Nord Stream
The new gas supply route for Europe

Nord Stream Environmental Impact Assessment
Documentation for Consultation under the Espoo Convention

Nord Stream Espoo Report: Key Issue Paper
Maritime Cultural Heritage

February 2009

English version | Key Issue Paper
Maritime Cultural Heritage

ENG

Please note:

The “Nord Stream environmental impact assessment documentation for consultation under the Espoo Convention” will, hereinafter and throughout the entire documentation as submitted hereunder, be referred to as the “Nord Stream Espoo Report” or the “Espoo Report”.

The English version of the Nord Stream Espoo Report has been translated into 9 relevant languages (hereinafter referred to as the "Translations") . In the event that any of the Translations and the English version conflict, the English version shall prevail.

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Abbreviations and definitions

3LPE	Three-layer polyethylene
BC	before Christ
BCM	billion cubic metres
BSH	Federal Maritime and Hydrographic Agency
BP	before present
DTM	digital terrain model
EEZ	exclusive economic zone
EIA	environmental impact assessment
FNBA	Finnish National Board of Antiquities
KUAS	Danish Heritage Agency (Danish: Kulturarvsstyrelsen)
MBES	multibeam echosounder
MST	Danish Environmental Protection Agency (Danish: Miljøstyrelsen)
NATO	North Atlantic Treaty Organization
NEGP	North European Gas Pipeline
PC	pipeline corridor, includes the combined area of the two pipelines, the zone between them and a buffer zone on each side of the pipelines
PZ	pipeline zone, the location of each of the two pipelines and a narrow buffer zone on each side of the pipelines
RAA	Swedish National Heritage Board (Swedish: Riksantikvarieämbetet)
ROV	remotely operated vehicle
SBES	single-beam echosounder
SBP	sub-bottom profiler
SMM	National Maritime Museums of Sweden (Swedish: Statens Maritima Museer)
SSS	side-scan sonar
UNCLOS (LOSC)	United Nations Convention on the Law of the Sea

1 Introduction

This Key Issue Paper presents an overview of maritime cultural heritage within the Baltic Sea and its relationship with the Nord Stream Pipelines. The paper has been developed based on information presented in the Nord Stream Espoo Report and the national EIA's.

Cultural heritage can be defined as the record of past and present human activity – in this case with a focus on maritime cultural environments. It must be recognised that cultural heritage resources are finite, irreplaceable and non-renewable; each site may contain information that is both unique and previously unknown. The cultural heritage sites of the Baltic Sea are primarily related to ship wrecks and submerged Stone Age settlements.

When planning a large-scale construction project, such as a twin gas pipelines across the Baltic Sea, it is important to pay appropriate attention to cultural heritage sites in the region. Cultural heritage is protected by legislation and the national authorities have developed procedures to avoid impacts on cultural heritage from construction projects. Desktop investigations and geophysical surveys have been performed by Nord Stream to locate known, previously unknown and potential cultural heritage sites. The relevant national authorities are reviewing the investigations related to cultural heritage.

This paper presents the:

- Strategy that was adopted to establish a rigorous baseline of actual conditions. This involved a combination of published studies, field surveys, reviews and consultation with authorities and other organisations
- Key results
- Project activities that might cause impacts
- Assessment of.potetial impacts
- Proposed mitigation measures to reduce potentiall impacts
- Further studies that are planned during the execution of the Project

2 Baseline for Cultural Heritage

2.1 General

National authorities in the Baltic countries have primarily gathered information about shipwrecks and other cultural heritage sites within their respective territorial waters. Knowledge of wrecks and other sites of cultural heritage outside territorial waters is.generally both random and limited /1/. Furthermore, the known underwater cultural heritage sites outside national territorial waters in the Baltic Sea are poorly researched, as sites on land and in territorial waters have been given priority /1/, /2/.

This has started to change during the last decade, as the UN Convention on the Law of the Sea (UNCLOS) has been ratified by an increasing number of nations bordering the Baltic Sea /3/. UNCLOS obliges these nations to protect and preserve archaeological and historical objects found in maritime areas outside national jurisdictions. Germany, Sweden, Finland, Russia and Denmark ratified UNCLOS in 1994, 1996, 1996, 1997 and 2004, respectively /3/. Since the ratification of UNCLOS by the above-mentioned Baltic countries, numerous transnational projects regarding cultural heritage have been initiated. Protection outside national maritime zones is also addressed in the 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage (although it has not yet been ratified by Germany, Sweden, Finland, Russia or Denmark) and in the Espoo Convention on Environmental Impact Assessment (EIA) in a transboundary context (1991), which has been ratified or signed by all Baltic countries /3/, /4/.

2.2 Underwater Cultural Heritage within the Baltic Sea

The maritime cultural heritage in the Baltic Sea primarily consists of two broad categories of underwater sites: shipwrecks and submerged settlements/landscapes.

In this section, the categories are described in general. Specific sites are discussed in later sections according to the country in whose EEZ or territorial waters they are situated.

2.2.1 Shipwrecks

Shipwreck sites reflect a diverse group of vessels that vary in age, size and type. Some shipwrecks are of no archaeological interest, whereas others are unique either due to construction method, degree of preservation, historical context or other factors. The integrity of shipwreck sites depends on a number of factors, in particular the manner, in which the vessel was wrecked, conditions on the seabed and later disturbance to the wreck or wreck site.

Due to physical conditions in the Baltic Sea (low salt content, low species diversity, relatively low temperatures, low oxygen content, etc.) the decomposition of organic materials progresses slowly. Consequently the preservation of organic materials is exceptional, even on an international scale. The preservation value and scientific potential of underwater cultural remains are therefore very great. The fact that the underwater cultural environment has not undergone much of the disturbance that has occurred on land, only adds to the potential archaeological value of the underwater cultural remains in the Baltic Sea /1/.

Once settled on the seabed, the wrecks are prone to physical destruction by activities like trawling. Still, a shipwreck does not necessarily need to be fully intact to be of archaeological interest. Even some highly degraded shipwrecks can yield valuable information after thorough investigations of the hull remains, equipment, cargo and other artefacts belonging to the wreck. It is therefore important to recognise that the "ancient monument area" of a wreck site is not only the hull itself, but includes the total deposit and distribution area of remains from a wreck, which in many cases is substantially larger than the actual hull.

Side scan sonar (SSS) is one of the preferred means for locating wreck sites. Wrecks with high relief or large dimensions are easily located by SSS surveys (see **Figure 2.1**). Smaller and/or degraded wrecks are more problematic to locate, especially in areas with irregular bottom features (rock outcrops or boulders). Shipwrecks completely embedded in sediments cannot be located by SSS. The effectiveness of SSS in locating wrecks is also highly dependent on frequency. High-frequency SSS is very detailed, whereas lower-frequency SSS surveys may obliterate features only making very distinct wrecks or remains discernible.

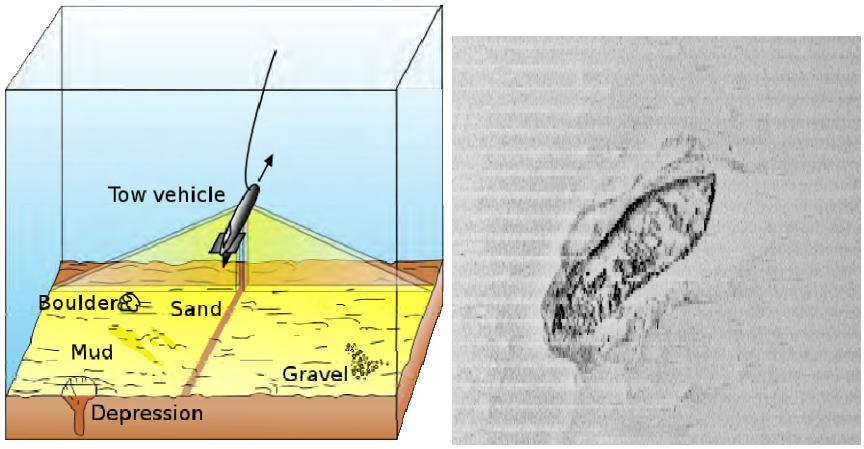

Figure 2.1 **The left picture illustrates how a side scan sonar is towed from a vessel while mapping features on the seabed. The right picture shows a side scan sonar image of an identified wreck in Danish waters**

Other geophysical methods are also used for the location of wrecks; namely magnetometry and highly resolved multibeam bathymetry. With the magnetometer it is possible to detect anomalous deviations from the normal magnetic field. Such deviations can be caused by ferrous material, e.g. an iron hulled vessel wreck, but also by concretions of rock with permanent magnetisation e.g. ballast stone from medieval vessels.

2.2.2 Submerged settlements and landscapes

Since the last glaciation, the Baltic Sea has undergone major environmental changes. Global warming at the end of the last glacial period led to rising sea levels, which, combined with isostatic upheaval of land masses, caused significant changes in the coastline of the Baltic /5/. The changes were neither uniform nor constant. Changing sea levels caused some former land areas to be submerged (particularly in the southern part of the Baltic Sea), also submerging human settlements, monuments and the landscapes around them.

The preservation potential of submerged settlements is in many cases far better than that of sites on dry land. Organic materials in particular may be very well preserved. Submerged settlements therefore represent a unique opportunity to gain knowledge of former ways of life. Submerged landscapes are also import for investigating the development of the Baltic Sea and the living conditions of people in the area.

In most cases submerged settlements and landscapes are not only submerged, but are also totally or partially covered by sediments. However, it is possible to predict the likely locations of submerged Stone Age settlements.

