCBs in total:28, 52, 101, 118, 138, 153, 180	mg/kg s.m	p.0,0001	≥0,3

Explanation to the table:

/ 1 / The Annex to the Regulation of the Minister of Environment of 16 April 2002 on the types and concentrations of substances that cause that spoil is contaminated (Journal of Laws of 2002, No. 55, item 498)

p - below the limit of determination

Characteristics of sediment

Sea depth in the area of the sediment sampling ranged from 2.2 to 6.3 m, length of cores taken ranged from 1.27 m to 2.0 m. The dominant material on the seabed is sand mixed with fine gravel, shells, colors from gray through beige to brown. There are interbeddings of silts, silty clay and humus admixture. Median sediment grain size is MD = 0.179 (Table 15). Averaged sediment parameters suggest that, this is fine-grained sand. Sediment sorting coefficient ranges from So = 1.24 to 1.41 which allows to determine deposits as well and medium sorted. The collected samples of sediment are dominated with grain size fraction 0.125 <d.0, 250, which is on average about 70%. The sediment is characterized with a high proportion of small fractions of 0.063 <d.0, 125 on average 18.81%.

Participation of fraction thicker than 0.5 mm does not exceed on average of 1.6% and of finer of 0,063 mm on average, 1% (Table 15).

A characteristic feature of the sand cover are numerous shells found in the upper layer of sediments to the test depth of 1.6 m under sea bottom. Two most numerous species of macrozoobenthos in sediments were: Mya arenaria and Cerastoderma glaucum. Macoma balthica was not present in the collected samples.

Table 15 Characteristics of sediments in the area of the planned external port in Świnoujście

No . of tests	**Weight grain content (%)**									
36	Grain diameter ranges d (mm)									Sum (%)
	d>8	4<d≤8	2<d≤4	1<d≤2	0,5<d≤1	0,25<d≤0,5	0,125<d≤0,25	0,063<d≤0,125	d≤0,063	
Mean values	0,17	0,07	0,18	0,26	0,93	8,39	70,14	18,81	1,06	100,00
No . of tests	**Characteristic diameters of sand grains**					**Sorting (acc. to Trask)**	**Mean diameter**	**Standard deviation**	**Sand kind**	
36	d_{10}	d_{25}	d_{50}	d_{75}	d_{90}	$S_O=(d_{75}/d_{25})^{1/2}$	$d_{średn.}$	σ(d)		
	(mm)						(mm)	(mm)		
Mean values	0,094	0,134	0,179	0,226	0,272	1,298	0,217	0,326	**Fine sand**	

Organic matter content

Organic matter content expressed as loss on ignition (at 550^{o}C) in 20 averaged soil samples 20 sediment cores collected as a part of work: "Disposal of the dredge spoil from the dredging works to the sea from the water bodies constituting water areas of the harbor of Szczecin and Świnoujście Seaport Authority S.A." and in 16 averaged soil samples from 16 cores delivered by the Maritime Office in Szczecin, executed in 2008, as part of the purity assessment of the bottom sediments in the area of the planned external port of Świnoujście were below 1.7%. The studied sediments are mostly sands characterized with low sorption capacity and low organic matter content. In the sediments composed of clay minerals, organic matter concentrations are much higher. The large surface area of particles of clay-muddy sediments affects the process of accumulation of organic matter.

Conclusion

Content of heavy metals, polycyclic aromatic hydrocarbons and the sum of congeners of polychlorinated biphenyls (PCBs 28, 52, 101, 118, 138, 153 and 180) in 36 averaged soil samples collected from 36 sediment cores collected from waters connected with the construction of waterfront at the port outer in Świnoujście is **lower** than the values that, cause spoil contamination in accordance with Regulation of the Minister of Environment of 16 April 2002 on the types and concentrations of substances which cause that spoil is contaminated (Journal of Laws, No. 55, item 498).

On this basis, it can be concluded that, **bottom sediment planned for dredging** from the basins connected with the construction of waterfront for unloading LNG at the external port of Świnoujście **is uncontaminated.**

6. ANALYSIS OF LOCATION OPTIONS FOR SPOIL DISPOSAL

As a part of looking for a dump site for spoil disposal from dredging works connected with the construction of waterfront at the external port in Świnoujście, three options of spoil disposal were considered: null 'do-nothing' variant and the variant of spoil disposal on designated - among three analyzed - site (W1, W2 or W2A) of seabed. In addition, alternative option was consideration - other spoil dump site than the sea.

6.1. Null 'do-nothing' variant

In a null 'do-nothing' variant, the investment (the construction of waterfront in the external port of Świnoujście and disposal of spoil) is not implemented, condition of the environment and biocoenoses of area will not be changed. Because of the spoil volume (2.4 mln. m^3) formed by saline marine sands derived in the coastal zone, transport and economic and nature considerations virtually make it impossible to dispose spoil on polders in the region of the Świna River mouth.

6.2. Description of the analyzed variants

The variant proposed by the Applicant

Three variants (sites) were considered for spoil disposal in the sea following the terms and conditions defined by the Seaports Authority:

- dump site for spoil disposal in the sea shall be located within the territorial sea, as near as possible to dredging place. Territorial sea is the water body stretching at the width of 12 nautical miles (22.2 km) from the shoreline;

- required capacity of dump site not less than 3.0 mln. m^3;

- location should exclude debris return to port into the approach lane to Świnoujście.

When choosing the location of dump site, variant was chosen, which took into account not only economic conditions, hydrodynamic and geological conditions, but also the least burdensome conditions to the environment, taking into account the following criteria:

- due to the impact on the biological environment:

  - condition of bottom biocoenoses (zoobenthos and fitobenthos),

  - fish spawning grounds and feeding areas,

  - migration routes of fish and marine mammals,

  - presence of birds;

- due to impact on physico-chemical environment:

  - condition of bottom sediments,

- water quality (e.g., transparency, oxygenation, salinity);

- due to impact on the human environment:

  - fishing activities,

  - shipping activities,

  - military operations,

  - mining operations,

  - existing and planned infrastructure (cables and pipelines),

  - planned wind farms,

  - tourism and recreation.

Location of the analyzed areas for spoil disposal is shown in Figure 1,and the characteristics of the parameters in Table 16. In addition to the environmental-biocenotic requirements while choosing location of dump sites, following factors were also taken into account:

- potential conflicts with the zone of intensive fishing,

- shipping activities,

- existing and planned infrastructure,

- obstacles on the seabed,

- mining o and energy operations.

Table 16 Characteristics of dump sites parameters (W1, W2 & W3)

Element	Unit	Disposal field		
		variant1	variant 2	variant 2a
Area of spoil dump site	km/km	1x3	1x3	1x3
Length and width of field	km^2	3	3	3
Average depth	m BMSL.	12,5	12,6	12,9
Distance from the shore line (in straight line) - bottom edge - upper edge - center	km	 14,2 15,2 14,8	 14,0 15,0 14,5	 19,2 18,0 18,75
Distance from the field center to spoil dredging center	km	18,0	21,0	21,0
Average height of spoil bank	m osl	1÷1,5	1÷1,5	1÷1,5
Base type	-	Fine sand	Fine sand	Fine sand
Quarter area	km^2	1,0	1,0	1,0
Number of quarters	n	3	3	3
Main direction of suspension transport - axis	-	spring–summer:W,E autumn-winter:W, NE, NW	spring–summer: W,E autumn-winter:W, NE, NW	spring–summer:W,E autumn-winter:W, NE, NW
Potential suspension range (negative impact on	km	0,335	0,335	0,225

hydrobionts)[1)]				

Variant 1

Spoil dump site is located to the east of the dredging works, in the coastal zone of the Pomeranian Bay. Dump site area occupies approximately 3 km^2 of the seabed. It takes into account the natural decline in the bottom allowing runoff of the deposited spoil in a north-easterly direction, limiting the return of deposits on the fairway Świnoujście. In the region of a variant 1, area biocenosis may be affected by suspensions of moving from the dump site of spoil from the dredging works connected with the construction of the breakwater. Dump site under this variant 1 is at the distance of approx. 0.75 km from the designated site.

Variant 2

Spoil dump site is located, about 14 km in a straight line from the shore, outside the zone of small-scale fishing. It covers, as in variant 1, approx. 3 km^2 of the seabed. The average depth of 12.6 m BMSL makes it more possible to limit redeposition of fine-grained sand (dominant in dredge spoil) during a significant storm surges. This option was preferred in the initial phase of work.

Variant 2a

Spoil dump site designated farthest from the shoreline, taking into account the comments from the Maritime Office in Szczecin. Located on the north-east of the proposed external port of Świnoujście, about 19 km from the coastline.

The average depth is 12.9 m. The capacity of the planned dump site, as in variant W1 and W2, is 3 mln. m^3. The data of the Baltic Geological Survey maps show that, the bottom surface of the proposed location of the dump site and its vicinity is dominated by fine-grained sand. The selected location of the dump site is located outside the designated route HELCOM coastal shipping. Because of the distance from the shoreline, it is advantageous from the point of view of existing spawning grounds in the area of the Pomeranian Bay. In this variant, distant from the dump site planned by the Maritime Office in Szczecin (site EFGH) for about 4 km with a potential impact on hydrobionts not exceeding 500-600 m, there will be no cumulative impacts.

The waters in the area of variant 2 of dump site, furthest away from the mouth of Świna River, are better oxygenated, contain less biogenic salt remaining under less influence of the "enriched" Świna River waters.

Overview of the environmental-biocenosis spoil dump sites are presented in Section 4 of this Report.

It should be emphasized that, the diversity of hydrodynamic, geological and sedimentary environment for the discussed variants is small. Condition of area biocoenoses and hydrology in the area of the spoil dump site are not within the range of significant impacts on the river waters, which have clearly eutrophic impact on coastal waters.

Lack of diversity in the structure and quantitative composition of benthic fauna between the variants. Bottom fauna living there is typical of the entire coastal zone of a shallow sandy bottom of the southern Baltic. No areas were distinguished by the presence of rare or endangered species (Osowiecki, 2004). Avifauna and fish fauna due to their high mobility and the short distance between areas, it is difficult to assign them a particular area. Thus, there might occur species, including protected species mainly connected with the availability of food base, which may be periodically interrupted in case of variants 1, 2 and 2a.

Alternative variant

Under alternative variant, it is anticipated to disposal spoil on the silting field on Ostrów Grabowski. in addition to many advantages, it also has some disadvantages that outweigh the benefits of such a solution. Disposal of all spoil on the Ostrów Grabowski only because of the cubic volume of excavated material (2.4 mln.m3) dredged in the coastal zone, natural and economic and transport considerations (there will be increased vessel traffic that causes the increase of exhaust emissions and noise nuisance for the shipping on the fairway Szczecin-Świnoujście at distance of approx. 68 km) virtually eliminate such alternative solutions. In addition, the project schedule envisages that, the dredging works shall be divided into two phases and should be completed within 4 months (phase I) and 6 months (phase II), what with such a large volume of spoil and the distance of silting field from the place of where the spoil shall be dredged is not possible to execute. Furthermore, this area is the lowest terrace of the Odra river with medium height of about 0.5 m AMSL. The area is not easily accessible, flooded with surges of surface water. Before commencement of exploitation, dump site on the Ostrów Grabowski requires construction of surrounding embankments, drainage ditches, installment of discharge pipe supports and piezometers. After considering the current zoning of land, excavated spoil volume possible to disposal on the dump site on Ostrów Grabowski is about 800 000 m3. Thus, for those reasons, this variant was not subject to further analysis. Only partial use of spoil is possible for the treatment of port areas on the Ostrów Grabowski.

6.3. The potential conflicts risk of spoil dump sites within the territorial sea

While choosing the location variant of spoil disposal at sea, potential conflicts risks for the variants 1, 2 and 2a have been defined. These include:

- potential conflicts with the zones of intensive fishing,

- shipping activities,

- existing and planned infrastructure,

- obstacles on the seabed,

- potential conflicts with mining activities and planned wind farms.

Potential conflicts with the zones of intensive fishing

Possible variants have been planned in such a way as to be located outside areas with the highest intensity of fishing. There is at least 31 taxa of fish in the waters of the bay. Constantly, there are 11 species of freshwater fish, 5 species of migratory fish and 15 marine species (Wolnomiejski, 1997;

Garbacik-Wesolowska and Boberski, 2000). The commercial species include: herring, sprat, flounder, perch, pike, roach and bream. The analyzed region of the spoil disposal (Variant 1) is an important area for local fishing. It is one of the spring breeding grounds for herring. Spawning grounds of the herd are located in shallow coastal waters (3-12 m) in lane of 3 nautical miles.

Analyzed dump sites are important areas for local fishing. They are located in the 12,5-13,0 m depth zones, i.e. at the border of Baltic herring spawning grounds. Results of fishing monitoring of fish occurring in the coastal zone of the Pomeranian Bay (Dudko & others, 2008) show that, the greater distance from the shoreline, participation of bottom fish in the fishing was significantly lower. Location of drag net route had no effect on the occurrence of dominant fish species. Flounder and perch occurred in almost every drag, regardless of its location in the coastal zone of the Pomeranian Bay. Thus, both in terms of protecting spawning grounds and remoteness from the shoreline, variant 2, which is located about 19 km from the coast on the basin with an average depth of 12.9 m makes this variant more preferable from the perspective of fishing. All analyzed variants of the location of spoil disposal W1, W2 and W2A (area of each is approximately 3 km^2) are located in the Baltic square D2 with area of approximately 343 km^2. Fishing productivity in the Polish maritime areas is about 36 kg/hectare (Development strategy ...). After calculations of 3 km^2 of dump site area, potential decrease in fishing for herring and cod is negligible. Closing quarters of 1 km^2 for the fishing for about 80 days when the spoil shall be deposited will decrease fishing insignificantly. To avoid conflicts with local fishermen, the works should begin after the spring spawning herring, i.e. in June and last until March, that is to the moment of occurrence of stocks moving in the direction of the traditional spawning grounds.

It should be noted that, in recent years (after Polish accession to the EU), there has been a clear tendency to reduce the fishing effort on the Pomeranian Bay, and thus on the discussed region, resulting from the process of scrapping of fishing vessels for the EU financial compensation. In 2007, compared to 2004, their number decreased, Świnoujście - 5,Międzyzdroje - 6, Karsibór - 1 (Borówka & others, 2007). This has not drastically influenced fishing effort, which decreased by about 17%.

When carrying out works connected with the disposal of excavated material in the sea, there might be, in the vicinity, some short-term outcomes related to the reduction of migration and concentration of fish in the area of the works (disturbance) and the periodic closure of the works area for the fishing boats and other vessels. Long-term effects for fishing are not expected.

During the works execution (preferred variant 2), the Contractor shall notify the Maritime Administration (Maritime Office in Szczecin and the Regional Sea Fisheries Inspectorate in Szczecin) on the need to take down nets, trawl nets, etc., during the disposal of spoil on the area of individual quarters.

Shipping activities

The usual shipping route leading to the Polish ports (Fig. 22) include:

- route D recommended for large tankers and ships with dangerous cargo - it leads to Danish Straits avoiding the Bornholm from the north to the ports of the Pomeranian Bay,

- routes from the north-eastern Baltic Sea to ports along the Gulf of Gdansk,

- southern route from the western Baltic Sea (south of Bornholm - route ‘B’ on fig. 22)

- coastal route linking the ports located on the Gulf of Gdansk with the ports of Szczecin-Świnoujście ports of central coast (Fig. 22 with route 'A'),

- coastal shipping route, the route proposed as a first-class HELCOM route (Fig. 22).

Designated locations W1 and W2 of dump sites according to the letter of the Maritime Office in Szczecin of 17 February 2010 No. ON-I-4180/01/02/10 are situated in the coastal shipping route (Route HELCOM), which shallowing, artificial from the navigation point of view, is unacceptable. With letter dated 11 March 2010 No. ON-I-4180/01/05/10, Director of Maritime Office in Szczecin, at the request of the report's authors, agreed, in terms of navigation, on the variant 2a of soil dump site location. Designated disposal place W2ais located at a safe distance from the shipping lanes. Under the current regulations, it should be marked with navigation signs, provided in order to minimize the risk of collision.

Desirable locations do not pose an obstacle for recreational sail. Placing information in a timely manner in nautical publications and introduction of spoil dump site on sea charts is of significant importance.

The existing and the proposed infrastructure

Within the Pomeranian Bay, telecommunication cables connecting Russia with Germany are located on the seabed (cable connecting the Pioneering Cape with Alhbeck in Germany). Gas pipeline connecting the town in Niechor in Poland with pipeline system in Denmark was designed, whose investor was Naturgas DONG A/S. The route of fiber-optic telecommunications cable Linx (Poland Network) to the landing place in Świnoujście is also being designed (Fig. 23). None of the existing plant goes through the proposed spoil dump site from dredging works, thus it does not constitute an obstacle to their implementation.

Fig. 22 Recommended and customary shipping routes to the Polish ports

Fig. 23 Existing and proposed systems in the Pomeranian Bay.

