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NORD STREAM GAS PIPELINE CONSTRUCTION AND OPERATION IN THE FINNISH EEZ

ENVIRONMENTAL MONITORING Q3/2010

RAMBØLL

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Environmental monitoring report Q3/2010

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CONTENT

APPENDICES

List of abbreviations and definitions

ADCP	Acoustic Doppler Current Profiler
AHT	Anchor Handling Tug
BHD	Backhoe Dredger
cm	centimetre
CTD	Conductivity, Temperature, Depth
DGPS	Differential Global Positioning System
dw	Dry Weight
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
FMI	Finnish Meteorological Institute
FNU	Formazin Nephelometric Units
FTU	Formazin Turbidity Unit
GoF	Gulf of Finland
GOFREP	Gulf of Finland Mandatory Reporting System
GVI	General Video Inspection
h	hour
HELCOM	Baltic Marine Environment Protection Commission
IMO	International Maritime Organisation
KP	Kilometre Point
l	litre
m	metre
m^3	cubic metre
MBES	Multibeam Echosounder
mg	milligram
MPSV	Multipurpose Support Vessel
N	Nitrogen
NTU	Nephelometric Turbidity Unit
O_2	Oxygen
P	Phosphorus
PSV	Pipe Supply Vessel
ROV	Remotely Operated Vehicle
s	second
TDM	Touch Down Monitoring (pipeline)
TSHD	Trailing Suction Hopper Dredgers
USBL	Ultra Short Base Line
ww	Wet Weight
Q2	Second quarter of a year from 1st of April to 31st of July
Q3	Third quarter of a year, from 1st of July to 30th of September
Q4	Fourth quarter of a year, from 1st of October to 31st of December
µg	microgram

1. SUMMARY

This report presents the results and preliminary findings of the environmental monitoring of the Nord Stream construction activities in the Finnish EEZ for the third quarter of 2010. The first quarterly Q2/2010 report was submitted to the authorities on 6th of September 2010. Ramboll Finland Oy has prepared this quarterly Q3/2010 report, based on the reports and the data received from Nord Stream and their contractors. The findings presented are preliminary. The final conclusions from the monitoring during 2010 will be presented in the annual monitoring report in spring 2011.

Activities that have been monitored in the Finnish EEZ during the third quarter (Q3 - July-September) of 2010 have been cable mattress installations and pipelay. Moreover, baseline water quality monitoring that started at the end of 2009 and pipelay undertaken during Q2/2010 (9 km) are also included in this quarterly report. Furthermore, sediment and benthos monitoring results from the monitoring activities for rock placement carried out during Q2/2010 are reported in this report. This is due to the relatively long processing time required for the analysis of the samples.

During Q3/2010 there were no storms (average speed >21 m/s) in the Finnish waters. Strong winds (average speed >14 m/s) were recorded in the northern Baltic Proper on 11 days, typically mainly in September and in the middle part of the Gulf of Finland on two days.

According to the pre-lay survey of the installation corridor from KP 123 to KP 489, the seabed bathymetry varies from the minimum depth of 41 m at KP 223 to the maximum depth of 183 m at KP 478. The only previously unidentified object detected during the pre-lay survey was a linear feature at KP 233.609, which has been interpreted as an unknown cable. Nord Stream is unaware of an active cable at this location and a further survey of the feature will be performed during the as-laid pipeline survey. Based on the as-laid survey of the pipeline from KP 350 to KP 498, it has been constructed in accordance with the permit provision, except over a length of 177 m, where the pipeline has been installed out with installation accuracy (maximum offset -8.51 m). The reason for this deviation was to ensure pipeline integrity by avoiding three boulders located within the installation corridor. As-laid pipeline profile is generally slightly deeper than predicted in the design. The total calculated as-laid post-lay rock volume is approximately the same as designed.

Pipelay with an anchored lay barge caused some minor increase in turbidity in the lowermost water layer at LAY2 monitoring station (KP 495), near the installation corridor. The highest peaks recorded by the fixed sensor, at a distance of 50 m from the pipeline alignment, were of the order 3-4 NTU. Increased turbidity values were not registered by the sensor at an offset of 800 m near the outer margin of the anchoring corridor. However, in the vessel monitored transect perpendicular to the pipeline, increased turbidity levels were recorded near the seafloor south of the pipeline. The highest value recorded was 37 NTU and the plume was located at a distance of 100-400 m from the pipeline. The most probable explanation for the increased turbidity is that the as-laid pipeline near this monitoring location was partly buried into soft bottom and the vertical movements of the embedded pipe at the same touchdown point during a 45 minute repair on *Castoro Sei*, during which the barge was stationary, may have brought the sediment into suspension. Minor increased turbidity (<10 NTU) was registered in the transect parallel to the pipeline to the north of the pipelay activities.

Concentrations of nearly all the heavy metals as well as the concentration of arsenic in the surface sediment along the monitored transect SED2 (KP 297) did not indicate any clear or statistically significant trend when compared to the background values taken before the rock placement. Concentration level of dioxins/furans was similar in the samples taken before and after the rock placement. Concentration of tributyltin (TBT- organotin compound) was relatively high both in pre and post samples, showing random concentration peaks along the transect locations. The TBT concentrations can be expected to be high near the fairways like the sampling area. It is also probable that in the surface sediment TBT is in the form of paint flakes or particles, which explains the random nature of the analysis results.

The natural small scale variability of the seabed and the prevailing oxygen conditions regulate strongly the presence of macrozoobenthos. Due to the mostly very poor oxygen conditions on the bottom the studied pre and post benthos samples from the transect BENT2 (KP 297) were practically lifeless excluding the furthest location from the rock placement area. Even here the abundance of macrozoobenthos was very low on both occasions.

Long-term monitoring of currents in the western (CONTROL1) and eastern (CONTROL2) parts of the Gulf of Finland showed that the current speeds were lower in the 10 meters water layer above the bottom, compared to the layer 10 meters below the surface. Average current magnitudes increased at CONTROL1 from 0.06 m/s to 0.09 m/s and at CONTROL2 from 0.06 m/s to 0.1 m/s. The highest recorded current magnitudes in the bottom layers of the stations were 0.37 m/s and 0.51 m/s, respectively. However, there were quite large variability in recorded values also in the lowermost layers. Current magnitudes increased towards the autumn. The quality of sea water near the bottom at the baseline monitoring stations did not differ from the values or trends that, at these depths, are typical during summer and early autumn in the Gulf of Finland. However, the differences in the eutrophication status in different parts of the Gulf (higher in the east) were seen in oxygen concentrations near bottom.

Dredging of the pipeline route at the Russian landfall during Q3/2010, some 27 kilometres away from the monitoring station in the Finnish waters near the Russian/Finnish EEZ border, did not cause any changes in water quality in this area.

2. INTRODUCTION

2.1 General

Nord Stream AG is constructing the offshore pipeline system to export gas from Russia to Germany through the Baltic Sea. The route starts in Vyborg, Russia, and passes through the Gulf of Finland and the Baltic Proper and makes landfall at Greifswald in Germany. The pipeline route passes through the Exclusive Economic Zones (EEZ) of Russia, Finland, Sweden, Denmark and Germany and enters the territorial waters (TW) of Russia, Denmark and Germany.

The total capacity of the two pipelines will be 55 billion m^3/year. The total length of the line is 1224 km of which 375 km (KP 123-498) passes through the Finnish EEZ. The average water depth of the section in the Finnish EEZ is approximately 88 m and the pipeline route is situated 20-30 km from the Finnish coastline. Works in the Gulf of Finland started in late 2009 with clearance of munitions along the pipeline route. The pipelay commenced in Sweden on 6th of April 2010.

The construction period for the first pipeline is estimated to last for approximately 1.5 years in the Finnish EEZ. Seabed intervention works along the route, including both pre-lay and post-lay activities, are carried out in campaigns throughout the entire construction phase. Pre-lay activities took around four months including the construction of the tie-in basement at KP 297. Post-lay activities will take place both before and after pressure testing. The pipeline system is designed to operate for at least 50 years.

In accordance with the granted water permit (*no. 4/2010/4*) Nord Stream is responsible for environmental monitoring and reporting during construction and operation of the pipeline. Monitoring and reporting of the collected data is executed by Nord Stream and their contractors. As environmental consultant Ramboll Finland Oy is preparing the quarterly and annual environmental monitoring reports covering the construction and operation phases. Ramboll reports are based on the reports and the data received from Nord Stream and their contractors.

This quarterly report Q3/2010 presents environmental monitoring results and preliminary estimations of the effects of pipeline construction activities in the Finnish EEZ. It is important to emphasize that these are preliminary findings. The final conclusions from the environmental monitoring activities during 2010 will be presented in the annual monitoring report that summarises the monitoring results from all monitored activities and for all parameters. Also comparison of the results for sediment spreading to those ones assessed by modelling and presented in the Environmental Impact Assessment (EIA) document and in the permit application will be included into the annual report.

The report covers the period from July to September 2010. However, some environmental monitoring activities started prior to this and these results are also presented in this report. Baseline (long term) water quality monitoring started already at the end of 2009. This data will be shown as a continuum in quartile reports. Benthos and sediment samples taken before and after pre-lay rock placement are reported in this Q3/2010 report, as the laboratory results were not available when Q2/2010 was reported. This includes also monitoring results of transboundary effects to Estonian waters, which are presented for information as an appendix 7. Furthermore, the results of water quality monitoring during the pipelay by the anchored lay barge in the Finnish EEZ that was performed during June and July will be included in this quarterly report.

2.2 Background

To optimize the route for the gas pipelines and to minimize environmental effects, an extensive assessment programme was carried out during the years 2005-2008. During the years 2007-2009 an environmental impact assessment (Espoo Report) was made, covering the whole length

of the pipeline. As part of the permitting process, the section of the pipeline route in the Finnish EEZ was assessed separately as a national EIA. The Finnish national EIA was delivered to the relevant authorities on the 6th March 2009 and on the 2nd July the coordinating authority, the Uusimaa Regional Environment Centre (since beginning of 2010 named Uusimaa Centre for Economic Development, Transport and the Environment), issued a statement that the document fulfilled the requirements in the EIA legislation. The assessment was updated according to the statement and project changes in the further permitting process after the submission of the EIA.

2.3 Permits and monitoring

2.3.1 Construction and operational permits granted

On the 5th November 2009 the Council of State granted an approval (*No. 678/601/2009*) to exploit the Finnish exclusive economic zone for construction of the pipeline (exploitation right) in accordance with regulations in the exploitation right consent. The decision was in its entirety enforceable regardless of appealing, unless otherwise decided by the appellate authority. Immediate enforcement made it possible to decide on a water permit matter on the basis of the Finnish Water Act. At present, the consent is lawful and binding.

On the 12th February 2010, the Southern Finland Regional State Administrative Agency granted a water permit (*No. 4/2010/4*) to Nord Stream AG for construction and operation of the Russia/Germany submarine natural gas pipeline in the Finnish EEZ. The permit allows the applicant to commence the work before the permit legally enters into force on the condition that Nord Stream AG issues a security deposit of 70 million Euros.

With its decision (*No. 83/2009/2*) on 2nd October 2009, the Western Finland Environmental Permit Authority granted the applicant a permit for clearing munitions in the Finnish EEZ.

2.3.2 Monitoring

The revision C2 of the "Baltic Sea Natural Gas Pipeline Environmental Monitoring Programme - Finland" /1/ for construction and operation of the pipelines within the Finnish EEZ, was approved by the decision *No. 4/2010/4* of the Southern Finland Regional State Administrative Agency on 12th February 2010.

The programme has been developed with the following objectives:

- To monitor that the pipeline is installed in accordance with the national permit conditions
- To confirm that the pipeline construction does not cause impacts not previously identified or has greater impacts than predicted
- To provide a basis for corrective actions, where required
- To document the recovery of the environment after construction
- To monitor that significant environmental effects will not be caused during operation
- To verify the findings in the permit application documents, including the modelling results used to predict environmental impacts

The "Monitoring Programme for Munitions Clearance in Phase 2 Finland" is attached to this programme as an Appendix 4. In addition, a separate “Monitoring Programme for Munitions Clearance Finland” was prepared for the munitions clearance in phase 1 and approved by the decision *No. 83/2009/2* of the Western Finland Environmental Permit Authority on 2nd October 2009.

Based on lessons learned during munitions clearance in 2009 and minor project changes after the decision *No. 83/2009/2* and *No. 4/2010/4* a proposal for specifying the “Monitoring Programme for Munitions Clearance Finland” and “Baltic Sea Natural Gas Pipeline Environmental Monitoring Programme - Finland” was submitted to the Centres for Economic Development, Transport and the Environment of Uusimaa and Southwest Finland on 21st April 2010. Furthermore, notifications according to permit provisions including implications to monitoring programmes have been made

to the Centres during the works in 2010. The Uusimaa Centre for Economic Development, Transport and the Environment has approved the proposed changes in a letter dated on 4th June 2010 (UUDELY/742/07.00/2010) and a letter dated on 23rd June 2010 (UUDELY/742/07.00/2010). Revision E of the "Baltic Sea Natural Gas Pipeline Environmental Monitoring Programme - Finland" /2/ and the revision G of the "Monitoring Programme for Munitions Clearance Finland" /3/ accommodate the approved changes.

Moreover, a "Transboundary Monitoring Programme Finland" /4/ for the monitoring of transboundary effects in the Estonian EEZ has been prepared and approved by the Consent No. 71 of the Estonian Ministry of Foreign Affairs on 7th June 2010.

This quarterly report focuses on the approved monitoring programme "Baltic Sea Natural Gas Pipeline Environmental Monitoring Programme - Finland" /2/ excluding its Appendix 4. Furthermore, monitoring of transboundary effects in the Estonian EEZ related to rock placement according to "Transboundary Monitoring Programme Finland" is presented as an Appendix for information. Monitoring based on the approved programmes for munitions clearance /3/ and /5/ as well as transboundary monitoring in the Estonian EEZ related to munitions clearance based on /4/ is presented in a separate report "Nord Stream Munitions clearance in the Finnish EEZ, Final monitoring results on Munition by munition basis".

Construction activities and the related monitoring targets according to the "Baltic Sea Natural Gas Pipeline Environmental Monitoring Programme - Finland" /2/ excluding Appendix 4 includes the following:

Activity	Impact target
Rock Placement	Seabed morphology, water quality and currents, cultural heritage, debris, existing infrastructure, sediment, benthos, HELCOM stations, commercial shipping and fishing
Cable mattress installation	Position of cable and condition of constructed crossings
Pipelay*	Seabed morphology, water quality, cultural heritage, debris, existing infrastructure, commercial shipping and fishing
Pre-commissioning**	Commercial shipping and fishing
Hyperbaric tie-in**	Commercial shipping and fishing
Dredging (in Russia)	Water quality (transboundary impact)

* includes anchor handling and thrusters wash
**not included in this Q3/2010 report

According to the permit (*No. 4/2010/4*) provision number 32:

- *The permit holder must monitor the project's effects on the state of the marine environment, and the recovery of the conditions.*

- *Monitoring must be carried out according to the monitoring programme (version C2, dated 8 February 2010) included as a supplement to the application. The monitoring plan may be further specified in the way accepted by the Uusimaa and Southwest Finland Centres for Economic Development, Transport and the Environment, provided that the changes to the plan do not weaken the reliability of the results or the coverage of the monitoring.*

- *In addition to what has been stated in the monitoring programme, the permit holder must monitor how the zinc dissolving from the corrosion protection zinc anodes affects the quality of the water and the seabed, and the biota at one zinc anode, as approved by the Uusimaa Centre for Economic Development, Transport and the Environment. Moreover, a one-off, measuring-based review must be carried out on the currents near the seabed in the vicinity of the pipelines. The monitoring programme and the review programme must be submitted to the Uusimaa Centre for Economic Development, Transport and the Environment by 30 June 2010.*

- *The results and summary of the monitoring must be submitted to the respective Centres for Economic Development, Transport and the Environment of Uusimaa, Southwest Finland, and Southeast Finland; the respective environmental protection authorities of the cities of Länsi-Turunmaa, Espoo, Hanko, Helsinki, Raasepori, Loviisa and Porvoo, and of the municipalities of Kemiönsaari, Inkoo, Kirkkonummi, Siuntio, Sipoo, Kökar, and Lemland annually by the end of February, and every quarter during the construction phase, and, when required, the results and summary must be presented to those whose rights or interests they may concern.*

- *Any unexpected events and findings are to be reported immediately.*

According to letter UUDELY/48/742/07.00/2010 during the construction of the pipeline the quarterly reports must be delivered to the authorities in English within two months after the end of each quarter. Finnish and Swedish versions should be delivered after three months.

The proposals for monitoring the effects of zinc released from one sacrificial anode and the one-off measurement based assessment of the bottom close currents have been submitted to the Centres for Economic Development, Transport and the Environment of Uusimaa and Southwest Finland on the 26th June 2010.

3. CONSTRUCTION ACTIVITIES DURING Q3/2010

Nord Stream's construction activities in the Finnish EEZ during Q3/2010 included rock placement, mattress installation and pipelay (Figure 3.1 and Appendix 1). Dredging activities at the Russian landfall have also taken place during Q3 and the transboundary impacts of this activity have been monitored in the Finnish EEZ. For this reason the dredging activity at the Russian landfall is described in this Section.

The implemented activities and the schedules described are based on information received from Nord Stream.

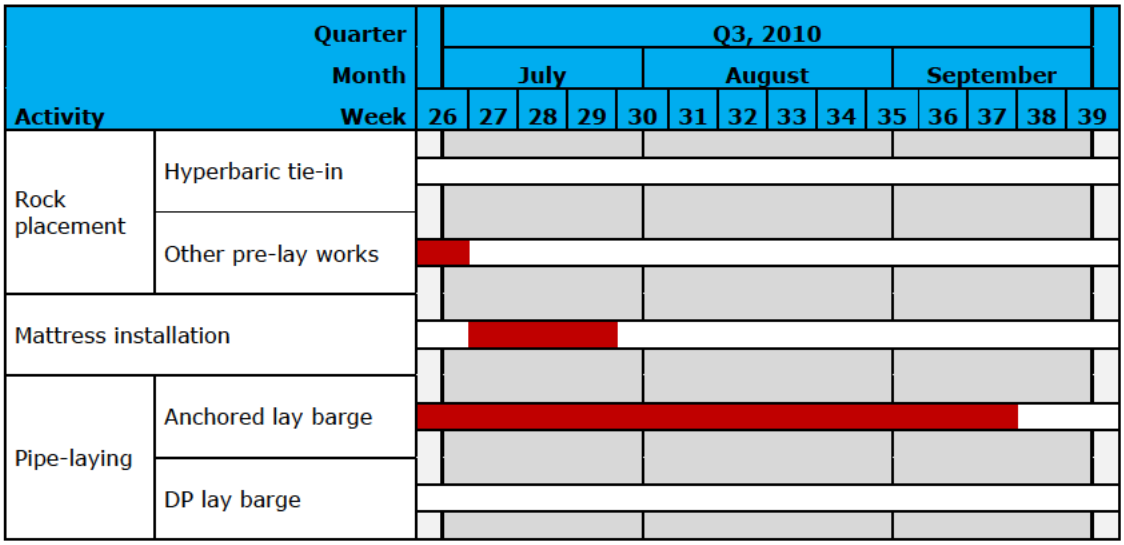


Figure 3.1 Construction activities during Q3/2010

3.1 Rock placement

Pre-lay rock placement in the Finnish EEZ was carried out during Q2/2010 along the pipeline corridors (north-west and south-east) and continued until 4th July 2010. This rock placement activity is already reported in Environmental monitoring Q2/2010 /6/.

3.2 Mattress installation

The Nord Stream pipelines cross cables at 24 locations on the seabed in the Finnish EEZ. As no mattresses will be installed for the six crossings of the UCCBF cable there will be a total of 18 cable crossings requiring protective concrete mattresses for the two pipelines (nine per pipeline). At crossings, concrete mattresses are installed to ensure that the pipeline does not come into contact with the cables and that the pipeline will not cause damage to the cable. Concrete mattresses are installed on top of (Type 1 mattress) or to either side of a cable (Type 2 mattress) in order to elevate the pipeline and to limit stress or vibrations (Figure 3.2).

