EIS, SEA and Habitat Assessment for BritNed Interconnector

Summary

BritNed Development Limited

25 August 2005

9M358

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1 INTRODUCTION

The plan
The European Union (EU) and the Dutch government wish to encourage competition in the European electricity market. This requires good international high-voltage connections between neighbouring countries. BritNed Development Limited is planning to lay and operate a high-voltage power cable between the east coast of the United Kingdom and the Maasvlakte development in the Netherlands. The plan also includes the connections to the British and Dutch grids.

The social aim
The aim of the high-voltage interconnector is to allow free trade in electricity between the United Kingdom and the Netherlands. But the interconnector also has other important social benefits, including security of the electricity supply and more efficient power generation.

The economic aim
BritNed is an independent party which will be developing and operating the high-voltage interconnector. Electricity will be supplied to customers by players in or outside the market who will buy transport capacity from BritNed. BritNed will facilitate the transport.

The decision
The Dutch Ministers of Economic Affairs (EZ) and Housing, Spatial Planning and the Environment (VROM) are planning to designate a corridor for the high-voltage interconnector in the Second Electricity Provision Structure Plan (SEV2). The route of the high-voltage interconnector is to lie within this corridor. The corridor will be within specific limits, thereby acquiring the status of what is known as a concrete policy decision (CBB). This means that other authorities must take account of these decisions when preparing their spatial plans. To be able to include the corridor in the SEV2, a partial review of this key planning decision (PKB) is required.

The EIS
An environmental impact statement (EIS) has been prepared in order to give environmental interests a proper place in the decision-making process regarding the review of the SEV2 PKB. The EIS has also been drawn up to aid decision-making with regard to the permit to be issued under the Public Works Management Act (*Wet beheer rijkswaterstaatswerken,* WBR). This permit is required as the high-voltage interconnector will be laid in the bottom of the North Sea and the coastal area. Both areas are managed by the Department of Public Works and Water Management (*Rijkswaterstaat*).

The EIS describes the environmental consequences of the proposed project and the alternatives that could reasonably be considered. The EIS also takes other aspects into consideration but only if they play an important part in the decision-making process, e.g. technology and cost.

The EIS describes the alternatives for and effects on the *Dutch part of the interconnector*. Alternatives and effects have also been investigated for the British end of the interconnector. A summary of the British environmental survey is included as an appendix to the main EIS report.

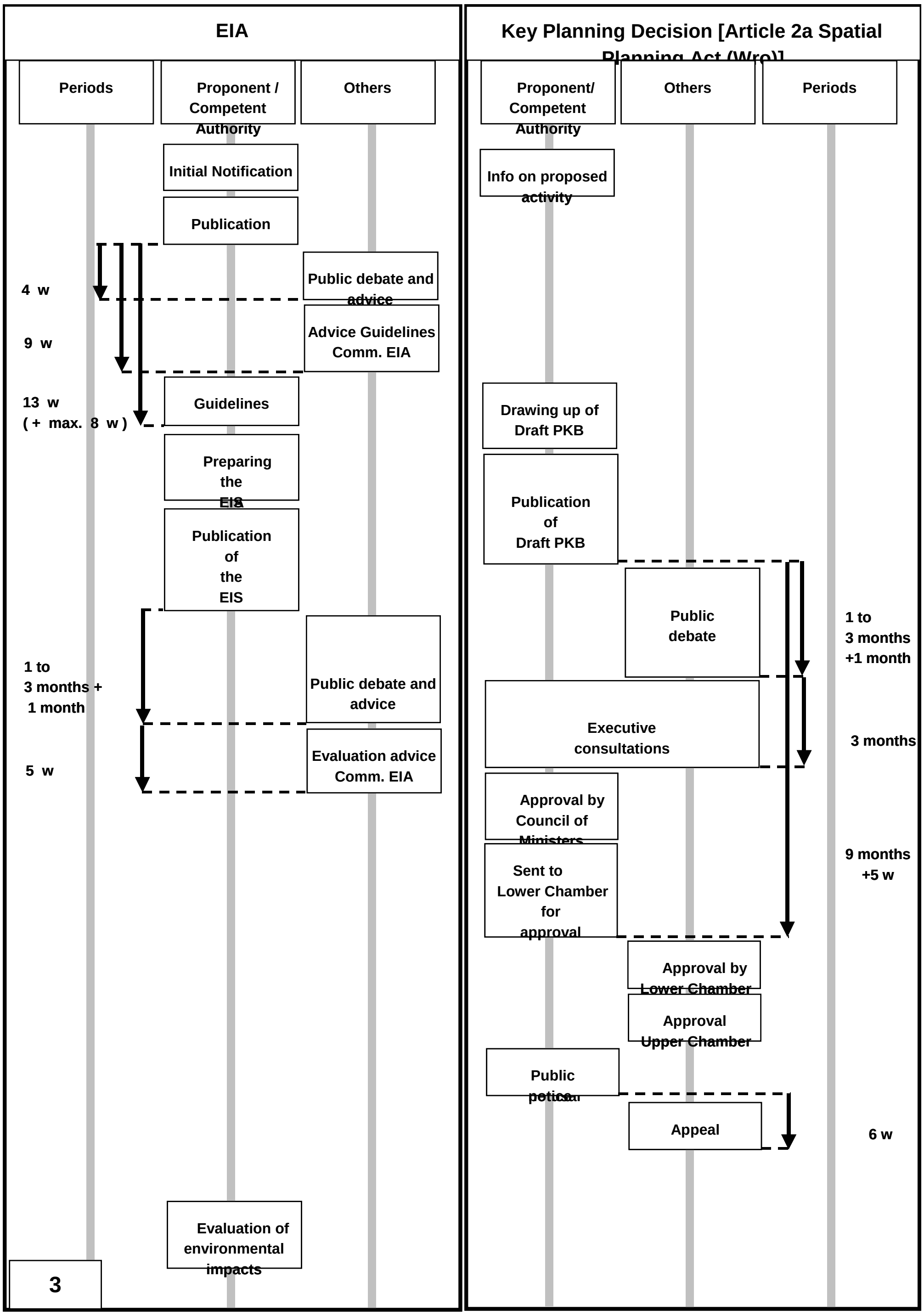

Figure 1.1 The PKB/EIA procedure

The PKB/EIA procedure
The proposal to lay the BritNed interconnector is subject to an environmental impact assessment (EIA), which means that the competent authority determines whether to apply the EIA procedure. BritNed decided in advance that it was desirable in this case to follow the EIA procedure. The competent authorities agreed to this, which meant that the formal assessment process could be dispensed with and the procedure could begin immediately. The PKB procedure for a partial review of the SEV2 must be followed. Figure 1.1 provides an overview of the PKB procedure and the EIA procedure. Preparing an EIS is a mandatory part of the EIA procedure.

Proponent and competent authority
BritNed is the *proponent* in this EIA procedure. BritNed is a joint venture between National Grid International Limited[1] and N-Link International B.V.[2]. National Grid Company (NGC)[3] and TenneT are the operators of the British and Dutch national high-voltage (interconnector) grids respectively. On 15 February 2002 BritNed sent the notification of intent for the environmental impact statement to the Minister of Economic Affairs. This notification of intent marked the start of the EIA procedure.

The Dutch Council of Ministers is formally the *competent authority* for the PKB procedure. The competent authority issues guidelines for the contents of the EIS, assesses the acceptability of the EIS and adopts the reviewed PKB. The Ministry of Economic Affairs coordinates the PKB and EIA procedures while the Transport, Public Works and Water Management is the *competent authority* for the WBR permit. The Province of South Holland (DCMR) must issue an environment permit and the municipalities of Rotterdam and Westvoorne building and installation permits to allow the interconnector to be laid on land.

Strategic environmental assessment
A new EU directive has been in force since the summer of 2004. It states that a Strategic Environmental Assessment (SEA) must be prepared before decisions are made on specific plans. The SEV2 is such a plan. At the time of publication of the notification of intent and for a considerable time thereafter, it seemed probable that a final decision would be made on the BritNed interconnector before the cut-off date for the transitional right for strategic environmental assessment elapsed, namely 21 July 2006. At the time of publication of this EIS this is no longer completely certain, which means that there may be a requirement to prepare an SEA.

The competent authority has decided in close consultation with the proponent to prepare and frame the EIS in such a way that it also meets the SEA requirement. As a result, a number of subjects have been added to the EIS, including landscape, safety and health.

The EIS contains a table that indicates where and how the SEA subjects are described. The EIS fully satisfies the procedural and substantive requirements of the EU SEA Directive.

[1] A subsidiary of the British grid company National Grid Transco plc (NGT).
[2] A subsidiary of the Dutch grid company TenneT BV.
[3] A subsidiary of NGT.

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Habitat Assessment
Some of the potential and surveyed routes for the BritNed interconnector are situated in or near areas protected under the Birds and Habitats Directives. Article 6, para. 3 of the European Habitats Directive states that: “Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives.” The assessment as stated in this Article 3 of the Habitats Directive has been recognisably included in the EIS by agreement with the competent authority.

Cross-border consultations
The high-voltage interconnector has no significant cross-border consequences for the environment. The Dutch and British competent authorities have nevertheless decided by agreement to exchange information. The Belgian authorities have also been kept informed by the Dutch competent authority.

Summary EIS
This is a summary of the *EIS for the BritNed interconnector which also serves as an SEA and Habitat Assessment.* The summary deals with the main points of the EIS. To make the summary easier to read, it has been arranged in a somewhat different order from the EIS. Its subtle distinctions and technical details have also been omitted from the text.

Guide
Following this introductory section, Section 2 provides a detailed explanation of the purpose of the BritNed interconnector. Why is the BritNed connector needed and what are the assumptions on which the project is based? Section 3 explains what the construction of the BritNed interconnector actually involves. How will the interconnector be laid and completed, where will it be situated, when will the interconnector be laid and what will happen once the interconnector has been laid?

If you are a “fast” reader who is mainly interested in the consequences of the proposed activity, please turn directly to Section 5. If you are interested, Section 4 provides a description of all the alternatives and variants examined, including the alternatives and variants which have been dropped. This section provides a useful overview prior to a detailed study of the main EIS report.

Section 5 gives a description of the possible impact of the BritNed interconnector. In Section 6 this impact is assessed in the light of current legislation, regulations and policy, including the Habitat Assessment. In Section 7 the alternatives which could reasonably be implemented are compared on the basis of their environmental impact, but also on the basis of technology and cost.

The alternative preferred by BritNed is described in Section 8 and this alternative is compared with the most environmentally friendly alternative. This will also show that environmental impacts can be compared in general terms. Finally, in Section 9, an overview is given of the knowledge and information used to prepare the EIS. This also shows where there are still gaps in our knowledge and whether it is necessary to monitor the environmental consequences after completion of the interconnector.

2 PROBLEM AND OBJECTIVE

2.1 Why is the BritNed interconnector needed?

Increased competition….
The European Union (EU) and the Dutch government wish to encourage competition in the European electricity market. The purpose of this is twofold: on the one hand it will break the monopoly positions held by suppliers, which means that electricity prices for *private individuals and businesses* can be reduced in the medium term. On the other hand it will give the *producers* of electricity a larger sales territory which will improve economies of scale and therefore the investment base for electricity producers.

….and other social benefits
Other social benefits of having good international high-voltage connections are:

- The cost of environmental measures associated with electricity generation can be mitigated by the improved investment base (exhaust gas cleaning, etc.).
- Security of supply will increase in the United Kingdom and the Netherlands if the cable is managed correctly.
- The interconnector can assist in restoring the situation to normal after any disaster that may occur.
- The larger sales territory will mean that production units will not be started up or operated on part load as frequently, thereby producing electricity more efficiently.
- Improved market access and usability will be achieved for large capacities of wind energy.
- The cable will reinforce government policy with regard to competition, the environment and energy (irrespective of the policy).
- The cable will contribute to the role of the Maasvlakte as an “energy hub”. An energy hub can be a driving force for new investment and employment. The Port of Rotterdam Authority (Havenbedrijf Rotterdam N.V.) is spearheading this development.

There is not yet a high-voltage connection with the UK
Electricity customers will therefore have to be able to decide for themselves where to buy it from. This requires new rules, but also new infrastructure. High-voltage connections are needed to transport electricity from suppliers to customers. The national main transmission systems (with a voltage of 380 kV and 220 kV in the Netherlands) have the largest transport capacity. These systems are interconnected by a limited number of international connections (interconnectors). For example, the Netherlands has two interconnectors with Belgium and three with Germany. These countries in turn have interconnectors with the national grids in their neighbouring countries.
At present, there is still no direct connection between the United Kingdom and the Netherlands.