Obstacles on the seabed

Designing location of spoil dump sites, wrecks and other objects on the seabed that, may hinder the works, should be taken into account. The coordinates of underwater objects are summarized after analysis of existing maps and databases on wrecks. Wrecks can be of cultural value or pose a threat to the environment (military wrecks). Collisions with wrecks should be avoided, so as not to cause adverse environmental changes while interfering with the wreckage structure.

As demonstrated by tests of the Institute of Marine, positions of wrecks and other objects may differ significantly from the directory coordinates, even at a distance of more than 600 meters away from them. Location of wreckage and buried objects (fishing hooks) are presented in Tab. 17. Proposed locations of spoil disposal do not interfere with localized wrecks, buoys, buildings situated on the bottom and dumping of chemical munitions sites.

Table 17 Summary of coordinates of wrecks and other objects in the vicinity of the proposed area of spoil disposal

Lp.	Coordinates L	Coordinates B	Description	Depth (m)
22	14.416666	54.000000	WK	
23	14.483333	54.016666	Foul	10,2
24	14.408333	54.016666	Foul	11,5
25	14.450000	54.078333	Foul	12,0
26	14.33833	54.158333	Wk	7,0
27	14.320000	54.228333	Wk	12,3
28	14.025000	54.495000	Foul	
29	14.191666	54.271666	Foul	16,0
30	14.243333	54.283333	Foul	15,5
31	14.210000	54.200000	Foul	13,7
32	14.275000	54.073333	Obstrn	12,9
33	14.273333	54.056666	Foul	
34	14.358333	54.053333	Obstrn	12,1
35	14.356666	54.045000	Foul	11,0
36	14.356666	54.023333	Foul	11,0
37	14.336666	54.021666	Obstrn	10,4
38	14.328333	54.015000	Wk	
39	14.290000	54.003333	Foul	10,5
40	14.295000	54.011666	Foul	11,9

Potential conflicts with mining activities and planned wind farms

Areas where mining activities are conducted and for which mining licenses have been issued (oil, gas, aggregates) are not located in an area of potential spoil dump sites.

Potential locations of wind farms in the western part of the maritime areas are located outside the territorial sea of the Republic of Poland. The proposed areas are mostly located at depths> 20 m (beyond the feeding reach of diving birds). In accordance with the requirements of the Seaports Authority, the spoil dump site from dredging basins are designated within the territorial sea. Thus, they do not conflict with potential wind power sites in the western part of the Baltic.

7. DESCRIPTION OF THE DISTRIBUTION OF THE DEPOSITED SPOIL

Disposal of spoil at the designated dump site may cause short-term and local disruption of marine environment.

To the moment when the sediments remain intact at the bottom, they do not constitute any threat to the marine environment, because they are largely connected (immobilized) with natural bottom material, due to what their ability to impact on the environment is very limited. The problem arises only when bottom sediment is moved resulting in formation of a sludge suspension which has the ability to spread rapidly in the marine environment.

Sedimentary material, deposited in the sea using scows, barges or dredges with its own hatch, is distributed and accumulated at the bottom. The material consisting of particulate matter sinks to the bottom due to gravity, whereat falling phenomenon is conditioned with several factors, such as - water density, salinity and water temperature and the influence of electrolytes.

Deposited material is subjected to a gradual density (densification). In the meantime, the distribution of sediments may be significantly changed due to the flocculation process. Other dynamic processes cause bottom erosion of previously embedded material and moving bottom sediments into re-suspension state (re-suspension), with a possible following settlement (re-sedimentation). Disposal, suspending and re-deposition and suspension processes may be repeated several times (Fig. 24).

Fig.24 Sketch of suspended sediment circulation

The sedimentation rate, i.e. falling rate of the solid matter to the bottom, depends on many factors. Regardless of the length of the sedimentation process, its end product is always the creation (or the gradual creation of) a new layer of bottom sediments.

If, after forming of the new sediment layer, there are favorable hydrodynamic conditions in its immediate environment, i.e. violent forces connected with strong currents occurring in the bottom layer or forces connected with the surge of water in the reservoir, or other factors which may lead to disruption of sedimentary layer do not affect the bottom sediment, there is successive consolidation of bottom sediments manifested by the gradual displacement of pore water mainly as a result of gravitational forces, striving to achieve the maximum density state of sediment grains.

The natural course of sedimentary processes in many places, particularly in the Gulf of Gdansk and the Pomeranian Bay, was destroyed anthropogenically. Construction of port breakwaters, water engineering development of banks, and dredging of the fairway to the port , as well as disposal of the spoil on the seabed from dredging works lead to local changes in hydrodynamic conditions and connected with them lithodynamical processes occurring on the bottom and edges of the sea.

Designated spoil dump sites at a depth below 10 m BASL limit re-sedimentation processes (redeposition) of fine-grained sands dominating on the seabed. The erosion and sediment transport processes that, occur during the average hydrodynamic conditions shall be small. Only during major storm surges redeposition of fine-grained sand may occur. Sand fractions with diameters of 0.063 - 0.25 mm migrate along the surface of the bottom in the form of sandy fields and ribbons, and after

repeated redeposition, they escape outside the zone of exposure to storm surges, where deposition takes place at the depth of 5-30 m. Material thicker than 0,25 mm transported only at high speeds is directed towards shore.

In order to estimate the expected range of impact of the spoil distribution process in the course of depositing the spoil on the dump site, summary of the main parameters affecting this process has been prepared:

- Granulometric characteristics of sediments:

  - fine-grained fraction (the largest) 0,125 mm ≤d<0.250 mm: 70%,
  - calculation diameter D_{50} = 0.179 mm and D_{50} = 0.094,

- Sludge Density ρ_s=1,6÷2,0 g/cm^3

- Water density ρ_s=1,002 g/cm^3

- The depth of the basin:

  - Variant I – hp=12.5 m,
  - Variant II – hp=13.0 m,
  - Variant III – hp=12,0 m,

- Water currents (mainly of the wind origin),

  - Spring-Summer period Vp = 10 cm/s, direction: west (spring) or eastern (summer)
  - Autumn-winter period Vp = 30 cm/s, western direction (winter) or north-western and north-east (autumn).

The component of net movement of sediment to be deposited depends on the horizontal component dependent on the speed of ocean currents and the vertical component, which is sedimentation velocity of grains of sediment in the water.

Velocity estimates of sediment grains sinking in water were made using the Onoszka empirical dependence:

$$w_s=9{,}45(s-1)^{0,8}D_{50}$$

where:

w_s – sinking rate of sediment particles in the liquid [cm/s]

$s=\rho_s/\rho$

D_{50} – characteristic sediment grain diameter [mm]

Velocity calculations of the sediment grains falling in water were performed for two variants of sediment density and diameter D50 characteristic of sediments planned for dredging and typical mud (Table 18).

Tab.18 Velocity of sediment grains falling in water

	ρ_s=1,6 g/cm^3 D_{50}=0,179 mm	ρ_s=2 g/cm^3 D_{50}=0,179 mm	ρ_s=1,6 g/cm^3 D_{50}=0,094 mm	ρ_s=2 g/cm^3 D_{50}=0,094 mm
w_s [cm/s]	1,12	1,75	0,59	0,92

As it shown above, the speed of free fall of particles in the water for the grains of the main fraction of sediments is contained in the range of 0.59 cm/s to 1.75 cm/s.

With the value of the two components of movement of sedimentary grains, the calculations were made for accident angle characterizing the movement of sedimentary particles in the process of sedimentation (the characteristic angle of grains falling).

$\tan ø = w_s/V_p$

For the previously obtained extreme values for parameter w_s, a value estimate of the parameter tan ø was calculated for different values of horizontal component of water currents (respectively).

The results are presented in Table 19

Table 19 Estimates of the value of the parameter tan ø

	Period spring - summer		Period autumn - winter		Period spring - summer	Period autumn - winter
	w_s=1,12 cm/s v_p=10 cm/s	w_s=1,75 cm/s v_p=10 cm/s	w_s=1,12 cm/s v_p=30 cm/s	w_s=1,75 cm/s v_p=30 cm/s	w_s=0,59 cm/s v_p=10 cm/s	w_s=0,59 cm/s v_p=30 cm/s
tanø	0,112	0,175	0,0373	0,0583	0,059	0,0196

The next step is to estimate the expected ranges of the spread of Lr bottom sediment during the spoil disposal process at the dump site. Calculations were made for periods of spring - summer and autumn - winter, for the variants under consideration of dump site location, for the smallest expected rate of sediment falling (the lowest value of the parameter tanø).

Fig. 25 Scheme of spread range of the spoil deposited at the sea.

For the situation shown in Figure 25, the spread range during spoil disposal at dump site can be calculated with the formula:

Table 20 Spread range during spoil disposal for variants W1, W2 and W2A

	Period spring - summer			Period autumn - winter		
	Dominating current directions W, E			Dominating current directions: W, NW, NE		
	h_p12,5 m tanø=0,112	h_p13 m tanø=0,112	h_p12 m tanø=0,059	h_p12,5 m tanø=0,0373	h_p13 m tanø=0,0373	h_p12 m tanø=0,0196
L_r [m]	112	75	203	335	223	612

The obtained estimates show that, in the case of works execution in the spring and summer, there will be a slight spreading of spoil in the eastern direction (in summer) or western (in spring), while in the case of works execution in the autumn and winter, range of the spread of sediment will be three times higher, however, spread direction will be respectively the western (winter) and north-west or north-east (in autumn). In the case of works carried out in the autumn and winter, sediment transport will take place away from the coastline.

Due to its small range (up to 500-600 m for the depth h = 12 m), this phenomenon shall not adversely affect the conditions of bottom formation, but it is recommended to monitor spoil dump site for the formation of shallow areas apart from the dump site. The obtained results confirmed the model research for the turbidity processes of adjacent Greiswaldzka Gulf, which showed that, the suspension concentration at a distance> 500 m from the immediate environment of dump site shall not exceed the natural values (report Nord Stream).

8. DETERMINATION OF THE ANTICIPATED ENVIRONMENTAL IMPACT OF THE ANALYZED VARIANTS

Areas of: dredging and spoil disposal are a coastal zone without any defined habitats. Habitat is understood as a set of abiotic factors that, dominate in a given area and affect the development of flora and fauna, population or biocenosis. Depending on the degree of generalization of parameters describing the habitat, habitats are distinguished at different levels of detail. The area as a whole can be regarded as a marine habitat covering the bottom, water depths and the airspace (and even the ice phenomenon). In the area of planned works, seabed biodiversity is dependent on depth, sediment type and impact (clash) of sea and freshwater. Designated areas are relatively homogeneous in terms of abiotic and biotic, i.e. they are not very diverse habitat. Even using the open classification of marine habitats by the European Information Network on Nature (EUNIS), division cannot be made – separation of habitats in the dump site areas. Generally, these areas are biological and taxonomically poor with low biodiversity.

The impact of the proposed project - dredging works and spoil dump site – during construction phase are presented in Tab. 21. For the construction phase, null variant is referenced alternative, i.e. null 'do-nothing' alternative – project is not implemented. Stage of exploitation shall not occur. The project will be completed during the construction phase (implementation). Center of proposed dump sites W1 and W2 is just over 14.0 km from the coastline, the site center (W2A) within an average of 18.75 km. Impact assessment of dredging works from the works connected with building of waterfront at the external port of Świnoujście and spoil dump site is given in three-point scale (Table 21).

During the construction phase, i.e. execution of dredging works, transport and disposal of excavated spoil on one of sites, major impact will be observed in the environmental-biocenotic processes, both of the port area and the disposal area. For 20 designated environmental-biocenotic elements, on which the project in the construction phase may affect (Table 21), for 13 it may be a significant impact. It should be remembered that, it concerns restricted area (port) with a very low biological potential and very small ecological significance. For dump sites, according to variant 1 and 2, significant impact within eight essential elements was estimated and for option 2a - 6 elements.

The port area will be subject to the complete authropogenization and shall be excluded from the coastal ecosystem. On the spoil dump site, the main change concerns the shallowing of bottom with leveled spoil embankments. Field of bottom currents within the artificial shoal can be also changed. Its surface after a period of depositional changes will be inhabited by associations of meiobenthos and macrobenthos typical for the area which shall be rebuilt after approx. 1 year after completion of works. The process of natural recreation of associations of bottom organisms of meio- and macrofauna depends on the species composition of association on adjacent areas and end of season of spoil disposal in different quarters. It is expected, according to previous experience, occupation of the new bottom by mussels of leading species in a given period and increase of the flocks of birds and schools of fish (including bottom) derivatives of increased food base of shallowing area. Full restoration of the age structure of bottom associations will require a longer period - will take place within 2-3 years (Osowiecki, 2004).

During the spoil disposal, negative impact of its ingredients shall cover mainly near field, both in the depths and the bottom (Table 22). Near field shall occur during the disposal, this site will disappear after the completion of site disposal. Bottom and wind currents will form a distant field during the disposal, it shall take more time for this site to disappear upon the spoil disposal. The impact of environmental changes on organisms of bottom and water column in the distant field is weak (not significant), although the long term. There will be no impact of disposal in the coastal zone, it will not in any way threaten the Natura 2000 sites and the Polish maritime areas.

Table 21 The impact of the proposed project on the environment (under the construction phase)

Impact	Port (dredging works)	Spoil disposal field			Alternative variant
		W1	W2	W2a	(a)
Landscape	3	1	1	1	1
Transport of earth masses	3	3	3	3	1
Habitats fragmentation	3	2	2	2	1
Biological losses (pelagial & bental)	3	3	3	3	1
Seabed changes	3	3	3	3	1
Pollutant emissions (atmosphere)	2	2	2	2	1
Acoustic climate	3	2	2	2	1
Impact on humans	1	1	1	1	1
Transboundary impact	1	1	1	1	1
Possible break-downs	3	3	3	3	1
Birds migration	2	2	2	2	1
Spawning grounds	3	2	2	2	1
Fish catching	3	3	3	2	1
Fish migrations	2	3	3	3	1
Fuel and energy usage	3	3	3	3	1
Compensation of natural losses	Not anticipated				-1
Project valorization	- economically and socially positive - environmentally not so significant				-
Sailing	3	3	3	1	1
Monuments	1	1	1	1	1
Climate	1	1	1	1	1
Sea shores	3	1	1	1	1
Tourism and recreation	3	2	2	1	1

1 - no impact, 2 - minor impact, 3 - significant impact.

Table 22 The potential range and impact of spoil disposal on the environment and marine biocenosis

Impact degree	Spoil disposal impact on environment and sea biocenosis					
	Close field*	Distant field**	Shore zone	Natura 2000 areas	Polish sea areas	Southern Baltic
	depths/bottom	depths/bottom				
Strong /permanent	3	1	1	1	1	1
Medium	3	2	1	1	1	1
Weak	3	2	1	1	1	1
Probable	3	2	1	1	1	1
Not evaluated	(±)	(±)	(±)	(±)	(±)	(±)

8.1. The possibility of transboundary environmental impact of the project

Implementation of the project in the Pomeranian Bay consists of dredging sediments in the area of the proposed waterfront in the port of Świnoujście and their disposal on the bottom at a distance of about 20 km from the place of dredging with the periodic seizure of approximately 3 km^2 (Variant 2a). As a result of these works, area of 0.25 km^2 will be permanently occupied, and the area of dump site (up to 3 km^2) will be occupied periodically (10 months). Distance from the dump site to the state border is about 10 km. Works will be performed in the territorial waters with impact small, limited to time on the environment and region biocenosis. The works, due to the local nature of project impact limited to the area with a relatively small space, shall not have general Baltic impact (in terms of environment and ecosystem), therefore they are not subject to the Espoo Convention on transboundary context.

9. CHOICE AND JUSTIFICATION FOR THE SELECTION OF SPOIL DISPOSAL LOCATION – MOST BENEFICIAL VARIANT FOR THE ENVIRONMENT

The analysis results of the disposal impact, on the discussed dump sites at the bottom of the Pomeranian Bay distant about 18 km (W1), 21 km (W2 and W2A) from the planned dredging works, has showed no significant environmental and biocenotic differences between them. When determining the final location of the spoil dump site (W1/W2/W2a) following was used: values of integrated biological quality indicators, impact on environmental-biocenotic processes, impact on the civilization activities, use of resources and values of waters, relations with the protected areas and the technical and economic aspects of the use of spoil dump sites. Five-grade scale of the impact strength of location variant of the of the spoil dump site on biotic and abiotic environment.

