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NORD STREAM 2

ENVIRONMENTAL MONITORING

PROGRAMME, DENMARK

SOUTH-EASTERN ROUTE

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Abbreviations

ADCP	Acoustic Doppler Current Profiler
AIS	Automatic identification system
CHO	Cultural heritage object(s)
CTD	Conductivity, temperature and depth
CWA	Chemical warfare agent(s)
EEZ	Exclusive economic zone
EIA	Environmental impact assessment
EU	European Union
HELCOM	Baltic Marine Environment Protection Commission - Helsinki Commission
ICES	International Council for the Exploration of the Sea
MBES	Multibeam echosounder
NSP	Nord Stream project
NSP2	Nord Stream 2 project
OBS	Optical backscatter sensor
PDCA	Dipropyl phenylarsonodithioite
ROV	Remotely operated vehicle
RQ	Risk quotient
SSC	Suspended sediment concentration
SSS	Side-scan sonar
TSS	Traffic Separation Scheme
TW	Territorial waters
UXO	Unexploded ordnance
VMS	Vessel Monitoring System

1. INTRODUCTION

The Nord Stream 2 project (NSP2) is an offshore natural gas pipeline from Russia to Germany. The NSP2 pipeline will connect the large natural gas resources of Russia with the European natural gas pipeline network. At full capacity, it will provide 55 billion cubic metres (bcm) of natural gas per year to European consumers.

The length of the entire two-pipeline system (NSP2) is approximately 1,230 km. The pipeline route crosses the territorial waters (TW) of Russia and Germany and runs within the exclusive economic zones (EEZs) of Finland, Sweden, Denmark and Germany. The pipeline construction works are planned to commence at the start of 2020 and be completed by mid-2020, with operation commencing in Q3-Q4 2020. The NSP2 pipeline is designed to operate for 50 years.

This document provides an overview of the environmental monitoring programme for the planned construction and operation of the NSP2 pipelines within the Danish EEZ. The length of the NSP2 route in Danish waters is approximately 147 km if the combination of the NSP2 route with V1 is selected, or approximately 164 km if the combination of the NSP2 route with V2 is selected. The two NSP2 pipelines (Line A and Line B) will run almost parallel to one another, and the separation distance for the two lines may vary between approximately 35 m and 155 m in Denmark.

2. ENVIRONMENTAL MONITORING DURING CONSTRUCTION AND OPERATION

2.1 General approach

The general approach by Nord Stream 2 AG to environmental monitoring is to direct monitoring at those areas of environmental sensitivity that are predicted to experience potential impacts of some significance from the Project. In the Danish EEZ, all potential impacts are assessed to be minor or negligible. Consequently, monitoring would not necessarily be required; however, it is considered important to validate accuracy of the impact assessment on certain fit-for-purpose activities and to deliver the main monitoring objectives for project.

The programme presented in this document focuses on the monitoring activities that are carried out during construction activities within the Danish EEZ. The monitoring programme will be finalised in consultation with the relevant Danish authorities and will be adjusted where necessary to accommodate permit conditions.

The monitoring programme has been planned and developed with the following objectives:

- To ensure that the pipelines are installed and operated in accordance with Nord Stream 2 AG's commitments;
- To monitor that the construction activities do not cause greater impacts than predicted in the environmental impact assessment (EIA);
- To monitor that no significant environmental impacts will occur during operation;
- To verify the findings of the EIA and assess the adequacy of modelling results used to predict environmental impacts;
- To provide the basis for corrective action where necessary.

The environmental monitoring for the NSP2 Project comprises three phases:

- Baseline studies (prior to construction - planning/permitting phase);
- Monitoring during construction;
- Monitoring during operation (after construction).

Although these steps require different actions, they are part of a single overall approach. It is important to note that monitoring parameters will vary considerably from one place to another and have been tailored to address national requirements.

To measure the effectiveness of monitoring and mitigation measures, relevant receptors and indicators identified within the monitoring programme should have/be:

- Low natural variability and broad applicability;
- Measurable; and
- Appropriate to the scale of impact, the impact mechanism and temporal and spatial dynamics.

A project-based concept in relation to overall oceanography will follow the evaluation of potential environmental impacts by consideration of the following:

- Intensive approach for shallow waters providing habitats for conservation objectives;
- Focus on potential impact areas for waters between 30 m and 80 m water depth;
- No biological investigations below the halocline at 80 m water depth.

The overall environmental monitoring of the NSP2 Project during construction and operation will thus vary in spatial range, temporal frequency, duration and monitored parameters in accordance

with the potential adverse impacts predicted and in relation to potential receptors. According to local variations in construction works, certain investigation will be carried out at selected sites or once for the entire route.

The objectives of environmental monitoring during the period of pipeline construction are:

- Impact monitoring – to detect environmental changes that may have occurred because of project implementation;
- Compliance monitoring – periodic sampling or continuous recording of specific environmental and social quality indicators for a defined purpose to ensure project compliance;
- Pro-active monitoring – timely routine and periodic checks via reactive monitoring by observation, measurement and evaluation for a defined purpose.

Further key principles guiding the development and implementation of the environmental monitoring programme for the NSP2 Project are as follows:

Consistency: It will be desirable to the extent practicable to have a harmonised approach in terms of sampling and analysis protocols along the length of the route. For some parameters there may be prescriptive requirements at the national level, but where this is not the case a harmonised approach across national boundaries will be used. This will deliver data that are more readily comparable and will allow for improved environmental management and performance. Monitoring will, where reasonable and possible, be congruent with the Baltic Marine Environment Protection Commission - Helsinki Commission (HELCOM) guidelines.

Synergy: In addition to the environmental surveys, the Project undertakes engineering inspection and maintenance-led surveys. These include seabed investigations to understand seabed conditions, shallow geology, the presence of obstacles and cultural heritage, and the condition of pipelines and their support structures. The results of the surveys will be compiled in integrated survey reports. This approach will be adopted to maximise the synergy between the various monitoring activities (environmental and engineering) with different initial objectives.

Reporting and Data Sharing: It will be important for the Project to have access to ongoing data acquisition programmes by third parties and government institutions to be able to fully interpret the data it collects. By the same token, subject to any constraints on disclosure placed by a national authority, Nord Stream 2 AG is committed to sharing its data with relevant stakeholders and making arrangements to facilitate this process. At a project-wide level, Nord Stream 2 AG is committed to report on its monitoring programme on a regular basis.

Seasonal and Inter-annual Variability: It is important to consider the inherent natural variability that is typical of many of the parameters used in marine monitoring programmes to avoid incorrect conclusions about its presumed impacts. Similarly, it is important that reference sites are used to account for the spatial variability that may occur in the marine environment. Hereby, data are acquired from within the impact area (as predefined in the EIA) and at reference areas located sufficiently far away to ensure that they will be unaffected by the Project and where natural environmental conditions will be preserved.

Review and Close Out: Monitoring is not an open-ended process. It is important to regularly review monitoring results, not just from the perspective of corrective action if required, for specific impacts, but also to establish whether there is any need for a particular element of the monitoring programme to continue, or to continue in its current form. Once a designated purpose has been served, some elements of monitoring will cease. Others may be enhanced or become more frequent in response to lessons learnt.

3. PURPOSE OF ENVIRONMENTAL MONITORING

This document provides a proposal for the monitoring programme for the NSP2 Project in the Danish EEZ.

The purpose of the monitoring programme is to ensure compliance with the construction permit where applicable and to confirm the conclusions on environmental impacts outlined in the Danish EIA /1/.

The monitoring programme has been designed to ensure that environmental impacts associated with construction and operation of the NSP2 pipeline are in line with the conclusions in the EIA /1/. The monitoring programme has been developed taking into account the results from the monitoring of the construction and operation of the Nord Stream project (NSP) pipeline undertaken in 2010 - 2015.

4. EXISTING CONDITIONS ALONG THE NSP2 ROUTE DENMARK

The environmental and socio-economic conditions inside Danish waters have been described and assessed in /1/. A summary of the most important parameters is given in this section.

4.1 Protected areas

Protected areas inside Danish waters are shown in Figure 4-1, and include Natura 2000 sites, HELCOM MPAs and Ramsar sites. There are no Natura 2000 areas inside Swedish or Polish waters close to Danish waters. Inside Danish waters, the NSP2 route will not cross any designated protected areas.

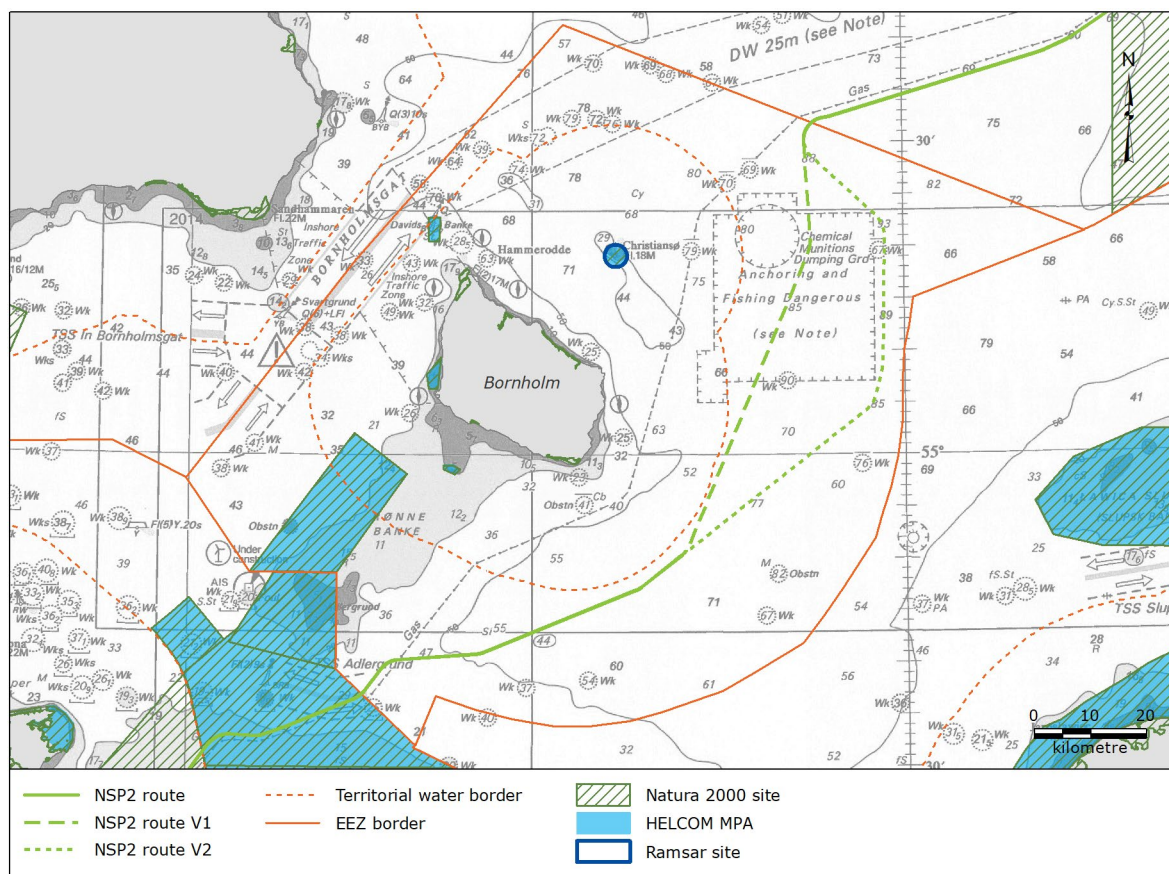


Figure 4-1 Protected areas in the proximity of the proposed NSP2 route, NSP2 route V1 and/or NSP2 route V2 within Danish waters /1/. Protected areas include Natura 2000 sites, HELCOM MPAs and Ramsar sites.

4.2 Munitions and chemical warfare agents

Munition screening surveys along the planned NSP2 route and both NSP2 route variants (NSP2 route V1 and NSP2 route V2) were performed in 2018-2019 (see Figure 4-2). The surveys included investigation of the seabed with gradiometer and visual inspections.

Reporting of the munitions screening survey (unexploded ordnance, UXO) covering the proposed NSP2 pipe-lay corridors and the intervention works footprint is being finalised at the time of preparation of this monitoring programme, and results identify munitions finds on both route variants. The routing has been adapted to safely accommodate all found munitions along the NSP2 routes, i.e. a minimum offset distance to the pipelines. A line of ground mines (explosive charge in the order of 800 kg) traverses NSP2 route V2 pipeline corridor. The required remedial actions will be developed in coordination with the appropriate authorities.

Such actions under consideration include one or a combination of the following:

- Rerouting; a potential reroute has been surveyed and is being assessed by engineering.
- Relocation of individual munitions to a permanent storage location on the seabed outside the influence of the pipeline corridor, which is yet to be agreed with the competent Danish authority.

A variety of different chemical munitions containing different types of chemical warfare agents (CWA) were dumped in the Bornholm Basin east of Bornholm after the Second World War.

As illustrated in Figure 4-2, the NSP2 route V1 crosses the area where bottom trawling, anchoring and seabed intervention works are discouraged. The NSP2 route V2 does not cross this area.