In recent decades, the "fishing-site model" has been used successfully to predict locations of submerged Stone Age settlements. The model is based on the knowledge that the Stone Age population was largely dependent on food from the sea /6/. Experience has shown that Stone Age people had very clear preferences for building settlements in specific areas that were favourable for fishing /7/. The theory behind the "fishing-site model" can be summarized as follows:

"Settlements were placed on the shore immediately beside good sites for trap fishery. Such places were mouths of streams, at narrows in the fjords, and on small islands and promontories close to sloping bottom in fjords" /6/.

Thus, it is possible to predict the most likely locations of submerged settlements by combining the principles of the fishing-site model with a basic knowledge of Quaternary geology, coastal morphology and sedimentary conditions of the area under study.

Visually, submerged Stone Age settlements are frequently identified (by divers) by the presence of worked flints on or just below the seabed sediments. In many cases the flints are

accompanied by remains of fishing weirs. Fireplaces or preserved organic artefacts such as wooden implements or food remains have been identified as well /7/. However, visual detection is only possible if some measure of erosion has taken place. Some settlement strata have become completely embedded and cannot be identified by visual means. Such situations are limited to areas with particular sedimentary conditions and can therefore be predicted.

Within the Baltic Sea it is not likely that submerged settlements are present at latitudes north of approximately 55.5°-56° N as these areas were not dry land during the Stone Age (see **Figure 2.2**), /8/.

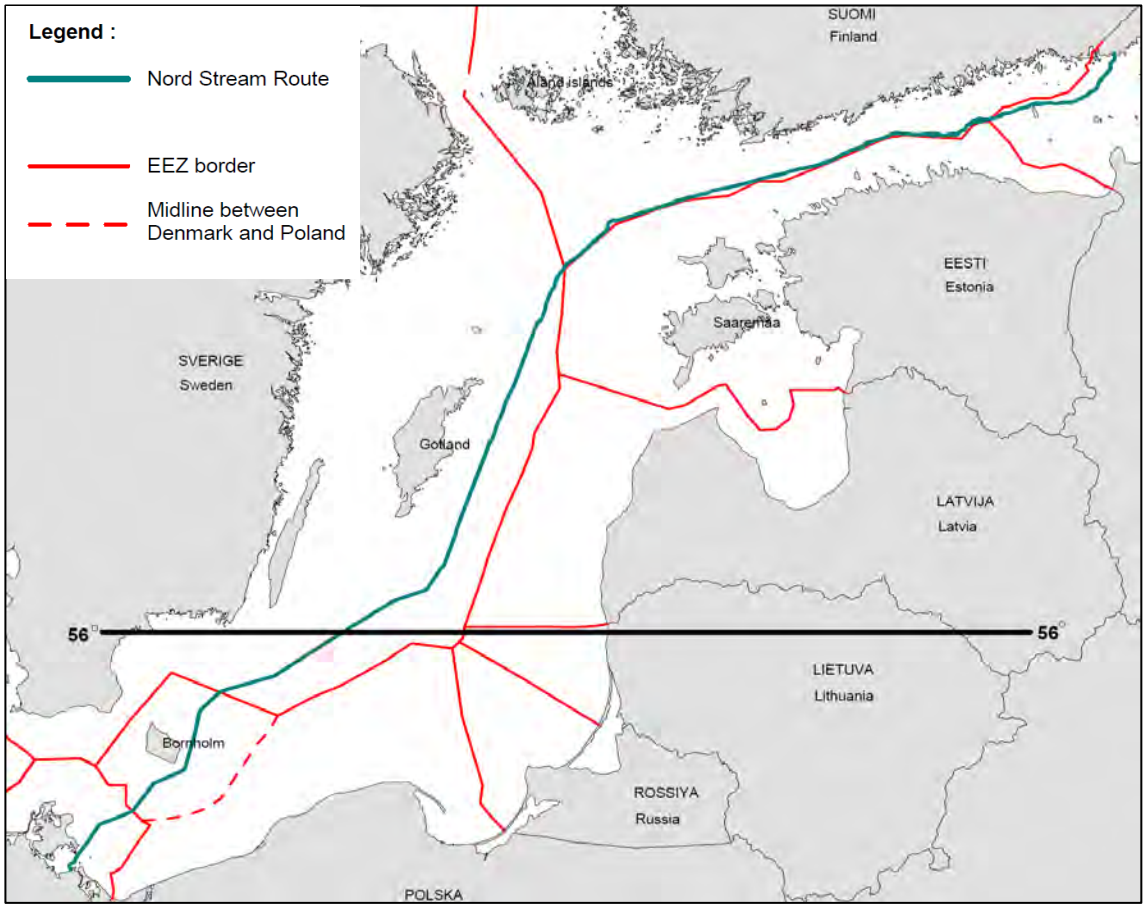

Figure 2.1 North of the 56th latitude is not likely that submerged settlements are present within the Baltic Sea

2.2.3 Zonation

Two "anticipation" zones have been identified in relation to the possible presence of cultural heritage sites in the Baltic Sea.

Table 2.1 Definition of anticipation zones

Zone	Definition
A	Shallow-water areas with water depth less than 20 m. In the middle and southern Baltic Sea (south of 56° N), submerged settlements may be present within Zone A. In the Baltic Sea in general Zone A may contain remains of degraded/broken shipwrecks (possibly embedded in sediments) that have not been discovered during surveys.
B	Zones with water depths greater than 20 m. Within Zone B there is a possibility of wreck sites embedded in sediments, undiscovered during surveys. In the shallowest areas of Zone B (less than 40-45 m) and south of 56° N there is a slight possibility of encountering submerged Stone Age settlements. The probability is, however, much smaller than in Zone A.

The possibility of encountering previously undiscovered cultural heritage sites varies between the zones. The need for awareness and alertness during construction work should vary accordingly. Highest awareness is necessary during construction work within Zone A, due to the possible presence of submerged Stone Age settlements.

In principle, Zone B could be divided into areas with softer sediments, where objects may be buried, and areas with hard substrates, where the probability of accidental finds is negligible. Such a subdivision, however, has not been applied for the present Project as it has no practical consequence during the construction process. **Figure 2.3** shows the anticipation zones along the pipeline's routes.

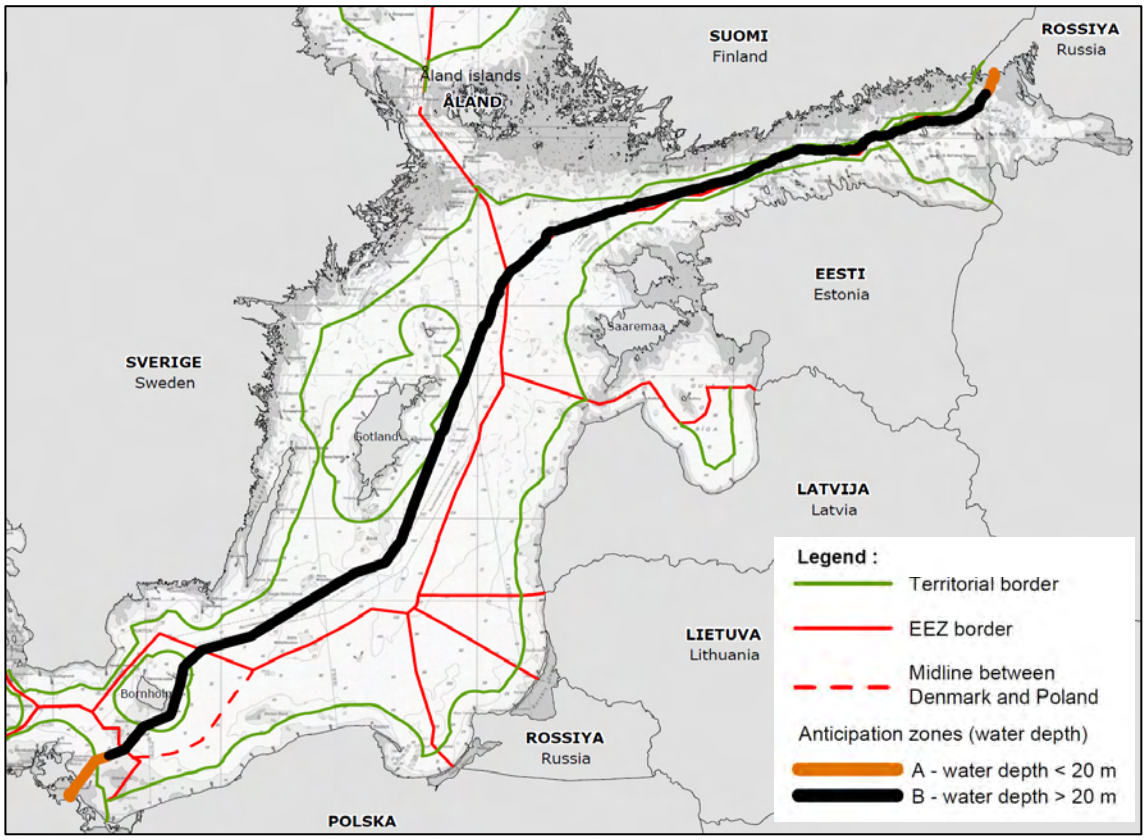

Figure 2.2 Anticipation zones (water depths) along the Nord Stream pipeline's routes

2.3 Field data

2.3.1 Survey Strategy

The identification of cultural heritage sites has been based on interpretations of side scan sonar data and magnetic data collected during geophysical survey campaigns.