The strength of environmental impacts:

1. incidental (very small)

2. weak

3. average

4. strong

5. very strong

Table 23 Analysis differentiating sites location in aspect of the spoil dump site (Variant 1, 2 and 2a) with respect to the quarters with an area of 1 km^2

Distinctive feature of the location	Variant 1	Variant 2	Variant 2a
Biological Quality in general	3	2	2
- Fishing	3	3	2
- Spawning grounds	3	3	2
- Migration	3	2	2
Environment disorders in general	3	3	2
- Suspension transport	3	3	2
- Changes in currents	2	2	1
- Sediment transport	2	2	2
Biocoenoses disorders in general	3	3	3
- Zoocenosis	2	2	2
- Pelagic organisms	2	2	2
- Birds	1	1	1
- Mammals	1	1	1
The impact on human activity in general	5	5	2
- Shipping	5	5	2
- Mining	2	2	2
Resource and assets use in general	3	3	2
- Tourism and leisure	2	2	1
- Sport Fishing	3	3	2
- Water sports	1	1	1
Impact on protected areas	2	2	2

Technical and economic considerations	2	3	4
Average	**2,5**	**2,5**	**1,9**

The impact on the environment in a scale of 1 ÷ 5

Suggestions and assessment collected from a group of professional stakeholders, the information obtained through consultation, the available research data, experience of research teams of the Maritime Institute in Gdansk, and companies executing dredging works in the Polish coastal zone were also used in the differentiating analysis. According to the adopted differentiating scale (from 1 to 5), defined integrated index (Table 23) indicates that, the site (Variant 2a) is best suited for spoil disposal. The only important element lowering the value of this site is greater need for transporting fleet and slightly larger financial inputs for the implementation of spoil disposal. Under this variant, fishing limitations are significantly smaller than on the site under Variant 1 and 2 and there are no navigational restrictions. Spoil impact on organisms of midwater and bottom is virtually identical in all areas. Spoil disposal on site under variant 2a shall not adversely affect the protected areas of the region, shall not cause coastal changes, shall not increase quantity of sand of fairway to the ports of Szczecin-Świnoujście. It shall not adversely affect areas of sand accumulations for artificial recharge of beaches designated in the coastal zone. After the disposal, the site with the embankment will be absorbed by the environment, and the bottom organisms involved in the ecosystem.

Among the analyzed variants of spoil disposal in the sea, variant 2a was chosen as the least disruptive to the environment, i.e. location of spoil dump site, which center is distant from the shore for about 18.75 km and with an average depth of 12.9 m (Fig. 1).

Basic aspects that influenced the choice of variant 2a of the spoil dump site compared with variant 1 and 2 are as follows:

- No conflicts with shipping lanes,

- Smaller effects on migration and spawning grounds of fish,

- Weaker environmental impact in the distant field (transport of suspended matter, sediment and derivatives of these processes),

- formation of an embankment at a greater depth than under variant 1 and 2, which reduces the disruptions of the current field facilitating colonization by zoobenthos,

- No effect on the tourism and recreation in the area of Świnoujście and Międzyzdroje,

- No impact on coastal water quality tested at monitoring position of WIOŚ,

- Area biocenosis will not be affected by suspensions moving from the spoil dump site of the Maritime Office in Szczecin.

The outcome of the consultation was the lack of acceptance of the location of spoil dump site under variant 1 and 2 by the Maritime Office in Szczecin. Both of the proposed dump sites were located in the area of coastal shipping route proposed as first class route HELCOM. From the navigation point of view, locations of dump sites in the area of shipping routes are unacceptable. Location of dump site under variant W2A, to the north of the proposed route HELCOM, obtained positive acceptance by

the Director of Maritime Office in Szczecin with letter of 11 March 2010, No. ON-I-4180/01/05/10 in terms of navigation and as such should be subject to further arrangements.

10. IMPACT ASSESSMENT OF THE SELECTED VARIANT OF SPOIL DISPOSAL ON THE NATURAL ENVIRONMENT DURING THE CONSTRUCTION PHASE, OPERATION AND LIQUIDATION

In the near field, estimated for approx. 1-10% of the dump site, there is differential impact, including partial destruction of midwater and most of the seabed organisms. Going further away from the center of the "center of disturbance," impact decreases and possibility to damage water organisms is limited only to juvenile forms. In the distant field, frightening of birds and deterrence of fish (or marine mammals) shall have place. The first layers of spoil may have a relatively strong impact (near field) and disrupting fish migration (far field). Assuming the implementation of the proposed scope of spoil disposal, outside the growing season, the biological losses in near field will not be large. It is estimated that, in the water it may cause loss of the several kg of wet weight of midwater organisms on a single spoil layer. Large losses in macrofauna are possible on the bottom surface. Losses in fish number are difficult to estimate. With regard to basic consumer species (cod, herring, sprat in the water column and fish flat on the bottom) it is estimated that, the losses shall be small and are estimated at 0.01% of the fishing from 1 km2 area of works execution. Losses were estimated based on average literature data. With regard to the avifauna loss of species on the surface of the sea is not expected. Spoil disposal can impact individual specimens of diving birds (benthofags) in the area of the near field and the adjacent area. Before that, birds shall be frightened by a vessel and noise connected with the ongoing works.

Determination of the expected environmental impact concerns in particular impact on humans, animals, vegetation, water, soil, climate, material assets, cultural assets, landscape and the interaction among these elements.

10.1. Construction phase

Construction phase (implementation) of the planned investment is spoil disposal from the dredging works to the sea from the water bodies constituting water areas of the harbor of Szczecin and Świnoujście Seaport Authority S.A. It is planned to dispose spoil with capacity of 2.4 mln.m^3 on dump site W2a designated and approved by stakeholders (Fig. 1).

Determination of the expected environmental impact concerns in particular impact on humans, animals, vegetation, water, soil, climate, material assets, cultural assets, landscape and the interaction among these elements.

10.1.1. Impact on humans, animals, plants, water and air

Impact on humans

It is not envisaged that, the project would have a negative impact on people. Inconvenience to the people, land workers, as well as people working "on the water" will vary, usually will be short-term, with limited range, and their impact on the health and well-being will be virtually unnoticeable.

Inconvenience to the employees of companies engaged in various types of works can be effectively absorbed by personal protective equipment (including hearing protection), resulting from the safety regulations and by the appropriate organization of works and proper supervision of the management of construction, however most of the works related to the implementation of investment constitutes a risk to security and human health.

Impact on Animals

Zooplankton

There shall be some disturbances in the water column due to its turbidity resulting from the disturbance of sediment. The disturbance shall be limited to the area and duration of the works and shall have a small indirect impact (depending on changes in phytoplankton) on zooplankton in the region.

Benthic fauna association

Unfavorable impact on benthic invertebrate fauna association communities will result from a mechanical violation of sediment layer. Given the species structure of macrozoobentos, dominated by opportunistic species with high levels of resistance to environmental stress, as well as the limited temporal and spatial range of construction phase, restoration to the original condition – re-colonization of benthic fauna associations – shall take place no later than after the end of the full life cycle of benthic organisms, i.e. the period of 2-3 years. This period should be taken as equivalent to a full reconstruction of benthic associations on the dump site.

Bottom of the area covered with dredging works takes about 0.25 km^2 of coastal sea colonized by sparse bottom zoocenosis. Spoil disposal takes about 3 km^2 of bottom colonized by zoocenosis typical for eastern slope of the Pomeranian Bay. They are poorly developed with low biodiversity. Poor food base, which consists of bethic zoocenosis of the dump site area does not create good living and feeding conditions for the fish fauna.

Avifauna

The disposal process of spoil in the sea shall not cause serious disruption of an important feeding and resting place of birds. Distribution of birds in the Pomeranian Bay, due to their ability to move quickly to other neighboring countries, areas richer in food resources, is diversified and is dependent on the availability of food base. The only negative factor for works execution may be temporary disturbances in the availability of food for the species most common in the area of the planned investment i.e. rusty neck grebes, horned grebes. However, this phenomenon is periodic, because re-colonization bottom of bottom by fauna occurs fairly quickly.

Ichtiofauna

Works connected with the spoil disposal may locally threaten local spawning of spring herring of the Pomeranian Bay. Spoil disposal shall significantly affect the fishing for flat fish (flounder and turbot).

Silting works shall cause increased mortality of young individuals and frightening of fish from the analyzed area, which will impact on the exclusion of this area from fishing operation (periodically, 1 km2).

The primary recommendation is for investors to plan their dredging works taking into account spring breeding period of fish. Works should begin after the spring spawning herring, i.e. in June. Commencement of spoil disposal earlier may prevent spawning in areas of works. Starting of works in June will also facilitate the spawning by sand goby, small turbot fish and sandeel. Work should be completed on 31 March, before the period of herring spawning.

Protected species

Avifauna – Periodically, there might be disturbances in the availability of food for diving species – feeding on the bottom macrofauna. In addition, due to the high mobility of birds, negative impact of the project on birds is not expected in the Pomeranian Bay.

Ichtiofauna - Negative impact on protected species will be limited to the area and duration of works. Sand goby – one of the protected species – is connected with the sandy bottom of the analyzed area of spoil disposal, which periodically shall lose a small part of their habitat. However, after completion of the works (the beginning of spawning), fish shall again inhabit the area of investment.

Marine mammals. Negative impact is not foreseen, because in the area of the proposed project presence of mammals is not reported. In the event of occurrence of mammals in the Pomeranian Bay possible nuisance to them will be limited to the area and duration of the dredging works and spoil disposal into the sea.

For the safe existence of porpoises, acoustic disturbances frightening the animals from their existing habitat are very important. Porpoises use sound for orientation, tracing the preys in the water column and for communication between individuals. If in the water column, there is a sound having a negative effect on the porpoise, the normal reaction to the appearance of the acoustic wave is their escape, i.e. avoidance of the sound. Based on this properties of porpoises, characteristics of their sensitivity was determined, indicating the noise volume level to the detriment of the animals, depending on the frequency. 50% of a sound threshold intensity is considered harmful at which the porpoise react negatively. Sound frequency range in which the sensitivity drops by 10 dB is deemed as the maximum sensitivity of sounds receipt. Porpoises have the greatest sensitivity for frequencies from 16 to 140 kHz. Sounds with frequencies from 16 to 160 kHz can be deemed as potentially harmful to the porpoises, which band is the sum containing the frequency band of maximum sensitivity and band of deterrent devices used on fishing nets. Sounds emitted by ships, with a frequency of less than 2 kHz are not heard by the porpoises, so there are no harmful effects.

Impact on plants

Phytoplankton

Impact on phytoplankton associations should be expected as a result of release of nitrogen and phosphorus from sediments into the water column. The increased concentration of biogenic compounds in the water column contribute to local and short-term increase in phytoplankton biomass and greater intensification of primary production.

Macrophytes

The discussed region is devoid of associations of underwater vegetation (macrophytes). The bottom of the area to a depth of about 10 m is located in the zone of fine-grained sand redeposition and is not favorable for occurrence of rooted plants.

Protected species

Phytoplankton. Phytoplankton species are not subject to protection under the European Natura **2000 network.**

Macrophytes. There will be no impact, because in the area of the planned dredging, water engineering works, as well as connected with the spoil disposal place, there are no protected species. They are not also in the vicinity of this area.

Impact on marine waters

Dredging works and spoil disposal on the dump site shall affect the aquatic environment at the time of their execution, with the degree of impact depending on the quality of the spoil intended to be dredged and the time for works execution. Disorders can be expected in the depths of water as a result of such e.g. re-suspension of material contained in the sediment, as well as modification of the hydrodynamic processes as a result of performing engineering works. The permanent effect of the works will be change in shape of the bottom area covered by the works.

Thermics and salinity

It is not expected for the dredging works and spoil disposal to impact changes in salinity and temperature of water in the Pomeranian Bay.

Horizontal distribution of temperature and salinity in the Pomeranian Bay shows a typical seasonal variations. In autumn and winter months, a significant loss of heat in the southern waters of the bay makes that, they are cooler than the open waters of the bay; in general, river water flowing via straits is also cooler. In the spring, coastal waters heat up much faster than the open water, and even flowing river waters are warmer, with the result that, the water temperature reaches the highest values near estuaries and coastal shallows.

Horizontal distribution of salinity of the bay is primarily dependent on the intensity, extent and direction of spread of river waters in the bay and from the influx of marine waters from the open sea areas.

Water Transparency

Execution of dredging works and spoil disposal in the sea will be accompanied by a temporary increase of content of suspension in the water, in the area of the works. This will be short-term and local impact, not affecting the water quality. Momentary increase in water turbidity shall not significantly affect life in the water column and increased content of the suspension shall not affect the deterioration of water quality in the area of closest beaches and bathing waters.

Hydro-chemical Conditions

Within the area of the spoil disposal in the water column, under the influence of mineral suspensions, reduction in transparency (light coverage) can occur, limiting primary production of euphotic zone. Organic suspension may reduce oxygenation of water, in this particular near bottom with local development of hydrogen sulphide. Soluble forms of nitrogen and phosphorus coming from excavations may locally increase the suspended matter in water. Generally, these processes have a negligible impact on the hydro-chemical regime of the spoil disposal area and do not have a significant impact on the biological balance.

Bottom sediments

There was no sediment concentrations of pollutants in any of the tested samples exceeding the limit specified in the Annex to the Regulation of the Minister of Environment of 16 April 2002. It means that, the spoil to be excavated is not contaminated and its disposal on the dump site shall not cause chemical contamination of the environment.

Disposal of bottom sediments will temporary increase water turbidity in the area of disposal, but which eventually returns to its original state. Dumping of dredge spoil shall cause following disruptions of the marine environment:

- physical: changes are possible in the topography at the bottom of the disposal, changes in sediment grain size, suspension and dispersion of fine-grained fraction often at considerable distances, the imbalance between the disposal of sediment on the bottom and their erosion,
- biological: direct burying of specimen inhabiting the bottom.

The impact of the dumped spoil on the marine environment depends not only on the quality of the dumped material, but also on the place of dumping. In a dynamic, devastated with natural processes environment, impact of the deposited spoil will be minor, as natural organisms living there have adapted to the fragility of their habitat, and polluting factor will be dispersed over large areas.

Impact on the atmospheric air

Estimation of the impact of project on the state of ambient air during construction is extremely difficult. Air quality in the project area will be influenced by the following factors:

- scope and nature of works to be performed;
- technology adopted for the conduct of dredging works;
- type of specialized dredging and construction equipment employed;
- the size of the involvement of auxiliary vessels (barges, tugs).

Many years of experience, however, show that in this type of works, the environmental hazards caused by emissions into the atmosphere will be negligible and short-term. This will be the impact of gas that is emitted by machines working on the platform and the floating vessels. Emissions, although directly affecting the air, shall not have any significant impact on the deterioration of ambient air in the area of the works, as well as in its surroundings. Equipment and devices used in the work must be technically efficient and meet the required norms.

In addition, studies indicate that, the execution of dredging works with a volume of 2.4 mln. m^3, phased into two stages, meets the requirements of environmental protection, i.e. shall not cause overstandard (0.2% of time of the year) exceeding of the permissible concentrations of emitted pollutants with reference to one hour, particularly of nitrogen dioxide concentrations equaling D1 = 200.

The investor, as well as a direct contractor of the works, should ensure that, during the works execution, through the proper organization of the site, selection of proper equipment and vehicles, and their correct operation, arduousness for the air shall be limited to a minimum.

10.1.2. The impact on the earth's surface, climate and landscape

The impact on the earth surface

The area of dredging works and spoil disposal lies in the Pomeranian Bay. Dredging works carried out in parts of the basin of the proposed external port associated with future waterfront for unloading LNG shall affect the earth's surface (bottom), which will be permanently changed.

Waste generated during the dredging works and spoil disposal into the sea (household waste, sewage, waste oil) shall be brought into port reception facilities (obligation of the Works Contractor.) This will not cause permanent, adverse changes in the earth's surface. Changing the surface of the bottom, with the planned volume of 2.4 million m^3 of spoil to be deposited, will affect the layout of the bottom. Ultimately, dump site with an area of about 3 km2 and a height of 1.5 m ÷ n n.p.d. shall be formed.

Impact on acoustic climate

Emission of noise caused by the operating floating equipment, used to perform the dredging works and spoil disposal, is comparable to the noise of engines of passing vessels, therefore shall not cause deterioration of the acoustic climate in the area of the works. During the dredging works periodic acoustic impacts shall occur caused by:

- work of floating cranes and tugs;
- work dredgers;
- work of units, pumps and other equipment and auxiliary machinery.

The range of the noise of the above equipment with 85 dB sound level descending to 65 dB is:

Note

It is emphasized that, this is descent to the value of sound level LA = 65 dB, while the descent to the level of 50 dB requires distance r = 560 m. The value LA = 65 dB was chosen as the limit value for industrial land (in Western Europe, these values shall be at the level of up to 70 dB).

To prevent the negative environmental impacts, contractor should use equipment in good working order meeting the contemporary state of the art. It can be concluded that, the impact of project on

the condition of the acoustic climate in the course of its implementation, should be considered temporary.

The impact on the landscape

There will be no permanent reduction in value of the landscape. According to the Law on Environmental Protection Law, during the spoil deposit, investor implementing the project is obliged to take into account environmental protection in the area of executed works.

10.1.3. Impact on cultural and historical monuments

The available information shows that, the implementation of the investment will not reduce or destroy the resources of cultural historical monuments, due to their absence within the direct impact of the planned investment. However, in case of coming across archaeological objects during the works, archaeological research under the supervision of conservation services should be performed in order to limit the negative impact of the works.