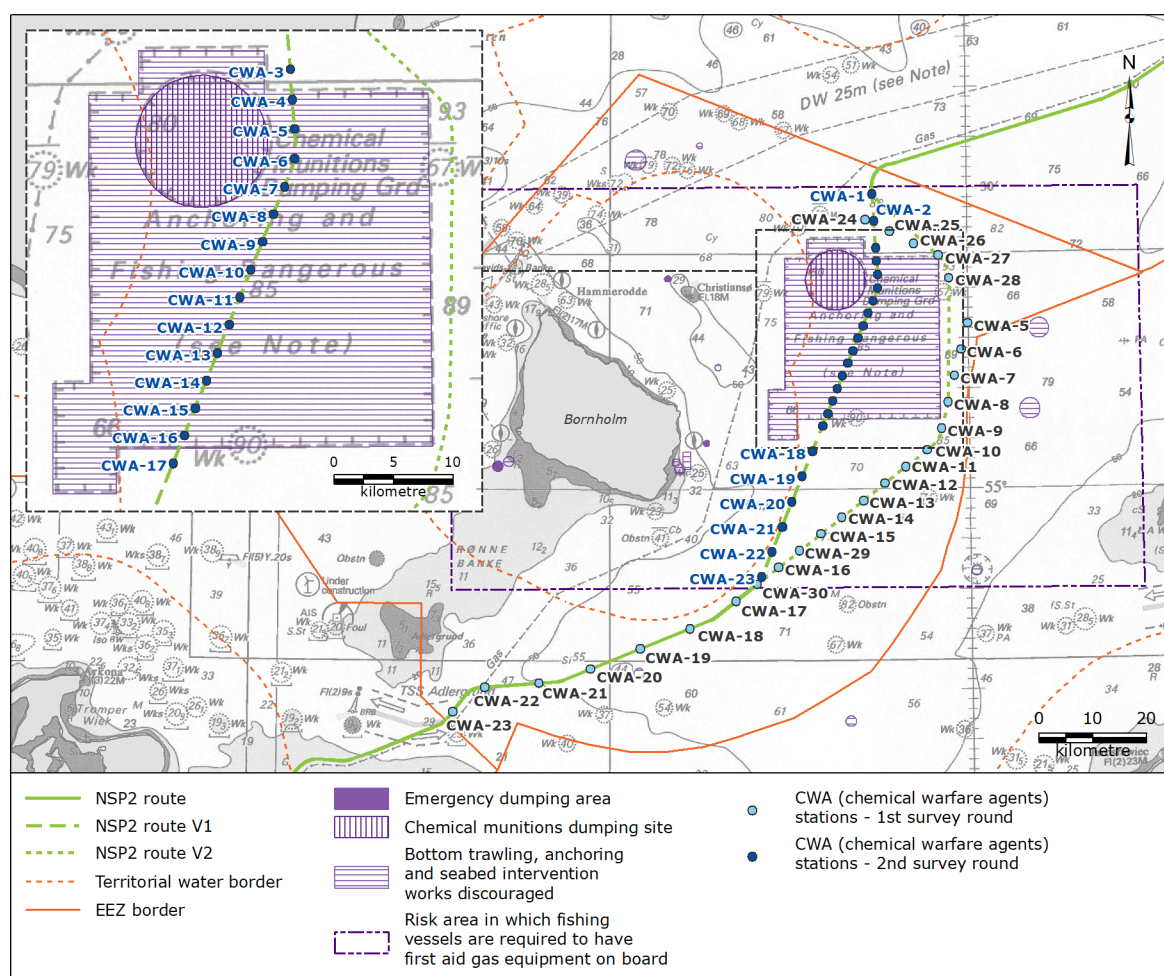


Figure 4-2 CWA survey stations along the NSP2 route V1 and V2 in the Danish EEZ /1/.

Results from the baseline survey of CWA in sediment along the NSP2 route and along the NSP2 route V2 carried out in 2018 did not show any intact CWA in the sediment, but degradation products of sulphur mustard (1,4-Dithiane and 1,2,5-Trithiepane) and PDCA (dipropyl phenylarsonodithioite) were detected, as summarized in Table 4-1.

Table 4-1 The average concentration of detected CWA degradation products (2018 survey) in samples with content above detection limits and the % of total number (30) of samples with concentrations exceeding detection limits. Concentrations are shown in µg/kg DW.

CWA grouping	CWA degradation product	Average concentration	% of the 30 samples exceeding detection limit
Sulphur mustard	1,4-D ¹	0.31	43
	1,2,5-T ²	0.77	63
Phenyldichloroarsine	DPP ³	3.5	60

¹1,4-Dithiane, ²1,2,5-Trithiepane, ³Dipropyl phenylarsonodithioite.

The results of the 2019 baseline survey of CWA in sediment along the NSP2 route V1 showed intact CWA substances (Adamsite and Triphenylarsine) at several stations both within the restricted area and outside of the designated dumpsite. The results therefore indicate that CWA were most likely dumped outside of the officially demarcated dumpsite. The presence of substantial trawl tracks on the seabed furthermore indicates that CWA components may have been dragged from their original dumping locations due to fishery activity in the area. The results are summarized in Table 4-2.

Table 4-2 The average concentration of detected CWA and CWA degradation products (2019 survey) in samples with content above detection limits and the % of total number (23) of samples with concentrations exceeding detection limits. Concentrations are shown in µg/kg DW.

CWA grouping	CWA or respective degradation product	Average concentration	% of the 23 samples exceeding detection limit
Sulphur mustard	Sulphur mustard	0.28	13
	1,4-O ¹	0.32	13
	1,4,5-O ²	0.96	65
	1,2,5-T ³	28.40	17
Adamsite	Adamsite	15.10	35
Clark I/II	Clark II	13.00	52
	DPA ⁴	1.70	65
	DPT ⁵	2.41	30
Triphenylarsine	Triphenylarsine	76.20	17
Phenyldichloroarsine	Phenyldichloroarsine	13.51	48
	PAA ⁶	6.79	100

¹1,4-Oxathiane, ²1,4,5-Oxadithiepane, ³1,2,5-Trithiepane, ⁴Diphenylarsinic acid, ⁵Diphenylpropylthioarsine, ⁶Phenylarsonic acid.

4.3 Bottom fishery

The spatial distribution of bottom trawling activities in Danish waters by Danish fishermen is mapped on the basis of Vessel Monitoring System (VMS) data and is shown on Figure 4-3 for the period 2010 – 2016. As illustrated in Figure 4-3 bottom trawl fishery is particularly intense along the NSP2 pipeline route in areas south and east of Bornholm.

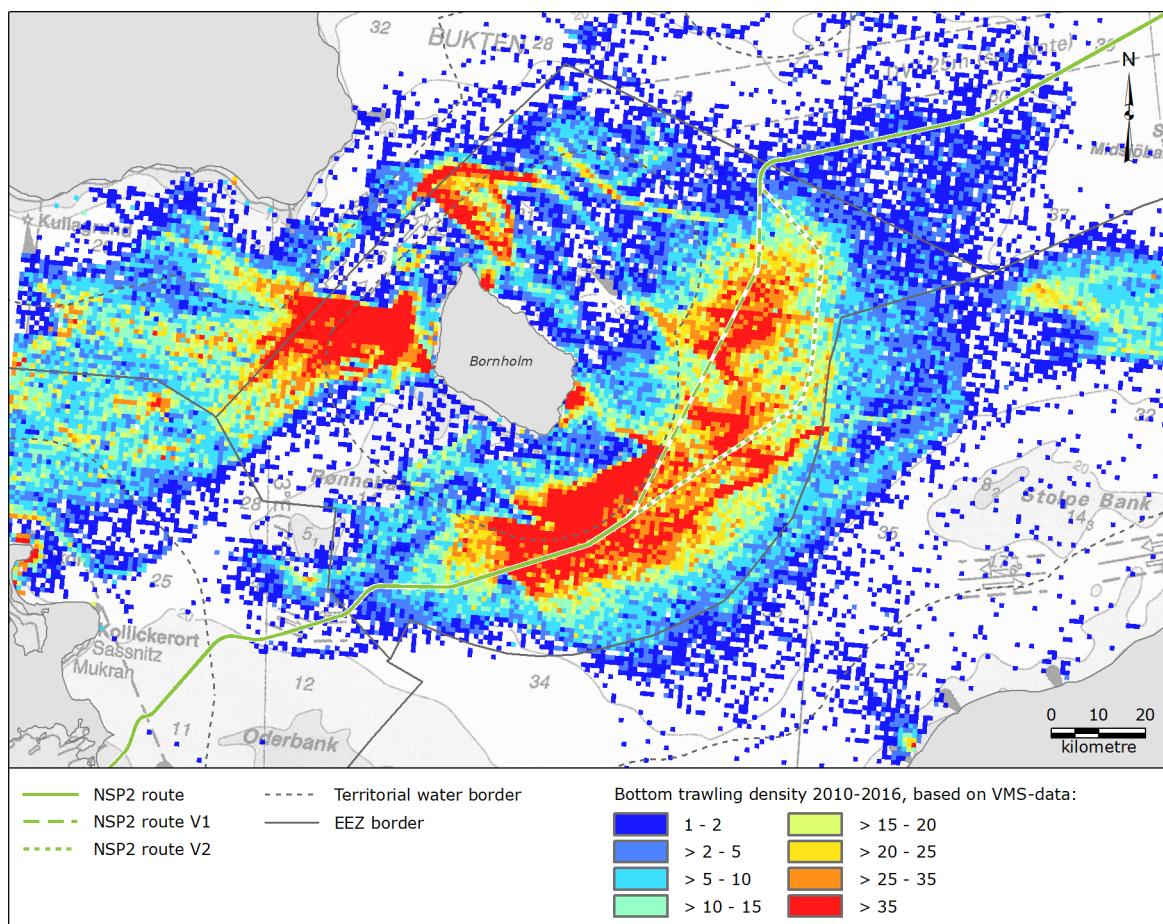


Figure 4-3 The overall distribution of fishery by bottom trawling by Danish fishermen in the waters around Bornholm, 2010-2016, derived from VMS data points per km² /1/.

4.4 Maritime traffic

The ship traffic density inside Danish waters is illustrated in Figure 4-4, Figure 4-5 and Figure 4-6. In Danish waters, the combination of the proposed NSP2 route with V1 or the combination of the NSP2 route with V2 will run east and south of Bornholm, avoiding the heavily trafficked Traffic Separation Scheme (TSS) Bornholmsgat. The only area with high ship traffic intensity is where NSP2 crosses the TSS Adlergrund, which has approximately 7,000 ship movements per year /1/. Furthermore, the NSP2 route crosses two minor routes; Route K with approx. 2,400 passages per year, Route I with approx. 5,300 passages per year, see Figure 4-4.

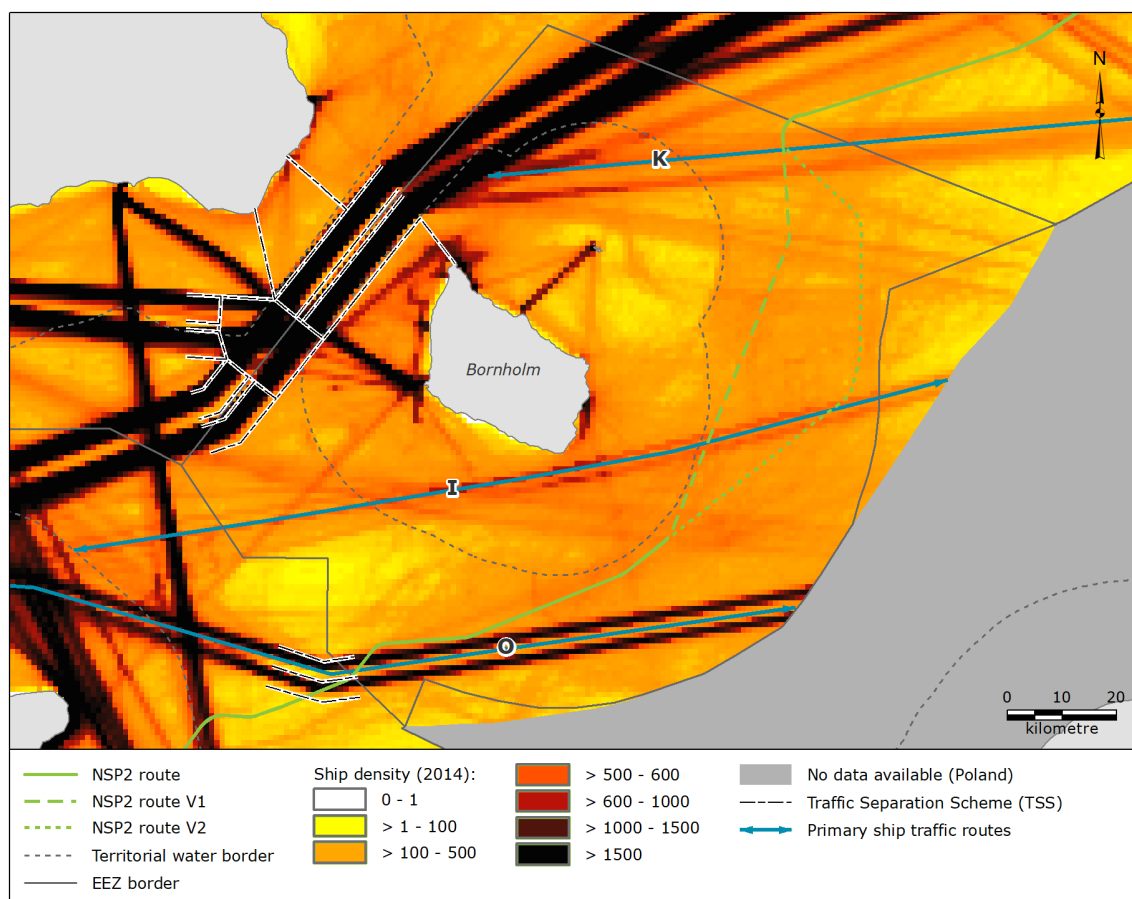


Figure 4-4 Ship traffic density in Danish waters based on Automatic Identification System (AIS) registrations in 2014 (numbering along the NSP2 route refer to KP points) /1/.

The annual number of ship crossings along the combination of the proposed NSP2 route with V1 and the combination of the NSP2 route with V2 within Danish waters have been estimated for each KP and are shown in Figure 4-5 and Figure 4-6, respectively.