Type 1 mattresses (6.0m x 2.5m x 0.3m) are multi-block concrete mattresses with rounded edges and are flexible in both directions. Type 2 mattresses (10.0m x 3.0m x 0.3m) are concrete beam mattresses and are rigid along the longer side.

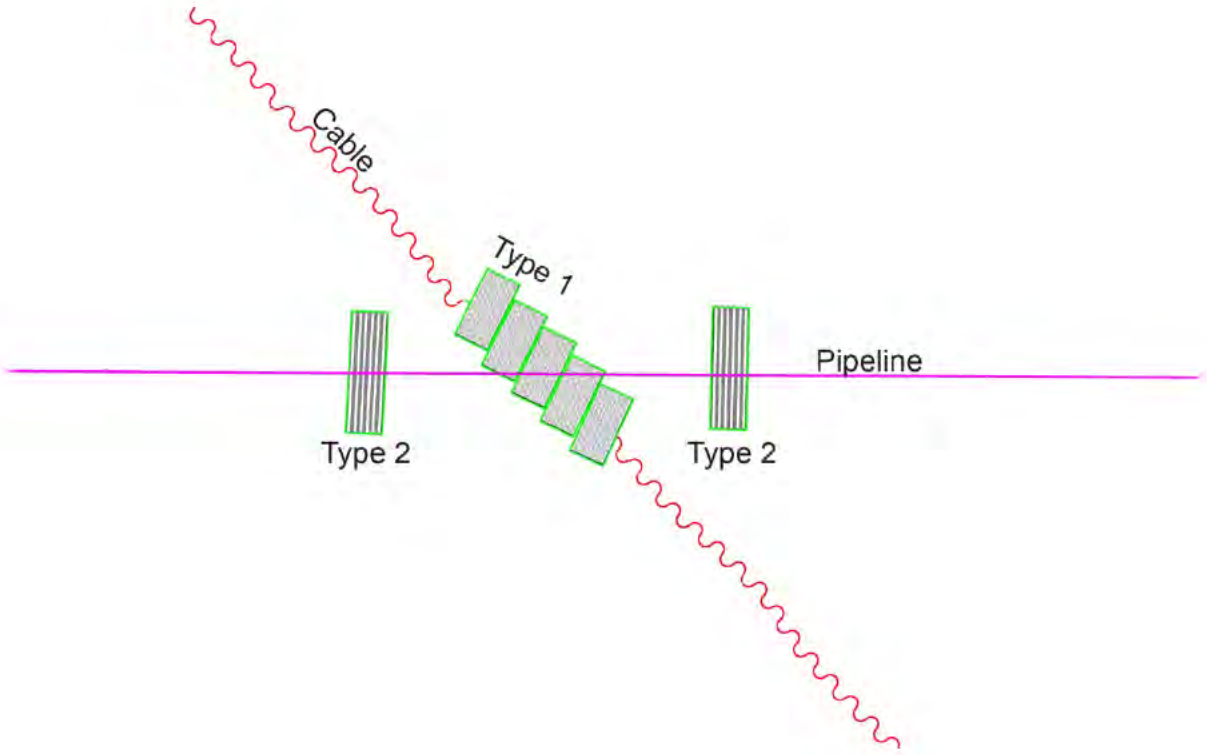


Figure 3.2 Schematic drawing of a typical arrangement of mattresses at a cable crossing /7/

Twenty-one concrete support mattresses for the three cable crossings were installed for the first pipeline (north-west). The mattresses were installed during Q3/2010, in July by the MPSV Far Samson (Table 3.1, Figure 3.3) /8-10/. Mattresses have been installed at all nine crossings of the first pipeline until the end of September 2010.

Table 3.1 Information on mattress installations during Q3/2010 /8-10/

Cable	KP			Number of mattresses installed Total (Type 1 + Type 2)	Installation date
FEC-2	216.199			7 (5+2)	10.-12.7.2010 18.-19.7.2010
EE-SF 2	218.226			7 (5+2)	9.-10.7.2010
EE-SF 3	238.040			7 (5+2)	19.7.2010

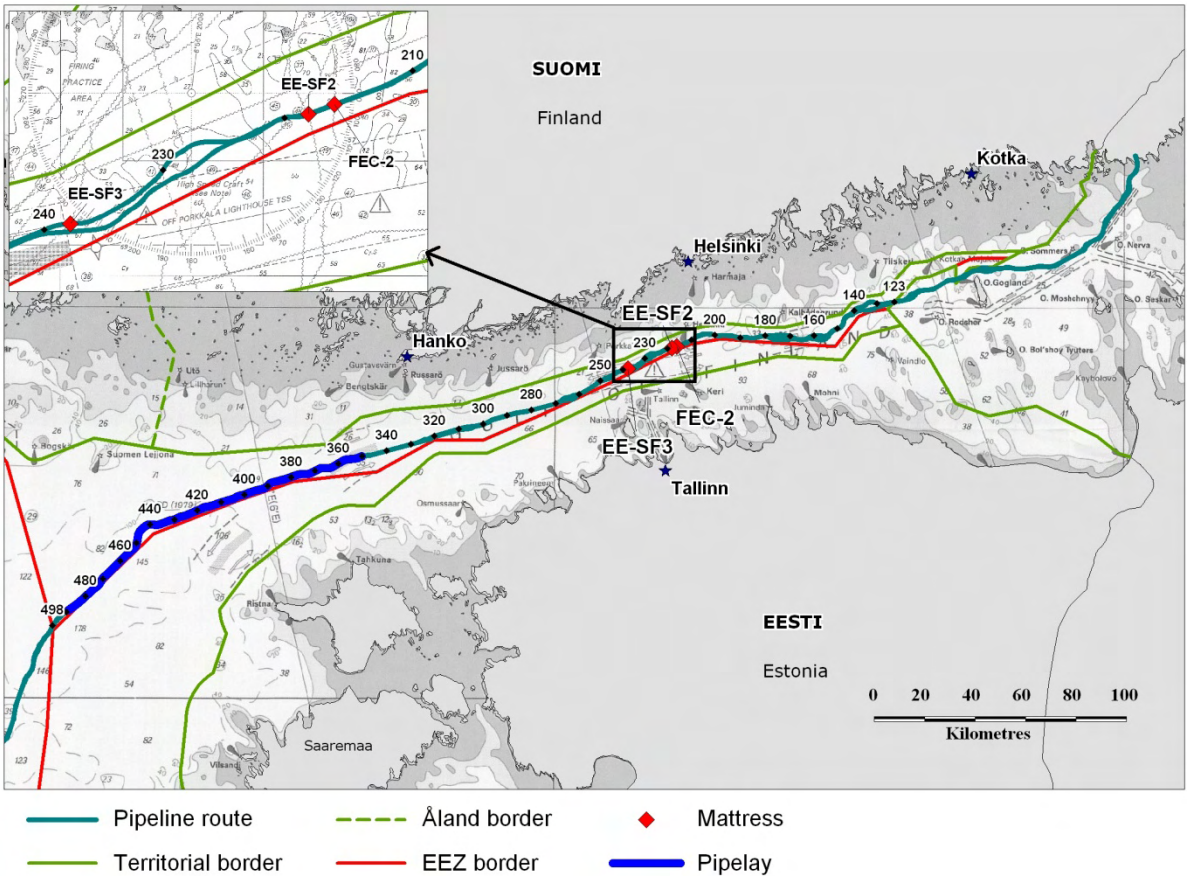


Figure 3.3 Locations of mattress installations and pipelay during Q3/2010

3.3 Pipelay

In the pipelay process individual pipe sections are transported by pipe supply vessels (PSVs) to the pipe lay barge, welded together onboard and lowered as a continuous string onto the seabed from the lay barge. The Nord Stream pipeline will be installed by two different pipe lay vessels in the Finnish EEZ. The *Castoro Sei* is an anchored lay barge and will lay the section from KP 498 to KP 350 for both pipelines. A dynamically positioned pipelay barge, *Solitaire*, will lay the remaining section, from KP 350 to KP 123 for both pipelines. *Solitaire* has started pipelay in the Finnish EEZ in October 2010.

Castoro Sei is a semi-submersible lay barge that floats on twin pontoons and uses 12 anchors for positioning. Three anchor-handling tugs (AHTs) are used for manoeuvring the anchors.

Castoro Sei started laying the first pipeline (north-west) in the Finnish EEZ during Q2/2010 and reached KP 489 by the end of Q2/2010. She continued pipelay in the Finnish EEZ until 18th July 2010 reaching KP 451, after which she left for Russia where she laid the Russian landfall section in July-August. *Castoro Sei* recommenced pipelay at KP 451 in the Finnish EEZ on 12th August 2010 and reached KP 350 on 20th September 2010 (Figure 3.3). /11/

For the section (KP 488 - KP 470), where pipeline route runs close to border of Estonian EEZ, two tugs ('live anchors') were used on the Estonian border side of the *Castoro Sei* (southeast from *Castoro Sei*) to avoid placing anchors within the Estonian EEZ. The two tugs were *Far Samson* and *Maersk Tackler*. This section of pipeline was installed between 2nd and 10th July. The nearest distance from pipeline route to Estonian EEZ border is about 280 m at KP 474 – KP 473. /11, 37/

3.4 Dredging at the Russian landfall

The necessity to bury the pipelines close to the Russian landfall location requires pre-trenching by means of dredging (underwater excavation). The types of dredgers used are backhoe dredgers (BHD), trailing suction hopper dredgers (TSHD) and land-based excavators. /12/

Dredging started during Q2/2010 and continued until 10th July. In Q3/2010 (from 1st July to 10th July) the excavated volume was 111,000 m^3 (see location of the dredging activity in Figure 4.6). /12/

4. MONITORING ACTIVITIES

This chapter describes the environmental monitoring activities performed during Q3/2010. Monitoring related to long term water quality monitoring, cable mattress installation, cable crossings, and pipelay with an anchored lay barge that were performed during Q3/2010. Sediment and benthos monitoring from Q2/2010 related to rock placement is presented in this report as the sampling results became available in Q3/2010. Monitoring targets and stations during Q3/2010 are presented in Table 4.1, Figure 4.1 and Appendix 2. A list of the equipment used is presented in Appendix 6. Monitoring activities have been conducted according to the monitoring programme /2/ unless stated otherwise.

Table 4.1 Monitoring activities during Q3/2010

Monitoring targets and stations during Q3/2010		
Water quality	CONTROL1	Long term monitoring
	CONTROL2	Long term monitoring
	FIX3	Transboundary monitoring during dredging in Russia
	LAY2	Pipelay with anchored lay barge
Sediment content	SED2*	Rock placement**
Benthos	BENT2*	Rock placement**
Benthos at HELCOM stations	LL5, LL6A and LL7 with two parallel stations x and y	HELCOM station monitoring related to pipelines on the seabed
Mattress installation	3 locations	Installation of mattresses on seabed for cable crossings
Cable crossings	2 locations	Monitoring of pipelay onto the cable crossings
Wrecks	S-10-3237	Pre-lay survey

* Relates to VOFIXIW1 for water quality monitoring

**Sampling was performed during Q2/2010, but as laboratory analyses were not available at the time of submission of the Q2 report the results are reported in this Q3 report

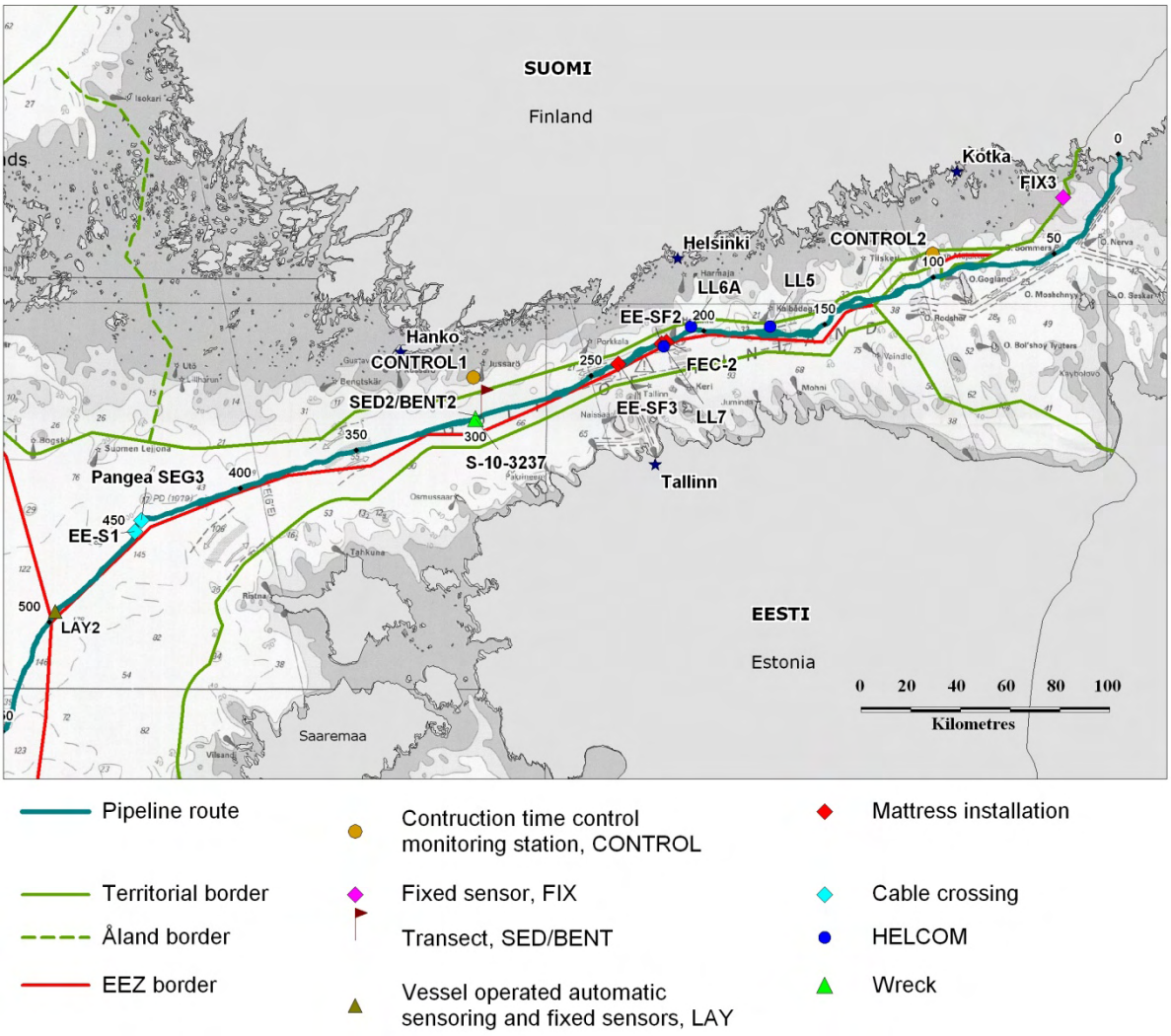


Figure 4.1 Locations of water quality, sediment, benthos and HELCOM monitoring stations as well as constructed cable mattresses, monitored cable crossings and wreck during Q3/2010 (Appendix 2).

4.1 Rock Placement

Monitoring of water quality and changes in seabed morphology related to rock placement has been presented in the Q2/2010 report. Sediment and benthos monitoring relating to the same rock placement activities are presented in this Q3 report. The rock placement at tie-in location was performed between 7th of April and 28th of June 2010. Sampling locations and timings at SED2/BENT2 stations are shown in Table 4.2 and monitored parameters and methods in Table 4.3. Monitoring equipment and methods are described in more detail in /13/.

Table 4.2 Sediment and benthos monitoring locations and timings related to rock placement activities in Q2 and Q3/2010 /13/

Location and timing of sediment and benthos monitoring for rock placement					
Station	Number of sampling site	Distance m	Rock berm / KP	Coordinates of sampling locations lat / long in WGS84	Sampling date
SED2 / BENT2	1	50	Tie-in / 297.3 Rock placed 7.4. – 28.6.2010	59°35,76´N, 23°32,55´E	pre 6.4.2010 post 2.8.2010
	2	100		59°35,78´N, 23°32,55´E	
	3	200		59°35,84´N, 23°32,55´E	
	4	400		59°35,95´N, 23°32,55´E	
	5	800		59°36,16´N, 23°32,55´E	
	6	1600		59°36,59´N, 23°32,55´E	
	7	3200		59°37,45´N, 23°32,55´E	

Table 4.3 Sediment and benthos monitoring parameters and methods for rock placement /2/ /13/

Sediment and benthos monitoring related to rock placement					
Monitoring target	**Parameter**	**Unit**	**Method**	**Location**	**Timing / frequency**
Sediment	Dioxins, organic tin compounds, As, Co, Cr, Ni, Zn, Cu, Pb, Cd, Hg and C_{tot}	mg/kg, µg/g	GEMAX	Transect SED2	Once before and once after rock placement, once after the completion of construction of the first pipeline and once after the completion of construction of the second pipeline (in total 4 times)
Benthos	Abundance of species and individuals, total biomass and oxygen concentration	ind./m², species/m² g ww/m² mg/l (oxygen)	Van Veen grab (ca 0.1 m²)	Transect BENT2	Once before and once after rock placement. Once a year during 3 years after construction (in total 5 times)

4.1.1 Sediment sampling

Sediment sampling has been carried out before and after rock placement along a transect line at SED2, which is related to the VOFIXIW1 station for water quality monitoring at the tie-in site (Figure 4.1). Sediment samples were taken with a GEMAX according to the approved monitoring programme /2/ from seven different locations along the transect line due north from the rock placement location at the tie-in site (Table 4.2 and Figure 4.2) /13/. The furthest locations (3,200 m from the rock placement site) served as control stations. From all sampling locations the samples were taken from the upper 0-2 cm sediment layer. In addition samples from 2-10 cm sediment layer was taken from the two nearest locations.

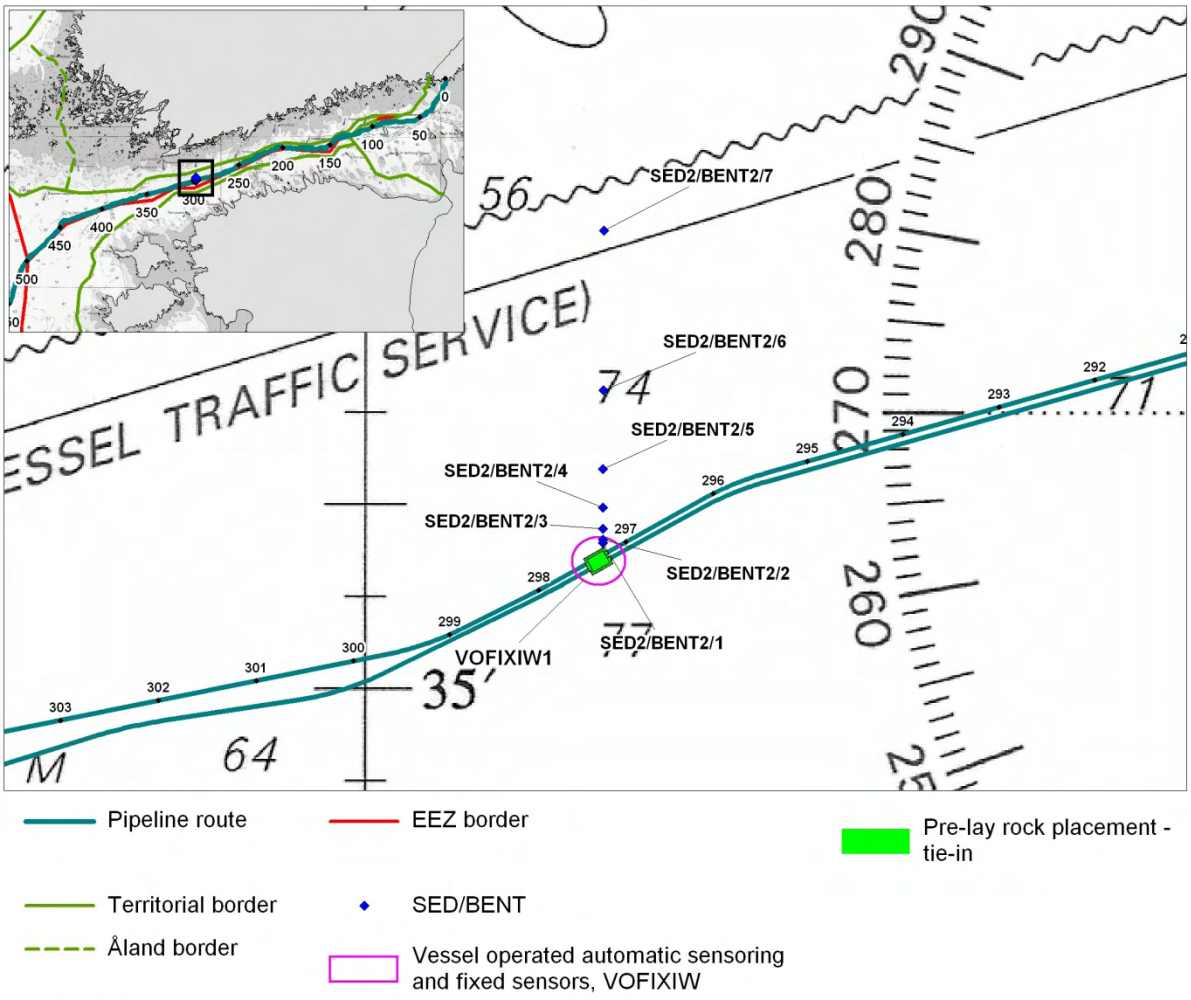


Figure 4.2 Locations of SED/BENT2 1-7 sampling sites

4.1.2 Benthos sampling

Benthos sampling has been carried out before and after rock placement along a transect line at BENT2, which is related to the VOFIXIW1 station for water quality monitoring at the Tie-in site (Table 4.4 and Figure 4.2). Samples were taken with a Van Veen grab at seven different distances from the rock placement site at the same locations as the sediment sampling (Chapter 4.1.1 and Table 4.2) according to the approved monitoring programme /17/. Three samples were taken at each site, which were studied separately. The monitoring equipment and methods are described in more detail in /13/. Samples were analysed for the abundance of species, number of individuals and total biomass. Oxygen concentration, salinity and temperature were measured just above the bottom at each sampling site.