Impact on archaeological sites

Although the presented location of the investment does not interfere with well-known archaeological sites, there is the possibility of encountering, during implementation of works, historical objects not included in the preservation records or archival positions which could not be located in the area. To avoid damage to objects, constant monitoring of excavated spoil by the dredger will be needed, and in case of stating occurrence of archaeological sites, carrying out of emergency research.

Impact on existing modern protected monuments

In the course of construction and possible liquidation of the project, there will be no impact on modern protected monuments due to the fact that, the area of investment no such objects are recorded, and the nearest historic facility, Gerhard's Fort –is at the distance of approx. 800 m.

10.1.4. Impact on marine natural environment

It should be expected that, as in the case of other hydro engineering works connected with the construction of ports, breakwaters, etc., the strongest impact of the project on the sea's natural environment will be during the construction phase. This impact will be primarily connected with interference in the sedimentary environment (dredging works, spoil disposal, preparation of the approach fairway). The impact of this will result in the elimination of, occurring in the area, associations of meio-and macrobenthos benthic organisms. One can also expect disruption to the depths of water as a result of e.g. re-suspension of material contained in the sediment, as well as the modification of hydrodynamic processes as a result of performing engineering works. Sandy bottom, where the fish fed, during dredging and disposal shall be coated with mud and silt, causing depletion of benthos forming food base of fish. In the area of investment, there are no fish spawning grounds, therefore there shall be no impact of underwater works on the eggs and larval stages of fish. The implementation of the investment will significantly improve conditions for the development and existence of all trophic groups of animals organisms, which will undoubtedly compensate small impact in the course of the works. The impact, however, will have little importance for the functioning of individual cells of the food chain. Seabed habitat in this part of the Baltic is not

diversified and is quite monotonous in terms of fauna, and the organisms inhabiting it are not used as food for birds. Bigger trophic importance, especially for certain groups of birds, have invertebrates inhabiting water depths. Execution of works will cause substantial movement of birds out of the investment areas, where they still have favorable food conditions. At the same time, it should be remembered that the impact will be temporary and will end with the construction phase.

10.1.5. Environmental impact in transboundary context

Works will be performed in the territorial waters with little impact on the environment and biocenosis region. The works will not have general Baltic impact (in terms of environment and ecosystem), therefore are not subject to the Espoo Convention in transboundary context. The area of dredging is an area of approx. 0.25 km, at a distance from the borders of the Republic of Polish of 5 km, dump site W2A more than 10 km.

Therefore, the aspect of transboundary investment impact during its construction, within the scope of various elements of the natural environment, appears to be negligible.

The location of investment and the scope of executed works will concern only the region with a relatively small area, located away from the territories of neighboring countries.

In the course of executed works and upon their completion, while meeting restrictions on emissions of nitrogen dioxide and thus meeting the existing air quality standards in the course of the works execution, there will be no transboundary impact.

10.1.6. Interaction between elements under points 10.1.1.-10.1.5.

Spoil disposal to the sea i.e. disposal of 2.4 mln. m^3 of sediment on dump site according to the variant 2a, shall be performed in the system of shallowing of the bottom (quarters) of the size of 1 km^2. It is assumed that, spoil shall be discharged from Hopper barges with opening flap and from the dredging with its cargo. They evoke the impact disrupting the dynamic balance of the environment, and then ecological system disorders of the impact area. Even less important (by volume) disturbances caused in one of the main elements of the structure/organization of the ecological system can be transferred across the system of impact area, to the point of compensation to natural conditions. For the construction phase, i.e. disposal of spoil, it is possible to show various disturbances (impacts) moving in the environment and marine biocenoses. They have, however, limited nature, spatially and temporally, and the potential environmental and ecobiological disturbances shall be leveled one year after works completion. The final result shall be bottom shallowing (artificial shoal) formed from natural marine bottom sediments occupying approx. 3 km2. It will be absorbed by the environment and biocenosis not showing any negative impact during the operation.

10.2. Operation phase

For the analyzed project of spoil disposal in to the sea (2.4 mln.m^3) from dredging works on basin of the proposed external port of Świnoujście, there is no operation phase, because the project will be completed during the construction phase (the actual implementation of the planned works).

10.3. Elimination phase

In a definable perspective, it is not planned to liquidate the newly built external port in Świnoujście for unloading LNG. Liquidation of dredging works and spoil disposal would be connected with renaturalisation of industrially developed areas using appropriate technology. As regards changes in the environment related to the spoil disposal at a designated place in the sea, the best way would be to leave matters to their own course, as return of benthic fauna associations to a state identical to the pre-investment condition, is quite probable.

11. IMPACT ASSESSMENT ON NATURA 2000 SITES

The basics for assessment is procedure described in the guide "Assessment of plans and projects significantly affecting Natura 2000 sites - Methodological guidance on the provisions of Article 6 (3) and (4) of the Habitats Directive 92/43 EEC" WWF 2005.

11.1. Description of Natura 2000 sites

Area of the proposed project will be located in the coastal zone of the Pomeranian Bay included in the protected area network Natura 2000 as a Special Protection Area "Pomeranian Bay (area code PLB 990003), and Special Area of Conservation Natura 2000 "Ostoja na Zatoce Pomorskiej (area code PLH 990002) (Fig. 26).

These areas are adjacent to:

- Special Area of Conservation Natura 2000 "Wolin and Uznam" (area code PLH 320019);
- Special Area of Conservation Natura 2000 " Ujście Odry i Zalew Szczeciński " (area code PLH 320018);
- Special Protection Area Natura 2000 "Delta Świny"(area code PLB 320002);
- Special Protection Area Natura 2000 “Przybrzeżne wody Bałtyku "(area code PLB 990002);
- Special Protection Area Natura 2000 “Zalew Kamieński i Dziwna "(area code PLB 320011);
- Special Protection Area Natura 2000 “Zalew Szczeciński "(area code PLB 320009).

The characteristics of Natura 2000 is based on standardized data forms (source: http:/natura2000.mos.gov.pl, updated September 2008) and other literature materials.

- **Pomeranian Bay PLB 990003**

Area description

Characteristics of area

It is the sea area along the western part of the Polish coast. Surface area is 311,877.3 hectares. Pomeranian Bay is a sea basin of a high variety of the sea bottom (from sandbars to large gravel and rocky areas). In the central part of the Pomeranian Bay, there is a large shallow called Ławica Odrzana (the Odra Bank) located with a minimum depth of 8 m. Ławica Odrzana (The Odra Bank) bottom is covered with gravel and rocks provides which is an excellent habitat for the development

of shellfish and marine algae. A detailed description of the bay are presented in Chapter 4 of this Report.

The value and importance of wildlife

There are at least three bird species from Annex I of Birds Directive. During migration and winter, there is at least 1% of flyway population (C2 and C3) of the following species: Great Crested Grebe, Red-necked Grebe, Horned Grebe, Aythya, Long-tailed duck, Common Scoter, Black Guillemot, Merginae and Velvet Scoter. In the relatively high numbers (C7) there are: Black-throated Loon and Red-throated Loon. Birds of the wetlands are present in concentrations above 20 000 individuals (C4) - over 100 000 individuals in the winter.

Threats

The main threat to the area are plans for wind farm placement. Some forms of fishing such as: standing nets and long lines can be a threat to birds. Eutrophication is another threat. It results from long-term, regular uncontrolled flow of cargo of biogenic substances to bay, mainly via the Odra River, as Świna, Dziwna Rega, Parsęta Rivers and other smaller rivers and canals. The planned investment does not require work at heights, and therefore does not interfere with regular flight route of birds and do not limit their migration. Dredging works in the external port of Świnoujście and spoil disposal in the sea shall not be a threat to protected species under the SPA “Pomeranian Bay".

Ownership structure

The area covered with PLB 990002 "Pomeranian Bay” is owned by the Treasury.

Description of protected species

Site PLB 990002 "Pomeranian Bay" has been designated for protection in order to secure the existence of rare and endangered bird species (Table 24).

Table 24 Species of birds occurring in the Pomeranian Bay PLB 990003 listed in Annex I of Council Directive 79/409/EEC and regularly occurring migratory birds not listed in Annex I of Council Directive 79/409/EEC and site importance assessment for these species.

	Code	Name	Migrating population			Area significance assessment			
			hatching	wintering	passing	population	Preservation condition	isolation	overall
Birds mentioned in the Annex I to Council Directive 79/409/EEC	A001	Gavia stel lata		>500i		D			
	A002	Gavia arctica		>500i		D			
	A007	Podiceps auritus		1225i		C	B	C	C
	A068	Mergus albellus		>500		C	B	C	C
Regularly occurring migrating birds not mentioned in Annex I to the Council Directive 79/409/EEC	A005	Podiceps cristatus		4180i		C	C	C	C
	A006	Podiceps grisegena		1275i		A	C	C	A
	A064	Clangula hyemalis		837000i		A	C	C	A
	A065	Melanitta nigra		215000i		A	B	C	A
	A066	Melanitta n a		300000i		B	C	C	B
	A069	Mergus serrator		3000i	3000i	C	C	C	C
	A202	Cepphus grille (		4000i		B	B	C	B
	A989	waterfowl		>10000i	>20000i	D			

* Overall assessment of area significance for the species protection is the result of the population assessment, conservation status and degree of isolation of given population occurring in these areas in relation to the natural range. This value is assessed in three - grade scale: A - excellent, B - good, C – significant. If it was found that, the presence of population in the described area is of no importance (e.g. occurs sporadically) it is classified as a minor population - D (Świerkosz, 2003).

- **Ostoja na Zatoce Pomorskiej PLH 990002**

Area description

Characteristics of area

The surface area is 243 132,7 h. Pomeranian Bay is a sea basin of a high variety of the sea bottom (from sandbars to large gravel and rocky areas). In the central part of the Pomeranian Bay, there is a large shallow called Ławica Odrzana (the Odra Bank). Extensive gravel and rocky areas occur on the north-west of Kołobrzeg, and in the coastal zone in front of the cliff coast (Rewal, Wolin).

The value and importance of wildlife

Here, there is a one habitat from Annex I of HD: sandbanks which are slightly covered by sea water all the time (1110)and the site of regular observations of porpoise. The area is important for the Baltic populations including Alosa fallax. Important bird sanctuary of international importance E82.

Threats

The main threat to the area are plans for wind farm placement. Some forms of fishing such as: standing nets and long lines can be a threat to birds.

Ownership structure

The area covered with PLH 990002 "Ostoja na Zatoce Pomorskiej” is owned by the Treasury.

Description of habitats

There is protected habitat: sandbanks which are slightly covered by sea water all the time (1110) in **the area of PLH 990002 " Ostoja na Zatoce Pomorskiej" (Table 25).**

Table 25 Habitat types listed in Annex I that located under the Natura 2000 PLH 990002 "Ostoja na Zatoce Pomorskiej " and assessment of the relevance of the protected area for these habitats.

Code	Habitat name	Coverage percentage	Representation level[1]	Relative area[2]	Preservation condition[3]	Overall assessment[4]
1110	sandbanks which are slightly covered by sea water all the time	25,00	A	A	A	A

[1] Representativeness level: to determine how typically a given habitat is developed, compared to the benchmark; scale: A: excellent, B: good C: significant, D: irrelevant.

[2] Relative area: the area of the habitat type occurring in Poland, A: 15-100%, B: 2-15%, C: 0-2%.

[3] Preservation condition: the degree of conservation of structure and function of the natural habitat type and its possible recovery in the event of deformation; scale: A: perfect preservation, B: good preservation, C: preservation in the medium or the impoverished state.

4 Overall assessment of the site value for preservation of habitat type (resultant of the above (1, 2 and 3) criteria, also taking into account the practical possibilities of area protection in the future; scale: A: excellent, B: good, C: significant (Świerkosz 2003).

SANDBANKS WHICH ARE SLIGHTLY COVERED BY SEA WATER ALL THE TIME (1110)

Characteristics of habitat

Habitat occurs on Ławica Odrzana with a minimum depth of about 8 m. Isobath 15 m is assumed as the border area. Morphology forming shallowing bottom at a considerable distance from the coast is characteristics of the region. Southern end in the straight line is far from the port of Świnoujście about 12.Mn. Seabed in this area is formed from a mix of sediments: small-, medium-and coarse-grained sands.

The value and importance of wildlife

Presence of macrophytes on the bottom of Ławica Odrzana has not been documented yet. Individual stones are overgrown by algae from the class of red algae: Ceramium diaphanum, Furcellaria lumbricalis and from the class of brown algae: Pilayella littoralis, Ectocarpus siliculosus. Significant distance of habitat from shore and therefore from the impact of pollution from land allowed the preservation of the natural environmental conditions for benthic fauna, represented mainly by the snails (Hydrobia Ulva) and mussels: Cardium glaucum, Mytilus edulis, Macoma baltica , Mya arenaria. Ławica Odrzana is also spawning ground for herring and place for growing of juvenile flatfish. Sandy shoals of the southern Baltic are important wintering sites for many species of seabirds such as: Clangula hyemalis, Gavia stellata, Gavia arctica on a European scale.

Threats

The main threats for habitat are: violation of the seabed through the extraction of aggregates in the immediately adjacent area, bottom trawling, the construction of wind farms. Violation of the neutrality of habitat may result in phenomena that pose a threat to the whole Baltic Sea, such as eutrophication, shipping, oil spills and toxic pollution.

Description of protected species

Area PLH 990002 "Ostoja na Zatoce Pomorskiej" is on a list of sites proposed by the Polish government for inclusion in the Natura 2000 network as a result of the presence in the area of animal species (fish, birds, mammals) for whose preservation it is required to designate special areas of conservation (Table 26, 27, 28).

BIRDS

Table 26 Species of birds according to Annex I of Council Directive 79/409/EEC occurring on the area Ostoja na Zatoce Pomorskiej PLH 990002 (according to the SDF) and regularly occurring migratory birds not listed in Annex I of Council Directive 79/409/EEC.

	Code	Name	Migrating population			Area significance assessment			
			hatching	wintering	passing	population	Preservation condition	isolation	overall
Birds mentioned in the Annex I to Council Directive 79/409/EEC	A001	Gavia stellata		P		D			
	A002	Gavia arctica		P		D			
	A007	Podiceps auritus		1225i		D			
	A068	Mergus albellus		>500		D			
Regularly occurring migrating birds not mentioned in Annex I to the Council Directive 79/409/EEC	A005	Podiceps cristatus		4180i		D			
	A006	Podiceps grisegena		1275i		D			
	A064	Clangula hyemalis		837000i		D			
	A065	Melanitta nigra		215000i		D			
	A066	Melanitta		240000i		D			
	A069	Mergus serrator		3000i	3000i	D			
	A202	Cepphus grille		4000i		D			
	A989	waterfowl		>100000i	20000i	D			

MAMMALS

Table 27 Mammals mentioned in Annex II to the Council Directive 92/43/EEC (Habitats Directive)

Code	Name	Area significance assessment			
		population	Preservation condition	isolation	overall
1351	Phocoena phocoena	B	B	B	B

FISH

Table 28 Fish mentioned in Annex II to the Council Directive 92/43/EEC

Code	Name	Area significance assessment			
		population	Preservation condition	isolation	overall
1103	Alosa fallax	C	C	C	C

11.2. Description of other projects and plans, which should be considered in conjunction with the proposed Project

In the area of Natura 2000 in the area of planned dredging works and dump site of spoil excavated from the sea, following projects and plans are expected:

- **Construction of the shielding breakwater and groin for the planned external port in Świnoujście**. The planned investment consists of construction of a new shielding breakwater for the external port in Świnoujście and the construction of a turntable and an approach fairway. Time of completion: 30 months, starting in 2010. The investment, i.e. a shielding breakwater, groin, and approach fairway will be located on the basin of the Baltic Sea (Pomeranian Bay), and partly on land. The investment shall be implemented in the shore zone of sea, within the area of 423 – 424 km of the Polish coast. The project involves the deepening of the basin bottom to the level of -14.15 m BSML for the external port of Świnoujście and removal of excavated material into the sea on the appropriate dump site. Volume of excavated material was estimated to 8.2 million m^3. The scope of dredging works performed as part of providing access to the port will cover a new turntable and a new ship lane connecting turntable with existing north lane. A new breakwater with a length of 2,980

meters will be located approximately 1050 meters east of the existing east breakwater in Świnoujście, shielding entry from the Pomeranian Bay to the Commercial Port of Świnoujście. A new groin, 255 meters long, will be built to the existing east breakwater, protecting newly created external port against surge. Approach lane to the proposed port will be connected with existing approach lane to Świnoujście in the waters of the Pomeranian Bay. As a result of the investment implementation, half-open water body with the area of 130 ha shall be created for the constructed external port in Świnoujście. According to the findings of the land use plan for Świnoujście, this is area designated for port development and maritime economy. The size of the water body of the Pomeranian Bay anticipated for occupation for works connected with construction of the shielding breakwater and groin on the existing eastern breakwater will be approx. 195 ha. This is an area of the dock along with the hydro-engineering facilities. Construction of shielding breakwater as an element of access infrastructure to the external port shall allow to service vessels bigger than the present possibilities of the port in Świnoujście. Reloading possibilities shall be increased with the new types of goods; furthermore, thanks to separation of shielding place for the vessels within the external port, the navigation safety in the southern region of the Baltic Sea will improve. The project entitled "Construction of the shielding breakwater for the external port of Świnoujście," is public use investment, located in the Polish maritime areas (territorial sea) - as a result of its implementation, infrastructure providing access to the port shall be created. Maritime Office in Szczecin (as investor) implements it within the statutory activities (in accordance with the Act on maritime areas - Art. 42 paragraphs. 2 pts. 20).