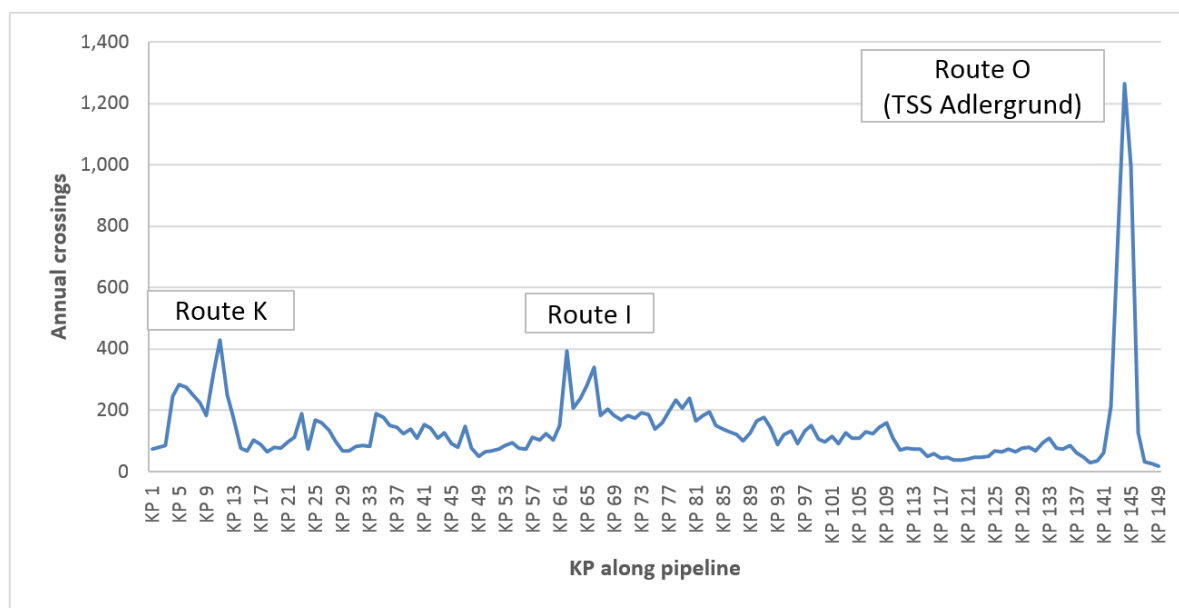


Figure 4-5 Annual crossings per KP-interval (e.g. 1 represents the interval between KP0 and KP1, see Figure 4-4) along the combination of the NSP2 route with V1 in Danish waters. KP 0 is at the Danish/Swedish EEZ border.

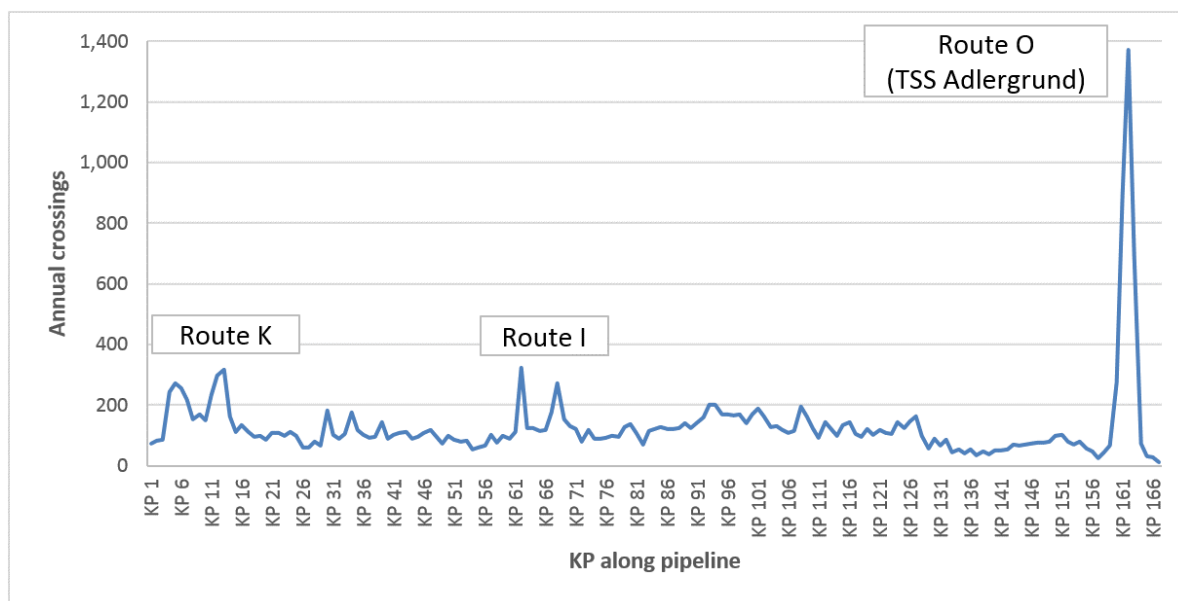


Figure 4-6 Annual crossings per KP-interval (e.g. 1 represents the interval between KP0 and KP1, see Figure 4-4) along the combination of the proposed NSP2 route with V2 in Danish waters. KP 0 is at the Danish/Swedish EEZ border.

5. NSP2 ACTIVITIES INSIDE DANISH WATERS

5.1 NSP2 activities

5.1.1 Introduction

Sources of potential impact from the construction and operation of NSP2 inside Danish waters have been identified as part of the EIA /1/ by considering how the various project activities within Danish waters may interact with environmental and socio-economic resources and receptors.

This has required detailed understanding of the various project activities and of the baseline environmental and socio-economic conditions. Furthermore, experience and knowledge gained from the monitoring of the existing NSP have served as important input to the identification of potential impacts for NSP2.

Table 5-1 presents a list of planned project activities relevant to the Danish sector and the associated sources of potential impact in relation to the construction and operational phases, respectively.

Table 5-1 Project activities in Denmark and associated sources of potential impact during the construction and operational phases /1/.

Project activities	Sources of potential impact
Project activities during construction	
- Vessel operation (during pipe-lay and seabed intervention works)	General physical disturbance by the presence of vessels etc., disturbance of the seabed and dispersion of sediment to the water column, and re-sedimentation.
- Pipe-lay	
- Post-lay trenching	
- Pre- and post-lay rock placement	
- Installation of support structures	
Project activities during operation	
- Presence of pipeline on seabed	General physical disturbance by the presence of vessels, and disturbance/changes in habitat by the presence of pipelines on the seabed.
- Vessel operation (inspection and monitoring)	

Below is a short description of the planned construction activities at the seabed.

5.1.2 Construction works at the seabed

At certain locations, pipelines need to be stabilized by either post-lay trenching or spot rock placement. In the Danish EIA /1/, the following seabed intervention works in Danish waters are assumed as the basis for the evaluations:

Post-lay trenching or spot rock placement for stabilization is assumed in one section ("Section 1") along a total of length of 4 km along each pipeline to a depth corresponding to the outer diameter of the pipeline (1.4 m assumed). Post-lay trenching is assumed to be performed with a speed of 300 m/hour and with a cross-section of 6.2 m², yielding a total soil volume of 24,660 m³ per pipeline. Rock placement would require approximately 21,500 m³ of rocks per line.

- **Spot rock placement at the pipeline crossing.** It is assumed that 30,000 m³ of pre-lay rock placement will be performed for each pipeline at the crossing of the existing NSP pipelines, yielding a total of 60,000 m³ of rock placement ("Section 2").

Figure 5-1 shows planned seabed intervention works for post-lay trenching and rock placement.

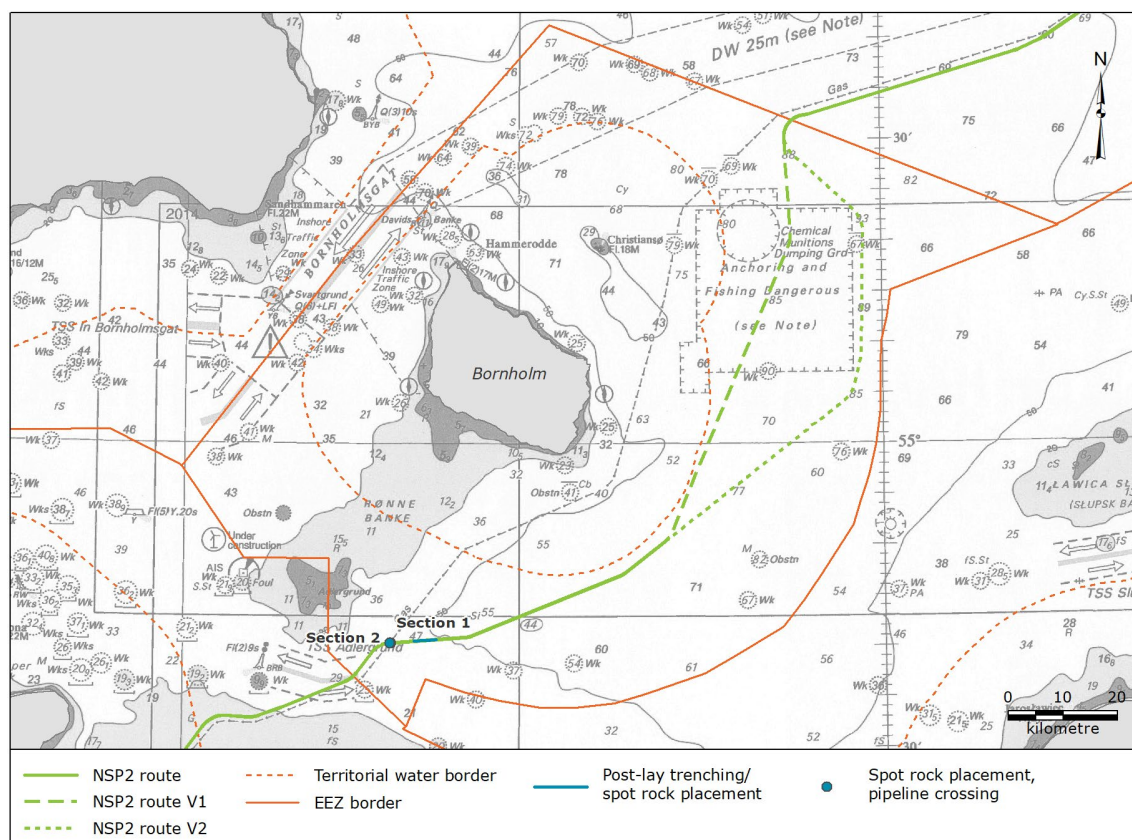


Figure 5-1 Potential intervention works in Danish EEZ as presented in the Danish EIA /1/

The general effects from seabed intervention works are considered to be:

- Temporary impact on water quality caused by sediment brought in suspension.
- Changes in surface sediment composition caused by direct physical disturbance of the seabed (as from the post-lay trenching vessel), and from re-sedimentation of suspended sediment.

During construction activities, munitions experts from the Danish Navy will most likely also be onboard the construction vessel (subject to agreement with the Danish authorities) to ensure that traces of CWA are not brought onboard and that appropriate procedures are implemented.

Along the NSP2 route in the HELCOM CWA risk area (see the purple dotted rectangle in Figure 4-2), any project vessels working in these areas shall carry the first aid materials and personal protective equipment defined by HELCOM (HELCOM Guidelines for Fishermen (areas of sea-dumped chemical munitions) at <http://www.helcom.fi/baltic-sea-trends/hazardous-substances/sea-dumpedchemical-munitions/>). Relevant vessel personnel shall have appropriate training in the recognition of chemical munitions, safety and decontamination procedures. This requirement applies when planned activities do not involve equipment intentionally placed on the seabed, as these precautions are necessary in the event of recovery of equipment accidentally in contact with the seabed.

Procedures shall be in place for the wash-down of equipment, inspection and testing for contamination, decontamination, and the immediate notification of the relevant authorities. Any cases of chemical munition material accidentally brought onboard or confirmed cases of contamination of equipment shall be reported to Nord Stream 2 AG by construction constructors as a near-miss incident and reported to the relevant authorities.

5.1.3 Occupation of the seabed by the pipeline structure







During operation, when the pipelines are placed on the seabed, the surface of the concrete coated pipelines and/or rocks used for stabilization of the pipelines will serve as new substrates for benthic organisms. The general effects from the pipelines, and from local changes of the seabed habitats immediately around the pipelines are considered to be:

- Growth/development of epifauna on the surface of the pipelines;
- Changes in benthic community structure immediately around the pipelines and on the slope of the trenched section with pipelines in the trench or at the rock berm locations;
- Changes in the fish community structure around the pipelines.

As most of the pipeline route is located outside the photic zone, at water depths >20 m, the establishment and growth of macrophytes is not expected to occur within the Danish section.

5.2 Construction activities and time schedule for NSP2

Construction activities in Danish waters include pipe-lay and seabed intervention works, see Figure 5-2.

Planned construction schedule Danish Sector	2019	2020			
	Q4	Q1	Q2	Q3	Q4
Construction Permit					
Pre-lay intervention works (NSP crossing) ¹					
Pipe-lay Line A window (pipe-lay approx. 45 days)					
Pipe-lay Line B window (pipe-lay approx. 45 days)					
Post-lay intervention works ²					
Pre-commissioning ³					

¹ Rock placement (e.g. as a preparation for the NSP crossing) and mattress placement for cable crossings

² Rock placement (e.g. NSP crossing) and potentially, according to as-laid survey results, rock placement or plough trenching

³ No planned intervention works associated with the Pre-commissioning operations, other than tracking of pigs by surface vessel

Figure 5-2 NSP2 construction activities in the Danish sector /1/.