4.2 Mattress installation

Concrete mattresses at three cable crossing locations were installed in the Finnish EEZ during Q3/2010. Locations of the cable crossings are presented in Chapter 3.2 (Figure 3.3 and Table 3.1).

A summary of the monitoring during the mattress installation is presented in Table 4.4. Timing of the mattress installation is presented in Table 3.1.

Table 4.4 Monitoring of cables during mattress installations /2/

Monitoring of the existing cables and the constructed crossings during Q3/2010					
Monitoring target	**Parameter**	**Unit**	**Method**	**Location**	**Timing**
Existing infrastructure (cables)	Position of cable and condition of constructed crossings	Coordinates, condition of crossing (intact, damage)	Visual inspection via ROV (plus cable tracker)	3 cable crossings	Immediately prior to and after crossing installation

Monitoring of cable crossings prior to and after the mattress installation has been performed by general video inspection with an ROV at each mattress installation site. Prior to installation the cables were located with an ROV equipped with a cable tracker by using a 50 m long runline along the pipeline route, after which the ROV followed the cable 50 m either side from the crossing point of the cable and route. Furthermore, five survey lines were undertaken at 5 m spacing (two to the south of the route and two to the north, and one along the pipeline centreline). Thereby the crossing point and the intended position of the mattresses were verified (Table 3.1). ROV and Ultra Short Baseline (USBL) transponders were utilized during the mattress installation. After the installation an as-built general video inspection (GVI) was made of the crossing structure. /8-10/

The monitoring equipment and methods used are described in detail in Appendix 6 and /8-10/.

4.3 Pipelay

Prior to pipeline installation the seabed morphology is monitored with an instrumented ROV along the pipeline installation corridor. During Q3/2010 this pre-lay survey has been performed between KP123 and KP 350 (Table 4.7). Prior to pipelay inspections of defined wrecks are also carried out. During Q3/2010 this inspection was performed to 1 wreck (S-10-3237) at KP 300. Water quality during pipelay with an anchored lay barge was monitored at one station (LAY2) approximately at KP 491-495. Pipeline touchdown monitoring (TDM) was performed in necessary sections to support pipelay with an instrumented ROV. After pipelay, post lay wreck inspections are carried out and an as-laid survey of the pipeline is performed. During Q3/2010 the as-laid survey was completed between KP 350 and KP 498, but no post lay wreck inspections were carried out - these will be performed in Q4 (Table 4.8).

A summary of the monitoring activities associated with pipelay is presented in Table 4.5. Timing of monitoring is presented in Table 4.6. More information about the used monitoring equipment is presented in Appendix 6.

Table 4.5 Monitoring of pipelay /2/. Numerical values for parameters marked with *italic* (related to pipe position) will be reported after the whole pipeline has been constructed. This table also includes some parameters which were monitored during Q2 but are reported in this Q3/2010 report.

Monitoring related to pipelay during Q3/2010					
Monitoring target	**Parameter**	**Unit**	**Method**	**Location**	**Timing**
Seabed morphology	Obstacles	Yes / no, location (E, N)	ROV instrumented with multi-beam echo sounder, sonar and video cameras	Pre-lay survey of KP 123 – KP 350 performed in Q3/2010*	Prior to pipelay (pre-lay survey)
	Seabed bathymetry	m (depth)			
	Rock berm – per design	m (height) m (E, N, depth)			
	Pipe position and condition	*m (E, N, depth)* intact/ damaged		As-laid survey of KP 350-KP 498 performed in Q3/2010	After pipelay (as-laid survey)
Water quality / anchored vessel	Suspended sediment, nutrients and contaminant dispersion, conductivity, depth and temperature	NTU (turbidity), µs/cm (conductivity), °C (temperature), and mg/l (oxygen)	Fixed sensors	1 sensor outside the pipeline installation corridor and 1 outside the anchor corridor (LAY2)	Planned: From 1 week before pipelay until 1 week after pipelay. Performed: 23.6. – 27.7.2010
	Water samples for oxygen, nutrient and metal analysis	mg/l and FTU (turbidity), mg/l (oxygen), µs/cm (conductivity) and µg/l (total and dissolved P and N, metals)	Water sampling for analysis	LAY2	During pipelay 30.6.2010
	Water samples and CTD-profile for the calibration	mg/l and FTU (turbidity), µg/l (total and dissolved P and N, metals) µs/cm (conductivity), °C (temperature), and m (depth)	Water sampling and CTD-profile for calibration	LAY2	During service/ recovery of fixed sensors 30.6.2010 27.7.2010
Cultural heritage, barrels and existing infrastruc-ture	Presence of new unknown objects	Yes no, location (E,N)	Visual inspection via ROV	Installation corridor along the entire pipeline length, KP 123-KP 350 inspected in Q3/2010*	Prior to pipelay (pre-lay survey)
	Position and integrity of cultural	coordinates, Intact / damage	Visual inspection via ROV	1 wreck (S-10-3237)	Prior to pipelay

Monitoring related to pipelay during Q3/2010					
	heritage				
	Position and condition of crossings	coordinates, Intact / damage	Visual inspection via ROV (plus cable tracker)	2 crossings inspected in Q3/2010	Pre-lay**, pipeline touchdown and post-lay

* Pre-lay survey of the installation corridor of pipeline 1 from KP 350 to KP 490 was performed already in Q2/2010, but is reported in this report, see section 6.3.1.
** Pre-lay survey of the crossings was performed already in Q2/2010, but is reported in this report, see section 6.3.1

Table 4.6 Summary of timing of monitoring related to pipelay in Q3/2010

Timing of monitoring related to pipelay in Q3/2010					
Station	**Vessel operated sensoring**	**Fixed sensors with turbidity sensor**	**Water sampling and CTD profile***	**Pre-lay survey**	**Post-lay survey**
Installation corridor / pipeline				KP 123 – KP 350 24.7. - 9.8.2010	KP 350 – KP 498 20.8.2010 – 22.9.2010
1 wreck (S-10-3237)				12.9.2010	
2 cable crossings (EE-S1, Pangea SEG3)					1-2.9.2010 23.9.2010
LAY2	30.6.2010	23.6.-27.7.2010	30.6.2010 27.7.2010*		

*CTD profile was taken during recovery of the instruments

4.3.1 Seabed morphology, obstacles and pipeline

Before pipelay the seabed bathymetry and presence of any obstacles within the installation corridor is surveyed with an ROV instrumented with multibeam echo sounder (MBES), sonar and video cameras (Table 4.7 and Appendix 6) /14/. The pipeline installation corridor survey extends +/- 7.5 metres either side of the centre line of the planned pipeline route.

The ROV was navigated along the pipeline route using Differential Global Positioning System (DGPS) and doppler aided USBL positioning. All significant targets within the installation corridor were investigated and a video of the target recorded. The ROV speed was typically maintained between 700 and 900 m/hr. During the close visual survey the scanning sonar was operated at a range scale of 20 m, to provide coverage across the installation corridor. Timing and KP interval for pre-lay survey are summarised in Table 4.7.

Table 4.7 Pre-lay surveys of the installation corridor during Q3/2010 /15-18/

Pre-lay surveys in the installation corridor during Q3/2010	
KP	**Timing of the surveys**
300 - 350	24.7. – 4.8.2010
270 - 300	30.7. – 4.8.2010
200 - 270	30.7 – 4.8.2010
123 - 200	4.8. – 9.8.2010

As-laid surveys are carried out on a section by section basis after installation of the pipeline (Table 4.8). The as-laid survey was undertaken by an ROV equipped with MBES, sonar and video cameras (Appendix 6). The MBES was used to survey of the pipeline to 10 m either side of the pipe (pipeline on seabed configuration). Adjacent targets were monitored with sonar. Video cameras were used for visual inspection of as-laid pipeline condition. With the as-laid survey the horizontal and vertical position of the pipeline and magnitude of freespans were measured. Also possible damage to pipeline, coating, anodes or field joints was inspected. The ROV speed during survey operations was typically 600-700 m/hour, and did not exceed 1,000 m/hour. In addition to as-laid surveys, during pipelay the pipe touch down to the seabed has been intermittently monitored with ROV /19/. Timing and KP interval for post-lay survey are summarised in Table 4.8. The method and equipment used are described in more detail in as-laid reports /20-25, 39/.

Table 4.8 As-laid surveys of the pipeline during Q3/2010 /20-25, 39/

As-laid surveys in the installation corridor during Q3/2010	
KP	**Timing of the surveys**
490 - 498	20.-21.8.2010
486 - 490	23.8.2010
415 - 486	6.-11.9.2010
390 - 415	14.-16.9.2010
380 - 390	20.- 22.9.2010
350 - 380	21.- 22.9.2010

4.3.2 Water quality

Water quality during pipelay at the LAY2 station has been monitored with vessel operated automatic sensoring, two fixed sensors with turbidity probe, CTD profile and water sampling (Table 4.5). The main water sampling was performed during turbidity monitoring from the vessel. CTD profile and two water samples were gathered during the recovery of fixed sensors. The two fixed sensors (LAY2 S1 and LAY2 S2) were located in a line perpendicular to the pipeline route at distances of 50 and 800 m to the North from the pipeline at KP 495 (Table 4.9 and Figure 4.3).

The vessel operated monitoring was performed along two transects, one parallel and the other perpendicular to the pipeline between KP 491-KP 493 (Figure 4.3 and 4.4). Based on discussions with Saipem, the parallel transect was performed closer to the pipeline (about 50 metres from pipeline) compared to the plan presented in the monitoring programme. Due safety reasons (e.g. anchor wires) the transect also had to be moved behind the pipelay vessel. The monitoring activity was interrupted many times due safety reasons upon request of the pipelay vessel leading to delays. Because of these delays both transects were monitored only once. The water quality monitoring with vessel operated monitoring was carried out on 30th of June 2010 and the

fixed sensors were monitoring between 23rd of June and 27th of July 2010. The monitoring results are reported in this Q3/2010 report in their entirety (Table 4.6) /26/.

Table 4.9 Coordinates (in WGS84) of two fixed sensors at the LAY2 monitoring station (S1-S2) /26/

Coordinates of fixed sensors at the LAY2 monitoring station		
Station	**Longitude**	**Latitude**
LAY2 S1	20.50783	58.88133
LAY2 S2	20.49733	58.88567

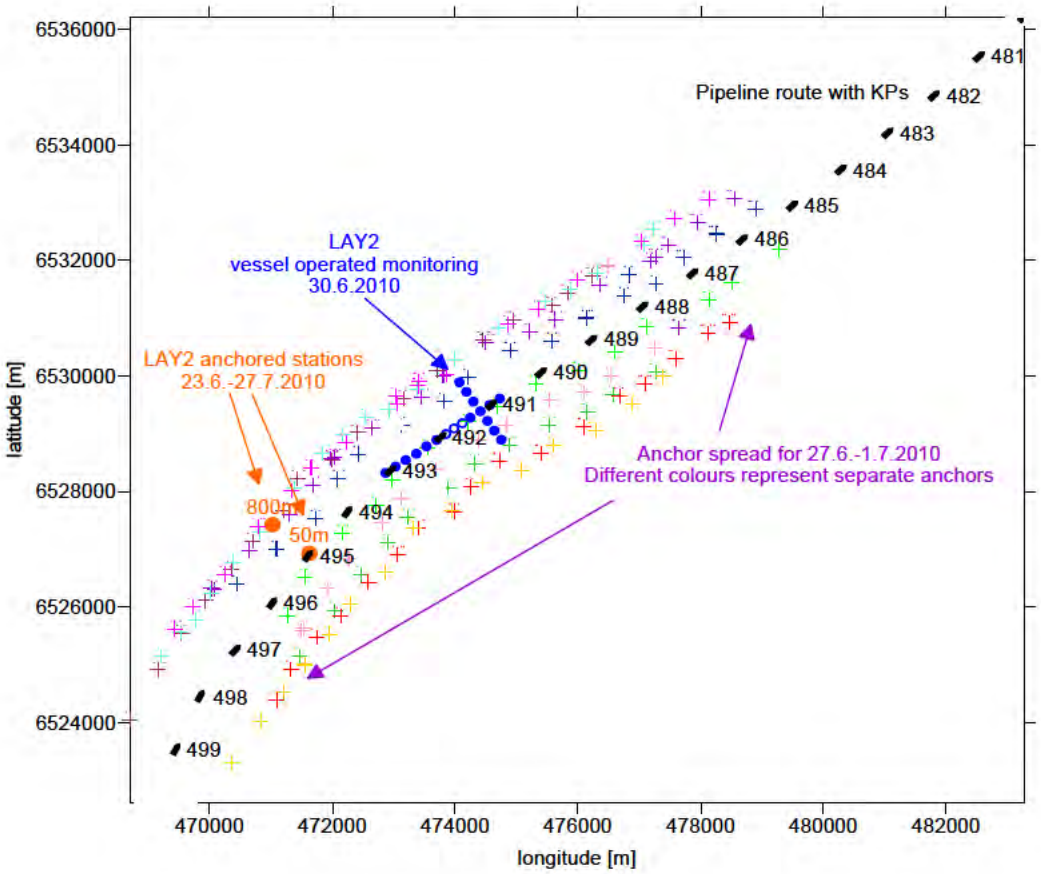


Figure 4.3 Progress of the pipelay and anchor spread on 27.6.-1.7.2010. A schematic drawing of the locations of the fixed monitoring sensors at KP 495 and orientation of the transect lines (blue dots) between KP 491-493 along the pipeline route /26/.

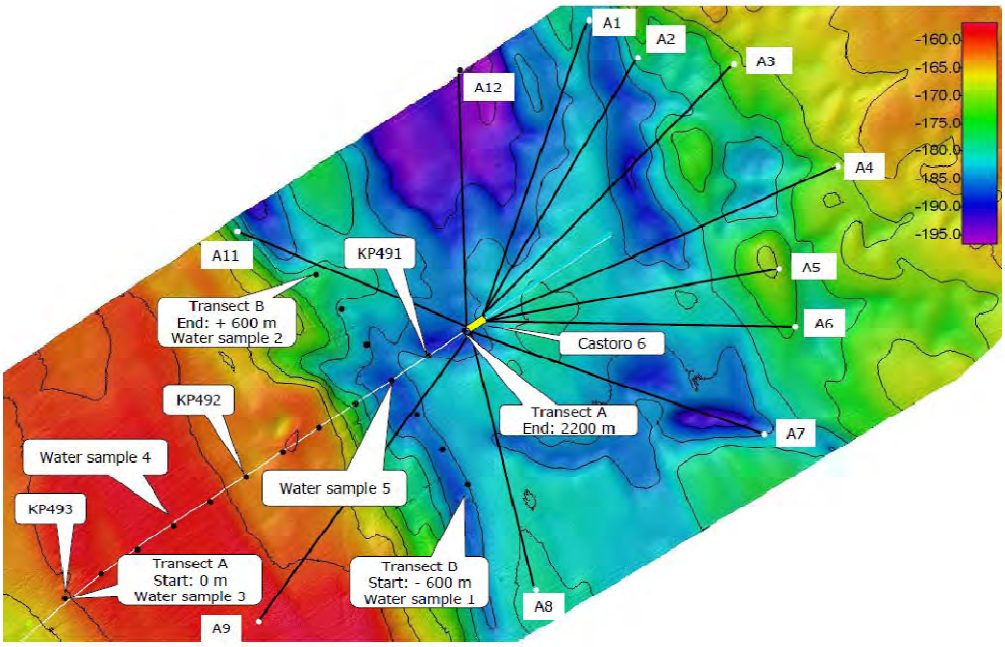


Figure 4.4 Vessel operated transects (black dots), water sampling locations and anchor positions (A1-A12) on a bathymetric map. The shown laybarge position (*Castoro 6* in the middle) and anchor pattern is around the time of the actual vessel operated monitoring /26/.

4.3.3 Wrecks, barrels and existing infrastructure

Within the anchoring corridor there are four wrecks of high cultural value (S-13-31313, S-13-34523, S-15-35565 and S-16-36567) to be monitored between KP 350 and KP 489 (the section where pipe was laid during Q3/2010). All wrecks included in the monitoring programme are presented in Figure 4.5. The pre-lay surveys of the wrecks in question were conducted during Q2/2010. The post-lay survey of these wrecks has been performed during Q4/2010.

The other four wrecks (S-07-2736, S-08-2939, S-08-10289 and S-10-3237) to be monitored are not located within the section where pipeline has been laid in Q3 (between KP 350 and KP 489). During Q3/2010 the pre-lay survey of the wreck S-10-3237 at KP 300 was performed /28/ (Figure 4.5). The pre-lay survey of the other three wrecks has been carried out in the beginning of Q4/2010.

There are no barrels to be monitored within the installation corridor of the first pipeline (north-west) between KP 350 and KP 489.

Between KP 350 and KP489 there are two cable crossings to be monitored: crossings for cable EE-S1 at KP 448 and for cable Pangea Seg 3 at KP 442. The first pipeline (north-west) was laid over the mattress arrangements of the crossings on 13th August 2010 (EE-S1) and 15th August 2010 (Pangea Seg 3). At these locations pipelay was monitored through ROV based touchdown monitoring (TDM). As-laid survey of the pipeline at crossing points was carried out on 9th and 10th September 2010. It consisted of MBES and visual surveys by using an ROV /24/. As-left surveys of the crossing structures were carried out on 1st, 2nd, and 23rd September 2010. As-left survey of each crossing consisted of a general video inspection over the whole crossing structure, MBES survey 200 m either side of the crossing along the pipeline and visual survey 1,000 m either side of the crossing along the cable. The inspections and surveys were performed using ROVs /29-30/.