Environmental impact assessment of the project assessed the impact scale of the investment. After careful consideration of how to implement the investment and wealth of natural area covered by the investment, together with adjacent areas, it was found that, the implementation and operation of investment shall not have a negative impact on protected species of plants and animals, areas of conservation and areas proposed for protection, together with the Natura 2000 areas and the impact on areas of conservation of this project shall be minimized by the action proposed in the report. The construction is scheduled to commence in March 2010, commissioning in June 2013.

- **Redevelopment of the existing east breakwater.** The investment in Świnoujście as part of the Operational Programme Infrastructure and Environment (Project No. POIS.07.02.00-00-003/09) is an element of a series of measures to ensure safe access from the sea to the ports of Świnoujście, Szczecin and Police. It is complementary with the project of construction of the external port of Świnoujście and with the second stage of modernization of the fairway Świnoujście-Szczecin. The investment includes redevelopment of an existing protections of western slope of the existing breakwater to a length of about 1,480 m, enabling maintenance of facilities in a safe technical condition, to protect it from the possibility of construction failures or disasters. After redevelopment, breakwater will be adapted to the depth of the fairway -14.5 m BSML. Expected implementation of the project 2008-2011 (or 2012).

  On the basis of environmental impact assessment and in accordance with the obtained environmental decisions, the project in question was not included to the projects which may significantly affect the environment. Inclusion of technical and technological solutions in the building permit design as well as conditions for the implementation and operation of

investments that, are tailored to the additional requirements specified in environmental decisions, and their application in designing, construction and operation, should protect the environment against the possible impact of the proposed activity, and shall not cause adverse effects on Natura 2000 sites, and their consistency and integrity.

- **The construction of re-gasification terminal for liquefied natural gas LNG.** LNG terminal shall be built on right-bank of Świna River, on the area reserved for the port development. For the purposes of the investment, pipelines shall be built to receive liquefied natural gas from vessels, two LNG tanks with a capacity of 160 000 m^3, and re-gasification plants. LNG terminal is safe for the environment and people. There is no possibility of environmental contamination. In the event of a leak, LNG will evaporate and dilute in air. Modern technologies of tank construction, special procedures and security systems ensure the highest level of security. The entire investment shall be implemented with respect for the environment. In order to preserve historic forts, bunkers and gray dunes, LNG terminal shall be shifted about 750 meters from the coastline and shall be built in Wolin part of Świnoujście on the industrial area – area of complex of Ports of Szczecin-Świnoujście - destined for development for a long time. The investment shall not reduce access to tourist sites and shall not reduce tourism values of the city in any way. As a typical, well-designed industrial investment, it will blend into seaside landscape, and gas carriers sailing into the port could be an additional tourist attraction. Infrastructure is currently in preparation at the site to commence construction works in the second half of 2010. LNG terminal in Świnoujście shall be put into operation on 30 June 2014 (www.polskielng.pl).

- **Search and exploration of oil and gas.** Considered investment of spoil disposal in the sea lies in the concessionaries area of Oil and Gas Exploration and Exploitation Company "PETROBALTIC S.A." with an area of 924 km^2, which acceded to the procedure for obtaining a decision on the environmental conditions for the concession on "Search and exploration of oil and natural gas in region "Wolin". With appropriate dredging works schedule, the project in question should not interfere with search and cumulative impact is not expected to occur.

- **Draft of Spatial Development Plan of the coastal zone of the Pomeranian Bay.**

  Article 37a (1)(2) and Article 37b (1) of the Act of 21 March 1991 on marine areas of the Republic of Poland and maritime administrations (Journal of Laws of 2003 No. 153 item 1502, as amended) requires the preparation of spatial planning in maritime areas. Competent minister with competence for spatial planning in the territorial, coastal waters has not executed a delegation from the Act on the sea areas on regulation, describing in detail the contents of the procedures for spatial planning in marine areas (Article 37b (4) of the a/m Act). On 20 September 2005, proposal of the Regulation of the Minister of Infrastructure on the required scope of spatial development plans of internal waters, territorial sea and exclusive economic zone was announced. The minister responsible for maritime affairs issues building decisions in the marine areas to the moment of announcing the Regulation (Article 23 of the a/m Act). It is expected that, as for part of the Gulf of Gdansk, pilot spatial development plan of the coastal zone of the Pomeranian Bay shall be developed, which shall take into account the possibility of spoil disposal form the dredging works in the sea.

- Protection plans for Natura 2000 areas. Protection plans prepared in accordance with the requirements of the Environment Regulations of 30 March 2005 on the manner and scope of draft development of protection plan for Natura 2000 (Journal of Laws, No. 61, item 549) shall be the primary source of information on the management principles of Natura 2000 areas. There are no plans approved by the Ministry of Environment for discussed SPAs and SACs Natura 2000. As part of the project PL/IB/2001/EN/02: Implementation of the Natura 2000 network in 2005, pilot protection plan was developed - protection management program – for the Natura 2000 "Pomeranian Bay PLB 990003 (project by: Wojciech Zyska, Eng.D. - project coordinator, Peter Pears, D.; Dariusz Janicki, D.; Ziemowit Sokolowski M. Eng., Przemyslaw Zyska, M. Sc.). A pilot plan for the protection of the Natura 2000 includes: internal division of the site into zones of varying degrees of protection rigor, periodic (zone II) or permanent (zone I) cutting off the fishing zones from operation, complete elimination of wind energy investment from the whole area of SPA Pomeranian Bay", defining time for reaching the established protection standards (vacatio legis) for zone I - two years, for zone II - 3 years. The area of the planned investment is located in the zone III of the southern water of part of Natura 2000 area along the shoreline with an area of 133 165.83 ha within which there are two areas temporarily closed to shipping and fisheries (military training grounds). On the other hand, it is allowed to use all legal tools and methods of fish catching, including fishing. Records of the plan do not apply to part of the coast where the investment is planned. More attention is devoted to Ławica Odrzana. In accordance with the plan, the area of potential investment is located between contour lines of biomass density of bottom organisms in quantities of wet weight of 750-1000 g/m2. The area is a place where grebes occur, however, it is not the biggest place of concentration of bird species such as: Merginae, loons, and Velvet Scoters and Common Scoters which are located outside the project area, in the area of Ławica Odrzana.

  In Chapter 6 of the Pilot Plan describing the impact on habitats and species of the operation area, the construction of port infrastructure is not specified as an investment which might be of importance for birds and other animal groups. Following are such investments: wind power plants, energy and telecommunication cables, pipelines, artificial reefs. The analysis of the impact of these types of investments on birds should be practically limited to the impact of wind turbine complexes. Other projects do not have a greater impact on birds. The records relating to water engineering works (dredging, construction works), the authors of plan relate to risks that may be caused by these works. These are not risks that will have long-term changes in the environment, directly and indirectly. Similar effects as with water engineering works connected with the lifting of bottom sediments, occur naturally after heavy storms. In the Standard Data Form prepared under this plan in chapter 4.3, entitled "Threats", there is a provision on the risk for food base, which is the exploitation of sediments and minerals. By contrast, the Standard Data Form at the website of the Ministry of Environment this provision is not posted (Spieczyński, 2009).

- **The diagnosis of disposal of sand to protect sea coasts by artificial refill.** Artificial refill of sand material obtained from the sea deposits is one of the methods of shore protection proposed in "Marine Strategy for the protection of sea coasts" and adopted for implementation under the Act on establishing a long-term program "The protection of sea coasts" (Journal of Laws No. 67, item 621 of 18 April 2003). Application of this method

requires determination and characterization of the areas where sand for filling in the economic distance from the shore section planned for filling defining the nature and sand material appearing on the shore planned for protection. In general, taking into account the protection of the shore zone, it has been assumed that, the excavation works must be kept away from the shore at a distance of not less than 3 km. Initial analysis carried out by the National Geological Institute concluded that, the potential sand deposit for artificial refill occurs in the anchorage area - Świnoujście bed and along the south side of the area periodically closable for fishing - Wisełka bed. They require accurate identification and designation of areas suitable for the accumulation of sand, shore artificial refill, i.e. material with a median 0,25-0,5 mm (> 0.22 mm) and thickness greater than 2 m. Deposit created a s a result of dredging works with thickness 1-1.5 m could be used in future (after appropriate analysis and research) as a source of material for artificial refill of shores in the area planned for protection km 411,8-413,5.

11.3. The impact assessment of dredging works and disposal of dredge spoil on Natura 2000 sites

- Description of possible, direct, indirect and secondary impacts of the investment on Natura 2000 sites:
  - size and scope of the investment – area of 3 km^2 for the dump site and 0,25 km2 for dredging works, the scoring impact (local), 4-season (summer, autumn) limited to the implementation phase of the investment,
  - in relation to the Natura 2000 sites – the investment will be implemented within the Natura 2000 sites “Pomeranian Bay" PLB 990003 and „Ostoja na Zatoce Pomorskiej” PLH 990002 – direct impact during the implementation of the investment,
  - emissions of pollutants into the air – gaseous pollutants from vessels,
  - noise emissions caused by dredgers’ work and supplementary equipment,
  - waste – shall not occur,
  - shifting of the ground in the sea – dredging works of about 2.4 mln.m^3 volume, deposited at the designated dump site area of surface 3km^2,
  - works execution:
    - implementation of 10 months (stage I - 4 months, stage II - 6 months),
    - liquidation - not applicable,
  - other impacts – none.
- Description of possible changes in the Natura 2000 sites:
  - reduction of habitat area – it will periodically reduce biomass of zoobenthos in the quarters area,
  - disturbance of physical and chemical parameters of water – direct impact during the implementation of the investment,
  - disturbance of key species of the area - changes shall not occur,

- habitat fragmentation– occurs in the field W2a whenever the quarters area within which the disposal of dredge spoil will be conducted,
- fragmentation of the species – possible within the quarters,
- changes in species density – possible within the quarters,
- changes in key indicators of protection value – shall not occur,
- climate change – shall not occur.

- Description of possible impacts on the Natura 2000 sites as a whole, relating to:
  - interference in key connections defining the structure of the area – the interference shall not occur,
  - interference in key connections defining the operation of the area – the interference shall not occur,
- Description of relevance indicators as a result of stating effects in relation to a loss, fragmentation, disintegration, distortion or change of the key elements of the area. There are no stated effects that, are subject to relevance indicator of structure disorder and functioning of habitat.
- Description of impacts

  Based on the findings, it is concluded that, none of the elements of the planned investment, and especially disposal of dredge spoil from dredging works shall have a significant impact on species and habitats, for the conservation of which Natura 2000 "Pomeranian Bay" PLB 990003 and „Ostoja na Zatoce Pomorskiej" PLH 990002 has been designated as well as its bordering areas: habitat „Wolin i Uznam" PLH 320019 and Special Protection Area „Delta Świny" PLB 320002.

Relevance assessment matrix of investment impact

Planned investment is not directly connected with or indispensable to the management of Natura 2000 sites and in the area of selected environmental - biocenothic elements and for identified periods may have significant impact. In an indirect way, may also cause negative consequences in the protected areas. This is the basis for making a relevance matrix of impacts of the investment on Natura 2000 sites. The matrix was developed (Table 29) on the basis of the comments and requests of stakeholders, consultation and analysis in this Report.

Table 29 Impact assessment matrix on habitats occurring on the area „Ostoja na Zatoce Pomorskiej" PLH 990002

Effect of the impact on the habitats	Sandbanks which are slightly covered by sea water all the time (1110)
Reduction of habitat area	none
Habitat fragmentation	none
Fragmentation of the species	none
Change in the environment quality	insignificant
Change in structure or/and operation	insignificant
Other disruptions	insignificant

Three-level scale system of the scope of impact was adopted, i.e. 1 – no impact, 2 – minor impact (insignificant, occurs in the construction phase, to be compensated), 3 – significant impact (during construction).

In the area of planned work of dredging and disposal of dredge spoil any habitat from Annex I to the Habitats Directive does not occur. The only habitat is the one occurring on Ławica Odrzańska located in the central part of the- Mainstay PLH 990002 - sandbanks which are slightly covered by sea water all the time (area code 1110). It is located in the area of SPA PLB 990003 the Pomeranian Bay. Shoal edge is about 3 km distant from the dump site field W2a. Isobath of 15 m is considered as the boundary of this area. The minimum depth is approximately 8 meters. Ławica is built from a mix of sandy sediments: fine, medium and coarse sand. Associations of animals occurring in the ecological conditions determining the habitat are its identifier. The habitat has not been located on the area covered by the potential investment activity. Habitat occurs on approximately 25% of the area (estimate) in the habitat mainstay on the Pomeranian Bay.

From the shore, in a lane 1Mm along a section Uznam and Wolin there is a habitat mainstay PLH 320019 "Woliński National Park" 13 km distant from the dump site field W2a. In the area of new port, estuary of Świna River is adjacent from the west and which is included in the SPA Delta Świny PLB 320002. The area of dump site (W2a) situated in the eastern part under the SPA of the Pomeranian Bay PLB 990003 is not bordered by any other area of bird or habitats mainstay. Environmental impact assessment on environment and species conservation of which Natura sites were created, relate mainly to SPA of the Pomeranian Bay PLB 990003. The area is 3,118.77 km^2, the planned investment will permanently occupy 0.25 km^2 (the area excluded from the SPA) and periodically about 3 km^2 (0,1% of the SPA). On this basis, it can be concluded that, the planned investment shall not aggravate the state of that habitat.

After completing the first quarters of dump site field (1 km^2), embankments will be leveled and during the period of filling other quarters the area of the first will be partially inhabited and re-colonized. The work will be carried out on 3 quarters through the period of about 300 days. After completing various quarters, they will be gradually integrated into the biological system of the seabed. The area of the leveled embankments will also be occupied by flat fish populations, and will be practically ready to receive the next spawning. Food base and in particular mollusc biomass will be quickly restored; it is possible that on the limited areas of seabed biomass of macrofauna may after 2-3 years exceed the output level.

The process of dredge spoil disposal at the seabed will have an insignificant impact on species and habitats in the area of which will be conducted. It will not result in habitat fragmentation, although it will lead to the rejuvenation of macrobenthos species, forming typical for the area hydrobiont complex. Within the pelagic and benthal zone of dump site area, there will be no significant changes in species structure and functioning of the ecosystem. Disorders of water and sedimentary environment under the influence of physical, chemical, pollution, and even biological impact shall be insignificant and shall mainly include water depths in the near field (disorder center) and filled seabed surface. Deposited settlements (dredge spoil) are mainly marine accumulants – sands: fine, medium with admixtures of river sediments and terrigenic matter.

At each discharge of dredge spoil to a depth of 12-13 m, there might occur new suspension barriers of a range depending on the content of loam in the dredge spoil and the velocity of water current that will not connect, but will form a sedimentary screen along the line of dredge spoil discharge. This phenomenon will have a relatively small scope and short-term impact. Any break in the disposal of dredge spoil in more than 24 hours will cause purification of the water depths from the suspensions in near field. Water currents washing down the embankments at the bottom will wash out their surface, moving small fractions within the embankments, leaving them in depressions. Part of this material may be carried out outside of the dump site area and intercepted by the bottom depression. From calculations carried out for the environmental conditions of the Pomeranian Bay follows that, the spread scope of the dredge spoil is dependent on depth, season and size of sediment grains, is insignificant: 200-600 m in autumn and winter to 75-200 m in the spring and summer. The impact in the area of Special Protection Area Pomeranian Bay PLB 990003 during the implementation of dredging works and disposal of dredge spoil will be small and short-term. It will be limited to the reduction of biomass especially macrozoobenthos, exhaust and noise emissions, and disturbance of birds and fish in the area of impact. Devastating impact on youth forms of aquatic organisms mainly in the near field is also possible (without affecting the overall condition of the biocenosis of the basin).

It has been concluded as a result of the evaluation that, it is unlikely that, the proposed works will exert a significant and irreversible impact on Natura 2000 sites. Implementation of the project shall not lead to negative consequences for the species conservation of which the SPA of the European ecological network Natura 2000 has been designated “The Pomeranian Bay" PLB 990003 and SAC „Ostoja na Zatoce Pomorskiej” PLH 990002.

11.4. Cumulative effect

In assessing the impact of the proposed investment on the environment, other intended investments to be implemented in the area of the Pomeranian Bay, that will interfere with the ecosystem of the Pomeranian Bay including protected areas Natura 2000 „Zatoka Pomorska” PLB 990003 and „Ostoja na Zatoce Pomorskiej” PLH 990002 cannot be ignored.