The pipeline installation phase in Danish waters is expected to last approximately 115 days for the NSP2 route with the NSP2 route V1 or 125 days for the proposed NSP2 route with the NSP2 route V2 in total for the two pipelines, and the installation is assumed to be sequential, meaning that one pipeline will be installed at a time in Danish waters. Construction activities in Danish waters are scheduled to be undertaken in 2020. It is noted that the schedule may be subject to change during project development. However, changes in the schedule would not impact the scope of monitoring.

6. ENVIRONMENTAL MONITORING PROGRAMME NSP2, DENMARK

6.1 Criteria for defining the monitoring programme

The proposed environmental monitoring programme has, including minor additions, been tailored on the basis of the environmental impacts documented in the EIA /1/. Additionally, the requirements in the construction permit from the Danish authorities will, when available, be included in the final monitoring programme.

The monitoring programme is commensurate with the significance of the impacts assessed in the EIA /1/. For each environmental aspect, decisions on monitoring requirements have been made on the basis of the assessed environmental impacts, commitments in Nord Stream 2 AG documents and, when available, conditions in the construction permit issued by the Danish Energy Agency.

The overall proposed monitoring programme for NSP2 in Danish waters is shown in Table 6-1. The approach to monitoring of the identified parameters is outlined in the following sub-sections.

Table 6-1 Proposed overall monitoring programme for NSP2 during construction and operation.

Proposed NSP2 monitoring programme for Danish waters			
Parameter	Before Construction (2018-2019)	During Construction (2020)	During Operation (2020-2022)
Water quality	-	+	-
Maritime traffic	-	+	-
Commercial fishery	+	-	+
Munition objects	+	+ ¹	+
Chemical warfare agents in sediment	+	-	+
Cultural heritage	+	+ ¹	+
Pipeline footprint and physical disturbance	-	-	+ ²
1: Control and documentation by NSP2 contractor that possible munitions objects/wrecks will not be impacted during pipe-lay, post-lay trenching/spot rock placement. 2: Assessment immediately after completion of pipeline installation and associated intervention works.			

The following sections provide an overview of the monitoring of relevant environmental impacts in Danish waters.

6.2 Water quality

6.2.1 Purpose

The construction phase of the proposed Nord Stream 2 pipeline system will generate sediment dispersion that can potentially have an environmental impact on marine life. Sediment dispersion from construction activities will be restricted to pipeline sections where post-lay trenching or rock placement is planned to take place. The pipeline sections where these two activities are planned to take place are shown on Figure 5-1.

Based on the planned seabed intervention works and experience from NSP regarding sediment spill rates, numerical modelling of the sediment dispersion has been carried out for NSP2. The modelling has shown that increased sediment concentrations from seabed intervention works in Danish waters will be limited to the close vicinity of the construction sites and sediment dispersion will be mainly associated with post-lay trenching /1/.

Based on the above, it has been decided to focus the monitoring on the only section of the pipeline route along which post-lay trenching is planned ("Section 1"). It should be noted that, as described in section 5.1.2 and shown in Figure 5-1, it is not yet decided if intervention works along Section 1 will comprise post-lay trenching or rock placement. Should rock placement be selected instead, then monitoring of water quality during pipeline construction will not be necessary at this or other locations along the pipeline route.

The purpose of the programme for the monitoring of dispersion of released sediments is to verify that the assessment in /1/ is correct. Monitoring of water quality will allow to confirm that the order of magnitude of sediment spill is assessed correctly, of short duration and very local, and that the overall impact on water quality is negligible.

6.2.2 Experience and lessons learnt from Nord Stream

6.2.2.1 Overview of water quality monitoring for NSP in Danish waters

Monitoring of dispersion of sediments resulting from post-lay trenching in Danish waters took place during construction for Line 1 and Line 2 of NSP in 2011 and 2012, respectively. The monitoring was carried out according to /2/.

The monitoring for Line 1 took place on 7, 9 and 13 February 2011 /3/. The monitoring on 7 February 2011 was carried out while test trenching was carried out, whereas the monitoring on 9 and 13 February 2011 was carried out when actual post-lay trenching took place. The monitoring for Line 2 took place on 16 February 2012 /4/.

6.2.2.2 Results of water quality monitoring for NSP in Danish waters

Sediment concentrations were measured using turbidity measurements calibrated to suspended sediment concentrations (SSC) established from water samples collected at the same time and place. The correlation established when carrying out post-lay trenching for NSP in Danish waters in 2011 is shown in Figure 6-1.

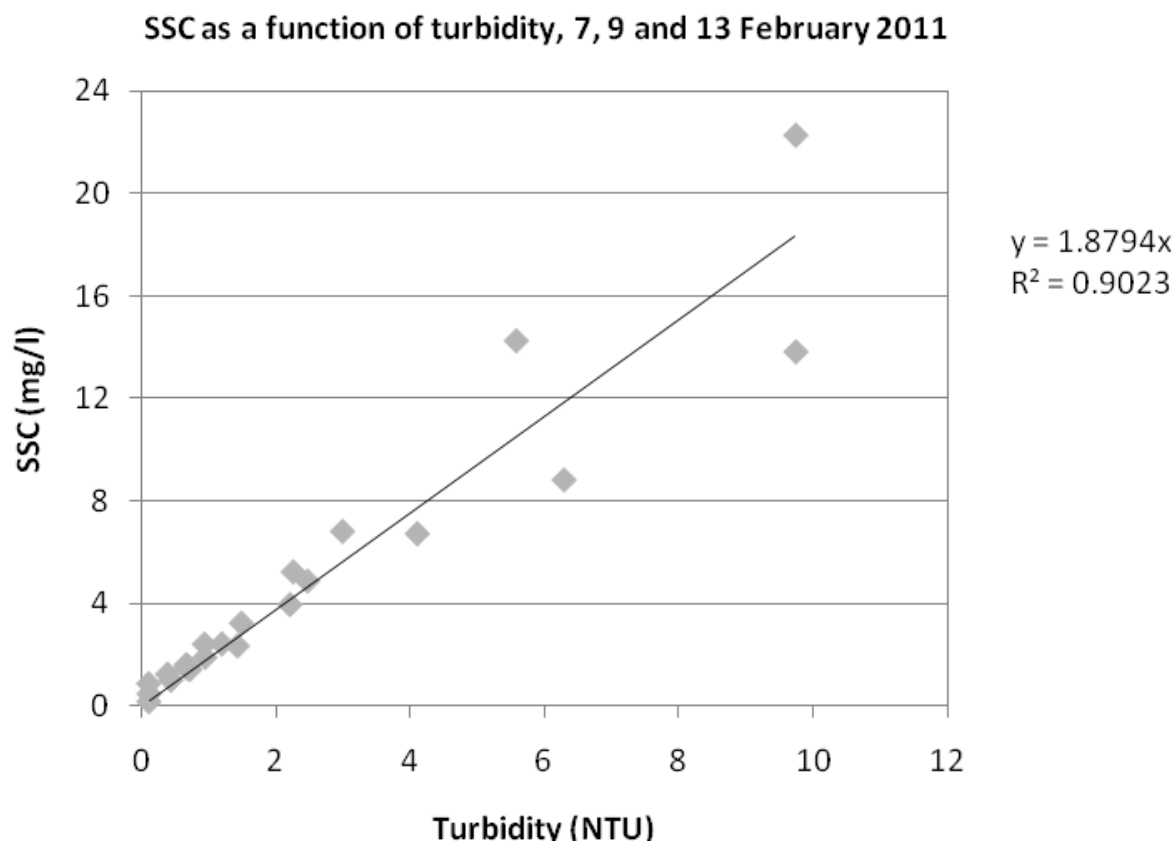


Figure 6-1 Linear correlation between turbidity and SSC, based on 23 water samples extracted in Danish waters on 7, 9 and 13 February 2011 /3/.

The monitoring for Line 1 was carried out in different situations, both with post-lay trenching speed and with respect to hydrographic conditions. Also, the post-lay trenching work differed between the dates. On 7 February 2011, test post-lay trenching was carried out, and the currents were relatively low. On 9 February 2011, post-lay trenching was carried out relatively slowly due to the hard seabed; the currents were up to 0.3 m/s from shifting directions. On 13 February 2011, the post-lay trenching was carried out in rough weather; current velocities were approximately 0.1 m/s /3/.

The position of the water samples taken are shown together with the Acoustic Doppler Current Profiler (ADCP) backscatter transect of the sediment plume, calibrated according to the results of the water samples and the optical backscatter sensor (OBS) turbidity measurements. Figure 6-2 shows that water samples have been taken where the sediment plume is densest, i.e. they can be considered representative for the maximum sediment concentration in the sediment plume 600 m from the post-lay trenching location, with a current velocity of 0.10 m/s. The signal in the uppermost part of the water column is caused by air bubbles from the wake of the post-lay trenching vessel, i.e. it is not caused by suspended sediments /3/.

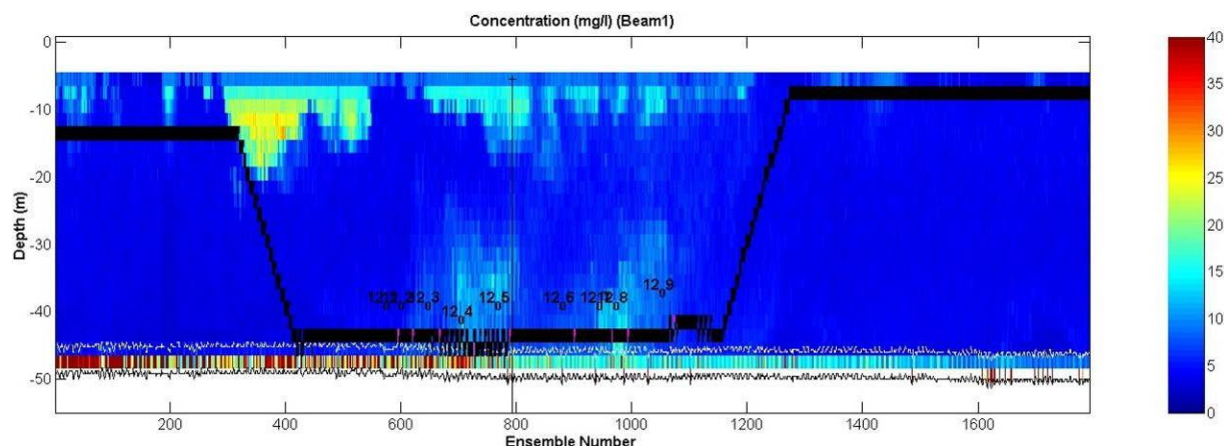


Figure 6-2 ADCP backscatter transect across a sediment spill plume in Danish waters, from NSP monitoring on 13 February 2011. The signal in the uppermost half of the water column is caused by air bubbles in the wake of the post-lay trenching vessel. The black 'step' line shows the 'path' of the conductivity, temperature and depth (CTD) / OBS sensor. The red markings shown indicate where water samples for calibration have been extracted /3/.

The transect shown in Figure 6-2 represents the measurements with the highest SSC measured during the entire measuring campaign, with water samples showing SSC up to 22 mg/l. Calculation of the sediment flux through the transect showed a sediment spill rate of approximately 7 kg/s. This is significantly less than 19 kg/s that was adopted in the modelling for the EIA for NSP for Denmark.

Monitoring of sediment spill connected with post-lay trenching for Line 2 in Danish waters took place on 16 February 2012. A total of nine turbidity transects were measured and 38 water samples were collected.

The current direction was generally towards the south, with speeds below 0.25 m/s. The results show that the plough created a plume of suspended sediment. The plume was densest near the plough, where concentrations of up to 20 mg/l were detected from turbidity measurements. The plume widened, and the concentrations decreased with distance from the plough. The concentrations 500 m behind the plough were observed to be less than 4 mg/l. This shows that the plume was diluted and that a significant quantity of the sediments had settled during the initial 500 m of transport.

6.2.2.3 Conclusions regarding NSP monitoring of sediment spill in Danish waters

The sediment spill measurements carried out during post-lay trenching for NSP in Danish waters confirmed that the spill rates used in the NSP EIA were conservative, i.e. higher than the measured spill rates.

It should, however, be stressed that it is difficult to measure the spill rate. Much of the time there is not a regular spill plume, due to non-continuous post-lay trenching activity and/or shifting current directions. Also, when the current velocity is very low or in the same direction as the post-lay trenching vessel, it is difficult to carry out measurements.

But the measurements that were carried out, both with respect to SSC and with respect to sediment spill rates, confirmed the above; namely, that the assumptions for the numerical modelling that formed the basis of the Danish EIA was conservative.

6.2.3 Scope of NSP2 monitoring

Even though the results from NSP monitoring show that the risk of significant levels of sediment dispersion are very low, some monitoring is appropriate in order to confirm the modelling results and therefore the validity of the assessment presented in the EIA.

It is suggested to carry out vessel-based monitoring of sediment spill rates during post-lay trenching for NSP2, by measuring turbidity and current direction during the post-lay trenching activity. Monitoring is proposed to be performed for both lines A and B.

The monitoring is suggested to be carried out during post-lay trenching for Line A and Line B at the WQ1 stations (see Figure 6-3). The duration of the monitoring is expected to be several days, subject to the duration of post-lay trenching.

The purpose of the monitoring of the sediment spill rate is to verify that the sediment spill rate that was used for modelling of the dispersion of spilled sediments from post-lay trenching can be considered representative for the actual situation. Since the results of the actual measurements from post-lay trenching for NSP are available, it is not expected that the sediment spill rate will be significantly different from what is assumed in the modelling.

6.2.3.1 Monitoring area

Vessel-based monitoring of water quality is planned to take place at station WQ1, where post-lay trenching may potentially be carried out (at the pipeline section from approx. KP 129 – 133 if the NSP2 route in combination with V1 is constructed, or from approx. KP 146 – 150 if the NSP2 route in combination with V2 is constructed).