The process adopted for cultural heritage investigations by Nord Stream includes the following steps:

- Assessment of published information
- Evaluation of prior surveys conducted between 2005 and 2006
- Performance of detailed geophysical surveys for the optimised pipeline alignments 2007/2008

- Consultation and communications with authorities from the Parties of Origin and Affected Parties
- Evaluations of survey data by National authorities from the Parties of Origin
- Development of the scope of work for the anchor corridor survey
- Performance of an anchor corridor survey to be used for the planning of the installation phase of the pipelines (ongoing: commenced November 2008 with completion Q3 2009)

The detailed geophysical surveys had the objective of finding a route for the two pipeline alignments which is feasible with respect to pipe lay, would require the least amount of seabed intervention works and which is acceptable as regards cultural heritage. During this process of optimisation the alignments have been modified through a succession of small changes. The investigation corridors were as described in **Figure 2.3**. Following the determination of feasible alignments, an even wider corridor, the "anchor corridor" is being investigated in order to map obstructions and wrecks in the corridor where the anchors of the lay vessels will be installed. With respect to cultural heritage the objective of all corridor investigations is to perform rigorous investigations with the utmost care in order to obtain a very high degree of certainty that any object of relevance will be found and inspected.

2.3.2 Prior Surveys – 2005 and 2006

Between 2005 and 2006 the Russian engineering- and survey contractor PeterGaz performed two main survey programmes. The surveys were supported by the Russian contractor Svarog and Fugro Osae from Germany.

In 2005 a general reconnaissance geophysical survey was performed to support route selection and optimisation. The survey results provided an evaluation of seabed morphology, surface soils, cultural heritage and other objects located within a nominal 2 kilometre wide corridor from the landfall in Russia to the landfall in Germany. The scope included approximately 17,000 kilometres of survey line.

In 2006 a detailed geophysical survey was performed along a 180 metre wide corridor centred on the selected "conceptual" pipeline routes. This survey of approximately 5,000 survey line kilometres provided higher resolution seabed topography (2 m by 2 m DTM) and located objects for further inspection. Following the geophysical phase, targets (potential munitions or wrecks) were selected for visual inspection by remotely operated vehicle (ROV). The selected objects were within 20 metres of the ‘conceptual’ alignment.

Equipment used during these campaigns included:

- Multibeam echosounder for bathymetric mapping

- Side scan sonar (100/300 kHz) for identification of seabed features
- Sub-bottom profiler (2 to 7 kHz chirp and boomer) for investigation of shallow geology
- Single magnetometer (Caesium and Overhauser) for identification of ferrous objects
- ROV (remotely operated vehicle) with video camera and pulse induction detection to locate buried or exposed conductive material

2.3.3 Detailed geophysical survey 2007-2009

Assessment of the results of the 2005 and 2006 surveys concluded that the survey approach could be improved and additionally, that the "conceptual" route alignment had been changed to minimise the environmental impact associated with the seabed intervention works.

This led to the planning and execution of a detailed geophysical and munitions screening survey during 2007-2009. The survey was designed to increase the degree of resolution and target detection reliability in a full corridor from Russia to Germany. The survey included:

- Step 1 Geophysical Phase: increased resolution of the side scan sonar system to greater than 500kHz
- Step 2 ROV mounted gradiometer: development of a gradiometer array to allow full ferrous detection coverage of the 15 m installation corridor
- Step 3 ROV visual inspection: visual inspection of all identified cultural heritage (within +/- 125 m) and possible munitions (within +/- 25 m)

The coverage achieved through steps 1 to 3 is presented in **Figure 2.3**:

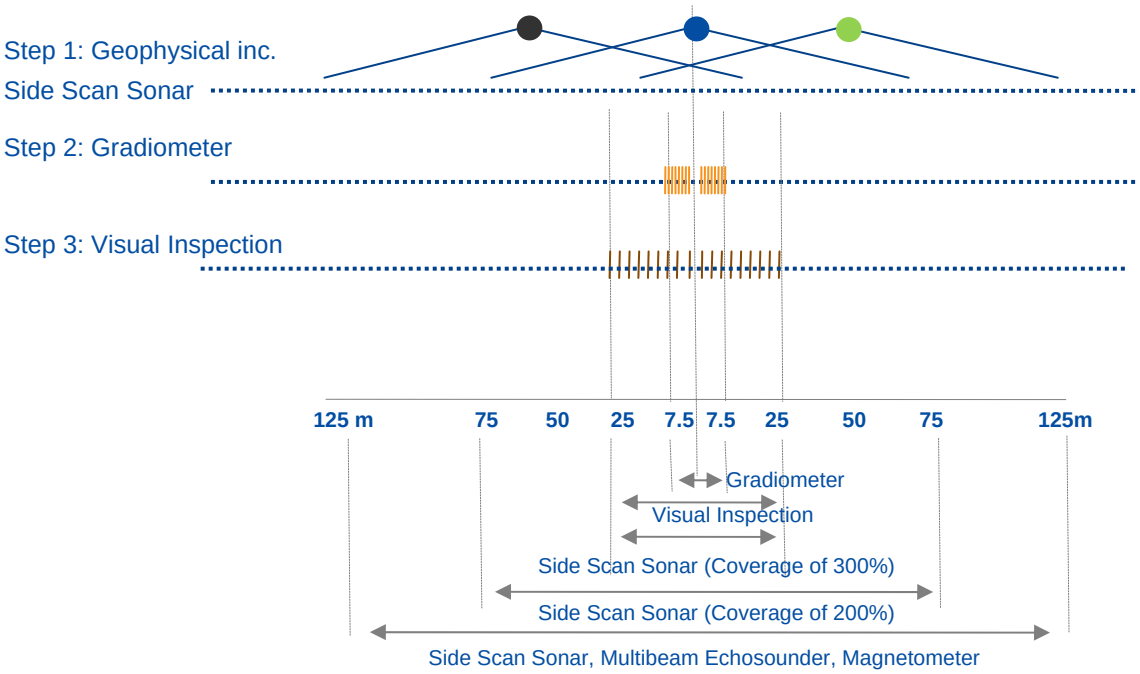

Figure 2.3 Detailed geophysical survey and munitions screening survey phases

2.3.4 Detailed geophysical and munitions Screening Survey Performance

Due to the constraints imposed by survey permits and permissions, the survey scope was divided into two main parts these being:

- Russian sector
- Combined sectors of Finland, Sweden, Denmark and Germany

Russian Sector

The geophysical phase, Step 1, was performed in 2007 by PeterGaz with the support of Svarog. The survey comprised approximately 800 survey line kilometres.

The ROV phase, Steps 2 and 3, commenced in December 2008 and is likely to continue through to mid-2009.

Combined sectors of Finland, Sweden, Denmark and Germany

Marin Mätteknik AB (MMT) of Sweden performed the full survey scope with a short period of support from DoF (Norway). Surveys were conducted over the period from March 2007 to August 2008.

The geophysical phase, Step 1, included both munitions screening and detailed engineering surveys. Approximately 13,300 survey line kilometres were performed.

The step 2 phase (ROV mounted gradiometer survey) included 6,400 survey line kilometres of ROV based gradiometer survey.

The visual inspection phase, Step 3, included inspections of all targets located within the installation corridors (15 m), and selected targets of potentially human origin within the security corridor (50 m). All targets of potential cultural heritage interest within +/-125 m of the installation corridor were also inspected.

2.3.5 Survey Results – Maritime Cultural Heritage

The results of the detailed geophysical survey with regards to cultural heritage are presented in the following section. However as long as national authorities are reviewing data and discussing survey results, Nord Stream will present findings but not be able to.reveal detailed coordinates. After the relevant authorities have concluded their assessments it will be their decision whether all details shall be made public.

Russian Sector

According to data provided by the National Cultural Heritage Inspection Department of the Leningrad Region Culture Committee, the route of the pipeline's crosses an area that is of historical, cultural and archaeological value. This area is Portovaya Bay and the north-eastern part of the offshore section of the pipeline in Russian waters, where the Battle of Vyborg took place in 1790.

Wrecks

According to Article 18 of the Law on Cultural Heritage Objects (historical and cultural monuments) of the Russian Federation No. 73-FZ dated June 25th 2002, any cultural heritage objects that are discovered shall be protected before a decision to include them on the register of cultural objects is taken.

During the geophysical surveys a number of wreck sites were discovered.

Two wrecks are situated less than 50 m from the pipeline routes. These wrecks are:

- 8-03-4529 (alternative ID 03-7W) – Wooden wreck (carvel built), very intact, approx. 21 m long. The wreck is identified from SSS data and visually inspected by ROV. It is situated closest to the West pipeline

- 8-03-0565 (alternative ID 03-1) – Wooden wreck (carvel built) with bow section intact, approx. 20 m long. The wreck is identified from SSS data and inspected visually by ROV. It is situated closest to the East pipeline, but also relatively close (60 m) to the West pipeline

Within the zone 50-250 m from the pipeline (alternative 1) in all eight wrecks or possible wrecks have been located:

- 8-02-3535 – Wreck identified from SSS data (situated closest to the East pipeline)
- 8-02-1286 – Wreck identified from SSS data and visually inspected by ROV (situated closest to the West pipeline)
- 8-02-0580 – Wreck identified from SSS data and visually inspected by ROV (situated closest to the West pipeline)
- 8-02-0099 – Wreck identified from SSS data (situated closest to the East pipeline)
- 8-03-5827 - Wooden sailing vessel. Identified from SSS and visually inspected by ROV (situated closest to the East pipeline)
- 8-03-2167 (alternative ID 03-5W) – Partially collapsed wooden wreck, approx. 25 m long. Galley with brick oven in good condition. The wreck is identified from SSS data and visually inspected by ROV. It is situated closest to the West pipeline
- 8-03-1106 (alternative ID 03-3W) – Wooden wreck (carvel built) with rudder intact, approx. 34 m long. The wreck is identified from SSS data and inspected visually by ROV. It is situated closest to the West pipeline
- 8-03-1040 (alternative ID 03-2E) – Wooden cargo vessel (carvel built) with anchor hanging from the bow, approx. 21 m long. The wreck is identified from SSS data and visually inspected by ROV It is situated closest to the East pipeline

