Nord Stream
The new gas supply route for Europe

Nord Stream Project

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## Abbreviations and definitions

| | |
|---|---|
| ADCP | Acoustic Doppler Current Profiler |
| AIS | Automatic Identification System |
| A&R | Abandonment and Recovery |
| Bcm | Billion cubic metres |
| CTD | Conductivity, Temperature and Depth recorder |
| CTDO | Conductivity, Temperature, Depth and Oxygen |
| CMP | Construction Management Plan |
| DCC | Distance of Cross Course |
| DGPS | Differential Global Positioning System |
| EEZ | Exclusive Economic Zone |
| EIA | Environmental Impact Assessment |
| ES | Environmental Study |
| EIA | Environmental Impact Assessment |
| GVI | General Video Inspection |
| HB | Hoburgs bank (Natura 2000 area in Swedish EEZ) |
| HSE | Health, Safety and Environment |
| HSES MS | Health, Safety, Environment and Social Management System |
| IMR | Inspection, Maintenance and Repair |
| IWs | Intervention Works |
| KP | Kilometer Point (starting with KP 0 km at Russian landfall) |
| $M^3$ | Cubic meter |
| MBES | Multi-Beam Echo-Sounder |
| MMT | Marin Mätteknik AB |
| NMB | Norra Midsjöbanken (Natura 2000 area in Swedish EEZ) |
| OBS | Optical Back-Scatter |
| PAM | Passive Acoustic Monitor |
| ROV | Remotely Operated Vehicle |
| SBF | Swedish Board of Fisheries |
| SMA | Swedish Maritime Administration |
| SMHI | The Swedish Meteorological and Hydrological Institute |
| SSC | Suspended Sediment Concentration |
| TOC | Total Organic Carbon |
| TW | Territorial Waters |
| USBL | Ultra-Short Baseline |

# 1 Summary

## 1.1 Summary (Swedish)

### 1.1.1 Inledning

Anläggningsarbetet med de två rörledningarna för naturgas offshore mellan Ryssland och Tyskland (Nord Stream-ledningen) startade under våren 2010. Rörledningarna kommer att koppla samman de stora naturgastillgångarna i Ryssland med det europeiska naturgasnätet.

Tillståndet för anläggning av rörledningarna innehåller ett krav på miljökontrollprogram. Programmet ska omfatta verksamheten från 2010 till 2014 inom den svenska ekonomiska zonen och har utarbetats av Nord Stream i samarbete med de svenska myndigheterna.

Kontrollprogrammet omfattar följande miljö- och socioekonomiska parametrar:

Miljöparametrar:
- Kontroll av röjning av krigsmateriel
- Kontroll av fisk längs rörledningen
- Kontroll av fisk i Natura 2000-områden
- Kontroll av bottenfauna
- Kontroll av vattenkvalitet
- Kontroll av hydrologiska förhållanden i Bornholmsbassängen
- Kontroll av ekotoxikologiska effekter på musslor
- Kontroll av havsbottenmorfologi

Socioekonomiska parametrar:
- Kontroll av fisket
- Kontroll av skyddsåtgärder vid nationella och internationella mätstationer
- Kontroll av kulturarv
- Kontroll av sjöfarten

Detta dokument ger en översikt över all miljökontroll som bedrivits av Nord Stream under 2010 inom den svenska ekonomiska zonen. Dokumentet omfattar statusen för kontrollen i allmänna ordalag tillsammans med de övergripande resultaten. Detaljerade beskrivningar av kontroll och resultat presenteras i särskilda kontrollrapporter, en för varje kontrollmodul.

Dokumentet är det första av fem planerade årliga rapporter vars syfte är att dokumentera statusen och resultaten av kontrollen i den svenska ekonomiska zonen och vid behov rekommendera lämpliga ändringar i kontrollens omfattning.

Fokus för kontrollen under 2010 har generellt sett varit nulägesbeskrivningar. Kontroll av de potentiella konsekvenserna av rörledningarna genomförs inte förrän 2011.

### 1.1.2 Anläggningsarbeten 2010

Följande anläggningsarbeten har genomförts i den svenska ekonomiska zonen under 2010:

- **Stenläggning**. Stenläggning innan rörläggning inleddes den 28 februari 2010. Huvuddelen av arbetet slutfördes den 5 maj 2010. Undersökningar för anpassning och verifiering av konstruktionen fortsatte i juni 2010 och en omkonstruktion vid sammanfogningsplatsen ”tie-in” vid KP 674 var nödvändig. Den totala volymen sten som använts för stenläggning innan rörläggning var cirka 164.000 $m^3$.

  I juni, juli och december 2010 genomfördes stenläggning efter rörläggning på sträckan mellan KP 498 till KP 674 för att korrigera fria spann. Den totala volymen sten som använts för stenläggning efter rörläggning var cirka 15.800 $m^3$.

- **Röjning av krigsmateriel**. Röjning av krigsmateriel påbörjades den 19 mars 2010 och avslutades den 3 april 2010. Kontrollerad undervattenssprängning genomfördes av de sju minor som ansågs vara en risk för anläggningsarbetena i den svenska ekonomiska zonen.

  De sju identifierade krigsmaterielobjekten (minorna) röjdes framgångsrikt genom att placera små laddningar bredvid objektet på havsbotten med hjälp av en fjärrmanövrerad undervattensrobot (ROV). Laddningarna detonerades från ett fartyg som låg på säkert avstånd från minan. Sprängningarna innebar att små kratrar uppstod på platserna där röjningen utfördes, kratrar med en maximal diameter på 10-12 m.

- **Kabelkorsningar (anläggning av betongmadrasser)**. Kabelkorsning genom anläggning av betongmadrasser påbörjades den 26 mars 2010.

  Flexibla betongmadrasser har valts för att säkerställa en permanent vertikal separation mellan rörledningen och kablarna. För vissa korsningar har betongbalksmadrasser valts ut för att ge ytterligare stöd till rörledningen och därigenom minska belastningen på kablarna vid korsningen.

  Visuell kontroll med ROV av befintliga kablar och kabelkorsningskontruktioner har genomförts under 2010 där omfattande identifikation och kontroll av läge och skick, omedelbart innan installation och efter att installationen har utförts. Efter installationen har relationshandlingar i form av en allmän kamerainspektion (GVI) gjorts av korsningens konstruktion. Dessutom har en ”as-left” undersökning utförts för att bekräfta positionen, anpassning och status för rörledningen i förhållande till kabelkorsning och betongmadrasser.

  Alla anläggningsarbeten bedömdes vara lyckade och färdiga i god tid före rörläggningen. Resultaten av undersökningar efter läggning har bekräftat att kabelkorsningarna är lyckade och stabila. Kabelägarna informerades kontinuerligt i enlighet med kabelavtalen.

- **Rörläggning från KP 674 till KP 498**. Arbetsmetoder för rörläggning antogs den 5 april 2010 efter godkända resultat från provläggning till havs. Rörläggningsverksamheten inleddes av rörläggningspråmen Castoro Sei med Linje 1 mot nordost den 6 april 2010. Rörläggning från KP 674 till KP 498 avslutades framgångsrikt den 27 juni 2010. Den totala rörläggningen i den svenska ekonomiska zonen var 176 km under 2010.

- Den 30 december 2010 återinträdde Castoro Sei i den svenska ekonomiska zonen efter avslutad rörläggning av Linje 1 i danskt vatten. Rörläggning av Linje 1 i den svenska ekonomiska zonen förväntas vara slutförd i tie-in läget öster om Gotland vid KP 674 under andra kvartalet 2011.

  Under rörläggning i svenska ekonomiska zonen assisterades Castoro Sei av tre ankarhanteringsfartyg. Dessa fartyg hanterade 10-12 ankare för att säkerställa att rörläggningspråmen fick en korrekt position. Dessutom transporterade fyra fartyg, s k pipecarriers rördelar mellan lagret i Slite på Gotland och Castoro Sei.

### 1.1.3 Kontroll av röjning av krigsmateriel

Under perioden 19 mars-3 april 2010 genomfördes kontroll av miljöparametrar i samband med röjning av krigsmateriel. Kontrollen genomfördes före, under och efter röjning. Syftet med kontrollen var att minska påverkan på den marina faunan (fisk, marina däggdjur) och att utvärdera och dokumentera effekterna på miljön från röjningen av krigsmateriel.

Följande parametrar/rutiner ingick i kontrollen:

- Observationer, med hjälp av ekolod, passiv akustisk övervakning (PAM), av marina däggdjur och fiskar före och efter röjning av krigsmateriel.
- Observationer av sjöfåglar före och efter detonation.
- Användning av fisk- och sälskrämmor före detonationen.
- Kontroll av havsvattnets strömhastighet och riktning.
- Kontroll av tryckvågor från detonationen.
- Multi-beam ekolod (MBES) mätningar av havsbotten och visuella undersökningar med fjärrmanövrerad undervattensrobot (ROV) före och efter detonation.

Resultaten av kontrollen visade att inga marina däggdjur eller sjöfåglar skadades eller dödades i samband med röjningsverksamheten. Generellt har endast små mängder fisk samlats in från havsytan efter varje detonation (<20 individer per plats).

### 1.1.4 Kontroll av fisk längs rörledningen

Kontroll av fisk längs rörledningssträckningen genomfördes under perioden september till november 2010. Kontrollen fokuserade på bottenlevande fiskarter och omfattade undersökningar genom trålfiske (TV3-520 tråll), garnfiske (nät typ K072), ekolodmätningar och visuella inspektioner med en ROV. Kontrollen har gjorts i tre områden med olika förutsättningar: Mellan Hoburgs bank och Norra Midsjöbanken (där rörledningen kommer att läggas direkt på havsbotten), Norra Midsjöbanken (där rörledningen kommer att grävas ned i bottnen) och Norra Midsjöbanken (där det kommer att vara stenläggning).

Syftet med kontroll av fisk längs rörledningssträckningen är att utvärdera och dokumentera de kvalitativa och, om möjligt, kvantitativa förändringarna i bestånden av bottenlevande fisk i de områden som gränsar till Nord Streams rörledningar, i förhållande till fiskbestånden på havsbottnen runt om.

Resultaten visar att torsk och sill dominerar fångsterna i de tre undersökta områden. Detta är också i enlighet med de fångstuppgifter som erhållits från svenska fiskare och Baltic International Trawl Survey i Östersjön. Skarpsill är glest representerad i undersökningsresultaten vilket var oväntat. Andra arter representerade i fångsterna var flundra, skarpsill, storspigg, rötsimpa, rödspätta och vitling.

Resultaten visade på stora geografisk skillnader mellan de studerade tre områdena i fråga om förekomst och sammansättning av fisk, skillnaderna orsakas sannolikt av variationer i bottensubstrat, djup och syrehalter.

### 1.1.5 Kontroll av fisk i Natura 2000-områden

Kontroll av fisk inne i de två Natura 2000-områdena Hoburgs bank och Norra Midsjöbanken genomfördes under perioderna juni 2010 och september/oktober 2010. Kontrollprogrammet omfattar 40 stationer på Hoburgs bank och 40 stationer på Norra Midsjöbanken, med 20 "påverkan" stationer, och 20 referensstationer på varje bank. Kontrollen omfattade nätfiske med K072 nät, CTDO-mätningar av konduktivitet (salthalt), temperatur, djup, syrehalt och Secchiskive-mätningar och livsmiljöbeskrivning genom undervattensvideoinspelningar av havsbotten.

Syftet med kontrollprogrammet är att utvärdera och dokumentera eventuella effekter på fiskfaunan inom Natura 2000-områden av anläggningsarbetena (särskilt dikning). Fokus ligger på bottenlevande fiskarter eftersom genomförda bedömningar tyder på att det främst är bottenlevande fisk som kan komma att påverkas eftersom störningen främst är koncentrerad till havsbotten.

Kontrollen år 2010 har till syfte att fastställa en nulägesbeskrivning för liknande undersökningar som planeras under 2011-2014.

Sammanlagt 12 olika arter fångades under de två undersökningarna. Resultaten från undersökningarna visar att de kvantitativt dominerande arterna var torsk, flundra, piggvar, rötsimpa, tånglake och strömming. Av övriga sex arter fångades endast en individ av varje art.

Förekomsten av torsk inne på grunt vatten i de två Natura 2000-områdena var god i september jämfört med juni. Däremot var förekomsten av flundra och piggvar högre i juni.

De övergripande skillnaderna i förekomst mellan de tre arterna torsk, flundra och piggvar mellan "påverkan"- och referensområdena på de två bankerna var:

- Torsk fanns rikligare i ”påverkan”-området, jämfört med referensområdet vid Hoburgs bank i septemberundersökningen. Det fanns inga skillnader i förekomst av torsk mellan ”påverkan”- och referensområden på Norra Midsjöbanken, varken under juni- eller septemberundersökningen. Det fanns inte heller några skillnader på Hoburgs bank vid juniundersökningen.

- Det var en högre förekomst av flundra i referensområdet vid Norra Midsjöbanken i september jämfört med ”påverkan”-området. Det fanns inga skillnader i förekomst av flundra mellan

”påverkan”- och referensområde vid Hoburgs bank vid juni- och septemberundersökningen. Det fanns inte heller några skillnader på Norra Midsjöbanken vid juniundersökningen.

- Det var en högre förekomst av piggvar i referensområden jämfört med ”påverkan”-området på bankerna vid både juni – och septemberundersökningen.

Undersökning av kön och ålder för individer av de tre vanligaste arterna visade att ungtorsk dominerade i alla områden i juni- och septemberundersökningarna. Könsmogen och lekande torsk observerades under juni, medan utlekt torsk observerades i septemberundersökningen. Detta visar, tillsammans med torskarnas individuella fördelning av längd och biomassa, att lek hade ägt rum under perioden mellan juni och september.

Könsmogen, lekande och utlekt flundra dominerade fångsten i juni, medan fångsten i september dominerades av könsmogna flundror. Flundrorna bedömdes vara på toppen eller i slutet av lekperioden i juniundersökningen.

Juni- och septemberundersökningarna dominerades av könsmogna piggvarar. I juni fanns ett relativt stort antal lekande piggvarar i ”påverkan”-området på Hoburgs bank, medan det generellt fanns ett relativt stort antal utlekta individer i alla områden i septemberundersökningen. Från resultatet gjordes bedömningen att piggvaren var på väg att börja eller precis hade börjat sin lek i juni.

### 1.1.6 Kontroll av fisket

Kontroll av fisket utförs som en skrivbordstudie baserad på uppgifter om fiske från svenska Fiskeriverket. För analysen år 2010 ingick data från de senaste 10 åren av fiske (2000-2009). Syftet med kontrollen av fiske i vattnen längs rörledningens sträckning är att utvärdera eventuella förändringar i bottenfiskemönster och fångad fisk efter anläggningen av rörledningarna.

Kontrolldata omfattar satellit- och loggboksdokumentation som sammanställs av Fiskeriverket och som är en del av den lagstadgade registreringen av fiskemönster och fångster av den svenska fiskeflottan.

Fiskemönster efter bottenlevande fisk beskrivs genom densitetsplottar för beräknad bottentrålning och bottengarnfiske men också genom beräknat antal fiskebåtar som trålfiskar över ledningarna per KP.

Mönstret för fångst beskrivs genom data (fångst (i kg) av olika arter) i en korridor med en bredd på ungefär 10 km runt rörledningens sträckning från KP 750 till KP 1004, både som en totalmängd och som sektionsmängd.

Resultaten av satellitdataanalysen visar att den generella bottentrålningen har varit begränsad till den västra delen av området mellan KP 930 till KP 950 och har minskat de senaste 6 åren. Bottengarnfiske har skett i områden ca 20 km nordväst om rörledningen, från KP 900 till KP 950.

Resultatet av analysen av loggboksuppgifter följer generellt trenderna för fångster i Östersjön. Det innebär t.ex. att torsk, sill, skarpsill och rödspätta är de dominerande kvotreglerade fiskarterna som

fångats i den specifika korridoren medan flundra, piggvar och vitling är de dominerande icke kvoterade fiskarterna.

### 1.1.7 Kontroll av bottenfauna

Kontroll av bottenfauna omfattar infaunaundersökningar en gång per år i juni från 2010 och epifaunaundersökningar en gång per år i september/oktober från och med 2011, efter att rörledningarna lagts ner.

Syftet med kontrollen av bottenfauna längs ledningssträckning är att utvärdera och dokumentera återkolonisation och återställning av infaunaförändringar efter att rörledningarna anlagts samt att utvärdera och dokumentera etablering och tillväxt av epifauna på rörledningar och stenvallar (som anlagts).

Kontroll av bentisk infauna har utförts på Hoburgs bank (elva stationer) och på Norra Midsjöbanken (tio stationer). I undersökningen vid varje station ingår en videoinspelning av havsbotten, mätning av konduktivitet (salthalt), temperatur, djup och syre i hela vattenmassan, sedimentprovtagning för analys av utvalda fysikaliska och kemiska parametrar och tre van Veen-hugg med prover för analys av infauna.

Kontroll av bentisk epifauna planeras mellan Hoburgs bank och Norra Midsjöbanken (område med rörledning på havsbotten), vid Norra Midsjöbanken (område där dikning sker) och på Norra Midsjöbanken (område för stenläggning). Kontrollen kommer att utföras som visuella inspektioner med videokamera (ROV) med start från och med 2011, efter det att anläggning av den första rörledningen har slutförts.

Resultaten av kontrollen under 2010 visade inga systematiskt geografiska förändringar i förekomst och biomassa av infauna, varken längs transekterna eller vid Hoburgs bank och på Norra Midsjöbanken. Förekomst och biomassa hos samhällena dominerades av ett fåtal arter av havsborstmaskar (Bylgides sarsi, Marenzelleria viridis och Pygospio elegans), musslor (Macoma balthica) och kräftdjur (Pontoporeia affinis och Saduria entomon) som är karakteristiska för områden med låg mångfald och låg salthalt i Östersjön. Förekomst av blåmusslor (Mytilus edulis), oidentifierade arter av fåborstmaskar och korvmask (Halicryptus spinulosus) var liten eller saknades helt på de flesta mätstationer. Trots den övergripande likheten av infaunan visade en statistisk analys att infaunan var annorlunda på några av stationerna längs de två undersökta transekterna.

En jämförelse av data från undersökningen 2010 med resultaten från en undersökning som genomfördes 2007 visade stora geografiska variationer och årsvariationer i artsammansättning och förekomst även inom samma område. Det finns dock inga statistiska förutsättningar för en jämförelse av data eftersom endast ett prov togs vid varje station i 2007 års undersökning.

### 1.1.8 Kontroll av vattenkvalitet

Kontroll av vattenkvaliteten påbörjades 6-7 november 2010 genom utplacering av fyra fasta mätstationer vid de två Natura 2000-områden som anses känsliga när det gäller påverkan på vattenmiljön. Två stationer vardera sattes ut vid den sydöstra gränsen av Natura 2000-områdena, Hoburgs bank respektive Norra Midsjöbanken. Stationerna planeras att vara i drift till och med juli 2011.

Syftet med kontrollen av vattenkvaliteten är att utvärdera koncentrationerna av suspenderade sediment (SS) och dokumentera efterlevnaden av gränsvärdet (15 mg/l över bakgrundsnivån) samt att verifiera resultaten från den simuleringsmodell om sedimentspridning som presenterats i den svenska miljöredovisningen.

De fasta mätstationerna mäter turbiditet (som kommer att omvandlas till SS), strömhastighet och strömriktning, salthalt, temperatur och skiktning samt sjunkande flöde (downward flux) av suspenderade sediment. Mätning utförs före, under och efter dikning. Komplettering av den automatiska mätningen vid de fasta mätstationerna sker vid driftbesök vid stationerna. Manuella mätningar görs av masskoncentration, suspenderade ämnen samt turbiditet och vattentemperatur/konduktivitet för varje meter av vattenpelaren.

Resultaten från de första två månadernas mätningar analyserades i januari 2011 och en modell för den naturliga variationen av SS (som främst beror av de meteorologiska och hydrologiska förhållandena) fastställdes för var och en av de fyra fasta stationerna. Denna modell används för att kvantifiera en eventuell ökning av SS vid gränsen till två Natura 2000-områden som orsakas av dikning.

Analysen visar att den naturliga koncentrationen av SS i området är mycket låg, i allmänhet under 2 mg/l. Den låga nivån gör att den eventuella ökningen orsakad av dikning kan kvantifieras med en relativt hög noggrannhet. Det bör noteras att den naturliga koncentrationen av SS ökade under hårt väder - särskilt under kortvariga stormar, vilket kan göra det svårt att göra en "korrekt" bedömning av den naturliga koncentrationen av SS.

Som ett komplement till de fasta mätstationer kommer kontroll från fartyg att utföras under dikning av rörledningarna i februari/mars 2011. Profiler av turbiditet, salthalt, vattentemperatur och strömmar kommer att mätas nedströms dikningsarbeten. Baserat på modellering av spridning av grumlade sediment från dikning med olika strömhastigheter har relationen mellan strömhastighet och minskningen i SS med avståndet från sedimentspridningskällan fastställts. Denna relation kommer att användas som ett tidigt varningssystem. Genom att mäta SS nära källan för sedimentspridning går det att förutse om verksamheten kan komma att överskrida gränsvärdet 15 mg/l vid gränsen till de två Natura 2000-områden. Dessutom kommer resultaten att ge stöd för tolkningen av data från de fasta mätstationerna.

### 1.1.9 Kontroll av hydrografiska förhållanden i Bornholmsbassängen

Kontroll av de hydrografiska förhållandena i Bornholmsbassängen startades i januari 2010 och avslutades i januari 2011. Syftet med det hydrografiska kontrollprogrammet på danskt och svenskt vatten var att skapa underlag för den teoretiska analysen av möjlig blockering av vatteninflödet till Östersjön orsakad av Nord Streams rörledning på havsbotten.

Kontrollen syftar till att beskriva bottenströmmar, gränsskiktsfriktion (interfacial friction) och skingrande av inflödande vatten. Händelser med inflödande vatten förväntas inträffa nära havsbotten (främst under vintersäsongen) och under haloklinen (främst under sommaren). Oceanografiska mätningar (hastighet, temperatur, salthalt) genomfördes initialt under en niomånadsperiod (varav ca 1 månad utan mätningar) vid KP 1036 nordost om Bornholm på ett

vattendjup av cirka 90 m. Hösten 2010 flyttades mätstationen till KP 966 för att även registrera mätningar från grundare vattendjup (ca 68 m).

Utöver den fasta stationen, har strömmar mätts i linjetransekter med ADCP. Linjetransekterna utförs längs ledningens sträckning mellan KP 1030 och KP 1070. Totalt 7 transekter var planerade att utföras i samband med serviceinspektioner (inkl. mobilisering och demobilisering) men dessa har reducerats på grund av väderförhållanden. I slutet av 2010 hade mätningar i fyra linjetransekter genomförts.

Resultaten av kontrollen kommer att överlämnas till myndigheterna under sommaren 2011 i en separat rapport när data har analyserats. Rapport kommer att ingå i den årliga uppföljningsrapporten till de svenska myndigheterna: "Environmental monitoring in Swedish waters 2011".

### 1.1.10 Kontroll av ekotoxikologiska effekter på musslor

Kontroll av ekotoxikologiska effekter på musslor inleddes i december 2010 och planeras pågå till april 2011. Kontrollen kommer att utföras före, under och efter dikning av Nord Streams nordvästra rörledning (Linje 1).

Syftet med kontrollen av ekotoxikologiska effekter på musslor är att utvärdera och dokumentera eventuell spridning av föroreningar i samband med att sediment grumlas i vattenmassan genom arbeten (dikning) syd-sydost om de två Natura 2000-områdena Hoburgs bank och Norra Midsjöbanken.

Kontrollen sker genom att mäta effekten på blåmusslor (Mytilus edulis) i burar/nätkassar vid sex fasta stationer vid gränsen till de två Natura 2000-områdena.

Vid 12 mätstationer belägna i områden med liknande vattendjup analyseras ett musselprov med avseende på fysiska egenskaper och tre prover avseende föroreningar. De föroreningar som ska analyseras är tungmetaller (Hg, Cd, Cu, As, Zn, Ni, Pb, Cr, Sn) och organiska tennföreningar.

Musslor, insamlade vid Faludden på södra Gotland, kommer vid varje station att placeras i burar under en 1 ½ månadsperiod. Därefter kommer de att samlas in och skickas för fysisk och kemisk analys. Detta förfarande kommer att genomföras tre gånger under perioden januari till april 2011.

Kontrollen under 2010 har omfattat insamling av musslor vid Faludden, fysiska och kemiska analyser av musslorna och etablering av de 12 stationerna med musselburar.

### 1.1.11 Kontroll av andra parametrar

**Havsbottenmorfologi**

Kontroll av havsbottenmorfologin har utförts före, under och efter anläggningsarbeten.

Innan anläggningen av rörledningen har havsbottenmorfologin kontrollerats med en instrumenterad ROV längs rörledningens installationskorridoren. Under 2010 har en undersökning längs mittlinjen av rörledningssträckningen utförts före läggning mellan KP 676 till 498 och KP 1004 till 990 med ROV försedd med Multi-beam ekolod (MBES), ekolod och videokameror. Lösa föremål av betydelse

och avvikelser i havsbotten som kunde äventyra en säker anläggning av rörledningen rapporterades och utvärderades omedelbart för att kunna planera och vidta nödvändiga korrigerande åtgärder innan rörledningen läggs ned.

Under anläggningen av rörledningen, användes ROV ”touchdown monitoring” (TDM) för att understödja rörläggningsfartyget Castoro Sei.

Efter rörläggning genomfördes en ytterligare undersökning av rörledningen med ROV. Multi-beam ekolod (MBES) användes för att kartlägga rörledningskorridoren från 0 till 10 m på vardera sidan av rörledningen. Eventuella angränsande avvikelser följdes upp med sonar. Videokameror användes för visuella inspektioner av rörledningens skick och eventuella skador, beläggning, anoder och skarvar på rörledningen inspekterades.

**Nationella och internationella miljöövervakningsstationer**
För att avgöra om anläggningen av rörledningarna påverkar nationella eller internationella miljöövervakningsprogram har mätstationernas placering i förhållande till rörledningen med tillhörande bygg- och driftaktiviteter identifierats. Koordinater för både nationella och internationella mätstationer har klargjorts och uppgifter om plats och vilka parametrar som mäts har sammanställts. Potentiell påverkan på miljöövervakningsstationer kan uppkomma om:

- Tiden för mätaktiviteter sammanfaller med anläggningsarbeten
- Miljöövervakningsstationerna är belägna i närheten av områden där arbeten i havsbotten sker (dikning eller stenläggning) och därmed potentiellt kan påverkas av återsedimentation av sediment som har grumlats under konstruktionsarbeten
- Miljöövervakningsstationerna ligger mycket nära rörledningarna och kan potentiellt påverkas av lokala förändringar i erosions eller sedimentationsmönster runt rörledningarna

Fyra av de befintliga miljöövervakningsstationerna i den svenska ekonomiska zonen ligger inom ± 1,5 km från rörledningarna (och en SMHI-station i Finlands ekonomiska zon). Riskreducerande åtgärder har föreslagits och överenskommits med myndigheterna.

**Kulturarv**
Syftet med kulturarvsövervakningen är att dokumentera skicket på vrak innan rörläggning, dikning, stenläggning och ankarhantering, att skydda vraken under anläggningsarbetena samt att kontrollera vrakens tillstånd efter anläggningsarbetena.

Inför anläggningen av Nord Streams rörledningar har utförliga säkerhets- och ankarkorridorsundersökningar genomförts i syfte att klargöra förekomsten av kulturarv inom rörledningens ankarkorridor (± 1 km från rörledningen). Data från dessa undersökningar har utvärderats av företaget Marin Mätteknik AB (MMT) och av Statens maritima museer. Ett kontrollerat anläggningsförfarande för platser där arkeologiskt viktiga vrak finns har därefter diskuteras och överenskommits med svenska myndigheter. Dessutom har den havsbotten som direkt påverkas av arbetena besiktigats före stenläggning, dikning och rörläggning för att kontrollera att inga nya objekt har tillkommit.

Kontrollen av kulturarven kommer att genomföras via en visuell inspektion med ROV. En ROV

kommer att användas på arkeologiskt betydande vrakplatser och ta undervattensbilder och videor av objekten. Kontrollen av vraken efter rörläggningen är planerad att genomföras när Linje 2 är anlagd, under 2012. Därför planeras kontrollresultaten om kulturarv ingå i årsredovisningen för 2012.

Under anläggningsarbetena i den svenska ekonomiska zonen passerades ett antal skyddade objekt som klassats vara av kulturhistorisk betydelse. Objekten bestod av såväl delvis intakta vrak som platser med sönderbrutna vrakdelar. Inför läggningspråmens passage av objekten hade en läggningsplan för ankare överenskommits med relevanta myndigheter. Denna plan kunde följas med endast ett undantag.

Under 2012 genomförs en efter läggning-undersökning som kommer att jämföras med den redan utförda undersökningen före läggning för att se om statusen för de skyddade objekten har förändrats.