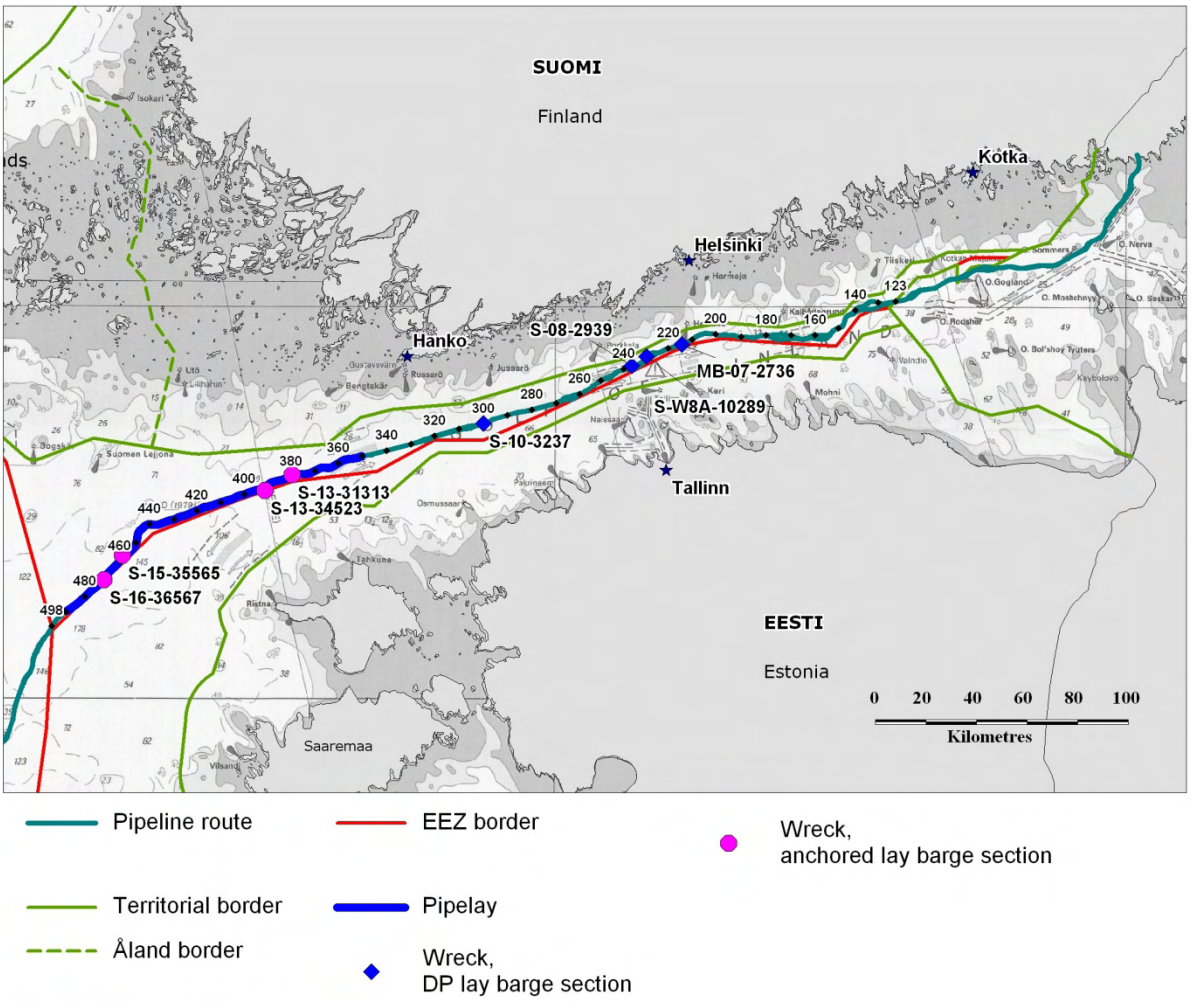


Figure 4.5 All wrecks included in the monitoring. During Q3/2010 the survey of the wreck S-10-3237 at KP 300 prior to pipelay was performed.

4.3.4 Ship traffic

Nord Stream has provided notifications from all vessels involved in pipelay to the Border Guard and the Finnish Traffic Agency before their entering the Finnish waters. Nord Stream has submitted both monthly forecast reports and monthly reports to the authorities. The vessels have provided weekly and daily progress reports to the relevant authorities.

Vessel movements have been monitored by GOFREP. The Finnish Transport Agency has published notices to mariners on project activities.

The cooperation between the authorities and Nord Stream has been very good during the reporting period.

4.4 HELCOM benthos station monitoring

Monitoring of HELCOM long term benthos monitoring stations will be performed before the installation of the first pipeline and thereafter annually for five years. There are three stations to be monitored: LL5, LL6A and LL7 (Table 4.10). The monitoring includes benthos sampling from these stations and two parallel locations x and y to these stations /2/. Using R/v Aranda SYKE has selected the locations of the parallel stations and taken pre-lay samples from all monitoring stations between 27th September and 3rd October 2010 (Table 4.11) /31/. The locations of the

parallel stations, monitoring methods as well as the results of HELCOM benthos station monitoring will be presented in the Q4/2010 monitoring report.

Table 4.10 Monitoring of HELCOM benthos stations

HELCOM benthos station monitoring					
Project activity	**Parameter**	**Unit**	**Method**	**Location**	**Timing / frequency**
Pipelay and operation	Abundance of species and individuals, oxygen concentration	ind./m^2, species/m^2 (abundance), biomass, mg/l (oxygen)	Van Veen grab (ca. 0.1 m^2)	Benthos sampling at HELCOM stations LL7, LL5 and LL6A and their two parallel sites x and y.	Once before installation of the first pipeline and, annually after construction of the first pipeline for 5 years.

Table 4.11 Pre-lay sampling from HELCOM stations /31/

HELCOM benthos station monitoring – pre samples		
Station	**Depth m**	**No of van Veen grabs**
LL5	69	3
LL5BEN_A	69	10
LL5BEN_B	70	10
LL6A	72	3
LL6ABEN_A	71	10
LL6ABEN_B	71	10
LL7	77	3
LL7BEN_A	76	10
LL7BEN_A	78	10

4.5 Long term water quality and current monitoring

Long term water quality monitoring is being carried out at two long term monitoring stations, CONTROL1 and CONTROL2 (Figure 4.1, Table 4.12) /32/.

Table 4.12 Coordinates (in WGS84) of the long term water quality monitoring stations CONTROL1-2 /32/.

Coordinates of long term water quality monitoring stations		
Station		
CONTROL1		
CONTROL2		

Long term water quality and current monitoring at CONTROL1 and CONTROL2 stations is performed with ADCP, turbidity sensor, water sampling and CTD profile. CONTROL 1 is situated in the western part of the Gulf of Finland at a depth of 43 m and CONTROL 2 is situated in the eastern part of the Gulf of Finland at a depth of 47 m. Both stations are situated close to Natura 2000 areas.

Monitoring equipment was installed in November 2009, two weeks prior to the commencement of the first munitions clearance phase. Water quality and currents will be monitored throughout the construction period. In this report the results are presented cumulatively for the time period of 4th of November 2009 – 1st of September 2010 for CONTROL 1 and 4th of November 2009 – 30th September 2010 for CONTROL 2 (Table 4.14).

Table 4.13 Long term water quality monitoring /2/ and /32/

Long term monitoring during Q3/2010					
Monitoring target	**Parameter**	**Unit**	**Method**	**Location**	**Timing / frequency**
Water quality	Current speed and direction, turbidity, conductivity, temperature and oxygen concentration	m/s (current speed), degrees (direction), NTU (turbidity), µs/cm (conductivity, °C (temperature) and mg/l (oxygen)	ADCP with a turbidity sensor and CTD profile	2 stations: one in Eastern Gulf of Finland (CONTROL2), and one close to Natura 2000 area in Tammisaari archipelago (CONTROL1)	Throughout the whole construction period. CTD-profile when uploading data
	Water samples for calibration of sensors and nutrient and metal analysis	mg/l and FTU (turbidity), mg/l (oxygen), µs/cm (conductivity) and µg/l (total and dissolved P and N)	Water sampling for calibration and analysis	CONTROL1-2	From two weeks before until two weeks after the construction works when uploading data

Table 4.14 Timing of long term monitoring and data downloading /32/

Timing of long term monitoring		
Station	**ADCP with turbidity sensor**	**Water sampling and CTD profile**
CONTROL1	4.11.2009→30.9.2010	26.3.2010 1.7.2010 1.9.2010
CONTROL2	3.11.2009→30.9.2010	5.5.2010 29.6.2010 16.10.2010

Monitoring at CONTROL1 and CONTROL2 stations has been conducted as outlined in the monitoring programme /2/, except that metals are analyzed from the water samples taken during service/ recovery of turbidity sensors. This parameter was added to collect reference values to water sampling performed during vessel operated monitoring. The monitoring equipment and methods used are described in detail in /32/.

4.6 Transboundary monitoring Russia - Finland

Impacts of the dredging activities in the Russian land fall area on the water quality in the Finnish waters have been monitored at one station, FIX 3 (Figure 4.6, Table 4.15) /32/.

Table 4.15 Coordinates (in WGS84) of the transboundary monitoring station FIX3 /32/

Coordinates of FIX3 monitoring station		
Station	**Longitude**	**Latitude**
FIX3	27.679333	59.732833

Monitoring at FIX3 station started on 5th May 2010 and has continued until 2 September 2010 (Table 4.17). The monitored parameters and monitoring methods are presented in Table 4.16. Timing of monitoring is presented in Table 4.17.

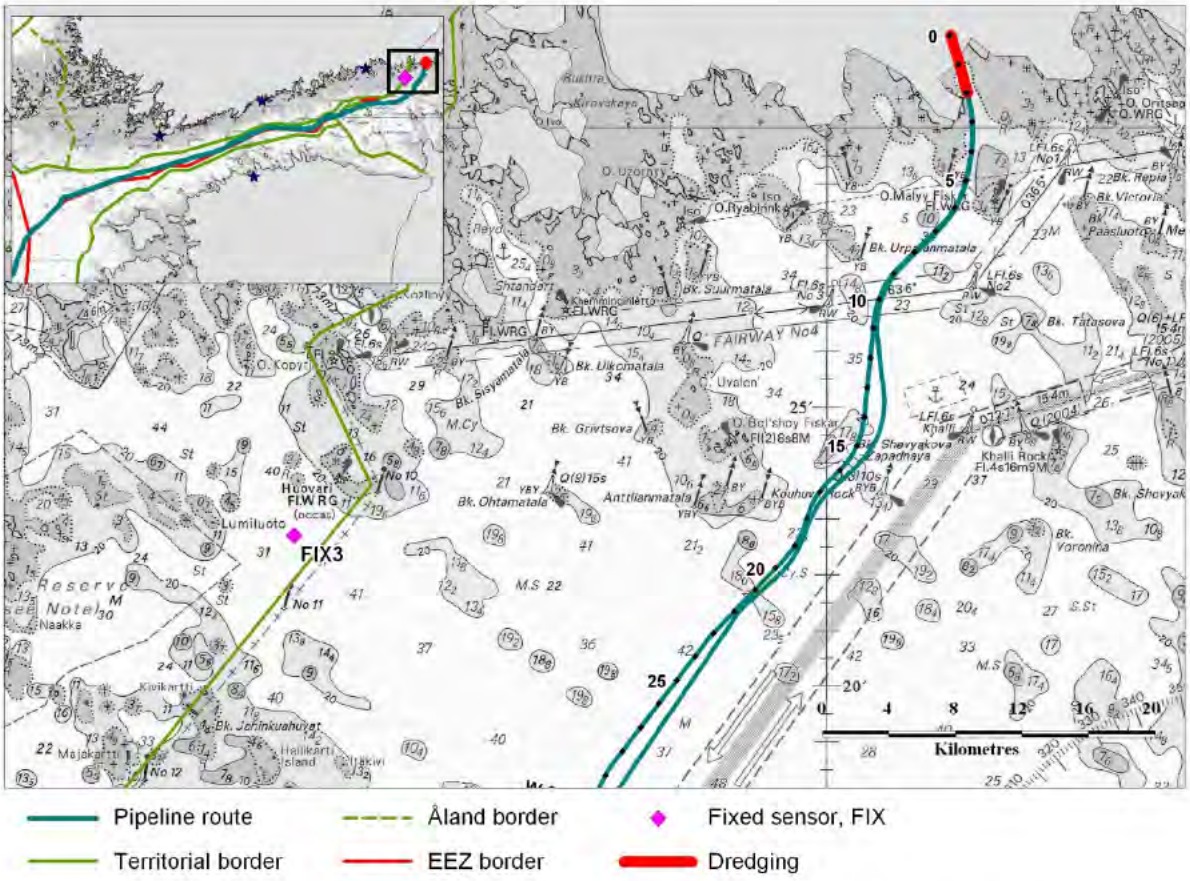


Figure 4.6 Monitoring station FIX3 and the dredged pipeline stretch close to the Russian landfall

Table 4.16 Monitoring of transboundary effects from dredging activities in Russia during Q3/2010 /2/ and /32/.

Monitoring of dredging in Russia during Q3/2010					
Monitoring target	**Parameter**	**Unit**	**Method**	**Location**	**Timing / frequency**
Water quality	Suspended sediment, conductivity, temperature and oxygen concentration	NTU (turbidity), µs/cm (conductivity), °C (temperature) and mg/l (oxygen)	Fixed sensoring and CTD-profile	1 station in the Eastern Gulf of Finland (FIX3)	Starts ca. 2 weeks before the dredging and continues ca. two weeks after the dredging, CTD-profile when downloading data
	Water samples for calibration of sensors and nutrient analysis	mg/l and FTU (turbidity), mg/l (oxygen), µs/cm (conductivity) and µg/l (total and dissolved P and N)	Water sampling for calibration and analysis	FIX3	When downloading data

Table 4.17 Timing of transboundary monitoring and data downloading /32/

Timing of transboundary monitoring		
Station	**ADCP with turbidity sensor**	**Water sampling and CTD profile**
FIX3	5.5.2010→2.9.2010	30.6.2010 2.9.2010

Monitoring was performed with a fixed multiparameter sonde that measures vertical turbidity, temperature, conductivity and oxygen concentration. The monitoring equipment and methods used are described in detail in /32/.

5. ENVIRONMENTAL CONDITIONS

This section provides a concise summary of the weather conditions experienced along the northern coast of the Gulf of Finland, during the third quarter of 2010 (Q3/2010).

July was an exceptionally warm month in the southern Finland. This was due to a permanent high pressure area over Russia from where hot weather flowed to Finland. During the month there were exceptionally many days where the temperature was over the limit (25 °C) classified as hot weather days. Moreover, there were many so called tropical nights where the temperature did not fall below 20 °C. Very local but heavy rain falls were typical. In Helsinki-Kaisaniemi, after one such event, total rainfall was 28 mm in a day (Figure 5.1).

Also at the beginning of August the air was very hot although unsteady with heavy thunder showers and local downbursts. The average air temperature of the month was some two degrees higher than a long term average in Helsinki-Kaisaniemi. At the end of August showers became more common and finally the weather chilled. Total rainfall in Helsinki-Kaisaniemi was 24 % higher than normal.

At the beginning of September cool air flowed from the north. In the middle of the month many depressions, following each other, meant locally heavy rains in the south. During the last days of the month the temperature decreased below freezing for several nights.

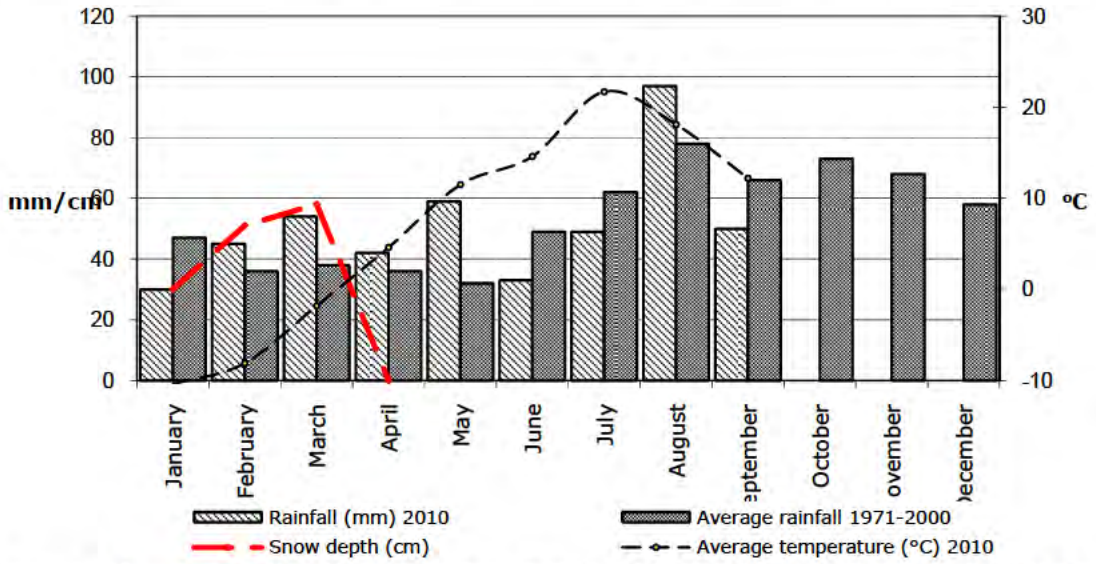


Figure 5.1 Rainfall and air temperature during July - September 2010, measured in the observatory of Helsinki-Kaisaniemi (FMI) /33/.

In the following wave height and direction, sea surface temperature, wind direction, speed and storms in the Finnish waters are discussed in more detail.

Wind direction and speed

Meteorological stations in the northern Baltic Proper and Gulf of Finland where wind observations are performed by FMI are shown in Figure 5.2 and Table 5.1.

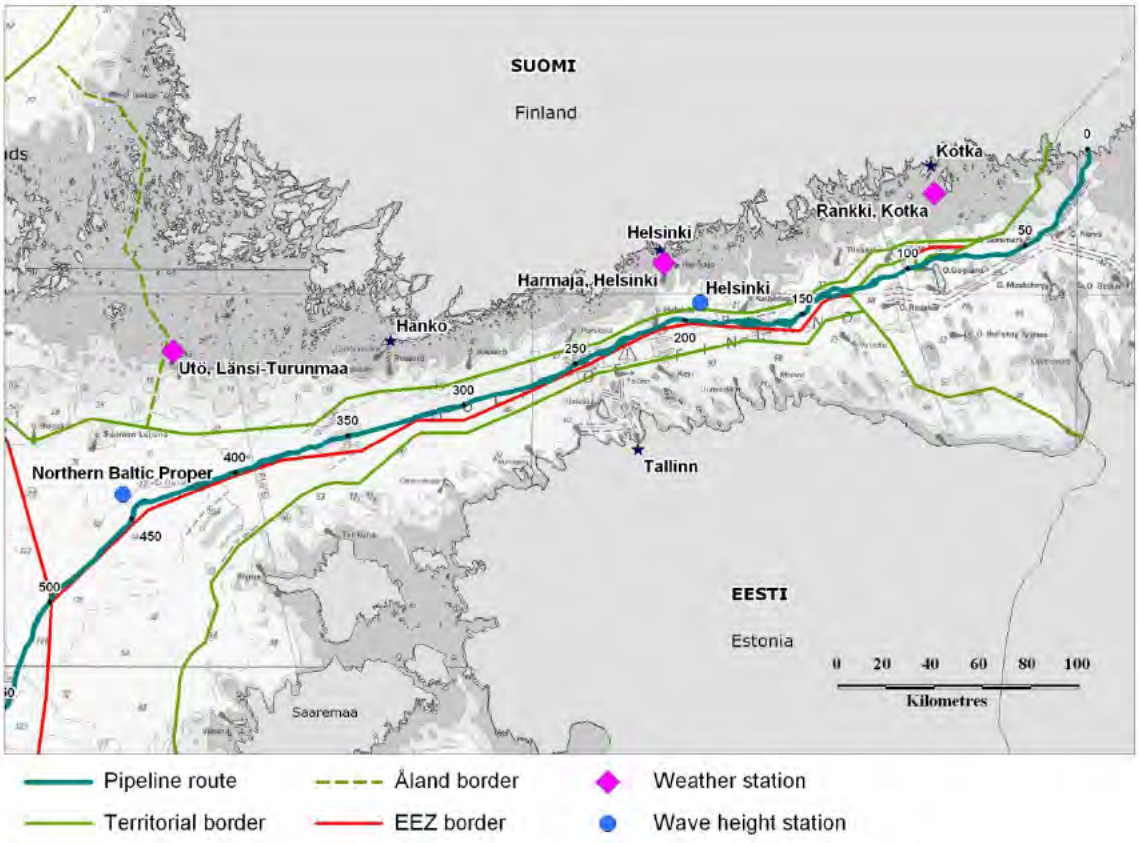


Figure 5.2 Locations of meteorological and hydrographical stations used

Table 5.1 Plurality of winds (%) from different compass points during July – September 2010 at the three selected stations (FMI) /33/.