Figure 2.4 SSS image and ROV footage from the wreck 8-03-5827

The following seven wrecks are situated more than 250 m away from the pipeline route, but still within the anchoring zone:

- 8-01-1159 – Wreck identified from SSS data (situated closest to the West pipeline)
- 8-02-0616 (alternative ID 02-3W) – WWII wreck, approx. 19 m long. The wreck is identified from SSS data and visually inspected by ROV (situated closest to the West pipeline)
- 8-02-0524 (alternative ID 02-2W) – Iron hulled sailing vessel, approx. 36 m long. The wreck identified from SSS data and visually inspected by ROV (situated closest to the West pipeline)
- 8-03-5365 – Wreck identified from SSS data (situated closest to the East pipeline)
- 8-03-3503 (alternative ID 03-6E) – Wooden wreck (carvel built), split longitudinally approx. 18,5 m long. Upturned clinker built whaler lying within the wreck pieces. The wreck is identified from SSS data and visually inspected by ROV. It is situated closest to the East pipeline
- 8-03-1860 (alternative ID 03-4E) – Wooden vessel, collapsed. The wreck is identified from SSS data and visually inspected by ROV. It is situated closest to the East pipeline
- 8-04-5077 (alternative ID 04-1E) – Barge like metal wreck, approx. 32 m long. The wreck is identified from SSS data and visually inspected by ROV. It is situated closest to the East pipeline

Table 2.2 Wrecks in the Russian sector

	Approximate distance from nearest pipeline (E/W)		
	0-50 meter	*50-250 meter*	*> 250 meter*
Number of wrecks or possible wrecks	2	8*	7*

*The list of wrecks at distances of more than 50 m from the pipelines may not be complete, as the wide anchoring corridor (1 km on each side) surrounding the pipeline routes has not yet been surveyed in detail.

The survey data have been submitted to the Institute of Material Culture History of the Russian Academy of Sciences for identification of the discovered objects, their description, evaluation and preparation of the appropriate expert's opinion.

Submerged settlements

The presence of submerged Stone Age settlements is not an issue of concern within Russian waters as this area of the Baltic has been subject to uplift and not submergence since the end of the glacial period.

Finnish Sector

Wrecks

A number of wrecks or possible wrecks have been identified along the pipeline routes from archival sources and surveys. The types of wrecks range widely and include a World War II destroyer, an aircraft and several wooden sailing vessels of varying ages. The archaeological significance of the wrecks within the installation corridor has been assessed by the Finnish National Board of Antiquities (FNBA) /9/. The FNBA will also perform the assessment of the anchor corridor.

A total of 4 wrecks or possible cultural heritage sites are situated less than 50 m from the pipeline routes. These wrecks are:

- *Small sailing dinghy* (S-10-3237) – Well-preserved clinker-built dinghy of a type well- known in Finland. Its age cannot be determined precisely, as the vessel may be between 50 and 150 years old. The date of the wreck is unknown, but it has been considered to be of no cultural value. Distance to West pipeline: 0 m

- *Assemblage of brown objects* (S-07-2744) – Assessed by a palaeontologist to be of natural origin (skeletal remains). The vertebrae are too large to be from a Pleistocene mammal, therefore possibly a whale skeleton. Distance to East pipeline: 8 m

- *Wooden wreck* (S-W8A-10289) – Preliminary assessment by FNBA: more than 100 years old and of cultural heritage interest. Distance to West pipeline: 25 m

- *Wooden ship wreck* (S-13-3526) – Preliminary assessment by FNBA: more than 100 years old. Distance to West pipeline: 48 m

Besides the wrecks described above a small section of a wooden mast has been located 14 m from the pipeline route. The mast piece has been video documented thoroughly by ROV and has consequently been considered as dispensable by the FNBA /10/.

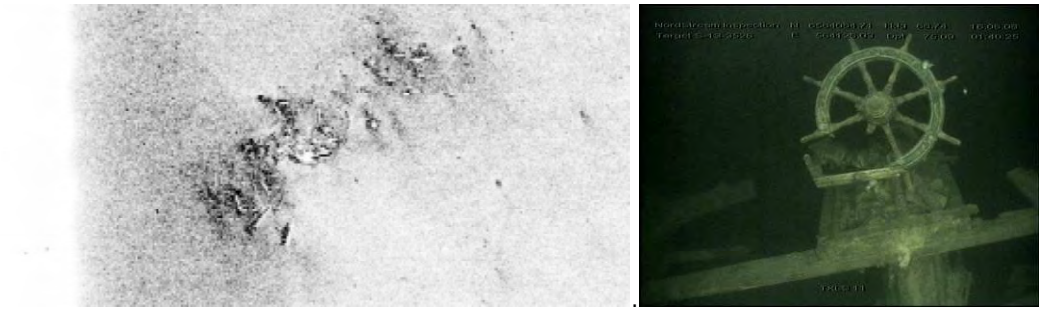

Figure 2.5 Left: sidescan image of target S-07-2744. Right: Still image of target S-13-3526

Within the zone 50-250 m from the pipelines a total of seven wrecks or possible wrecks have been located:

- *Wooden sailing vessel* (S-05-2385) – Estimated date of construction 1880-1920. Date of sinking unknown, but likely to be more than 100 years ago. Considered to be of cultural historical interest. Situated closest to the East pipeline

- *Battleship* (S-07-2736 and FNBA reg. ID 2440) – Wreck of the Russian battleship *Rusalka*, sunk in 1893. The wreck is of cultural heritage interest. Situated closest to the East pipeline

- *Aeroplane* (S-08-2610) – Unidentified aeroplane. Possibly of eastern European origin and possibly from WWII or earlier. Not of interest to the FNBA, but possibly of interest to the Finnish Aviation Museum or Finnish Ministry of Defence. Situated closest to the West pipeline

- *Wooden sailing vessel* (S-11-3138) – Wreck of a typical coastal vessel from the 20th century. Many parts of the wreck are broken. Situated closest to the West pipeline

- *Large battleship* (S-09-3025) – Wreck of a large battle ship. The wreck is believed to be the Russian destroyer *Smetleyvi*, sunk in November 1941 after hitting a mine. Falls under the legislation of the Finnish Ministry of Defence. Situated closest to the East pipeline

- *Modern wreck* fragment (S-14-3569) – Wreck remains of modern origin. Possibly buried wreck, but more likely just a fragment of wreck remains. The remains are not of cultural heritage interest. Situated closest to the West pipeline

- *Porkkala Open Sea Wreck* (FNBA reg. ID 2422) – Wreck of unidentified wooden sailing vessel, probably from 19th century. Situated closest to the East pipeline

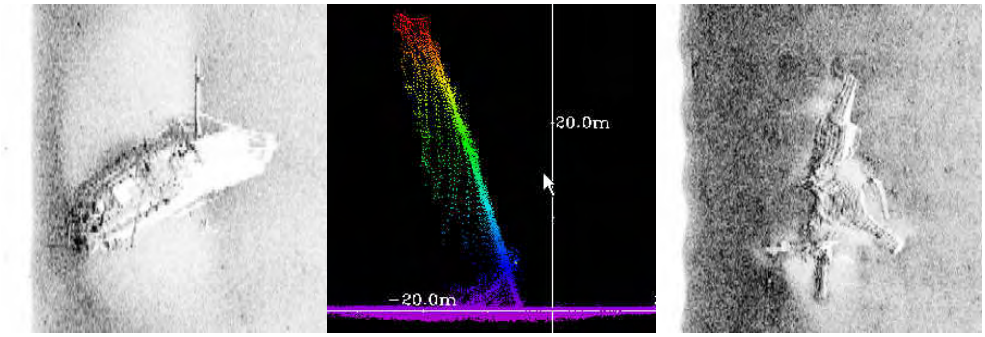

Figure 2.6 **Left: Sidescan image of target S-05-2385. Middle: Multibeam sonar image of Rusalka, clearly indicating its near vertical position in the water column. Right: Sidescan image of target S-08-2610**

The following six wrecks or possible wrecks are situated more than 250 m away from the pipelines routes, but still within the anchoring zone:

- *Wooden sailing vessel* (S-08-2939) – Relatively intact wreck of a type most likely built in the middle or latter half of the 19th century. Contact mine situated close to starboard side. The wreck is considered to be of cultural heritage interest. Situated closest to the West pipeline

- *Possible wreck* (16-14) – SSS anomaly interpreted as a wreck. Visual inspection by ROV indicates that it could be a wreck, although the site is not fully understood. The site is assessed to be of cultural heritage interest. Situated closest to the West pipeline

- *MUS1* (FNBA reg. ID 2489) – Wreck of Russian steam passenger ship *Andrei Zdanov*, sunk in November 1941 after hitting a mine. Falls under the legislation of the Finnish Ministry of Defence. Situated closest to the East pipeline

- *Unidentified wreck* (1-10) – Wreck identified from SSS only. The archaeological significance of the wreck has not yet been assessed. Situated closest to the West pipeline

- *Unidentified wreck* (4-9) – Wreck identified from SSS only. The archaeological significance of the wreck has not yet been assessed. Situated closest to the East pipeline

- *Unidentified wreck* (3-9) – Wreck identified from SSS only. The archaeological significance of the wreck has not yet been assessed. Situated closest to the East pipeline