**Sjöfarten**
Syftet med Nord Streams kontroll och övervakning avseende sjöfart är att minimera risken för kollisioner eller andra olyckor med kommersiell fartygstrafik och/eller fartyg som utför bygg- och anläggningsverksamhet för projektet. Säkerhetszoner av varierande utbredning etableras runt alla fartyg som utför anläggningsarbeten under vatten. Ledningssystem för fartyg används (t.ex. Automatic Identification System (AIS) för identifiering och lokalisering av fartyg). Information om kommande och pågående bygg- och anläggningsverksamhet lämnas till berörda myndigheter som i sin tur, genom informationskanaler såsom "Underrättelser för sjöfarande" och NAVTEX, meddelar fartygstrafiken. Information avsedd för fiskenäringen tas regelbundet fram och levereras både till enskilda fiskare och fiskets organisationer.

Under anläggningsarbetena i den svenska ekonomiska zonen, har Nord Stream och konstruktionsfartygen följt det kommunikations- och rapporteringsförfaranden som har överenskommits med svenska myndigheter och organisationer. Nord Stream har försett berörda myndigheterna med t.ex. dagliga uppdateringar från anläggningsfartygen liksom vecko- och månadsprognoser för anläggningsarbetena. Fiskerinäringen har försetts med regelbunden information sedan anläggningsverksamheten påbörjades och fortsatt information kommer att lämnas under hela anläggningstiden.

Nästan alla typer av anläggningsverksamhet som planerades inom Nord Stream-projektet i den svenska ekonomiska zonen har redan genomförts flera gånger under det senaste året - undersökningsaktiviteter, röjning av krigsmateriel, anläggning av betongmadrasser, stenläggning och rörläggning.

Försiktighetsåtgärder avseende säkerhet har framgångsrikt implementerats och anläggningsverksamheten har utförts utan några olyckor eller tillbud för tredje parts fartyg.

## 1.2 Summary (English)

### 1.2.1 Introduction

The construction of the two offshore natural gas pipelines from Russia to Germany (the Nord Stream Pipeline) commenced in spring 2010. The pipelines shall connect the large natural gas resources of Russia with the European natural gas pipeline network.

As part of the permit requirements for construction of the pipelines, an environmental monitoring programme covering activities from 2010-2014 within the Swedish EEZ was elaborated by Nord Stream in collaboration with the Swedish authorities.

The monitoring programme covers the following environmental and socioeconomic parameters:

Environmental parameters:

- Monitoring of munitions clearance
- Monitoring of fish along pipeline
- Monitoring of fish inside Natura 2000 areas
- Monitoring of benthic fauna
- Monitoring of water quality
- Monitoring of hydrographic conditions in the Bornholm Basin
- Monitoring of ecotoxicological effects on mussels
- Monitoring of seabed morphology

Socioeconomic monitoring parameters:

- Monitoring of fishery
- Monitoring of / mitigation measures at national and international monitoring stations
- Monitoring of cultural heritage
- Monitoring of maritime traffic

This document provides an overview of all environmental monitoring activities carried out by Nord Stream in 2010 within the Swedish EEZ. The document covers the status of monitoring in general terms along with the overall results. Detailed descriptions of monitoring activities and results are presented in specific monitoring reports, one for each monitoring module.

The document is the first of five planned annual reports, the purpose of which is to document the status and the results of the monitoring activities in the Swedish EEZ and if necessary recommend appropriate adjustments to the monitoring scope.

The focus of the monitoring in 2010 has generally been baseline monitoring. The monitoring of potential impacts of the pipelines is not undertaken until 2011.

### 1.2.2 Construction activities 2010

The following construction activities were undertaken in the Swedish EEZ during 2010:

- **Rock placement**. Pre-lay rock placement works was commenced on 28 February 2010. The majority of the work was completed by 5 May 2010. Investigations for calibration and verification of design were continued in June 2010 and subsequent re-design at the hyperbaric tie-in positions at KP 674 was necessary. The total volume of rock used for the pre-lay rock placement was approximately 164,000 $m^3$.

  In June, July and December 2010 post-lay rock placement (after pipe-laying) was undertaken between KP 498 to KP 674 for free span correction. The total volume of rock used for the post-lay rock placement was approximately 15,800 $m^3$.

- **Munitions clearance**. Munitions clearance activities started on 19 March 2010 and were completed by 3 April 2010. Controlled underwater explosion of seven mines which were considered a risk to the construction activities in the Swedish EEZ was completed.

  The seven identified munitions objects (mines) were cleared successfully by placing small charges next to the identified munitions objects on the seabed using a Remotely Operated Vehicle (ROV). The charge was detonated from a ship located at a safe distance from the target. The explosions resulted in creation of small craters at the munitions sites, with maximum diameters of 10-12 metres.

- **Cable crossing (mattress installations)**. Cable crossing mattress installation started on 26 March 2010.

  Flexible concrete mattresses have been selected to ensure a permanent vertical separation between the pipeline and the cables. For some crossings, concrete beam mattresses have been selected to provide additional bearing support to the pipeline thereby reducing the loading on the cables at the crossing locations.

  Monitoring of the existing cables and the constructed crossings during 2010 was done by visual inspection via ROV to identify and verify the target position and condition immediately prior to and after crossing installation. After the installation an as-built general video inspection (GVI) was made of the crossing structure. In addition the as-left crossing survey was done to confirm the position, alignment and status of the pipeline in relation to the cable crossing and mattresses.

  All installations were deemed successful and locations were ready well in advance prior to pipe-laying. Post-lay survey results have confirmed the cable crossings to be successful and stable. Cable owners were continuously kept informed in accordance with cable agreements.

- **Pipe-lay from KP 674 to KP 498**. Working procedures for the pipe-lay were approved by 5 April 2010 based on successfully performed sea trials. Pipe-lay activities were commenced by the pipe-lay barge Castoro Sei with Line 1 towards the northeast on 6 April 2010. The pipe-lay from

KP 674 to KP 498 was successfully completed on 27 June 2010. The total pipe-lay in the Swedish EEZ in 2010 was 176 km.

On 30 December 2010 Castoro Sei re-entered into the Swedish EEZ after completing pipe-lay of Line 1 in Danish waters. Pipe-lay of Line 1 inside Swedish EEZ is expected to be completed at the tie-in location east of Gotland at KP 674 in the second quarter of 2011.

During pipe-lay in Swedish EEZ Castoro Sei was supported by three dedicated anchor vessels handling 10-12 anchors to ensure the correct position of the pipe-lay vessel. In addition, four pipe carriers provided pipes transported from the stockyard at Slite on Gotland to Castoro Sei.

### 1.2.3 Monitoring of munitions clearance

Monitoring of environmental parameters related to munitions clearance was undertaken before, during and after clearance in the period from 19 March to 3 April 2010. The purpose of the monitoring is to reduce impacts on the marine fauna (fish, marine mammals) and to evaluate and document effects on the environment from the munitions clearance.

The following parameters/procedures were included during monitoring:

- Observations of marine mammals and fish before and after munitions clearance, by use of echo-sounder, passive acoustic monitoring (PAM).
- Observations of seabirds before and after detonation.
- Use of fish and seal scarer before detonation.
- Monitoring current velocity and direction of seawater.
- Monitoring of the blast wave from the detonation.
- Multi-beam echo-sounder (MBES) measurements of the seabed, and visual surveys with a Remotely Operated Vehicle (ROV) before and after detonation.

The results of the monitoring showed that no marine mammals or seabirds were injured or killed during the clearance operations. Generally, only a low numbers of fish were collected from the sea surface (<20 individuals per location) after each detonation.

### 1.2.4 Monitoring of fish along the pipeline

Monitoring of fish along the pipeline was undertaken in the period from September to November 2010. The monitoring was focused on demersal fish species and comprised surveys on trawl fishery (TV3-520 trawl), gill net fishery (gill net type K072), echo-sounder measurements and visual inspections with a remotely operated vehicle (ROV). The monitoring was undertaken in three areas with different conditions; between Hoburgs bank and Norra Midsjöbanken (where the pipeline will be laid directly on the seabed), Norra Midsjöbanken (where the pipeline will be trenched into the seabed) and Norra Midsjöbanken (where there will be rock placement).

The purpose of the monitoring of fish along the pipeline is to evaluate and document the qualitative and, if possible, quantitative changes in the demersal fish communities in the areas adjacent to the Nord Stream pipelines compared to the fish community of the surrounding seabed.

The results show that Cod and Herring dominate the catches in the three surveyed areas, which is in accordance with the fish catch data obtained from the Swedish fishermen and the Baltic International Trawl Survey in the Baltic Sea. However, Sprat is sparsely represented in the survey results, which is unexpected. Other species represented in the catches include Flounder, Sprat, Three-spined stickleback, Shorthorn sculpin, Plaice and Whiting.

The results indicated a large spatial difference between the three studied areas in terms of abundance and composition of fish, which is likely to be caused by variations in bottom substrates, depth and oxygen levels.

### 1.2.5 Monitoring of fish inside Natura 2000 areas

Monitoring of fish inside the two Natura 2000 areas Hoburgs bank and Norra Midsjöbanken was undertaken in the periods June 2010, and September/October 2010. The monitoring programme included 40 stations at Hoburgs bank and 40 stations at Norra Midsjöbanken, with 20 “impact” stations, and 20 reference stations at each bank. The monitoring comprised gill net fishery with K072 gill nets, CTDO-measurements of the conductivity (salinity), temperature, depth, oxygen and secchi desk measurements, and habitat description by underwater video recordings of the seabed.

The purpose of the monitoring programme is to evaluate and document potential effects of construction activities (especially trenching) on fish fauna inside the Natura 2000 areas. Its focus is on demersal fish species because assessments indicate that primarily demersal fish might be affected as the disturbance is mainly concentrated at the sea bed.

The monitoring in 2010 has established a baseline for similar surveys planned in 2011-2014.

In total 12 species were caught at the two surveys. The results from the surveys show that the dominating species in order of quantity were: Cod, Flounder, Turbot, Shorthorn sculpin, Eelpout and Herring. Furthermore, only one individual from each of the remaining six species was caught.

The abundance of Cod inside the two shallow water Natura 2000 areas was high in September compared to the abundance in June. In contrast, the abundance of Flounder and Turbot was higher in the June survey.

The overall differences in abundance between the three species Cod, Flounder and Turbot between the “impact” area and the reference areas at the two banks were:

- Cod was more abundant in the impact area, compared to the reference area at Hoburgs bank in the September survey. There were no differences in abundance of Cod between impact and reference areas at Norra Midsjöbanken during the June or the September survey, or at Hoburgs bank in the June survey.

- There was a higher abundance of Flounder at the reference area at Norra Midsjöbanken in September when compared to the impact area. There were no differences in abundance of Flounder between the impact and reference area at Hoburgs bank during the June or the September survey, or at Norra Midsjöbanken in the June survey.

- There was a higher abundance of Turbot at the reference areas compared to the impact areas at both banks both in June and in September.

Investigation of sex and maturity of individuals of the three most common species revealed that juvenile Cod dominated in all areas in the June and September surveys, but also maturing and spawning Cod were observed during the June survey, while spent Cod was observed in the September survey. This, together with individual length and biomass distribution of Cods indicates that spawning had taken place in the period between June and September.

Maturing, spawning and spent Flounders dominated the catch in June, while the catch in September was dominated by maturing Flounder. It is assessed that Flounders in the June survey were at their peak or in the end of their spawning period.

June and September were dominated by maturing Turbots. In June, a relatively high number of spawning Turbots were observed at the impact area of Hoburgs bank, while in general, a relatively high number of spent individuals were observed in all areas in the September survey. It is assessed that in June, Turbots were about to start or had just started their spawning.

### 1.2.6 Monitoring of fishery

Monitoring of fishery is performed as a desk study based on fishery data supplied from the Swedish Board of Fisheries (SBF). In 2010 it included data from the last 10 years of fishery (2000-2009). The purpose of monitoring fishery in the waters along the pipeline route is to evaluate potential changes in bottom fishery patterns and fish catches after installation of the pipelines.

Monitoring data comprises satellite and logbook recordings collected by SBF as part of the statutory recording of fishery pattern and fish catches by the Swedish fishing fleet.

The bottom fishery pattern is described in terms of density plots for calculated bottom trawling and bottom net fishing as well as in terms of calculated number of fishing boats trawling across the pipelines per KP.

The fish catch pattern is described in terms of data extraction (catch (in kg) of different species) from a corridor with a width of approximately 10 km around the pipeline route from KP 750 to KP 1004 both as a total amount and as sectional amounts.

The results of the satellite data analysis show that the general bottom trawling has been limited to the western part of the area between KP 930 to KP 950 and has been declining during the last 6 years. The general bottom net fishery has been performed in areas approximately 20 km northwest of the pipeline route from KP 900 to KP 950.

The results of the logbook data analysis is generally following the trends concerning fish landings in the Baltic Sea, e.g. Cod, Herring, Sprat and Plaice are the dominant quota regulated fish species landed in the specific corridor and Flounder, Turbot and Whiting are the dominant non-quota fish species landed.

### 1.2.7 Monitoring of benthic fauna

Monitoring of benthic fauna includes infauna investigations once annually in June from 2010 and epifauna investigations once per year in September/October from 2011 after installation of the pipelines.

The purpose of monitoring benthic fauna along the pipeline route is to evaluate and document re-colonization and recovery of the infauna changes after installation and to evaluate and document the establishment and growth of epifauna on the pipelines and on rock berms (established during rock placement).

The monitoring of benthic infauna was undertaken at Hoburgs bank (eleven stations) and at Norra Midsjöbanken (ten stations). The survey at each station included an underwater video recording of the seabed, measurement of conductivity (salinity), temperature, depth and oxygen throughout the entire water column, sediment sampling for analysis of selected physical and chemical variables and three van Veen grab samples for analysis of the infauna.

The monitoring of benthic epifauna is planned between Hoburgs bank and Norra Midsjöbanken (area with pipeline on seabed), at Norra Midsjöbanken (area for trenching) and at Norra Midsjöbanken (area for rock placement). The monitoring will be performed as visual inspection by video (ROV) starting from 2011 after construction of the first pipeline has been completed.

The results of the monitoring in 2010 indicated no systematic spatial changes in abundance and biomass of the infauna neither along the transect, nor at Hoburgs bank and at Norra Midsjöbanken. The abundance and biomass of the communities was dominated by a few species of polychaetes (*Bylgides sarsi*, *Marenzelleria viridis* and *Pygospio elegans*), bivalves (*Macoma balthica*) and crustaceans (*Pontoporeia affinis* and *Saduria entomon*) characteristic for areas with low diversity and low salinity in the Baltic Sea. The Common mussel (*Mytilus edulis*), unidentified species of oligochaetes and Pripulida (*Halicryptus spinulosus*) was scarce or absent at most monitoring stations. Despite the overall similarity of the infauna a statistical analysis indicated that the infauna was different at some of the stations along the two surveyed transects, respectively.

A comparison of data from the 2010 survey with findings from a survey carried out in 2007 revealed large spatial and interannual variations in species composition and abundance even within the same area. There is however no statistical evidence for a comparison of the data as only one sample at each station was taken in the 2007 survey.

### 1.2.8 Monitoring of water quality

Monitoring of water quality was initiated on 6-7 November 2010 by deployment of four fixed monitoring stations at two Natura 2000 areas considered sensitive with regards to impacts on the water environment. Two stations were placed at the southeast border of each of the two Natura 2000 areas; Hoburgs bank and Norra Midsjöbanken respectively. The stations are planned to be operating until July 2011.

The purpose of the monitoring of water quality is to assess levels of suspended sediment concentrations (SSC) and document compliance with the limit value (15 mg/l above background

level) and to confirm model simulation results of the impact presented in the Swedish Environmental Study.

The fixed monitoring stations measure turbidity (which will be converted to SSC), current velocity and direction, salinity, temperature and stratification as well as downward flux of suspended sediments. Measuring is performed before, during and after trenching. The automatic measuring at the monitoring stations is supplemented by manual measurements of mass concentrations and suspended solids as well as turbidity and water temperature/conductivity for each metre of the water column during service visits to the stations.

The results of the first two months of measurements were analysed in January 2011 and a model for the natural variation of SSC (governed mainly by the meteorological and hydrographic conditions) was established for each of the four LT-stations. This model is used to quantify a possible increase of the SSC at the border of the two Natura 2000 areas caused by the trenching works.

The analysis shows that the natural SSC in the area is very low, in general below 2 mg/l. The low level ensures that the possible increase caused by the trenching works can be quantified with a relatively high accuracy. It should be noted that the natural SSC also includes increased SSC during rough weather – especially during storms for very short periods, which can make it difficult to give a "correct" assessment of the natural SSC.

As a supplement for the fixed monitoring stations, vessel-based monitoring will be carried out during trenching of the pipelines in February/March 2011. Profiles of turbidity, salinity, water temperature and currents will be measured downstream of the trenching activities. Based on modelling of the dispersion of spilled sediments from trenching at various current velocities, relations have been established between current velocity and the reduction in SSC with distance from the sediment spill source. These relations will be used as an early warning system in order to predict if the SSC measured closer to the spill source will jeopardize the 15 mg/l limit at the border of the two Natura 2000 areas. Furthermore, the results will support the interpretation of data from the fixed monitoring stations.

### 1.2.9 Monitoring of hydrographic conditions in the Bornholm Basin

Monitoring of hydrographic conditions in the Bornholm Basin was undertaken in January 2010 and ended in January 2011. The purpose of the hydrographic monitoring programme in Danish and Swedish waters is to establish documentation for the theoretical analysis of the possible blocking of the water inflow to the Baltic Sea caused by the presence of the Nord Stream Pipeline.

The monitoring aims to describe the bottom currents, interfacial friction and dissipation of inflow waters. Inflow events are expected to occur near the seabed (mainly during winter season) and below the halocline (mainly during summer). Oceanographic measurements (velocity, temperature, salinity) were carried out initially during a period of 9 months (including approximately 1 month down period) at KP 1036 northeast of Bornholm at a water depth of approximately 90 m. In autumn 2010 the monitoring station was moved to KP 966 in order to also record measurements from shallower water depths (approximately 68 m).

In addition to the fixed station, line transects of currents have been carried out by ADCP. The line transects are carried out along the pipeline route between KP 1030 and KP 1070. A total of 7 transects were planned in relation to each service inspection (including mobilisation and demobilization), which has been reduced due to the actual weather conditions. By the end of 2010 4 successful line transects have been carried out.

The results of the monitoring will be submitted to the authorities in summer 2011 in a separate report when the data has been analysed. This separate report will be included in the following yearly monitoring report to the Swedish authorities: “Environmental monitoring in Swedish water 2011”.

### 1.2.10 Monitoring of ecotoxicological effects on mussels

Monitoring of ecotoxicological effects in mussels was initiated in December 2010 and is planned to continue until April 2011. The monitoring will be carried out before, during and after trenching of the northwest pipeline (Line 1).

The purpose of the monitoring of ecotoxicological effects in mussels is to evaluate and document possible spreading of contaminants associated with sediments mobilised in the water column by seabed intervention (trenching) east-southeast of the two Natura 2000 areas Hoburgs bank and Norra Midsjöbanken.

Monitoring is carried out by measuring the impact on common mussels (*Mytilus edulis*) in cages/net bags at six fixed stations at the border of, and at six fixed stations inside the two Natura 2000 areas.

At the 12 fixed monitoring stations located on approximately equal water depth one sample of mussels is analysed for physical properties, and three samples are analysed for content of contaminants. The contaminants to be analysed include both heavy metals (Hg, Cd, Cu, As, Zn, Ni, Pb, Cr, Sn) and organic tin compounds.

Mussels collected at Faludden, south of Gotland are placed in mussel cages at each station for a period of 1½ month, after which they are collected and sent for physical and chemical analysis. This procedure will take place three times from January to April 2011.

Monitoring in 2010 has included sampling of mussels at Faludden south of Gotland, physical and chemical analysis of mussels from Faludden, and establishment of the 12 stations with mussel cages.

### 1.2.11 Monitoring of other parameters

**Seabed morphology**
Monitoring of the seabed morphology has been carried out before, during and after construction.

Prior to pipeline installation the seabed morphology is monitored with an instrumented ROV along the pipeline installation corridor. During 2010, pre-lay surveys along the centre line of the design route have been performed between KP 676 to 498 and KP 1004 to 990 by ROV instrumented with multi-beam echo-sounder (MBES), sonar and video cameras. Significant debris or seabed anomalies that could compromise the safe installation of the pipeline were immediately reported and evaluated in order to be able to plan and take necessary remedial action prior to pipe-lay.

During pipeline installation, ROV pipeline touchdown monitoring (TDM) was performed as required to support the pipe-lay vessel Castoro Sei.

After pipe-lay an additional survey of the pipeline was performed by ROV. The multi-beam echo-sounder (MBES) was used to survey the pipeline itself and 10 m to either side of the pipeline. Any adjacent targets were monitored with sonar. Video cameras were used for visual inspection of the pipeline condition and any damages to pipeline, coating, anodes or field joints were inspected.

**National and international monitoring stations**
In order to determine whether the establishment of the Nord Stream Pipeline affects governmental or international monitoring programs, the locations of the monitoring stations have been identified in relation to the pipeline route and related construction and operation activities. Coordinates of both national and international monitoring stations have been investigated and the information concerning location and measured parameters has been compiled. Potential impacts on environmental monitoring stations could be caused, if:

- The time of monitoring activities coincides with construction work.
- Monitoring stations are located close to areas with seabed intervention works (trenching or rock placement) and therefore potentially affected by re-sedimentation of sediment that has been brought into suspension during construction.
- Monitoring stations are very close to the pipelines and potentially affected by local changes in erosion/sedimentation patterns around the pipelines during operation.

Four of the existing monitoring stations in the Swedish EEZ are located within ±1.5 km from the pipelines (and one SMHI station in the Finnish EEZ). Mitigation measures have been proposed and agreed with the authorities.

**Cultural heritage**
The purpose of cultural heritage monitoring is to document the condition of wrecks before pipe-laying, trenching, rock placement and anchor handling, to safeguard the wrecks during construction and to verify the condition of the wrecks after construction.

Prior to the construction of the Nord Stream pipelines, detailed security and anchor corridor surveys have been performed, in order to investigate the presence of cultural heritage sites within the pipeline anchor corridor (± 1 km from the pipeline route). Data from these surveys has been evaluated by the company Marin Mätteknik AB (MMT) as well as by the Swedish National Maritime Museum. A controlled installation procedure for locations where archeologically significant wreck sites are present has thereafter been discussed and agreed with Swedish authorities. Additionally, areas of directly affected seabed have been surveyed prior to rock placement, trenching and pipe-laying to verify the seabed conditions, i.e., that no new objects were present.

The monitoring of cultural heritage will be carried out as a visual inspection by ROV. An ROV will dive onto the archeologically significant wreck sites and record an underwater footage of the objects. The wreck monitoring after pipeline installation is planned to be carried out when Line 2 is installed

in 2012. Hence the monitoring results regarding cultural heritage are planned to be included in the annual report for 2012.

A number of safeguarded objects classified as being of cultural significance were passed during construction within the Swedish EEZ. These objects were both semi-intact wrecks and shattered wreck pieces. The anchor pattern plans for the passages of these objects, which had been agreed beforehand together with relevant authorities, could be adhered to with just one exception. After the post-lay survey inspection in 2012 has been performed, a comparison will be done with the pre-lay survey to see if the status of the objects of interest has changed.

**Maritime traffic**
The purpose of Nord Stream's control and monitoring in relation to marine traffic is to minimize the risk of collisions or other accidents involving commercial ship traffic and/or vessels performing construction activities for the project. Safety zones of varying sizes are established around all vessels performing underwater construction work and vessel management systems (such as Automatic Identification System (AIS) for identification and locating of vessels) are used. Information on upcoming and ongoing construction activities is provided to the relevant authorities, who in turn inform the ship traffic through information channels such as 'Notices to Mariners' and NAVTEX. Information designated for the fishing communities is being produced and delivered both to individual fishermen and fishing organization on a regular basis.

During the construction in the Swedish EEZ, Nord Stream and its construction vessels have followed the communication and reporting procedures that have been agreed with Swedish authorities and organizations. Nord Stream has provided the relevant authorities with e.g. daily updates from the construction vessels as well as weekly and monthly forecasts. Regular information to the fishing community has been provided from the time construction activities started and will continue throughout the construction period.

Almost all types of construction activities which are planned within the Nord Stream Project in the Swedish EEZ, have already been carried out several times during the last year, i.e. survey activities, munitions clearance, mattress installation, rock placement and pipe-laying. Precautionary safety measures were successfully implemented and the construction activities have all been performed without any accidents or significant incidents with third party vessels.

# 2 Introduction

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

The length of the entire two-pipeline system ('the Nord Stream Pipeline') is approximately 1,220 km. The pipeline crosses the exclusive economic zones (EEZ) of Russia, Finland, Sweden, Denmark and Germany, and territorial waters (TW) of Russia, Denmark and Germany. The construction of the first pipeline commenced in April 2010, and will be completed in 2011. The second pipeline is planned to be completed in 2012. The Nord Stream Pipeline is designed to operate for 50 years.

## 2.1 Construction permit and conditions for environmental monitoring

On 21 December 2007, Nord Stream applied for the Government's permission under section 15 a of the Continental Shelf Act (1966:314) to lay two pipelines for the transport of natural gas on the continental shelf in the Swedish Exclusive Economic Zone of the Baltic Sea.

The permit for construction of the Nord Stream Pipeline inside Swedish EEZ water was given by the Swedish Government on 5 November 2009. The following conditions regarding environmental monitoring are stated in the permit /1/:

*7. The Company shall have an environmental monitoring programme for supervision of the activity during the construction and operation phases of each pipeline. This monitoring programme shall be developed in consultation with the Swedish Coastguard, the Geological Survey of Sweden, the Swedish Environmental Protection Agency, the Swedish Maritime Administration, the Swedish Transport Agency, the Swedish Board of Fisheries and the Swedish Meteorological and Hydrological Institute. The form and scope of the environmental monitoring programme shall be established in good time before the work commences. The programme shall be subject to review on an ongoing basis and shall be revised as required. Any surveys, studies etc. carried out as part of this environmental monitoring programme shall be made available to the relevant authority.*

*8. The Company's environmental monitoring programme shall include inter alia the monitoring of bottom currents and stratification of bottom water in the Bornholm Basin, monitoring sediment spillage during the construction phase, and monitoring turbidity levels during underwater operations as provided by section 9* [should be section 10]*.*

*9. When handling anchors and performing construction work in depths of less than 35 metres during construction work in the deepwater route south of Norra Midsjöbank and Hoburgs bank, the Company shall take measurements of the actual depth immediately after laying of the pipe is complete and confirm to the Swedish Maritime Administration and the Swedish Transport Agency that the depth has not been changed by the laying of the pipe in question.*

*10. Turbidity caused by seabed operations connected with the laying of each pipeline should, as a guideline, amount to a maximum of 15 mg/l at the boundaries of the Natura 2000 areas Hoburgs bank and Norra Midsjöbank (in accordance with the classification of these areas as Natura 2000*

*areas). The measurement technique and procedure shall be governed by the environmental monitoring programme which the Company is to produce pursuant to section 7. If monitoring of the turbidity shows that this value has been exceeded, additional precautionary measures shall be taken during seabed operations, such as cutting back on or temporarily ceasing seabed operations so that the value can be maintained. Thereafter, the Company shall, in so far as possible, ensure that any breach of the limit is not repeated.*

*11. Waste, both solid and liquid, shall be source-sorted, stored so that no pollution occurs and transported ashore for handling in accordance with the rules applicable to the waste in question.*

*12. When winding up the operation, the Company shall take restorative measures. The Company shall inform the Government of its intentions in good time before the pipelines are taken out of service and, at the same time, provide a plan of how it is proposed that the wind-up should proceed. The operation shall be deemed to having been closed down if there has been no transport of natural gas for a continuous period of two years. The Government will decide to what extent the pipelines should be removed by the Company and what other measures are required in order to restore the seabed to as close to its original state as possible.*

Additionally, the permit states that:

*The Government draws attention to the Swedish Armed Forces' opinion that it will be necessary to remove military debris. Where such removal is required, the Company undertakes to monitor the occurrence of and frighten away marine mammals and fish. In the event of mines and other unexploded ammunition or other military debris, such as chemical weapons, in addition to those identified in the Company's application, being encountered during construction work etc., the Company shall be responsible for the removal of such objects should this be necessary from a safety point of view.*

*The Government further draws attention to the fact that, under section 2 a of the Continental Shelf Ordinance (1966:315), the Swedish Coastguard is responsible for monitoring compliance with section 15 a of the Continental Shelf Act and conditions made pursuant to that subsection.*

## 2.2 Environmental monitoring within the Swedish EEZ

To accommodate the conditions laid out in the construction permit a programme for environmental monitoring within the Swedish EEZ was elaborated by Nord Stream in collaboration with the Swedish authorities. A final environmental monitoring programme was presented to, and discussed with, Swedish authorities at a meeting on 10 February 2010. Nord Stream received formal approval of the framework for the monitoring programme on 25 February 2010.