The principal factor deciding about the range and scale of the impact is the construction of the shielding breakwater planned in this area for external port in Świnoujscie (implementation in the years 2010 to 2013) and construction of LNG re-gasification terminal (implementation in the years 2010 to 2014). While analyzing the work schedule of the construction of the breakwater, entry road to the breakwater, pier and LNG terminal some of the investments will be implemented in the same time.

Due to this situation accumulation of the implemented investments might be excepted in the area of:

- increased emissions of gaseous pollutants and noise into the air,
- impact of dredging works on the aquatic environment (deterioration of hydrobiological level of water),
- potential increase of traffic of vessels in the basin,
- disturbance of birds,

— potential increase of contamination of the Pomeranian Bay as a result of emergencies (oil spills, leaks).

Increased emissions of gaseous pollutants will appear as a result of work of equipment and machinery at the same time. However, very advantageous position of dredging works and disposal of dredge spoil into the sea against compass rose causes that, pollution generated in the basin of the Pomeranian Bay (during its construction) will be significantly - particularly in the winter season (heating season) scattered and moved in a northerly and northeasterly direction, towards the open sea. Increased noise level should be also expected in case of overlapping of works. However, these impacts will cease at the completion of the construction investment. However, it is recommend to use modern equipment (especially floating), which has been already appropriately silenced, reducing significantly the occurrence of the cumulative effect.

In the natural environment, it is clear that the resources and the condition of some habitats and species will soon be reduced and degraded. Total effects of planned investments implemented at varying degrees have additive character of cumulative impacts, they sum up within the resources degradation or a reduction in area of habitats and species. Synergistic effects - mutually reinforcing should not be expected.

Due to the abundant resources of species of benthic fauna at the local level, their indiscriminate and widespread occurrence, whether involving the combined impact of destruction of the local resources shall have no noticeable effect on the state and prospects of the local population. Interference in resources of habitats and endangered and protected species does not accumulate in the case of ongoing and planned projects. There are no habitats of aquatic ecosystems in Annex I to the Habitats Directive in the area of project implementation.

Dredging works will be executed during the construction of the pier and the breakwater. These works shall affect the aquatic environment. The deepening of the water reservoir, regardless of the type of dredging and leads to changes in the structure and configuration of the bottom. In addition to mechanical impact, direct effects on fish was coating of sandy bottom, during dredging, with mud and silt, where flounders preyed, which resulted in a significant depletion of benthos which is food base for these fish. However, it will be a short-term phenomenon, held in a small space. It is noted that, the phenomenon of filling the bottom leading to the disappearance of certain molluscs is natural and occurs during the storms.

Cumulative effect on the environment of the Pomeranian Bay resulting from disposing to the sea dredge spoil on the dump site of the Maritime Office in Szczecin and proposed dump site field W2a, due to approximately 4 km distance from each other, is not expected. This is because the projected size of the spread of suspensions does not exceed 500-600 m.

After completion of construction of all investments and the stabilization of the hydrological conditions, the external port and breakwater may have positive impact on the Ichtiofauna of the Pomeranian Bay, creating the possibility of overwintering fish in the deep basin and by allowing the herring roe on the seaward side of the breakwater.

In the case of operation of the external port and the LNG terminal, most of the threats posed by sea vessels occur also at present. Vessels entering the port will not use its own drive. Streams behind propellers of tug-boats, with much smaller submersion, will not bother the fish to a large extent. As planned, during a stop at the piers, ships will not generate any pollution or leakage, and loading

facilities shall not emit appreciable noise, besides they will work periodically, only during unloading the vessels. For reloading positions, in accordance with the designers' guidelines, adequate protections against possible contamination of the aquatic environment will be designed. (according to Mejszelis and others, 2008).

To limit the consequences of the cumulative effect, environmental monitoring should be carried out throughout the construction of the breakwater, taking into account both the beach environment, as well as areas adjacent dunes, and the environment of the Pomeranian Bay. Proposed actions should be implemented to minimize adverse impacts on the environment of analyzed investment of the Pomeranian Bay.

Given the above, it should be noted that, the construction of the breakwater against the investments planned in the neighborhood shall not have significant adverse impact on the functioning of these areas.

12. THREATS TO THE ENVIRONMENT DUE TO POSSIBLE BREAK-DOWNS AND EMERGENCY SITUATIONS

In accordance with the provision of Article 3, paragraphs 23 and 24 the Act of 27th April 2001 - Environmental Protection Law, "major industrial accident" is defined as an event, in particular the emission, fire or explosion, resulting in the industrial process, storage or transport, where there is one or more hazardous substances, leading to an immediate threat to life or human health or environment or emergence of such threat such with a delay. Environmental risk of the effects of potential breakdowns and emergencies may arise as a result of human error or meteorological unexpected situations.

Potential risks that may arise during dredging works and disposal of dredge spoil into the sea within the construction of the waterfront in the external port in Świnoujście are generally dangers occurring in the water area where there is traffic of vessels. During the implementation of the investment, the following breakdowns and emergencies can occur:

- collision of vessels,
- collision of vessel with the hydro-engineering facility,
- finding of unexploded ordnance,
- explosions of ammunition in the course of dredging carried out in the project area,
- fire on the vessel engaged into the construction,
- serious accident with people employed for the construction,
- unexpected leak of petroleum or other chemicals to the water or soil,
- construction collapse,
- terrorist attack,
- storm of unprecedented power, or other catastrophic meteorological events.

It is assumed that at the start of construction works associated with construction, the contractor will have: among others telephone communication; VHF communications; medical service; basic fire-fighting equipment; adequately protected work front from water side, including marked, accessible and visible positions with lifebuoy with the dart; proven and efficient technical equipment and instructions for its use in all conditions; a book of procedures in case of emergency and emergency communications.

Świnoujście Port Authority - Vessel Traffic Control System, as the body responsible for security in their area have at their disposal crash procedures such as: collision of vessels or vessel with the object fixed/floating, ship collision with the quay, entrance ashore, pollution, fire on a board (vessel on the fairway, a vessel in port), Maritime Search and Rescue Service (SAR) (call in distress), accidents with people on board, the procedure - violation of the regulations on the discharge of harmful

substances, garbage and sewage, the procedure of the Regional Focal Point, the storm procedure, individual warnings for ship, dangerous maneuver, procedure - the transition of the vessel without valid security documents, PSC procedure in the event of notification on the breach of the vessel safety, the environment or the qualifications of the crew, detention by the PSC/Captain of the Port, navigation obstacle. Ambulance Service and Municipal Hospital are located on the west side of the fairway Świnoujście – Szczecin. State Fire Service has a branch on the east side (Mejszelis i in., 2008).

13. DESCRIPTION OF EXPECTED, SIGNIFICANT IMPACTS OF THE PROPOSED PROJECT ON ENVIRONMENT, INCLUDING DIRECT, INDIRECT, IMITATIVE, CUMULATIVE, SHORT, MEDIUM AND LONG TERM, PERMANENT AND TEMPORARY IMPACT ON THE ENVIRONMENT ARISING FROM THE EXISTENCE OF THE INVESTMENT

13.1. Existence of the project

Depending on the size of implemented investment, technology of performance and way of exploitation, as well as equipping with protection devices, the potential impact could have the character:

due to the range:

- local: limited to the near field of the implementation of the project – applicable.
- over local: manifested by the decrease of the environment quality standards, or increase of disturbance in the areas adjacent to the area of investment with a zone of safety - not applicable.

due to the magnitude of changes in the environment:

- significant: manifested by the decrease of the environment quality standards – not applicable,
- insignificant: manifested by a deterioration of environmental quality components without lowering standards – applicable,

due to duration:

- short term: typical for the construction period, such as unorganized vessel noise, emission of substances into the air caused by dredging works (gases, hydrocarbons) – applicable,
- medium and long term: period of the exploitation of the facility – applicable,

due to the kind:

- direct: impact of non-specific (foreign) factor on the environment such as emissions, noise, change in the properties or structure of the environment – applicable,
- indirect: impacts on the environment, which are not directly results of the project, referred to as imitative impacts – applicable,
- cumulative: simultaneous influence of several factors – applicable.

13.2. Description of the expected impacts on the environment and biocoenosis

To the expected, significant impacts of the planned investment on the environment following might be included:

- permanent changes in the depth of seabed in the areas of LNG unloading quay and dump site. These changes arise due to the influence of drawing the dredge spoil from basins connected with construction of pier and its disposal on dump site,
- changes in different periods of the aquatic and sedimentary environment due to drawing and discharge of the dredge spoil on the field according to the 2a option (increase in turbidity and decrease in water transparency, filling bottom zoocenosis),
- the impact of two centers of disturbance of the environment (port basin and dump site) shapes the extent of biocenotic changes of pelagic and benthic zone of both areas. These changes will disappear after completion of works, and damaged and permanently changed bottom zoocenosis shall be largely rebuilt
- during works quite significant biological loss shall occur mainly in the complexes of bottom organisms. There will be transitional turning off of the bottom area from the spawning-feeding system for fish (without affecting the spring and autumn herring spawning). These losses only relate to a small portion of bottom quarters with an area of 1 km2, which shall not affect the continuity of bottom habitats. Development of the algae, crustaceans and molluscs in the area of the port is to be expected. It is possible to increase biodiversity, food base and improve the spawning characteristics of dump site bottom. In addition, there will be periodic intensification of bothersome noise and transport related to the dredgers' work, frightening birds and burdensome in the tourist season for people vacationing.

Tab. 30 Potentially significant impacts of the investment on the environment and biocoenosis

	Potentially significant impacts	Stage	Characteristics of the impact
1.	Landscape and topography (port and bottom of the dump site)	Construction and exploitation of the port[1]	Direct, permanent, long term
2.	Air and acoustic climate	Construction of the port and disposal of the dredge spoil[2]	Direct, short term, local, accumulated in the period of overlapping schedule of water engineering works
3.	Changes of the bottom environment: - zoocenosis - ichtiocenosis - fragmentation of the habitats	Construction and exploitation of the port. Dump site areas.	Direct, short term Direct, periodical, under reconstruction (reintroduction)
4.	Changes of the pelagic zone	Construction of the port and	Direct, short term, under

[1] Construction and exploitation of the port – dredging works on the basins connected with the construction of pier in the external port in Świnoujście and its exploitation

[2] Deposit of dredge spoil – deposit of the dredge spoil on the dump site

	environment: - chemical barriers and suspensions - fish migration disorder - biological production disorder - thermals water disorder - transparent disorder - field current disorder	disposal of the dredge spoil	reconstruction (reintroduction)
5.	Changes of the benthic environment in the area of: - port - dump site	Construction of the port and disposal of the dredge spoil	Direct, medium term, under reconstruction
6.	Development of the centers of disturbance of the environment	Construction of the port and disposal of the dredge spoil	Direct, short term (temporary), cumulating in the periods of depositing the dredge spoil
7.	Bathymeric changes in the area of: - port - dump site	Construction and exploitation	Direct, permanent, long term
8.	Biological loss in the area of: — port — dump site	Construction and exploitation of the port and disposal of the dredge spoil	Direct, medium term
9.	Ichtiofauna loss: — bottom fish — pelagic fish fishing	Construction of the port and disposal of the dredge spoil	Direct, short term
10.	Pelagic and benthal structure disorder	Construction of the port and disposal of the dredge spoil	Direct and indirect, short term
11.	Biological profits	Construction and exploitation of the port	Indirect, long term, new habitats

13.3. Emissions

The investor should be obliged to make sure that, the labor force use an equipment that, meets the technical requirements and have low emission of pollutants into the air, they organize their work, choose and operate the equipment correctly. Labor force should apply Best Available Techniques.

In the course of the project, there will be emissions of a local range:

— to the air – emission of the pollutants from the vessels and dredging equipment of a short term and disorganized nature,

— noise – work of the dredging equipment,

— sewage, garbage and material waste – disposed in the port of Świnoujście,

— oily and oil-derivative wastes – disposed in the port of Świnoujście.

Stated emissions are typical for the construction period and will disappear with the completion of investment works.

13.4. Description of the applied forecasting and assessments methods and used data

The probability to assess trends of changes in the ecosystem under natural conditions is growing with the lengthening series of observations over time. The introduction of anthropogenic factors significantly increases the difficulty in assessing the variability of the environment and its biocoenoses, thus it is very rarely possible to predict trends and end-state complex biological system of Pomeranian Bay. Lack of long term research of individual elements of the environment and marine biocoenoses which, allow for the designation of the trend and volatility forecasts of both the global and local factors, is cause of the subjectivity of forecasting methods valuation of particular environmental elements. On the grounds of identifying the main types of impacts of the project and knowledge of environmental conditions, effects, which should be considered in the assessment can be identified with some probability. Then, using the method of forecasting (simulation models, descriptive models) the variation trend of the different elements in the environment is shown. Identification and forecast of the impact of effects decide about the final evaluation. The various components of environment, that are subject to the project were put in multiple rankings allowing evaluation of their changes, even in case of lack of full information.

During the implementation of the environmental impact assessment of the analyzed project, following were used:

- applicable laws;
- recommendation of the European Commission handbook 'Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6 (3) and (4) of the Habitats Directive 92/43/EEC (European Commission DG Environment, November 2001);
- assessment of hydrometeorological, hydrochemical, ecobiological trends (including ichtiofauna and avifauna) of the Pomeranian Bay and the southern Baltic;
- quality analysis – current and projected during works execution and after its completion – the environment and biocoenoses in the region of investment;
- analysis of data obtained from environmental surveys carried out in 2007-2008 for the purposes of evaluation of the environmental impact of construction of the external port of Świnoujście;
- analysis of literature data, reports, environmental impact assessments of the coastal zone of the Pomeranian Bay of the projects planned for the implementation and results of monitoring of the area;
- knowledge and experience of the executive team of environmental impact assessment of the investment in marine areas;

- information about the environmental impact of similar investments;
- analysis of the economic, technological and location indicators of the implementation of the project;
- analysis of monitoring guidelines and possible compensation of nature;
- the results of evaluations of the matrix of environmental quality and impact of the project;
- ranking analysis of the effects of the investment in hierarchical systems.

The results of mathematical modeling (simulations) of environmental processes (sediment transport, waving scenarios, flow velocity) and their variability under the influence of the investment were also used. In study made by BMT Cordan (Final Report…, 2008) for the planned construction of a shielding breakwater for the external port in Świnoujście, analysis of deep-water surge using surge model WAM4 (widely used in the world) and modeling of sediment transport using Dutch numerical program UNIBEST-LT were carried out.

Modeling results allowed to regionally characterize hydro and litho-dynamic conditions in the context of the planned construction of the external port of Świnoujście.

14. ACTIVITIES AIMING AT PREVENTING, REDUCING OR NATURAL COMPENSATION OF POSSIBLE NEGATIVE IMPACTS ON THE ENVIRONMENT

14.1. Mitigating measures

The environmental impact assessment of the investment conducted under the name - Disposal of dredge spoil into the sea from the dredging work of the basins forming water areas of Seaports Authority showed that:

- during the construction stage, significant impacts on certain elements of the environment will occur, but they will have short term nature (limited to time for work) and shall be limited directly to the work area;
- exploitation stage shall not occur. The investment will be completed at the implementation stage. Thus, there will be no impact on the environment of the Pomeranian Bay.

Also there will be no significant, negative impact on the particular conservation objectives (the species and habitats), for the protection of which Natura 2000 sites where designated.

In order to eliminate and reduce significant impacts, actions to reduce or minimize the interference in the environment caused by the investment were planned. Mitigating measures will be implemented at the stage of construction (implementation) of the investment.

14.1.1. Construction stage

Mitigating the adverse impact of the works connected with dredging and disposal of dredge spoil on the environment of Pomeranian Bay will consist of:

- planning time limit of work conduct that will not collide with the fish spawning periods and application of seines, i.e. breaks during dredging works and disposal of dredge spoil into the sea from 1/04 to 31/05 due to the herring spawning period;
- proper organization of the construction site;
- the correct selection of dredging equipment;
- use of machinery and high-tech equipment in fully skilled and managed by qualified persons;
- compliance with safety standards and procedures related to works carried out in the sea, resulting from separate legislation;
- providing supplies and equipment that limit and collect any leakage of possible pollutants from vessels;
- prohibition of the discharge of sewage into the sea due to the anticipated intensity of works in the area;

— division of dump site field on 3 quarters of approximately 1 km^2 surface;

— determination of the order of plot selection so that, in the in the autumn spawning periods (from IX to XI) and immediately after herring spawning dredge spoil was deposited in the northern plot, most distant from the spawning grounds;

— execution of the dredging works with the division into two stages: stage I (720 000 m^3), implemented in accordance with the schedule in 2010, stage II - (1 680 000 m^3), implemented in accordance with the schedule in 2012 - to maintain the standards of air quality in area of planned works. Stage II should be divided into III periods, i.e. dredging works are separated by works that are not related to deepening. In the I period, volume of dredging works will be 1 100 000 m^3 of dredge spoil, in the II period of 580 000 m^3 of dredge spoil. This will help to meet environmental requirements i.e. it will not cause exceeding (0.2% of time in a year) concentrations of the permissible pollutants emitted in one hour, particularly nitrogen dioxide concentrations equal D_1 = 200 ¶ g/m^3;

— ensuring an adequate standard of performance of particular elements of investment by companies performing dredging works and dredging spoil in the sea through the internal control over execution, in order to obtain high quality of work

— transport of dredge spoil to the dump site in the zones designated for its transport;

— necessity of cleaning the surface of the water from pollutions that will appear due to execution of dredging works should be included (e.g., branches, aquatic vegetation, the old wooden structures, remains of fishing nets, etc.)