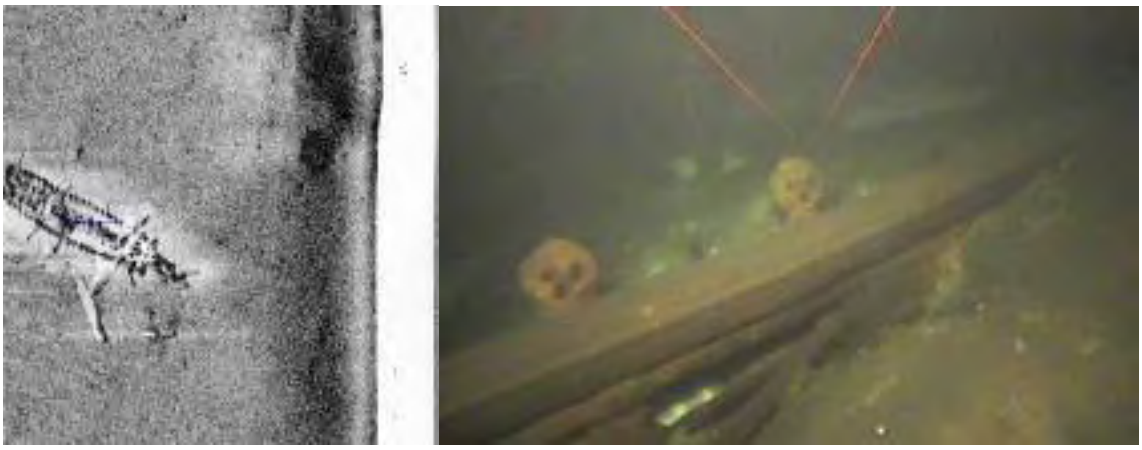

Figure 2.7 Images of wreck site S-08-2939 in Finnish EEZ discovered during survey. The dead eyes (part of the rigging) are still in place

During survey of the pipeline routes and an adjacent area a WWII submarine was discovered. The submarine is situated at a distance of > 1200 m off the pipeline route. The wreck is thus not situated within the Project area as it is outside the anchoring zone and will not be affected by the Project. This wreck is therefore not described further in the text.

The pipeline routes are situated approximately 7.5 km from the protected area around the wreck site of the passenger ferry Estonia /11/. The protected area around the wreck site is indicated on **Figure 2.9** together with the rest of the wrecks finds along the Nord Stream pipelines in the Finnish EEZ.

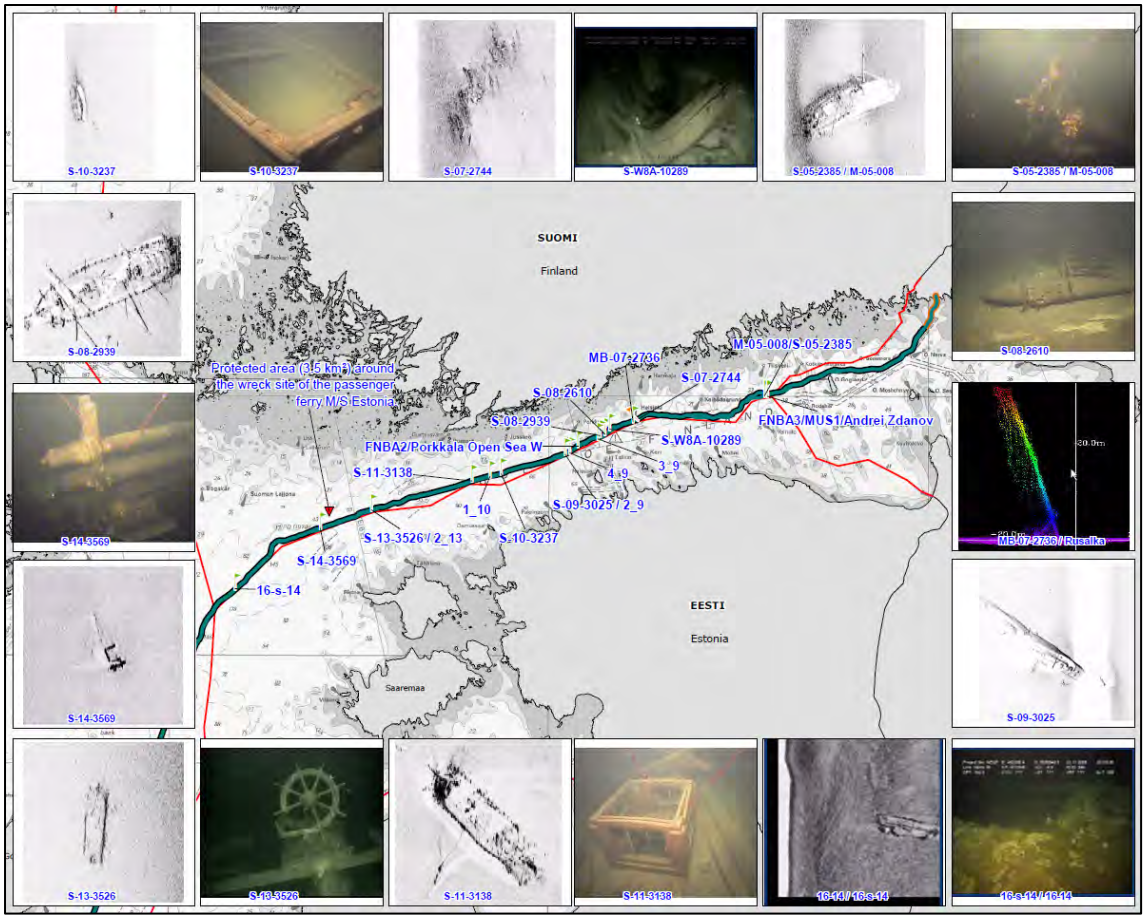

Figure 2.8 Wreck finds along the Nord Stream pipeline routes in the Finnish EEZ

Submerged settlements and landscapes

As previously described it is unlikely that any submerged settlements are present at latitudes north of approximately 55.5°-56° N in the Baltic Sea, as these areas were not dry land during the Stone Age /8/. Therefore, submerged settlements are not relevant when assessing cultural heritage in the Finnish EEZ (see **Figure 2.2**).

Swedish Sector

Wrecks

During surveys, no wreck sites were found within the pipeline corridor (+/- 125 m) in the Swedish sector. To a large extent the sea bottom within the pipelines corridors was found to be clear of objects. A number of modern objects, however, were identified, as well as an entangled fishing net and two unidentified manmade objects that may be of a certain age, but with no

archaeological significance. The survey data is currently being assessed by the National Maritime Museum of Sweden.

Submerged settlements and landscapes

The National Maritime Museums of Sweden (SMM) have not registered any archaeological sites within the pipeline corridor /2/. The pipeline corridor is outside Swedish territorial waters and consequently not an area where systematic archaeological surveys and registration have been carried out.

During the Mesolithic Age (Äldre jägerstenålder, or Older Stone Age from 8000-4200 BC) parts of the Södra Midtsjöbanken, located south of Öland and Gotland, were land areas. It is therefore possible that there may be remains of settlements and/or seasonal hunting stations in the presently submerged area /12/.

According to the Swedish National Heritage Board (RAA), the coastline of Blekinge (approximately 75 km west of pipeline route) was some 20 m lower 10,000 years BP (before present) /13/. It is therefore likely that submerged Stone Age settlements are present in water depths of 20 m and less. However, it cannot be ruled out that submerged settlements could be encountered in slightly deeper waters, as sea-level changes in the Baltic Sea have not been uniform.

The pipeline route crosses the southernmost part of Hoburgsbanken and just between Nordra and Södra Midtsjöbanken in water depths of more than 20 m.

According to survey information, the sea bottom in the area where the pipeline route crosses between Nordra and Södra Midtsjöbanken (water depth 25-45 m) consists primarily of till and bedrock. The possibility of encountering *in situ* remnants of Stone Age settlements is very slim, as these areas have most likely have undergone some degree of erosion since submergence. Embedding of settlement layers in bedrock or glacial till is not possible.

Only along approximately 4.5 km out of the 55 km-long stretch between Nordra and Södra Midtsjöbanken does the sea bottom consist of more recent sediments. These areas, however, are in water depths of more than 38 m. Although it is possible that remains of submerged settlements could be present in these areas, it is more likely they are not. Such younger sediments, however, could also contain embedded wreck sites from later periods.

Danish Sector

Wrecks

Seven wreck sites or possible wreck sites were identified during the 2007/2008 SSS surveys along the pipeline routes in Denmark.

Two wrecks are situated less than 50 m from the pipeline routes:

- S-DK1-2-36-4472 – Wooden wrecks, collapsed. The debris area is approx. 28 m long. The wreck is situated closest to the West pipeline
- S-S33-3802 – Iron wreck, approx. 42 m long. The wreck is situated closest to the East pipeline

The following three wrecks are situated between 50 and 250 m from the pipelines:

- S-S34-3811 – Wooden wreck of recent origin, probably fishing vessel. The wreck is approximately 15 m long. The wreck is situated closest to the East pipeline
- S-S33-3809 – Wooden wreck, covered in fishing nets, approximately 26 m long. The wreck is situated closest to the East pipeline
- S-S33-3782 – Wooden fishing vessel of recent origin, approximately 20 m long. The wreck is situated closest to the West pipeline

Two wrecks are situated more than 250 m from the pipelines:

- S-S33-3790 – Wooden wreck, approximately 25 m long. The wreck is situated closest to the East pipeline
- S-S33-3768 – WWII submarine. The wreck is situated closest to the West pipeline

The archaeological significance of the wreck sites as well as a general review of the survey data is currently being assessed by the Viking Ship Museum. The position of these wrecks and possible wrecks in relation to the pipelines is presented in

Table 2.3. The locations of the wrecks and images of the sites are presented in **Figure 2.10**.