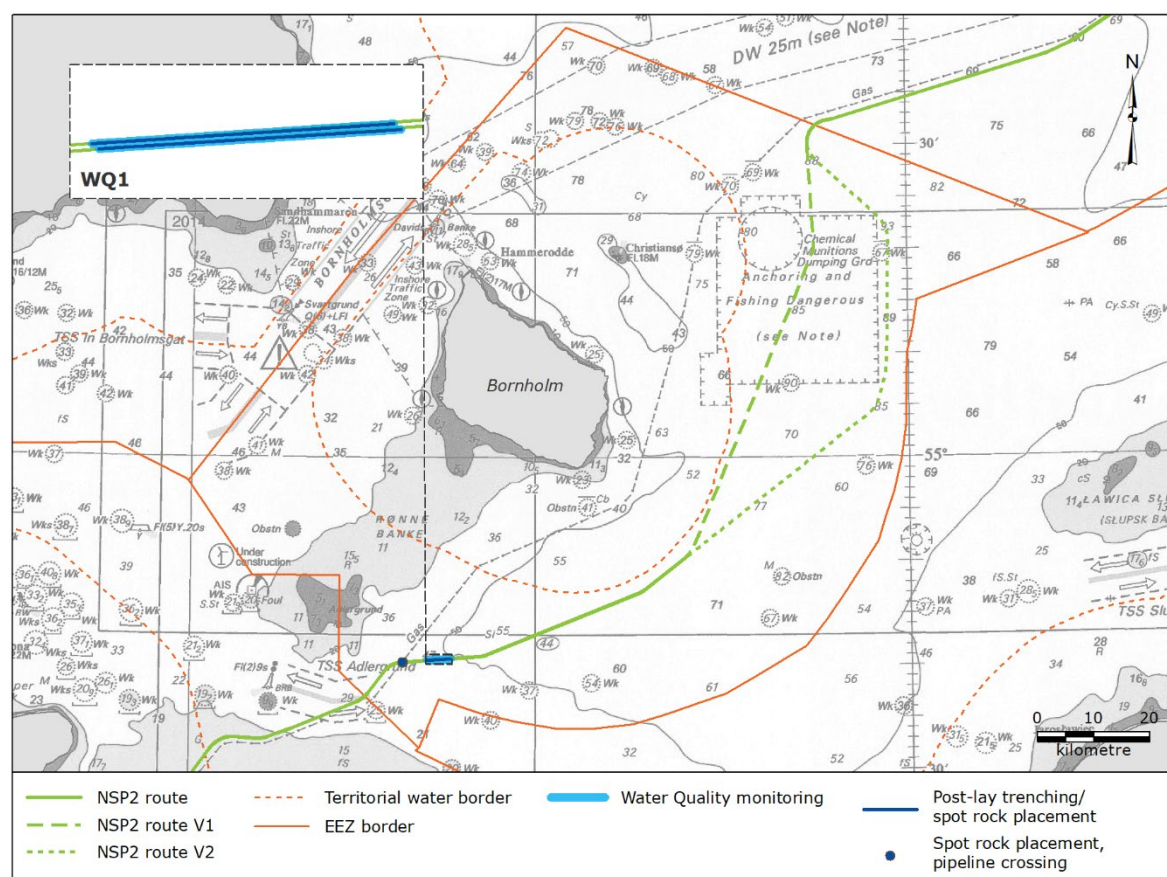


Figure 6-3 Water quality monitoring station WQ1 (post-lay trenching).

6.2.4 Methodology

6.2.4.1 Monitoring equipment

Monitoring of profiles of turbidity/suspended sediment concentrations by turbidity sensors (calibrated with water samples) and currents will be undertaken from a vessel during periods of seabed intervention works.

Turbidity is measured by an OBS mounted on a cable. On the same cable there will be a CTD sensor for measuring water temperature and conductivity/salinity.

To make it possible to convert the results of the turbidity measurements to concentrations of suspended sediments, water samples are taken frequently at the same levels as where the turbidity sensors are measuring.

The profiles are measured downstream of the working areas at locations where a sediment plume from the seabed intervention works can be expected. The extent and direction of the sediment plume depends on the position of the intervention works and the current direction and speed, and the extent of the plume is visualised onboard the monitoring vessel by the backscatter signal from the ADCP on the vessel. Monitoring is carried out with respect to measuring positions etc. to establish the temporal and spatial characteristics of the sediment plume.

An ADCP will measure the underwater current field (current speed and direction) vertically throughout the whole water column and will be used from the vessel.

6.2.4.2 Water sample analysis for calibration of turbidity measurements

Water samples are taken from the same levels in the water column as where the turbidity meters are situated. The number of water samples from each level depends on the variability of the sediment concentrations, the degree of heterogeneity of the suspended sediment grain size distribution, etc. The water samples are analysed for mass concentration of suspended solids. This will be done by filtering the water samples through pre-rinsed and pre-weighted 0.45 µm Millipore membrane filters or similar and weighing the dried filters afterwards. In that way the mass of suspended solids in the sample per volume unit of the water-sediment suspension can be established.

Conversion from turbidity measurements to mass concentration of suspended sediments is done using regressions between these parameters established from the above turbidity measurements and water samples from the same time and level in the water column.

6.2.4.3 Calibration and maintenance of measuring equipment

Calibration and maintenance are determined together with the contractor. The frequency depends on the exact type of instruments to be used and is planned with due consideration to vessel logistics.

6.2.4.4 Monitoring setup

The vessel-based sediment spill monitoring is proposed to be carried out the same way as it was done during NSP monitoring.

A vessel equipped with water samplers and automatic ADCP, OBS and CTD sensors will be used. By using dedicated software to interpret the backscatter signals from the ADCP, the distribution of suspended sediment beneath the vessel will be visualized and used for optimizing the quantitative turbidity measurements and water sampling. A water sampler carousel fitted with OBS and CTD sensor will then be lowered to the depths and locations with the highest turbidity values.

Monitoring of sediment dispersion is planned to take place as close to the plough as considered safe from the perspective of both the post-lay trenching activities and the monitoring vessel. The distance currently expected to be acceptable is 200 m behind the plough and 200 m to the sides

of the post-lay trenching vessel. These distances were evaluated as a good safety zone during the likewise monitoring for NSP. No activities are allowed in front of the post-lay trenching vessel. To give priority to the safety for all involved parties, a video link communication system will be installed on all vessels. In Figure 6-4, a schematic layout of the principle used for vessel-based monitoring is shown.

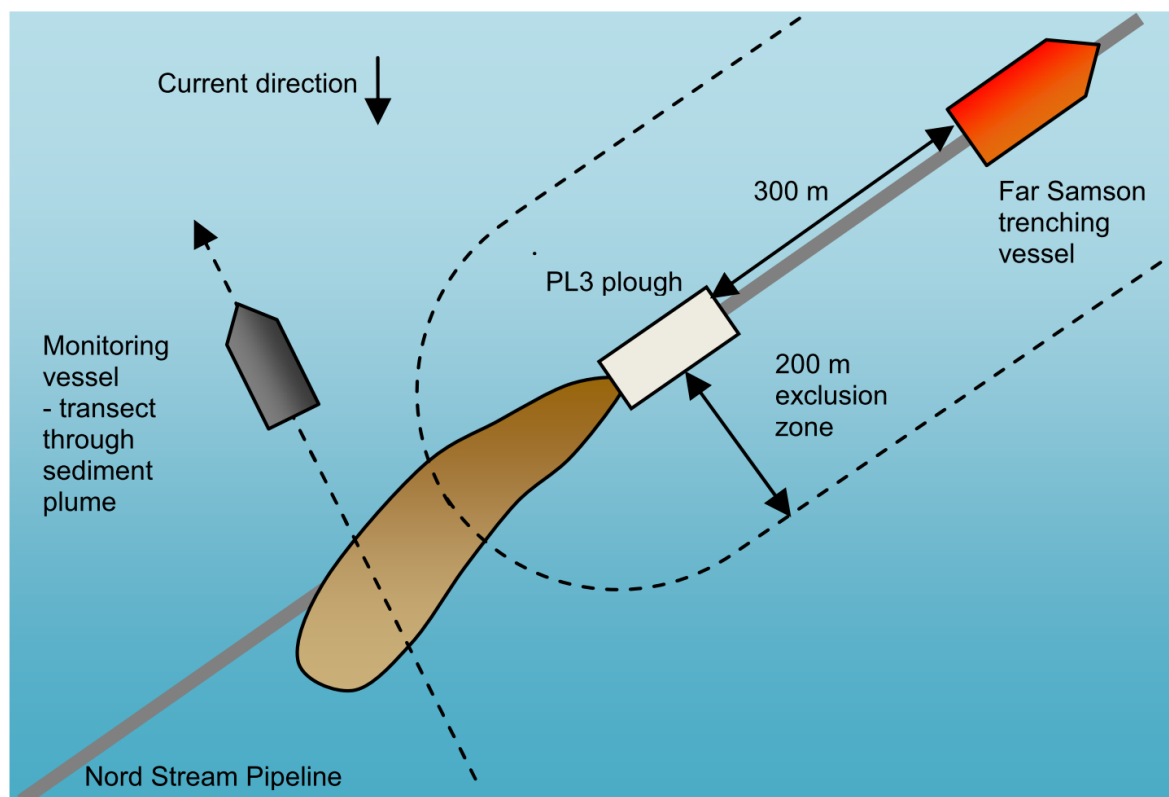


Figure 6-4 Schematic layout of the principle used for vessel-based monitoring for NSP and suggested for NSP2 (not to scale).

6.3 Maritime traffic

6.3.1 Purpose

The overall purpose of the control and monitoring of marine traffic is to minimize the risk of collisions or other accidents involving commercial shipping traffic and/or vessels carrying out construction activities for the project. By analyzing the ship traffic data and possible incidents, the risk assessment performed in the EIA will also be verified.

Monitoring of the offshore activities during the construction phase of NSP2 is described in the following with the purpose of documenting safe navigation for commercial ships passing the construction works during the construction phase.

6.3.2 Experience and lessons learnt from Nord Stream

During NSP, monitoring of ship traffic was performed using AIS data and reported to authorities to verify/adjust risk reducing measures ensuring safety for commercial ship traffic during the construction phase.

Yearly analysis of ship tracks along the pipeline was performed to identify if there had been any incidents in which:

- Ships had drifted and performed emergency anchoring close to/on top of the pipeline;
- There was indication of unintentional dragged anchors impacting the pipeline.

During construction in Danish waters, Nord Stream AG and its construction vessels followed the communication and reporting procedures that were agreed with the Danish authorities and organizations. Nord Stream AG provided the relevant authorities with a four-week notification period prior to the commencement of new construction activity, weekly and monthly forecasts as well as daily updates from the construction vessels. Regular information to the fishing community was provided from the time when the construction activities started and continued throughout the construction period.

Precautionary safety measures were successfully implemented, and the construction activities were all performed without any accidents or significant incidents with third party vessels. On some occasions, mainly during the initial weeks of construction, other vessels entered the requested safety zones around the construction vessels. The monitoring and communication procedures onboard the construction vessels were then followed successfully and none of these safety zone intrusions resulted in any risk-related situations or incidents.

6.3.3 Scope of NSP2 monitoring

The monitoring activities for maritime traffic described in the Danish EIA /1/ focus on the information provided from Nord Stream 2 AG to the authorities on a day to day basis in relation to notification of work plans and monitoring of third-party vessels passing the construction activities. The approach to monitoring is the same as during the construction of NSP, as described above (section 6.3.2).

The monitoring activities proposed for NSP2 will focus on demonstrating that information has been provided to the authorities as agreed (monitoring 1), that the construction vessels operate as intended (monitoring 2) and that safe passage for third-party vessels is possible (monitoring 3).

The following construction activities in the Danish waters will be monitored:

- Monitoring 1: Information flow from Nord Stream 2 AG during construction to the authorities;
- Monitoring 2: Construction vessel traffic;
- Monitoring 3: Commercial maritime traffic around the safety zone of the pipe-lay vessel.

6.3.3.1 Monitoring area

The monitoring will follow the construction vessels. During construction works in Danish waters, a daily report on all construction activities will be transmitted from the vessels. These reports will include the name, call sign, current position and plan of the vessel for the next 24 hours. Before and during construction, the locations of the construction vessels will be announced in Notices to Mariners by the Danish authorities to increase awareness of project-generated vessel traffic.

6.3.4 Methodology

6.3.4.1 Monitoring information flow from Nord Stream 2 AG during construction to the authorities

The purpose of this activity is to document that Nord Stream 2 AG has provided information to the authorities as agreed in the Danish EIA /1/.

By analysing correspondence between Nord Stream 2 AG and the authorities, it will be investigated whether information has been provided to the authorities as agreed.

6.3.4.2 Monitoring construction vessel traffic

The purpose will be to monitor construction vessel traffic using AIS data to document the proper and safe operation of construction vessels to the authorities. The construction vessels, supply and guard vessels during construction will include vessels operating during the following activities:

- Pipe-lay;
- Rock placement (pre-lay and post-lay);
- Post-lay trenching;
- Cable crossings;
- Survey operations.



The purpose of this monitoring activity is to document to the authorities that the construction vessels follow their intended routes.