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Other options are inadequate
Other options for achieving the desired objectives and social benefits were also considered, as well as the construction of the BritNed interconnector:

- Gas transport instead of electricity transport.
  Transporting gas for electricity production has only a limited effect on the average electricity price (for “base load”). Moreover, this limited effect only applies in the longer term. The BritNed interconnector will mainly be used during continuously occurring but short-lived differences in the price of electricity between the Netherlands and the UK (for “peak load”). These differences do not last long enough to cause large production units, which are needed to generate electricity from imported gas, to be switched on and off. The BritNed interconnector will mainly be used by production units which are currently in operation. If there is a trend towards more structural (longer-lasting) price differences, this may give rise to a reorganisation of base load production and possibly even gas transport until such time as the structural price differences have been substantially eliminated.

- Use of existing connections and laying of new connections over land.
  Currently, it is only possible to transport electricity between the United Kingdom and the Netherlands indirectly and on a limited scale via the Belgian, German and French grids and the existing cable interconnector between France and the UK. However, the capacity of this transport route is inadequate for the Netherlands. Moreover, the use of existing or new long transport routes over land is inefficient and harmful to the environment as it not only results in increased transport costs but also in more infrastructure and bigger energy losses.

In other words, there is no good alternative to the laying of a direct high-voltage interconnector between the Netherlands and the United Kingdom across the North Sea, given the desired objectives and social benefits of the BritNed project.

2.2 What are the assumptions for the project?

Social and economic benefits
It has been explained above why a direct high-voltage interconnector between the United Kingdom and the Netherlands is necessary and what benefits it will bring. BritNed’s aim is to develop and operate the interconnector on a sound economic basis, so as to be able to facilitate electricity transports for producers and customers.

Assumptions for the project
The desired social and economic objectives have given rise to the following assumptions which play an important part in the assessment of alternative means of constructing the BritNed interconnector:

Technology and economics
- Sufficient capacity for short-term trading in electricity between the United Kingdom and the Netherlands.
- Economic pay-back period of not more than 25 years.
- Operation viable at a technical service life of at least 40 years.
- Technical design, installation and operation must be reliable.
- Proven technologies to be used wherever possible.
- Risk of damage to the cable to be minimised.
- A direct interconnector between the Netherlands and the United Kingdom, connected to the 380 kV grid on the Maasvlakte.

Planning, nature and the environment
- Regulations and government policy on planning, nature and the environment to be observed.
- A good fit in terms of spatial planning, taking account of other forms of land use in the area. This in turn translates into:
  - Efforts to minimise environmental impacts during installation, operation and dismantling.
  - Efforts to minimise effects on the ecology, flora and fauna.
  - Efforts to minimise nuisance and risks to other forms of land use.

Box 2.1 Project assumptions

3 WHAT IS IT ABOUT?

Laying, operation, maintenance, removal
The planned activity for which the EIS has been prepared concerns not only the laying, but also the operation, the maintenance and (after about 40 years) the removal of an submarine high-voltage interconnector which directly connects the British and Dutch transmission grids. Transmission grids are the national main connections for transporting electricity. The capacity of the interconnector should be approx. 1,320 MW, which is also the maximum achievable capacity.

On sea and on land
The planned activity concerns not only the submarine part of the interconnector but also the infrastructure needed on land.

Features of the interconnector
This section describes the main features and environmental aspects of the BritNed interconnector. The basic design indicates “how” the interconnector is to be designed and installed, “where” it will be located, “when” it will be installed and “what” will happen after its installation and period of use.

3.1 HOW will the interconnector be designed?

System: a bipolar direct current connection
The BritNed interconnector will be designed as a bipolar direct current connection. A bipolar direct current connection consists of two separate cables that conduct electricity at high voltage and are installed right next to each other in the ground. One cable has a high positive voltage in relation to the earth and the other has a high negative voltage. The cables themselves each have a diameter of approximately 120 to 150 mm and each consist of one copper conductor with electrical insulation material and protective armour around it.

The direct current cannot simply be connected to the Dutch transmission grid, because it operates on alternating current voltage. A converter station will therefore have to be used to convert the alternating current voltage to direct current voltage and vice versa. This type of converter station is required because alternating current is unsuitable for long cable interconnectors.

The environmental aspects of a bipolar direct current interconnector
The cable and its protective devices will be designed to ensure that no short-circuit currents which are a threat to installations or people working on them can arise via the ground. Electrical fields created by the cable itself are completely shielded by the cable design from the surrounding area; they can therefore be said to be kept inside the outer casing of the cable. Magnetic fields around the cable cannot be prevented but can be substantially reduced by installing the two cables that comprise the interconnector close together. This is because the magnetic fields around the cables are opposite and, to a great extent, neutralise each other. Weak electrical fields can also be generated outside the cable by induction phenomena. However, the system and the operational management of the BritNed interconnector will be designed to ensure that the consequences of these induction phenomena are negligible.

The heat produced by the cables is minimised by the design of the cables. The diameter of the copper core of the cable will be selected so as to ensure that the cable temperature does not become too high. The heat generated can be further reduced by installing the cables further apart. However, this is not necessary. Moreover, the disadvantage of this is that it would increase the size of the magnetic fields around the cables. On land, the removal of heat will be improved by providing the composition of the soil around the cables with good heat-conducting properties.

Negative consequences of oil or tar in the cable will be prevented by using cable types in which these substances do not arise or cannot leak out into the environment. Moreover, BritNed will not use sea electrodes, thereby avoiding stray currents and electrochemical effects in the seawater.

Type of cable and cable insulation
Various types of electrical insulation material are available for the cables. The basic design is based on two Mass-Impregnated (MI) cables that will both carry high voltage. The MI cable is the only cable type that is a technical, economic and commercial option for the BritNed interconnector (see Figure 3.1).

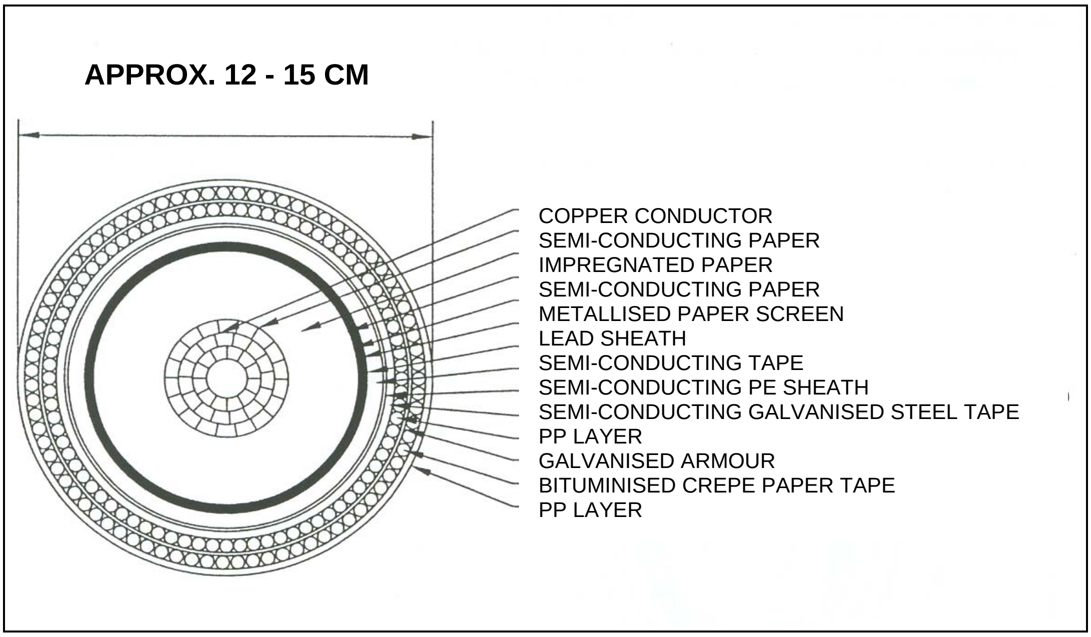
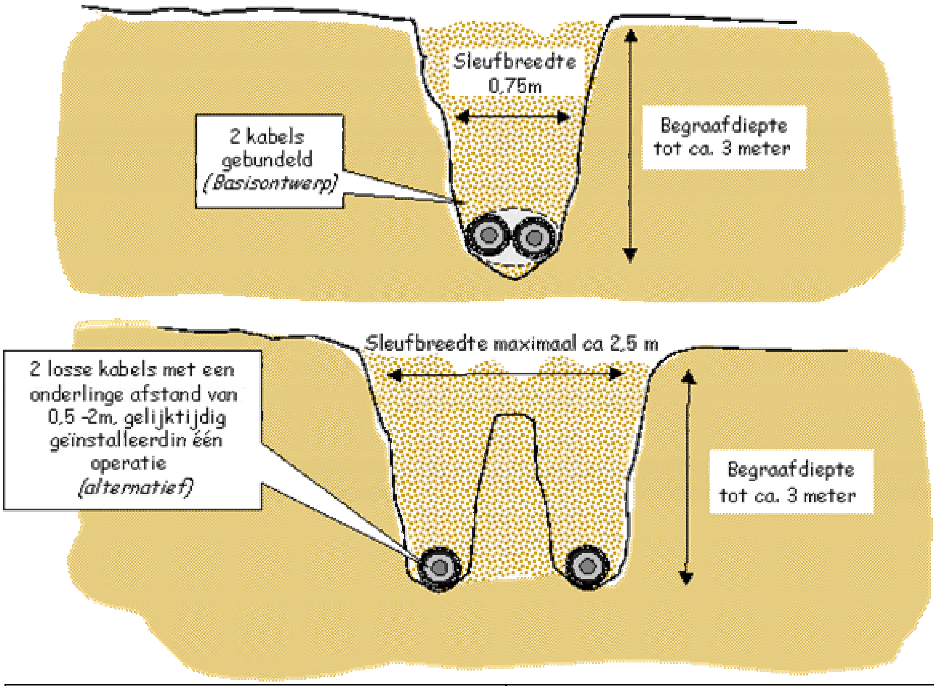


Figure 3.1 The cable type for the interconnector is a Mass-Impregnated (MI) cable

Cable-laying configuration
The two cables comprising the interconnector are bound together and buried in a single trench in the seabed or close together in two separate trenches. Both methods are shown diagrammatically in figure 3.2. On land the cables are laid next to each other in a single cable channel and buried.



Sleufbreedte 0,75 m	Trench width 0.75 m
2 kabels gebundeld (Basisontwerp)	2 cables, bundled (Basic Design)
Begraafdiepte tot ca. 3 meter	Burial depth up to approx. 3 metres
Sleufbreedte maximaal ca. 2,5 m	Maximum trench width approx. 2.5 m
2 losse kabels met een onderlinge afstand van 0,5 – 2 m, gelijktijdig geïnstalleerd in één operatie *(alternatief)*	2 separate cables at a distance of 0.5 - 2 m, both installed at the same time (*alternative*)
Begraafdiepte tot ca. 3 meter	Burial depth up to approx. 3 metres

Figure 3.2 Cable-laying configuration; a single trench (above) or two narrow trenches next to each other (below)

3.2 WHERE will the cable be laid?

Landfall and connection in the Netherlands: the Maasvlakte

The BritNed interconnector will be laid between the Maasvlakte in the Netherlands and the Isle of Grain on the east coast of the United Kingdom. Depending on the route, the interconnector will be some 240 to 280 kilometres long. A connection to the 380 kV station on the Maasvlakte is the only option if the desired transport capacity is to be achieved.

Other connection points, including Borssele and IJmuiden, have been dropped because of connection limitations. Removing these limitations would require a huge investment in the grids concerned. In addition, long interconnectors would have to be laid over land, resulting in a prolonged procedural and completion time. Moreover, no environmental gain can be achieved with other landfall sites. The cable will have to pass through the coastal waters containing most natural values in any case, whereas the disruption at other sites further inland would be substantially greater than on the Maasvlakte. This relates not only to concealing the cables, but also landscaping the converter station.

Cable route at sea

Various routes connecting the landfall locations in the Netherlands and the United Kingdom are possible. Map 1 at the end of this summary shows the exploration zone within which the alternative sea routes for the BritNed interconnector have been developed. There is little point in developing a route outside this zone as this would make the sea routes too long. Not only is this economically undesirable, it would also involve an unnecessary additional load on the seabed, a longer installation period and, as a result, a longer period of disturbance. It appears from the EIS that it is possible to develop several alternative routes within the exploration zone which are economically viable and of which the effects on the environment are kept to a minimum. Table 3.1 provides an overview of all the criteria used in this process. Some of these criteria are requirements which cannot be departed from: *veto* criteria. Other criteria are *basic principles* which can be departed from if specific conditions are met or if there are no alternatives. In addition, there are criteria which only indicate a *preferred* route. Section 4 provides a description of the cable routes.