The environmental monitoring programme comprises the following documents:

- Nord Stream. Environmental monitoring programme Sweden. 01.03.2010. G-PE-PER-REP-000-EnvMonSE Rev. B. /2/.
- Nord Stream. Monitoring programme for fish and fishery within the Swedish EEZ. 17.03.2010. G-PE-PER-REP-100-04090000 Rev. B. /3/.

- Nord Stream. Monitoring programme for benthic fauna within the Swedish EEZ. 18.03.2010. G-PE-PER-REP-100-04140000 Rev. B. /4/.
- Nord Stream. Monitoring programme for turbidity, sediments and ecotoxicological effects within the Swedish EEZ. 06.04.2010. G-PE-PER-REP-100-04100000 Rev. B. /5/.
- Nord Stream. Hydrographic effects: Deep water inflow in the Bornholm Basin (Danish EEZ). 15.03.2010. G-PE-PER-REP-000-HydrogSE Rev B. /6/.
- Nord Stream. Monitoring measures for munitions clearance Sweden. 15.03.2010. G-PE-PER-REP-000-MunCleSE Rev. B. /7/.

In the Swedish Environmental Study /8/ all potential impacts from construction and operation of the Nord Stream Pipeline were assessed to be minor. Consequently, monitoring would not necessarily be required, however, it is considered important to employ additional effort to validate accuracy of the impact assessment on certain fit-for-purpose activities and to deliver the main monitoring objectives for the project.

In order to measure the effectiveness of the monitoring and mitigation measures, relevant receptors and indicators identified within the monitoring programme are characterised by the following:

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

Monitoring of potential environmental factors and related impacts considers:

- Emission intensity
- Sensitivity of the receptor and conservation value

A project-based concept in relation to overall oceanography follows the evaluation of potential environmental impacts with consideration to the following:

- Focus on shallow waters providing habitats for conservation objectives.
- A general approach on potential impact areas for waters between 80 m and 30 m water depth.
- No biological investigations below the halocline at 80 m water depth if other options are available, in view of the anoxic conditions at these depths.

Nord Stream's environmental monitoring in the Swedish EEZ therefore varies in spatial range, temporal frequency and duration depending on the nature of the monitored parameters and in accordance with the potential impacts predicted and in relation to potential receptors. According to local variations in environment and construction works, certain investigations are carried out only at selected sites.

The environmental and socioeconomic monitoring comprises the following main objectives:

*Change monitoring:* to detect environmental changes that may have occurred as a result of project implementation. This includes monitoring undertaken before construction (baseline monitoring),

during construction (not necessarily in direct connection to construction activities in a specific area) and during the first years of operation (post-construction).

*Compliance monitoring:* periodic sampling or continuous recording of specific environmental and social quality indicators for a defined purpose to ensure project compliance.

*Pro-active monitoring*: timely routine and periodic checks by observation, measurement and evaluation for a defined purpose, which includes corrective action.

### 2.2.1 Construction and environmental control

Besides the additional environmental monitoring which comes as a result of permit conditions and authority discussions, and which is the focus of this report, Nord Stream also has its own overall system in place to manage and control all aspects of environmental relevance of the project. This control structure is called the Environmental and Social Management System (ESMS). The ESMS is to a large extent guided by the findings and recommendations of the National Environmental Impact Assessments (EIAs), Environmental Studies (ESs), and the Espoo Report, EU EIA Directive requirements, lenders´ requirements and the requirements of the relevant authorities. The purpose of the ESMS is as follows:

- Establish a framework for implementing mitigation and management measures and to monitor the effectiveness of those measures.
- Provide assurance to authorities and other stakeholders that their requirements with respect to environmental and social performance will be met.
- Provide for the implementation of corrective measures where required.
- Establish a framework for performance monitoring to enable Nord Stream to ensure that its commitments and policies with respect to environmental and social performance are met.

A number of management plans have been produced in order to structure the requirements for the different construction activities and/or areas. Each management plan provides detailed information, requirements and minimum environmental standards relating to either a specific construction activity (e.g. seabed intervention) or an environmental/social issue (e.g. waste management). In this way the environmental and social management as well as mitigation and monitoring actions to be undertaken by Nord Stream and its contractors are clearly stated, the roles defined and adherence easily followed. Nord Stream has also prepared bridging documentation to align the contractor's management system with that of Nord Stream.

Contractor compliance, of both documentation and the work itself, is further controlled and supervised by a number of internationally renowned independent environmental and technical consultants (such as Det Norske Veritas, Global Maritime and Environ). These companies have provided support in ensuring that the contractors have followed and implemented Nord Stream's obligations and commitments as appropriate, as described in the management plans, during the first year of construction. The contractor's compliance with the defined procedures has been carefully monitored through offshore inspections and reporting throughout the construction phase, for example through vessel safety audits by a marine warranty surveyor prior to mobilization and periodical on-site environmental and safety inspections by an environment, health and safety representative.

## 2.3 Purpose of the document and reading instructions

This document provides an overview of all environmental and socioeconomic monitoring activities carried out by Nord Stream in 2010 within the Swedish EEZ. It is the first of five planned annual reports the purpose of which is to document the status and the results of the monitoring activities in the Swedish EEZ and if necessary recommend appropriate adjustments to the monitoring scope. The reports will be submitted each year and cover all activities undertaken the previous year. The monitoring programme for the Swedish EEZ covers activities from 2010-2014.

The document starts with a description in Chapter 3 of all construction activities undertaken in 2010. In Chapter 4 the status of the monitoring of the environmental parameters is described, followed by a status of the monitoring of socioeconomic parameters in Chapter 5. A comparison with the results of the monitoring and the assessments made in the Environmental Study is presented in Chapter 6, followed by conclusions and recommendations in Chapter 7.

The monitoring activities that have required more detailed studies and/or field studies have been divided into eight different modules:

- Monitoring of munitions clearance
- Monitoring of fishery
- Monitoring of fish in Natura 2000 areas
- Monitoring of fish along the pipeline (reef effect)
- Monitoring of benthic fauna
- Monitoring of ecotoxicological effects in mussels
- Monitoring of hydrographic effects
- Monitoring of water quality

Each module is presented in individual module reports included in the yearly reporting. A brief presentation of the status of each module is given in this main report along with the overall results in Chapter 5 and 6. The module reports are based on reports elaborated by the companies that have undertaken the actual field work tasks. Each task has been tendered in fair competition among the most respected and competent specialist companies in the region with in-depth knowledge of the specific conditions governing the natural environment in the Baltic Sea.

It should be noted that due to the timing of the monitoring of ecotoxocological effects in Common mussel, hydrographic effects and water quality, detailed reporting of these modules will not be presented until summer 2011.

It should also be noted that the focus of the above-mentioned monitoring modules in 2010 is baseline monitoring. The monitoring of potential effects of the pipeline is not undertaken until 2011.

# 3 Construction activities in 2010

In Chapter 3 the Nord Stream construction activities carried out inside the Swedish EEZ in 2010 are described. Depending on the specific activity, the location along the pipeline route and the period when the activity is undertaken, the construction works may result in effects on the marine environment, and therefore the construction works have governed the individual monitoring programmes. The monitoring programmes and the results for 2010 are described in Chapters 4 and 5.

Construction commenced in the Swedish EEZ on 28 February 2010 with pre-lay rock placement. It continued with munitions clearance and cable crossing mattress installation activities and was followed by pipe-lay sea trials, which were performed successfully, Working procedures were approved on 5 April 2010. On 6 April 2010 Castoro Sei started laying the northwest pipeline (Line 1) at KP 674 east of Gotland and it continued until 27 June 2010 when it entered into Finnish waters.

**Figure 3.1** Castoro Sei passing the Great Belt Bridge early morning on 26 March 2010 on its way to pipe-lay work in the Swedish EEZ.

The following chapters provide further information on the completed construction activities during 2010 in the Swedish EEZ which included:

- Rock placement
- Munitions clearance
- Cable crossing (mattress installations)
- Pipe-lay at KP 674 to KP 498

## 3.1 Rock placement

Pre-lay rock placement activities commenced on 28 February 2010 at the tie-in location at KP 674. Some schedule changes were implemented due to the ice situation in Kotka, Finland, and to some extent for the same reason, three vessels were performing the work in the Swedish EEZ (e.g. Seahorse, Rolling Stone and Sandpiper). Pre-lay rock placement works for Line 1 and 2 were completed by 5 May 2010, but minor investigations for calibration and verification of the desired designs continued until the beginning of June 2010. An increase in the total volume of rocks was expected due to the encountered soil conditions at some locations, and additional investigations concluded that a re-design was necessary to ensure on-bottom stability for the hyperbaric tie-in positions at KP 674.

The total volume of rock used for pre-lay rock placement was approximately 164,000 $m^3$, which was mainly placed at the tie-in locations at KP 674. The pre-lay rock placement activities and locations are shown in Table 3.1 and visualised in Figure 3.2.

**Table 3.1** Pre-lay rock placement activities in 2010.

| **Pre-lay rock placement activities 2010, Sweden** | |
|---|---|
| **Line** | **Rock berms locations** |
| Line 1 | L1-SE-01-W1102 at KP 770<br>L1-SE-01-W1105 at KP 777<br>L1-SE-01-W1103 at KP 778<br>L1-SE-01-W1104 at KP 779 |
| Line 2 | L2-SE-01-E1105 at KP 550<br>L2-SE-01-E1102 at KP 775<br>L2-SE-01-E1103 at KP 775<br>L2-SE-01-E1104 at KP 779 |
| Hyperbaric tie-in locations | L1-SE-01-W-Tie-in at KP 674<br>L2-SE-01-E-Tie-in at KP 674 |

Later, in June/July 2010 and in December 2010 post-lay rock placement for free span correction was undertaken at some locations between KP 498 and KP 674. The total volume of rock used for post-lay rock placement was approximately 15,800 $m^3$.

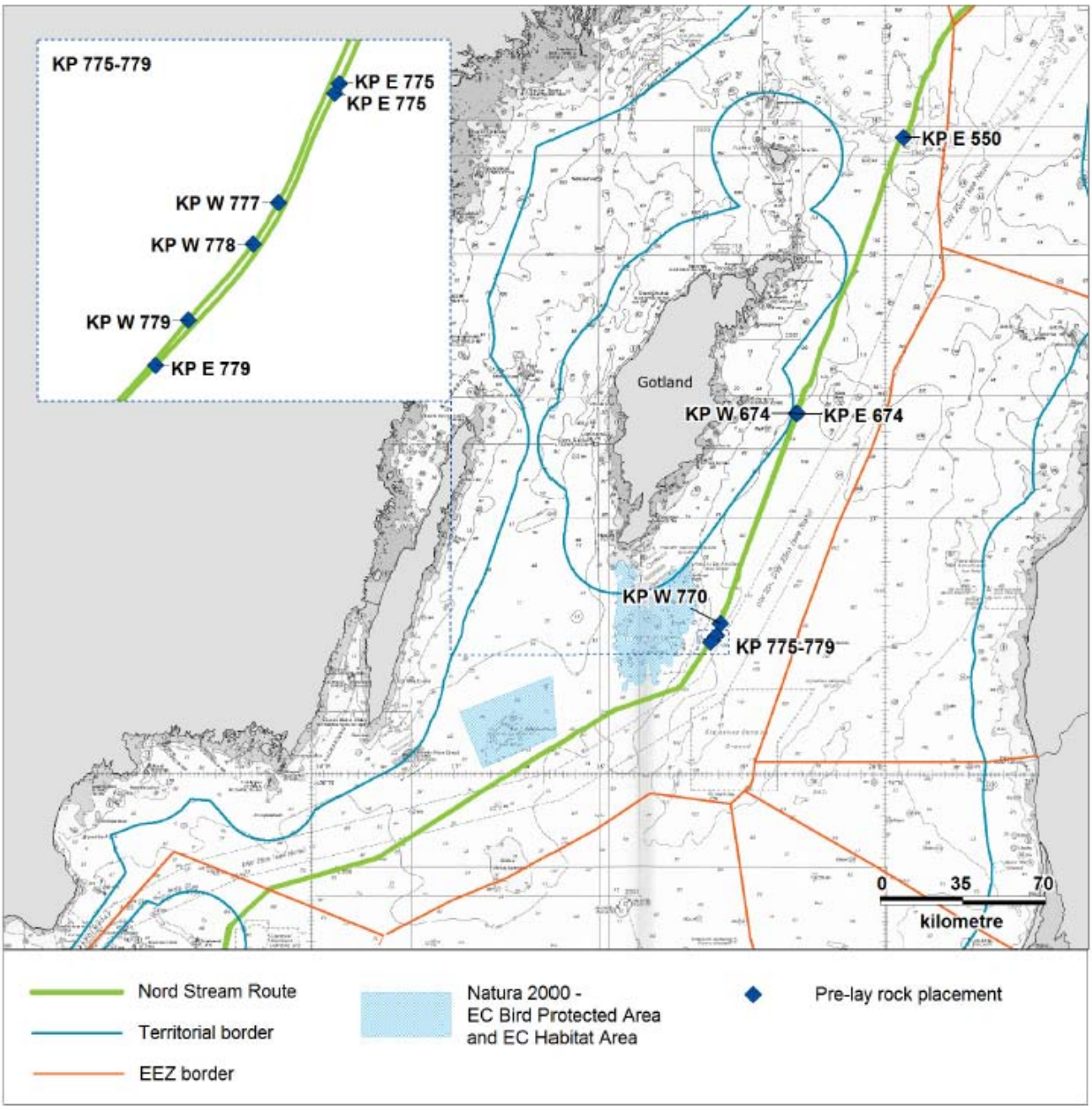


**Figure 3.2** Pre-lay rock placement locations.

## 3.2 Munitions clearance

Munitions clearance activities started on 19 March 2010 and were completed by 3 April 2010. The vessel Edda Freya was equipped with underwater explosives, detonation signals and lights to perform the scope of work, which was clearance of seven mines that were considered a risk to

construction activities in the Swedish EEZ. The clearance operation included survey activities, installation and operation of environmental equipment and a controlled underwater explosion at each of the seven munitions locations, as described in /7/, and in Chapter 5.1. The munitions clearance sites are shown on Figure 3.3.

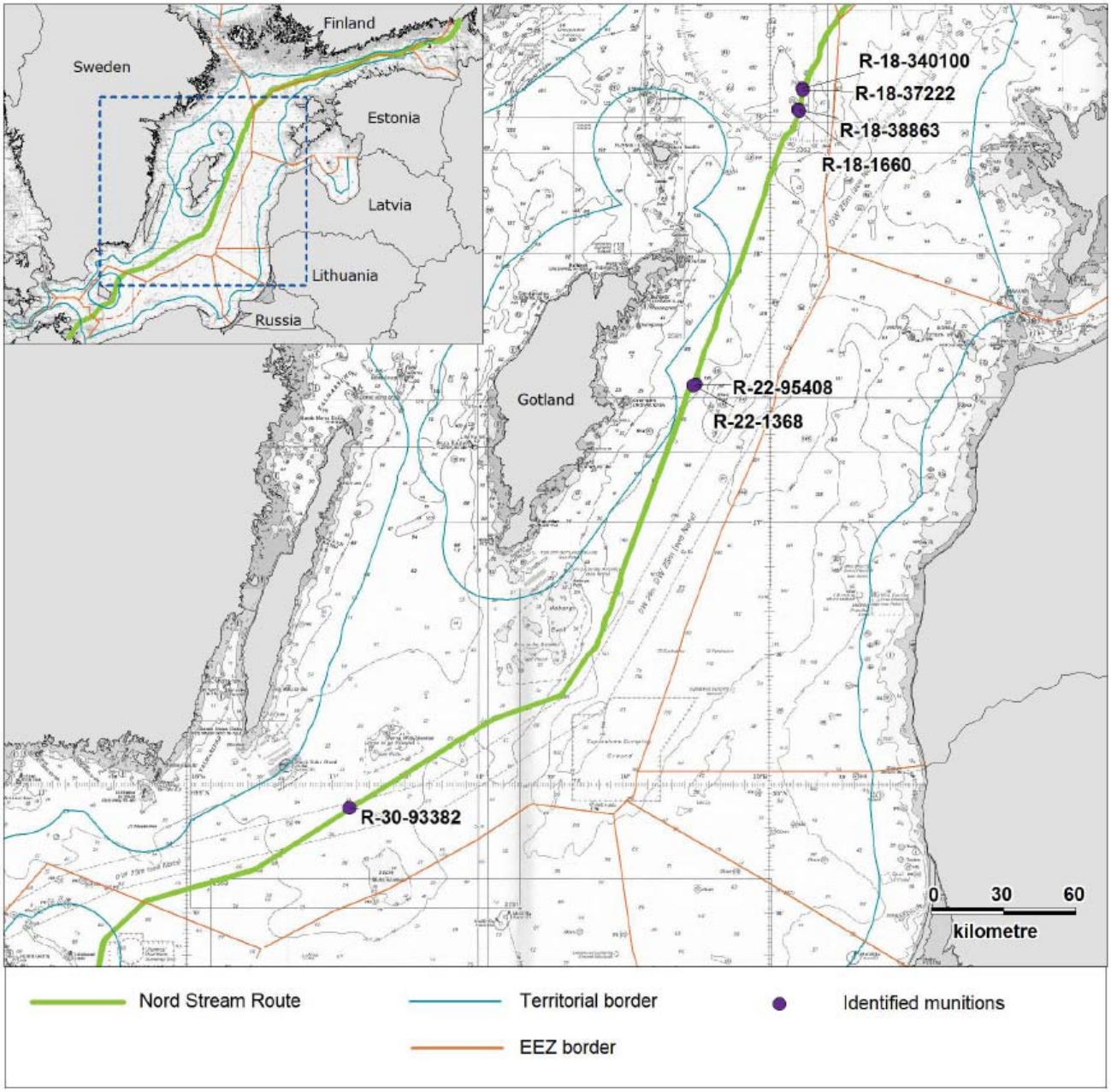


**Figure 3.3** The seven munitions clearance sites.

The mine-specific disposal dates, times, coordinates and blast wave recordings were measured by a blast wave monitor, as shown in Table 3.2. Two of the seven munitions objects to be cleared were not destroyed by the first attempt and therefore two blast waves were recorded for each of these objects.

**Table 3.2** The list of blast wave recordings in the Swedish EEZ.

| Target ID | Coordinates | | Date | Blast wave recordings |
|---|---|---|---|---|
| | East | North | | |
| R-18-340100 | 455047** | 6495619** | 02.04.2010 | 13.8 psi |
| R-18-37222 | 455284* | 6494891* | 31.03.2010 | 59.8psi |
| R-18-38863 | 453153* | 6487143* | 01.04.2010 | 135 psi |
| R-18-1660 | 453609* | 6486529* | 30.03.2010 | 33.3 psi |
| R-22-95408 | 409695* | 6375946* | 26.03.2010 | 43 psi |
| | | | 28.03.2010 | 17.9 psi |
| R-22-1368 | 408705* | 6375522* | 23.03.2010 | Not advised |
| | | | 28.03.2010 | 18 psi |
| R-30-93382 | 632254* | 6197590* | 20.03.2010 | 90 psi |

**: UTM zone 33
*: UTM zone 34

The detonations have resulted in the creation of a number of small craters at the munitions sites, with a maximum diameter of 10 - 12 metres.

A more detailed description of munitions clearance and environmental monitoring carried out in relation to the clearance is provided in Chapter 5.1 and in the report “Munitions Clearance in the Swedish EEZ” /7/.

## 3.3 Cable crossing (mattress installation)

Construction of the pipelines necessitates the crossing of several fibre optic and power cables. Each crossing has been designed to take into consideration the crossing angle and cable burial depth (e.g. specific survey results detailing an installed cable state of burial).

Flexible concrete mattresses have been selected for placement over the cables at the crossing locations to increase the bending radius imposed on the cables and to ensure a permanent vertical separation between the pipeline and the cables. In cases where the cables have been buried at a lesser depth, neoprene pads have been added to the lower surface of the mattresses. For some crossings, concrete beam mattresses have been selected for placement under the pipelines at locations adjacent to the crossing locations to provide additional bearing support to the pipeline thereby reducing the load on the cables at the crossing locations.

**Figure 3.4** Beam mattresses prior to installation in the Swedish EEZ.

Monitoring of the existing cables and the constructed crossings during 2010 was done by visual inspection via ROV to identify the target position and condition immediately prior to and after crossing installation. Thereby the crossing point and the intended position of the mattresses were already verified during the mattress installation. After the installation, an as-built general video inspection (GVI) was made of the crossing structure. In addition, the as-left crossing survey was done to confirm the position, alignment and status of the pipeline in relation to the cable crossing and mattresses.

Mattresses were placed over the five existing cables within the Swedish EEZ during two periods in 2010, 26-28/3 and 29/10-16/11. The pipeline was placed over four of these cables during spring and late December 2010.

### 3.3.1 LV-S1 cable monitoring

Due to the very hard seabed conditions, minimal embedment of the mattresses at the crossing location was done. Figure 3.5 and Figure 3.6 show the LV-S1 cable at the crossing point during the as-built and as-left surveys at KP 564.

**Figure 3.5** LV-S1 cable at the crossing point during the as-built survey.

An as-left survey of the LV-S1 cable route was conducted to confirm the position, alignment and status of the cable, mattresses and pipeline. Additionally the cable was surveyed to the extent of the anchor corridor. All mattresses at the LV-S1 crossing location were found to be well established in relation to the seabed and it was confirmed that there had been no movement in the mattress arrangement and furthermore no seabed disturbances or anchor cable scars were observed.

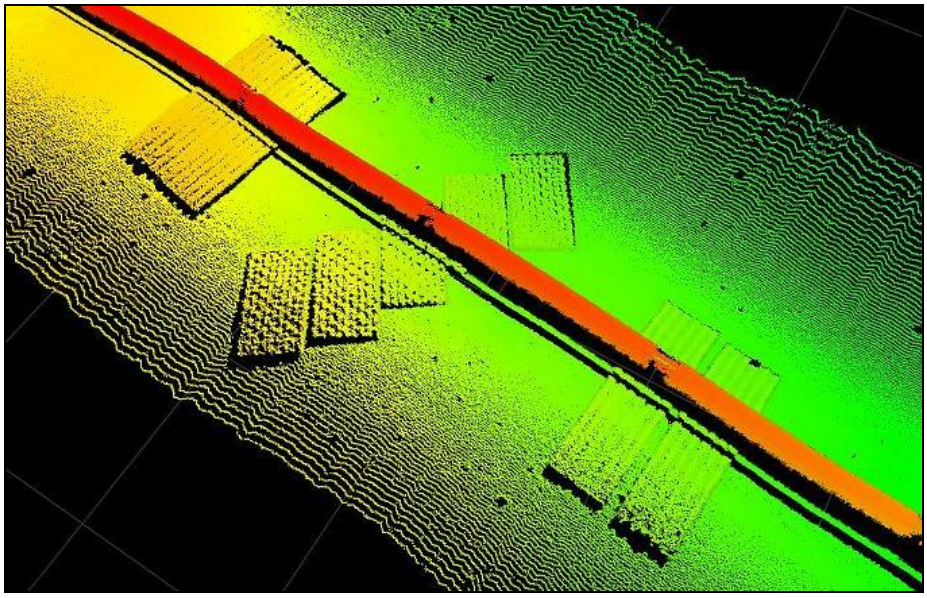

**Figure 3.6** LV-S1 cable at the crossing view from west during the as-left survey. This digital terrain model (DTM) image illustrates the pipeline and mattress arrangement configuration.

### 3.3.2 BALTKOM cable monitoring

At the crossing position of the BALTKOM cable small adjustments to the mattress target positions were made to ensure the correct offsets were maintained. All the mattresses were installed within the prescribed tolerances. Due to very soft seabed conditions, significant embedment of the mattresses at the crossing location was done. Furthermore sediment partially covered the mattresses after the installation.

An as-left survey of the BALTKOM cable route was conducted to cover the extent of the anchor corridor. The pipeline was found to be crossing almost centrally over the mattresses. The pipeline was observed to be in contact with the seabed and the mattresses throughout. Mattresses to either side of the crossing have settled into the seabed material such that they are virtually level with the mean seabed. No seabed disturbances or anchor cable scars other than the cable trench were observed on the cameras, multi-beam echo-sounder (MBES) or sonar throughout the surveys.

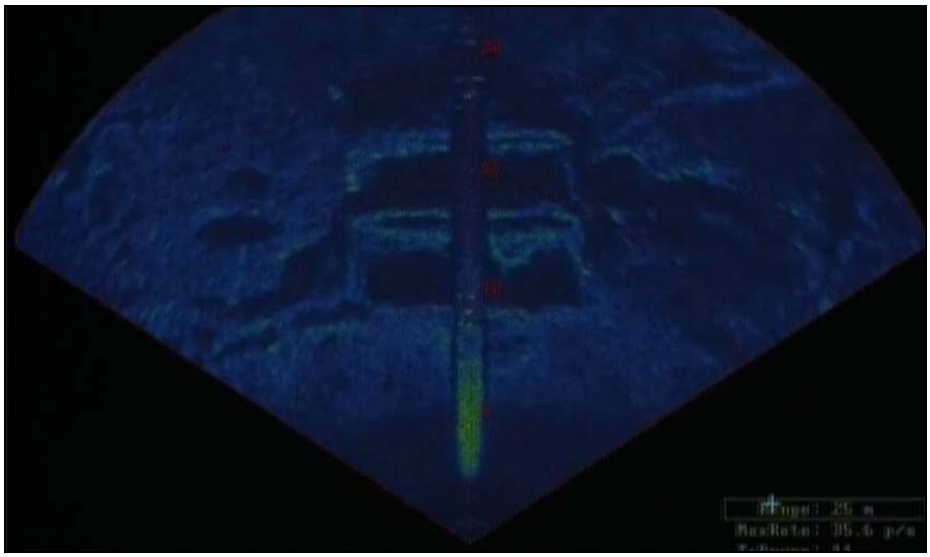

**Figure 3.7** BALTKOM cable at southern mattresses crossing location during the as-left survey. The pipeline was found to be crossing almost centrally over the mattresses as seen in the video still of the sonar image.

### 3.3.3 SWE-POL HVDC/MCRC cable monitoring

The SWE-POL HVDC/MCRC crossing position was installed in accordance with the design. All the mattresses were installed within the prescribed tolerances. Due to very soft seabed conditions, substantial embedment of the mattresses at the crossing location was done. Furthermore sediment partially covered the mattresses after the installation.

An as-left survey of the SWE-POL HVDC/MCRC cable route was conducted to confirm the position, alignment and status of the cable, mattresses and pipeline. All thirteen mattresses at the SWE-POL MCRC/HVDC crossing locations have settled into the very soft seabed. The pipeline was found to be well aligned on the mattresses over the cable crossings. No movement in the mattress positions

and no visible evidence of seabed disturbances or anchor cable scars were found throughout the survey.

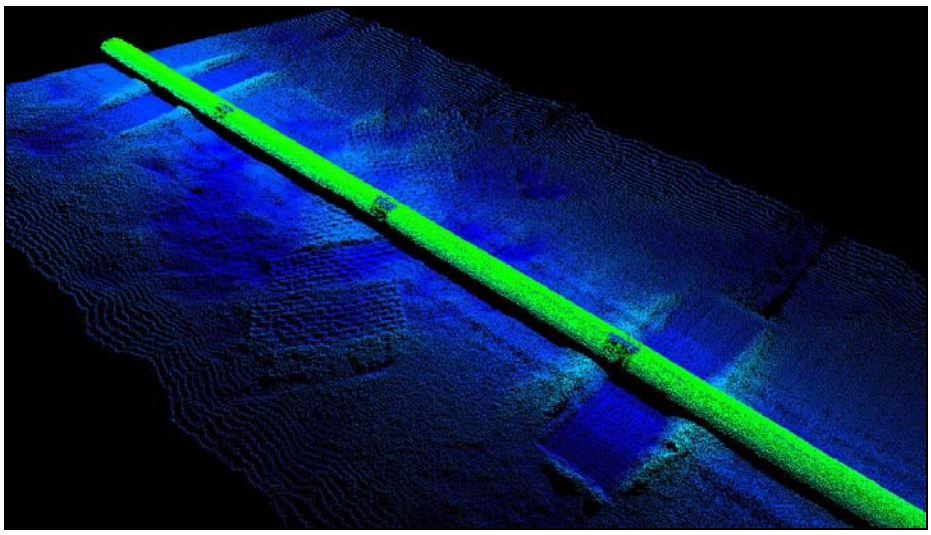

**Figure 3.8** SWE-POL cable crossing view from southeast during the as-left survey. This DTM image is illustrating the pipeline and mattress arrangement configuration.

### 3.4 Pipe-lay at KP 674 to KP 498

Pipe-lay activities commenced in the Swedish EEZ on 6 April 2010. The learning curve for work performance was good and in accordance with expectations, and the construction reached a laying rate of approximately 2.5 kilometres per day after a few weeks. Before commencing pipe-lay activities, sea trials were performed successfully, and the applicable working procedures were approved by 5 April 2010. The pipe-lay from KP 674 to KP 498 was successfully completed on 27 June 2010 and the operations continued into Finnish EEZ. The total lay of pipeline in the Swedish EEZ in 2010 was 176 km, see Figure 3.9.