Wind directions during Q3/2010									
	Utö			HARMAJA			RANKKI		
	July	August	September	July	August	September	July	August	September
	%	%	%	%	%	%	%	%	%
N	7	8	12	5	5	13	3	7	10
NE	7	15	17	9	18	11	9	20	17
E	4	17	4	13	21	4	15	22	3
SE	10	13	9	11	9	7	14	9	2
S	28	12	23	15	9	27	16	6	22
SW	21	19	17	35	20	20	22	19	26
W	12	9	9	5	11	7	16	15	13
NW	11	6	9	5	3	8	5	2	7
	Calm weather (%)			Calm weather (%)			Calm weather (%)		
	0	0	1	2	3	3	0	0	0
	Average velocity (m/s)			Average velocity (m/s)			Average velocity (m/s)		
	5.9	6.0	7.7	4.9	5.4	6.0	4.2	4.8	4.8

As during the previous quarter, southerly and westerly winds were prevailing in the most western station (Utö), average velocity being 6.5 m/s. In the middle part of the GoF (Harmaja) the most common wind direction during Q3 was again from the southwest. Average wind velocity was 5.4

m/s. Also in the eastern part of the GoF (Rankki) south-westerly winds were most common. Average wind velocity was 4.6 m/s.

Storms and strong winds
There were no storms (average speed >21 m/s) in Finnish waters during Q3/2010.

Strong winds (average speed >14 m/s) were not recorded at all in the eastern GoF during July - September. However, in the middle part of the Gulf speeds higher than normal were quite common during latter half of September. Dates when average wind speeds exceeded 14 m/s during Q3/2010 are presented in Table 5.2.

Table 5.2 The dates for the strong winds during Q3/2010 at the meteorological stations /33/

Station	Date
Utö	30.,31.7.2010; 4.8.2010; 2., 14.-16., 21., 22., 27., 28.9.2010
Harmaja	4.8.2010; 3.9.2010
Rankki	-

Wave height and direction and sea surface temperature

The range of the significant wave heights in July-September was large at both measurement sites shown in Figure 5.2. However, the monthly mean wave heights were low. Surface water was warm in July-August but cooled clearly in September (Table 5.3).

Table 5.3 Data from the two wave buyos in July-September 2010 at the stations of Northern Baltic Proper and Helsinki (see Figure 5.2).

Wave buoy	Significant wave height monthly mean and range (m)			Sea water temperature monthly mean and range (°C)		
	July	August	September	July	August	September
Northern Baltic Proper	**0.8** (0.1-3.2)	**1.0** (0.1-2.6)	**1.4** (0.1-3.7)	**20.1** (15.8-23.1)	**19.6** (16.6-20.4)	**15.6** (12.1-17.2)
Helsinki	**0.6** (0.1-2.3)	**0.8** (0.1-2.3)	**0.8** (0.1-2.4)	**19.6** (14.0-22.7)	**20.4** (17.1-23.9)	**14.6** (12.6-17.5)

6. MONITORING RESULTS AND DISCUSSION

This chapter describes the main environmental monitoring results from Q3/2010 and sediment and benthos analyses results related to pre-lay rock placement performed in Q2/2010. Detailed reports of the monitoring of currents, water and sediment quality and benthos are included as Appendix 3.

6.1 Rock placement

Almost all pre-lay rock placement berms were constructed during Q2/2010. The results of sediment and benthos monitoring along the transect SED2/BENT2 near the tie-in location at KP 297 in the Finnish EEZ before and after the rock placement, which were not available in Q2/2010, are presented in sections 6.1.1 and 6.1.2 (for complete report see Appendix 3A). The footprints of constructed rock berms have also been calculated in Q3/2010 and are presented in Appendix 4.

6.1.1 Sediment

Table 6.1 shows that the average concentration of dry matter was higher in the deeper sediment than in the surface sediment. It also shows that the percentage of dry matter was higher in both layers after the activity was finished, but this difference can be explained by natural variation of sediment's physical composition. The percentage of organic matter was generally low and the value decreased below the uppermost surface layer. Concentration of clay in the sediments was quite high, on average >50 %, ranging from 42 to 81%. Highest value was measured in post samples at a distance of 100 m from the tie-in area. At the same location the content of organic matter was zero.

Table 6.1 The average physical composition of the surface sediment along the transect SED2 (see also Fig. 6.3) /13/.

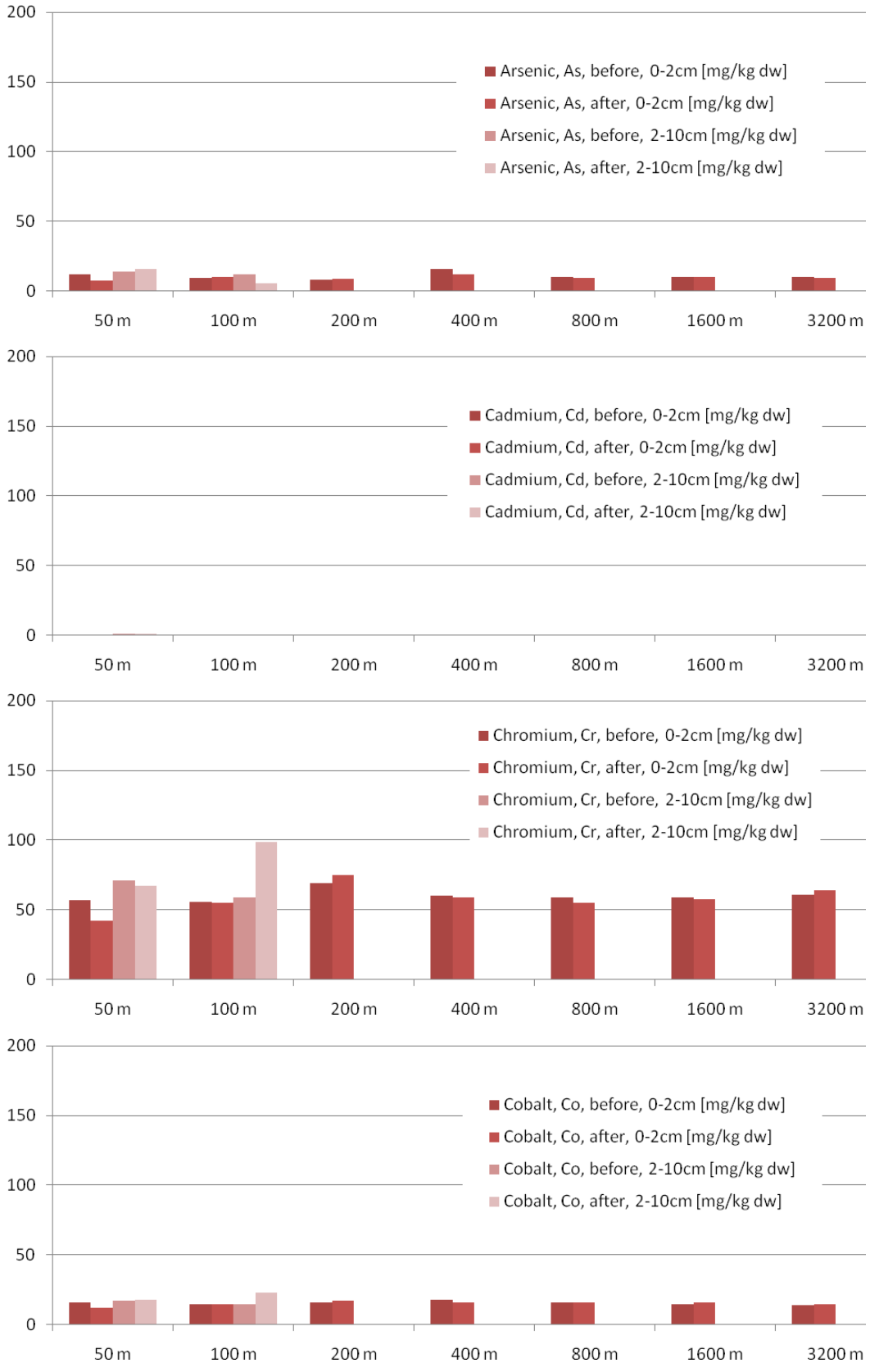
Sediment quality	0–2 cm (locations 1-7)		2-10 cm (locations 1-2)	
	pre	post	pre	post
Dry matter concentration %	14.7	19.8	24.7	39.2
Organic matter content % dw	9.4	8.8	4.2	4.1
Clay particles (<0.002 mm) % dw	52 (pre/post)		63 (pre/post)	

General
The histograms in Figures 6.1 - 6.5 present the sediment analysis results without normalisation[1]. The normalised values are presented in Appendix 3A.

[1] By normalisat on the concentrations of metals and organ c compounds in sediment are corrected into standard sediment that consists of 25 % clay and 10 % organic matter.

Metals

Concentrations of arsenic and heavy metals were generally low. One elevated value of copper (220 mg/kg dw) was analysed from a sample taken before the rock placement started, in location SED2/2B (distance 100 m, depth 2-10 cm).



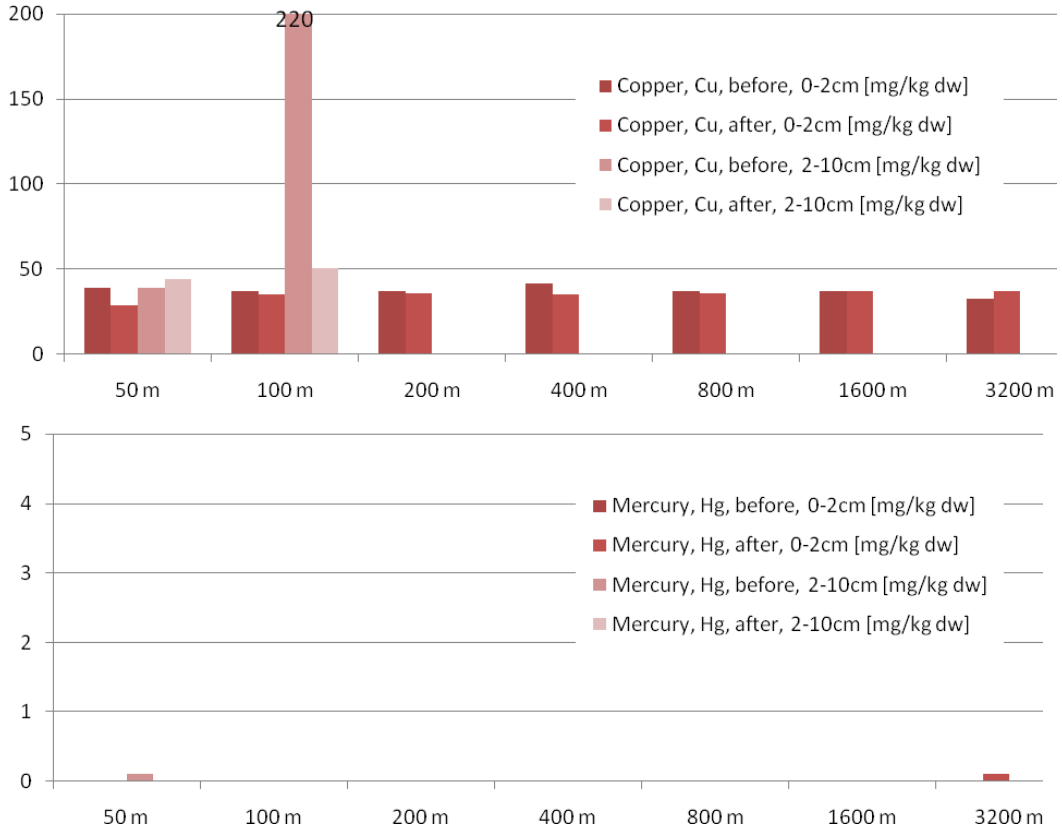
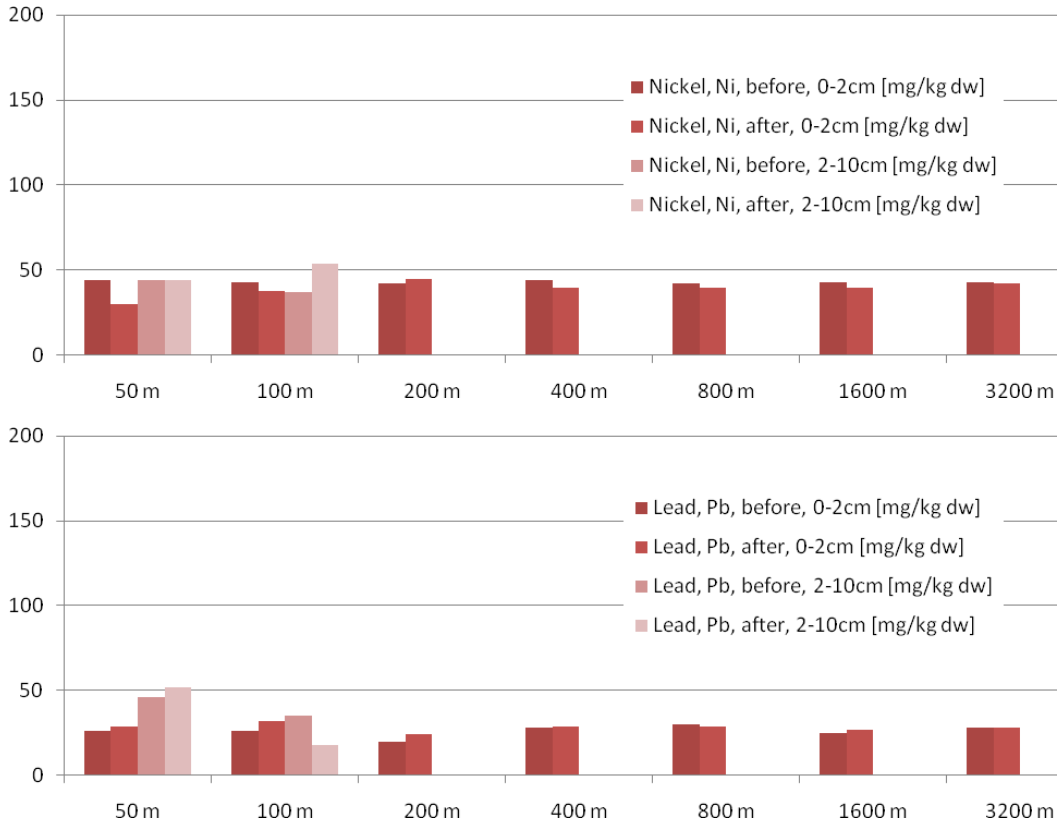


Figure 6.1 Concentrations of arsenic, cadmium, chromium, cobalt, copper and mercury in surface sediment along the transect SED2 before and after rock placement /13/.



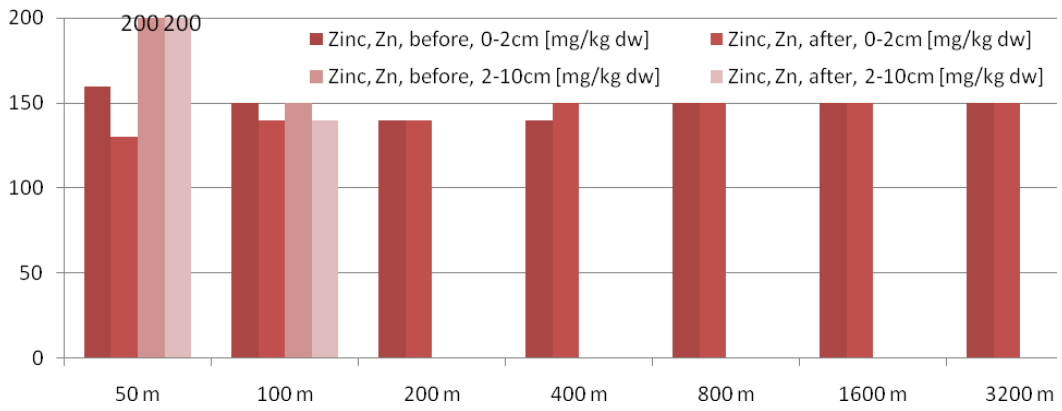


Figure 6.2 Concentrations of nickel, lead and zinc in surface sediment along the transect SED2 before and after rock placement /13/.

After normalisation (Appendix 3A, Table 3) concentrations of arsenic and most heavy metals did not exceed the Level 1 of the Finnish quality criteria developed for the instructions for dredging and depositing dredged materials /34/. The normalised concentrations below or at Level 1 are considered to be uncontaminated and harmless to the water environment.

The elevated single copper concentration of sample SED2/2B was 150 mg/kg dw, Level 1 being 50 mg/kg dw and Level 2 being 90 mg/kg dw (all values normalised). Normalised concentrations exceeding the Level 2 are considered to be contaminated.

Cadmium showed slightly elevated concentrations of 0.6-0.9 mg/kg dw, Level 1 being 0.5 mg/kg dw and Level 2 being 2.5 mg/kg dw (all values normalised) in some locations. Normalised concentrations between the Levels 1 and 2 are considered to be slightly contaminated.

The change of arsenic and heavy metal concentrations in surface sediment, dry matter content and residual on ignition before and after the rock berm construction plotted against distance from the berm is presented in Figure 6.3.

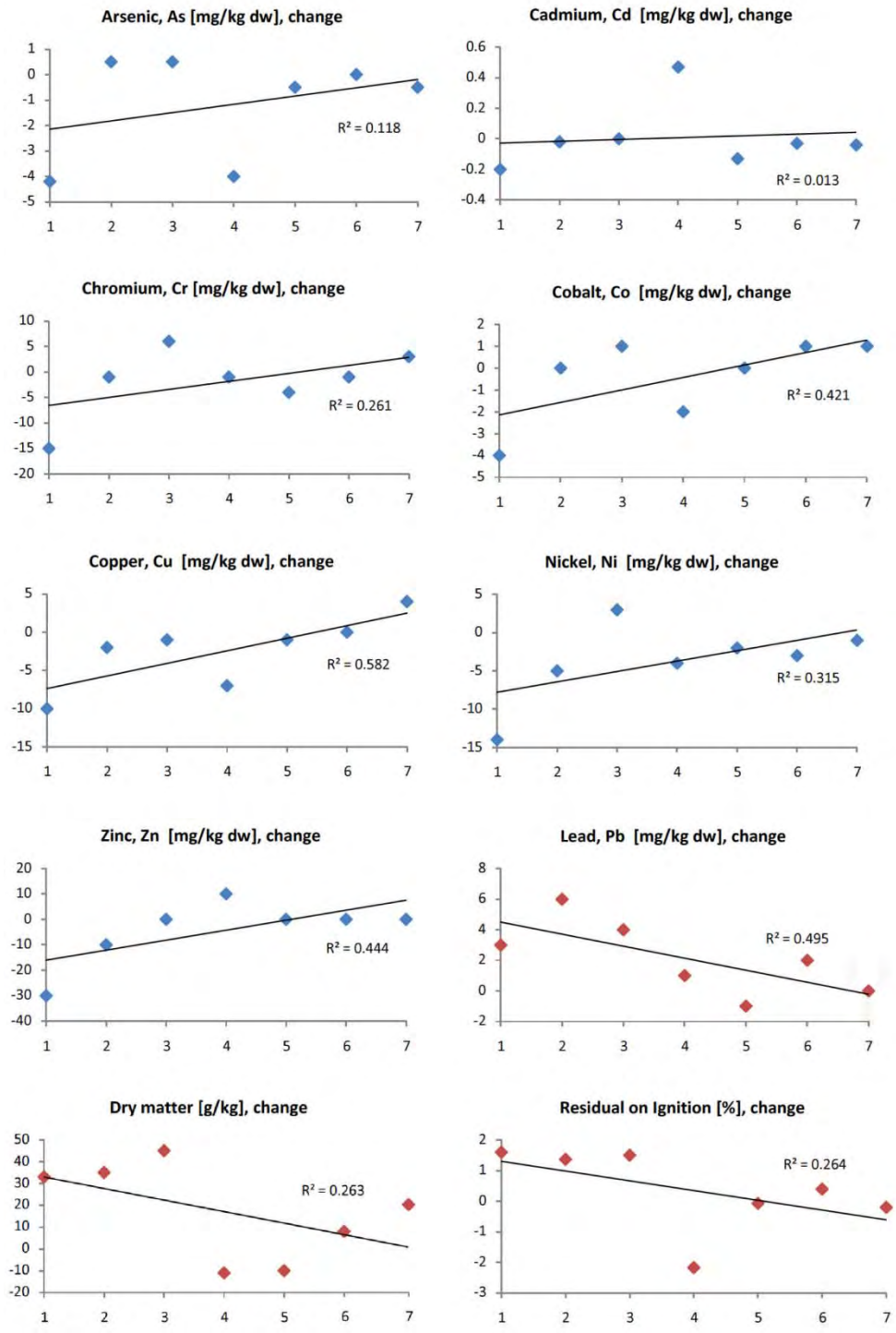


Figure 6.3 Change of metal concentrations (without normalisation), dry matter content and residual on ignition in pre and post activity sampling near the tie-in site /13/. The X-axis refers to the sampling location's number along the transect (see Chapter 4, Table 4.2).