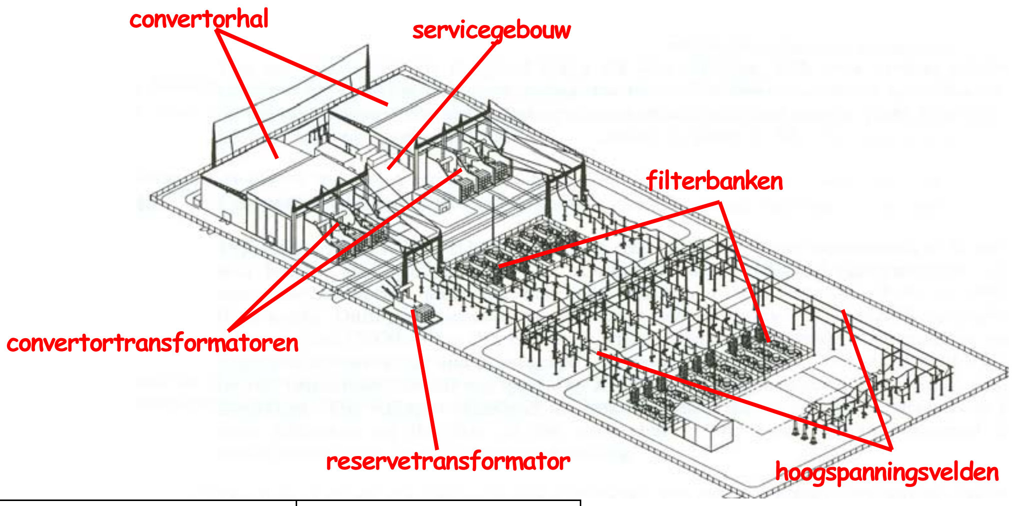
Criterion	Effect in terms of spatial planning	Status
1. TECHNOLOGY AND ECONOMICS		
1.1 Connection to be as direct as possible		
1.1.1	Cable corridor to be as short as possible	Principle
1.2 Risky areas to be avoided		
1.2.1	(Potential) sand and gravel extraction sites to be avoided	Principle
1.2.2	Bundling in or alongside shipping lanes which are being dredged to be avoided (Euro/Meuse channel [*Euro/Maasgeul*])	Veto
1.2.3	Crossings with shipping lanes being dredged to be avoided	Principle
1.2.4	Active spoil spreading sites to be avoided	Veto
1.2.5	Area around active spoil spreading sites to be avoided	Principle
1.2.6	Inactive spoil spreading sites to be avoided	Principle
1.2.7	Anchorages to be avoided	Veto
1.2.8	Morphologically unstable areas to be avoided	Principle
1.2.9	Sand waves to be avoided where possible, otherwise, route to be as parallel as possible to sand waves	Principle
2. PLANNING		
2.1 Options and multiple land use to be exploited efficiently		
2.1.1	Cable corridor generally to be as short as possible provided that fragmentation of the North Sea is avoided	Principle
2.1.1	To be bundled with other cables and pipes (observing minimum distances)	Preferred
2.1.2	Opportunities for combining functions in space and time to be investigated	Principle
2.2 Spatial conflicts to be avoided with: Shipping		
2.2.1	Combining with shipping lanes for deep-draught ocean-going vessels to be avoided (Euro channel, Meuse channel)	Veto
2.2.2	Crossings with shipping lanes being dredged to be avoided	Principle
2.2.3	Busy traffic separation systems to be avoided	Principle
2.2.4	Anchorages to be avoided	Veto

2.3 Spatial conflicts to be avoided with: Mineral extraction		
2.3.1	(Potential) sand and gravel extraction sites to be avoided	Principle
2.3.2	Sufficient distance to be kept from oil and gas platforms	Veto
2.3.3	Exploitable oil and gas fields to be avoided	Principle
2.4 Spatial conflicts to be avoided with: Other cables and pipelines		
2.4.1	Sufficient distance to be kept from oil and gas pipelines and telecommunication cables	Veto
2.4.2	Crossings to be at 90^o where possible and outside shipping lanes	Preferred
2.5 Spatial conflicts to be avoided with: Ministry of Defence areas		
2.5.1	Areas where mines are detonated to be avoided	Principle
2.6 Spatial conflicts to be avoided with: Harbour development		
2.6.1	Route to be to the north of the Maasgeul, and where possible south of the Haringvliet line	Veto
2.7 Avoid destruction of: Cultural and historic values		
2.7.1	Maintain sufficient distance from shipwrecks	Principle
3. NATURE		
3.1 Encroaching on protected nature reserves to be avoided		
3.1.1	The Voordelta [pre-delta] to be avoided where possible, otherwise cable corridor to be as short as possible	Principle
3.2 Encroaching on areas with special ecological qualities to be avoided		
3.2.1	Route through coastal waters to be as short as possible	Principle
3.2.3	If possible, no route to be south of the notional extension of the demarcation line	Principle
3.2.2	If possible, no route to pass through future exploration zone for a marine reserve, otherwise to be as short as possible, taking account of other interests	Principle
3.3 Harming vulnerable and protected species to be avoided		
3.3.1	Maintain sufficient distance from seal colonies during periods when they are sensitive to disturbance	Principle
4. THE ENVIRONMENT		
4.1 Encroaching on areas under environmental protection to be avoided		
4.1.1	If possible, keep sufficient distance from wildlife sanctuaries	Principle
4.2 Emissions to air, water and land to be minimised		
4.2.1	Cable corridor to be as short as possible	Principle
4.3 Where possible, environmentally friendly "necessary" technologies to be used		
4.3.1	Where possible, avoid areas where dredging is required	Principle

Table 3.1 Overview of the criteria for developing routes at sea

Location of converter station

A new TenneT switching and transformer station is situated in the immediate vicinity of the E.On power station on the Maasvlakte. The TenneT station is the point where the BritNed interconnector will be connected to the Dutch grid. A converter station is needed to convert the direct current of the BritNed interconnector to the alternating current of the grid. The E.On power station site still has sufficient space on it to build this converter station. The main advantage of this is that the converter station and the grid connection point are next to each other and the converter station will be in keeping with an industrial landscape.



Convertorhal	Converter halls
Servicegebouw	Service building
Filterbanken	Filter banks
Convertortransformatoren	Converter transformers
Reservetransformator	Reserve transformer
Hoogspanningsvelden	High-voltage fields

Figure 3.3 Components of a converter station

Figure 3.3 shows what a converter station looks like. The size of the site for the converter station is about 4 hectares. The maximum building height is 25 metres. In general, the main environmental aspects of the converter station are the sound and its visual effect. The use of impermeable cellars and facilities for collecting and draining rainwater will ensure that there is no environmental impact on the soil and groundwater.

Cable route on land
A short cable connection on land is also required to enable the direct current interconnector to be connected to the converter station. A number of cable routes on land are available depending on the exact spot where the sea cable comes ashore on the Maasvlakte. The alternative cable routes on land are described in the next section. Each of these routes is situated on or over the edge of the Maasvlakte.

An alternating current voltage connection will be laid from the converter station to the TenneT switching and transformer station. The converter station and the grid connection point will be so close together that the alternating current connection can be mounted between the two stations as a surface high-voltage line.

3.3 HOW will the interconnector be laid?

Laying the cables on the seabed

There is one ship for transporting and laying the cable on the seabed. It is followed at a maximum distance of 1 km by a second ship with a burial machine. This is the most commonly used method, involving the least risk, for heavy cables.

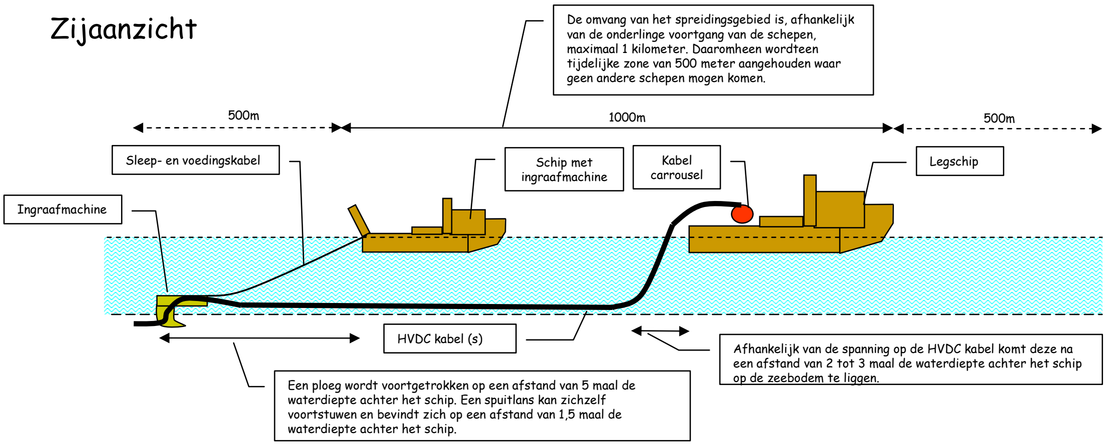
Levelling the seabed in advance, if necessary
In areas with high and steep sand waves (a type of dune on the seabed) the seabed will first have to be levelled with a trailing suction hopper dredger before the cable can be laid on the seabed.

Burying the cable
The cable will be buried by a burial machine that moves or is dragged over the seabed. The next section specifies the burial techniques that were considered by BritNed and which of them have been discarded.

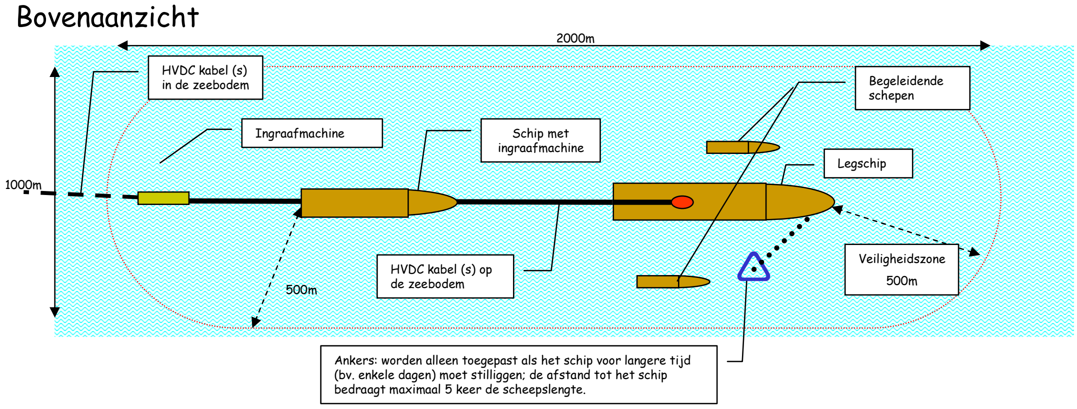
Burial depth of the cable
The bottom of the North Sea is constantly moving. That is why it is important to bury the cable in the seabed. If the cable becomes exposed it may be damaged by dragnets from fishing boats and ships' anchors. That is the reason why the cable will be buried at a maximum target depth of 3 metres below the seabed in the Dutch part of the North Sea.

Burial scenario
In areas containing sand waves the tops of these waves will be levelled so that the cable can be buried at a maximum depth of about 3 metres below the levelled waves and will remain about 1 metre below the seabed for about 15 years. If the sand cover is decreased by erosion or shifting sand waves until less than approx. 1 metre is left, the cable will be reburied to a greater depth. The period of about 15 years is an estimated economic optimum, based on calculations.