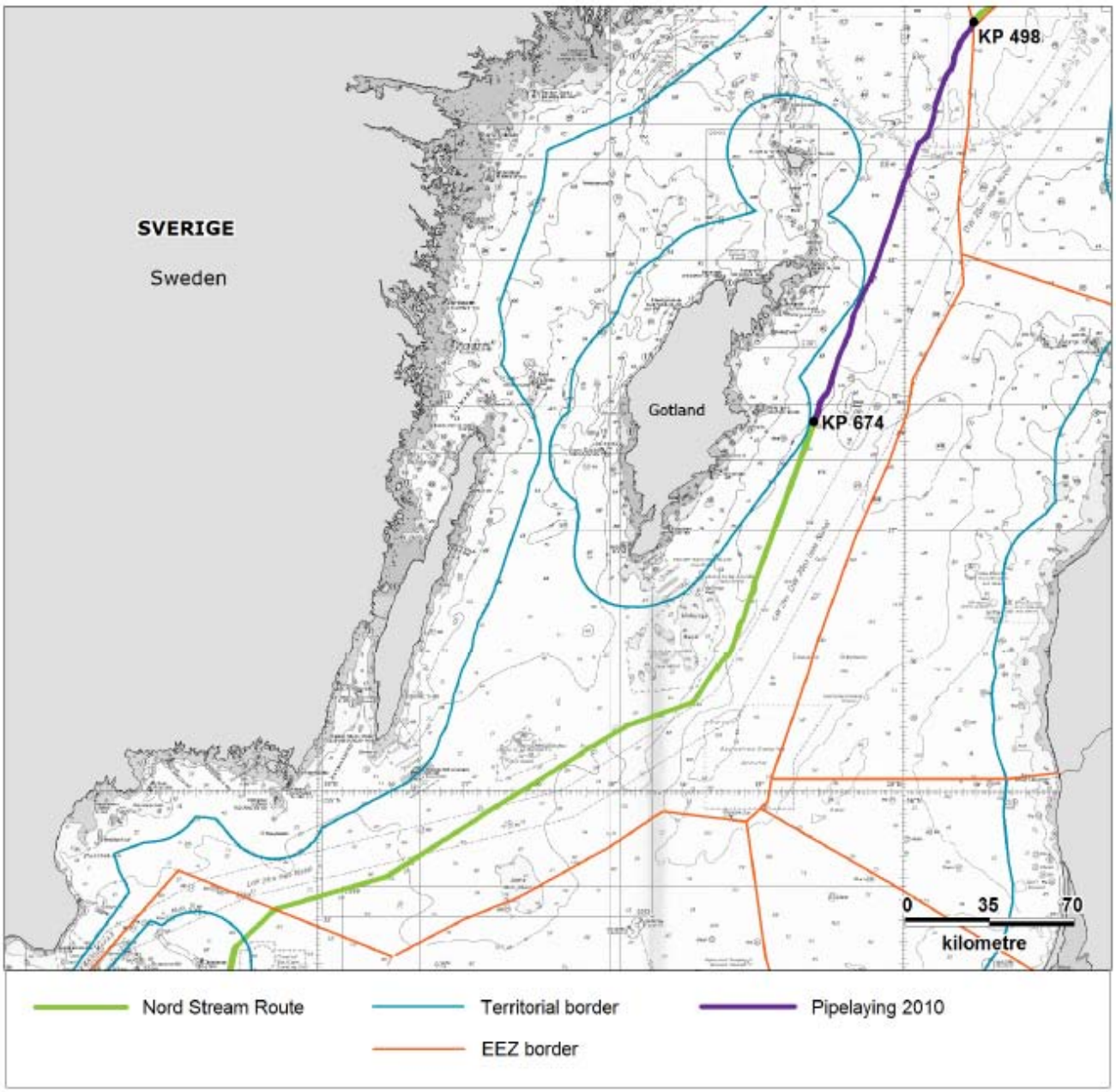


**Figure 3.9** Total lay of pipeline (Line 1) in the Swedish EEZ in 2010.

On 30 December 2010 Castoro Sei re-entered Swedish waters after completing pipe-lay of Line 1 in Danish waters. Pipe-lay of Line 1 inside Swedish EEZ is expected to be completed at the tie-in[1] location east of Gotland at KP 674 in the second quarter of 2011.

[1] Connection of pipeline sections. At tie-in locations, pipeline sections will be purposely over laid in preparation for cutting and alignment for the hyperbaric welding.

During the performance of pipe-lay in the Swedish EEZ, the so-called Abandonment & Recovery (A&R) procedure was performed a few times due to rough weather. This means that the lay barge lowered the end of the pipeline to rest on the seabed, and after the weather had improved, recovered the end of the pipeline back to the lay barge in order to continue the pipe-lay operations.

During pipe-lay in the Swedish EEZ Castoro Sei used 10-12 anchors to ensure the correct position of the barge. The anchors, which are moved by dedicated anchor-handling vessels, are placed up to approximately 1000 metres from the pipeline alignment. A typical anchor pattern is outlined in Figure 3.10. Three anchor-handling vessels supported Castoro Sei during the construction works within the Swedish EEZ.

In addition, four pipe carriers provided the pipes for the barge. During the first construction phase pipes were transported from the stockyard at Slite on Gotland to the lay barge (KP 674 to KP 498).

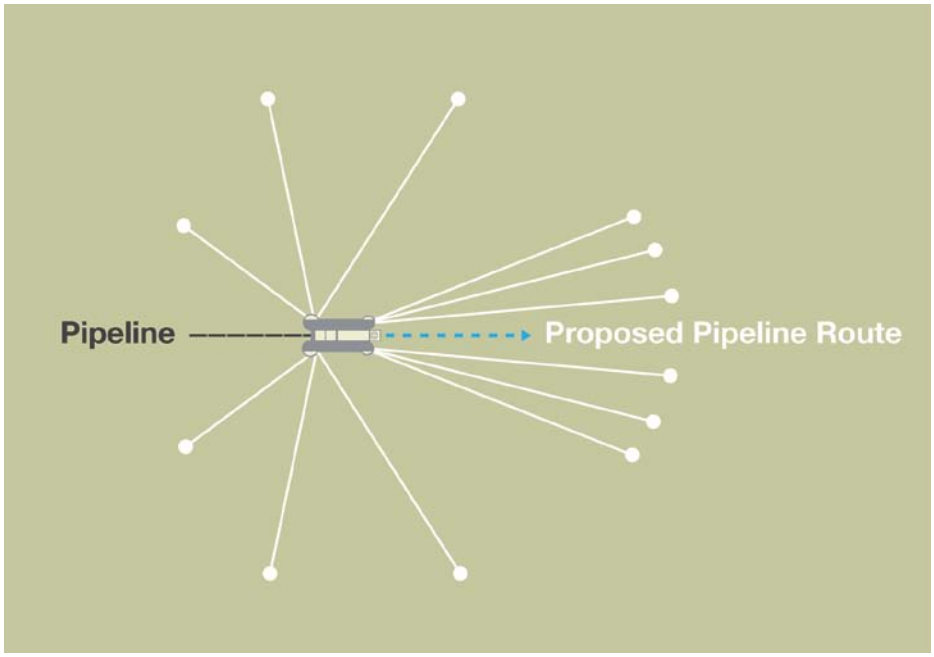


**Figure 3.10** Outline of anchor pattern around the lay barge.

# 4 Environmental monitoring within the Swedish EEZ

## 4.1 Monitoring of munitions clearance

### 4.1.1 Monitoring programme, purpose and period of monitoring

The monitoring programme for monitoring of environmental parameters during munitions clearance is described in /7/.

The monitoring programme includes the following parameters/procedures to be undertaken during munitions clearance:

- Observations of marine mammals and fish before and after munitions clearance, by use of echo-sounder, passive acoustic monitoring (PAM).
- Observations and registrations of sea-birds before and after detonation.
- Use of fish and seal scarer before detonation.
- Monitoring current velocity and current direction.
- Monitoring of the blast wave from the detonation.
- Multi-beam echo-sounder (MBES) measurements of the seabed, and visual surveys using a remotely operated vehicle (ROV) before and after detonation.

The purpose of monitoring environmental parameters at the munitions clearance sites was:

- To reduce impacts on the marine fauna (fish, marine mammals) from munitions clearance.
- To evaluate and document effects on the environment from the munitions clearance.

Monitoring was planned to be undertaken before, during and after clearance of the single munitions objects /7/. The notified munitions objects in Swedish EEZ were planned to be cleared during the period from March to May 2010.

### 4.1.2 Monitoring and results 2010

A total of seven mines were cleared in Swedish waters from 19 March to 3 April 2010. The company BACTEC International Limited performed the clearance. The seven munitions clearance sites are shown on Figure 3.3.

The basic principles that were applied for the munitions clearance, involved placing a small charge next to the identified munitions object on the seabed using a specially designed ROV. The charge was detonated from a ship located at a safe distance from the target thereby detonating the munitions object.

Prior to each of the detonations the appropriate amount of charges necessary to detonate the munitions object were calculated.

All seven identified munitions objects along the pipeline route in Sweden were successfully cleared during the operations.

For two of the seven munitions (R-22-95408 and R-22-1368 located east of Gotland, Figure 3.3 ), a second attempt was necessary due to the charge case inside the mines not having been destroyed by the first attempt.

No marine mammals or sea-birds were injured or killed during the clearance operations. In five of the seven clearances (the 7 + 2 detonations) a small number of fish were collected from the sea surface (<20 individuals/location).

The explosions resulted in creation of small craters on the munitions sites (maximum 10-12 m in diameter). As an example of this, Figure 4.1 and Figure 4.2 show munitions no. R-30-93382 before and after clearance. The diameter of the crater was 10–12 meter, and the depth (height range) of the crater was between -0.27 m. to 0.71 m (seabed as 0 m).

For further details on the clearances and results, please refer to the report “Munitions Clearance in the Swedish EEZ” /9/.

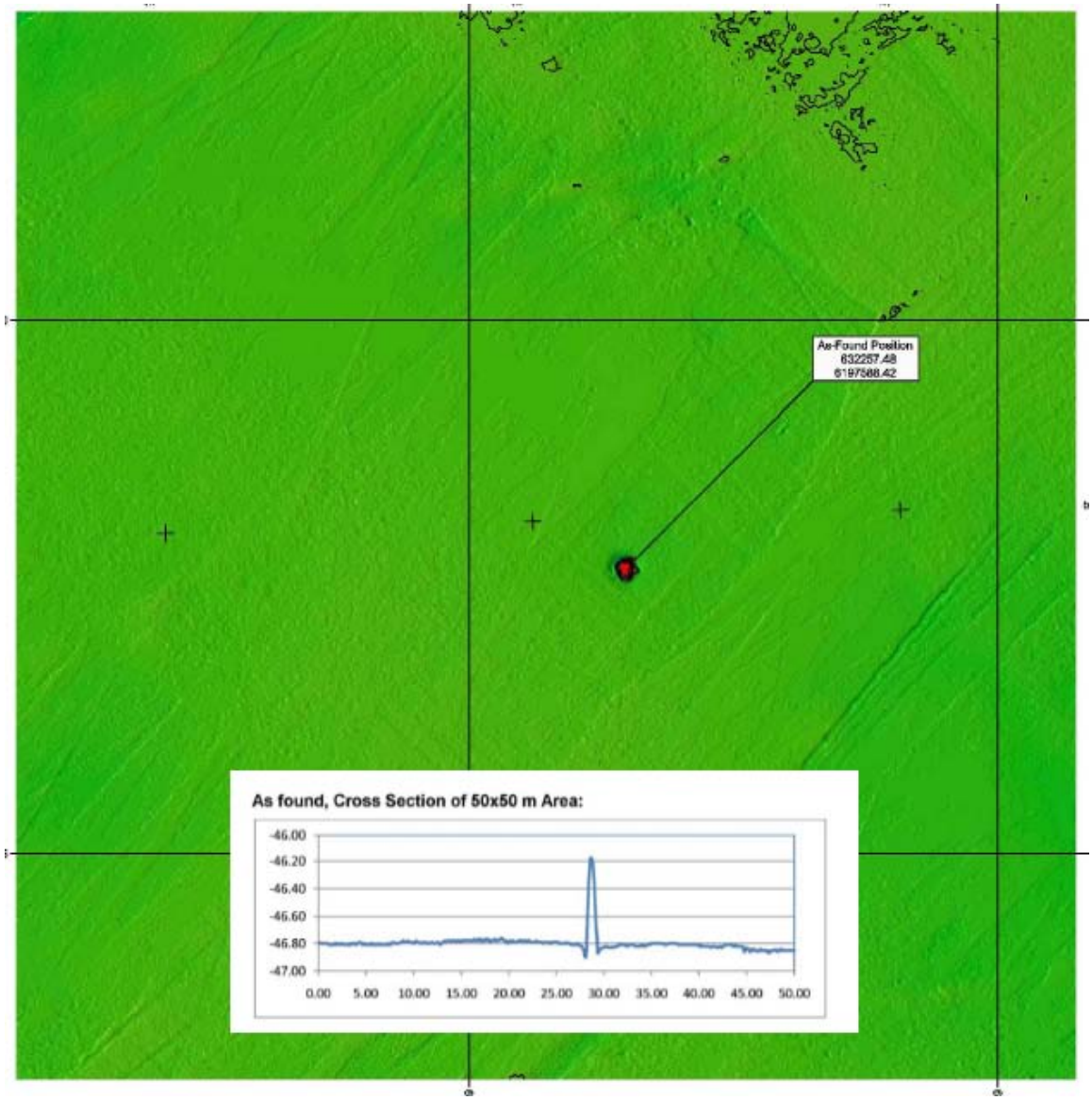


**Figure 4.1** Munitions object no. R-30-93382 as found on the seabed.

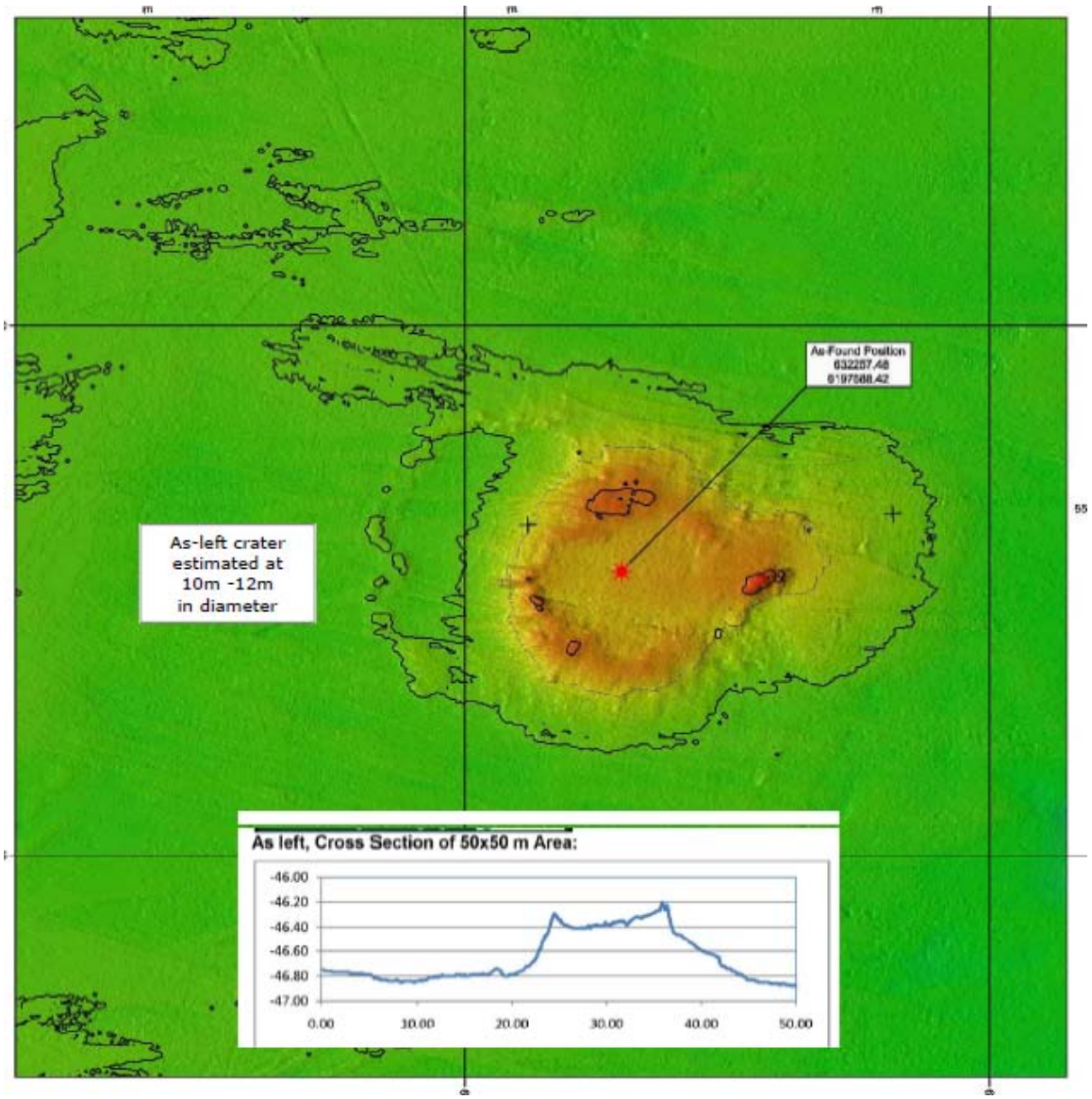


**Figure 4.2** Munitions no. R-30-93382 after clearance (as-left position). Contour lines are 0.5 meter.

## 4.2 Monitoring of fish along pipeline

### 4.2.1 Monitoring programme, purpose and period of monitoring

The monitoring programme for fish along the pipeline is described in /2/ and /3/, and will be carried out before and after the establishment of the Nord Stream Pipeline.

The purpose of the monitoring programme for fish along the pipelines is:

- To evaluate and document the qualitative and if possible the quantitative changes in the demersal fish communities in the area adjacent to the Nord Stream pipelines, compared to the fish community of the surrounding seabed.

The intention of the monitoring programme is to investigate whether the presence of the pipelines lead to a so-called "reef effect"[2] and to determine the extent of changes in fish abundance.

Fish monitoring is carried out at the following types of locations:

- Where the pipelines are placed directly on the seabed.
- Where rock placement has been carried out.
- Where trenching has been carried out.
- At reference locations ≥1 km from the pipelines.

The monitoring of fish at and close to the pipelines is focused on demersal fish species, as no effects from the presence of the pipelines on the seabed are expected for pelagic fish species. In addition to survey trawl fishery (TV3-520 trawl) and gill net fishery (gill net type K072), echo-sounder measurements and visual inspections with an ROV will also be carried out.

Table 4.1 and Figure 4.3 show the locations of the fish monitoring areas. Investigations are undertaken in three areas (HNB[3], NMT[4], and NMR[5]), with two monitoring stations in each area (one impact station and one reference station).

Monitoring of fish along the pipeline is planned to be undertaken during September/October once per year from 2010-2014.

[2] The hard structure of the pipeline and rock berms creating new reef-like habitats.
[3] HNB: Between Hoburgs Bank and Norra Midsjöbanken - pipeline on seabed.
[4] NMT: Norra Midsjöbanken – post-lay trenching (ploughing).
[5] NMR: Norra Midsjöbanken – rock placement.

**Table 4.1** Locations of fish monitoring areas (see Figure 4.3).

| Location | Installation activity | Number of stations at the area | KP section (km) |
|---|---|---|---|
| **Area: HNB** Between Hoburgs bank and Norra Midsjöbanken | Pipeline direct on seabed | 1 impact station<br>1 reference station | KP 855-867 |
| **Area: NMT** Norra Midsjöbanken | Post-lay trenching | 1 impact station<br>1 reference station | KP 867-879 |
| **Area: NMR** Norra Midsjöbanken | Rock placement | 1 impact station<br>1 reference station | KP 902-903 |

**Table 4.2** Summary of the monitoring programme for fish fauna along the pipeline in Sweden.

| Fish in Sweden | |
|---|---|
| **Monitoring of fish fauna along the pipeline** | |
| Purpose | To evaluate and document the qualitative and if possible the quantitative changes in the fish community in the area adjacent to the Nord Stream pipelines |
| Area to be monitored | Three selected areas in the vicinity of the Natura 2000 areas |
| Activity to be monitored | Presence of pipelines on the seabed, post-lay trenching and rock placement |
| Method to be used | Fish investigations by survey trawl and/or gill net. Hydroacoustic (echosounder) measurements for fish. Video recordings of seabed inside section to be trawled and conductivity, temperature, depth, oxygen profiles and secchi depth at stations with trawling |
| Period of monitoring | September/October 2010-2014. If the preliminary results from monitoring show that the impact is insignificant or negligible, suggested changes for subsequent monitoring activities are reported to the relevant authorities |
| Results | Documentation of changes in fish fauna along the pipelines compared with seabed without pipelines |

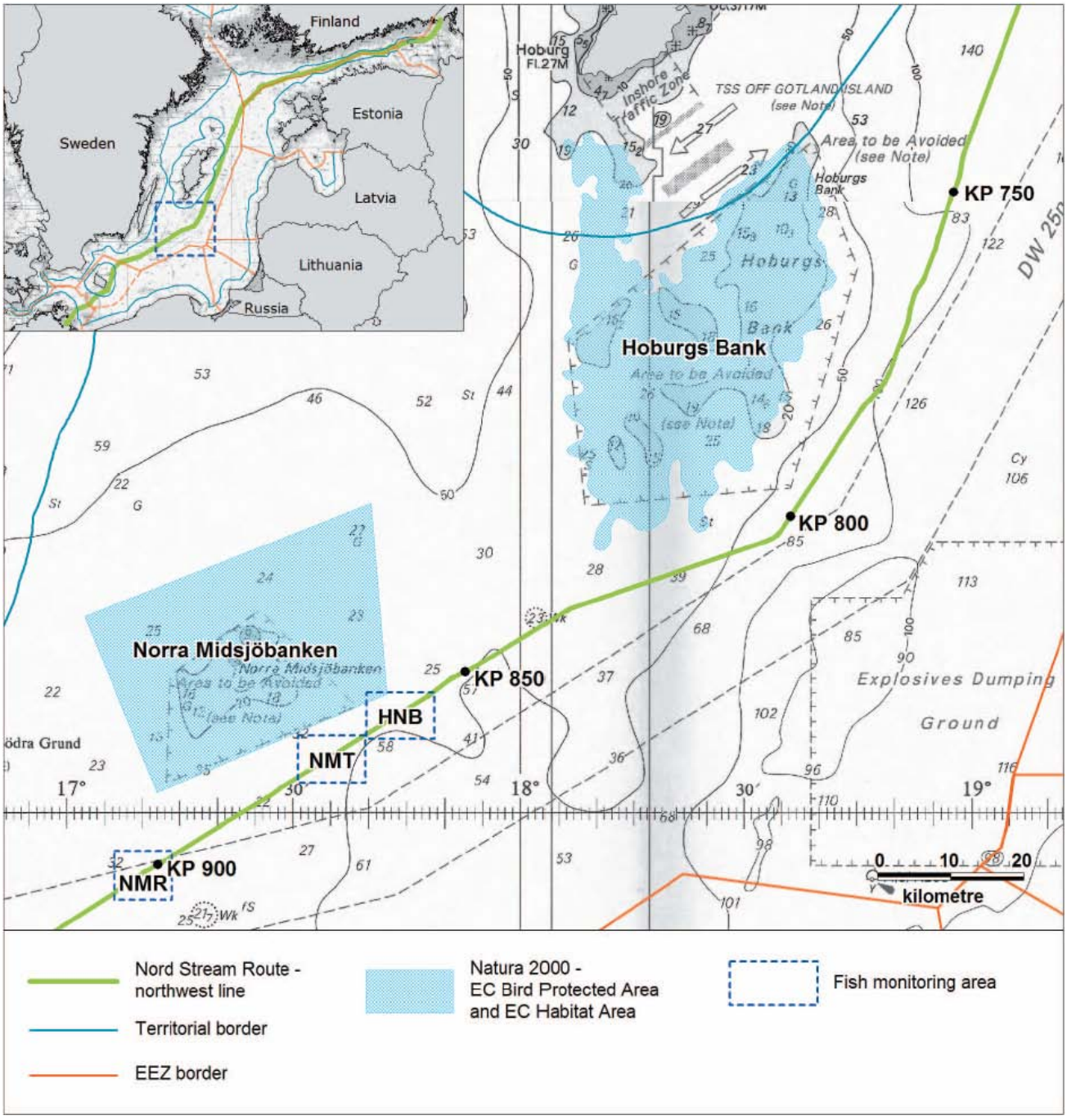


**Figure 4.3** Areas for monitoring of fish along the pipeline in Sweden.

#### 4.2.2 Monitoring and results 2010

In accordance with the monitoring programme /3/, monitoring started in September 2010 and was completed in November 2010. The results of the monitoring in 2010 shall function as baseline for the later monitoring surveys. The results from the fish survey are described in detail in the report "Monitoring of fish along the pipeline, Sweden 2010" /10/.

Sampling was conducted within three different areas: HNB, NMT and NMR. Area HNB was sampled with bottom trawl, area NMT was sampled with gill nets and area NMR was sampled with both ($NMR_{trawl}$ and $NMR_{gill\ net}$).

In general, the data from the 2010 survey is in accordance with the fish catch data obtained from Swedish fishermen and the Baltic International Trawl Survey in the Baltic Sea /11/, /12/, which shows that Cod and Herring dominate the catches in the three surveyed areas. One exception is however, that Sprat is not very highly represented in the Nord Stream survey data for 2010, which might otherwise have been expected. Other species represented in the catches includes Flounder, Sprat, Three-spined stickleback, Shorthorn sculpin, Plaice and Whiting.

The results indicated a large spatial difference between the three studied areas in terms of abundance and composition of fish, but no significant statistical difference between impact and reference stations within the same area was found. One exception however, is the length distribution pattern for cod at $NMR_{trawl}$ impact stations where the average length was longer than at $NMR_{trawl}$ reference stations. Not all catches were large enough for a statistically reliable valuation, making a comparison between impact stations and reference stations uncertain.

Differences between the three studied areas are likely caused by variations in bottom substrates, depth and oxygen levels.

### 4.3 Monitoring of fish inside Natura 2000 areas

#### 4.3.1 Monitoring programme, purpose and period of monitoring

The monitoring programme for fish inside the two Natura 2000 areas Hoburgs bank and Norra Midsjöbanken is described in /2/, /3/. Monitoring is planned to be carried out before and after the Nord Stream pipelines have been established.

The purpose of the monitoring of fish inside the two Natura 2000 areas is:

- To evaluate and document potential effects of construction activities (trenching) on fish fauna inside the two Natura 2000 areas Hoburgs bank and Norra Midsjöbanken.

The fish monitoring programme will evaluate possible impacts on fish species inside the two Natura 2000 areas Hoburgs bank and Norra Midsjöbanken. Its focus is on demersal fish species because assessments indicate that primarily demersal fish might experience impacts because the disturbance is mainly concentrated at the seabed.

Fish investigations carried out by SBF at Hoburgs bank in May-June 2006, 2007 and 2008 and at Norra Midsjöbanken in May-June 2008 will, when results are publicised, be used as baseline data

together with the results from the Nord Stream monitoring surveys in May-June 2010, and September-October 2010.

The monitoring is carried out by test fishing at 20 impact stations and 20 reference stations at each bank with K072 gill nets. The positions of the stations are shown on Figure 4.4.

Monitoring of fish inside the two Natura 2000 areas Hoburgs bank and Norra Midsjöbanken is planned to be undertaken twice every year in the period from mid May-June, and September - October from 2010 - 2014.