As shown in Figure 6.3, concentrations of nearly all the heavy metals as well as the concentration of arsenic in the surface sediment, tend to decrease after the rock berm construction. The decrease was most distinct at the sampling locations closest to the berm. However, the only statistically significant decrease was for copper (R^2 = 0.58, while the limit for the statistical significance is 0.56). Concentrations of lead showed an exception, values indicated slight increase between pre and post sampling. However, this trend was not statistically significant and the

general level of lead was low. The concentration of dry matter and residual on ignition results close to the rock berm showed small increases when comparing the values from pre-sampling with the values from post-sampling. The above mentioned differences between pre- and post-sampling results can be explained by natural variation of sediment's quality and physical composition, and there is no statistical evidence that the differences were related to the rock berm construction work.

The pre- and the post-sample concentrations of arsenic and heavy metals indicated no clear or statistically significant trends during the rock placement.

Dioxins/furans

The WHO-TEQ and I-TEQ concentrations of dioxins/furans were practically identical. The concentration level of dioxins/furans was generally low (Figure 6.4). However, the concentrations analysed from the sample SED2/1B (distance 50 m, depth 2-10 cm) were 2-3-fold higher compared to the general level.

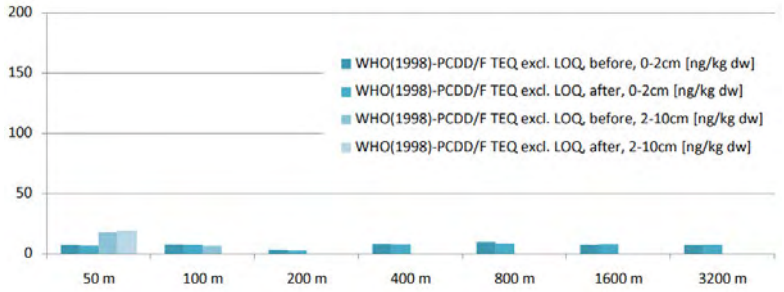


Figure 6.4 WHO-TEQ concentrations of dioxins/furans in surface sediment along the transect SED2 before and after rock placement /13/.

Normalised concentrations of dioxins/furans were mainly below or very close to the Level 1 (Appendix 3A, Table 3). Normalised concentrations of the pre-sample from the SED2/1B location were highest, being on the level of 30-32 ng/kg dw WHO-TEQ/I-TEQ. Even these concentrations can be considered to be relatively low compared to the Levels 1 and 2 (20 ng/kg dw and 500 ng/kg dw WHO-TEQ/I-TEQ normalised, respectively).

Concentrations of dioxins/furans showed no change during the rock placement.

Organotin compounds

Concentrations of tributyltin (TBT) were relatively high both in pre and post samples, showing random concentration peaks along the monitored transect (Figure 6.5). However, concentrations of other organotin compounds were low or moderately low.

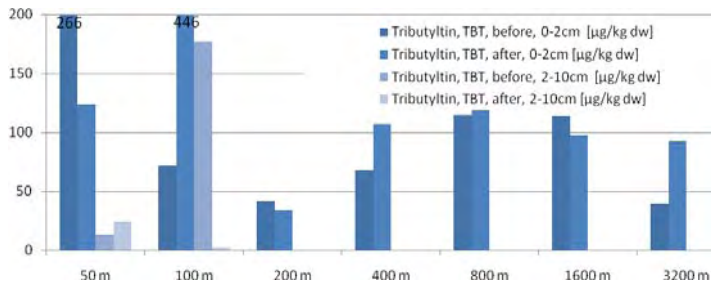


Figure 6.5 Concentrations of tributyltin (TBT) in surface sediment along the transect SED2 before and after rock placement /13/.

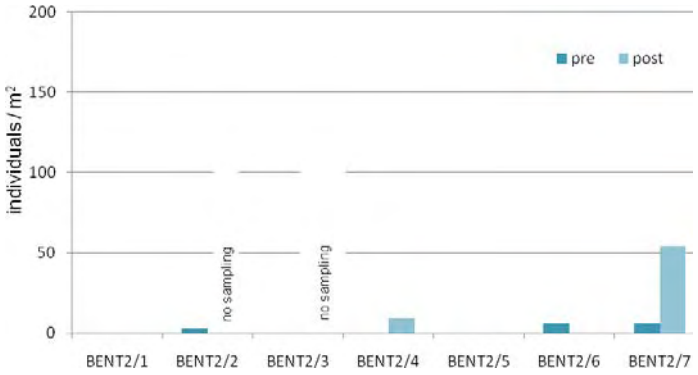
The normalized TBT values were all categorized above Level 1 (3 µg/kg dw) and in four samples the concentrations exceeded Level 2 (200 µg/kg dw; Appendix 3A, Table 3). The main origin of TBT is antifouling paints used on the hulls of vessels. Although TBT was banned in the EU in 2003 and by the IMO in 2008, for the time being its occurrence can be considered to be ubiquitous in the sedimentary bottoms of the Baltic Sea (as well as in the sediments of other sea areas). The concentrations can be expected to be highest near the fairways used during winter (i.e. during ice cover). It is probable that TBT is in the surface sediment in the form of paint flakes or particles, which explains the random nature of the concentration in seabed sediments.

Based on the monitoring results and what is stated above, rock placement did not have any evident effect on the concentration of organotin compounds in the surface sediments studied.

The natural variability (heterogeneity) of the seabed and the variability/uncertainty caused by laboratory treatments and analyses should be kept in mind when interpreting the sediment monitoring results. When interpreting concentrations of metals and organic compounds, the analyses results for metals and the level of accuracy is of the order ±20-35 %, for dioxins ±20-30 % and for organotin compounds ±20-33 %. However, the 95 % confidence limits for the analysed concentrations of harmful substances are according to the laboratory reports between 8-25 %, depending on the substance.

6.1.2 Benthos

The prevailing conditions, especially the oxygen concentration, in deep sea bottoms are highly important as to the presence of macrozoobenthos. The measured oxygen level in water just above sediment along the transect BENT2 varied from very poor to tolerable (0.2-5.6 mg O_2/l) during pre sampling in spring and was very poor (0.3-1.0 mg O_2/l) at all locations when post activity samples were taken in late summer. Due to unfavourable living conditions on the bottom, the sampling locations were practically lifeless, excluding the furthest sampling site (BENT2/7) from the rock placement area (Figure 6.6).



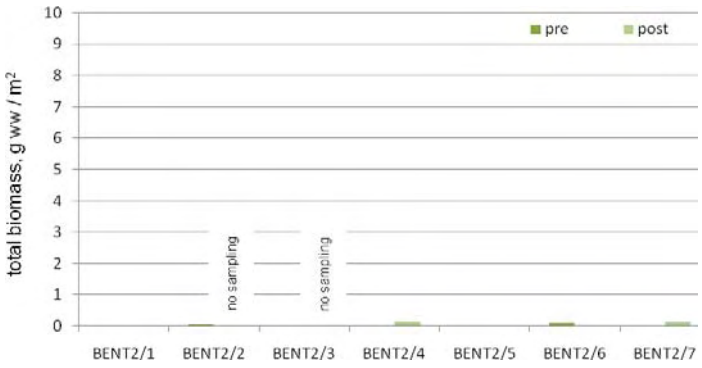


Figure 6.6 Abundance and biomass of benthos at the transect BENT2. No post-monitoring data was collected from BENT2/2 and BENT2/3 due to bad weather conditions (only 0-3 ind./m^2 was recorded during pre-monitoring phase on these locations).

At BENT2/7 some individuals of the non-indigenous species *Marenzelleria arctia* (Polychaeta) and some individuals of *Macoma baltica* (Bivalvia) were present. At this location total abundance of macrofauna in pre-samples was 6 ind./m^2 and post-samples 54 ind./m^2. Total biomass was 0.02 g ww/m^2 and 0.13 g ww/m^2, respectively /13/.

The natural small scale variability (heterogeneity) of the seabed and the prevailing oxygen conditions regulate strongly the number of macrozoobenthos species and their abundance. At transect BENT2 the low oxygen concentration above the sediment was the most dominant regulative factor making the living conditions unfavorable at these depths.

6.2 Mattress installation

Prior to the installation of the mattresses for the three cable crossings the cables were located and crossing positions were verified. The crossing position was as planned for cable EE-SF2. Crossing positions for cable FEC-2 and EE-SF3 had to be adjusted 1.3 m east and 0.3 m west respectively /8-10/.

The results of the as-built surveys carried out after the installations were:

- All mattresses were installed in positions as planned within prescribed tolerances. In addition, it was confirmed by using Pipetracker TSS 440 that the cable was under the Type 1 mattresses.
- No debris was found during the installations at the crossing locations
- Estimated embedment of the mattresses was 0.4 m at maximum, depending on the seabed type. Some of the mattresses were partially covered by sediment after the installation. /8-10/

6.3 Pipelay

6.3.1 Seabed morphology, obstacles and pipeline

Pre-lay survey

The pre-lay survey results for the installation corridor from KP 123 to KP 489 are presented in sections in the pre-lay survey field reports /15-18, 40-42/. This section summarizes the main pre-lay survey findings.

The pre-lay survey findings for the installation corridor from KP 350 to KP 489, where pipe was laid during Q3/2010 by the anchored lay barge *Castoro Sei* are presented in Table 6.2. The seabed bathymetry of this route section varies from the minimum depth of 65 m at KP 367 to the maximum depth of 183 at KP 478.

Table 6.2 Munitions, debris and engineering features (cable crossings, rock berms) identified in the pre-lay survey between KP 350 and KP 489 /15-17/.

Features found in pre-lay survey between KP 350 and KP 489			
Feature	**Feature type**	**Number of features**	**Note**
Munitions		0	All munitions identified in earlier surveys cleared.
Debris	Drum/ possibly drum	1	Identified in earlier surveys.
	Wreck	0	
Engineering features	Pre-lay rock berm	0	No berms installed in this section.
	Cable mattress installation	2	Crossings installed for pipeline 1.
	Crossing with out-of-service cable (UCCBF/ unknown cables)	0	

The pre-lay survey findings for the installation corridor from KP 123 to KP 350, where pipe is being laid during Q4/2010 by the dynamically positioning lay barge *Solitaire* are presented in Table 6.3. The seabed bathymetry of this route section varies from the minimum depth of 41 m recorded over the rock berm at KP 223 to the maximum depth of 93 m at KP 335.

Table 6.3 Munitions, debris and engineering features (rock berms, cable crossings) identified in the pre-lay survey between KP 123 and KP 350 /18, 40-42/.

Features found in pre-lay survey between KP 123 and KP 350			
Feature	**Feature type**	**Number of features**	**Note**
Munitions		0	All munitions identified in earlier surveys cleared.
Debris	Drum/ possibly drum	12	Identified in earlier surveys
	Wreck	1	Identified in earlier surveys as target S-10-3237. According to FNBA of no high cultural value[1].
Engineering features	Pre-lay rock berm	13	Berms installed for pipeline 1.
	Cable mattress installation	7	Crossings installed for pipeline 1
	Crossing with out-of-service cable (UCCBF/ unknown cables)	10	All identified in earlier surveys
	Crossing with a linear feature, a suspected unknown cable, at KP 233.609[2]	**1**	**Not identified in earlier surveys**

[1] Finnish National Board of Antiquities 2009. Evaluation of Underwater Cultural Heritage in the Finnish EEZ.
[2] For further details and planned action see Section 6.3.4.

As-laid survey

As-laid pipeline results from KP 350 to KP 498 are presented in sections in the as-laid survey field reports /20-25, 39, 43-47/ and associated as-laid pipeline charts. An example of an as-laid survey field report for KP 350.292 to KP 380.000 and an associated as-laid pipeline chart for KP 356.657 – KP 359.727 is included in Appendix 5. The following section summarizes the main as-laid pipeline survey findings compared to design regarding the pipeline alignment and profile, freespans and post-lay rock placement needs.

As-laid pipeline alignment with respect to installation accuracy to Route C16.5 /43-47/

Pipeline 1 has been installed by the anchored pipelay barge *Castoro Sei* from KP 498 to KP 350. Within this section the pipeline deviated outside the specified lay tolerance of ±7.5 m on four occasions as shown in Figure 6.7 and defined below:

- KP 359.499 to KP 359.676 (maximum offset -8.51 m) - Straight section of route
- KP 368.276 to KP 368.390 (maximum offset -8.04 m) - End of curve
- KP 416.116 to KP 416.518 (maximum offset -9.59 m) - Curved section of route
- KP 444.501 to KP 445.088 (maximum offset -9.68 m) - Curved section of route

In accordance with Water Permit provision 1 'Pipeline location and structures' the pipeline shall be constructed with an installation accuracy of ±7.5 m on straight sections and ±15 m within curved sections.

Consequently over a length of 177 m between KP 359.499 and KP 359.676 the pipeline has been installed out with the permit provision (Appendix 5). The reason for this deviation was to ensure pipeline integrity by avoiding three boulders located within the installation corridor during the pre-lay survey at KP 359.573, KP 359.564 and KP 359.558.

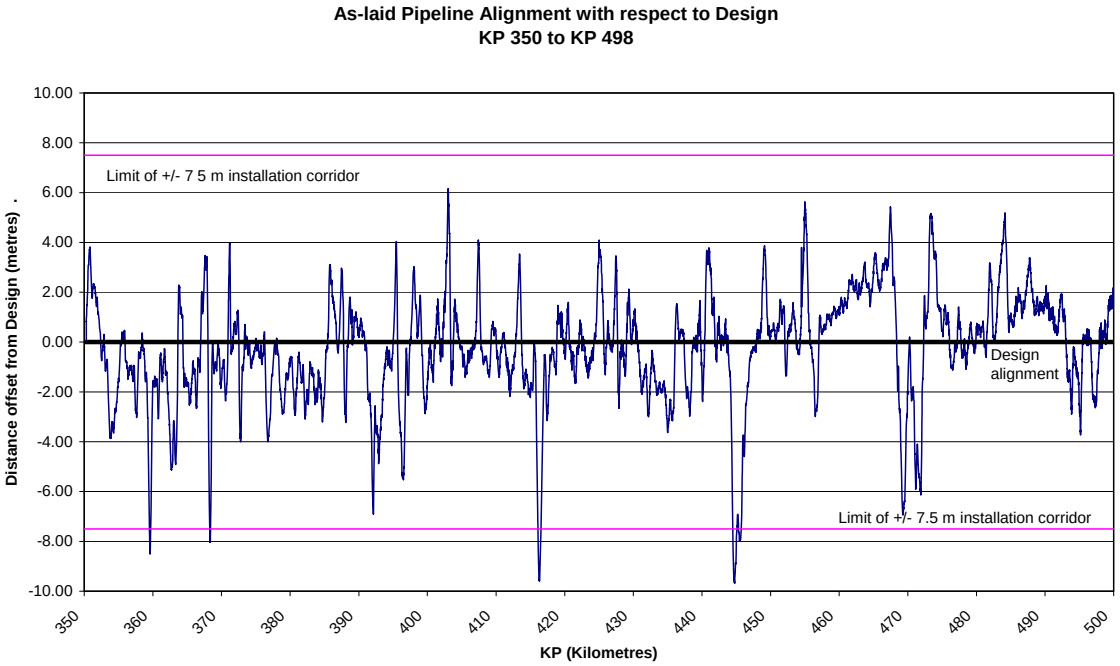


Figure 6.7 As-laid pipeline alignment with respect to design from KP 350 to KP 498

As-laid pipeline profile: vertical offset with respect to design pipe profile /43-47/

As-laid pipeline profile from KP 350 to KP 498 is generally slightly deeper than predicted in the design. This is due to higher pipeline embedment observed over the majority of the section. Figure 6.8 shows an example of an approximately 50 % embedded pipe at KP 420. The higher embedment is most likely a result of conservatively considering the upper bound soil properties (stiffer than actual) for design.

Locally, at discreet locations the pipeline profile is higher than expected due to outcrops, for example at KP 354.59, KP 359.69 and KP 438.25.

Figure 6.8 Field joint showing approximate 50% pipeline embedment at KP 419.975

As-laid pipeline freespan comparison with respect to design

The summary of observed freespans, including all freespans with a length of greater than 10 m, based on as-laid surveys of the pipeline 1 from KP 350 to KP 498 are presented in Table 6.4. The results in Table 6.4 reflect the situation prior to post-lay rock placement.

Table 6.4 Summary of observed freespans from KP 350 to KP 498 based on as-laid data /20-25, 39/

Pipeline section	Total no. of free spans[1]	Maximum free span length, m	Maximum free span height, m
KP 350 - KP 380	39	176 KP 368.454 - KP 368.630	1,20 KP 368.454 - KP 368.538, KP 367.020 - KP 367.148
KP 380 - KP 400	18	70 KP 397.093 - KP 397.163	1,50 KP 397.093 - KP 397.163
KP 400 - KP 420	14	78 KP 401.618 - KP 401.696	1,10 KP 401.618 - KP 401.696
KP 420 - KP 440	14	202 KP 438.167 - KP 438.369	2,30 KP 438.167 - KP 438.369
KP 440 - KP 470	95	175 KP 467.637 - KP 467.812	3,10 KP 451.912 - KP 452.081
KP 470 - KP 490	81	259 KP 478.601- KP 478.860	2,9 KP 481.198 - KP 481.401
KP 490 - KP 500	23	193 KP 491.159 - KP 491.352	1,40 KP 495.689 - KP 495.858, KP 496.235 - KP 496.379

[1] Including all freespans greater than 10 m in length.

Based on comparisons of pipeline as-laid and design data, the as-laid freespans are generally shorter than design freespans, with the following main exceptions: KP 359.69, KP 367.09, KP 438.25 (Figure 6.9), KP 447.6, KP 448.2, KP 467.7, KP 478.7, KP 481.3, KP 491.3 and KP 496.1.

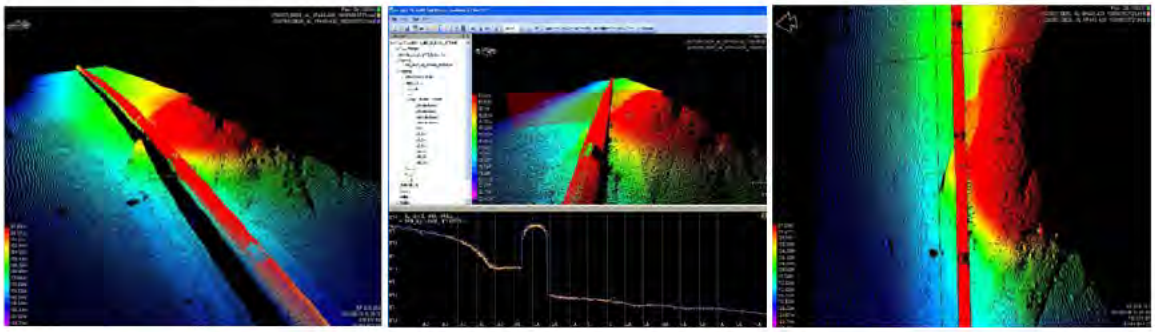


Figure 6.9 Freespan from KP438.167 to KP438.369 (length 202 m and maximum height 2.30 m). Pipeline traversing the edge of seabed mound at KP438.254.

Based on the engineering assessment of the as-laid configuration of the pipeline from KP 350 to KP 498 only three of the fourteen design post-lay rock placement works are still required, namely W2373 (KP 368.6), W2341 (KP 438.3), W2347 (KP 452.0). Six rock berms not foreseen in the design have been added for pipeline flooding, pressure test and operating conditions. These berms are W2379 (KP 354.621), W2380 (KP 367.050), W2381 (KP 367.116), W2382 (KP 368.512), W2378 (KP 438.240) and W2645 (KP 467.153). Berm W2645 is required for fatigue in long term (operation) condition and may be installed during the Phase 3 rock placement (after dewatering), whereas the other berms will be installed during Phase 2 rock placement (before flooding).