Zijaanzicht



Bovenaanzicht



Zijaanzicht	**Side view**
De omvang van het spreidingsgebied is, afhankelijk van de onderlinge voortgang van de schepen, maximaal 1 kilometer. Daaromheen wordt een tijdelijke zone van 500 meter aangehouden waar geen andere schepen mogen komen.	Depending on the relative progress of the ships, the size of the spreading area is a minimum of 1 kilometre. Around this, a temporary zone of 500 meters is established which no other ships can enter.
Sleep- en voedingskabel	Dragging and supply cable
Ingraafmachine	Burial machine
Schip met ingraafmachine	Ship with burial machine
Kabel met carrousel	Cable carrousel
Legschip	Laying ship
HVDC kabel(s)	HVDC cable(s)
Afhankelijk van de spanning op de HVDC kabel komt deze na een afstand van 2 tot 3 maal de waterdiepte achter het schip op de zeebodem te liggen	Depending on the tension on the HVDC cable it is laid on the seabed at a distance of 2 to 3 times the water depth behind the ship
Een ploeg wordt voortgetrokken op een afstand van 5 maal de	A plough is dragged at a distance of 5 times the water depth

waterdiepte achter het schip. Een spuitlans kan zichzelf voortstuwen en bevindt zich op een afstand van 1,5 maal de waterdiepte achter het schip	behind the ship. A jetting machine can propel itself and is positioned at a distance of 1.5 times the water depth behind the ship
Bovenaanzicht	**Top view**
HVDC kabel(s) in de zeebodem	HVDC cable(s) in the seabed
Ingraafmachine	Burial machine
Schip met ingraafmachine	Ship with burial machine
Begeleidende schepen	Auxiliary ships
Legschip	Laying ship
Veiligheidszone 500 m	Safety zone of 500 m
HVDC kabel(s) op de zeebodem	HVDC cable(s) on the seabed
Ankers worden alleen toegepast als het schip voor langere tijd (bv. enkele dagen) moet stilliggen; de afstand tot het schip bedraagt maximal 5 keer de scheepslengte	Anchors are only used when the ship has to stay in one place for a prolonged period (e.g. a few days). The distance from the ship is a maximum of 5 times the ship's length.

Figure 3.4 Operation involving one cable-laying ship followed by one ship with the burial machine

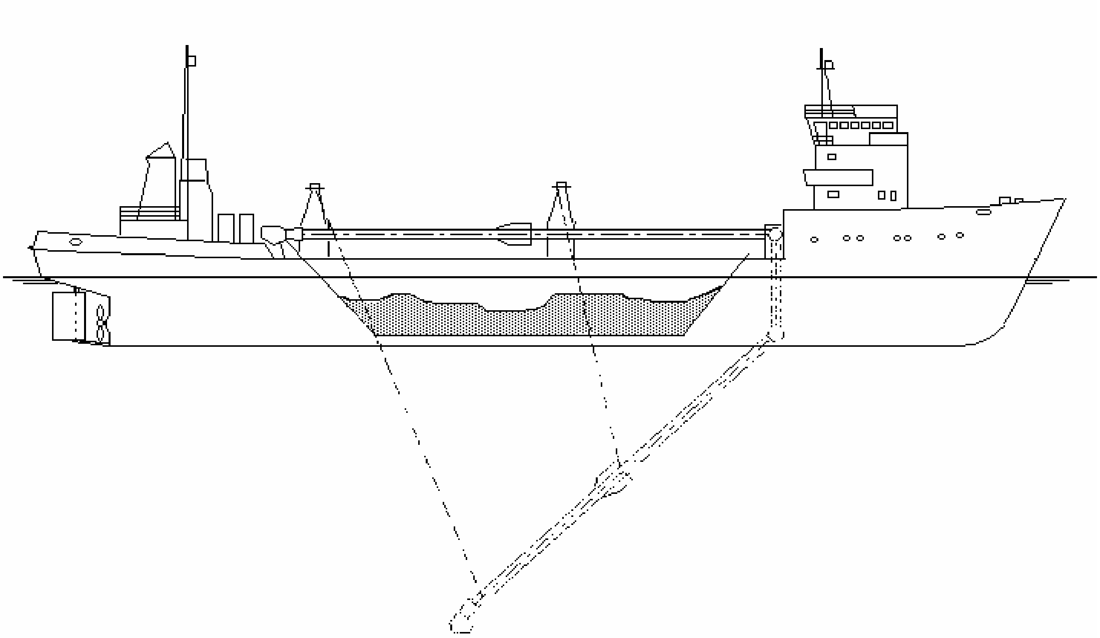


Figure 3.5 Trailing suction hopper dredger for levelling sand waves as required

Figure 3.6
A plough is lowered into the sea from the auxiliary vessel (source: Metoc)

Cable joints
The maximum length of cable that can be transported by a ship is about 100 kilometres. If two cables are being laid at the same time from a single cable-laying ship, as is the case with BritNed, the maximum cable length will therefore be about 50 kilometres. This means that a cable joint will have to be installed in several places. Once the first cable section has been laid, the ship returns to the plant to collect the next 2x50 km section. In the meantime, the cable ends already on the seabed will be temporarily protected and monitored. When the ship returns, the ends are hoisted on board and joined to the next 2x50 km section of cable. This is a delicate operation that takes about two weeks. The diameter of the cable joint is a little wider than the diameter of the cable itself and will also be buried in the seabed using a burial machine.

Crossing other cables and pipelines
The BritNed interconnector will inevitably cross the path of cables and pipelines, generally running over the top of the other cables and pipelines. A protective layer consisting of concrete mats or a rock placement will be placed between the BritNed cable and the other cables or pipelines.

Landfall
The technique used to make landfall on the coast depends on local conditions in the area where the cable comes ashore. In the next section the different alternative landfall techniques are described for each alternative sea route.

Burying the cables on land
On land, the DC cables will be laid at least 1 metre deep in a pre-dug trench using regular trench diggers, after which the trench will be closed. To cross infrastructure such

as cables and pipelines, roads and railway lines, existing pipe joints (conduits) under this infrastructure will be used wherever possible. If this is not possible, a hole will be drilled under the existing infrastructure through which the cable can be drawn.

3.4 WHEN will the interconnector be laid?

The EIS provides a detailed schedule for the installation work. The schedule will serve as an example to show that work can be carried out outside ecologically sensitive periods. This applies in particular to work carried out at landfall and on land. The storm period from mid-October to mid-April also has to be taken into account. Installation at sea is avoided during this period due to the risk of bad weather, which makes installation at sea more difficult. This period is generally avoided for landfall due to the additional requirements involved in crossing the sea defences.

The total installation time – from testing on the open sea until completion of the last components of the interconnector – will be about 2 years. The work carried out at sea will take a total of about 5 months, landfall a few weeks to a few months (depending on location) and the work on land about 2 months. It will take about 20 months to build the converter station. The interconnector is not expected to be completed before the spring of 2007, which means that the interconnector can be operational by 2009.

3.5 WHAT will happen after its installation and period of use?

Inspection, maintenance and repair
After the cable has been buried, regular measurements will be carried out to inspect whether the cable is still at a sufficient depth. If necessary, the cable will be reburied or buried more deeply in the seabed. According to the schedule this is not expected to be necessary for 15 years. Repairs are seldom required if a cable has been installed correctly. The main causes of damage are fishing nets and ships' anchors. The equipment used in repairs is similar to the machines used for the installation work.

Decommissioning and removal
The cable will be removed at the end of its service life. BritNed proposes to remove first any sections of cable located in places where this can be done without difficulty, using divers or a grapnel attached to a ship. Where the shifting of the seabed has buried the cable too deep, the covering layer will first have to be dredged away before the cable itself can be removed. A better alternative is not to carry out dredging operations but to leave the buried cable sections where they are until the natural processes of the seabed have decreased the burial depth sufficiently. The recovered cable will be removed for final disposal (recycling).

4 WHAT ALTERNATIVES HAVE BEEN INVESTIGATED?

4.1 General

A large number of alternatives were investigated in the EIS
To take account of the interests of nature and the environment in as effective and practical a way as possible, BritNed decided to consider all the alternatives that could be relevant from an environmental point of view. The main alternatives as described and investigated in the EIS are set out again in this section. This section is therefore intended not only as a summary of the alternatives investigated, but also as a guide to the EIS, which is very detailed on this point.

Basic design and reasonable alternatives for consideration
Alternatives which are not feasible for technical or economic reasons, do not meet project requirements or are not in keeping with nature protection policy have not been considered further in the EIS. In the EIA procedure these alternatives are usually designated as alternatives which "cannot reasonably be considered". In the rest of this section, these alternatives are designated as "not an option" or, where an initial investigation has been carried out to ascertain whether or not they are feasible, as "investigated but rejected". All the remaining alternatives were then investigated in terms of their environmental consequences and compared. All the remaining alternatives are designated as "alternatives that can reasonably be considered". Without wishing to state a preference in advance for one of these reasonable alternatives, the EIS designates the most likely alternatives as "basic design".

4.2 Cable and converter system

Cable and converter systems	Selection
Bipolar, 2 polar cables capacity 1,000-1,320 MW	Basic design
Monopolar, 1 polar cable, 1 current return cable* capacity 600-800 MW	Alternative that can reasonably be considered
Monopolar, 1 polar cable, 1 current return cable** capacity 600-800 MW	Alternative that can reasonably be considered
Monopolar, 1 polar cable, sea electrodes	Not an option

* lightly insulated, ** heavily insulated and can therefore be upgraded to the bipolar system

Basic design
The basic design for the BritNed interconnector consists of a bipolar cable and converter system with a capacity of 1,000 to a preferred maximum of 1,320 MW. A bipolar system is so called because the system consists of two polar high-voltage cables. One cable has a high positive voltage in relation to the earth and the other has a high negative voltage. The two cables conduct electricity at a high voltage of -500 kV and +500 kV respectively.

METOC

Alternatives that can reasonably be considered
Because of uncertainty as to social and economic trends, BritNed considers that the interconnector should initially have a smaller capacity of about 600 to 800 MW. From a technical and economic point of view, a monopolar system will probably be the preferred option for an interconnector of this capacity. Such a system will consist of one polar high-voltage cable of about 250 to 500 kV with an insulated return cable. Unlike the polar cable, the return cable is not carrying a very high voltage of several hundred thousand volts

Whether the return cable in this alternative monopolar system will be lightly (tot 50 kV) or heavily (up to 500 kV) insulated, will depend on whether it is decided to leave the option to upgrade to a bipolar system open. After being upgraded to a bipolar system the heavily insulated return cable can easily be placed under a voltage of between 250 and 500 kV. The return cable can simply be left in the seabed. Upgrading does not therefore involve replacing and reburying a cable. The eventual choice of system will depend on market conditions and trends at the time of the tendering phase of the project.

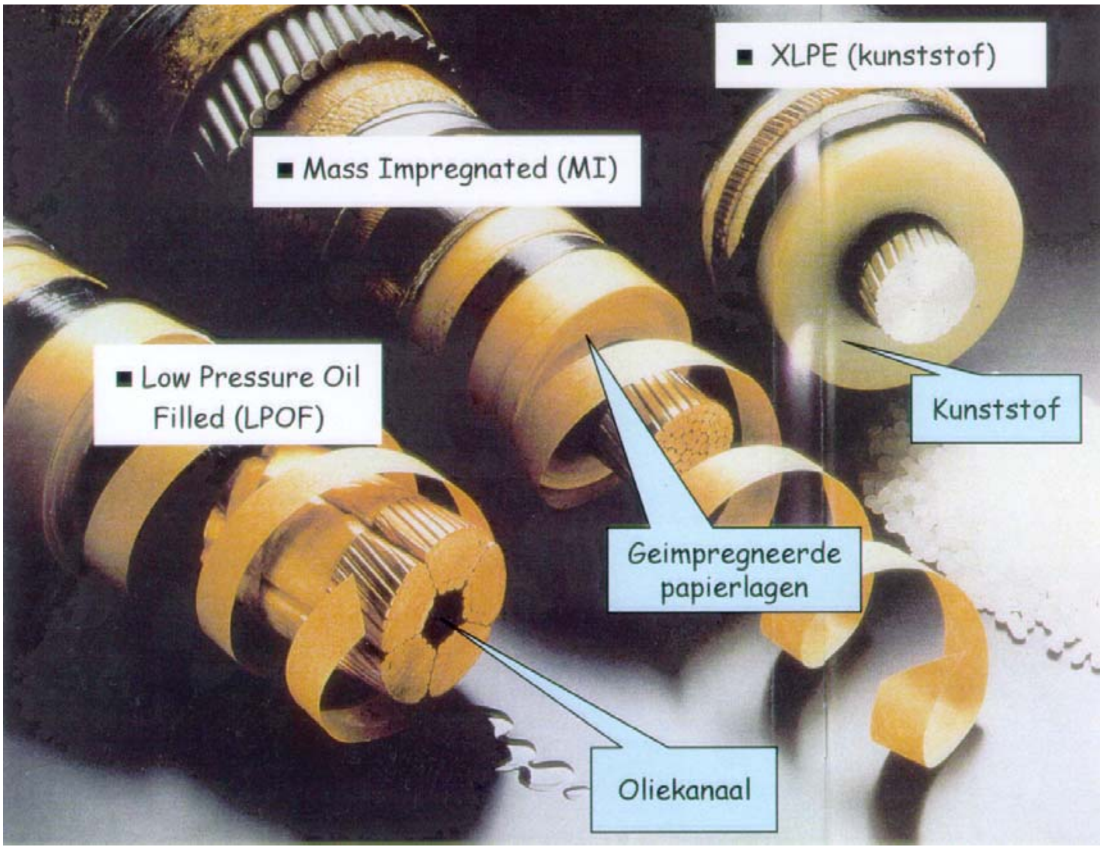
The technical construction of a monopolar interconnector with a heavily or lightly insulated return cable is somewhat different from a bipolar interconnector, but the environmental impact and the method of installation are similar. This also applies, for example, in the case of magnetic fields. Just as in a bipolar system, the magnetic fields of the two cables neutralise each other in a monopolar system if they are placed close together.