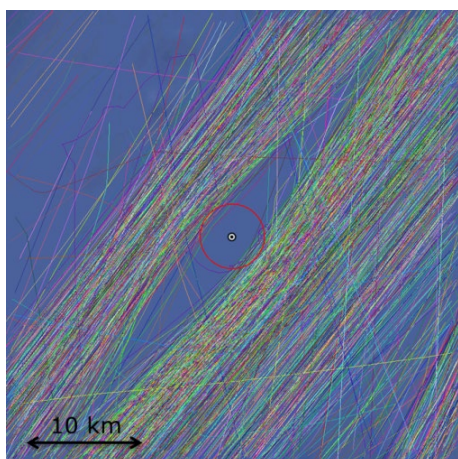
AIS data for the construction vessels will be gathered and analysed to illustrate observed ship tracks from the construction vessels. The observed ship tracks from the construction vessels will be compared to the intended operation of the construction vessels as described in the plans for the construction activities and the restrictions given by the safety zones. The comparison is done to show how much the observed operation of the construction vessels matches the plans.

The results will be presented in maps showing the operation of the construction vessels. If incidents of special interest occur, then videos presenting vessel movements in space and over time can be produced to illustrate the situation. If this monitoring is done continuously throughout the construction period, it will enable Nord Stream 2 AG to either confirm or adjust the operation of the contractor performing the construction activities.

6.3.4.3 Monitoring commercial maritime traffic passing the NSP2 pipe-lay vessel

Monitoring the commercial ship traffic passing the slow-moving construction vessels (e.g. the lay barge) will be undertaken using AIS data. This is done to document to the authorities that commercial ship traffic has safe and free navigation when passing the construction vessels.

Any unexpected vessels entering a 'closest point of approach' radius during the construction work will be contacted and monitored closely and, if necessary, the support vessels of the spread will be used to alert them. In order to notify smaller vessels, fishing organizations and maritime organizations will be informed prior to the commencement of construction works and updated during the performance of the construction works.



AIS data for commercial ships will be gathered and analysed to construct observed ship tracks from commercial vessels when passing the safety zones around the slow-moving lay barge.

The observed ship tracks from commercial ships will show if the commercial ships are able to recognise the construction vessels and their safety zone in due time to safely plan their journey around the slow-moving construction vessels.

Furthermore, when the slow-moving construction vessels are working inside a TSS, such as the TTS Adlergrund, then the observed ship tracks from the passing commercial ships will show whether the commercial vessels are able to pass the safety zones of the construction vessels and stay inside the TSS, maintaining safe and free navigation.

If incidents of special interest occur, then videos presenting vessel movements in space and over time can be produced to illustrate the situation. If this monitoring is done continuously throughout the construction period, then it will enable Nord Stream 2 AG to either confirm or adjust the safety measures adopted to enable safe and free passage of commercial ships passing the construction activities.

6.4 Commercial fishery

6.4.1 Purpose

The purpose of the commercial fishery monitoring programme is to investigate whether the commercial fishery pattern and fish catch by Danish fishermen in areas close to the NSP2 are changed after the installation of the pipelines. Thus, the monitoring programme described in this section includes monitoring of the bottom trawling fishery and bottom gill net fishery along the NSP2 route.

6.4.2 Experience and lessons learnt from Nord Stream

For the NSP project, no specific monitoring regarding commercial fishery was undertaken for Denmark. However, meetings were held with the Bornholm fishery organisation during operation of the NSP pipelines. Based on the meetings, it was concluded that there had not been any incidents or loss of fishing gear caused by the NSP pipelines, as there had not been any changes in fish catch that could potentially have been caused by the construction and operation of the NSP pipelines.

The monitoring programme for NSP for Sweden included a monitoring programme for commercial fishery that was set up in cooperation with the Swedish authorities. As the monitoring programme for commercial fishery for Denmark proposed for NSP2 is comparable with the earlier monitoring programme for Sweden for NSP, the overall results from the monitoring are briefly described below.

The fishery patterns were evaluated based on VMS data, and fish catch data close to and along the NSP pipelines were based on logbook data to identify any changes in fish catch before and after construction of the NSP pipelines.

The results showed that the general bottom trawling pattern and net fishery pattern in Swedish waters from the period 2010-2014 was the same as that observed during the baseline survey for the period 2004-2009, and no changes to the fishery patterns were observed due to the presence of the pipeline system.

Bottom trawling close to the pipelines in the period 2010-2014 was limited and generally located west of the pipelines and south of Öland, and during that time most of the bottom trawling activity was performed outside the Swedish EEZ, towards Poland. However, the activity varied slightly over time and in terms of geographical location. Most of the bottom trawling activity close to the pipeline system was performed almost perpendicular to the pipeline route.

The fish catch along the NSP pipeline that was evaluated based on logbook data showed that catches by bottom trawling and bottom net fishery in 2010-2014 after installation of the pipeline system generally showed annual variations in landings of both quota and non-quota fish species. It has also been assessed that none of the changes in annual fish landings can be attributed to the presence of the NSP pipeline.

6.4.3 Scope of NSP2 monitoring

The scope of the fishery monitoring programme inside Danish waters is to investigate whether the commercial fishery pattern and fish catches for bottom trawling and bottom gill net fishery in areas close to NSP2 are changed after the installation of the pipelines.

6.4.3.1 Monitoring area

The monitoring programme for fishery will cover the commercial fishery along/across the NSP2 pipelines, for the whole NSP2 section inside Danish waters, with focus on the important fishery south and east of Bornholm by Danish fishermen.

6.4.4 Methodology

The methodology for commercial fisheries is based on evaluation of fisheries pattern and data on fish catches along the NSP2 pipelines. The basis for the monitoring will be VMS data and logbook data for Danish commercial fishery.

It is noted that fishery in Danish waters comprises both Danish fishing boats and fishing boats of other nationalities. Given the availability of data, the monitoring will focus on Danish fisheries, though it is assessed that the monitoring results will represent the general fishing patterns in the area and therefore provide a robust description of commercial fishery in Danish waters along the proposed NSP2 route.

6.4.4.1 Fishery pattern

The fishery pattern is evaluated based on VMS data. The VMS is a satellite-based monitoring system compulsory for European Union (EU) fishing vessels with length greater than 15 m. The VMS monitors the position and speed of the fishing vessels for each hour of sailing. Since only fishing vessels with lengths greater than 15 m are required to use VMS, the calculations performed as part of the evaluations will not include vessels with lengths less than 15 m; this is, however, assessed not to have significant influence on the overall conclusions.

The fishery pattern along the NSP2 pipeline, which automatically will include the International Council for the Exploration of the Sea (ICES) sub-rectangles crossed by the NSP2 pipelines, is proposed to be recorded for the period 2012 – 2019 for the baseline situation and 2020-2022 for the operational phase.

The fishery pattern is described in terms of:

- Density plots for calculated bottom trawling and bottom net fishing;
- Calculated number of fishing boats trawling across the pipeline (Line A and Line B) per KP.

6.4.4.2 Fish catch along the NSP2 pipelines

The fish catch pattern is evaluated based on logbook data. Logbook recordings and reporting to authorities are compulsory for EU fishing vessels with lengths greater than 10 m. Each logbook includes specifications concerning the fishing boat, fishing gear used; ICES sub-rectangle for fishery, location (geographic coordinates) for net fishery or set point for trawling and catch size. Since only catches from vessels longer than 10 m are subject to registration, the calculations performed as part of the evaluations do not include vessels below 10 m; this is, however, assessed not to have any significant influence on the conclusions.

It should be noted that the reference coordinates from the logbook recordings cannot be correlated to the previously described VMS data recordings. Thus, it is only the set point for trawling and not the specific trawling route which can be assessed.

Fish catch along the NSP2 route, that automatically will include the NSP pipelines, is proposed to be extracted from the period 2012 – 2019 for the baseline situation, and from 2020 – 2022 for the operation period.

The fish catch pattern is described in terms of:

- Data extraction from the corridor around the pipeline route, both as a total and in sections. The corridor width is proposed to be ± 5 km from where data is extracted.

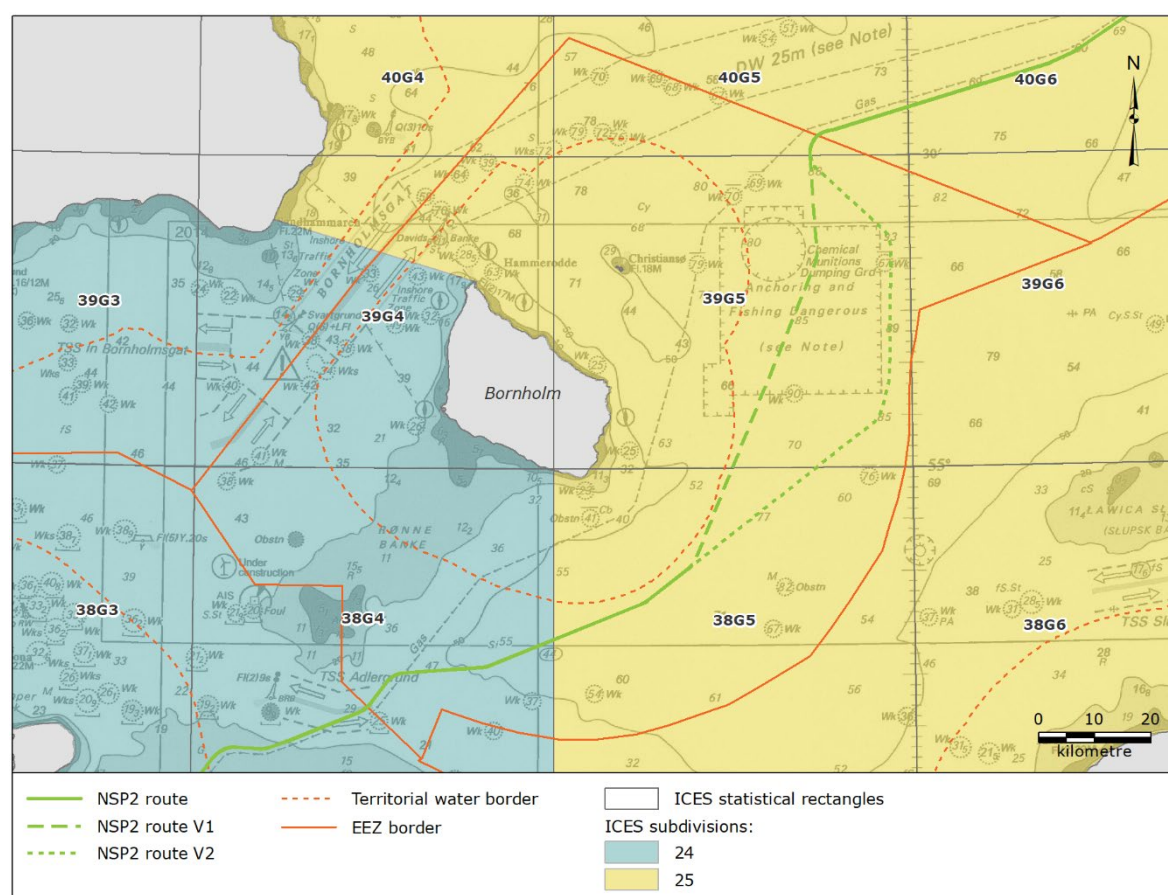


Figure 6-5 The ICES rectangles along and adjacent to the NSP2 route. In Danish waters the pipeline route crosses the following ICES statistical rectangles: 38G4, 38G5, 39G5 and 40G5.

6.5 Munitions (conventional and chemical munitions)

6.5.1 Purpose

The purpose of the monitoring programme for munitions in Danish waters is to document that identified munitions objects are not disturbed during the construction or operation of NSP2.

6.5.2 Experience and lessons learnt from Nord Stream

In Denmark, the detailed munitions surveys conducted by Nord Stream AG prior to pipeline installation led to the discovery of seven chemical munitions objects east of Bornholm. The Danish Navy assessed these objects and it was agreed that the chemical munitions should be left on the seabed and not disturbed during installation of NSP. During installation of both Line 1 and Line 2, this was ensured by using a controlled pipe-lay with monitoring by remotely operated vehicle (ROV).

Nord Stream AG agreed with the Danish authorities on an environmental monitoring programme for Denmark. Monitoring of the seven chemical munitions objects was included as part of the programme. The munitions monitoring was carried out as a visual inspection by ROV before and after pipeline installation. The inspections served to evaluate whether any disturbance had occurred to the chemical munitions objects during pipeline installation.

Post-lay munitions monitoring for Line 2 was conducted in the summer of 2012, and the results of the monitoring were that no munitions were impacted from the pipeline installation.

6.5.3 Scope of NSP2 survey

The baseline munition surveys for the NSP2 route and both route variants, NSP2 route V1 and NSP2 route V2, were finalised in the beginning of 2019. Reporting of the UXO survey covering the NSP2 pipe-lay corridors and the intervention works footprint is being finalised as of Q2-Q3 2019, and the early results identify munitions finds on both route variants /1/. The routing has been adapted to safely accommodate the all found munitions along the NSP2 routes, i.e. a minimum offset distance to the pipelines, with the exception of an identified line of ground mines (explosive charge in the order of 800 kg per mine), which traverses the complete corridor of the NSP2 route V2. The required remedial actions will be agreed in consultation with the appropriate Danish authorities.

Such actions under consideration include one or a combination of the following:

- Rerouting, potential reroute has been surveyed and is being assessed by engineering.
- Relocation of individual munitions to a permanent storage location on the seabed outside the influence of the pipeline corridor, which is yet to be agreed with the competent Danish authority.

Before pipe-lay (pre-lay survey), after pipe-lay (as laid survey), and during operation, munition surveys are planned to be carried out for both Line A and Line B. Dedicated monitoring of munitions found along the route shall be discussed and agreed upon with the Danish authorities/Danish Navy.

6.5.3.1 Monitoring area

Monitoring of potential munition objects, including new objects (identified as chance finds during construction and operation) will be undertaken along the entire route of the NSP2 pipelines in Danish waters.