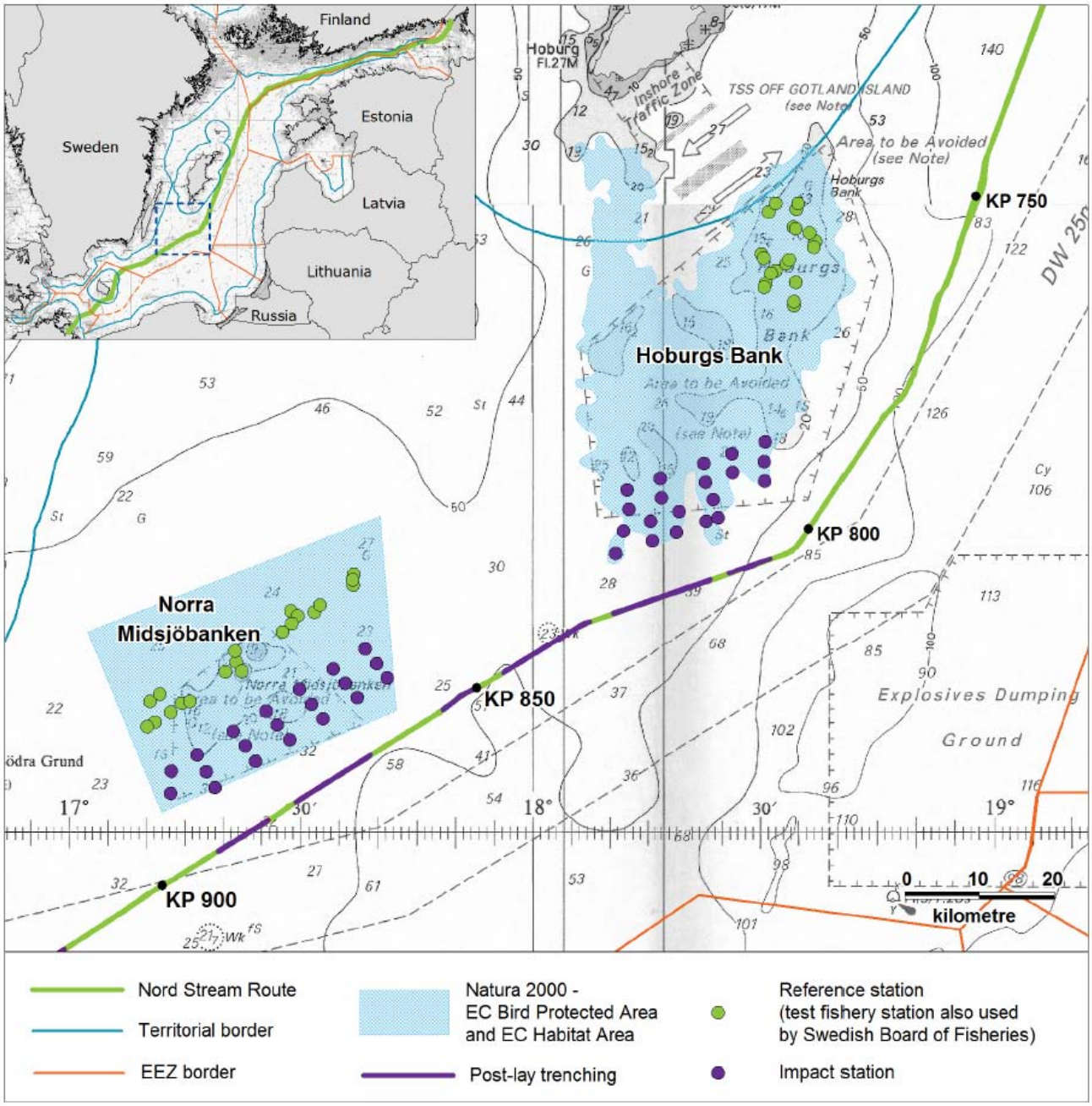


**Figure 4.4** Fish monitoring stations at Hoburgs bank and Norra Midsjöbanken.

**Table 4.3** Summary of the monitoring programme for fish fauna inside Natura 2000 areas in Sweden.

| Fish in Sweden | |
|---|---|
| **Monitoring of fish fauna inside Natura 2000 areas** | |
| Purpose | To evaluate and document potential effects of construction activities on fish fauna inside Natura 2000 areas Hoburgs bank and Norra Midsjöbanken |
| Area to be monitored | Hoburgs bank and Norra Midsjöbanken |
| Activity to be monitored | Post-lay trenching |
| Method to be used | Fish survey using gill nets and video recording of seabed at 40 stations inside Hoburgs bank and 40 stations inside Norra Midsjöbanken. Otoliths from cod, turbot and flounder removed and stored. CTDO profiles |
| Period of monitoring | May-June and September-October 2010-2014. If the preliminary results from the monitoring show that the impact is insignificant or negligible, suggested changes for subsequent monitoring activities are reported to the relevant authorities |
| Results | Documentation of the effects on demersal fish species and community caused by sediment dispersion and re-sedimentation. Focus on cod, turbot and flounder |

### 4.3.2 Monitoring and results 2010

In accordance with the monitoring programme /2/, /3/, monitoring was undertaken in June 2010, and in September-October 2010.

The monitoring programme for fish inside Natura 2000 areas in Sweden included 40 stations at Hoburgs bank and 40 stations at Norra Midsjöbanken, with 20 “impact” stations, and 20 reference stations at each bank.

The survey at each station included gill net fishery with K072 gill nets, CTDO-measurements of the conductivity (salinity), temperature, depth, oxygen, secchi desk measurements, and habitat description by underwater video recording of the seabed. The monitoring in 2010 has established a baseline for similar surveys planned in 2011-2014 with the overall objective to enable assessments of potential impacts on the fish fauna inside the two Natura 2000 areas due to the construction work.

In total 12 fish species were caught during the June and September surveys. The dominating species in order of quantity were Cod, Flounder, Turbot, Shorthorn sculpin, Eelpout and Herring. For the remaining six species, only one individual/species was caught.

The abundance of Cod inside the two shallow water Natura 2000 areas in September was high compared to the abundance in June. In contrast, the abundance of Flounder and Turbot was higher in the June survey.

The overall differences in abundance between the three species Cod, Flounder and Turbot between the “impact” area and the reference areas at the two banks were:

- Cod was more abundant in the impact area, compared with the reference area at Hoburgs bank in the September survey. There were no differences in abundance of Cod between impact and

reference areas at Norra Midsjöbanken during the June or the September survey, or at Hoburgs bank in the June survey.

- There was a higher abundance of Flounder at the reference area at Norra Midsjöbanken in September in comparison to the impact area. There were no differences in abundance of Flounder between the impact and reference areas at Hoburgs bank during the June or during the September surveys, or at Norra Midsjöbanken in the June survey.

- There was higher abundance of Turbot at the reference areas compared with the impact areas at both banks both in June and in September.

Investigation of sex and maturity of individuals of the three most common species revealed that juvenile Cod dominated in all areas in the June and September surveys, but also maturing and spawning Cod were observed during the June survey, while spent Cod was observed in the September survey. This, together with individual length and biomass distribution of Cod indicates that spawning had taken place in the period between June and September.

Maturing, spawning and spent Flounders dominated the catch in June, while the catch in September was dominated by maturing Flounder. It is assessed that Flounders in the June survey were at the peak or at the end of their spawning period.

June and September was dominated by maturing Turbots. In June, a relatively high number of spawning Turbots was observed at the impact area of Hoburgs bank, while in general, a relatively high number of spent individuals were observed in all areas in the September survey. It is assessed that Turbots in June were about to start or had just started their spawning.

Higher abundance and biomass of Flounder and Turbot in June than in September can possibly be explained by their pre- and/or spawning aggregations in shallow water monitoring areas.

The monitoring survey in 2010 was undertaken as planned in the monitoring programme /2/. Procedures used in the 2010 survey will be updated for the 2011 survey based on the recommendations and findings during the 2010 survey. It has been agreed that:

- Monitoring surveys should take place in the periods May/June, and September/October from 2011.

- Otoliths should be taken from Turbot and Flounder (max. 200 individuals/area) in future. (No otoliths should be taken from Cod, as done in 2010). Otoliths are taken as back-up. Should any abnormal changes in species abundance or distribution be encountered between the “impact” and the reference stations, in relation to what has been previously observed in the area (baseline study 2009 and data collected by SBF in 2006 to 2008) it has to be decided if otoliths should be examined.

An evaluation of the impact from construction and operation of the pipeline will be achievable after sampling results from surveys carried out after construction of the first pipeline are available. The annual monitoring report for 2011 is going to focus on effects on fish species/communities in the

"impact" area of the two banks, compared with the two reference areas. This will be done by comparing results from the baseline monitoring in June and September 2010 with the monitoring results from 2011.

Detailed results from the fish survey in June 2010, and September-October 2010 is included in the report "Monitoring of fish inside Natura 2000 areas, Sweden 2010" /13/.

## 4.4 Monitoring of benthic fauna

### 4.4.1 Monitoring programme, purpose and period of monitoring

The monitoring programme for benthic fauna to be undertaken once every year is described in /2/, /3/, /4/. Monitoring of infauna will be carried out before and after establishment of the Nord Stream pipelines on the seabed, while monitoring of epifauna will not start until Line 1 has been established on the seabed. Monitoring of the benthic fauna includes:

- Infauna investigations: Once per year in June/July from 2010-2014.
- Epifauna investigations: Once per year in September/October from 2011-2014.

The purpose of the monitoring module for benthic fauna along the pipelines is:

- To evaluate and document re-colonisation and recovery of the infauna changes around the pipelines due to establishment of the Nord Stream pipelines.
- To evaluate and document the establishment and growth of epifauna on the pipelines and on rock berms (established during rock placement).

The monitoring areas for benthic infauna are shown in Figure 4.5. The benthic infauna stations are located in areas where trenching is planned, and where the most pronounced effects from sediment dispersion and re-sedimentation can be expected. The benthic infauna transects are located in north-eastern directions, in accordance with the most obliging current direction. There are ten stations and one reference station at the transect at Hoburgs bank and nine stations and one reference station at the transect at Norra Midsjöbanken. Three Van Veen grab samples are collected at each station along with one core sample for analysis of physical and chemical properties of the seabed sediment.

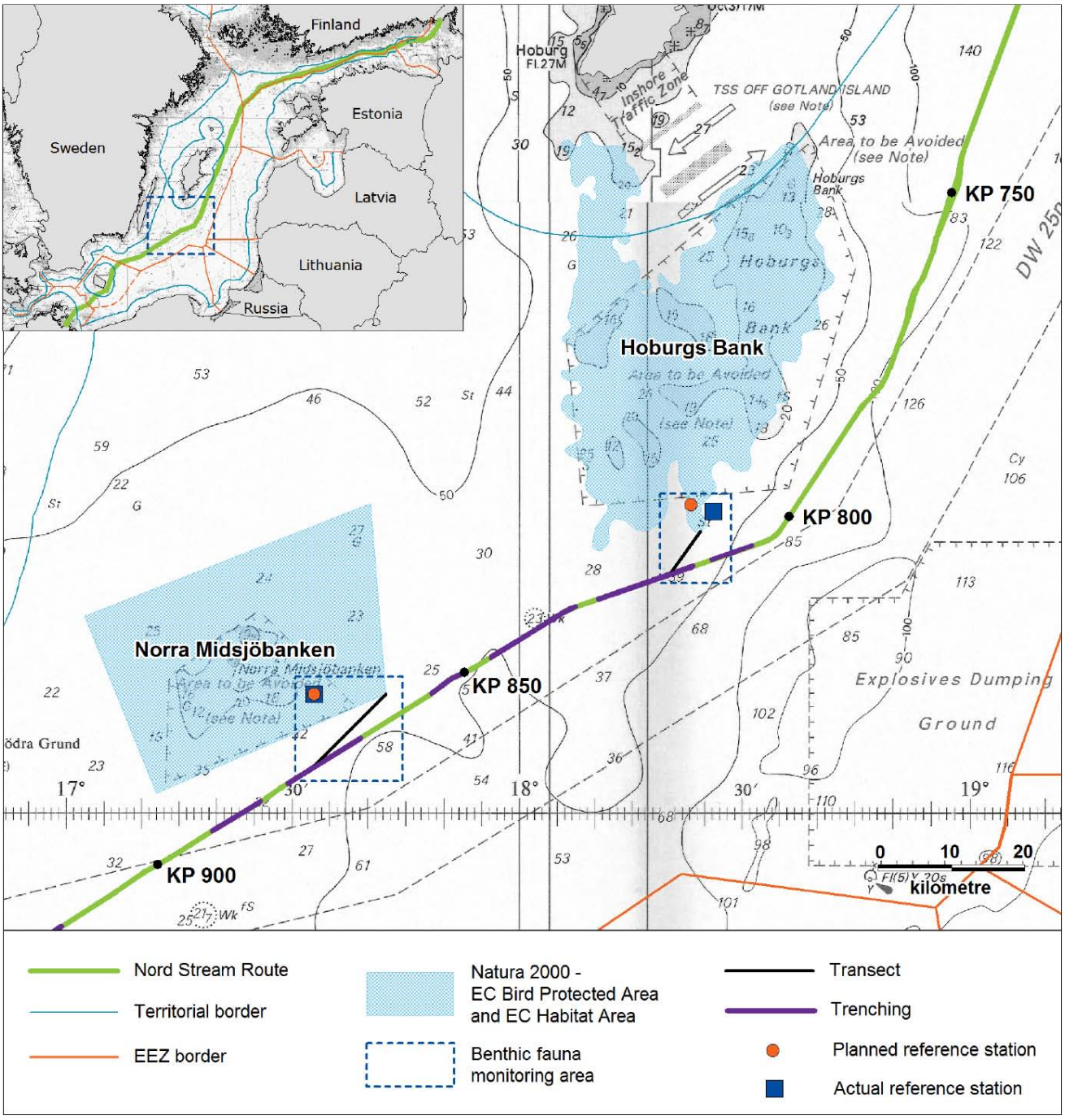


**Figure 4.5** Areas and transects for monitoring of benthic infauna in Sweden.

**Table 4.4** Summary of the monitoring programme for re-colonization and recovery of the infauna in Sweden.

| Benthic flora and fauna in Sweden | |
|---|---|
| **Monitoring of re-colonization and recovery of the infauna** | |
| Purpose | To evaluate and document re-colonization and recovery of the infauna |
| Area to be monitored | One area to be trenched south of Hoburgs bank and one area to be trenched east of Norra Midsjöbanken |
| Activity to be monitored | Post-lay trenching |
| Method to be used | Samples collected by a Van Veen grab sampler. Video inspections. Sediment analysis: grain size, dry matter, loss of ignition, total organic carbon at all stations. Water measurements: conductivity, temperature, depth, oxygen profiles at all stations |
| Period of monitoring | June/July 2010–2014. If the preliminary results from the monitoring show that the impact is insignificant or negligible, suggested changes for subsequent monitoring activities will be reported to the relevant authorities |
| Results | Documentation of the recovery and re-colonization of infauna |

Inspection of colonisation and growth of epifauna on the pipelines and on rock berms will be undertaken by visual inspections of the pipeline structure and rock placement locations at relatively shallow depths. Visual inspections are planned at three locations as described below, in which the growth of benthic epifauna will be described and evaluated. The three locations are the same locations where monitoring of fish along the pipeline is carried out.

The monitoring programme for benthic epifauna includes:

- Visual inspection of a pipeline section where the pipeline will be laid directly on the seabed (area HNB on Figure 4.6).
- Visual inspection of a pipeline section where the pipeline will be trenched into the seabed (area NMT on Figure 4.6).
- Visual inspection of a pipeline section where there will be rock placement (area NMR on Figure 4.6).

The pipeline sections where the three stations are located are shown on Figure 4.6.

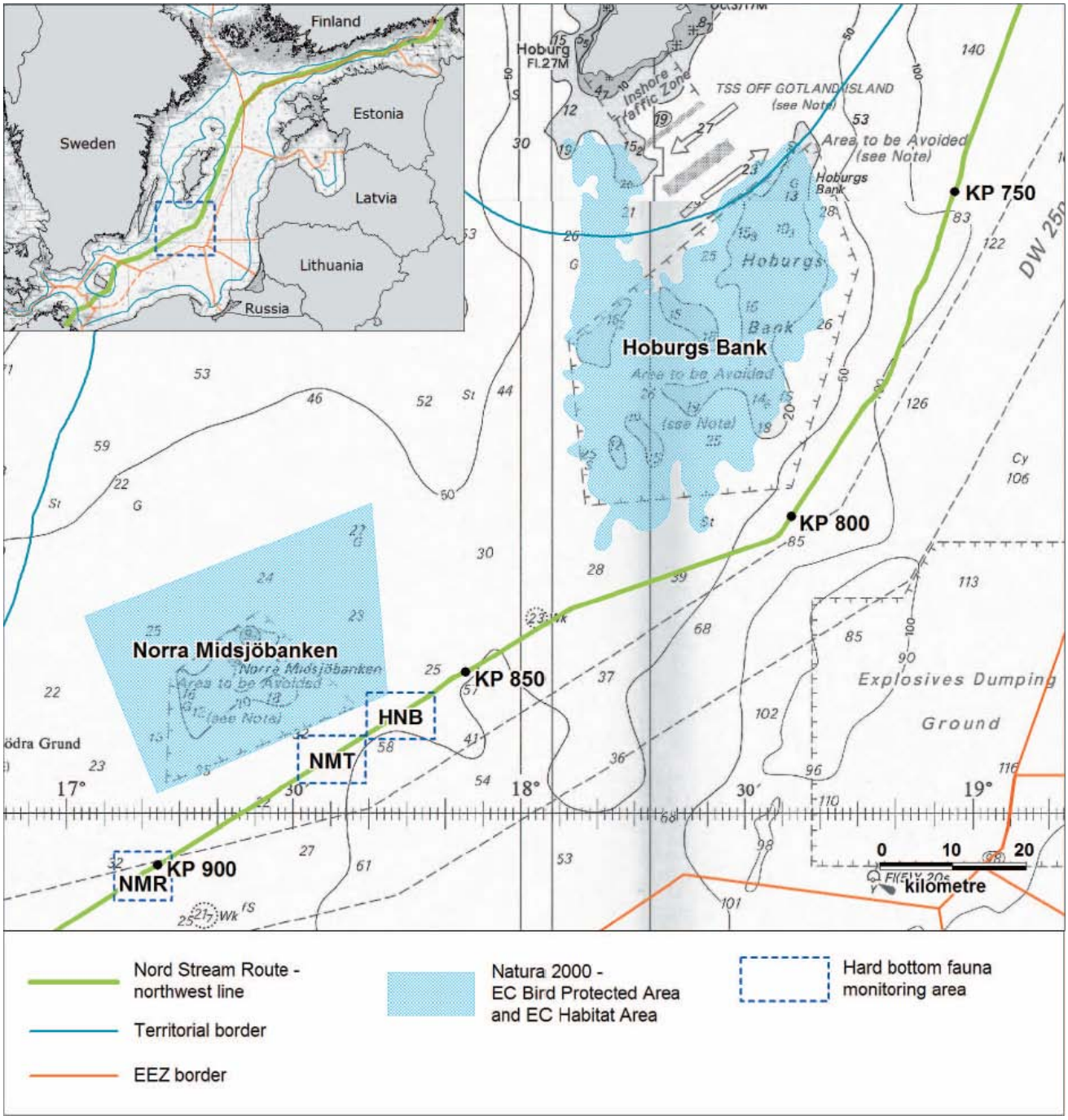


**Figure 4.6** Areas for monitoring of benthic epifauna in Sweden.

**Table 4.5** Summary of the monitoring programme establishment and growth of epifauna on the pipeline in Sweden.

| Benthic flora and fauna in Sweden | |
|---|---|
| **Monitoring of establishment and growth of epifauna on the pipeline** | |
| Purpose | To evaluate and document the establishment and growth of epifauna on the pipeline |
| Area to be monitored | At three selected locations at Norra Midsjöbanken |
| Activity to be monitored | A trenched section, a section with pipeline established directly on seabed and a section with rock placement |
| Method to be used | ROV video recording for qualitative assessment of epifauna on the pipelines and on rocks at rock placement location |
| Period of monitoring | September-October 2011-2014 |
| Results | Documentation of the establishment and growth of epifauna on pipelines and rocks |

### 4.4.2 Monitoring and results 2010

In accordance with the monitoring programme described in /2/, /3/, /4/ monitoring of benthic infauna was undertaken in June 2010. Results from the monitoring in 2010 will function as baseline for the later monitoring surveys. The results from the benthic infauna survey in June 2010 are included in the report “Monitoring of benthic fauna, Sweden 2010” /14/.

The monitoring programme for infauna in Sweden in June 2010 included 11 stations at Hoburgs bank and 10 stations at Norra Midsjöbanken. The survey at each station included an underwater video recording of the seabed, measurement of conductivity (salinity), temperature, depth and oxygen throughout the entire water column, sediment sampling for analysis of selected physical and chemical variables and three Van Veen grab samples for analysis of the infauna. The monitoring in 2010 has established a baseline for similar surveys planned in 2011-2014, the overall objective of which is to enable assessments of impacts on the macrozoobenthos and the seabed due to the construction work.

The depth at the stations at Hoburgs bank ranged from 34.5 to 38.6 m and from 40 to 45.6 m at Norra Midsjöbanken. The oxygen concentrations were high and almost identical at the surface and at the bottom, where the concentrations were far above critical levels for the benthic fauna. The temperature declined from the surface to the bottom and a termocline was observed in a depth range of approximately 12-25 m. The temperature was as low as 4-5$^{o}$C close to the bottom. The surface of the sediment was oxidized and no smell of hydrogen sulphide ($H_2S$) was recorded during sampling.

The composition of the sediment at Hoburgs bank was characterised as fine sand, except at one station where the sediment was described as coarse sand. The sediment was coarse and heterogeneous at Norra Midsjöbanken, and sampling was difficult.

There were no systematic spatial changes in abundance and biomass of the infauna neither along the transect nor at Hoburgs bank and Norra Midsjöbanken. The abundance and biomass of the communities were dominated by a few species of polychaetes (*Bylgides sarsi*, *Marenzelleria viridis* and *Pygospio elegans*), bivalves (*Macoma balthica*) and crustaceans (*Pontoporeia affinis* and

*Saduria entomon*) characteristic for areas with low diversity and low salinity in the Baltic Sea. The Common mussel (*Mytilus edulis*), unidentified species of oligochaetes and Pripulida (*Halicryptus spinulosus)* were scarce or absent at most monitoring stations. Despite the overall similarity of the infauna a statistical analysis indicated that the infauna was different at some of the stations along the two surveyed transects, respectively.

A comparison of data from the 2010 survey with findings from a survey carried out in 2007 revealed large spatial and inter-annual variations in species composition and abundance even within the same area. There is however no statistical evidence for a comparison of the data as only one sample at each station was taken in the 2007 survey. Nonetheless it gives a good indication of the large inter-annual variations which can be found. Biological variability driven by e.g. stagnation periods and salt-rich water inflow together with differences in physical and chemical conditions e.g. depth, grain size and oxygen level does in general often result in relatively large spatial and inter-annual variations in the fauna communities.

The data gathered during the baseline survey in 2010 makes the basis for future monitoring and impact assessments. The survey in 2011 is planned to take place in June. Procedures used in the 2010 survey will be updated based on the recommendations and findings during the 2010 survey. An evaluation of the impact from construction and operation of the pipeline will be achievable after results from surveys carried out after construction of the first pipeline are available.

## 4.5 Monitoring of water quality

### 4.5.1 Monitoring programme, purpose and period of monitoring

The purpose of the water quality programme in Sweden is:

- To monitor any increase in Suspended Sediment Concentration (SSC) and sedimentation at the border of the two Natura 2000 areas during trenching, including compliance with SSC thresholds as defined in the Swedish Permit /1/.
- To monitor the sediment plume during trenching, in order to validate the assumptions for the Environmental Study for the Swedish part of the pipeline /2/.

The monitoring programme is detailed in /5/, /6/.

### 4.5.2 Monitoring of SSC (turbidity), and sedimentation at the border of the two Natura 2000 areas

Two Natura 2000 areas (Hoburgs bank and Norra Midsjöbanken) near the pipeline route in the Swedish EEZ were identified as sensitive with regards to impacts on the water environment. These areas are known to be important for birds, especially the long-tailed duck (*Clangula hyemelis*), due to the high amounts of mussels (*Mytilus edulis*) which function as the food source for the birds. Furthermore these relatively shallow water areas are important nursery and spawning areas for several fish species, including turbot (*Psetta maxima*).

Works on the seabed take place at a minimum distance of approximately 4 km from these sensitive areas. Despite the fact that model simulations of sediment dispersion during works on the seabed have shown that no effects are to be expected in the two Natura areas, concerns have been raised that suspended sediment can still reach these areas. These concerns are reflected in the conditions

of the permit for the Swedish EEZ, which limits the allowed Suspended Sediment Concentration (SSC) to 15 mg/l above background level at the border of each of the two Natura 2000 areas. The main objectives of the monitoring programme are therefore to assess levels of suspended sediment and document compliance with the above-mentioned limit value and to confirm model simulation results of the impact presented in the Swedish Environmental Study /8/.

The monitoring programme comprises four fixed monitoring stations (LT1 to LT4) which are established at the borders of each of the Natura 2000 areas, with two stations at the border of Hoburgs bank and two stations at the border of Norra Midsjöbanken (see Figure 4.7). The scope of the fixed station monitoring is:

- To measure turbidity (which will be converted to SSC) at the borders of the two Natura 2000 areas over a longer period of time (before, during and after trenching) under different current and weather situations. This is done by an Optical Back-Scatter sensor (OBS) placed at each station. The data received is compared with results from vessel-based monitoring undertaken during trenching activities (see below). Measurements before trenching have been performed to establish a model for the natural variation of SSC at the stations, in order to enable calculation of the excess SSC caused by the trenching activities.

- To measure vertical profiles of current velocity and direction. Currents are measured by Acoustic Doppler Current Profilers (ADCPs) which measure current speed and direction vertically through the water column.

- To measure salinity, temperature and stratification of the water column. This is done by CTD-sensors at three levels in the water column: 1 m, 5 m, and 15 m above the seabed.

- To measure the downward flux of suspended sediments. This is done by the use of duplicate sediment traps. The traps are installed on a separate monitoring string at the same levels as the CTD- and turbidity sensors, i.e., 1 m, 5 m and 15 m above the seabed. The sediment traps measure the downward vertical sediment fluxes, and collect sediments that can be used for subsequent laboratory analysis. Moreover, the measurements can be used in combination with the turbidity measurements to establish the settling velocity of the suspended sediments. Measurements at different levels above the seabed make it possible to distinguish between the fluxes caused by local re-suspension and the fluxes due to e.g. Nord Stream construction works /15/. Sediment collected from the sediment traps will be stored until at least one year after conclusion of the sediment monitoring programme for later physical and chemical analysis, if needed.

The four fixed stations were deployed 6-7 November 2010, and they are planned to be operating until July 2011. This will provide a clear indication of the natural levels of suspended sediment concentration/turbidity in the area before, during and after trenching takes place. The seabed intervention works are planned to be carried out in February/March 2011.

Seabed samples were collected both from the position of the four fixed stations and from the seabed to be trenched, at the time of deployment. Results of the analysis of these samples are used to identify the possible origin of sediments collected in the sediment traps, i.e. if it is the material from

sediments released during trenching works, material from local re-suspension or/and advectively supplied material from other areas.

The stations are equipped with data transmission ability in order to facilitate real time transmission of measurements of currents and turbidity. This facilitates the possibility of monitoring the turbidity, which can be converted to SSC based on calibration against previously extracted water samples. Thus compliance with the permit requirement regarding a maximum increased sediment concentration of 15 mg/l, as a consequence of the construction works, can be assured in real time.

The stations are located at the southeast borders of each of the two Natura 2000 areas which are closest to the pipeline route alignment and close to where trenching activities are planned. The positions of the four fixed monitoring stations are shown on Figure 4.7. The position of LT2 has been changed slightly from the planned position. This is because the stations are designed to fit the expected water depths within a very narrow range, and the water depth at the planned position of LT2 happened to deviate from the expected depth by several meters. Therefore, it was necessary to move the station to a position with the required water depth.

A number of water samples are collected during service visits to the fixed stations. The water samples are analysed for mass concentration of suspended solids. In addition, vessel-based measurements of turbidity and water temperature/conductivity are taken at each metre through the water column during the service visits to establish turbidity profiles and the stratification of the water column with a finer vertical resolution.

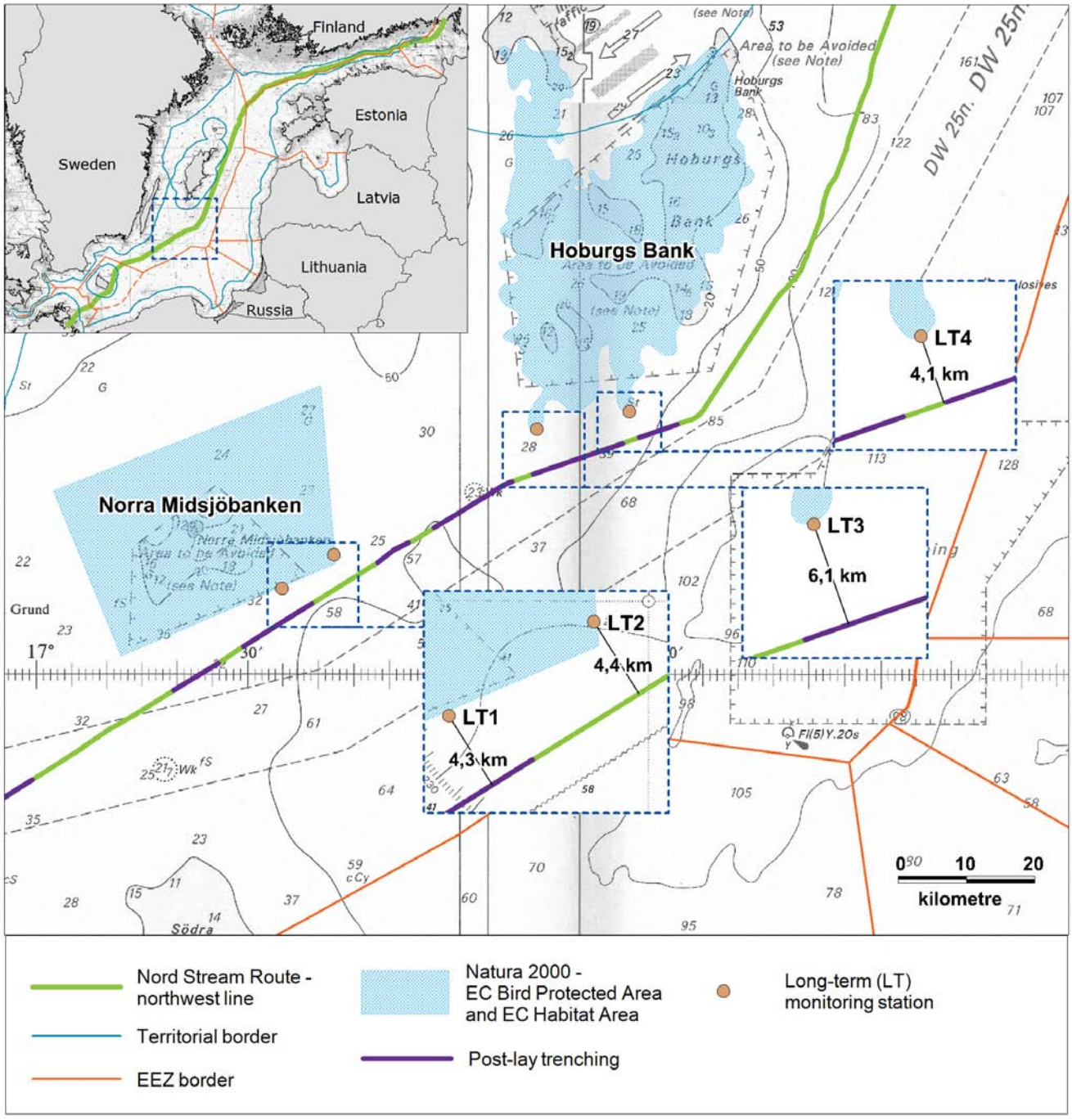


**Figure 4.7** Location of Natura 2000 areas in the vicinity of the pipeline route, with trenching areas shown. At the four long-term (LT) monitoring stations, turbidity, salinity, water temperature, currents and downward particle fluxes are measured.