Systems which are unsuitable or have been rejected after investigation
BritNed will not in any case be choosing a monopolar system in which the return current is supplied by sea electrodes. The use of sea electrodes produces undesirable environmental and other effects.

4.3 Cable type

Type of cable and cable insulation	Selection
MI cable, with 1 conductor per cable	Basic design
MI cable, with two conductors in 1 cable (FMI)	Not an option
MI cable, with integrated return cable (IRC)	Not an option
Oil-filled cable (LPOF)	Not an option
XLPE cable (plastic cable)	Alternative that can reasonably be considered*

* only if return cable is in a monopolar system



XPLE (kunststof)	XPLE (plastic)
Kunststof	Plastic
Geimpregneerde papierlagen	Impregnated paper layers
Oliekanaal	Oil channel

Figure 4.1 Three types of cable and insulation: MI, oil and plastic. The MI cable is the basic design and the plastic cable is a reasonable alternative if the return cable is in a monopolar system.

Basic design

The basic design is a bipolar interconnector with two Mass-Impregnated (MI) cables. The MI cable comprises a single copper core with layers of paper around it that serve as electrical insulation (see Figures 3.1 and 4.1). The layers of paper are impregnated with a non-viscous oil. This is the reason why this type of cable is described as mass-impregnated cable. Around the impregnated paper layers is a watertight lead casing, enclosed in a protective layer and armour.
The protective layer is bituminous, but does not contain PAHs. The armour is made up of galvanised steel wires. A plastic is wound round the armour. The outside of the cables is therefore of plastic. The armour provides protection against damage but is also needed to absorb the forces exerted on the cable while it is being laid.

Alternatives that can reasonably be considered

The alternative is a monopolar system with two mass-impregnated cables or a monopolar system with one mass-impregnated cable and one plastic cable for the return current. Only in the first case would it be possible to eventually upgrade the monopolar system to a bipolar system because a plastic (XLPE) cable is not suitable for very high voltages in a DC system.

Cable types which are unsuitable or have been rejected after investigation
Other cable types are not suitable for the BritNed interconnector. In the case of IRC cables and FMI cables two copper conductors are combined in a single cable, which means that only one cable is required in a DC interconnector instead of two. However, IRC and FMI cables have insufficient capacity. LPOF cables are unsuitable for long distances. Moreover, there is a small risk of an oil leak if the cable breaks as LPOF cables contain viscous oil as electrical insulation.

4.4 Cable configuration

Cable configurations at sea	Selection
2 cables bound together	Basic design
2 separate cables, 0.5 to 2 metres apart	Alternative that can reasonably be considered
2 separate cables, more than 2 metres apart	Not an option
Cable configuration on land	**Selection**
2 cables, approximately 40 cm apart	Basic design

Basic design
The basic design at sea is based on two cables which are bound together. The bundled cables are laid together in one trench in the seabed and in a single operation. This is the best way of minimising the magnetic field magnitude and disturbance of the seabed. Moreover, the two cables can be installed in a single operation. Even if it is necessary to level the seabed this can be done in a single operation. A thicker copper conductor may be required to prevent the bundled cables from becoming too hot.

On land too, the cables are installed together, about 40 centimetres apart, in a single trench.

Alternatives that can reasonably be considered
The alternative cable configuration at sea is also based on two cables, but with a small distance of 0.5 to 2 metres between them. The two cables are then installed in two narrow trenches right next to each other. The magnetic fields of the two cables also neutralise each other in this configuration, but to a lesser extent than in the case of bundling. Less heat is generated in this alternative because the cables are laid in two separate trenches. This means that a thinner copper conductor will suffice, requiring lower investment costs. Because the distance between them is limited to two metres, the cables can be installed in a single operation, just as in the basic design. The same applies to the levelling of the seabed.

On land it is inadvisable to lay the cables further apart as they would take up too much space and two separate trenches would have to be excavated.

Configurations which are unsuitable or have been rejected after investigation
Having a distance of more than two metres between the two cables is not an option for BritNed either at sea or on land. This is because the magnetic fields of the two cables would not be reduced sufficiently. Moreover, two separate laying and burying operations would be required, which would involve more disturbance and increased installation costs.

4.5 The installation procedure at sea

Installation procedure at sea	**Selection**
Laying and burying cable in one operation, using two vessels	Basic design
Laying and burying cable in one operation, with one vessel	Alternative that can reasonably be considered, but unlikely
Laying and burying cable in two operations	Not an option
Levelling the seabed in areas with high and steep sand waves	**Selection**
Dredged material to be deposited in the immediate vicinity of the trailing suction hopper dredger	Basic design
Dredged material to be removed	Alternative that can reasonably be considered, but unlikely
Dredged material to be used for land reclamation for Maasvlakte 2	Alternative that can reasonably be considered, but unlikely
Technique for burying cable in the seabed	**Selection**
Jetting machine	Basic design
Non-displacement plough	Basic design
Displacement plough	Alternative that can reasonably be considered, but unlikely
Vibrating plough	Not an option
Mechanical burial machine	Not an option
Dredging	Not an option, unless local conditions require this
Choice of burial scenario	**Selection**
Sand cover of 1m for approximately 15 years	Basic design
Minimum sand cover	Alternative that can reasonably be considered, but unlikely
Sand cover of 1m for approximately 40 years	Alternative that can reasonably be considered

Basic design
The basic design is based on laying and burying the cable in a single operation. To keep the progress of the cable-laying ship and the burying of the cable independent of each other, two ships are used: one to lay the cable and one to bury it (see Figure 3.1).

In areas containing high and steep sand waves, the seabed will first be levelled using a trailing suction hopper dredger. The dredged material will be immediately deposited in the vicinity of the trailing suction hopper dredger (up to 1 kilometre away).

A non-displacement plough or a jetting machine will be used to bury the submarine cable. Both techniques are the most suitable options from a technical and economic point of view and also cause the least disruption to the environment because the cable is buried in the seabed without displacing the soil. With a plough the cable is so to speak “cut” into the seabed whereas with a jetting machine the seabed is softened with high-pressure water, after which the cable sinks into the sea floor under its own weight.

The *initial* burial depth of the cable will be no more than about 3 metres. In places where there are high and steep sand waves, the tops will be dredged away so that the cable will – according to model computations – still have sand cover of approx. 1 metre after 15 years. This is known as the 15-year “burial scenario”. After about 15 years it may be necessary to rebury the cable at some time and in some places. In this scenario both the costs and the environmental impact are kept to a minimum.

Alternatives that can reasonably be considered
One alternative is to have one ship lay the cable on the seabed and then bury it. However, there are very few cable-laying ships that have sufficient space on deck to accommodate both cable-laying and burial equipment while transporting the cable and can then simultaneously lay the heavy cable and deploy the burial machine. In any case, using two separate ships makes little difference in terms of the environment.

An alternative method of levelling the seabed would be to dispose of the dredged material outside the area where it was extracted. However, this has the disadvantage that it increases turbidity at the dumping site and more trips would have to be made. Another alternative to use the dredged material in the construction of Maasvlakte 2. This option can only be investigated when the work is taking place as it will then be clear whether these activities coincide and/or the sand extracted is suitable for this use. For the rest, it is probably not worthwhile harmonising the logistics and material for the two operations for small quantities. Nevertheless, this is an option that will be considered when work starts.

An alternative method for burying the submarine cable is the use of a displacement-type plough. The disadvantage of this technique is that it causes greater disturbance of the seabed. However, this method cannot be ruled out in advance.

Two other scenarios have been investigated as an alternative to the 15-year burial scenario. They are: a scenario in which dredging is only carried out to ensure that normal burial machines can cope with the “topped” high and steep sand waves and a scenario in which dredging is carried out until, according to model computations, the cable will still have a minimum covering of about 1 metre of sand even after some 40 years. In the first case, the depth at which the cable is buried will decrease quickly as a result of the shifting sand waves and there is a greater risk of exposure. This would increase maintenance costs, the risk of damage to the cable and the cost of any failure of and repair to the interconnector. These costs exceed the costs of dredging. In the second case, the dredging costs and the quantity of dredged material increase, but less maintenance is required.

Installation methods which are unsuitable or have been rejected after investigation
The submarine cable could also be installed in two separate steps, in which the cable is first laid by a cable-laying ship and then buried by a second ship at a later date. However, this method is unsuitable because it would mean leaving the cable unprotected on the seabed for some time.

Burial techniques other than the plough or jetting machine are not being considered on technical, economic or environmental grounds. Although a vibrating plough can vibrate light cables into the seabed it is not designed to install heavy high-voltage cables and, as far as is known, has never been used in deep water (10 metres or more). The mechanical burial machine is designed solely for harder subsoils than the bottom of the North Sea between the UK and the Netherlands. The use of this machine would result in increased costs and greater disturbance of the seabed. Dredging will only be carried out to level sand waves and not to bury the cable. The decision not to use dredging as a burial technique will substantially minimise the environmental impact at sea. Dredging will only be used to bury the cable in places where this is unavoidable.

4.6 Cable routes at sea

A number of alternative routes in the Dutch part of the North Sea were developed for the EIS. The location of these routes is indicated on Map 2a appended to this summary. In order to explore all the possibilities in terms of routes, variants of the various alternatives were also brought into focus and considered. None of these variants appeared to be any better at first sight. There were not therefore included in the impact prediction in the EIS. Two alternative routes (Northern Sea Route A and Southern Sea Route A) were subsequently found to be less suitable than other alternatives and were also rejected. The rejected routes and variants are shown on Map 2b appended to this summary.

In any case, to minimise interference with the construction of Maasvlakte 2, the route chosen must be outside the exploration zone for this development (Map 3.6 in the map appendix). In the north this means a route heading to the Meuse estuary (*Maasmond*), where ships enter and leave the port of Rotterdam. In the south it means a route heading to the southwest point of the Maasvlakte, next to the “De Slufter” spoil dump.

From a technical point of view, a landfall in the north would be very complicated and costly because it means having to cross the entrance to the port. However, a landfall in the south would mean having to cross the Voordelta. The Voordelta is the shallow area of sea in front of the South Holland and Zeeland Delta and enjoys international protection under the Birds and Habitats Directives. Part of the Voordelta has also been designated as an exploration zone for a future marine reserve. Precisely because of the policy of protecting the Voordelta, the option of a landfall via the Meuse estuary, a very technically complex operation, has also been investigated.
Box 4.1 provides more detailed background information on the development of sea routes.

Northern sea routes

The Notification of Intent for this EIS and the Guidelines are based on an alternative known as Northern Sea Route A (then known as the Northern Route) (see Map 2b in this summary). Further analysis has shown that, because of shipping interests, this route is not a reasonable alternative. Both the Port of Rotterdam Authority and the Dutch coastguard have indicated that Northern Sea Route A is unacceptable on nautical grounds . At the time, the route was being developed as the shortest route with a northern landfall on the Maasvlakte. To achieve this, however, a great deal of the route would lie in the busy shipping traffic system at the entrance to the port of Rotterdam. The policy adopted by the Port of Rotterdam Authority and the coastguard was therefore not to permit this route. For this reason, BritNed has dropped Northern Sea Route A.

Northern Sea Route B has been defined as an alternative (referred to in the Guidelines as the Northern Plus Route) (see Map 2a in this summary). This route is 2 kilometres longer than Northern Sea Route A in coastal waters. However, the route will be technically complicated and costly because the Meuse estuary and the coastal defences will have to be crossed to make landfall on the Maasvlakte. Northern Sea Route B is also complicated in terms of spatial planning. Only a very narrow corridor is available in the coastal waters to the north of the Meuse estuary to make landfall on the Maasvlakte possible. Although there is enough space to install a high-voltage cable there, this space is limited by the ample presence of oil and gas infrastructure and spoil spreading sites. The consequence of this is that it is not always possible to maintain the desired distance from these facilities.

Southern sea routes

A number of southern sea routes have been defined and investigated for the EIS. A start was made with Southern Sea Route A (still referred to as the Southern Route in de Notification of Intent and the Guidelines) (see Map 2b in this summary). This route crosses the Voordelta, a protected site under the Birds and Habitats Directives, and the exploration zone for a marine reserve yet to be established, which is intended to compensate for the construction of Maasvlakte 2. Landfall on the Maasvlakte would take place close to the Hinderplaat, an important seal colony.