6.5.4 Methodology

As stated above, the routing has been adapted to safely accommodate the all found munitions along the NSP2 routes, i.e. a minimum offset distance to the pipelines, with the exception of an identified line of ground mines (explosive charge in the order of 800 kg per mine), which traverses

the complete corridor of the NSP2 route V2. The required remedial actions will be agreed in consultation with the appropriate Danish authorities.

Since there are no known munitions along the routing of the proposed NSP2 route with V1, the focus of the monitoring, should this route be selected, will be objects identified as chance finds during construction and operation. Given the presence of the ground mines along the complete corridor of the NSP2 route V2, should the combination of the NSP2 route with V2 be selected, the focus of the monitoring will be on the status of the previously identified line of ground mines that traverses the NSP2 route V2 corridor, as well as new objects identified as chance finds during construction and operation.

A visual and sonar pre-lay survey will be undertaken prior to the laying of the pipelines to ensure that the routes are clear of any debris and natural or man-made hazards. The ROV pre-lay survey will include a single run along the proposed pipeline route using a combination of video, multibeam and sonar, where the ROV sonar will be configured to provide high resolution coverage for approximately ± 40 m to also detect potential hazards directly outside the pipeline corridor. No contacts will be touched or (re)moved. Major observations (as munition findings) will be reported instantly, where a major observation is one that may require a route deviation or removal outside the capabilities of the spread /5/.

The ROV support vessel will carry out an ROV as-built survey of the pipelines and surroundings as soon as practically possible. Major anomalies, such as munition findings, observed during the lay-operation or during the as-built survey will be reported instantly /5/. Figure 6-6 shows an illustration of an ROV inspecting a munitions object, and an example of a monitored munition object on the seabed.

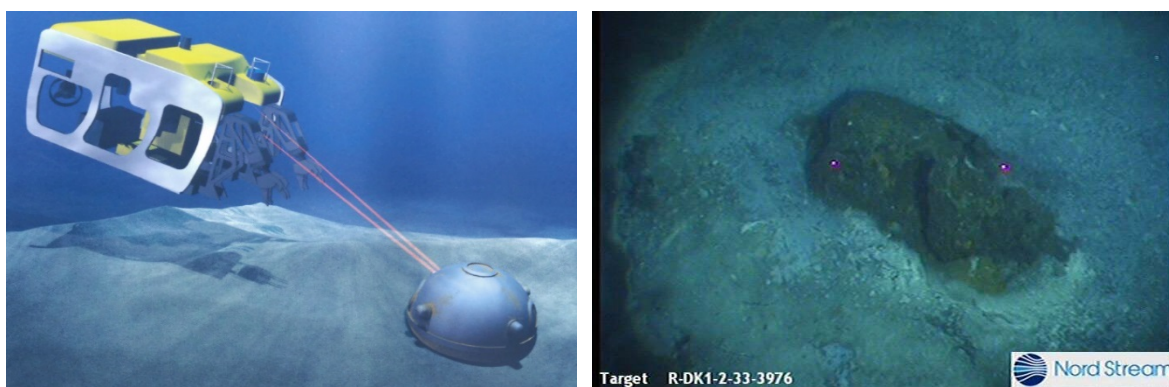


Figure 6-6 Left: Inspection of a munitions object with ROV. The method was used for the monitoring of chemical munitions objects in Danish waters. Right: Example of munition object, showing a chemical mustard gas bomb with heavily corroded casing.

6.6 Chemical warfare agents in sediment

6.6.1 Purpose

Construction of NSP2 pipeline may result in mobilisation and dispersion of seabed sediments and associated CWA. The NSP2 route V1 crosses the area where bottom trawling, anchoring and seabed intervention works are discouraged due to the risk of encountering chemical munitions. No seabed intervention works are anticipated in this area; only pipe-lay is planned. The NSP2 route V2 does not cross the discouraged area. However, contaminated with CWA seabed sediments may also be present outside of the discouraged area. Dispersed CWA may pose risk to the marine environment causing toxic effect either through direct exposure or through bioaccumulation/food chain.

The purpose of the monitoring programme for CWA in Denmark is to document changes in the levels of CWA in seabed sediments due to project activities resulting in the disturbance of contaminated sediment and confirm the conclusion of the EIA that there is no risk to the marine environment associated with CWA disturbance.

6.6.2 Experience and lessons learnt from Nord Stream

No intact CWA were detected over the course of the NSP monitoring programme, and concentrations of detected CWA degradation product residues, i.e. Adamsite (DM), phenyldichloroarsine (PDCA), Clark I and II and a degradation product from trichloroarsine (TCA), were low and comparable between sampling years.

In the assessment, the risk to the fish community was defined by the risk quotient (RQ). As long as the RQ remained below 1, no effect on the exposed fish community was expected. The calculated total CWA risk from suspended sediment with CWA residues was calculated to be a maximum of $RQ = 0.0001$, significantly below 1. Thus, the impact on the marine environment caused by the NSP construction works was insignificant to non-existent.

On the basis of the monitoring results, it has been concluded that seabed intervention works did not cause any significant or long-term negative impacts on the levels of CWA in seabed sediment that could have had an effect on local fish communities.

6.6.3 Scope of NSP2 survey

Nord Stream 2 AG shall document changes in concentrations of CWA in seabed sediments prior to start of construction and after construction is completed. This would allow the assessment of whether construction activities resulted in disturbance of contaminated seabed sediments associated with dumped chemical munitions.

Seabed sediments shall be collected along the NSP2 route and concentrations of defined CWA shall be measured. Associated measurements in the water column at the sampling stations shall be made as described in section 6.6.4.

Monitoring of CWA in seabed sediments was performed prior to start of construction in 2018-2019. Seabed sediments were sampled at 43 stations along the NSP2 route V1 / NSP2 route V2 (see Figure 4-2) and analysed for the presence of CWA and their degradation products. Measurements in water column (salinity, oxygen concentrations, temperature) were conducted throughout the water column at the monitoring stations.

Monitoring of CWA in seabed sediments after construction shall be performed after all construction activities in the Danish waters are completed (planned for Q3-Q4 2020).

6.6.3.1 Monitoring area

Monitoring of CWA in sediment will be undertaken along the entire route of the NSP2 pipelines in Danish waters. The locations of the monitoring stations will coincide with the CWA survey stations used in the 2018 and/or 2019 baseline monitoring campaign (see Figure 6-7), depending on whether the NSP2 route with V1 or V2 is permitted.

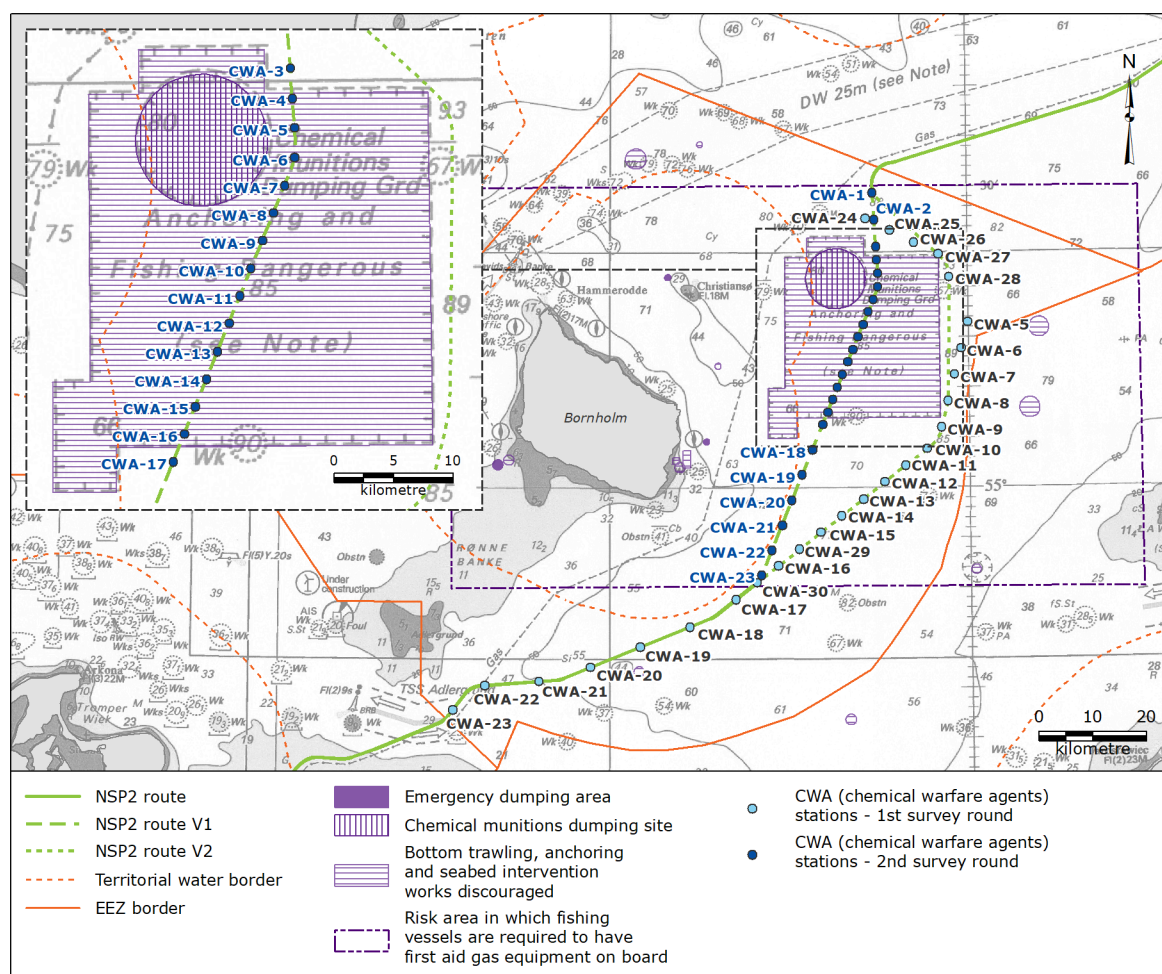


Figure 6-7 CWA survey stations along the NSP2 route V1 and V2 in the Danish EEZ /1/. Post-construction monitoring will be performed along either V1 or V2, depending on which route is permitted.

6.6.4 Methodology

Sampling and analysis of CWA in seabed sediments shall be conducted at the same stations and following the same methodology as during the baseline surveys conducted along the NSP2 route, so as to allow for direct comparison of the results. Post construction monitoring shall only take place on the stations of the final approved route, i.e. at approx. 2.5- to 5-km intervals along the NSP2 route V1 / NSP2 route V2 (depending on the final route selection) and at approx. 10-km intervals along the remaining, western part of the route.

Seabed sampling will be performed with either a HAPS core sampler or a Van Veen sampler and a video system (see Figure 6-8).

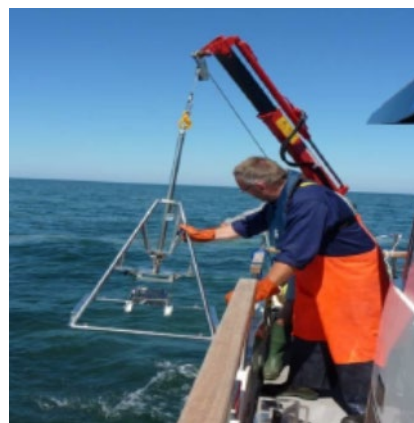


Figure 6-8 Sampling of the surface sediment will be undertaken using a video camera (left) and either a HAPS core sampler (right) or a Van Veen sampler.

The video system will allow for observation of seabed conditions along a 25-50 m transect and avoidance of potential UXO. One sediment core of up to 30 m depth will be collected with the sampler from each station and will be photographed and described in terms of composition, colour, odour, and depth of oxidised surface layer onboard the survey vessel. Oxygen concentrations in the seawater at 1 m above the seabed will also be measured at each sampling station.

Subsamples of the uppermost 5 cm will be taken from each core and approximately 100-150 ml will be transferred to two plastic containers. The subsamples will be subsequently deep-frozen, and one set will be transported to the accredited laboratory VERIFIN for analysis for the following parameters:

- Sulphur mustard (H)
- Thiodiglycol (TDG)
- Thiodiglycol sulfoxide
- 1,4-Dithiane
- 1,4-Dithiane oxide
- 1,4-Oxathiane
- 1,4,5-Oxadithiepane
- 1,2,5-Trithiepane
- Adamsite (DM)
- 5,10-Dihydrophenarsazin-10-ol 10-oxide
- Clark I (DA)
- Clark II (DC)
- Diphenylarsinic acid
- Diphenylpropylthioarsine
- Triphenylarsine (TPA)
- Triphenylarsine oxide
- Phenylchloroarsine (PDCA)
- Phenylarsonic acid
- Dipropyl phenylarsonodithioite
- α -Chloroacetophenone (CN)
- Lewisite I (L1)
- Dipropyl (2-chlorovinyl)arsonodithioite
- Lewisite II (L2)
- Bis(2-chlorovinyl)arsinic acid
- Bis(2-chlorovinyl)propylthioarsine
- Tabun
- Trichloroarsine (TCA).

6.7 Cultural heritage

6.7.1 Purpose

Pipe-lay, anchor-handling, post-lay trenching and rock placement could damage cultural heritage objects (CHO) or make them inaccessible for archaeological investigations.

The purpose of cultural heritage monitoring programme in Danish EEZ would be to document the condition of confirmed CHO that are close to/relatively close to the planned NSP2 pipeline to verify that construction of NSP2 has not affected CHO.

6.7.2 Experience and lessons learnt from Nord Stream

Nord Stream AG agreed with the Danish authorities on an environmental monitoring programme for Denmark. The monitoring programme for NSP included visual inspection of two wrecks located closest to the pipeline. The monitoring was carried out as a visual inspection with a ROV before and after pipeline installation, as well as during operation of the pipeline. The inspections served to evaluate whether wrecks have been disturbed or otherwise affected by the installation of the pipelines or any other activity related to the presence of the pipelines.