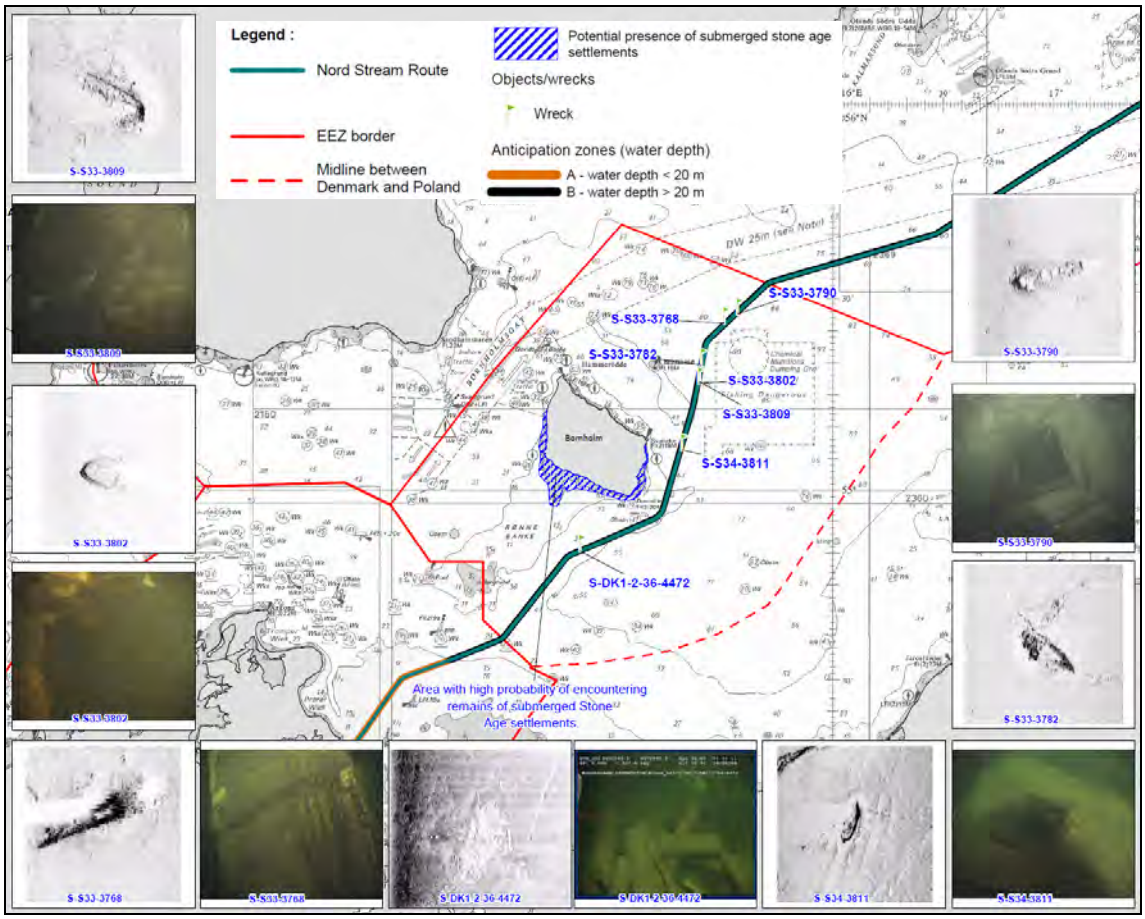

Figure 2.9 Wreck finds and areas with potential remain of submerged Stone Age settlements along the Nord Stream pipeline route in Danish waters

Moreover, two loose finds (a rudder and a keel) have been made along the pipeline routes.

Table 2.3 The position of wrecks in relation to the pipelines

	Approximate distance from nearest pipeline (E/W)		
	0-50 m	50-250 m	> 250 m
Number of wrecks or possible wrecks	**2**	**3***	**2***

*The list of wrecks at distances greater than 50 m from the pipelines may not be complete, as the anchoring corridor surrounding the pipeline route (1 km to each side) has not yet been surveyed in detail.

Submerged settlements and landscapes

According to the local museum (Bornholm Museum), submerged settlements and ancient submerged forests may be encountered in waters shallower than approximately 40 m in the area around Bornholm. Certain areas, however, are more likely to contain the remains of submerged Stone Age settlements than others. These areas were identified by the government agency Fredningsstyrelsen (Danish Conservation Agency) in 1986 and are indicated on **Figure 2.9**. The designated areas are in depths of less than 20 m and thus correspond well (and conservatively) with the parameters of Zone A.

Ancient submerged forests have for many years been encountered by fishermen and aggregate extractors working in the waters around Bornholm. Although areas with the remains of ancient forests as such are not usually prioritised with respect to heritage protection, the stumps of submerged trees (particularly oak trees) are of archaeological interest as they can possibly be dated, thus providing valuable information on sea-level changes in the area. Almost all known submerged forests are in depths of less than 20 m, although some occur in deeper water (20-40 m) /14/, /15/.

Figure 2.10 Tree roots from submerged forests around Bornholm. Picture: Courtesy of Bornholm Museum

The pipeline routes crosses into water depths less than 40 m east and south of Dueodde and south-east of Rønne Banke. The pipeline routes do not cross into water depths less than 20 m.

No submerged settlement sites are registered in the cultural heritage records and no indications of submerged settlements sites were identified during the survey operations in the Danish section of the pipeline routes.

German Sector

Wrecks

At the entrance to Greifswalder Bodden the pipelines crosses through a blockade of sunken ships consisting of 20 ships sunk during the Great Nordic War (1700-1721) to prevent enemy ships entering the bay. The wrecks are spread along an East-West line approximately 1,5 km in length. The distance between the individual wrecks is around 15 m to 40 m /16/, /17/. The wrecks are of importance to both regional and northern European history and constitute a rich source of information on shipbuilding and sailing at that time.

The pipeline routes crosses through the line of ships. The controlled removal of one of the smaller wrecks from the barrier is therefore necessary. Archaeological documentation and investigation of the wreck was carried out during the late autumn of 2008 and winter of 2009. The work is being managed by the "Agency for Preservation of Monuments of the State of Mecklenburg-Western Pomerania". The "Agency for Preservation of Monuments of the State of Mecklenburg-Western Pomerania" will also be making diving investigations of potential wreck sites during the winter/spring of 2009. These investigations may reveal previously undiscovered sites.

Closer to the landfall site of the pipelines near Lubmin a wreck (see left image in **Figure 2.12**) has been located approximately 100 m away from the pipeline centreline. Another wreck has been discovered close to the boundary of the 12 nm zone. The wreck is situated approx. 550 m south east of the pipeline routes.

The BSH (Bundesamt für Seeschifffart und Hydrographie) has several records of underwater obstacles (which may be wrecks or other obstructions) in the area. None of the recorded objects are closer than 400 meters to the pipeline routes /17/

Figure 2.11 Left: Side scan sonar image of wreck near Lubmin and Right: Detail of a clinker built wreck in the ships blocking /18/

Submerged settlements

The "Agency for Preservation of Monuments of the State of Mecklenburg-Western Pomerania" has been carrying out diving investigations of potential submerged Stone Age settlement sites during the winter/spring of 2008/2009. The results of these investigations are not yet available and may reveal previously undiscovered sites.

Most of the pipeline routes in German waters are within Zone A.

2.4 Consultations and meetings

Consultations with national authorities in all affected countries have been carried out to access the procedure for handling of identified wrecks in vicinity of the Nord Stream pipeline..The main objectives of the consultation and expert meetings have been to facilitate information and knowledge transfer, as the assessment and interpretation of survey data has been performed by the national cultural heritage authorities.

2.4.1 Consultations

An expert workshop has been conducted under the Espoo process. The meeting was held in Hamburg on September 17th 2008. The workshop was attended by the Finnish National Board of Antiquities, the Danish Cultural Heritage Agency, the Danish Viking Ships Museum as well as various German, Danish, Swedish, Finnish, Polish and Lithuanian participants representing environmental ministries, research institutes and organisations.

The main objectives of the meeting were to present survey results and possible impacts in a transparent manner. Key clarifications during the work shop included:

- Survey corridor definition i.e. installation corridor and anchoring corridor
- Planned anchor corridor survey
- Precision in pipe laying and anchoring
- Reliability of survey results and objectivity of.archaeological assessments
- Information flow between countries i.e. sharing archaeological information with the country of origin of discovered wreck sites

2.4.2 Meetings

A number of meetings have been held on a national level to address the cultural heritage issue. The meetings have primarily been focused on presenting survey data, delivery of survey data to the authorities, discussion of the strategy for the archaeological assessment of data and informing regarding the pipeline installation procedures.

Finland:

February 2nd 2007, National Board of Antiquities (FNBA)

January 10th 2008, National Board of Antiquities (FNBA)

January 30th 2009, National Board of Antiquities (FNBA)

Sweden:

October 22nd 2008, National Maritime Museums (Statens Maritima Museer)

Denmark:

August 28th 2008, The Viking Ship Museum – Roskilde (Vikingeskibsmuseet)

December 11th 2008, Danish Cultural Heritage Agency (Kulturarvsstyrelsen)

3 Project Activities that may cause impact

3.1 Planned Activities

3.1.1 Construction Phase

The pipelines will be installed from a pipelay barge (see **Figure 3.1Figure 3.12**). The primary pipe-laying barge will maintain position with the use of anchors. A secondary pipe-laying barge using dynamic positioning i.e. the use of computer controlled propulsion will be used along a stretch in the Gulf of Finland. To ensure the safe installation of the pipelines all areas where there is the potential for seabed disturbance are surveyed to locate potential maritime cultural heritage sites.