Southern Sea Routes B and C have been developed both to minimise the length along which the cable crosses the marine reserve exploration zone and to keep as much distance as possible between the cable and the Hinderplaat (see Map 2a in this summary). These routes run between two active sand extraction sites. Of all the routes, Southern Sea Route C intersects the marine reserve exploration zone over the shortest distance. Southern Sea Route C does however traverse the Voordelta site protected under the Birds and Habitats Directives over a greater length than Southern Sea Route B. Southern Sea Routes B and C follow the same line close to the coast and approach the Slufterstrand beach near the Maasvlakte from a south-westerly direction. Southern Sea Route A approaches the beach from a more southerly direction. For the last kilometre heading towards the beach Southern Sea Route A is inside the 1200m disturbance contour for resting seals on the Hinderplaat. Because of the presence of the seals, another alternative to Southern Sea Route A has been developed; this is Southern Sea Route A2 (see Map 2 in this summary). This route bends at a distance of about 5 kilometres from the Hinderplaat to the north and makes landfall in the same place as Sea Routes B and C.

With these routes, all the space within the southern corridor has been explored. A more northerly route outside the marine reserve exploration zone is not possible because there is a large sand extraction site and also a shipwreck. This means that Southern Sea Route C cannot be shifted further north. A more southerly route than Southern Sea Route A was not considered as it would have been south of the Demarcation Line. Because of its natural value, the area south of the Demarcation Line has been protected from industrial development and has also been designated as a nature development area in the province's policy document. .

Box 4.1 Background to development of alternative northern and southern routes.

Sea routes*	Selection
Northern Route A	Investigated but rejected
Variant: combining with pipeline	Investigated but rejected
Variant: partial combining with shipping lanes	Investigated but rejected
Northern Route B	Basic design for a northern landfall
Southern Route A	Investigated but rejected
Variant: landfall in Meuse estuary	Investigated but rejected
Variant: deep-water route	Investigated but rejected
Variant: route via Haringvliet estuary	Investigated but rejected
Southern Route A2	Alternative that can reasonably be considered
Southern Route B	Basic design for a southern landfall
Southern Route C	Alternative that can reasonably be considered

* See Maps 2a and 2b at the end of the summary and Maps 4.1 - 4.12 in the map appendix

Basic design
Two routes have been developed to the level of a basic design for the Dutch part of the North Sea. The basic design for a route to the south of the Meuse channel (*Maasgeul*) and if possible to the south of the planned location for Maasvlakte 2 is Southern Sea Route B. This route traverses the Voordelta and a very small part of the exploration zone for a future marine reserve. Landfall will take place on the coast at the southwest point of the Maasvlakte (see Maps 4.3 and 4.5 in the map appendix).

The basic design for a route to the north of the Meuse channel and to the north of the exploration zone for Maasvlakte 2 is Northern Sea Route B. Landfall will take place, via the Meuse estuary, on the north coast of the Maasvlakte.

Alternatives that can reasonably be considered
In the case of a southern sea route, two routes can be classified as reasonable alternatives for consideration: Southern Sea Routes A2 and C (see Map 4.8 in the map appendix). In view of the space limitations in the area to the north of the Meuse channel (shipping, cables and pipelines, sand extraction, spoil spreading sites, oil and gas platforms) there are no alternative sea routes to Northern Sea Route B which could reasonably be considered for the installation of the BritNed interconnector.

Sea routes which are unsuitable or have been rejected after investigation
Two alternative sea routes have been rejected on the basis of detailed investigation. Southern Sea Route A has been rejected because of its proximity to resting seals on the

Hinderplaat and the relatively greater length of the route passing through the marine reserve exploration zone (see Box 4.1). Northern Sea Route A is unacceptable to the Port of Rotterdam Authority and the coastguard because it constitutes a hindrance and risk to shipping. A great deal of Northern Route A lies in the busy shipping traffic system at the entrance to the port of Rotterdam.

So as not to rule out any options, the EIS describes and considers a number of additional variants of Southern Sea Route A and Northern Sea Route A. None of these variants offers major advantages, but they do involve new objections. For the basis of and further information on these objections, please refer to the EIS.

4.7 Landfall location and route

Landfall location and route for Northern Sea Route B*	**Selection**
Landfall at Edison Bay (*Edisonbaai*) via Meuse estuary	Basic design for northern sea route
Landfall at Hook of Holland	Investigated but rejected
Landfall at Beer channel, via Meuse estuary and Caland channel	Investigated but rejected
Landfall location and route for southern sea routes*	**Selection**
Landfall southwest of Slufterstrand beach	Basic design for southern sea route
Landfall northwest of Slufterstrand beach	Investigated but rejected
Landfall west of Slufterstrand beach	Investigated but rejected
Landfall directly on Slufterstrand beach	Investigated but rejected
Landfall south of Slufterstrand beach	Investigated but rejected

* See Maps 4.9, 4.11 and 4.12 in the map appendix, ** See Map 4.9 in the map appendix

Basic design for northern landfall

There is only one way that Northern Sea Route B can make landfall on the Maasvlakte, i.e. by crossing the Meuse estuary. The cable comes ashore at Edison Bay. The precise spot where the Meuse estuary has to be crossed is determined by the position of the Noorderdam, nautical safety requirements and the presence of a pipeline in the Meuse estuary. The fact that the coastal waters near the Meuse estuary are relatively deep means that the large cable-laying ship can get close to the Noorderdam. The section below explains how the cables will then be installed in the Meuse estuary.

Basic design for southern landfall

The coastal waters off the southwest point of the Maasvlakte are relatively shallow. This means that the large cable-laying ship cannot get close to the coast. However, this option is preferable from a logistical point of view as it keeps the route through shallow water as short as possible. In shallow water smaller ships have to be used and possibly a pontoon as well.

The basic design for the landfall of the southern sea route is based on a south-westerly route towards the Slufterstrand beach on the Maasvlakte. In the event of a south-westerly landfall, the distance between the landfall operations in the Voordelta and any point on the seal colony on the Hinderplaat will be over 1,200 metres (see Map 9.4 in the map appendix). Research carried out in the Wadden Sea shows that at this distance it is possible to avoid disturbing seals[4]. Other considerations which have played a part in the choice of the south-western landfall route are the relatively minor coastal erosion, the short length of the route through shallow water, the almost complete avoidance of affecting Maasvlakte 2 and the suitability of the slope of the beach and the dunes.

Part of the soft sea defences in the most recent design for Maasvlakte 2 [August 2005] coincide with the basic design for the landfall route for the southern sea routes. However, closer consideration of the planned soft sea defences indicates that they do not constitute a mechanical or electrical threat to the cables. BritNed therefore maintains the landfall route for the southern sea routes so that it can guarantee the minimum distance of 1,200 metres between them and the seal colony.

Alternatives that can reasonably be considered
With regard to both Northern Sea Route B and the southern sea routes, the technical, economic and environmental aspects of the landfall location and route have been investigated and optimised so that there are no better or equivalent alternatives. The alternatives which have been investigated and rejected are described below.

Landfall routes which are unsuitable or have been rejected after investigation
Alternative options to Northern Sea Route B were sought to avoid crossing the Meuse estuary. It is also important to note that *another* complex crossing will eventually have to be made when Northern Sea Route B is created. This is because the land route of Northern Sea Route B will inevitably cross the area where the future expansion of the Yangtze harbour (*Yangtzehaven*) is planned (see Map 4.11 in the map appendix). This expansion consists of an extension of this harbour from the current Maasvlakte to Maasvlakte 2. The extended Yangtze harbour will then become the new harbour entrance to Maasvlakte 2. Two alternative options for avoiding these complex crossings were considered.

One option is to make landfall on the coast at Hook of Holland. However, as far as BritNed is concerned, this is not a reasonable alternative for consideration since the countryside around Hook of Holland does not contain a connection point to the high-voltage grid which is suitable for the BritNed interconnector. BritNed will therefore have to rely on the 380 kV station on the Maasvlakte. In order to still be able to use the connection point on the Maasvlakte after landfall at Hook of Holland, a protected dune area, the built-up area of Hook of Holland, the Nieuwe Waterweg and the Caland channel (*Calandkanaal*) would have to be crossed in rapid succession, after which the cable would have to follow a long path through the industrial estate and harbour basins (see Map 4.12 in the map appendix). This is much more complex than crossing the Meuse estuary.

[4] Brasseur, S.M.J.M. & P.J.H. Reijnders, 1994; Invloed van diverse verstoringbronnen op het gedrag en habitatgebruik van gewone zeehonden, IBN Report 113, Wageningen.

The other option would be not to make landfall in Edison Bay via the Meuse estuary but in the Beer channel (*Beerkanaal*) (see Map 4.11 in the map appendix). This means that a relatively long route has to be dredged along the length of the Meuse estuary, then the Caland channel and finally the Beer channel. All three are heavily used by shipping. This too is more complex and also has more risks to shipping than crossing the Meuse estuary diagonally and crossing the Yangtze harbour.

However, the area considered for the landfall of the southern sea routes has its own limitations in terms of space, although landfall here would not be complex. The available landfall site is bounded on the southern side by the Demarcation Line extended seawards[5], and on the northern side by the probable location of Maasvlakte 2. Although the coastal waters are protected on the seaward side and to the south of the Maasvlakte under the Habitats Directive, most of the natural values in this area are to the south of the extended demarcation line. The higher natural values here are mostly related to the shallow water. Dutch national policy is inclined towards not allowing port and industrial activities in the area to the south of the extended Demarcation Line. A little further north lies the probable location of Maasvlakte 2. As far as possible, this area is also avoided in the basic design for the southern landfall route and location, although some overlap with the outermost soft sea defences of Maasvlakte 2 should not be a major problem (see above).

What remains is a usable landfall zone a few hundred metres wide. It is made even narrower by the principle of remaining outside the disturbance range of any seals on the Hinderplaat on the south side and outside a relatively unstable part of the coast (serious erosion and sand suppletion) on the north side or the sphere of influence of Maasvlakte 2. Effectively, therefore, what still remains is a narrow coastal strip which is suitable and available for the landfall. All the southern sea routes classified as reasonable alternatives for consideration make landfall here.

Maps 4.8 and 4.9 in the map appendix show the landfall routes and locations which have been investigated and rejected because they are outside the “suitable landfall corridor”. The “north-western and western landfall” on the Slufterstrand beach lie to the north of the suitable landfall corridor and are undesirable because of the relatively serious coastal erosion at this spot and the effect of the construction of Maasvlakte 2. Because of coastal erosion, a (buried) cable could be exposed, which of course is undesirable. The future development of Maasvlakte 2 will probably mitigate the problem. However, it is not known at present if and when the construction of Maasvlakte 2 will take place [August 2005]. In the existing situation, places suffering from serous erosion will therefore be avoided wherever possible.

The major disadvantage of the “direct landfall” investigated is that it would be relatively closer to any seals on the Hinderplaat than the basic design (the south-western landfall). Moreover, a direct landfall on the beach and the Slufter dunes is problematic from a technical point of view, because the slope of the dunes is too steep at this point (gradient in excess of 1:5). This causes unacceptable tensions in the cables.

[5] On land, the demarcation line is the boundary between the port area of the municipality of Rotterdam and recreation and nature reserves of the municipaliy of Westvoorne. This “artificial” boundary has been notionally extended seawards, with a view to the development of Maasvlakte 2.

Although the “southern landfall route” investigated has a more gentle slope, it is even closer to the seal colony on the Hinderplaat than the direct landfall, i.e. within the 1,200 metre disturbance contour.

4.8 Landfall techniques

Landfall technique* Northern Sea Route B	**Selection**
Dredging in the Meuse estuary	Basic design
Drilling under the Meuse estuary	Investigated but rejected
Landfall technique* Southern Sea Routes A2, B and C	**Selection**
Excavating trench in beach and dunes between sheet piling	Basic design
Excavating trench in beach drilling under the dunes	Alternative that can reasonably be considered

* See Maps 5.1 - 5.4 in the map appendix

Basic design for northern landfall
Landfall on the Maasvlakte from the north means that the 26-metre deep Meuse estuary has to be crossed. The basic design assumes that a trench will be dredged diagonally across the Meuse estuary via a route to the west of and parallel to the existing BP pipeline. The distance between the cable and the pipeline will be at least 100 metres. This is to keep the two systems accessible for maintenance and to prevent damage during installation. The depth of the Meuse channel is maintained by dredging. To prevent the cable from being damaged, the trench will be dredged to a depth of about 10 metres under the bed of the Meuse estuary. Once the cable has been installed in the trench it will be covered with rocks. This will provide the cable with adequate protection. The trench can then be topped up with material dredged from the trench. It will take about 12 weeks to dredge this trench and keep it at the right depth before the cable can be laid in the trench. The operation will be carried out in close cooperation with the traffic management department of the Port of Rotterdam Authority to keep the estuary safe and accessible to shipping. Other specific concerns to be taken into account will be the foundations of the lighthouse, the stability of the Zuiderdam and any future extension of the Noorderdam if the harbour entrance is enlarged.