During installation of NSP, protection zones with a radius of 200 m were established and respected around a number of cultural heritage locations, as agreed with the Danish Agency for Culture and Palaces and the Viking Ship Museum. During installation of Line 1, 27 of such exclusion zones were established and respected. During installation of Line 2, this number was reduced to 17, as the Viking Ship Museum concluded that 10 of the locations were of no interest with regard to cultural heritage.

Wreck monitoring was conducted:

- After construction of Line 1 and prior to construction of Line 2 in January 2011;
- After construction of Line 2 in July 2012;
- In September-November 2014, to determine the status of the wrecks on the seabed and to assess any possible disturbance to the sites since the previous survey.

The post-lay wreck monitoring surveys from 2011 and 2012 showed that neither of two wrecks relatively close to the NSP pipeline in Danish waters was affected by the installation of NSP. The comparison of the images obtained during wreck inspection conducted in 2014 against images from the survey carried out in 2012 indicated that the presence of the pipeline on the seabed does not cause disturbance of the wrecks.

6.7.3 Scope of NSP2 survey

Investigations aimed at identification of potential CHO along the proposed NSP2 route, the NSP2 route V1 and the NSP2 route V2 have been completed in 2019. Surveys included examination of the seabed with multibeam echo sounder (MBES), side-scan sonar (SSS), sub-bottom profiler and magnetometer. Visual inspections with a ROV allowed confirmation of the finds.

Results of NSP2 surveys have been assessed by the relevant Danish authorities. The Danish Agency for Culture and Palaces has concluded that none of the identified objects require dedicated monitoring before, during or after construction.

If new findings are identified as chance finds during construction and operation of the NSP2 pipelines, the finds will be reported to the relevant Danish authorities to define monitoring requirements. The need for further inspections, establishment of exclusion zones and the need for monitoring will be agreed in consultation with the Danish Agency for Culture and Palaces.

6.7.3.1 Monitoring area

The monitoring area along the NSP2 route depends on the locations of confirmed CHO that require monitoring (identified as chance finds).

6.7.4 Methodology

Only chance finds identified during pre-lay survey may require dedicated monitoring since no CHO identified during previous surveys require monitoring, as agreed with the Danish Agency for Culture and Palaces.

If new CHO are identified as chance finds and monitoring needs to be undertaken, the methodology for monitoring will be agreed with the Danish Agency for Culture and Palaces. Generally, the following approach to the chance finds have been agreed with the Danish Agency for Culture and Palaces:

- Nord Stream 2 AG reports chance finds identified during the pre-lay survey to the Viking Ship Museum for assessment;
- The Viking Ship Museum makes a recommendation to the Danish Agency for Culture and Palaces about the significance of the new find;
- The Danish Agency for Culture and Palaces instructs Nord Stream 2 AG on how the new find shall be treated; e.g. if the find can be archived based on sufficient information collected during the pre-lay survey, or whether further actions, including monitoring, are needed.

Should monitoring of confirmed CHO be needed, it is anticipated that it will follow the same approach that was used during NSP project. Monitoring will include geophysical investigations and visual inspections before and after construction. If required, monitoring will be performed during operation of the pipeline.

6.8 NSP2 pipelines footprint

6.8.1 Purpose

The purpose is to document and calculate the area of the seabed occupied by the NSP2 pipelines and associated structures, and to document physical loss and physical disturbance of the different habitat types crossed by the NSP2 route inside Danish waters. Habitat types along the NSP2 route will be defined based on /6/, /7/.

6.8.2 Experience and lessons learnt from Nord Stream

Calculations of the seabed area occupied and directly impacted by the NSP pipelines and associated structures (arising e.g. from post-lay trenching and rock placement) and indirectly affected (by deposition of remobilized sediments) along the NSP pipelines inside Danish waters yielded a total area of <5 km² /8/.

6.8.3 Scope of NSP2 survey

Post-lay monitoring and documentation of the seabed area occupied and impacted by the NSP2 pipelines (physical loss and physical disturbance) will be undertaken in 2020 and reported in 2021.

Monitoring will be part of as-built surveys to document the footprint of the pipelines/associated structures and to document physical loss and physical disturbance of the overall habitat types.

6.8.3.1 Monitoring area

The monitoring area includes the entire NSP2 pipeline section (Line A and Line B) inside Danish waters.

6.8.4 Methodology

Monitoring will include a combination of ROV-, SSS – and/or MBES surveys, which would provide sufficient information to document the footprint of the pipelines/associated structures and to document physical loss for the overall habitat types. An illustration of the interpreted MBES data that will be used for the assessment of the pipeline footprint is shown in Figure 6-9 below.

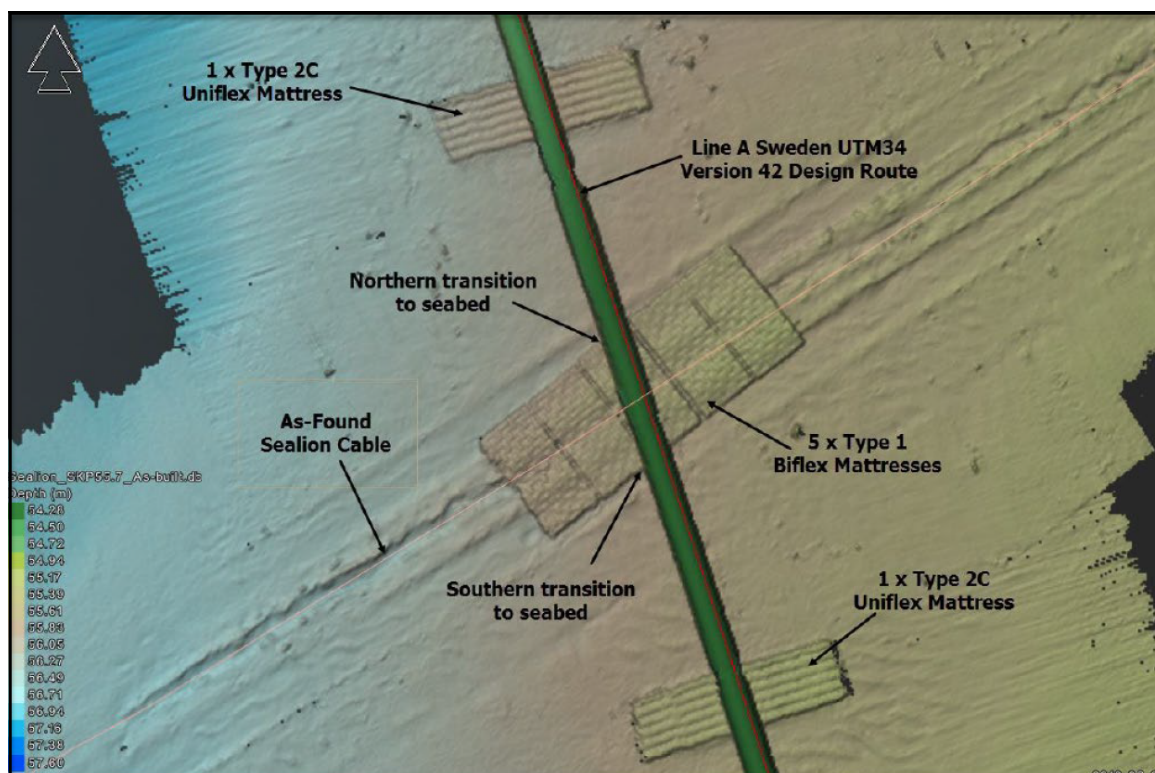


Figure 6-9 Illustration of the interpreted MBES data that will be used to assess the pipeline footprint. This image shows the area of the Sea Lion cable crossing.

The definition of the habitats along the NSP2 route inside Danish waters will be based on surface sediment composition, seabed morphology, depth, current, salinity, temperature and oxygen condition, as described in/and according to /6/, /7/. The results of environmental baseline surveys performed in 2018-2019 will be taken into account. Calculations of the pipeline footprint and the loss and physical disturbance of overall habitats will be made based on the as-built survey results and the seabed sediment types along the NSP2 route.

7. TECHNICAL INSPECTIONS DURING OPERATION

In addition to environmental monitoring, regular inspection surveys of the pipeline system will be carried out as part of the inspection, maintenance and repair (IMR) programme throughout the operational phase. The main goal of the inspection surveys is to ensure the safe and reliable operation of the pipeline system throughout its lifetime.

Before the start of operation of the pipeline system, an Inspection and Monitoring Strategy has been developed. It describes the main types of inspections, their requirements and frequency. All inspection requirements identified during the design phase as affecting the overall pipeline integrity (safety and reliability) during operation are covered by the Inspection and Monitoring Strategy.

Four types of inspections are planned for the entire route of the NSP2 pipelines from Russia to Germany:

- External offshore inspection for the main marine section of the system (depths greater than approximately 15 m);
- Internal inspection over the full pipeline length (from the pig-trap in Russia to the pig-trap in Germany).
- Shallow water and onshore inspection surveys, using geophysical surveys of the buried sections (Russia and Germany) – not performed in Denmark;
- External inspections of the exposed onshore sections (Russia and Germany) – not performed in Denmark.

7.1 External offshore inspection

External offshore inspection will evaluate the pipeline/seabed configuration and the external condition of the pipelines. This inspection survey will be executed from a survey vessel equipped with ROVs or autonomous underwater vehicles (AUVs) equipped with visual, acoustic and electro-magnetic survey tools. During offshore external inspections, the following information is obtained:

- Damage to the pipelines e.g. to concrete coating and field joints;
- Damage to pipeline support structures e.g. rock berms and cable crossing support mattresses;
- Damage or depletion of anodes and deficiencies of cathodic protection;
- Significant movement of pipelines, in particular if movement is outside of the installation corridor or outside the defined lateral movement acceptance criteria;
- Locations where rock placement must be carried out as a remedial action to support the pipeline, based on the survey inspection information;
- Possible new objects (UXO, CHO or other) and targets within the pipeline installation corridor;
- The location and condition of wrecks and barges in the vicinity of the pipelines;
- The location of munitions in the vicinity of the pipelines.

All collected data are compared with previous surveys and annual inspection surveys to allow comparison to the design and as-built condition. Historical trending is used to assess the development of such items as free spans, seabed scour, areas prone to damage, and consumption and physical loss of anodes (prediction of anode wastage).

7.2 Internal inspection

Internal inspection is executed with internal pipeline guides. During pipeline internal inspections, potential local anomalies in the pipeline geometry are detected with pipeline inspection gauges (pigs):

- Pipe internal or external metal losses (wall thickness anomaly) e.g. due to corrosion;

- Individual wrinkles (internal diameter anomaly);
- Out-of-roundness (ovality) dents;
- Change in the curvature of the pipelines (bending).

The frequency and the starting date of each subsequent inspection will depend on the results of the previous inspection surveys.

The Inspection and Monitoring Strategy also provides special inspections in case of any unexpected events which may impair the safety and reliability of the system. If the pipeline parameters are discovered to deviate critically from the design limits in any of the inspections, an appropriate maintenance or repair programme will be implemented.

8. REPORTING

8.1 General

The monitoring results and conclusions of the environmental impacts associated with construction and operation of the pipelines will be presented in reports for the period 2018 - 2022. The annual reports will be provided to the authorities the Q2 of the following year (period 2021– 2023).

The annual reports will include the construction/inspection and maintenance activities, and results from the specific monitoring programmes, see Table 8-1. Specific monitoring reports for each monitoring activities will be made available if requested. The reporting schedule as presented as Table 8-1 shall be agreed upon with the Danish authorities.

The specific monitoring reports and the annual report summarise the monitoring results from all monitored activities for each monitored parameter. In the annual report, the significance of environmental impacts is assessed and discussed based on monitoring results of each specific monitoring programme. The results will be compared with the monitoring results received during a similar gas pipeline project (NSP) in the same sea area in the Danish waters.

Reports will be prepared in English. The reports will be submitted to the supervising authorities for each calendar year 2021 – 2023 (for relevant monitoring activities).

Unexpected events and chance finds will be reported immediately.

Table 8-1 Overview of each specific monitoring programmes, including timing for the planned monitoring and for completion of monitoring reports.

Reporting from monitoring programmes ¹		
Monitoring programme	Monitoring carried out (period)	Reporting (period)
Water quality	Q1 – Q2 2020 (Line A) Q1 2020 (Line B)	2021 (Lines A + B)
Maritime traffic ²	2020 (Construction)	2021 (Construction)
Commercial fishery ²	2012 – 2019 (Baseline) 2020 – 2022 (Operation period)	2021 (Baseline + After construction) 2023 (Impact operation)
Munitions ³	2018 - 2019 (Before construction) 2020 (After construction)	2021 (After construction ⁴)
Chemical warfare agents in sediment	2018 – 2019 (Baseline) 2020 (After construction)	2021 (Baseline + After construction)
Cultural heritage ³	2018 – 2019 (Before construction) 2020 (After construction)	2021 (Before construction + After construction)
Pipeline footprint	2020 (Construction)	2021 (Construction)
1: Based on the time schedule in Section 5.2 and to be agreed upon with the Danish authorities. 2: Depending also on the availability of data from authorities. 3: Control and documentation by NSP2 contractor that possible munitions objects/CHO will not be impacted during pipe-lay, post-lay trenching/spot rock placement. 4: Reporting will include both the status of munitions previously identified along the pipeline route (should the NSP2 route with V2 be selected) as well as new, confirmed munitions found as chance finds.		

9. REFERENCES

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- /7/ Miljøministeriet, Naturstyrelsen (Danish Ministry of Environment and Food, Nature Agency), 2014. Marin habitatkortlægning i de indre danske farvande 2014. Aarhus Universitet, GEUS.
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