— due to the location of the planned investment within the Natura 2000 "Pomeranian Bayn " PLB 990003, and "Ostoja na Zatoce Pomorskiej" PLH 990002, it is particularly important to take into account the values of animated nature in the course of the construction works. The construction manager should cooperate with a specialist from the environmental field on regular and long-term basis,

— actions minimizing the avifauna are not expected. As a result of the implementation of the investment feeding habitat shall be depleted in a minimum scope. In place of lost bottom surface, there shall be new ones formed - breakwater, quay, which will provide a new substrate for benthic organisms and periphyton;

— to preserve the potential archaeological sites that are beneath the ground or layer of bottom sand during the excavations, observations of dredge spoil excavated from the bottom should be conducted. In case of historical buildings, archaeologist should be informed so that they could document the position;

— the conditions of works execution resulting from decisions of the Director of Maritime Office in Szczecin of 12/01/2010 with ref No. ON-I-4147/02/02/10 should be met, consenting on the temporary occupation of the basin of territorial marine waters in order to implement dredging works related to the implementation of the project concerning ‘Construction of the waterfront for the external port in ŚwinoujŚcie’.

14.2. Natural compensation

Act of April 27, 2001 Environmental Protection Law (Journal of Laws, No. 62, p. 627, as amended) defines natural compensation, as: "... *set of actions, including in particular the works, earthworks, soil reinstatement , afforestation, or vegetation cluster formation, leading to restoring the natural balance or the creation of vegetation clusters, leading to restoring the balance of nature in the given area, to compensate for the damage done to the environment by carrying out an operation and maintenance of landscape values* ..." (art.3 p.8). The obligation to comply with natural compensation can be imposed with decision on environmental conditions. The required scope of compensation in case of project for which the proceedings on the environmental impact assessment were conducted is defined in decision on environmental conditions.

Based on the environmental impact assessment of the investment, involving the disposal of dredge spoil into the sea from dredging works from the basins forming water areas of Seaports Authority, it is stated that, irreversible damages in the environment shall not occur. Natural balance will be slightly disrupted and the biological losses will occur at a level that will not require natural compensation.

15. ESTABLISHMENT OF THE LIMITED USE AREA AND DETERMINATION OF THE BORDER OF SUCH AREA

The project consisting of disposal of dredge spoil from dredging works from water basins related to the construction of the waterfront in the external port of Świnoujście is not mentioned in the Article 135 of Environmental Protection Act as an activity for which it is allowed to create such an area.

In accordance with Article 135 paragraph 1 of Environmental Protection Act, limited use area is created when, despite the use of available technical solutions, technology and organization cannot comply with environmental quality standards. The obligation to establish such an area is derived from the environmental impact assessment.

16. ANALYSIS OF POSSIBLE SOCIAL CONFLICTS CONNECTED WITH THE PLANNED INVESTMENT

16.1. Conflicts identification

Planned investment, particularly disposal of dredge spoil at the designated area according to the variant 2a may, during the time of construction work (10 months) cause the occurrence of various conflicts. Conflicts can occur in the following areas:

- **Conflict: project - fishing**. Dump site according to the option 2a is located in a fishing square D2 and takes approximately 3 km^2 area of the bottom surface. Disposal of dredge spoil will be conducted in two stages, in total for about 300 days, except for spawning periods. However, this work can restrict the migration of fish through the dump site area and application of for example herring seines. Dump site area is beyond the reach of small-scale fisheries, fishing boats from the west coast ports operate on them. Given that, the investment area occupies approximately 0.9% of the fishing square, it appears that the exclusion of this area from fishing during the construction work should have no impact on the potential conflict with the community of fishermen due to the small potential losses in the fishery. Similar situation occurs in other marine investments, it can be considered that, any documented fishing loss (for example invoiced) must be compensated by the financial equivalents and stocking, in a way of mitigating the social conflicts. The investment will not change marine habits of fishermen. Does not apply to a fishing quota and funding of the sector.

- **Conflict: investment – environmental protection** (Nature Conservator, environmental and social groups) - associated with the threats and the possibility of degradation of selected environmental resources or values. The area of the planned investment is located within the protected area: "Pomeranian Bay" PLB 990003 and „Ostoja na Zatoce Pomorskiej" PLH 990002. Areas are included in the European network Natura 2000. Works connected with disposal of dredge spoil into the sea can generate concerns that, they may have an impact on the protection objectives for which they were set up and cause a conflict resulting from the short-term disruption of nature protection function of avifauna and ichtiofauna. For this reason, it is recommended to schedule construction work time in a way that does not interfere with fish spawning periods. This threat will be minimized by using the best available techniques (BAT) i.e. the use of technically efficient equipment that corresponds to the level of the modern techniques and methods of disposal of dredge spoil on the quarters and other actions to minimize the impact of the project on protected areas (Chapter 14).

- **Conflict: the project - the military activity.** There will be no conflicts. The area of the investment is not in the interest of the Navy.

- **Conflict: investment – sport fishing**. The area of spoil disposal should be excluded from active use by anglers and scuba divers during the period of disposal of dredge spoil. On the border of dump site field, cluster attracting birds and marine mammals and even sports anglers can be formed fish. Limiting their activities in the area of dump site will not

constitute the grounds for the potential reduction of conflicts apart from the limitation of fishing activities in the dump site area and transport route of dredge spoil.

- **Conflict: investment – maritime navigation**. The transport route of dredge spoil – hopper barge complexes to and from dump site areas and disposal itself can constitute an navigation obstacle to fishing boats and coastal shipping units. Going round the dump site area may extend routs of fishing boats to fishery and increase the cost of fishing. The use of other fisheries may also increase in the region, disrupting the balance of ichtiocenosis (overfishing). However, period of the implementation of the investment limited to approximately 10 months, will not constitute a significant impact on the sea navigation area and the change in sailing habits of fishermen.

- **Conflict: investment – the exploitation of raw materials.** Dump site area does not belong to the area rich in detrital materials. It is not an area where natural aggregates are obtained in a long run, therefore, the work carried out here will not cause conflicts with those who apply for licenses to extract raw materials from the seabed. There will be also no limitations in identifying oil and gas resources conducted in the licensed area of Petrobaltic.

16.2. Social consultations

Within social consultations, stakeholders were consulted, whose statutory activity is connected with the planned location of disposal of dredge spoil from deepening water basins in the area of the territorial sea.

Chosen entities (Table 31) where provided with the technical and location details of the proposed investment, with a request for an opinion on the presented options and identification of potential conflicts which may arise from implementation of the investment in terms of activities carried out by particular institutions.

	Institution	Address	Letter number	Answer
1.	Maritime Office in Szczecin	ul. Plac Batorego 4 70-207 Szczecin	ZHM/01/02	17.02.2010 & 11.03.2010
2.	Navy Command	Skwer Kościuszki 12 81-912 Gdynia	ZHM/02/02	02.03.2010
3.	Voivodship Inspectorate for Environmental Protection	ul. Wały Chrobrego 4 70-502 Szczecin	ZHM/03/02	email: 05.03.2010
4.	The West State Sanitary Inspector	ul. Spedytorska 6/7 70-632 Szczecin	ZHM/04/02	17.02.2010
5.	Regional Sea Fisheries Inspectorate in Szczecin	ul. Starzyńskiego 8 70-506 Szczecin	ZHM/05/02	17.02.2010
6.	Commander of the Maritime Border Guard to them. Col. Charles heed	ul. Oliwska 35 80-917 Gdańsk	ZHM/06/02	15.02.2010
7.	Board of Maritime Ports of Szczecin and Świnoujście	ul. Bytomska 7 70-603 Szczecin	ZHM/07/02	phone

Table 31 List of stakeholders participating in the process of social consultation on the proposed investment.

Name of the institution	Applications submitted	Preferred option of the dump site
Maritime Office in Szczecin	Lack of acceptance for the two proposed locations of dump site due to their location in the area of the coastal shipping routes proposed as a first-class tour of HELCOM, the positive agreement in terms of navigating of the modified variant 2 to variant 2a, the necessity to obtain the required by the law, agreements or decisions, in order to implement the proposed project.	Proposal to move the field in the north-west direction. Acceptance of the modified variant 2a.
Navy Command	No conclusions	No comments were received.
Voivodship Inspectorate for Environmental Protection	It has been reported that, the south from the indicated fields of disposal of dredge spoil, WIOŚ conducts research on quality of transitional waters and coastal areas (sections 2 and SW), due to the planned quantity of deposited and stored material, it is possible to impact on water quality in the measurement points, request to provide information on places, dates and quantities of dredged material and its quality.	No comments were received regarding the location of dump site field.
The West State Sanitary Inspector	No conclusions	No comments were received.
Regional Sea Fisheries Inspectorate in Szczecin	Investment could interfere with the protection and rational exploitation of living marine resources, a copy of a letter has been sent to the MARD in Warsaw (Fisheries Department) - the body responsible for protecting marine resources beyond the internal waters, applied for an appropriate public consultation and the use of options available to the Minister, request of confirming the information on the final selection of the dump site area	From the two options W1 and W2 - advantageous option 2 (field EFGH)
Commander of the Maritime Border Guard to them. Col. Charles heed	Implementation of this investment in the proposed locations will not adversely affect the performance of statutory duties of the Maritime Border Guard Department	No comments or objections were received.
Board of Maritime Ports of Szczecin and Świnoujście	No conclusions	No comments were received.

The consultation provided opinions and suggestions from those who are interested in implementation of the investment, environmental protection, and particularly in the effects of dredge spoil on the seabed.

Negative attitude to Variant 1 and 2 presented by the Maritime Office in Szczecin, who pointed out the conflict between the location of the dump site field and the proposed in this area shipping route of HELCOM first class. To minimize the impact of the dredge spoil on sailing, variant 2a, moved in a northwesterly direction in relation to the location W2, was suggested. Taking into account the processes of spreading the suspension and transport of debris, variant 2a was set at a distance of about 750 m from the coastal shipping route (HELCOM route), thereby preventing shallowing of the route through the sediment. The proposed location of the disposal of the dredge spoil from deepening of the water reservoirs that are connected with the construction of quay it the external port of Świnoujście at the area defined as variant 2a was agreed favorably in navigational terms by the Director of Maritime Office in Szczecin (letter of 11 March 2010, ref. No. ON-I-4180/01/05/10. Shifting further north the dredge spoil field is also good for the fishery (distance from the spawning, greater depths) and the tasks performed by WIOŚ, which within the State Environmental Monitoring conducts research of the quality of transitional and coastal waters in positions 2 and SW that are about 1 Mm distant from the coast.

17. PRESENTATION OF THE PROPOSED MONITORING IMPACT OF THE PLANNED INVESTMENT DURING ITS CONSTRUCTION AND OPERATION

In order to determine changes, that may happen to the marine environment of the investment implementation area: the construction of the waterfront in the external port of Świnoujście and the use of the seabed to dispose the dredge spoil - a monitoring proposal should be done. Monitoring obligations imposed by the law of 16 April 2004, the Nature Conservation (Journal of Law No. 92 pos. 880, as amended) as well as the recommendations of the Helsinki Convention (1974, 1992). Monitoring area of the investment, that is located entirely within the waters of the Pomeranian Bay, is an area of storage of dredge spoil (dump site) coming from dredging works carried out within the investment and covers an area of approximately 3 km^2 identified in the Report as a field IJKL - Variant 2a. Nearest corner point of the dump site (I) is located about 19 km from the investment site in a north-easterly direction. Dump site area is divided into three quarters with an area of 1 km^2 each, where in two stages within 10 months will set aside about 2.4 mln.m^3 of the dredge spoil.

Ex-ante and ex-post investment monitoring research will allow to verify the projected outcomes set out in this report of the impact of the investment on the environment. Ex-ante as well as ex-post monitoring (Table 33) includes:

- bathymetric measurements of dump site field,
- photographic and film documentation of the sea surface and bottom in the area of dump site,
- examination of benthic fauna,
- biological and physico-chemical study of water
- listening of porpoises.

The purpose of monitoring will be:

– determination of the background in the area of dredging work and disposal of dredge spoil at a designated area of the Pomeranian Bay, for the parameters examined in the monitoring after the investment,

– documenting changes in the environment of gulf in the near and far area of disorders center.

Therefore, the realization of two basic types of monitoring are suggested: ex-ante and ex-post and supplementary during the implementation of the investment.

Performing the ex-ante monitoring is necessary to determine the situation in the environment, to which ex-post monitoring results will be referenced. As a part of that, research should be carried out prior to the dredging works and disposal of the dredge spoil in respect of the basic abiotic and biotic parameters of the environment. In the ex-post monitoring (after the completion of the investment)

the same tasks are proposed to be performed to determine possible changes in individual elements of the ecological and hydrodynamic quality.

Monitoring of the marine environment of the dredging works will be carried out within the natural monitoring conducted for the investment "Construction of the shielding breakwater for the external port in Świnoujście". Area of planned dredging works related to the future quay for unloading LNG is located in the part of the basin of the proposed external harbor.

The monitoring area includes four locations of research areas:

- I research area (main) covering water reservoir 13 ha of the planned external port Świnoujście,
- II research area (secondary) adjacent to the east breakwater,
- III research area (control) located within the bird mainstay PLB 990003 “Pomeranian Bay” situated 5 km east of the east breakwater,
- IV research area (dump site) covering the area of 12 km^2 , located in its entirety in the waters of the Pomeranian Bay,
- reference position ZP2, ZP4, ZP5 and three positions on dump site.

Program of the monitoring indicating the scope and frequency of observation is summarized in Table. 33.

Table 33 Program of the monitoring of the ex-ante and ex-post project for the location W2a field of the disposal of dredge spoil.

Element of monitoring	Ex-ante stage	Ex-post stage	Frequency of ex-post monitoring
Implementation of the bathymetric plan – dump site area and the adjacent area (buffer zone 500m)	+	+	1 time each year for 5 years[3]
Photogrammetry of dump site area (aerial and satellite photos) – barrier suspension – center of disorders – the range of near field	+	+	8 times during the period of disposal of dredge spoil (dependent on the wind direction and suspension movement)
Tests of benthic fauna (species composition, quantity and biomass)	+	+	1 time each year for 3 years – 5 positions
Research of biological and physico-chemical parameters of water	+	+	Once after completion of the investment – 3 positions
listening of porpoises (2-4 hydrophones on the buoys designating dump site)	±		Every year since the start of work

3 + Basic measurement ± secondary measurement

Implementation of video monitoring of bottom areas (recognition of spawning, the presence of macrophytes)	+	+	1 time every year for 5 years from the start of work[4]

Ex-ante monitoring of the investment should be carried out once, for no longer than until the start of operation of dump site. Monitoring should be carried out on selected transects and positions, before the start of the investment, in its course and for at least three years after its completion.

Conduct of the additional monitoring during transportation and disposal of the dredge spoil is assumed. Includes:

- assessment of the size and specific composition of bird populations in the region of dump site, testing the scope of the turbidity of water suspension of deposited dredge spoil,
- selected elements of the assessment spawning-fishing of the area, monitoring of the excavated dredge spoil.

Measurements of monitoring should be carried out by specialized teams. Monitoring of the marine environment in the pelagic and benthic zone should be carried with accordance with standard methods recommended by the Baltic Marine Biologist and methods of monitoring the marine environment recommended by HELCOM and ICES conventions. Obtained results will be used both to assess impact of the investment on the environment and a base for basic works. The current transformation of the Baltic Sea eco-system mainly of an anthropogenic nature requires intensification of the research. Coastal region of the Pomeranian Bay is included to the areas with intensive land development in the phase of rising human impact. Therefore, both, special protection and conduct of comprehensive environmental monitoring is required.

4 * in case of stabilization of measurement results , their frequency can be shorter
**on four longitudinal sections and three cross sections

18. DIFFICULTIES RESULTING FROM INSUFFICIENT TECHNOLOGY OR GAPS IN MODERN KNOWLEDGE WHICH WERE ENCOUNTERED WHILE DEVELOPMENT OF THIS REPORT

Carried out research and analysis on the impact of the proposed investment on the environment, including the Natura 2000 sites, also location variants of the dredge spoil disposal from deepening works were considered.

Available information enabled the regional characteristics of the Pomeranian Bay and its extrapolation to the projected investment area. When drawing up the report the difficulties were encountered in relation to various analyzed factors. Heterogeneous and incomplete database was used, which allowed the description of the environment area of the investment with varying degrees of accuracy (e.g. poorly known species composition of meiobenthos, hydro-meteorological data, data on physico-chemical parameters of water).