Basic design for southern landfall
When the southern route makes landfall, the BritNed interconnector will cross the beach and the dune in front of the Slufterdam. The basic design is to float the cables ashore from a smaller cable-laying ship or pontoon and bury the cable on the beach. The cables will be buried in a trench excavated in the dune, which may require the use of (temporary) sheet piling.

The burial depth on the low-lying part of the beach will be one metre below the Low Low-Water level. The burial depth on the high part of the beach near the foot of the dune will be 4 metres as this area is susceptible to erosion. In the high dune zone the cable will be buried at a depth of 2 metres.

Alternatives that can reasonably be considered
Although alternatives to the northern landfall have been investigated, they have been found to be unrealistic (see below).

An alternative to the southern landfall would be to pull the cables through two cable protection pipes installed under the dune in a horizontal directional drilling operation. This would require sheet piling on the beach to collect the drilled material in a construction pit. The cable protection pipes containing the cables could be fitted with a cooling system to prevent excessive heat build-up inside the pipes. Any cooling system would be housed in a separate small building on the Slufter dyke (*Slufterdijk*).

There are two conceivable alternatives to the burial depth on the beach which would provide the cable with even more protection against exposure than the basic design. One possible alternative would be to fit jointed cast-iron shells manually round the cable. This would substantially increase the protection afforded to the cable against, for example, wave attack and human activity. Direct human contact with the cable would then be ruled out, although human contact would not be dangerous if the cable was undamaged. It would also be possible to bury the cable more deeply under the low-lying part of the beach, so that it would be permanently buried at a depth of one metre for its entire service life.

Landfall techniques which are not being considered or have been rejected after investigation
A detailed study was made of the options for drilling under the Meuse estuary as an alternative to dredging for the northern landfall. The conclusion was that drilling such a long bore hole 1,400 metres under the Meuse estuary was too risky and not acceptable to BritNed. This is evident from various studies specifically carried out for this purpose and from previous experience of the drilling operation for the BP pipeline, which failed no less than five times. Eventually, this pipeline was therefore installed in a dredged trench in the bottom of the Meuse channel. Box 4.2 summarises the main risks involved in drilling under the Meuse estuary.

Several studies have shown that drilling under the Meuse estuary entails the following risks which are beyond anyone's control or influence:
- because of the considerable length of the bore hole combined with the steep bank – which means that drilling must take place at an awkward angle – the feasibility of the operation is in doubt;
- moreover, it would be necessary to drill under the Noorderdam where the earth pressure is very high and fluctuates considerably, increasing uncertainty as to the feasibility of the operation.
- the positioning of the drill head in the middle of the Meuse estuary and 10 metres below the seabed is a complex matter and therefore an additional failure factor, particularly when combined with the presence of the BP pipeline;
- pulling in the cables over such a distance and at an awkward angle is also risky because the considerable tensile forces involved could damage the cables;
- there are layers of gravel under the Meuse estuary but there is no reliable way of ascertaining where they are. Drilling fluid can leak away into these gravel layers, causing the drill rod to seize and the drilling operation to fail.
- there are also risks during the operational phase. The considerable earth pressure means that the cables would have to be installed in steel cable protection pipes. There would be a risk of the cables overheating inside these pipes, causing the interconnector to fail. Repair would be practically impossible, as it is unlikely that it would be possible to pull the cables out of the cable

protection pipes again, especially when they are partially fused together. This would mean having to carry out another drilling operation with all the same risks and complexity during the installation and operational phases, assuming there was still space under the Meuse estuary for a new drilling route.

Box 4.2 The risks of drilling under the Meuse estuary are not acceptable to BritNed.

4.9 Location of converter station

Location of converter station	Selection
E.On power station site	Basic design
Lyondell site	Not an option

Basic design
BritNed has investigated a number of sites for the converter station in conjunction with the Port of Rotterdam Authority. The converter station must be situated close to the grid connection point and the existing cable and pipeline corridor on the Maasvlakte and the site must be of a sufficient size (4 hectares). Other important aspects are the availability of the site and the minimising of its impact on the environment. On the basis of these criteria, the E.ON site was chosen as the basic design. The converter station will therefore be situated right next to the connection point to the 380 kV grid.

Sites which are unsuitable or have been rejected after investigation
Another location which has been investigated lies to the north of the site on which the chemical company Lyondell is based. BritNed has an option on this site, which is still undeveloped. However, the Port of Rotterdam Authority has decided to move the Yangtze harbour to the south and to expand it to 600 metres. This makes the site unusable for the construction of the converter station.

4.10 Cable routes on land

Land route for northern landfall*	Selection
Northern land route	Basic design
Land route for southern landfall*	**Selection**
Southern land route – cable/pipeline corridor east	Basic design
Southern land route – cable/pipeline corridor central	Alternative that can reasonably be considered, but unlikely
Southern land route – cable/pipeline corridor west	Alternative that can reasonably be considered, but unlikely
Customs route – crossing railway lines	Alternative that can reasonably be considered

Customs route – crossing road	Alternative that can reasonably be considered, but unlikely
Zigzag route	Alternative that can reasonably be considered, but unlikely
Zigzag route, in combination with customs routes and cable/pipeline corridor routes	Alternative that can reasonably be considered, but unlikely
Western land route	Alternative that can reasonably be considered, but unlikely

* See Maps 4.10 and 4.11, and 5.5 - 5.8 in the map appendix

The cable route on land must be as direct a route as possible, preferably in reserved cable and pipeline corridors on the Maasvlakte wherever possible and preferably clustered with other infrastructure. Furthermore, there must be sufficient space available on the route for installation and maintenance and future developments in the port area must not be allowed to obstruct the cable, or vice versa.

Basic design for northern land route
On the basis of Northern Sea Route B, the submarine cable comes ashore on the north side of the Maasvlakte via Edison Bay. The cable/pipeline corridor is immediately behind the soft coastal defences. The route then follows the cable/pipeline corridor south until it reaches the converter station on the E.ON site.

Basic design for southern land route
The basic design is based on a land route south of De Slufter. It runs from the shoulder of the North Sea Boulevard to the central cable/pipeline corridor on the Maasvlakte. The route then follows the cable/pipeline corridor north until it reaches the converter station. The cable will lie at the eastern edge of the cable/pipeline corridor, next to an underground 150 kV cable and under existing high-voltage lines. The main advantages of this southern land route situated at the east side of the cable/pipeline corridor are:

- agreement with the Port of Rotterdam Authority on this route;
- efficient use of cable/pipeline corridor: pipes to the west, electrical infrastructure to the east;
- no drilling required to cross other infrastructure;
- the cable is easily accessible for maintenance;
- no interference with future developments in the port area.

However, a major consideration for the southern land route is that it lies a little to the south of the demarcation line since the demarcation line on the Maasvlakte is on the crest of the Slufterdam. The area to the south of the demarcation line, including the North Sea Boulevard, the dunes and the beach belong to the municipality of Westvoorne and functions as a nature zone. The municipality of Westvoorne has promised to cooperate in the planning of this route. The terrestrial cables will be laid underground here in the northern shoulder of the North Sea Boulevard.

Alternatives that can reasonably be considered – northern land route
No alternatives to the northern land route are conceivable which would be better on technical, economic or environmental grounds.

Alternatives that can reasonably be considered – southern land route
However, there are various possible alternatives to the southern land route. A land route to the west of De Slufter and further along the coastline from the Maasvlakte is the most direct route to the converter station. The disadvantages of this western land route are possible interference with and from the construction of Maasvlakte 2, the need to cross the Hartel corridor (*Hartelstrook*) where future infrastructure is planned and possible interference with the Distripark which is being expanded towards Maasvlakte 2. The zigzag land route also follows a route to the west of De Slufter, but veers off to the east between De Slufter and the Distripark. The route then runs to the north towards the E.On site. The zigzag route does not have the disadvantage of having to cross the future extension of the Distripark. The route does however have the disadvantage of passing through the Hartel corridor and the Vogelvallei bird (breeding) colony (see Map 9.6 in the map appendix). Furthermore, the length of the zigzag route is a major disadvantage.

A number of variants of the location of the southern land route, the basic design, have been investigated. Each of these variants has disadvantages compared with the basic design. For example, the “cable/pipeline corridor central” variant is located next to a number of pipelines. A certain distance would have to be maintained from these pipelines to avoid the effects of electromagnetic fields and heat development. This would result in a less efficient use of space in the centre of the cable/pipeline corridor. The “cable/pipeline corridor west” variant lies along the west side of the cable/pipeline corridor. This route would require a complex drilling operation in the C2 bend in order to cross the infrastructure – roads and railway lines – located there.

Another two variants of the southern route lie between the Distripark and the rail yard alongside the cable/pipeline corridor. From the C2 bend, the land route follows a route to the north as far as the customs offices. That is why this variant is known as the “customs route”. To reach the E.ON site, it would have to cross the cable/pipeline corridor. This is possible in two places. If the crossing point was level with the railway lines, the route would end up in the cable/pipeline corridor, after which the route would continue towards the converter station. This is the most reasonable alternative to the basic design. If the crossing point was further north the cable would not be in the cable/pipeline corridor but in the immediate vicinity of the E.On site where the converter station is planned. To achieve this, a number of roads that converge at this point would have to be crossed

4.11 Installation on land

Installation of the terrestrial cables*	**Selection**
Installation in a concrete duct or in a sand-filled trench	Basic design
Crossing terrestrial infrastructure*	**Selection**
Existing conduits to be used, no drilling required	Basic design
Boring required if use of conduits is not possible	Alternative that can reasonably be considered

* See Maps 5.5 - 5.8 in the map appendix

Basic design
Inside the cable/pipeline corridor, the basic design is to lay the terrestrial cables in a concrete duct in a pre-excavated trench at a depth of about 1 metre. The concrete duct would be about 1 metre wide. Outside the cable/pipeline corridor, the terrestrial cables would be laid directly in the excavated trench, which is about 1 metre deep and 1.5 metres wide. Once the cable has been laid the trenches are partially backfilled with excavated earth and if necessary partially filled with special filling sand to improve thermal conduction.

Alternatives that can reasonably be considered
Other techniques will have to be used where crossing points with other infrastructure occur in locations where there is no suitable conduit. In the case of short crossings under roads, the road can be opened up temporarily. Drilling will be required where crossings are longer and more complex. BritNed has chosen a basic design for the land route in which it is possible to avoid drilling operations in the vicinity of areas containing natural values. It is impossible to give assurances on this point in advance.

5 WHAT ARE THE POSSIBLE CONSEQUENCES?

5.1 General

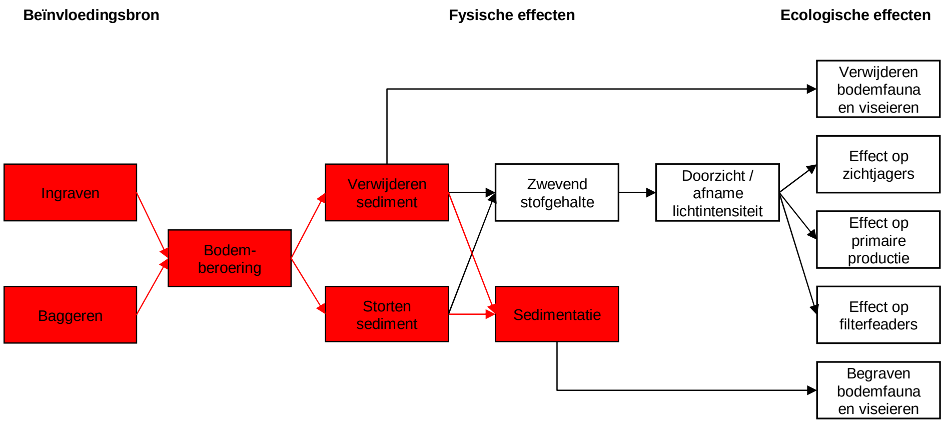
The environmental consequences of the basic design and the reasonable alternatives
Section 4 provided a description of the basic design and the alternatives which have been investigated. This section describes the environmental consequences of the basic design and the alternatives that could reasonably be considered.