**Table 4.6** Summary of the monitoring programme for turbidity and sedimentation at the border of the two Natura 2000 areas in Sweden.

| Water quality in Sweden | |
|---|---|
| **Monitoring of turbidity and sedimentation** | |
| Purpose | To evaluate and document any increase in turbidity (SSC) and sedimentation at the border of the two Natura 2000 areas |
| Area to be monitored | Hoburgs bank and Norra Midsjöbanken |
| Activity to be monitored | Post-lay trenching |
| Method to be used | Two fixed stations at Hoburgs bank, and two fixed stations at Norra Midsjöbanken. Stations equipped with ADCP and OBS sensors and sediment traps. Periodic water sampling for calibration of turbidity measurements. Sediment from sediment traps analysed for weight and stored for later analysis, if needed |
| Period of monitoring | November 2010 until June/July 2011 |
| Results | Data on turbidity and sedimentation at the border to Natura 2000 areas |

**Monitoring and results 2010**

The four LT-stations were deployed on 6-7 November 2010. During the same cruise, water samples for subsequent analyses for SSC were extracted, and seabed samples were collected for subsequent grain size distribution analyses.

The results from the first two months of measurements were analysed in January 2011. In general, correlations between the SSC (measured as turbidity) and hydrographic conditions (currents, waves) were not significant.

The data analysis shows that the natural SSC in the area is very low, in general below 2 mg/l. This low level ensures that the possible increase caused by the trenching works can be quantified with a relatively high accuracy. During periods of rough weather, high natural SSC has however been measured, in particular close to the seabed. Therefore, when analysing the SSC values during the trenching period, the hydrographic conditions (currents, waves, salinity and water temperature) will be taken into account.

Monitoring at the LT-stations will be finalised in the summer of 2011, and the results of the monitoring will be documented in a separate report, when the data has been analysed. This separate report shall be delivered to the Swedish authorities in summer 2011, and shall also be included in the following annual monitoring report to the Swedish authorities: “Environmental monitoring in Swedish waters 2011”.

### 4.5.3 Vessel-based monitoring of the sediment plume during trenching

As a consequence of the general authority requirement to protect the two Natura 2000 areas close to the pipeline route, two sections close to the banks are subject to vessel-based monitoring during trenching:

- A section south of the Natura 2000 area Hoburgs bank
- A section south of the Natura 2000 area Norra Midsjöbanken

Figure 4.7 shows the sections to be trenched. Vessel-based monitoring of turbidity is planned to be carried out at the sections that are closest to the Natura 2000 areas.

The measurements are carried out outside the specified safety zones for the construction works[6], which is agreed with the vessel operator. During trenching works, profiles of turbidity, salinity, water temperature and currents are measured from a vessel. The profiles are measured downstream of the trenching activities, aiming at measuring the maximum sediment concentrations. Reference measurements are carried out upstream of the trenching works in order to establish the natural background sediment concentration. ADCP backscatter signals are used to locate the position of the sediment plume, allowing for the profile measurements to be carried out at the optimal positions. Turbidity is measured by an OBS sensor mounted on a cable. A CTD sensor is mounted on the same cable to measure water temperature, conductivity (salinity) and depth. To enable conversion of the results of the turbidity measurements to concentrations of suspended sediments, water samples are taken frequently at the same depths at which the turbidity meters are located.

Based on modelling of the dispersion of spilled sediments from trenching at various current velocities, relations have been established between current velocity and the reduction in SSC with distance from the sediment spill source. These relations will be used as an early warning system in order to predict whether the SSC measured closer to the spill source will jeopardize the 15 mg/l limit at the border of the two Natura 2000 areas.

The duration of the monitoring at the two locations south of Hoburgs bank and east of Norra Midsjöbanken is expected to be approximately two days at each location. The results will support the interpretation of data from the fixed monitoring stations.

**Table 4.7** Summary of the monitoring programme for the sediment plume during trenching in Sweden.

| Water quality in Sweden | |
|---|---|
| **Monitoring of the sediment plume during trenching** | |
| Purpose | To evaluate and document the sediment plume during trenching, and to provide an early warning for the 15 mg/l authority requirement at the border of the two Natura 2000 areas |
| Area to be monitored | Section to be trenched south of Hoburgs bank and south of Norra Midsjöbanken |
| Activity to be monitored | Post-lay trenching |
| Method to be used | Vessel-based monitoring of turbidity (OBSs) and current (ADCPs) and water samples for calibration of turbidity measurements |
| Period of monitoring | Two days at each N2000 area during trenching in the first part of 2011 |
| Results | Description of distribution of sediment plumes during trenching, and establishment of basis for early warning for the 15 mg/l requirement. |

[6] During monitoring as close as 200 m to the side of the plough and 100-200 m behind the plough, but in front of the vessel survey vessels must adhere to the 1nm safety zone

**Monitoring and results 2010**
Vessel-based monitoring is planned to be carried out during trenching of the pipeline which will take place in February/March 2011. The results of the monitoring will be documented in a separate report, when the data has been analysed. This separate report will be included in the following annual monitoring report to the Swedish authorities: "Environmental monitoring in Swedish water 2011".

## 4.6 Monitoring of hydrographic conditions in the Bornholm Basin

### 4.6.1 Monitoring programme, purpose and period of monitoring

The purpose of the hydrographic monitoring programme in Danish and Swedish waters is:

- To establish documentation for the theoretical analysis of the possible blocking of the water inflow to the Baltic Sea caused by the presence of the Nord Stream Pipeline as reported in /15/.

The saltwater inflows from the Kattegat are sporadic and ecologically important. Concern has been raised in relation to the influence of the pipelines on the inflowing of high-salinity bottom water through the Bornholm Basin. In response, Nord Stream carried out an extensive study to address the issue /16/. The study concluded that the impact of the pipelines on the inflow of high-saline bottom water in the Baltic Proper will be negligible.

During the Swedish public consultation process, questions were raised as to whether existing knowledge and data would be sufficient for an exhaustive description of the problem. Consequently, Nord Stream decided to establish a hydrographic monitoring programme in collaboration with the relevant authorities.

The purpose of the hydrographic monitoring programme is to investigate the influence of the pipelines on the inflowing, high-saline deepwater in the Bornholm Basin. It was assessed that it is impossible to directly monitor the effect due to the presence of the pipelines. This is due to the natural variability being several orders of magnitude higher than a possible local effect. The scope, therefore, is focused on verifying the hypothesis of the previous investigations by SMHI in their consulting report /16/.

Hydrographic measurements in 2010 and 2013 respectively, are planned in order to verify the influence on blocking and mixing caused by the presence of the pipeline described in /16/. Field investigations before construction lasted approximately one year (began on 21 January 2010 and ended 11 January 2011). The measurements aim to describe the bottom currents, interfacial friction and dissipation of inflow waters. Oceanographic measurements (velocity, temperature, salinity) were carried out initially during a period of 9 months (including approximately one month down period) at KP 1036 northeast of Bornholm at a water depth of approximately 90 m. The location was selected in mutual understanding with SMHI and the fishermen's organisation on Bornholm. In autumn 2010 the measuring station was moved to KP 966 in order to also obtain measurements from the halocline level at shallower water depths (approximately 68 m). The two locations of the monitoring station are presented in Figure 4.8.

In addition to the fixed station, line transects of currents have been carried out by ADCP. The line transects done in 2010 were carried out along the pipeline route between KP 1030 and KP 1070. A total of seven transects were planned in relation to each service inspection (including mobilisation and demobilization). By the end of 2010, four successful line transects had been carried out. The reduction in the number of transects is mainly due to the weather conditions during service cruises.

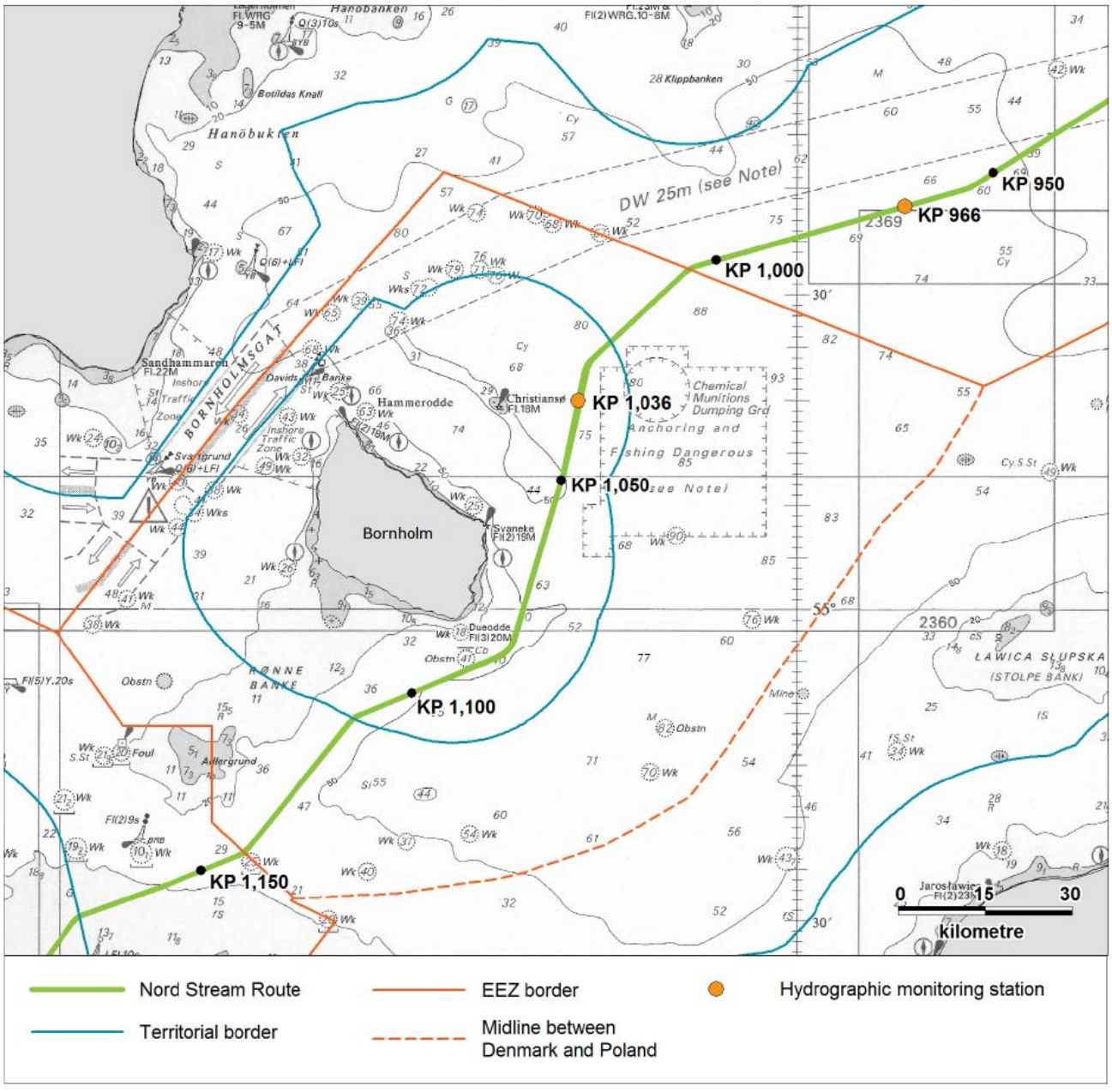


**Figure 4.8** Location of hydrography monitoring station in Denmark and Sweden. The station was originally deployed near KP 1036. In autumn 2010 it was moved to shallower water at KP 966.

**Table 4.8** Summary of the hydrographic monitoring programme in Denmark and Sweden.

| Hydrography in Denmark/Sweden | |
|---|---|
| **Monitoring of water inflow** | |
| Purpose | Description of bottom currents, interfacial friction and dissipation of inflow waters. Evaluation of changes caused by the Nord Stream pipelines |
| Area to be monitored | Transects at the pipeline route between KP 1030 and KP 1070 in the Bornholm Basin. The measuring station was positioned at KP 1036 in Danish water and at KP 966 in Swedish water |
| Activity to be monitored | Presence of the pipelines on the seabed |
| Method to be used | ADCP, CTD (fixed station). Ship mounted ADCP (line transects) |
| Period of monitoring | Continuous measurement for one year (2010) before construction and after the pipelines have entered into operation (2013) |
| Results | Documentation of effects from the pipeline on inflowing saline/oxygenated bottom water from the Danish straits |

### 4.6.2 Monitoring and results 2010

**Fixed monitoring stations**

The fixed monitoring station was installed at KP 1036 on 21 January 2010. The station was retrieved from this location on 11 October 2010. The station was trawled up on 7 March 2010 and redeployed on 8 April 2010. No data was consequently compiled during this period. The equipment was moved to a new position at KP 966 on 5 November 2010 and retrieved 11 January 2011.

Monitoring activity and data availability is summarised in Figure 4.10.

**Table 4.9** Monitoring activity and data availability for the fixed stations at KP1036 and KP966 of the 2010 hydrographic monitoring campaign.

| Date | Activity | Monitoring location | Data available |
|---|---|---|---|
| 22.01.2010 - 07.03.2010 | Measuring | KP1036 | Yes |
| 07.03.2010 – 08.04.2010 | Trawled up | KP1036 | - |
| 08.04.2010 – 11.10.2010 | Measuring | KP1036 | Yes |
| 11.10.2010 | Retrieved | KP1036 | - |
| | | | |
| 05.11.2010 – 11.01.2011 | Measuring | KP966 | Yes |
| 11.01.2011 | Retrieved | KP966 | - |

Unfortunately data from the ADCP instrument (Aquadopp) from 12 m depth to the bottom is missing in the following three periods: 30 April 2010 – 16 June 2010, 22 August 2010 – 31 August 2010 and

17 September 2010 – 11 October 2010. In the first case it seems to be due to unstable power supply since internal cabling has been changed in the subsequent service. In the second case data is classified as “unvalidated”, and in the latter case, it is due to battery failure, which is surprising since data loss occurs less than two weeks after last service inspection.

Salinity and temperature data from the mooring and from CTD profiles are in general of a very high quality. In the ADCP data from the mooring, some depths have excessive noise levels and have been disregarded. This is mostly due to known effects, such as reflection from the bottom, blanking distance from the instrument and disturbances from sharp interfaces (the density interface above the mixed bottom layer).

**Line transects**
Line transects for monitoring currents with ADCP have been carried out. Each line transect is carried out at the pipeline route over a 40 km distance between KP 1030 to KP 1070. By the end of 2010 the following four line transects have been carried out as summarised in Table 4.10.

**Table 4.10** Monitoring activity and data availability for line transects of the 2010 hydrographic monitoring campaign.

| Date | Transect ID | Data |
|---|---|---|
| 16.02.2010 | T1 | Yes, but noisy |
| 17.03.2010 | T2 | Yes |
| 16.06.2010 | T3 | Yes |
| 01.09.2010 | T4 | Yes |

Transect T1 is of lower quality, in part due to cold water and low particle content, a known problem for acoustic instruments.

An extra fifth line transect is planned to be carried out during March/April 2011. This line transect will be extended towards the northeast in order to cover the fixed monitoring position at KP 966. The length of the line transect will be 130 km, covering the entire distance between the two mooring locations.

**Preliminary results**
The results from the CTD sensors show a surface mixed layer, 40-45 m thick. Beneath the pycnocline (45-70 m depth), one or two more or less well-defined layers may be found. Temperature gradients form in the surface layer in spring and summer.

In the beginning of 2010, temperature at the surface was colder than at the bottom. Events of colder water penetrating from mid- to deeper layers occurred from mid-February, and in April, May and to a lesser extent also in the beginning of June. Most of these were resulting in a lowering of salinity. Stable conditions lasted throughout summer. On 5-6 October, warmer and saltier water penetrated all the way to the bottom and 15 m above the seabed. This is in accordance with observations of higher oxygen levels at the bottom at the monitoring station BY4 in the beginning of October.

Current velocities at the bottom vary between 0-0.2 m/s and between 0-0.5 m/s 30-50 m above the seabed. Some of the cold water penetrating downward can be associated with higher velocities. There is no obvious pattern with respect to current direction.

Unfortunately, the bottom ADCP data is missing during the period of saline inflow. No signal is found in the AWAC data facing up, however, this instrument was situated above the inflow. Figure 4.9 shows a current rose from the bottom cell (2 m above the seabed) based on all the data between January to October 2010. Data have been averaged to remove noise.

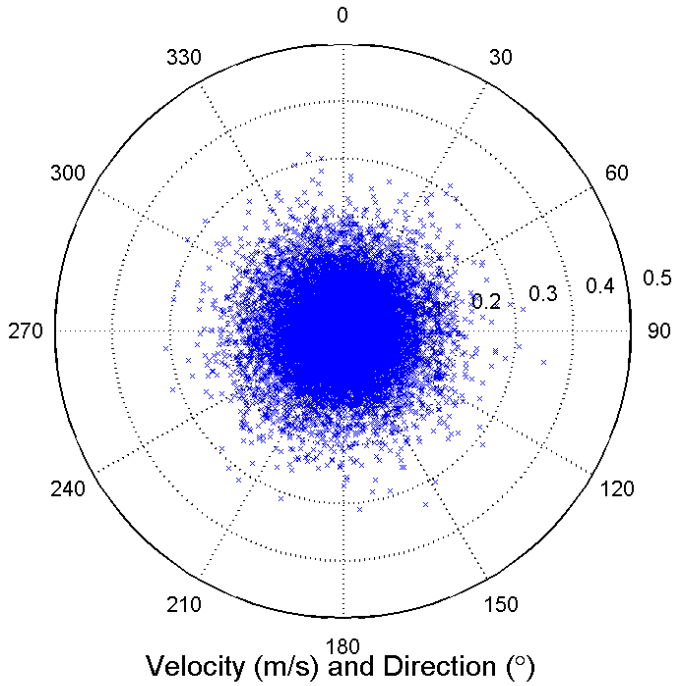


**Figure 4.9** Current rose diagram, January to October 2010, 2 m above seabed at the fixed monitoring station, KP 1036.

Post-processing of data was initiated at the end of 2010. Current data were filtered using a Butterworth filter of the same length as the inertial frequency (>14 h) to remove noise. Some of the data displayed very high noise levels, some of which are connected to bottom effects or the presence of a sharp density interface. To avoid confusion, these data are removed from the data set before plotting.

Since the last raw data was retrieved in January 2011 the post-processing is still ongoing. The data will form the source for evaluation of the basis for /15/. The evaluation will include assessment of the validity of the conclusion in /15/.

The results of the monitoring will be documented in a separate report, when the data has been analysed. This separate report will be included in the following annual monitoring report to the Swedish authorities: “Environmental monitoring in Swedish water 2011”.

## 4.7 Monitoring of ecotoxicological effects on mussels

### 4.7.1 Monitoring programme, purpose and period of monitoring

Monitoring of ecotoxicological effects on mussels is planned to be undertaken in the period December 2010 to April 2011. The planned monitoring programme is described in /2/, /5/, /17/ and will be carried out before, during and after trenching of the Nord Stream northwest pipeline (Line 1) into the seabed.
The purpose of the monitoring of ecotoxicological effects on mussels is:

- To evaluate and document the possible spreading of contaminants associated with sediments mobilised in the water column by seabed intervention (trenching) east of the two Natura 2000 areas Hoburgs bank and Norra Midsjöbanken.

Monitoring of possible spreading of contaminants associated with sediments mobilised by seabed intervention works is carried out by measuring the impact on common mussels (*Mytilus edulis*) in cages/net bags at six fixed stations at the border of the two Natura 2000 areas.

Filter feeders like the common mussel feed by extracting suspended particles from the water column. If fine-grained sediments with elevated levels of contaminants are mobilised, the contaminants could bio-accumulate (in case of digestion of particles) or bio-magnify (in case of digestion of organisms of a lower trophic level) in the mussel tissue. Because of this tendency, blue mussels are good indicators of dispersion of particle-associated contaminants and bio-accumulation/bio-magnification in the marine environment.

By comparing the chemical composition of these mussels with mussels from reference cages/net bags that have not been exposed to the potential source of contaminants, it is possible to measure the exposure of the mussels to contaminants from seabed intervention works associated with Nord Stream. The contaminants to be analysed include both heavy metals (Hg, Cd, Cu, As, Zn, Ni, Pb, Cr, Sn) and organic tin compounds.

Monitoring of mussels will be performed from mid December 2010 until approximately two months after trenching at the location, see Figure 4.10. The station locations were chosen to be located inside areas of approximately equal water depth.

At each station one sample of mussels is analysed for physical properties, and three samples are analysed for content of contaminants.

In addition to the planned monitoring stations, it has been decided to establish four extra stations as an extra security if some of the stations should be lost during the monitoring period. Mussels from these extra stations (Fix 5 and Fix 6, MC 5 and MC 6) will only be analysed if some of the other stations are lost, or if the results from the other stations make it relevant to carry out extra analyses, see Figure 4.10.

Mussels collected at Faludden, south of Gotland will be placed in mussel cages at each station for a period of approximately 1½ months, after which they will be collected and sent for physical and chemical analysis. This procedure will take place three times. Physical and chemical analysis of mussels will be carried out as follows:

- Mid December 2010 (before pipe lay and trenching the pipeline into the seabed)
- End January 2011 (before trenching the pipeline into the seabed)
- Mid March 2011 (immediately after trenching the pipeline into the seabed)
- End April 2011 (after trenching the pipeline into the seabed)

This preliminary schedule is subject to change due to weather.

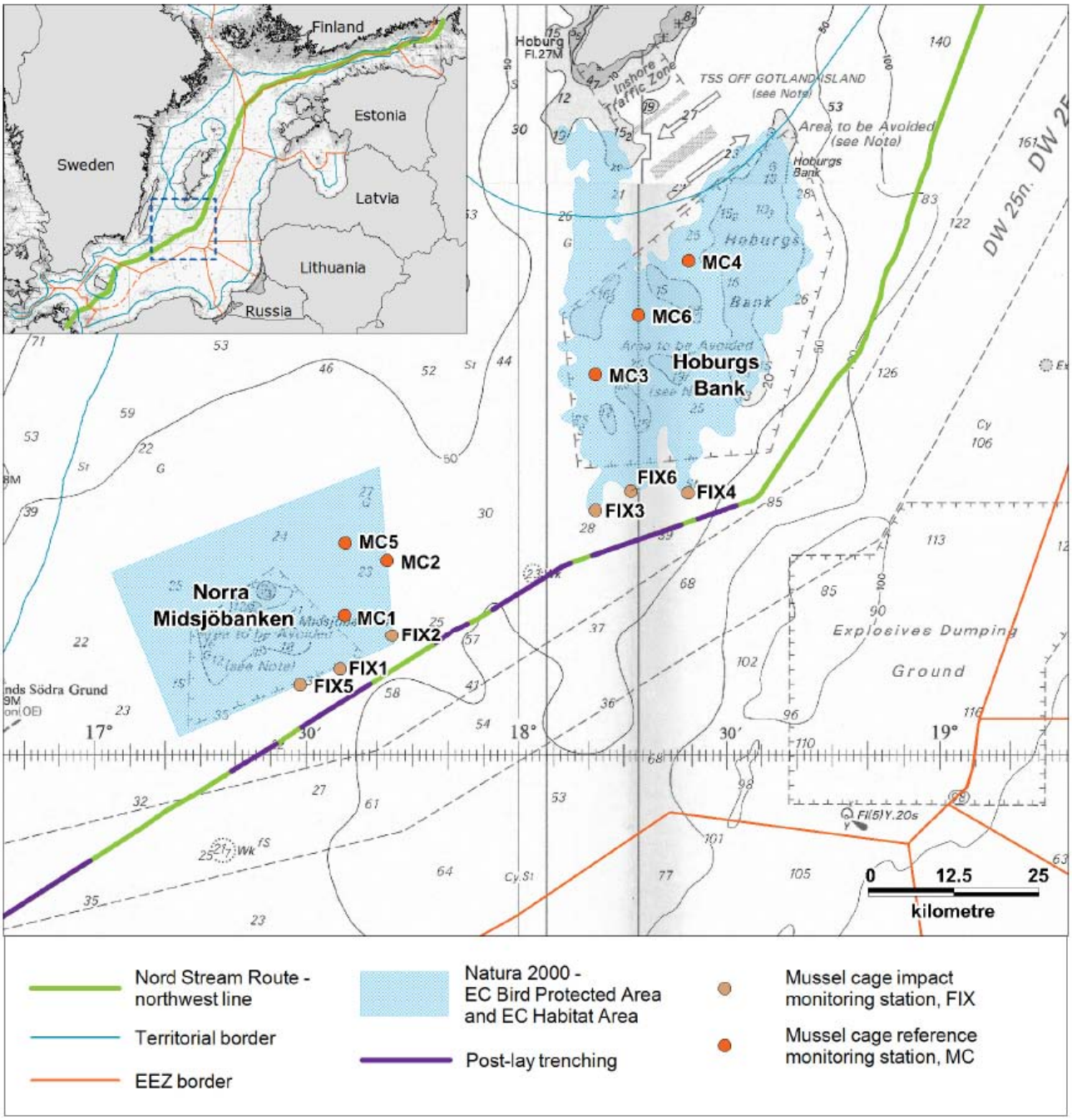


**Figure 4.10** Position of the mussel stations.

**Table 4.11** Summary of the monitoring programme for spreading of contaminants associated with sediments mobilised in the water column by seabed intervention in Sweden.

| Water quality in Sweden | |
|---|---|
| **Monitoring of ecotoxicological effects in mussels** | |
| Purpose | To evaluate and document possible spreading of contaminants associated with sediments mobilised in the water column by seabed intervention works |
| Area to be monitored | Hoburgs bank and Norra Midsjöbanken. Six stations (three impact stations and three reference stations) at each area |
| Activity to be monitored | Post-lay trenching |
| Method to be used | Common mussels (*Mytilus edulis*) in net bags/cages at the stations. Collection of mussels from stations four times during monitoring period for chemical analysis |
| Period of monitoring | December 2010 until approximately two month after construction at the location |
| Results | Description of the changes in concentrations of contaminants in common mussel during monitoring |

### 4.7.2 Monitoring and results 2010

Monitoring in 2010 has included sampling of mussels at Faludden south of Gotland, physical and chemical analysis of mussels from Faludden, and establishment of the 12 stations with mussel cages.

## 4.8 Monitoring of seabed morphology before, during and after construction

Prior to pipeline installation the seabed morphology is monitored with an instrumented ROV along the pipeline installation corridor. During 2010, pre-lay surveys along the centre line of the design route have been performed between KP 676 to 498 and KP 1004 to 990 by ROV equipped with multi-beam echo-sounder (MBES), sonar and video cameras. The sonar, video, and instrumental data were continuously recorded throughout the duration of the survey. All significant targets within the pipeline installation corridor were investigated and a video was recorded of the targets. Significant debris or seabed anomalies that could compromise the safe installation of the pipeline were immediately reported and evaluated in order to be able to plan and take necessary remedial action prior to pipe-lay.