The following Table 6.5 shows the comparisons of the calculated design and as-laid post-lay rock volumes. As shown, there is a very slight decrease in the total calculated rock volume, however, the majority of post-lay rock berms will now be installed during Phase 2.

Table 6.5 Comparison of the calculated design and as-laid post-lay rock volumes

	Design[2]	**As-laid Assessment /**43-47**/**
Number of post lay rock berms Phase 2 (before flooding)	6	8
Calculated rock volume phase 2	11986 m^3	16474 m^3
Number of post lay rock berms Phase 3 (after dewatering)	8	1
Calculated rock volume phase 3	5172 m^3	454 m^3
Total calculated rock volume	**17158 m^3**	**16928 m^3**

The exact location and details of the pipeline as a structure on the seabed will be reported when the whole pipeline is constructed.

6.3.2 Water quality

In the following the main results of water quality monitoring during pipelay and anchor handling at the station LAY2 are presented /26/. Total water depth at the locations of the two fixed sensors, at a distance of 50 m and 800 m from the pipeline, was 183 m and 191 m, respectively (Figure 4.3).

Turbidity

Results of vessel operated monitoring on 30.6.2010 showed some increased turbidity in the lowermost 10 m water layer in transect B (see Figure 4.4), approximately 100 m behind the touchdown point of the pipe at approximately KP 491.2 (Figure 6.10). The highest value recorded was 37 NTU, one metre above the seabed, 100-400 m south of the pipeline route. The most probable explanation for the increased turbidity is that based on the as-laid data the pipeline at KP 491.1 is partly buried into soft bottom and the vertical movements of the embedded pipe at the touchdown point at this KP during a 45 minute repair on *Castoro Sei* (when the lay barge was stationary and pipeline at the same touchdown point) may have brought the sediment into suspension /26/. Turbidity increase was monitored just above the bottom in a water depth more than 180 m and where the oxygen condition was poor. Based on the highest turbidity values observed and the circumstances where increase in turbidity occurred, one can assess that it did not cause any harmful impacts to biota.

In transect A (see Figure 4.4) parallel to the installation corridor, 50 m away from the pipeline alignment, only small increase in turbidity (<10 NTU) was recorded on the same day /26/.

[2] Data Sheet - Gravel Works and Mattresses (Finland) G-EN-PIE-DAS-102-00070024 Rev D

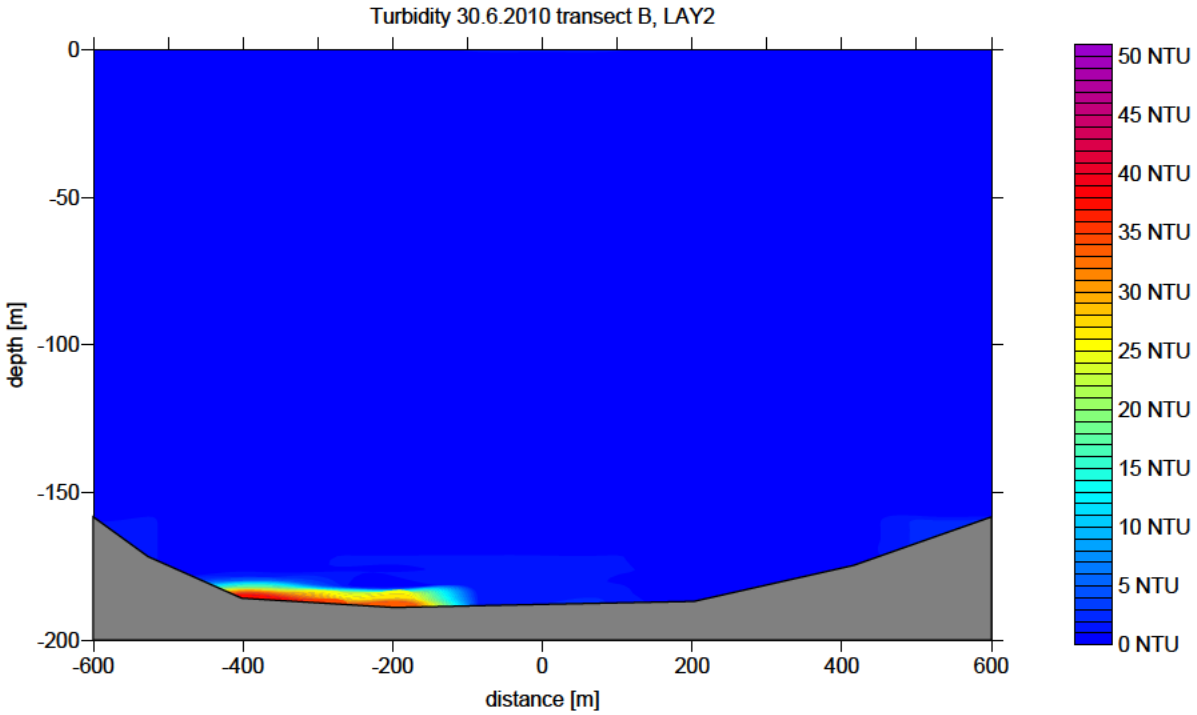


Figure 6.10 Vessel operated monitoring. Turbidity transect B (see Figure 4.4) perpendicular to the pipeline installation corridor at LAY 2 on 30th June. The zero distance point represents the location of the pipeline. Negative distances are measured towards south and positive ones towards north /26/.

Water sampling

The results of water samples taken from five locations ('Water sample 1-5'; Figure 4.4) during monitoring of the transects on 30th June, are presented in Appendix 3C. Sampling depth was normally from the lowermost 50 m.

Oxygen concentration of all the studied depths was poor (≤1 mg/l) in all locations. Bottom near waters were, typically to the Baltic Sea, rich in phosphorus (100 – 110 µg P/l). Turbidity values were generally low (0.36 – 1.2 FNU). Concentrations of heavy metals in water were at the background level.

In location 'Water sample 1' (Figure 4.4), starting point of monitoring transect B, some 600 m towards south from the pipeline, no signs of disturbance in water quality at the studied depths (deepest sampled depth 155 m) were detected.

Fixed sensors

In Figure 6.11 the impacts of pipelay activities (anchor handling, pipeline touchdown and pipeline touchdown monitoring by ROV) on turbidity are seen when these actions were happening in the vicinity of the sensors. Small turbidity peaks were recorded at the nearest fixed sensor from the activity. The highest value measured 50 metres away from the pipeline on 27th June was 3.4 NTU lasting less than 2 hours. Another period when slightly elevated values were recorded by the same sensor was from the 29th – 30th June. During these days the turbidity increase was only approximately 1 NTU unit, compared to the results of the sensor furthest away. Values decreased to a background level within hours. For comparison, the highest value, 4 NTU, was measured on 17th July. By this time the pipelay activities were performed tens of kilometers away from the fixed sensors and the observed peaks cannot be attributed to these activities.

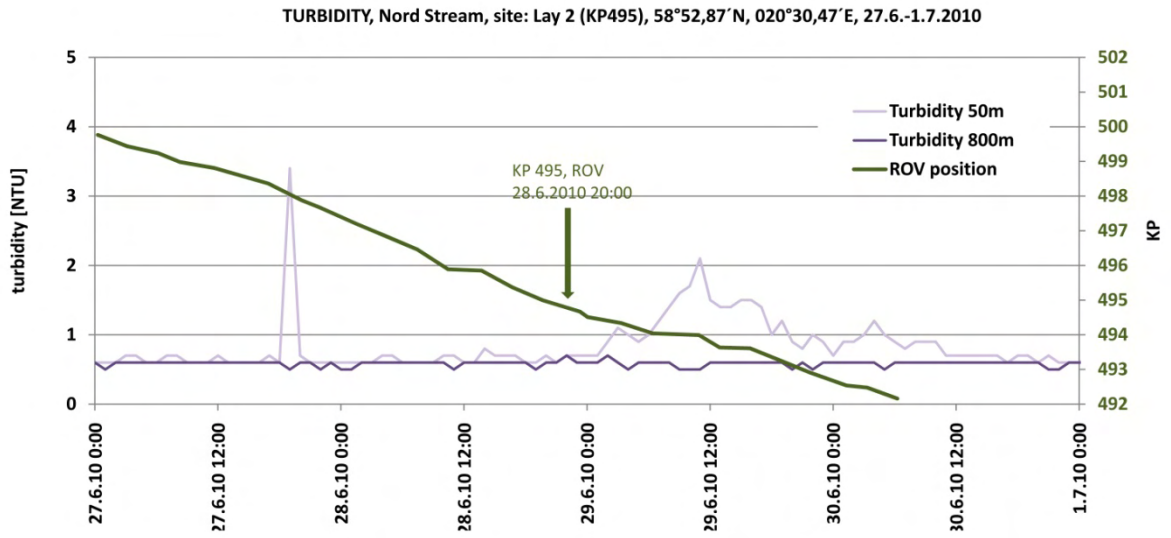


Figure 6.11 Turbidity recordings of the two fixed sensors from 27th June – 1st July 2010 at LAY2, when pipelay and pipeline touchdown monitoring by an ROV were conducted in the vicinity of the station /26/.

Water sampling and CTD- profile

Bottom near waters (1.5- 2.0 m above the seafloor) at the sensor locations were free of oxygen during the monitored period, 23rd June – 27th July 2010. A CTD profile from the closest sensor recorded on the 27th July is presented in Appendix 3C. Results of water samples taken in locations of both sensors, on the same day, were in line with each other and with the results gathered during the transects monitoring /26/.

6.3.3 Wrecks, barrels and existing infrastructure

Four wrecks required post-lay monitoring along the section of pipeline installed during Q3/2010. However, post-lay surveys have been performed during Q4/2010 and the findings will be compared with the pre-lay survey findings in the environmental monitoring report for Q4/2010.

There were no barrels to be monitored along the section of pipeline installed during Q3/2010.

The cable crossings for the cable EE-S1 at KP 448 and for the cable Pangea Seg 3 at KP 442 were included in the monitoring during Q3/2010. According to the as-laid survey performed for the pipeline at the crossing points and the as-left surveys performed for the crossing structures and cables, the pipeline was laid over the mattress arrangements within the specified lay tolerances (+/-2.5 m) /29-30/. Other results of the as-left surveys were:

- General video inspection showed that the mattresses were partly embedded to the seabed. For some of the mattresses at the crossing for the cable EE-S1 the top surface of the mattresses was almost at the level of the seabed. All the mattresses at the crossing for cable Pangea Seg 3 were settled into the sediment to varying degrees and some of them were barely visible because of the sediment.
- General video inspection showed that the pipeline was partly in freespan at the crossing for cable EE-S1. No visible freespans were found at the crossing for cable Pangea Seg 3.
- Compared to the surveys performed before pipelay no movement in the mattresses positions was found in the MBES survey.
- No cable damage caused by anchors was found in the visual survey covering +/-1,000 m from the crossing point along the cable /29-30/.

6.3.4 Chance findings and unplanned events

During pipelay, four unplanned events occurred: three waste dumpings and an oil spill. A subcontractor to Saipem had on three occasions emptied a container filled with concrete coating material into sea from *Castoro Sei* /35/. According to incident reports, the amount of concrete dust in the container was approximately 1 m^3 /35/. Dates of these incidents are 14.8.2010, 19.8.2010 and 23.8.2010. Following corrective actions were implemented to prevent reoccurrence of similar unplanned events:

- Official *tool box talk* has been arranged with *Castoro Sei* and all subcontractors' personnel. It was highlighted that all waste dumping into sea is strictly forbidden according to vessel's waste management plan and MARPOL 73/78 and HELCOM guidelines. If this practise will not be followed, disciplinary actions will be taken.
- The management team on *Castoro Sei* has informed electronically the personnel of Saipem and their subcontractors and leaflets have been placed on the ship's information boards highlighting that waste dumping into the sea is strictly prohibited.
- Additional waste containers were ordered to ensure that all concrete waste can be collected and delivered for treatment onshore.
- Environmental inspection focusing on waste management was conducted on *Castoro Sei* on the 6th- 7th of September 2010 by Environ and Nord Stream.

Notification of these events has been submitted to the Finnish authorities on 7th of September 2010.

The oil spill happened on the 8th September 2010 from the pipe supply vessel Maersk Fetcher, which belongs to *Solitaire*'s pipelay spread, in the Kotka harbour. The oil spill into the sea was estimated to be up to 50 l and the spill retained on board >200 l. The spill was most probably a result of ineffective repair or maintenance. The Kotka Port Authority was notified verbally about the spill and confirmed to Allseas that no further action is required /36/.

During the pre-lay survey of the installation corridor of Pipeline 1 from KP 123 to KP 350 a previously unidentified linear feature (Fig 6.12) was recorded at KP 233.609. Allseas interpreted the feature as an unknown cable. Based on existing cable databases, discussions with various cable owners in the permitting phase and consultations with Finnish authorities about planned infrastructure projects in the Gulf of Finland, Nord Stream is unaware of an active cable at this location. As no crossing mattresses have been installed and in order to clarify the situation a video and multibeam survey of the linear feature will be performed as part of the as-laid pipeline survey.

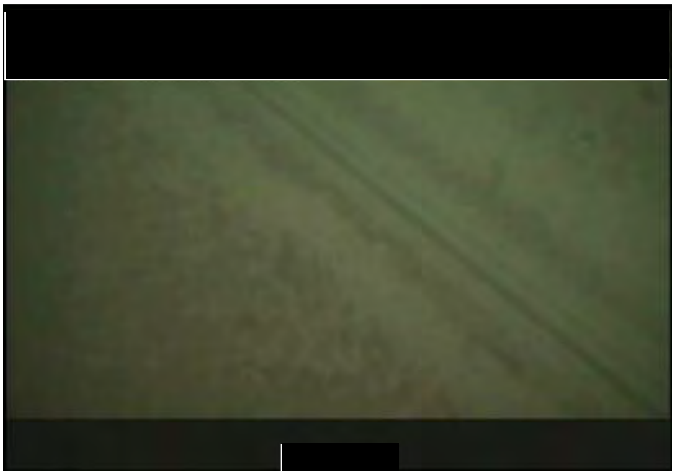


Figure 6.12 The linear feature, a suspected unknown cable, identified at KP 233.609 during the pre-lay survey /40/

6.4 Long term water quality and current monitoring

In the following chapters the main cumulative data on baseline water quality and current monitoring at the stations CONTROL1 and CONTROL2 since autumn 2009 is presented. The detailed results are presented in Appendix 3B.

6.4.1 Currents

Current measurements have been carried out between 4.11.2009 and 30.9.2010 by an automatic ADCP equipment /32/. A schematic drawing of a long term monitoring station is presented in Appendix 3B.

Average current magnitude at CONTROL1 was around 0.06 m/s in the lowest 10 meters water layer and 0.09 m/s in the water layer,10 meters below the surface. At CONTROL2, average current magnitudes increased from 0.06 m/s to 0.1 m/s, when moving from the bottom layer towards the surface layer. The highest recorded current magnitude in the bottom layer of CONTROL1 was 0.37 m/s and 0.51 m/s at CONTROL2.

At CONTROL1 south westerly currents were dominating in the surface layer. In the lowermost layer north easterly currents were typical. At CONTROL2 current distribution varied more. However, south easterly direction was slightly more typical than the others, but no distinct dominant direction was recorded (Figure 6.13). At both stations current magnitudes increased towards the autumn.

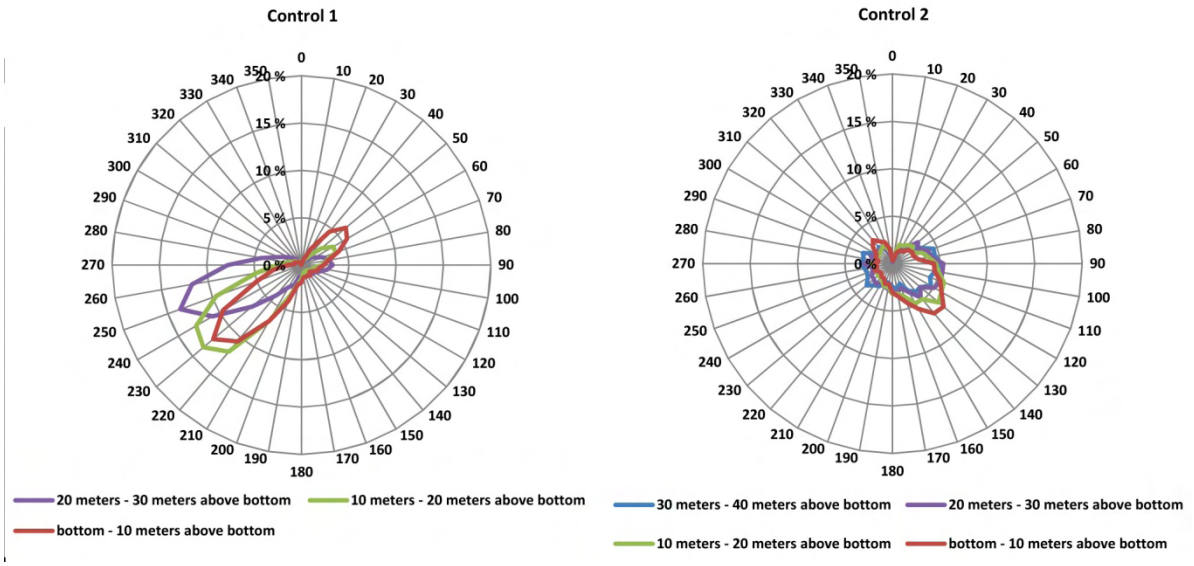


Figure 6.13 ADCP data. Current roses for current directions at the CONTROL1 and CONTROL2 stations during 4.11.2009-1.9.2010 and 4.11.2009-30.9.2010, respectively. Percentage values show the prevailing direction of flow during the monitoring period. Direction 360° = 0° /32/.

6.4.2 Water quality

In the following figures the time series graphs (cumulative data) at the stations CONTROL1 and CONTROL2 (Fixed sensors*)* since autumn 2009 for turbidity and dissolved oxygen are presented. The graphs of the other recorded parameters (temperature, salinity) are shown in Appendix 3B.

Turbidity

Turbidity remained low in bottom near waters also during July-September (Figure 6.14). Average turbidity level was close to 1 NTU. The highest single value recorded during Q3 was 5 NTU at

CONTROL2. However, some minor increases in turbidity were recorded in July-August at both stations /32/. This coincided with decreasing trend of dissolved oxygen concentration in the same water layer, meaning the presence of organic matter.