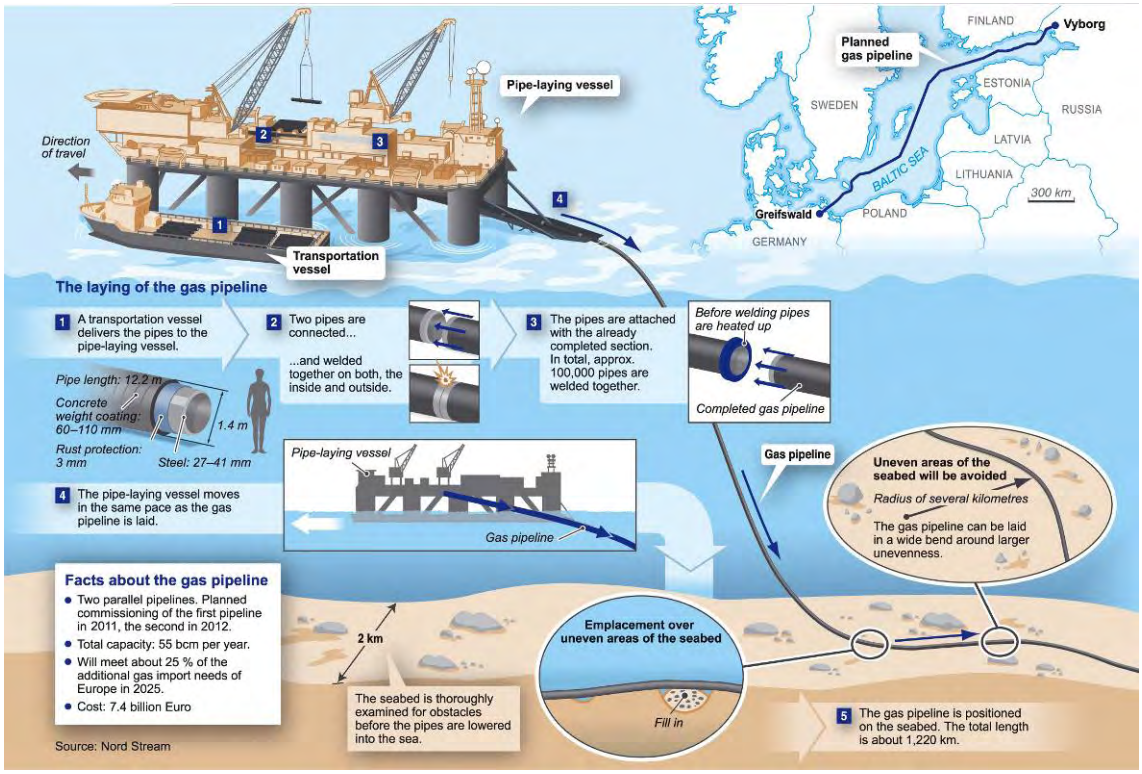

Figure 3.12 Typical pipe-laying process

Impacts on cultural heritage sites during realisation of the Nord Stream Pipelines in the Baltic Sea may be the result of:

- Direct impact from pipe-laying
- Direct impact from anchoring of the lay barge and support vessels
- Direct impact from seabed intervention works
- Direct impact from works regarding munitions

The possible impacts on cultural heritage are not restricted to particular regions of the Baltic Sea. The descriptions of the specific possible impacts are therefore not treated according to nation, but for the Baltic as a whole.

Impacts from pipe-laying

In certain areas the pipelines will be lowered into the seabed to protect it from impact and to stabilise the pipelines. If submerged settlements are present within the pipeline zones and the pipelines interfere with them, they may be damaged by trenching and be rendered inaccessible for future research.

Impacts from anchoring

Pipeline installation is performed using an anchor-type pipe-laying barge. The pipe-laying barge uses a positioning system consisting of 12 anchors, each anchor weighing approximately 25 tonnes. The pipe-laying barge is supported by other vessels, which may or may not use anchors.

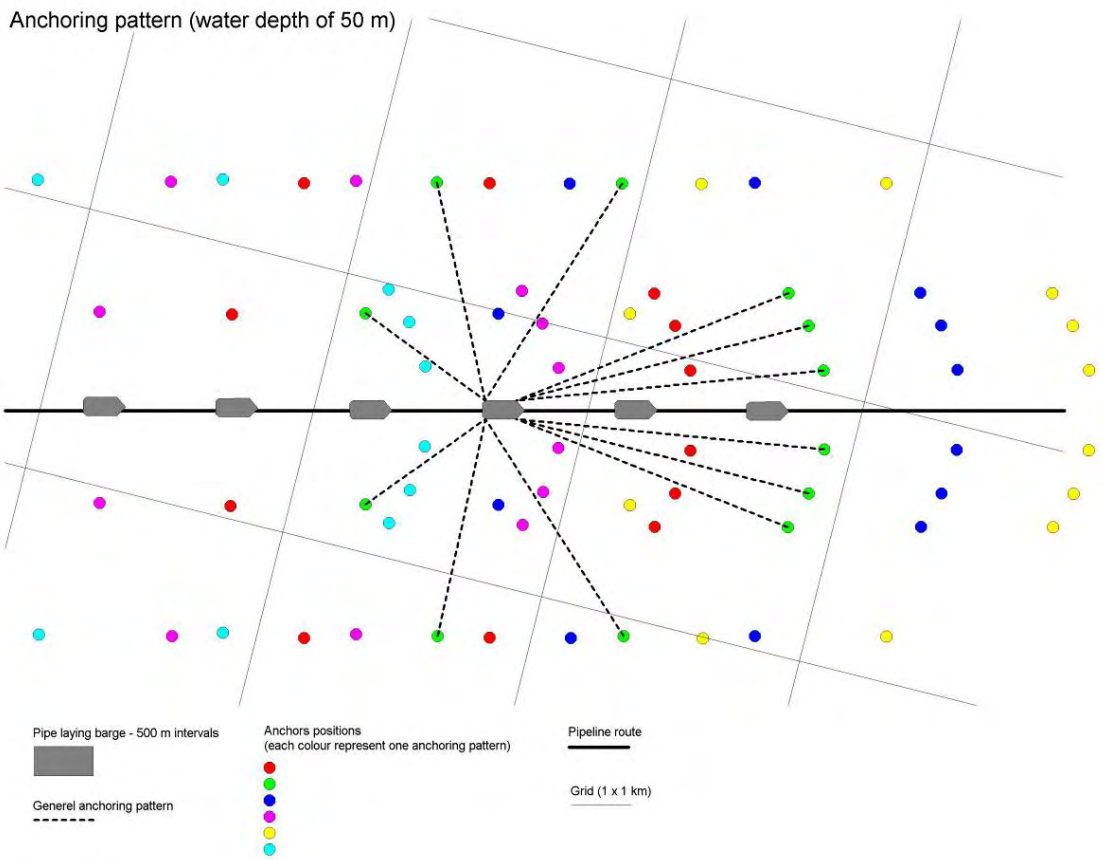

Figure 3.2 Anchoring pattern in water depth of 50 m

Shipwrecks can be damaged by anchoring. Even small ships generate great force on their anchors and can cause significant damage to a shipwreck if the anchor gets hold of it /19/. The damage is both immediate and long term. The immediate damage is obvious, as the wreck's structure may be broken apart by the forces exerted on it. In the longer term, the structures of wrecks may become weakened due to the forces exerted on the wreck, leading potentially an accelerated collapse. In the case of iron wrecks, damage induced by anchors exposing non-corroded iron will generate renewed corrosion on the affected parts, thus accelerating the degradation of the wreck. Anchoring in areas of submerged Stone Age settlements will disturb the stratigraphy of the archaeological layers and possibly destroy artefacts.

Not only the anchors, but also the movement and sweep of the anchor wires must be considered in relation to cultural heritage. As the pipe-laying barge moves forward the part of the anchor wire closest to the anchor will sweep forward across the sea floor, until the anchor is recovered and positioned further ahead. The part of the anchor wire elevated in the water column must also be considered when anchoring in areas, where wrecks protrude from the sea floor.

The width of the anchoring corridor (within which the anchors will be placed) varies between approximately 2 km in water depths of 150 m to approximately 1.6 km in water depths of 50 m.

Impacts from seabed intervention works

The limit of free-span length of the pipelines depends on the structural parameters of the pipelines, soil conditions, waves and currents. A large number of non-allowable free spans and pipeline crossings along the pipeline routes are identified on the basis of the surveys. In certain areas (especially landfall areas) the pipelines needs to be lowered into the sea bed in order to stabilise it.

The following methods of seabed intervention works are likely to be employed during the construction of the pipelines, where re-routing of the pipelines is not an option:

- Placement of fill material (to create support)
- Trenching/dredging
- Rigid support structures
- A combination of the above-mentioned options

Placement of fill material will take place both before and after pipe-laying. The pre-lay gravel works are intended to mitigate unacceptable free spans and support other load bearing structures, while post-lay gravel works are intended to stabilise and protect the pipeline.

Any kind of seabed intervention works, either intrusive, involving excavation (trenching or ploughing) or re-modelling or filling (aggregate placement) may cause an impact on cultural heritage artefacts, if any exist in the affected area.

Intrusive seabed intervention works will naturally have a destructive effect on all types of cultural heritage sites present at the location as well.

Placement of aggregates/raw material may or may not cause damage to sites of cultural heritage. Rock placement will most likely damage shipwrecks, whereas placement of sandy sediments may serve to enhance preservation of the wrecks (unless the physical impact of the placement causes additional damage to the wreck). Sites covered by sediments and topped by a pipeline will be inaccessible for archaeological investigation during the lifespan of the pipeline. The Project does not plan any aggregate placement on wrecks.