One should be aware of the subjectivity of the assessments presented in the report, which are the reason of subjectivity of the evaluators, as well as their own assessments based on incomplete data base on the state and the dynamics of the environment and the biocoenoses on the analyzed fields of dump site area. Deficiencies of knowledge concerning this report result from the lack of protection and management plans of Natura 2000 sites. This plan in accordance with the Law on Nature Protection must determine, among others, risk assessment, the conditions for the protection of habitats and species and the necessary protection tasks. In addition, major difficulties in preparing a report were not encountered.

19. ABSTRACT IN A NON-SPECIALIST LANGUAGE OF THE INFORMATION INCLUDED IN THE REPORT

The subject of the report is environmental impact assessment for the project involving removal of the dredge spoil to the sea from dredging of the water bodies constituting water areas of the harbor of Seaports Authority S.A. connected with construction of the quay for reloading LNG in the external port in Świnoujście.

The project under this EIA is located offshore the Pomeranian Bay to the east of the estuary of the Świna River and existing east breakwater. The scope of the designing works covers dredging works on the water body from the port turntable to shielding breakwater on the length of the LNG cargo handling position and the position of the water intake. The depth of the water body is -14.5 m (the position of mooring the vessel) and -12.5 m (other areas) and disposal of spoil excavated from dredging works at a designated site on territorial sea.

According to the Regulation of the Minister of Transport and Construction of 26th January 2006 on the procedures for issuing permits for disposal at sea of dredged spoil and the dumping at sea of waste or other substances (Journal of Laws of 2006, No. 22, item 166), it is required to assess the impacts of the project involving the disposal of dredged spoil at sea from dredging of the bottom on the marine environment.

Furthermore, investment consisting of the construction of quay in the external port in Świnoujście was classified in accordance with § 2. 1 pt. 32 of the Regulation of Council of Ministers on the types of enterprises that, may significantly affect the environment and specific conditions for qualifying projects to draw up the environmental impact assessment (Journal of Laws, No. 257, 2004, item 2573, as amended) as a project likely to significantly affect the environment for which it is required to draw up environmental impact assessment.

The planned investment is not related to the use of installations covered by the requirement to obtain an integrated permit, in accordance with the regulation of Minister of Environment of 26 July 2002 on the types of installations that can cause significant pollution of the various elements of nature or the environment as a whole (Journal of Laws of 2002 No 122, item. 1055).

During the implementation of environmental impact assessment of the analyzed investment, the results from field studies on the marine environment and carried out in 2007-2008 in the area of planned construction of a shielding breakwater for the external port of Świnoujście were used. The results of modeling of sediment movement and waving in the area of the proposed external port developed by BMT Cordan Sp. z.o.o. were analyzed. The expertise and the available literature and scientific work on the Pomeranian Bay and similar investments carried out in similar conditions elsewhere were used. In the expert assessment of environmental impacts on the components of the environment, the method of assessment that, determines a significance and scope of impacts was used.

The performance of dredging works on the basin of emerging external port in Świnoujście is projected on the area of about 0.25 km^2 and 2.4 mln.m^3 volume of dredge spoil. Dredging sediments

will be set aside for marine dump site (according to variant 2a) with an area of about 3 km^2 and average depth of 12.9 m AMSL. Dump site will create embankments of about 1 ÷ 1.5 m over seabed level, which will be leveled. Implementation of the investment is planned for 2010-2012. Schedule provides that the dredging works shall be phased in two stages:

- **stage I** – before commencement of the works connected with pile driving and waterfront construction, assuming extraction of approx. 30% of the spoil i.e. 720 000 m3 within 4 months in the period (07.–10.2010),

- **stage II** – upon completion of waterfront construction, assuming extraction of approx. 70% of the spoil i.e. 1 680 000 m3 within 6 months in the period (06-11.2012 r.).

Schedule provides for a 30% reserve time for unforeseen circumstances during implementation e.g. technical, weather, etc. Dredging works shall be carried out round the clock, even at night. Bottom sediments planned for dredging have been analyzed for the state of pollution (36 cores). The content of heavy metals, PAHs and PCBs is lower than the values indicated in the Regulation of Minister of Environment on the types and concentrations of substances that make that, the dredge spoil is contaminated (Journal of Laws of 2002, No 55, pos. 498) which states that, dredge spoil from the basin connected to the construction of waterfront in the external port of Świnoujście is uncontaminated and can be stored in the marine environment.

Averaged parameters of sediments indicate that, the sand is fine, medium and well sorted of a low content of organic matter. Dominant fractions of a grain size 0.125 <d.0,250 is about 70%.

Variant processing concerned the place of disposal of dredge spoil from deepening of the basin connected to the construction of pier. Three options of disposal of dredge spoil were considered: null 'do-nothing' option, disposal of dredge spoil on the designated – from the three analyzed - area (W1, W2 and W2a) of seabed. In addition, alternative option was considered – other place of disposal of dredge spoil than the sea.

Based on the analysis of environmental and biocenothic conditions, evaluations and opinions of stakeholders, the scientific community and result of ranking analysis, it has been assumed that, the least burdensome to the environment will be removing the dredge spoil to the sea and depositing it according to the variant 2a (Pic. 1). The analysis shows that, the works carried out here shall not have a significant adverse effect on the areas of conservation of species and habitats Natura 2000. During the discharge of dredge spoil, suspension field in the depths will slightly exceed borders of dump site fields, and the suspension and the rubble transported at the bottom shall not jeopardize the approach fairway to the port of Świnoujście.

The bottom area of dump site after the completion of the works shall be included in the ecosystem, re-colonized and settled by meio- and macrobenthos and used for as spawning and feeding areas for fish. Variant W2a of location of disposal of dredge spoil does not interfere with existing and proposed routes of shipping.

Due to the capacity of dredge spoil (2.4 mln.m^3) formed by marine saline sands deredged in the coastal zone and the transport and economic considerations, the option of disposal of the entire dredge spoil in the silting field Ostrów Grabowski, located about 68 km from the dredging works was rejected. Variant null 'do-nothing' was also considered – non implementation of the investment,

which translated into other methods of utilization of dredge spoil which from the perspective of natural and socio-economic development was rejected.

The nature of the proposed investment does not anticipate organized emission of pollutants into the atmosphere. A slight increase in unorganized emissions in the course of the investment might be expected, associated with an increased traffic of construction machinery and vessels floating during the dredging of the basin and transport of dredge spoil into the dump site field. Emissions from vessels will be restricted to the region of works that shall be carried out (work of dredgers, excavators and transport of dredge spoil by hopper barge to the indicated place of dump site).

In conclusion, the project implementation, while maintaining the assumed phasing of works in stages and the use of dredgers with suitable operating performance, shall not cause significant changes in the current condition of air pollution in this region. The emission of pollutants will be limited to the construction area. Due to the very good ventilation of work area, which is a consequence of favorable wind directions, there shall be no stagnation of polluted air in any season. The impact on the acoustic climate in the stage of the implementation of the investment shall be connected with operation of vessels intended for dredging works and transport - dredger, tug, excavator, hopper barge. Exceed of the permissible noise levels as a result of the implementation and operation of the proposed investment is not expected.

The planned investment shall not cause increase in demand for water both during implementation and operation of the investment. Sewage discharge and other wastes into the marine environment is not expected. Waste such as used oil, car batteries, oily materials, packaging and waste and household waste generated during the implementation of the investment shall be taken in the port of Świnoujście. In the course of dredging works waste such as: trash, wood components, the remains of fishing nets can be released from the bottom of the basin, and will be collected on an ongoing basis.

The proposed investment shall not cause risk increase of environmental factors on the surface of land, landscape and historical values of the analyzed area. Also, it shall not affect the foreland of the exposure of objects of cultural values that exist in other parts of the region. Port of Świnoujście is a consistent dominant in the landscape, and the designed external port with the waterfront for unloading LNG will be its new dominant. In case of coming across the archaeological sites while dredging rescue research should be carried out under the supervision of conservation staff.

The impact of removing the dredge spoil into the sea shall have no significant impact on the environment and biocoenoses elements discussed during the ex-post period. In the case of overlapping the schedule of dredging works and disposal of dredge spoil of the analyzed investment with the construction of the shielding breakwater for external port in Świnoujście, cumulative impacts of implemented investments on the environment within the scope of gas emissions into the air and noise emissions should be expected. The use of modern vessels, a very favorable position of the investment against wind rose, causing the scattering and movement of pollutants towards the open sea, and conducted nature monitoring shall significantly reduce the consequences of cumulative effect. Cumulative impacts of disposal of dredge spoil on the dump site field of Maritime Office in Szczecin and the proposed dump site field W2a on the natural environment of the Pomeranian Bay are not expected because of their remoteness from each other (4 km). The potential extent of the spread of the suspensions shall not exceed 500-600 m.

Biological losses mainly concern the teams of meio-and macrobenthos, also include minor larval forms of bottom organisms and water depths. The losses of benthic fauna shall be restored relatively quickly. Reconstruction of the quality and species composition will take place within the year. Mobile opportunistic species will inhabit the area of the dump site field probably immediately after the completion of the work. Reconstruction of its age structure occurs in 2-3 years. This period should be taken as equivalent to a full recovery of bottom communities in the Gulf of Pomerania.

Impact on birds is not expected, which due to the high mobility, they are able to quickly move to other, neighboring, richer in food resources areas of the Pomeranian Bay.

Due to the protection of fish a break in the works execution (IV-V) was established. The proposed method of disposal of retained dredge spoil/ filling with dredge spoil quarters of the field (according to variant 2a), the most distant from the spawning grounds will substantially reduce the impact of work son the herring spawning. During spawning season in autumn (IX-XI), dredge spoil must be placed on the northern quarters reserved for dredge spoil excavated during the autumn spawning. Immediately after the spring spawning i.e. in June remaining field quarters, the most distant from the coastline, should be filled.

Most fish species are not only in the region of dredging works and disposal of dredge spoil, but are distributed in the Bay of Pomerania, which cause that possible shortage of the fish will be small.

In case of appearance of mammals in the Pomeranian Bay, any nuisance caused to them will be limited to the area and duration of the works related to the dredging works and disposal of dredging spoil into the sea.

Based on analysis of the impact of the planned investment on the individual elements of the environment and the proximity to the borders of the Republic of Poland (dredging works area - about 5 km, dump site field - more than 10 km), transboundary impact is not expected while using minimizing actions.

Impact assessment of the investment on Natura 2000 sites

Conducted assessment of the impact of the investment on the various protection objects (habitat and species) which were established for the protection of Natura 2000 sites (Special Area of Conservation „Ostoja na Zatoce Pomorskiej” PLH 990002 and Special Protection Area ”Pomeranian Bay” PLB 990003 points to the fact that, substantial (significant) negative impact on habitats and protected species shall not appear. At the area of the investment no habitat listed on Annex I to the Habitats Directive occurs. The only (potential) habitat is the one occurring on Ławica Odrzańska - sandbanks which are slightly covered by sea water all the time (area code 1110). Southern edge of Ławica Odrzańska is 3 km distant from dump site field W2a.

The impact of the investment on the habitat will be insignificant i.e. causing no obvious changes in habitat conditions and behavior of organisms. The implementation of the investment shall not significantly adversely affect the integrity of Natura 2000 sites operating in this part of the coast. There are 12 species of protected birds, 1 species of fish and 1 marine mammal (porpoise) according to the information given in the Standard Form Data on areas "The Pomeranian Bay" PLB 990003 and „Ostoja na Zatoce Pomorskiej” PLH 990002.

The movement of vessels, increased noise emission, mobilization of bottom sediments and related to it change in water transparency, the level of oxygen and nutrient concentrations in water, may temporarily worsen the conditions of feeding of diving birds, especially ichtiofags. However, disposal of dredge spoil in the quarters of area of about 1 km^2 and the correct choice of equipment will minimize the impact of the dredging works on avifauna and other physical, chemical and biological elements.

Proposed investment poses no threat to human life and health. Workers employed in construction work and dredging works will be trained, equipped with protective clothing and will undergo a medical examination required by applicable regulations. There was also no environmental effects of the proposed investment, resulting from the use of natural resources - its performance did not significantly increase their consumption (e.g. energy, food, etc.).

The proposed investment will increase the likelihood of an emergency during the construction phase due to the work of dredgers and movement of vessels (collisions, oil spills, weather emergencies). Therefore, it is assumed that, the water engineering works on the water, will be conducted only in weather conditions specified in the certificates of the vessels which will minimize the possibility of an emergency.

Due to the location of the planned investment within the Natura 2000 sites "Pomeranian Bay" PLB 990003, „Ostoja na Zatoce Pomorskiej" PLH 990002, it is particularly important to incorporate the advantages of animated nature in the course of construction work.

Mitigating the adverse effect of works related to the disposal of dredge spoil to the Pomeranian Bay on the environment of marine zone will include among others:

- division of dump site field into quarters of an area of approximately 1 km^2,
- making pauses in dredging works and disposal of dredge spoil to the sea from 1.IV to 31.V due to a period of spawning herring,
- phasing of works to reduce the accumulation of negative impacts and to meet quality standards of air and noise pollution,
- the use of high-tech machinery and equipment fully operational

Natural compensation

Due to the fact that, the interaction of the proposed investment on the environment will be restricted to its boundaries, and irreversible changes in the habitats and species composition should not arise as a result of using the minimizing action, the estimated, potential biological and habitat loss in relation to areas of the Natura 2000 will not require natural compensation.

There is no possibility for the investment to establish an area of limited use in accordance with the environmental protection. The obligation to establish such an area is derived from the environmental impact assessment.

The planned investment of disposal of dredge spoil from dredging works into the sea related to the construction of quays in the external port of Świnoujście may result in the occurrence of a variety of conflicts during the period of work. Conflicts can occur in the following areas: investment - fishing –

environmental protection (environmental and social groups, nature conservator) - maritime navigation. In order to prevent possible social conflicts, consultation with stakeholders were conducted, whose statutory activity is connected with the proposed investment. Stakeholders' suggestions were included in this report.

Before starting water engineering works: dredging and disposal of dredge spoil and after their completion, the monitoring related primarily to the evaluation of changes in the biological environment of the spoil disposal area is proposed. The recommendations of the monitoring include: monitoring of selected elements of the biological quality and morphology of the seabed.

When drawing up the Report difficulties in relation to various analyzed factors were encountered. Heterogeneous and incomplete database was used, which has allowed the description of the environment of the investment area with varying degrees of accuracy (e.g., incomplete data on meiobenthos, incomplete hydrometeorological data).

Conclusion

In the analysis which is the subject to this report, the principles of sustainable development and requirements to observe the impact of the investment on the environment were followed (in terms of threats and implementation of the conservation objectives of Natura 2000 sites).

Implementation of the investment "**Disposal of the dredge spoil from the dredging works to the sea from the water bodies constituting water areas of the harbor of Szczecin and Świnoujście Seaport Authority S.A.**" related to the future waterfront for unloading LNG in the basin of the Pomeranian Bay shall have **insignificant** impact on the environment and marine biocenoses. Also, there will be no negative impact on areas of protected species and habitats of the Natura 2000: "Pomeranian Bay" PLB 990003 and „Ostoja na Zatoce Pomorskiej" PLH 990002.

Therefore, the investment can be implemented in accordance with established technology of dredging works and disposal of dredge spoil as described in Chapter 2 of the Report and in accordance with practical actions to reduce the negative environmental impact specified in Chapter 14.

20. SOURCES OF INFORMATION THAT FORM GROUNDS FOR THIS REPORT

As the output information to draw up report source materials submitted by the Investor were used, in respect to specific issues of proposed investment:

- Decision on environmental conditions of approval for implementation of the investment "Construction of the quay in the external port of Świnoujście" (RDOŚ decision in Szczecin of 18 June 2009, ref No. RDOŚ-32-WOOŚ-6613-5-7/08/at,
- Decision of West Pomeranian governor No 2/2009 of 23.10.2009 on establishing the investment location in the terminal,
- Decision of West Pomeranian governor No 3/2010 of 15 January 2010 on the permission for the construction of the investment in the terminal, sign: I.I-AŚ-7111/322-4/09,

Other information used for the report, including:

- Study of conditions and directions of spatial development of the city of Świnoujście 2002.
- Conception of the gasport location in Świnoujście to diversify gas supply, Marshal Office of Zachodniopomorskie Voivodeship 2006
- Construction investment "Construction of the waterfront in the external port of Świnoujście". Volume II p. 5.11. dredging works, Pojmors.
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- The navigation analysis, Maritime Academy in Szczecin, S. Gucma, 2009
- Unpublished results of morphological and lithological research, located in sources of Hydrotechnology Marine Resources Marine Institute in Gdansk.
- The results of environmental research of the Pomeranian Bay from 2007-2008 for the purposes of environmental impact assessments.
- Sea bathymetric map 1:75 000 - Baltic sheets: the Pomeranian Bay
- Geological Map of the Baltic Sea-Bed, 1:200 000 (sheet: Kołobrzeg) (J.E. Mojski - ed., 1991).
- Photo – interpretation atlas of the sea-shore dynamics Świnoujście Pogorzelica scale 1: 5000 (red. Musielak St., 1991)
- Own information

— Published literature (detailed in the Bibliography below.)

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