The purpose of the pre-lay route survey was to ensure that the 15 m wide installation corridor was free from any debris. The location of existing seabed features and structures, in particular the rock embankment at KP 676-674 and pre-installed mattresses at cable crossings were also confirmed. In addition, the survey verified the bathymetric profile along the pipeline route. The ROV was navigated along the pipeline route using Differential Global Positioning System (DGPS) and Doppler aided USBL positioning. During the close visual survey the scanning sonar was operated at a range of 20 metres, to provide coverage across the installation corridor.

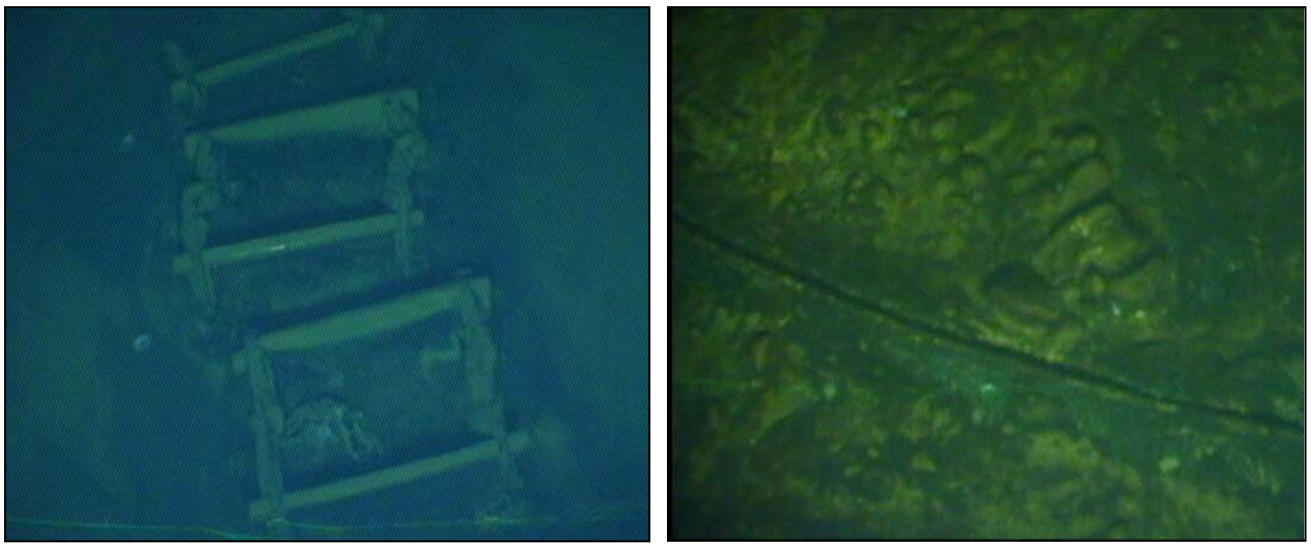

**Figure 4.11** Left: Debris observed during the pre-lay survey at KP 475. Right: LV-S1 telecommunications cable observed during the pre-lay survey at KP 564.

During pipeline installation, ROV pipeline touchdown monitoring (TDM) was performed as required to support pipe-lay operations by vessel Castoro Sei.

After pipe-lay, a survey of the pipeline condition and position on the seabed was performed by ROV. The multi-beam echo-sounder (MBES) was used to survey the pipeline itself and 10 m to either side of the pipeline. Any adjacent targets were monitored with sonar. Video cameras were used for visual inspection of the pipeline condition. The initiation head at KP 674 was also visually inspected and was observed to be in good condition with no visible damage.

The pipeline route survey was performed in order to determine and document the following:

- The horizontal and vertical position of the pipeline along the pipeline route.
- The horizontal and vertical integrity between the pipeline crossing mattresses, any other seabed features, and infrastructure.
- The horizontal and vertical integrity between the pipeline and natural seabed.
- Position and size of any freespan and reporting of all spans outside of the defined limits.
- Damage to the pipeline, coating, anodes, and field joints, including any remedial works undertaken.
- The position and distance of the pipeline from cables, and other seabed facilities.
- As-left survey of all pipeline crossings and intervention works.

A selection of findings from the surveys is illustrated in Figure 4.12 and Figure 4.13.

**Figure 4.12** Left: Field Joint observed at KP 500. Right: Boulder observed adjacent to the pipeline at KP 524

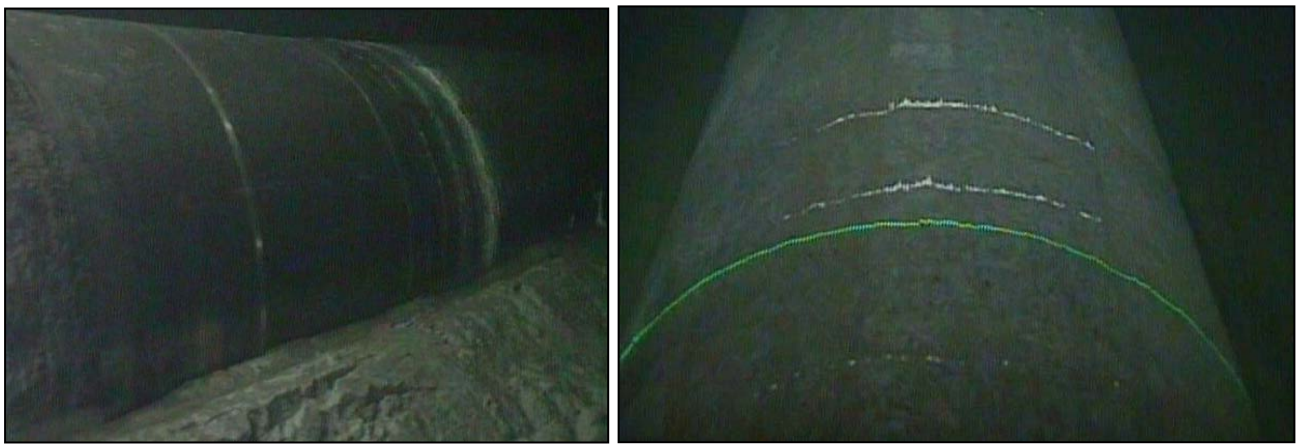

**Figure 4.13** Left: Pipeline buckle arrestor observed at KP 513. Right: Minor concrete damage observed at KP 512.

The initial results regarding the position of the pipeline, in height and width within the Swedish EEZ, show that the pipeline in general appears to be stable and well supported. The results also indicate that the pipeline has been laid as planned within the 15 meters wide installation corridor, with only three exceptions: Max. DCC (Distance of Cross Course) of ÷7.84 m (East side) at KP 507, Max. DCC of ÷10.04 m (East side) at KP 511, and Max. DCC of ÷11.84 m (East side) at KP 512.

# 5 Socio-economic monitoring within the Swedish EEZ

## 5.1 Monitoring of fishery

### 5.1.1 Monitoring programme, purpose and period of monitoring

Monitoring of fishery is performed as a desk study based on fishery data supplied by the Swedish Board of Fisheries (SBF). It includes data from the last 10 years of fishery (2000-2009) and will be

supplemented with future data from 2012-2016. The monitoring programme for fishery is described in /2/, /3/.

The purpose of monitoring fishery in the waters along the Nord Stream Pipeline is:

- To evaluate changes in bottom fishery patterns and fish catches.

Fishery communities have voiced their concern about future conditions for bottom trawling over and in the vicinity of the pipelines. In addition, SBF has expressed its concern that fish are likely to gather around the pipelines, which could result in overfishing of fish stocks that are not subject to quotas.

Therefore, the monitoring programme is designed to describe and evaluate possible changes in commercial bottom fishery patterns and fish catches after installation of the pipelines. In particular, changes in bottom trawling patterns and changes in fish species and catch levels (kg) in the immediate vicinity of the pipelines will be evaluated. This is due to the fact that a reef effect (if any) would be expected to attract demersal fish species to areas in the immediate vicinity of the pipelines. The programme covers the waters along the pipelines in the southern part of the Swedish EEZ from the rim of the Gotland deep (KP 750) to the border between the Danish and Swedish EEZ (KP 1004), since fishing for demersal fish (which to a large extent depends on water depth) is limited in the northern part. Furthermore the performance of the trawl board developed for trawling in the vicinity of the pipelines will be evaluated as part of the monitoring.

Monitoring data comprises satellite and logbook recordings collected by SBF as part of the statutory recording of fishery patterns and fish catches by the Swedish fishing fleet. Baseline data (before the pipelines are established) include fishery data from the last 10 years. These data shall constitute the baseline for the future monitoring of fishery in Swedish EEZ. After the pipelines have been established, annual reports are planned for every year from 2012-2016 to describe fishery activity and changes to bottom fishing patterns and catch levels.

Details concerning the monitoring programme for fishery in Swedish EEZ are summarized in Table 5.1.

**Table 5.1** Summary of the monitoring programme for fishery in Sweden.

| **Fisheries in Sweden** | |
|---|---|
| **Monitoring of changes in bottom fishery patterns along the pipeline** | |
| Purpose | To evaluate and document changes in bottom fishery patterns along the pipeline |
| Area to be monitored | Section from KP 750 to KP 1004 |
| Activity to be monitored | Pipeline on the seabed |
| Method to be used | Collection of data from commercial fishery (logbooks, satellite tracking) along the pipeline.<br>Evaluation of the performance of the new trawl board. |
| Period of monitoring | 2000-2016 |
| Results | Description and evaluation of changes of commercial fish catch along the pipeline |

### 5.1.2 Monitoring and results 2010

Results from monitoring in 2010 will function as baseline for the later monitoring after the pipelines have been established on the seabed. The results from the baseline monitoring of fishery are included in the report “Monitoring of fishery, Sweden 2010” /18/.

The fishery pattern is evaluated based on vessel monitoring system (VMS) data, which monitors the position and speed of the fishing vessels (>15 meter length) for each hour of sailing. VMS-data concerning bottom trawling and bottom net fishery by Swedish fishing vessels has been supplied by SBF for the years 2004-2009. The fishery pattern is described in terms of density plots for calculated bottom trawling and bottom net fishing as well as in terms of calculated number of fishing boats trawling across the pipelines per KP.

The column plot in Figure 5.1 illustrates the estimated amount of trawling tracks crossing the pipelines divided by KP points in the same time periods. Figure 5.2 and Figure 5.3 present the calculated density of bottom trawling and bottom net fishery. The colour scheme illustrates the total number of trawling tracks or net fishing boats counted in specific areas in a specific time period.

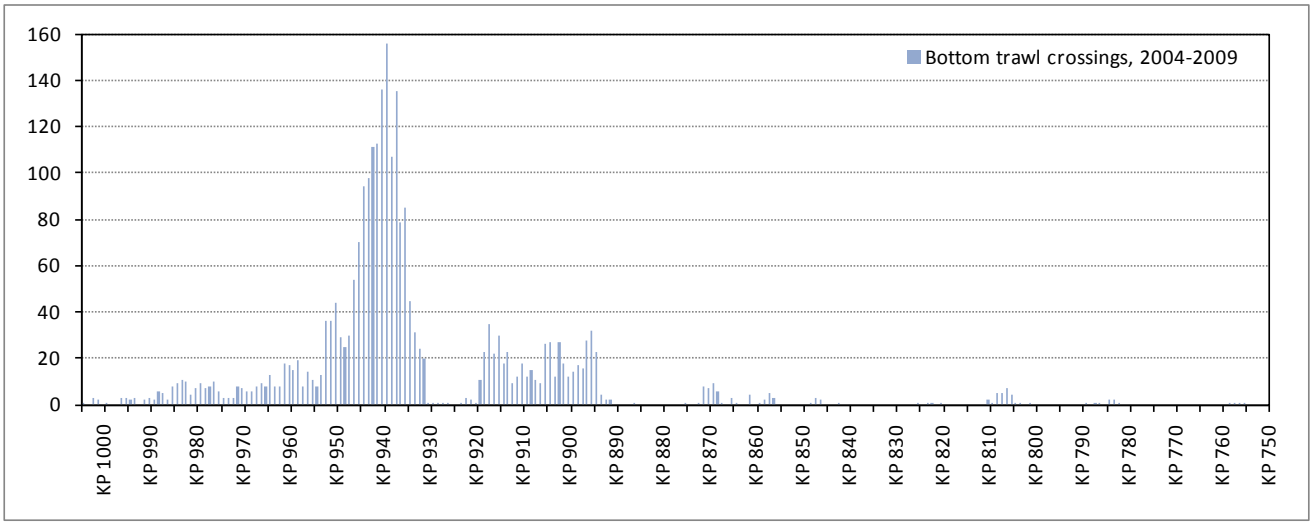


**Figure 5.1** Calculated number of trawling tracks crossing the route in the period 2004-2009 by Swedish fishing vessels (>15 m) along the pipeline route.

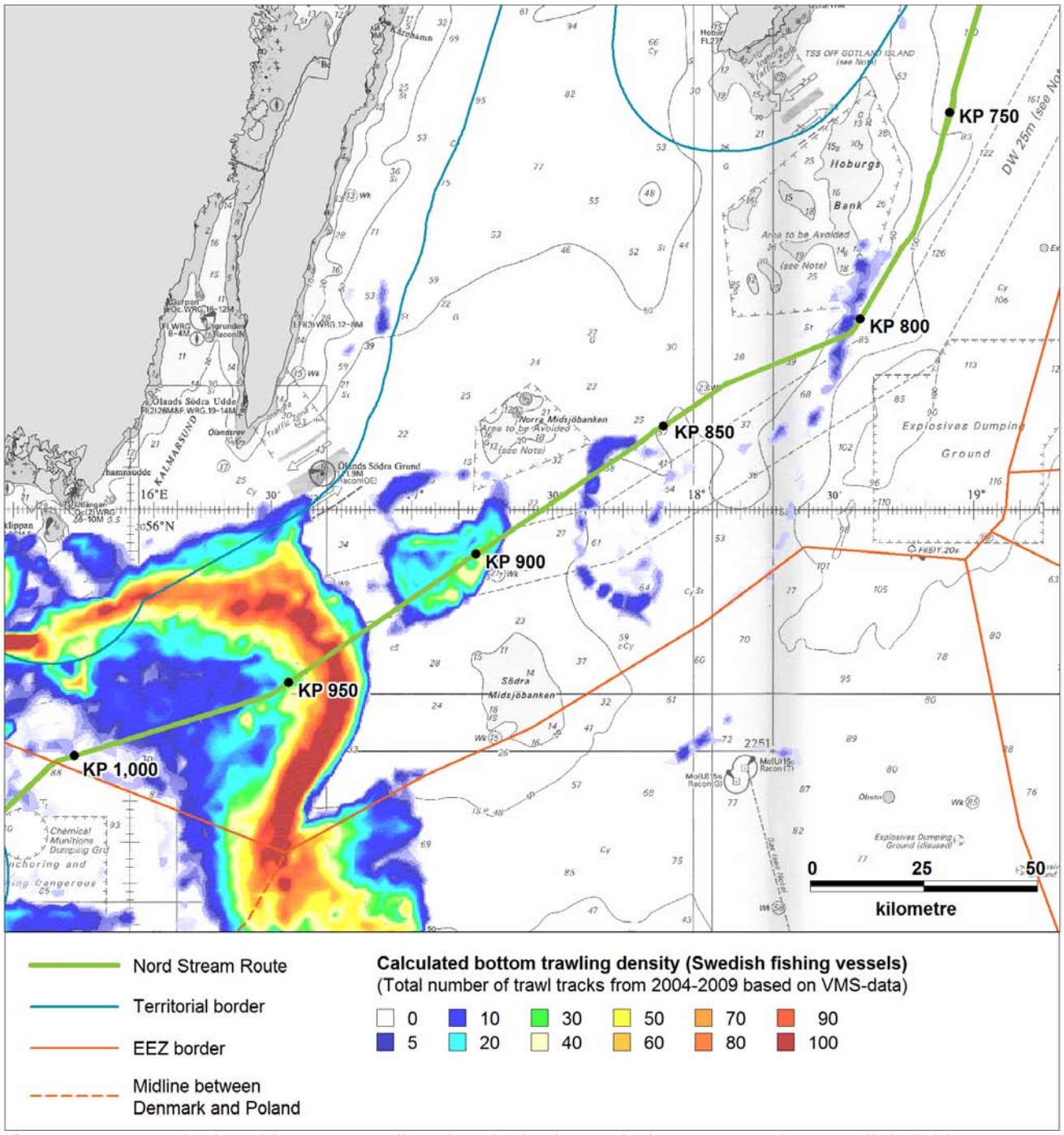


**Figure 5.2** Calculated bottom trawling density in the period 2004-2009 by Swedish fishing vessels (>15 m) along the pipeline route.

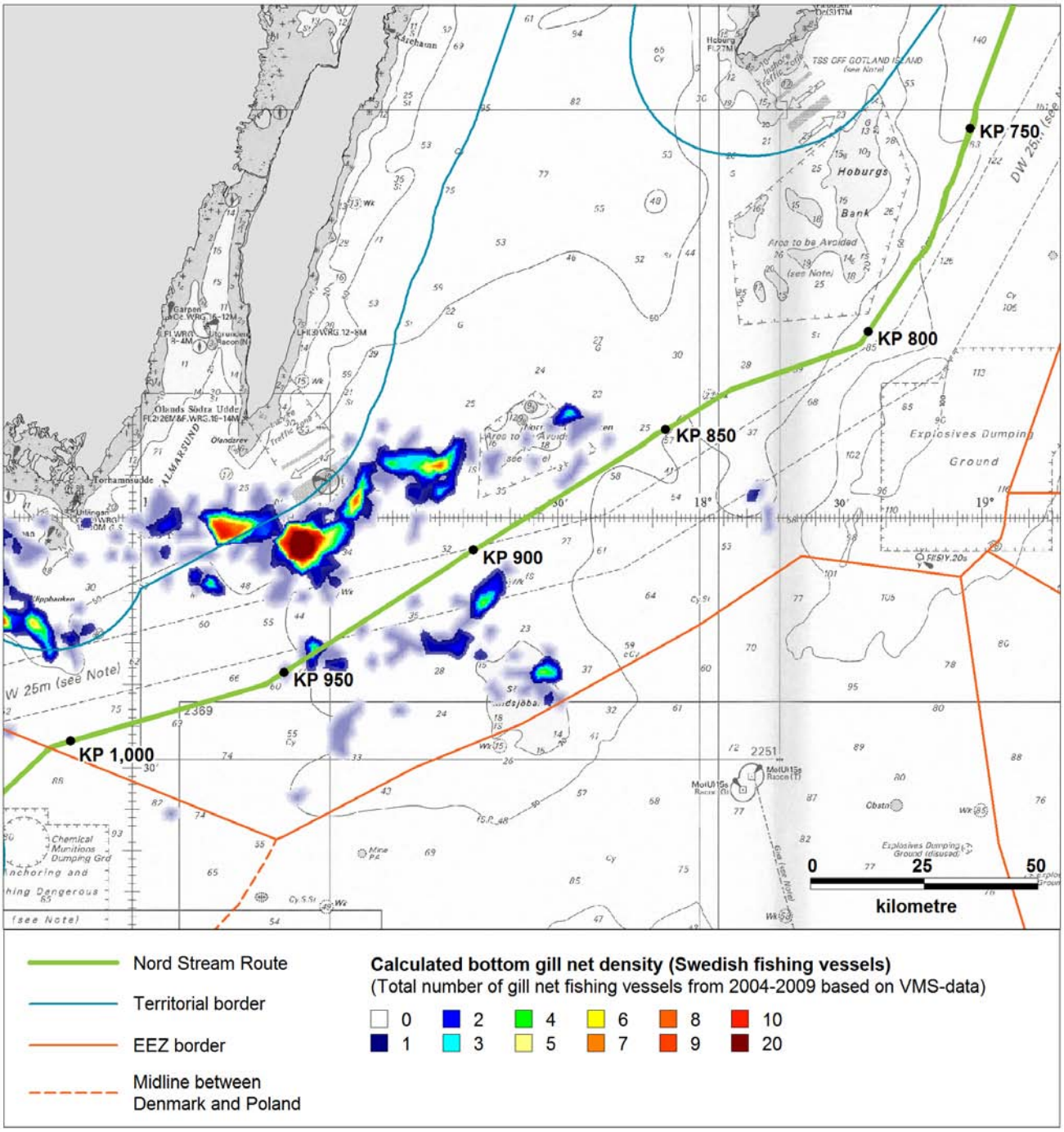


**Figure 5.3** Calculated total bottom net density in the period 2004 to 2009 by Swedish fishing vessels (>15 m) along the pipeline route.

The results of the analysis show that the general bottom trawling has been limited to the western part of the area between KP 930 to KP 950 and has been declining the last 6 years. The general bottom net fishery has been performed in areas approximately 20 km northwest of the pipeline route, from KP 900 to KP 950.

The VMS-data analysis is evaluated to constitute an adequate basis for the analyses of fishery pattern. By performing similar analyses after installation of the Nord Stream Pipeline it is considered possible to establish any occurring significant changes in the fishery pattern.

The fish catch pattern is evaluated based on logbook data. Logbook data concerning landings by Swedish bottom trawling and bottom net fishery has been supplied from SBF for a 10-year period from 2000-2009. The fish catch pattern is described in terms of data extraction from a corridor with a width of approximately 10 km around the pipeline route from KP 750 to KP 1004 both as a total amount and as sectional amounts. The total catch (in kg) of different species by bottom trawling and bottom net fishery is presented in Table 5.2 and Table 5.3.

**Table 5.2** Total landings by Swedish bottom trawling vessels (>10 m) with registered starting points for trawling in a 10 km corridor from KP 750 to KP 1004.

| Trawl fishery (kg) - Total 10km corridor | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|
| Cod | 682,406 | 577,536 | 437,097 | 520,853 | 533,889 | 326,980 | 257,947 | 362,903 | 193,608 | 41,566 |
| Herring | 13,000 | 0 | 2,200 | 1,600 | 0 | 15,300 | 9,000 | 2,000 | 2,000 | 4,040 |
| Sprat | 10,000 | 0 | 5,500 | 0 | 0 | 26,500 | 3,000 | 22,000 | 23,500 | 0 |
| Flounder | 2,252 | 1,589 | 2,866 | 1,871 | 811 | 700 | 150 | 650 | 55 | 40 |
| Plaice | 156 | 149 | 88 | 1,092 | 442 | 308 | 204 | 498 | 431 | 120 |
| Turbot | 524 | 252 | 176 | 1,366 | 182 | 82 | 14 | 48 | 98 | 16 |
| Whiting | 135 | 0 | 0 | 491 | 571 | 16 | 60 | 2,393 | 1,106 | 0 |
| Other species | 144 | 111 | 73 | 98 | 61 | 12 | 24 | 30 | 122 | 0 |
| **Total** | **708,616** | **579,637** | **448,000** | **527,371** | **535,956** | **369,898** | **270,399** | **390,522** | **220,920** | **45,782** |

**Table 5.3** Total landings by Swedish bottom net fishing vessels (>10 m) with net placement registered in a 10 km corridor from KP 750 to KP 1004.

| Net fishery (kg) - Total 10km corridor | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|
| Cod | 56,790 | 60,740 | 4,575 | 20,154 | 9,317 | 1,334 | 884 | 34 | 1,800 | 15,976 |
| Herring | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sprat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Flounder | 0 | 15 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 21 |
| Plaice | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 |
| Turbot | 0 | 0 | 0 | 0 | 550 | 0 | 0 | 0 | 0 | 0 |
| Whiting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Other species | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **56,790** | **60,755** | **4,575** | **20,154** | **9,889** | **1,334** | **884** | **34** | **1,800** | **15,997** |

The results of the logbook data analysis are generally following the trends concerning fish landings in the Baltic Sea, e.g. Cod, Herring, Sprat and Plaice are the dominant quota regulated fish species landed in the specific corridor and Flounder, Turbot and Whiting are the dominant non-quota fish species landed.

The logbook data analysis is considered to be subject to ambiguity especially due to the uncertainty of the geographical registration of the landings. Thus, it might be difficult to make correlations between the presence of the pipelines and future changes in fish landings. Significant future changes in the landings of especially non-quota fish species are however evaluated to be registered with the analysis.

## 5.2 Monitoring/mitigation measures at national and international monitoring stations

### 5.2.1 Monitoring programme, purpose and period of monitoring

The need of monitoring and mitigation measures at national and international monitoring stations due to the construction and operation of the Nord Stream Pipeline has been investigated and described in /2/.

In order to determine whether the establishment of the Nord Stream Pipeline affects governmental or international monitoring programs, the locations of the monitoring stations have been identified in relation to the pipeline route and related construction and operation activities. Coordinates of both national and international monitoring stations have been investigated and information concerning location and measured parameters has been compiled. An assessment of impacts has been conducted and mitigation measures have been recommended.

Potential impacts on environmental monitoring stations could be caused, if:

- Monitoring activities coincide in time with construction work.
- Monitoring stations are located close to areas with seabed intervention works (trenching or rock placement) hence potentially being affected by re-sedimentation of sediment that has been brought in suspension during construction.
- Monitoring stations are very close to the pipelines therefore potentially affected by local changes in erosion/sedimentation patterns around the pipelines during pipeline operation.

Figure 5.4 shows the locations of the national and international monitoring stations in the Swedish EEZ.

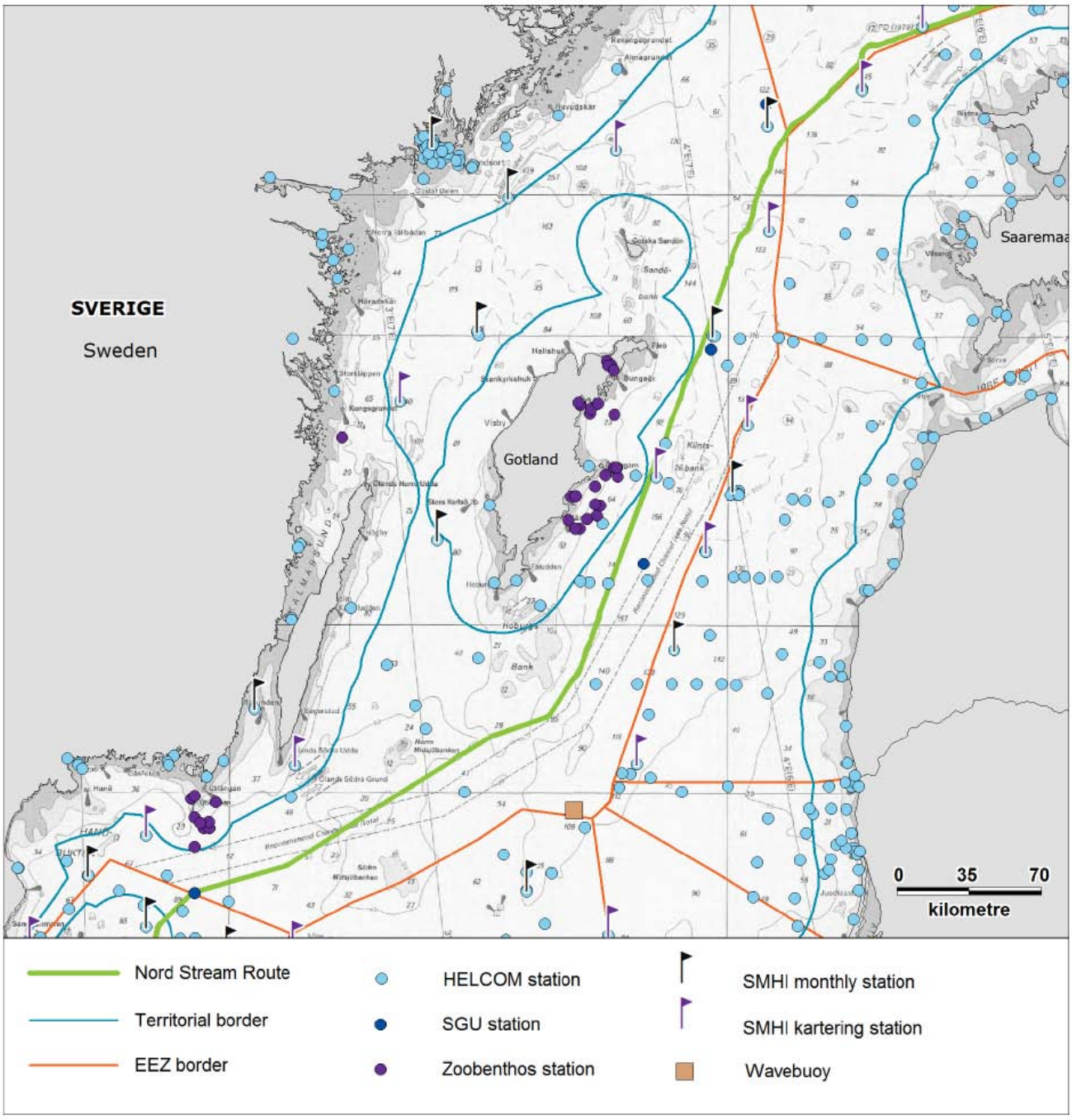


**Figure 5.4** Governmental and international monitoring stations in the Swedish EEZ.

For a more detailed study of monitoring stations, those within a corridor of 3 km around the pipeline have been chosen and assessed in detail. Impacts from low risk of conflict with the vessels involved in the construction work and from increased sedimentation during construction and operation could

be expected close to the pipeline route. Of the existing monitoring stations in the Swedish EEZ, four stations are located within ±1.5 km from the pipelines (and one SMHI station in the Finnish EEZ), see Table 5.4 and Figure 5.5.