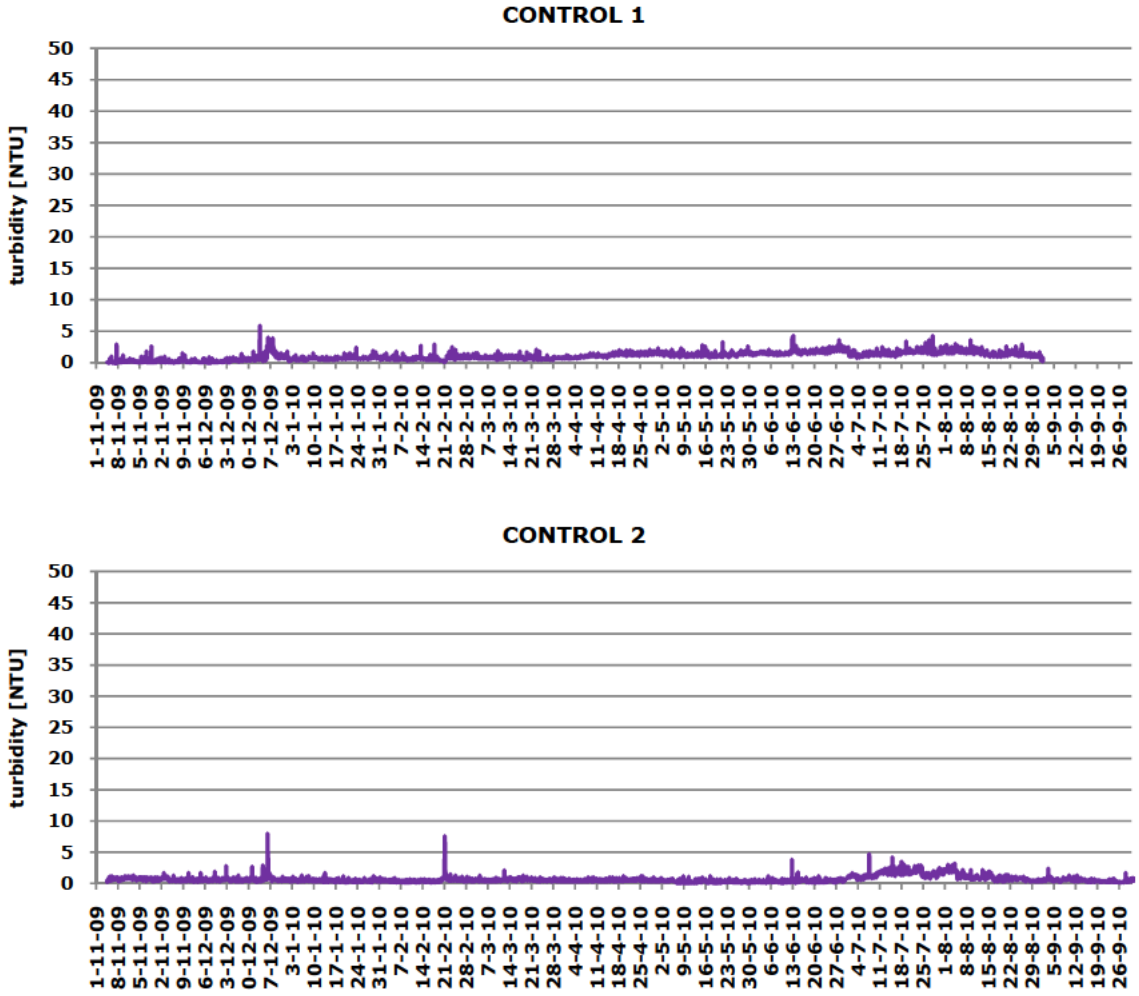


Figure 6.14 Fixed sensors. Recorded turbidity (NTU) near the bottom at the CONTROL1 and CONTROL2 stations 4.11.2009-1.9.2010 and 4.11.2009-30.9.2010, respectively /32/.

Oxygen

At the CONTROL stations dissolved oxygen concentration during Q3 was good (CONTROL1) or poor (CONTROL2) in a scale consisting of five categories from excellent to poor. The result that concentrations above the bottom were clearly higher in CONTROL1 compared to CONTROL2 reflects the differences in the state (eutrophication status) of the Gulf of Finland between west and east. The decreasing trend towards the late summer is typical to the conditions in the Gulf of Finland (Figure 6.15).

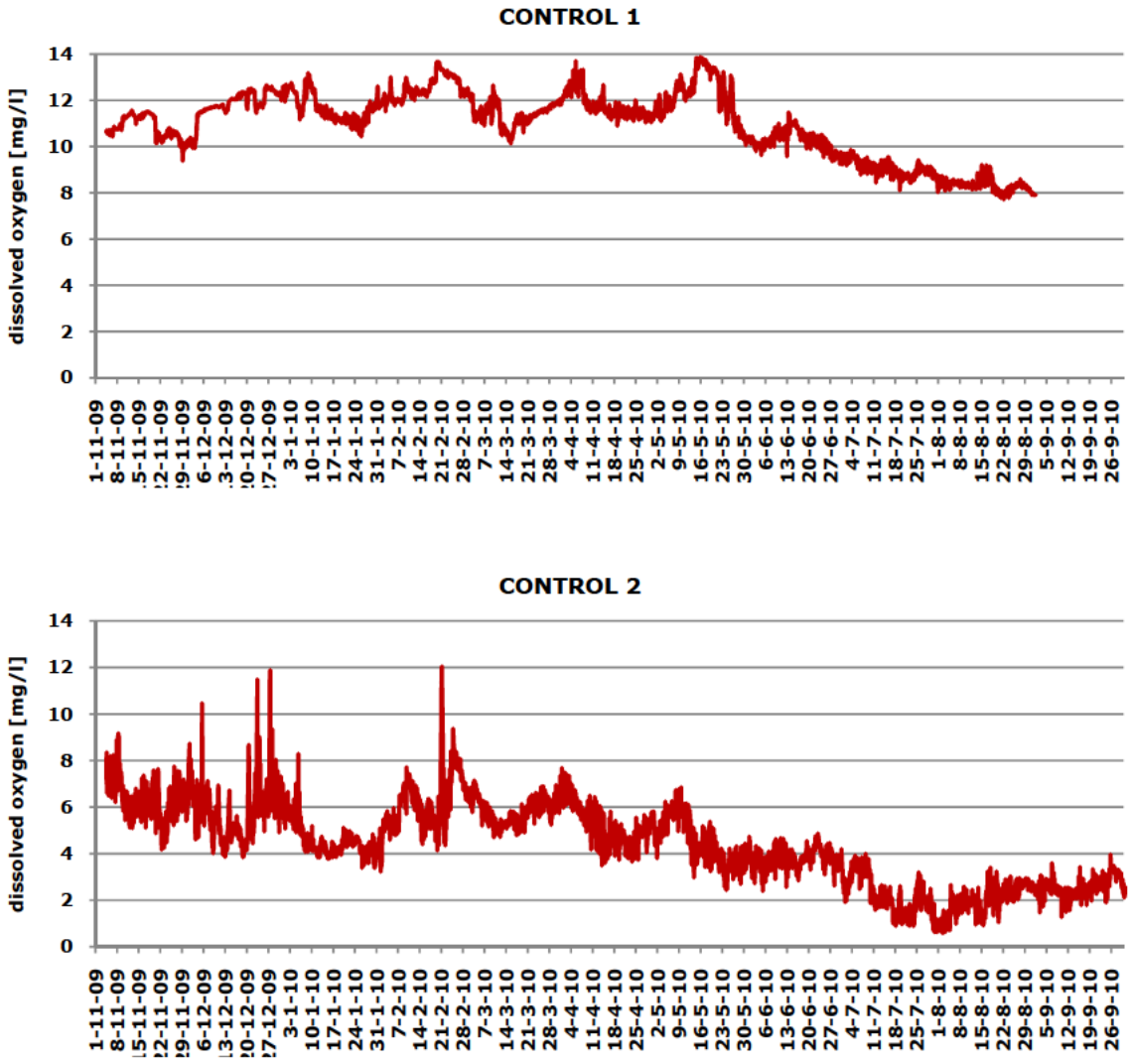


Figure 6.15 Fixed sensors. Recorded oxygen (mg/l) concentrations near the bottom at the CONTROL1 and CONTROL2 stations during 4.11.2009-1.9.2010 and 4.11.2009-30.9.2010, respectively /32/.

6.5 Transboundary monitoring Russia - Finland

A fixed sensor (multiparameter sonde) was installed at FIX3 station on 5 May 2010, i.e. approximately four weeks before the start of the dredging works at the Russian landfall /32/. Monitoring ended on 2nd September 2010, eight weeks after the end of dredging works. Water depth at the station was 42 m.

The recorded vertical turbidity and oxygen concentration data near the seafloor (1.5-2.0 m above) is presented in the following figures. The graphs of the other recorded parameters (temperature, salinity) are shown in the Appendix 3B.

Turbidity

Recorded turbidity data stayed at the background level during the whole monitoring period (Figure 6.16) /24/.

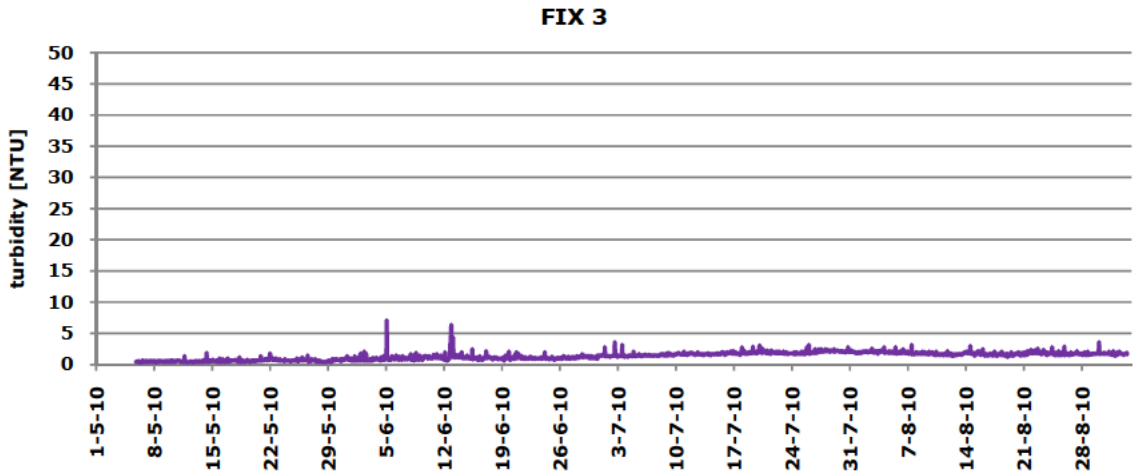


Figure 6.16 Fixed sensor. Turbidity (NTU) near the seafloor at FIX3 on 5.5.-2.9.2010 /32/.

Oxygen

Oxygen concentration at the station was poor during the whole period (Figure 6.17). In August the situation was poorest.

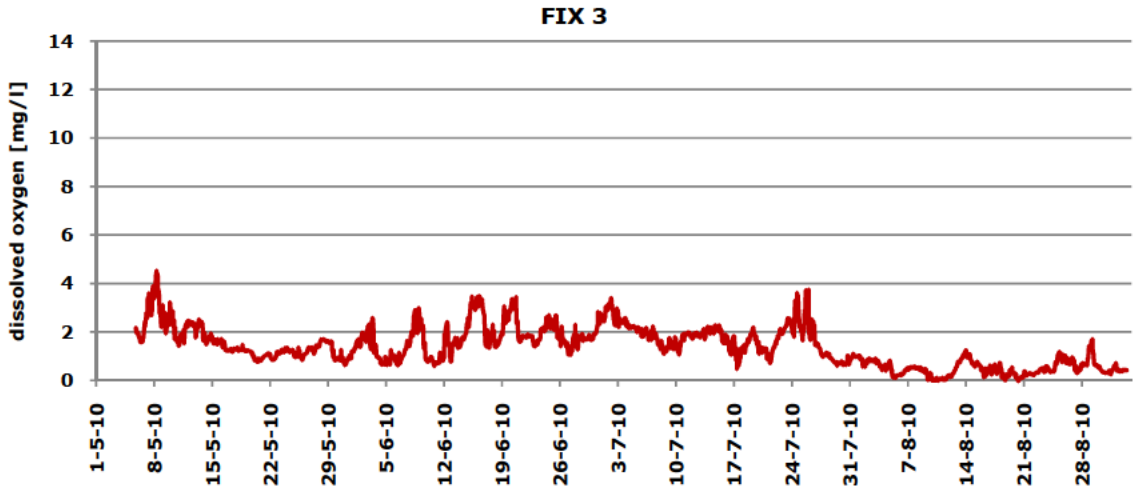


Figure 6.17 Fixed sensor. Oxygen concentration (mg/l) near the seafloor at FIX3 on 5.5.-2.9.2010 /32/.

According to the turbidity values recorded there was no sign of the effects at the FIX3 station of the dredging activities at the Russian landfall.

Water sampling and CTD-profile

The analyses results of the water sample as well as the CTD-profile taken on 2.9.2010 are presented in Appendix 3B.

7. PRELIMINARY CONCLUSIONS

Rock placement

The sediment analysis results for the sediment samples taken from the same transect locations before and after the rock placement activity at the tie-in area showed expected variation because of the natural small scale variability (heterogeneity) of the seabed and the variability/uncertainty caused by laboratory treatments and analyses. The results for the samples taken after the rock placement from the transect locations showed that the concentrations did not indicate any clear or statistically significant trend when compared to the background values. The results indicated a weak correlation between the concentrations of nearly all heavy metals and the distance to the rock berm. The concentrations of dioxins/furans showed no change during the construction work. The TBT concentrations were relatively high before and after the activity, showing random concentration peaks along the transect locations. The TBT concentrations can be expected to be high near the fairways and it is probable that TBT is in the surface sediment in the form of paint flakes or particles, which explains the random nature of the analysis results. Based on the results, rock placement activity did not have any evident effect on the concentrations of TBT or other organotin compounds in the surface sediments studied.

The natural small scale variability of the seabed and the prevailing oxygen conditions regulate strongly the presence macrozoobenthos. The number of macrozoobenthos species and their abundance was low in different locations of the transect near the tie-in before and after the rock placement. In this case the low oxygen concentration near the seafloor, being typical to these depths, is the most dominant regulative factor making the living conditions unfavorable. As a conclusion, based on these results, the rock placement works have not caused significant harmful impacts at these depths to benthos in the vicinity of the tie-in area.

Pipelay

For the most part, the pipeline has been constructed in accordance with the permit provision from KP 350 to KP 498. However, over a length of 177 m the pipeline has been installed out with installation accuracy (maximum offset -8.51 m). The reason for this deviation was to ensure pipeline integrity by avoiding three boulders located within the installation corridor. As-laid pipeline profile is generally slightly deeper than predicted in the design. The total calculated as-laid post-lay rock volume was approximately the same as designed. However, deviating from the design, the majority of post-lay rock berms will be installed prior to pressure testing..

Monitoring results by fixed sensors showed that pipelay with an anchored lay barge caused minor short-term, turbidity peaks above the bottom, not far from the installation corridor. The highest value recorded 50 metres away from pipeline was low, 3.4 NTU. No general increase in turbidity was observed. The soft clay bottoms had no aerobic biota because of complete lack of oxygen.

Clearly elevated turbidity values near the bottom were recorded during vessel operated monitoring of the transect perpendicular to the pipeline, within less than 500 m distance from the pipeline alignment. The highest value was 37 NTU, recorded one metre above the seabed. Based on anchor logs, it is unlikely that anchoring would have caused this turbidity increase. Most probably this increase is attributed to vertical movement of partly buried pipe at the same touchdown point during a 45 minute repair on the pipelay barge. However, when taking into consideration the turbidity level, its occurrence near the bottom and prevailing unfavorable living conditions there, no harmful effects to biota are assessed to have been caused.

Mattress installations

Mattresses at cable crossings (cables FEC-2, EE-SF2 and EE-SF3) were installed as planned.

Wrecks, barrels, and cable crossings

The pipeline was laid over the mattress arrangements at cable crossings for the cables EE-S1 and Pangea Seg 3 as planned. Still the pipeline was partly in freespan at the crossing for the cable EE-S1. It is not expected that the freespan has any effect on the cable, because the mattresses are in any case between the pipeline and the cable.

Ship traffic

Notifications from all vessels involved in rock placement, cable mattress installation and pipelay have been provided to the authorities prior to entering Finnish waters. Also daily, weekly and monthly reports have been submitted to the authorities. Vessel movements have been monitored by GOFREP and notices to mariners on project activities published by Finnish Transport Agency. The cooperation between the authorities and Nord Stream has worked very well.

Chance findings and unplanned events

Four minor incidents related to pipelay happened during Q3/2010. Approximately 3 m^3 of concrete waste (dust from coating) in total was dumped into the sea on three separate occasions from *Castoro Sei*. Subsequently corrective action was taken to prevent the reoccurance of similar events. In addition, one small oil spill from a pipe supply vessel at Kotka harbour was detected.

One previously unidentified linear feature was detected during the pre-lay survey of the installation corridor of Pipeline 1 at KP 233.609. Allseas interpreted the feature as an unknown cable. Nord Stream is unaware of an active cable at this location and a further survey of the feature will be performed as part of the as-laid pipeline survey.

Long term water quality monitoring

Recorded levels of temperature, salinity, turbidity and dissolved oxygen concentration in sea water were typical to the values measured in the Gulf of Finland during summer and early autumn.

Transboundary monitoring Russia / Finland

Based on the results recorded dredging at the Russian landfall did not have any effects on the water quality in the Finnish waters near the border.

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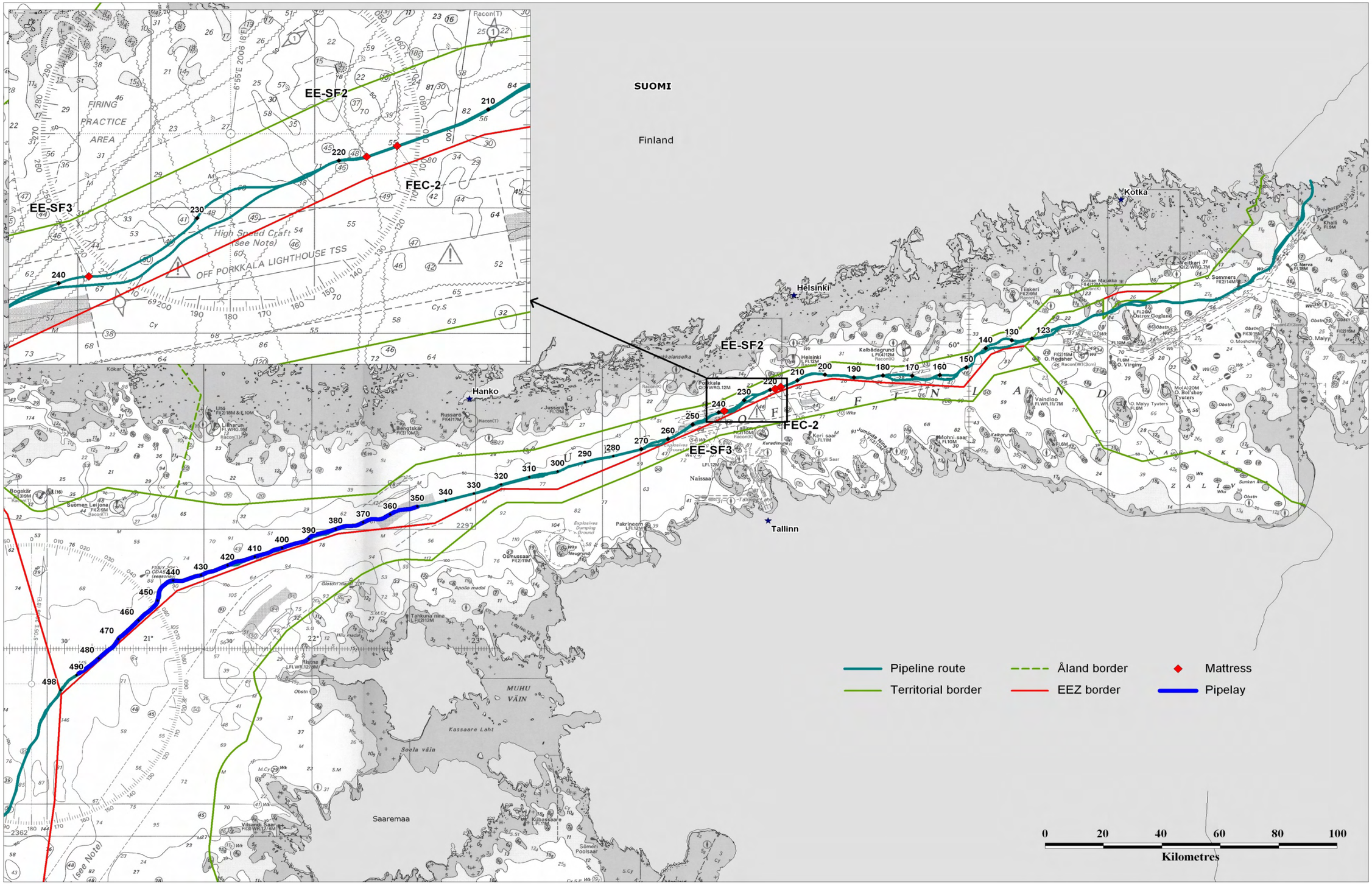
APPENDIX 1

Nord Stream Gas Pipeline construction and operation in the Finnish EEZ.
Environmental monitoring Q3/2010

Nord Stream construction activities in the Finnish EEZ during Q3/2010



APPENDIX 2

Nord Stream Gas Pipeline construction and operation in the Finnish EEZ.
Environmental monitoring Q3/2010

Nord Stream monitoring locations in the Finnish EEZ during Q3/2010