Trenching will take place within certain short stretches of the pipeline routes in German, Swedish, Russian and Danish waters.

Impacts regarding dumped munitions

Clearance is being considered for a number of sea mines close to the pipeline routes. None of these mines are at a distance from wrecks where an underwater detonation will cause any impact.

3.1.2 Operational phase

Impacts on cultural heritage during operation of the Nord Stream Pipelines in the Baltic Sea may be the result of:

- Indirect impact from changed sedimentation pattern
- Indirect impact from corrosion
- Direct impact from sea bed intervention works

Indirect impact from changes in sedimentation patterns

Sedimentation and erosion patterns will be altered slightly in areas where the pipelines are placed directly on the sea bottom. Calculations show that erosion will increase in the immediate vicinity of the pipelines (up to approximately 10 m away from the pipelines). This very local erosion will decrease over time as the pipeline erodes itself into the seabed.

The changes in sedimentation patterns in the immediate vicinity of the pipelines are not considered to be problematic in relation to cultural heritage sites.

Indirect impact from corrosion

The pipelines will be protected with an anti-corrosion coating consisting of 3LPE. The entire anti-corrosion coating will be covered by a reinforced concrete coating. The cathodic protection will be based upon sacrificial anodes. The pipelines are not induced by a current for anti-corrosion protection, and metal parts of wrecks in the vicinity of the pipelines therefore will not be affected by increased corrosion.

Impacts from seabed intervention works

Maintenance works may be required during the operations phase, for example placement of gravel to ensure pipeline integrity.

The possible impact of maintenance works is similar to the possible impact of sea bed intervention works during the construction phase (described in the section **Impacts from seabed intervention works**).

3.2 Unplanned Events

The worst possible impact in the construction phase could be destruction of previously undiscovered sites if the pipelines are laid in an area of cultural heritage. For this reason, an immense effort has been put into locating sites of cultural heritage in order to avoid their destruction. Moreover, mitigation efforts will be introduced to minimise impacts on identified sites of cultural heritage (see **chapter 5**).

4 Potential Environmental Impacts on the Baltic Countries

4.1 Russia

The pipeline routes passes by two wreck sites at distances of less than 50 m between the pipeline and wreck. A strategy for avoiding impacts during construction (through controlled installation procedures) will be developed. A general strategy for the documentation of incidental finds and findings can be adopted as mitigation.

4.2 Finland

The planned pipeline routes in Finnish waters passes close to wreck sites that have been assessed as being culturally significant. A strategy for avoiding impacts during construction (through controlled installation procedures) will be agreed upon with the FNBA. A general strategy for the documentation of incidental finds and findings can be adopted as mitigation.

4.3 Estonia

With the planned routing of the pipelines there will be no impact within Estonian waters.

4.4 Sweden

In Swedish waters the planned pipeline routes does not pass close to wreck sites of anticipated significance. The planned pipeline routes do cross areas where the prehistoric landscape has been submerged. The specific geological characteristics of the planned route make it unlikely that important archaeological features will have been preserved exactly where the pipelines are planned to pass. However, the prehistoric landscape of the area and its archaeological features are not well-studied or well-known. A general strategy for the documentation of incidental finds and findings can be adopted as mitigation.

4.5 Denmark

In Danish waters the planned pipeline routes passes close to a few wreck sites, of which the cultural significance is currently being assessed. A strategy for avoiding impacts during

construction or for research in anticipation of damage will be discussed with the Danish authorities (KUAS and Vikingeskibsmuseet). Moreover, in the vicinity of Bornholm the planned pipeline routes are in proximity to an area of submerged prehistoric landscape where settlement sites may be present. No trenching or ploughing will take place within this area. A general strategy for the documentation of incidental finds and findings can be adopted as mitigation.

4.6 Germany

The planned pipeline routes affect one wreck in the ship blockade at the entrance to the Greifswalder Bodden. This wreck will be documented archaeologically, before it is removed by the "Agency for Preservation of Monuments of the State of Mecklenburg-Western Pomerania".

The planned pipeline routes and any alternative will pass through zone A, which indicates potential impact on submerged Stone Age settlements.

4.7 Lithuania

With the planned routing of the pipelines there will be no impact within Lithuanian waters.

4.8 Latvia

With the planned routing of the pipelines there will be no impact within Latvian waters.

4.9 Poland

With the planned routing of the pipelines there will be no impact within Polish waters.

5 Mitigation measures for Cultural Heritage

Although the area along the pipeline routes is well investigated in close cooperation with the national authorities and the impact on cultural heritage is assessed to be low, cultural heritage will be part of the Project's Monitoring Programme. This will further reduce the small risk that sites may be affected during construction activities. To mitigate the risks to cultural heritage the following measures are foreseen:

5.1 Avoidance strategy in relation to shipwrecks

A number of shipwrecks (not all of archaeological interest) have been located through desktop investigations and field surveys.

In order to avoid impacts on wrecks and associated materials, the primary strategy has been to reroute the pipelines away from shipwrecks wherever possible.

A clearance distance of 50 m or more means that the avoidance strategy concentrates on the positioning of anchors and anchor wires during construction.

Clearance distances of less than 50 m imply that specific consideration and tailor made solutions (controlled installation procedures) will be necessary to protect the integrity of the site or safeguard archaeological information. In some cases sustainable protection may not be possible. Subject to the assessment of their archaeological significance, a tailor made plan may need to be devised indicating how the archaeological information of a site will be safeguarded.

The plans will be discussed with the relevant authority.

5.2 Avoidance strategy in relation to submerged settlements

No known submerged settlements have been located through either desktop investigations or geophysical surveys. Due to the development history of the Baltic Sea, the presence of submerged Stone Age settlements is most likely in water depths of less than 20 meters (zone A). Presence of submerged settlements in water depths up to approx. 40 m cannot be ruled out, but it much less likely than in shallower waters.

The main mitigation strategy in relation to submerged settlements is to avoid pipe- laying in water depths of less than 20 meters. This naturally does not apply to the German landfall, where the pipelines will cross areas of shallow water. In the German landfall area investigations by divers have been carried out by the "Agency for Preservation of Monuments of the State of Mecklenburg-Western Pomerania" to locate potential submerged settlement sites.

5.3 Precautions in anchoring

To avoid damage to sites of cultural heritage, a survey of the anchoring corridor will be carried out prior to pipelines construction. The survey is ongoing (commenced November 2008) and is expected to be completed in Q3 2009. The surveying will be performed by high-resolution SSS and combined with visual inspection by ROV of selected targets that interfere with anchoring patterns /9/.

To get the best possible anchorage, the vessels will anchor in areas without obstacles such as shipwrecks, outcrops of rock and unidentified bottom features. The catenaries (curves) and sweeps of the anchor wires will be calculated precisely in order to avoid damage to cultural heritage sites and avoid getting stuck in other bottom obstacles. If necessary the wires can be held off the sea bed by buoys or tugs in areas where wrecks are present. The likelihood of anchors or anchor wires damaging sites of cultural heritage within the pipeline corridors is therefore slim.

During the construction process all vessels involved will be provided with information on cultural heritage sites and will be instructed to anchor at a safe distance in relation to them. The sweep of anchor wires will also be considered and precautions will be taken to avoid damage to cultural heritage sites.

5.4 Protocol

Even when a detailed survey has been done prior to construction work, there is always the risk of chance finds of cultural artefacts when construction work begins.

The exact location where the pipelines are to be laid has been surveyed very closely (high-resolution SSS and visual survey by ROV). It is therefore unlikely that undetected, unburied wrecks are present in the immediate path of the pipelines. However, wrecks embedded in sediments may have eluded detection. The same applies to submerged settlements and landscapes, which traditionally are not detected by the surveying methods employed.

The manner in which chance finds could be made will vary according to the laying methods applied in a specific section of the pipeline route. Chance finds could be made visually at the seabed (if visual inspection of construction is being performed) or by artefacts being trapped in equipment when it is hauled onboard. If chance finds are made during construction work, a predefined protocol for safeguarding the archaeological information will be implemented.

By following a predefined protocol, negative impacts on accidental finds are reduced and turned into positive results by securing the information in a structured and adequate manner.

The protocol has been developed to include guidelines for actions to be taken in case of chance finds of cultural heritage artefacts. The guidelines will describe how to document observations and deal with artefacts that may be encountered during construction work. The cultural heritage authorities of the respective countries will be given the opportunity to comment on the protocol prior to its adoption.

6 Further Studies

6.1 Anchor Corridor Survey

Prior to pipeline installation an anchor corridor survey is required to identify, verify and catalogue all probable obstructions that could impact safe pipe- lay, anchoring of the lay barge and/or lead to an adverse impact on the environment. The corridor will extend 1,000 m either side of each pipeline route in water depths greater than 100 m and 800 m in water depths of less than 100 m.

The survey was commenced on 15 November 2008 and is planned continue through to the third quarter of 2009. The scope of work was developed from the detailed geophysical and munitions screening survey which established a highly detailed baseline of potential obstructions and hazards. In addition to establishing the seabed topography across the complete corridor, the survey will focus on locating and assessing cultural heritage sites and potential hazards (such as munitions) to pipeline installation and the pipelines' long term integrity.

The anchor corridor survey will include four phases as follows:

- Phase 1: Geophysical survey, multibeam, side scan sonar, magnetometer
- Phase 2: ROV visual inspection
- Phase 3: ROV based gradiometer surveys in critical sections
- Phase 4: Expert evaluation of objects

The results of the anchor corridor survey will be input into a formal risk assessment to determine the risks of anchoring during pipeline installation.

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