**Table 5.4** Monitoring stations in the vicinity of the pipeline route in the Swedish EEZ.

| Station | Measured Parameters | Distance | |
|---|---|---|---|
| | | Line 1 | Line 2 |
| SGU<br>**N Bornholm Basin**<br>**SE-11** (SWE EEZ) | Contaminants in sediments | 0.4 km | 0.3 km |
| SMHI<br>**BY13** (SWE EEZ) | Physical and chemical properties in the water column | 3.2 km | 2.8 km |
| SMHI<br>**BY27** (FIN EEZ) | Physical and chemical properties in the water column | 0.8 km | 1.6 km |
| Marine Research Centre at the Finnish Environment Institute (Syke)<br>**Algaline 11** (SWE EEZ) | Physical, chemical and biological properties in the water column. Sample taking unattended (FerryBox) on cargo ships. Samples depths approximately 5 m | 0.4 km | 0.3 km |
| Marine Research Centre at the Finnish Environment Institute (Syke)<br>**HA3** (SWE EEZ) | Physical and chemical properties in the water column and zoo benthos | 0.7 km | 0.9 km |

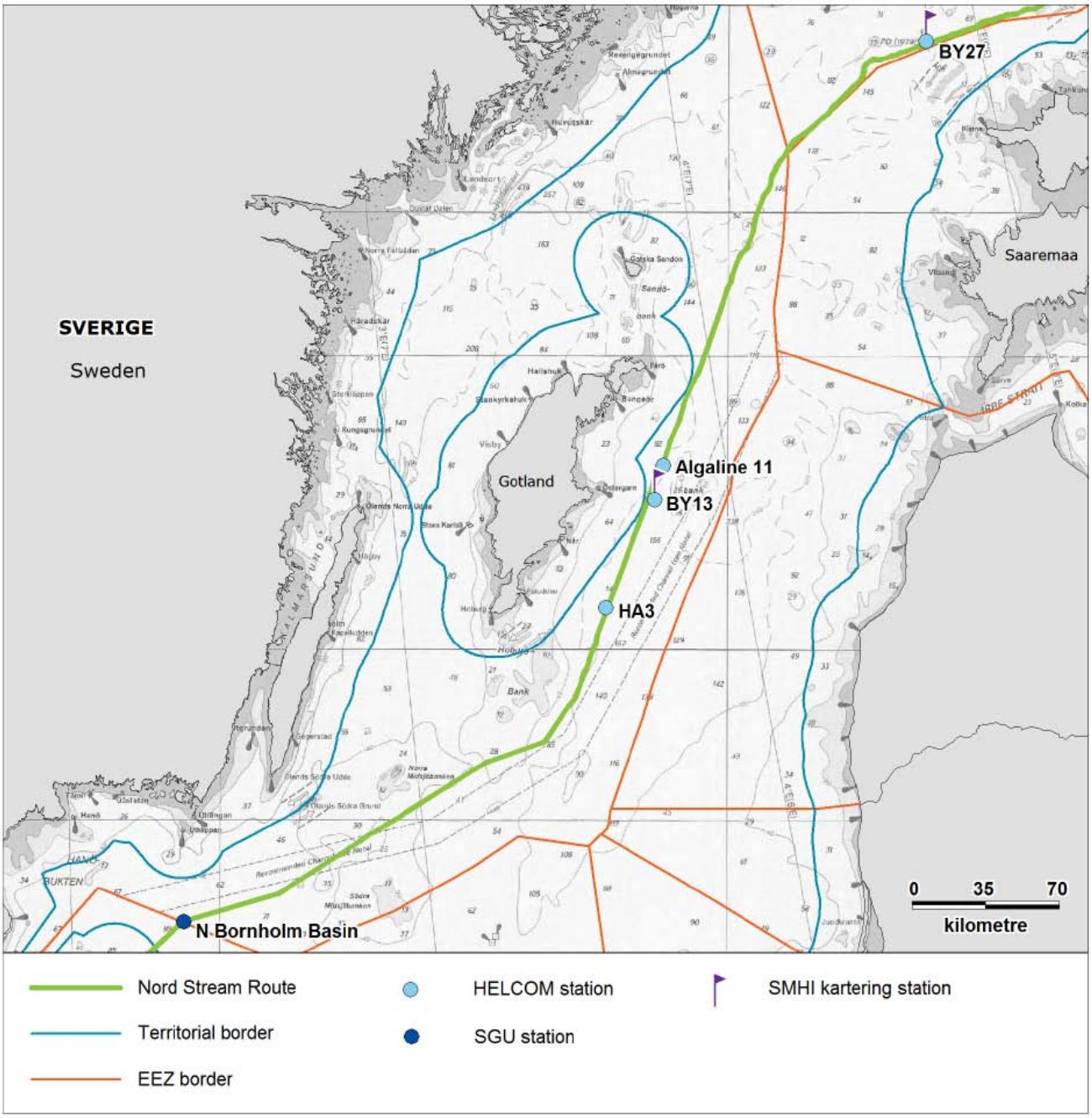


**Figure 5.5** Assessed national and international monitoring stations in the Swedish EEZ and one Swedish monitoring station in the Finnish EEZ.

### 5.2.2 Monitoring and results 2010

Table 5.5 shows the mitigation measures that have been proposed and agreed with the authorities, and the mitigation measures taken by Nord Stream in 2010.

**Table 5.5** Assessment of impacts, proposed mitigation measures and Nord stream activities related to the five national/international monitoring stations located ≤ 1.5 km from the pipelines.

| Station | Assessment | Mitigation proposed | Influence 2010 |
|---|---|---|---|
| SGU contaminants **N Bornholm Basin SE-11** (SWE EEZ) | The monitoring station for monitoring contaminants in sediment can be affected by disturbance of the seabed during construction, and from changes in local sedimentation conditions in the vicinity of the pipelines. | SGU contacted and since monitoring could be impacted, mitigation measures are agreed. A new position for the measurements will be searched for by SGU. | At the end of 2010 SGU informed Nord Stream that a new position for SE-11 had been found, - located approximately 40 km from the "old" station, and 10 km from the NSP pipelines. |
| SMHI kartering **BY13** (SWE EEZ) | There will be no impact on the monitoring station as monitoring is restricted to the water parameters. Monitoring at the station can only be affected if it is undertaken at same time as NS construction activities.<br><br>Monitoring will occur approx. once a year at the station. | SMHI contacted and has confirmed that monitoring will not coincide with the construction work during 2010. If construction schedule changes SMHI will be informed and mitigation measures agreed. | No significant changes in construction schedule in 2010 at this location, and therefore no risk of impact with monitoring at BY13 by SMHI. |
| SMHI kartering **BY27** (FIN EEZ) | There will be no impact on the monitoring station as monitoring is restricted to the water parameters. Monitoring at the station can only be affected if it is undertaken at same time as NS construction activities.<br><br>Monitoring will occur approx. once a year at the station, - normally during winter. | SMHI contacted and has confirmed that monitoring will not coincide with the construction work during 2010. If construction schedule changes SMHI will be informed and mitigation measures agreed. | No impacts as pipe-lay for Line 1 was undertaken from June – September 2010, while monitoring at BY27 was in February 2010. |
| Finnish Environment Institute (Syke) **Algaline 11** (SWE EEZ) | There will be no impact on the monitoring station as monitoring is restricted to the water parameters. Monitoring at the station can theoretically be affected if it is undertaken at same time as NS construction activities. NS activities include only pipe laying. | Marine Research Centre contacted and as the monitoring is performed by using cargo ships there is no fixed monitoring time schedule. Marine Research Centre to be informed and updated with the construction schedule. | Pipe lay near Algaline 11 was undertaken from 11 – 16 April.<br><br>As the monitoring station is a ferry box station (measured every time a ferry passes the station) – there will be no effects on monitoring. |

| Station | Assessment | Mitigation proposed | Influence 2010 |
|---|---|---|---|
| Finnish Environment Institute (Syke) **HA3** (SWE EEZ) | The station is used for monitoring water parameters and benthos.<br><br>Effects on monitoring of water parameters and benthos will be restricted to the situation where monitoring and construction activities take place at same time.<br><br>Effects on the seabed during construction activities are assessed not to affect the benthos monitoring station. This is because benthos have not been found on the station for many years (anoxic conditions). It is assessed to be hypothetical that minor changes in the seabed, caused during construction of the pipelines, can have effects on fauna colonization, if in future oxygen condition will be improved. | Marine Research Centre contacted. Marine Research Centre to be informed and updated with construction schedule. | To be finalized (Nord stream construction activities will first take place in spring 2011). |

## 5.3 Monitoring of cultural heritage

### 5.3.1 Monitoring programme, purpose and period of monitoring

The purpose of cultural heritage monitoring is to document the condition of wrecks before pipe-laying, trenching, rock placement and anchor handling, to safeguard the wrecks during construction and to verify the condition of the wrecks after construction.

Prior to the construction of the Nord Stream pipelines, detailed security and anchor corridor surveys have been performed, in order to investigate the presence of cultural heritage sites within the pipeline anchor corridor (± 1 km from the pipeline route). The data from these surveys has been evaluated by the company Marin Mätteknik AB (MMT) as well as by the Swedish National Maritime Museum.

A controlled installation procedure for locations where archeologically significant wreck sites are present has been discussed and agreed with the Swedish National Maritime Museum and the Swedish National Heritage Board. During pipeline installation of Line 1 a protection zone has been established for all wrecks located in the pipeline anchor corridor to minimise the risk of impacts to these sites. The same procedures will be applied when Line 2 is installed in Swedish waters.

Additionally, areas of directly affected seabed is surveyed prior to rock placement, trenching and pipe-laying to verify the seabed conditions, i.e., that there are no new objects.

The monitoring of cultural heritage will be carried out as a visual inspection by ROV. An ROV will dive onto the archeologically significant wreck sites and record an underwater footage of the objects. The ROV will be equipped with three cameras. Two cameras heading forward and one backward, one of the front cameras is a color camera. In addition, parallel lasers are mounted on the main camera for size estimation of targets. The lasers are mounted to give two parallel beams which are 40 cm apart. Furthermore, a dual Scanning Chirp Sonar is mounted in front of the ROV, as well as the fitting of an altimeter and a depth sensor. The recorded footage is used to evaluate the condition of the wreck sites before and after the pipelines have been installed.

The following procedures are followed for the wreck inspections:

**Procedures for inspection of wooden wrecks**
The survey will be performed by circling round the entire vessel as well as inspecting the deck and items on the seafloor around the wreck.

- The inspections start in either the stern or the stem of the wreck and continue along one side to investigate the shape of the hull which tells much about the age of the ship. It is especially important to get good side-views of the curvature of the stem and stern. Inspection continues to the other side of the wreck.

- Proceed to investigate both ends of masts, yards and spars if it is a sailing ship. These are of high interest in identifying the wrecks age or type. Blocks or deadeyes are not very interesting for this purpose. Make a search on the seafloor for parts of masts, yards and spars.

- Investigate the deck. Small artifacts including the ship's working equipment, weaponry, navigation instruments, tools, personal possessions, ceramic, porcelain, metal buckets/cooking pots/cauldrons, cargo and so on are of high interest and close ups are important. Glass-bottles and tiles are less useful for dating cultural heritage.

**Procedures for inspection of steel/iron wrecks**
- The inspections start in either the stern or the stem of the wreck and continue along one side at deck level for a good view of the ship alignment. Continue to the other side of the wreck. Look for the ship's name on stern and side.

- Proceed to the deck. The deck alignment is important since the placing of cargo holds, cabins and working space and cargo tells about how the ship was functioning. The small artifacts are not of much importance.

- Mechanical items like deck winches and cranes are of interest for dating wrecks. On warships the amount and placing of guns are interesting as well as smaller artifacts including working equipment, weaponry, navigation instruments, tools, personal possessions and so on. Any such item should be documented with close ups.

The survey will be performed by circling round the entire vessel as well as inspecting deck and items on the seafloor around the wreck. Wrecks that are less distinct on the seabed or areas of debris around a wreck shall be surveyed using a grid line plan, with line spacing determined by visibility

conditions, but nominally set at 5m. The grid search area shall be extended to determine the limits of any debris field around the wreck.

### 5.3.2 Monitoring and results 2010

The construction of pipeline 1 in the northern part of the Swedish EEZ took place between April and June 2010. During this period a number of five safeguarded objects, classified by the Swedish Maritime Museum as being of cultural significance, as well as other objects on the seabed were passed. The safeguarded objects were both semi-intact wrecks and shattered wreck pieces.

In order to make sure that neither the pipeline, nor the 12 anchors that keep the lay vessel in its correct position, would come too close to these objects, anchor pattern plans where created in advance for each passing occasion. These plans where discussed and agreed together with the Swedish Maritime Museum and the National Heritage Board before the construction started in the respective areas. The anchor pattern plans for the passing of these objects were all adhered to and the objects were safely passed with one exception. At this specific location a combination of weather and sea state coupled with generally poor anchor-holding ground conditions required a change from the planned anchor pattern. During repositioning of an anchor, a loss of tension was noted by the lay vessel, which allowed a section of the wire to touch the sea bed in the vicinity of the object. An ad-hoc ROV inspection shortly afterwards revealed that the anchor wire probably had come in contact with the object. The post-lay survey inspection in 2012 will reveal any interference caused, as agreed and discussed together with the Swedish authorities

## 5.4 Monitoring maritime traffic 2010

The purpose of Nord Stream's control and monitoring in relation to marine traffic is to minimize the risk of collisions or other accidents involving commercial ship traffic and/or vessels performing construction activities for the project. A number of activities have been, or are being, performed in order to achieve this goal. Mitigation and risk reducing measures have been analyzed and discussed in risk assessments and have been included and implemented in ship traffic management procedures (or plans). Safety zones of varying sizes are established around all vessels performing underwater construction work. Vessels within the construction spread, or additional vessels, can serve as guard vessels during certain construction activities or in particularly sensitive areas such as shipping lanes. Information on upcoming and ongoing construction activities is provided to the relevant authorities, who in turn inform the ship traffic through information channels such as 'Notices to Mariners' and NAVTEX. Dedicated information for the fishing communities is being produced and delivered both to individual fishermen and fishing organization on a regular basis.

The ship traffic management procedures are developed by the contractors before the start of the construction activities to ensure the safety of both third party shipping and the vessels involved in the construction activities. These procedures include e.g. normal and emergency communication lines and flowcharts, safety measures and responsibilities, required safety zones and vessel management systems (such as Automatic Identification System (AIS) for identification and locating of vessels).

Safety zones of varying sizes are established in agreement with the Swedish shipping authorities around all vessels performing underwater construction work. No other vessels are allowed to enter

this zone without permission from the working vessel's captain. In line with the watch keeping procedures the traffic is regularly monitored visually and by radar. The track and speed of any vessel approaching the safety zone is monitored and any vessel on course to enter the safety zone is contacted and requested to change course. Vessels within the construction spread (or additional vessels) can also act as guard vessels during certain construction activities or in particularly sensitive areas such as shipping lanes. In case radio contact with a vessel is not established, the guard vessels are able to intervene and potentially intercept an approaching vessel.

When operating in the Swedish EEZ a daily report is transmitted from the vessels of all construction activities. These reports include e.g. the vessel name, call sign, present position and plan for the next 24 hours. Before and during construction the locations of the construction vessels are announced in 'Notices to Mariners' by the Swedish Maritime Administration (SMA) in order to increase the awareness of project generated ship traffic. SMA also issue navigational warnings (NAVTEX) in the affected areas, so that intervening vessels are aware of the current locations of the construction vessels.

Prior to the commencement of construction activities Nord Stream has informed the fishing associations about the planned activities and safety zones of different construction works. Throughout the construction period regular information is made available (e.g. weekly newsletter) addressing construction vessels, work scopes and potential safety concerns.

The control and monitoring of marine traffic is important during the whole construction phase of the project.

### 5.4.1 Monitoring and results 2010

During the construction in the Swedish EEZ, Nord Stream and its construction vessels have followed the communication and reporting procedures that have been agreed with Swedish authorities and organizations. Nord Stream has provided the relevant authorities with a notification four weeks prior to the commencement of a new construction activity, weekly and monthly forecasts as well as daily updates from the construction vessels. Regular information to the fishing community has been provided from the time when the construction activities started and will continue throughout the construction period.

Almost all types of construction activities that are planned for, within the Nord Stream project in the Swedish EEZ, have already been performed a number of times during 2010, i.e. survey activities, munitions clearance, mattress installation, rock placement and pipe-laying. Precautionary safety measures were successfully implemented and the construction activities have all been performed without any accidents or significant incidents with third party vessels. On some occasions, mainly during the initial weeks of construction, other vessels entered into the requested safety zones around the construction vessels. The monitoring and communication procedures onboard the construction vessels were then followed successfully and none of these safety zone intrusions resulted in any risk-related situations or incidents.

## 6 Comparison of monitoring results with assessment in the Swedish ES

A comparison of the monitoring results at the specific monitoring locations with the description of the existing environmental conditions (baseline) in the Swedish Environmental Study (ES) shows that the findings from monitoring of benthic fauna and fish in 2010 are in accordance with the description of these parameters in the Swedish ES.

The comparison of the monitoring results with the assessment of effects and impacts in the Swedish ES is only possible for monitoring programmes that have been fully finalised. For 2010 this includes monitoring in connection with munitions clearance, and monitoring at cable crossings.

The results from the munitions clearance and cable crossings show that impact on the environment have been restricted to the immediate vicinity where these activities have been carried out. This is in line with what was assessed in the Swedish ES, where it was stated that the overall impact on the environment from munitions clearance and cable crossings would be insignificant as effects are local, and in relation to munitions clearance, of short duration.

The main part of the evaluation of effects and impacts from the Nord Stream Pipeline will f be achievable only when results from monitoring surveys carried out after construction of the first pipeline are available. Results from the monitoring in 2010 have established a baseline for similar surveys planned for the following years, with the overall objective to enable assessments of possible effects and impacts on the environmental parameters which are monitored.

For the following monitoring modules a comparison with the assessment in the Swedish ES can first be undertaken from 2011 and onwards:

- Monitoring of fish along the pipeline
- Monitoring of fish inside Natura 2000 areas
- Monitoring of benthic fauna
- Monitoring of fishery
- Monitoring of water quality
- Monitoring of hydrographic conditions in the Bornholm Basin
- Monitoring of ecotoxicological effects on mussels

The last three of the listed monitoring modules are currently ongoing, and will be finalised in 2011. Munitions clearance has, as described above, been undertaken without any significant effects on the environment.

Furthermore, environmental monitoring is carried out for:

- Cultural heritage
- National and international monitoring stations close to/relatively close to the Nord Stream Pipeline
- Seabed morphology before, during and after construction of the Nord Stream Pipeline
- Maritime traffic

The results from monitoring of cultural heritage and a comparison of the assessment in the ES will be reported in 2012 when both pipelines have been established. A post-lay wreck survey will be undertaken to verify the condition of the wrecks after both Line 1 and Line 2 have been established.

Monitoring/evaluation of effects on national and international monitoring stations in the Baltic Sea have resulted in a successful search for an alternative location for the station SE-11, one of the Swedish monitoring stations in the northern part of the Bornholm Basin. SGU have carried out investigations of the seabed around station SE-11 in 2010, and have found a new location for the station 10 km from the Nord Stream Pipeline where there will be no risk of impact on the station from the construction activities. There has been no risk of impact to the other national and international monitoring stations during the Nord Stream construction activities in 2010.

Monitoring of changes in seabed morphology during and after pipe-lay has not shown any significant changes. Changes caused by pipe-lay and rock placement, have been local and only evident in the very close vicinity of the pipeline.

During the construction in the Swedish EEZ, Nord Stream and its construction vessels have followed the communication and reporting procedures that were agreed with Swedish authorities and organizations. Nord Stream has provided the relevant authorities with notifications four weeks prior to commencement of new construction activities and daily updates from the construction vessels as well as weekly and monthly forecasts. Regular information to the fishing community has been provided from the time when the construction activities started and will continue throughout the construction period.

There have been no accident or near missed accident in relation to maritime traffic including fishing vessels in 2010, and the impacts on maritime traffic during 2010 have been found to be minor, local and short-term as also assessed in the Swedish ES.

# 7 Conclusion and recommendations

Based on the results from the Nord Stream monitoring for 2010 it is concluded that effects and impacts on the marine environment have been limited to the immediate vicinity of the pipelines. This is in accordance with assessments in the Swedish ES. Furthermore, impacts have been assessed to be local and of minor to insignificant effect.

Munitions clearance was finalised in 2010 and resulted in the creation of small craters on the munitions sites of maximum diameter of 10-12 m. No marine mammals were injured or killed during the clearance, and only a low number of fish were collected from the sea surface after the 9 detonations.

The monitoring of benthic fauna at the two locations south of Norra Midsjöbanken and south of Hoburgs bank showed a fauna community that was in accordance with the results from earlier monitoring undertaken by Nord Stream and from HELCOM. Furthermore, results showed that there were no systematic spatial changes in abundance and biomass of the infauna along the transects at the two banks.

The monitoring of fish along the pipeline that was carried out inside three areas south and southwest of Norra Midsjöbanken showed that the fish caught was in accordance with the fish catch data obtained from the Swedish fishermen and the Baltic International Trawl Survey in the Baltic Sea. Furthermore, the results indicated a large spatial difference between the three areas in terms of abundance and composition of fish, but no statistical significant difference between impact and reference stations within the same area was found.

Results from monitoring of fish inside the two Natura 2000 areas Hoburgs bank and Norra Midsjöbanken are in accordance with the results from literature and with results from earlier investigations at the two banks. In total 12 fish species were caught during the two surveys, which were dominated by Cod, Flounder, Turbot, Shorthorn sculpin, Eelpout and Herring. The results showed significant difference in abundance of Turbot between impact and reference areas, while difference in abundance for Cod and Flounder between these two areas was minor and restricted to either the June or the September survey/to either Hoburgs bank or Norra Midsjöbanken.

The desk study of fishery along the Nord Stream route for the period 2004-2009 showed that bottom trawling is limited to the western part of the area between KP 930 to KP 950 and has been declining during the last six years. The analysis of the logbook data is generally following the trends concerning fish landings in the Baltic Sea. For instance Cod, Herring, Sprat and Plaice are the dominant quota-regulated fish species landed in the investigated corridor along the Nord Stream Pipelines, from KP 750 to KP 1004. Flounder, Turbot and Whiting were the dominant non-quota fish species landed inside the investigated corridor.

The results from the above-mentioned monitoring surveys for infauna, fish along the pipeline, and fish inside the Natura 2000 areas, along with the desk study of fishery, will function as baseline for future monitoring activities. Therefore, an evaluation of the impact from construction and operation of the pipelines will be achievable only after retrieving results from surveys carried out after construction of the first pipeline.

Results from the other monitoring programmes, such as monitoring of water quality, monitoring at the hydrographical station in the Bornholm Basin, and monitoring of ecotoxicological effects on mussels started end 2010 and will be finalised and reported to the authorities in 2011.

Separate reports have been elaborated for the 2010 annual reporting for the following issues:

- Munitions clearance in the Swedish EEZ
- Monitoring of fish along the pipeline, Sweden 2010
- Monitoring of fish inside Natura 2000 areas, Sweden 2010
- Monitoring of benthic fauna, Sweden 2010
- Monitoring of fishery, Sweden 2010

The annual monitoring report for 2011: “Environmental monitoring in Swedish waters 2011” will include the same issues as included in the 2010 report. Furthermore, separate reports for the following monitoring parameters will be prepared for the 2011 annual reporting:

- Monitoring of water quality, Sweden 2011
- Monitoring of hydrographic conditions in Bornholm Basin, Sweden 2011
- Monitoring of ecotoxicological effects in mussels, Sweden 2011

The 2010 monitoring surveys have been undertaken as planned, and procedures used in the 2010 survey will be updated for the 2011 survey based on findings and recommendations. Based on the execution and the results from monitoring in 2010, it is evaluated that there will be no need for changes of the monitoring programmes for 2011.

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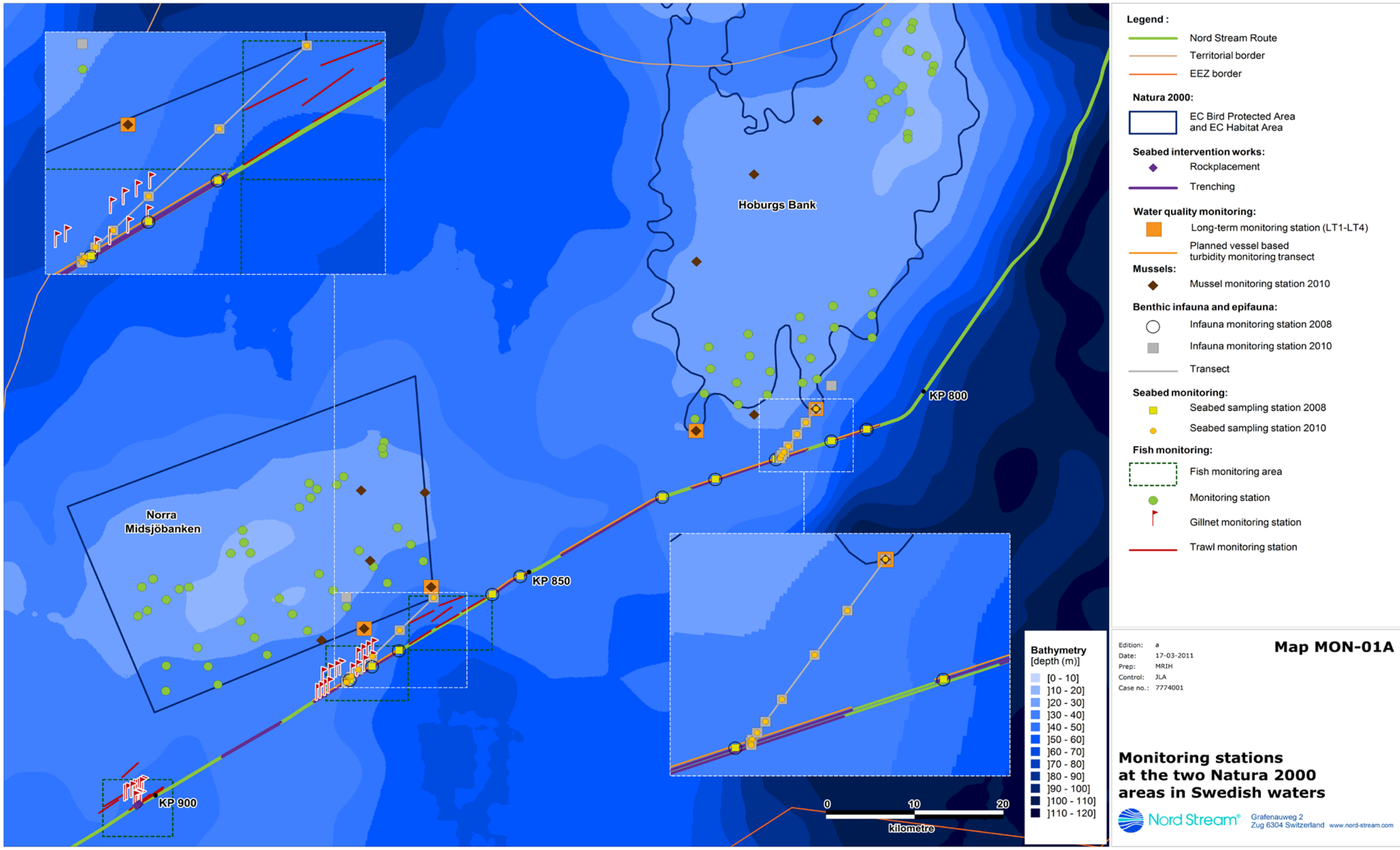
# APPENDIX A

Nord Stream monitoring stations in the Swedish EEZ


Hoburgs Bank
Norra Midsjöbanken
KP 800
KP 850
KP 900
0
10
20
kilometre
Bathymetry [depth (m)]
[0 - 10]
]10 - 20]
]20 - 30]
]30 - 40]
]40 - 50]
]50 - 60]
]60 - 70]
]70 - 80]
]80 - 90]
]90 - 100]
]100 - 110]
]110 - 120]
Legend :
Nord Stream Route
Territorial border
EEZ border
Natura 2000:
EC Bird Protected Area and EC Habitat Area
Seabed intervention works:
Rockplacement
Trenching
Water quality monitoring:
Long-term monitoring station (LT1-LT4)
Planned vessel based turbidity monitoring transect
Mussels:
Mussel monitoring station 2010
Benthic infauna and epifauna:
Infauna monitoring station 2008
Infauna monitoring station 2010
Transect
Seabed monitoring:
Seabed sampling station 2008
Seabed sampling station 2010
Fish monitoring:
Fish monitoring area
Monitoring station
Gillnet monitoring station
Trawl monitoring station
Edition: a
Date: 17-03-2011
Prep: MRIH
Control: JLA
Case no.: 7774001
Map MON-01A
Monitoring stations at the two Natura 2000 areas in Swedish waters
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