The technical design, the method of installation and the routes of the basic design of the BritNed interconnector and the reasonable alternatives for consideration have been chosen to ensure that only very limited environmental effects remain. This means that even the differences between the basic design and the reasonable alternatives for consideration are generally small, if not actually negligible. For this reason the consequences of the BritNed interconnector are described in a general way in this summary. Only where there is a clear difference in environmental effects will this be stated.

Existing situation and autonomous development
The environmental consequences are described against the background of the existing situation with regard to the environment and autonomous development where the interconnector is laid. In most cases, the existing situation and the autonomous development of the area in which the northern sea route and land routes are located are similar to the area in which the southern sea route(s) and land route(s) are located. The two cases involve the North Sea and the Maasvlakte respectively. There is actually a difference in a number of cases. For example, the position and height of sand waves on the seabed are not the same everywhere. This means that different earth-moving operations are required to install the cable at a safe depth in the seabed. Animal species likely to be disturbed by the installation work are not present everywhere in the same population densities. For example, the Voordelta south of the Maasvlakte contains seal colonies whereas there are none north of the Maasvlakte.

Effect chains
The environmental impacts are described in the EIS on the basis of cause-effect chains. Figure 5.1 shows an example of such a cause-effect chain. The diagram can be explained as follows. The operations to level the seabed and bury the cable disturb the sea bottom. The result of this is that sediment is stirred up in the seawater. This sediment then settles back down on to the seabed and can cover the bottom fauna and fish eggs with a thin layer (sedimentation). The churned-up sediment also increases the amount of suspended matter in the water column, which reduces the light intensity in de water column. This can have a temporary and localised effect on the primary production of organic matter in the water column and reduce visibility for fish and birds which are then unable to spot their prey as efficiently or quickly (effect on visual predators).

Dealing with the precautionary principle in impact prediction
Inevitably, assumptions have been made at every stage in the effect chain, from the cause to the effect. As far as possible, these assumptions have been based on literature and empirical data. In the MER it is always stated which sources have been used to this end. Nevertheless, it is the effects “at the tail end of the effect chain” which ultimately have the greatest margins of accuracy (or inaccuracy) in impact prediction.



Beïnvloedingsbron	Source of influence
Fysische effecten	Physical effect
Ecologische effecten	Ecological effects
Ingraven	Burial
Baggeren	Dredging
Bodemberoering	Bottom disturbance
Verwijderen sediment	Removal of sediment
Storten sediment	Dumping of sediment
Zwevend stofgehalte	Suspended matter content
Sedimentatie	Sedimentation
Doorzicht / afname lichtintensiteit	Visibility / decrease in light intensity
Verwijderen bodemfauna en viseieren	Removal of bottom fauna and fish eggs
Effect op zichtjagers	Effect on visual predators
Effect op primaire productie	Effect oin primary production
Effect op filterfeaders	Effect on filter feaders
Begraven bodemfauna en viseieren	Burying bottom fauna and fish eggs

Figure 5.1 Example of a cause-effect chain

There are, in principle, two methods of dealing with these margins whereby it can be concluded with sufficient certainty whether significant effects will arise and a reliable comparison of alternatives is still possible. They are the use of “worst case” assumptions and assessments based on “effects at the top of the effect chains”. The advantage of using “worst case” assumptions is that an upper limit is determined for the effects, including at the tail end of the effect chains. In this way, the actual effects will always be less serious than the effects as described. By contrast, assuming the worst case may result in overestimating the effects. In practice, the likelihood of the worst case actually happening is often remote. For this reason, the environmental consequences in the EIS are also described and compared, where possible, on the basis of the “effects at the top of the chain”. In fact, the prediction of seabed disturbance is relatively easy and accurate. The consequences for visual predators at the tail end of the effect chain is more difficult to predict (see the example of the effect chain in figure 5.1). In the case of relatively limited interventions in complex systems such as the North Sea and the Voordelta, the latter method provides a more realistic basis for comparing and assessing alternatives. For this reason, the consequences for the physical environment and the noise emissions have in all cases been calculated quantitatively where possible, in order to obtain as reliable a measure as possible for the comparison of the effects. The effects on the environment and land use are mostly described in terms of quality. Where possible, these qualitative descriptions have been based on the quantitative calculations.

Which environmental consequences have been studied?
Table 5.1 contains a summary of all the environmental and other aspects which have been studied in the EIS. In the description of the effects on these aspects the BritNed interconnector project was divided into the following phases:

- Installation, maintenance and any repairs to the interconnector
- Presence of the interconnector
- Use of the interconnector
- Decommissioning of the interconnector
- Removal of the interconnector

(Environmental) aspects studied	Summary of (environmental) effects studied
Physical environment	Effects on the soil/seabed ▪ disturbance of the soil/seabed ▪ sedimentation (at sea) ▪ heating of the soil/seabed
	Effects on the water ▪ increase in suspended matter ▪ reduced visibility
	Energy effects ▪ Electrical and magnetic fields ▪ Transport losses ▪ Heat production
	Sound ▪ Sound emissions from installation equipment (to the air) ▪ Sound emissions from installation equipment (under water) ▪ Sound emissions from permanent installations

Ecology	Effects resulting from soil/seabed disturbance ▪ removal and burial of benthos and fish ▪ hindrance to visual predators ▪ reduction in primary production
	Effects resulting from disturbance due to noise, presence ▪ disturbance of species ▪ disturbance or loss of biotopes ▪ loss of vegetation
	Effects resulting from energy effects ▪ effects of magnetic fields ▪ effects of induced electrical fields ▪ effects of heat production
Land uses	Interference with other users and land uses ▪ sand and gravel extraction ▪ spoil spreading ▪ oil and gas extraction ▪ cables and pipelines ▪ archaeology and cultural history ▪ shipping and navigation ▪ fishing ▪ military activities ▪ wind energy ▪ recreation ▪ harbour development
Other (environmental) aspects	Other effects ▪ landscape ▪ safety and health

Table 5.1 Summary of (environmental) effects studied

5.2 Physical effects

5.2.1 General

Effects on soil/seabed and water
This section describes the effects on the soil/seabed and the water of laying the BritNed interconnector. The consequences of maintenance, any repairs and removal of the cable are similar. The operation of the interconnector has no effects on soil/seabed and water, except for very limited energy effects.

Energy effects
The energy effects of operating the cable are the magnetic and induced electrical fields as well as the heating of the soil/seabed immediately around the cable. The installation, maintenance, any repair work and the removal of the interconnector have no energy effects.

Summary of the effects
Table 5.2 provides a summary of the physical consequences for the undersea section of the interconnector. The effects are the consequences of the basic design. The consequences of Southern Sea Routes A2 and C are similar to those of Southern Sea Route B.

Physical effects	Northern Sea Route B	Southern Sea Route B	Preference
Churning of seabed			
[disturbance]	50 ha	-	Slight, but not relevant preference for north
- Meuse estuary	-	15 ha	
- Voordelta	8 ha	-	
- Coastal waters*	114 ha	167 ha	
- North Sea**			
Churning of seabed [dredging]			No clear preference
- Meuse estuary	2.000 m^3x10^6	-	
- Voordelta	-	-	
- Coastal waters*	-	-	
- North Sea**	0.127 m^3x10^6	0.751 m^3x10^6	
Sedimentation [peak values]			Slight, but not relevant preference for north
- Meuse estuary	negligible	-	
- Voordelta	1.5 mm	6.0 mm	
- Coastal waters*	2.0 mm	0.0 mm	
- North Sea**	1.0 mm	negligible	
Suspended matter [peak			Slight, but not relevant preference for north
values]	negligible	20 mg/l, after 1 tide 2 mg/l	
- Voordelta	8 mg/l, after 1 tide 1 mg/l	negligible	
- Coastal waters*	65 mg/l, after 1 tide 3 mg/l	155mg/l, after 1 tide 7 mg/l	
- North Sea**			
Reduced visibility			Slight, but not relevant preference for north
- Voordelta	negligible	45%, after 2-3 tides negl.	
- Coastal waters*	25%, after 1 tide negl.	negligible	
- North Sea**	80%, after 1 tide negl.	90%, after 2-3 tides negl.	
Magnetic field [distance 5 m]	2.2 µV/m	2.2 µV/m	No preference

Electrical field [distance 5 m]	1.9 µT	1.9 µT	No preference
Heating of soil***	5.5^0 at 30 cm deep	5.5^5 at 30 cm deep	No preference

* North of the Voordelta; ** Outside the Voordelta and coastal waters *** Sand cover of cable 1 metre

Figure 5.2 Summary of physical effects of installing and operating the basic design at sea.

The above summary of effects is described in detail below. Alternative techniques may produce different results. Where relevant, this will also be briefly stated. The physical effects on land are limited and have not therefore been summarised in a table but they are described in brief.

5.2.2 Effects on the soil/seabed

Effects on the seabed

The bottom of the North Sea mainly consists of sandy sediments. The position of the seabed is constantly changing as a result of natural processes. Sand waves are also shifting. Along the alternative routes for the BritNed interconnector, these sand waves only occur outside the relatively shallow coastal waters. Human activities have a considerable effect on the seabed. Examples include bottom-disturbing fishing activities, the dredging of shipping channels, the dumping of silt, sand extraction and the effect of major interventions such as the construction of Maasvlakte 2, which has yet to take place.

The burial of the cable and above all the levelling of high and steep sand waves will have most effect on the seabed. However, the effect is localised and minimal, with a short recovery period for the subsequent effects, such as the churning up of the seabed and the covering of the seabed with dredged and churned-up material from the sand waves. The effects are negligible compared with the natural dynamics of the seabed and other bottom-disturbing activities in the North Sea. Most of the effects will have disappeared again after 1 or 2 tidal periods. For this reason, there are no significant differences between the Northern and Southern Sea Route.

Table 5.2 shows the area of the seabed that will be disturbed during installation, the approximate amount of material that will be dredged away and the extent of the maximum bottom coverage expected locally.

The overall extent of bottom disturbance will be at its greatest in the case of Northern Sea Route B because of the dredging of the cable into the Meuse estuary. In the North Sea itself, the sand-moving operations will be somewhat more extensive on Southern Sea Route B. This is mainly due to the presence of more and higher sand waves. For this reason, the sedimentation along the southern sea route(s) will also be somewhat higher. Dredging in the Meuse estuary will not result in increased local sedimentation because the dredged material will be removed elsewhere and because of the fast currents in the Meuse estuary.

The effects on the seabed of the reasonable alternative techniques do not differ significantly from the basic design. Although the choice of a different burial scenario will have an effect on bottom disturbance and sedimentation, this will be of little or no consequence in terms of subsequent effects. Table 5.2 is based on a scenario in which the cable is covered by more than 1 metre of sand for 15 years. If we assume a scenario in which only the very tops of the sand waves are dredged away, the dredged volume will be 0.017 $m^3 \times 10^6$ for Northern Sea Route B and about 0.060 $m^3 \times 10^6$ for the southern sea routes. The major disadvantage of this option is that the cable would have to reburied at the right depth more often, the first time probably after 4 years. If we assume a covering of more than 1 metre of sand for a prolonged period of 40 years, a much larger part of the sand waves would have to be dredged away. In this case, the dredged volume would be about 0.8 $m^3 \times 10^6$ for Northern Sea Route B (excluding the dredging in the Meuse estuary) and 2.6 $m^3 \times 10^6$ for Southern Sea Route B. The maximum localised sedimentation expected would be 9 mm. This thickness of the layer would however be of short duration and, in view of the existing natural dynamics of the North Sea, insignificant.

Effects on the soil on land
The soil on the Maasvlakte mainly consists of reclaimed sand. In places where the cable makes landfall there is also sand, carried there by sea and wind and sometimes deposited there to maintain the coastline. In view of the type of soil involved, burying the cable on land will have no appreciable effect.

5.2.3 Effects on the water

Effects on the seawater
The water in the North Sea is subject to currents which are mainly caused by the Gulf Stream and tidal movements. Seawater naturally contains suspended matter in average concentrations of 20-30 mg/l in coastal waters and 4-5 mg/l in the open sea. After a period of storms these concentrations increase temporarily by two to four times.

The removal and return of sediment during the levelling of the seabed will result in a temporary increase in suspended matter in the water and a decrease in visibility. The effects are summarised in Table 5.2.

Northern Sea Route B is somewhat better in terms of its localised and temporary effect on the seawater. However, the differences are insignificant and both the average values and the peak values will have substantially disappeared again after 1 or 2 tidal periods. The extent of the effects is no worse than the effects of a fierce summer storm, but they do not last as long and are much more localised. Immediately after dumping, the suspended matter content of the North Sea increases to a maximum of 65 mg/l in places for Northern Sea Route B to 155 mg/l for Southern Sea Route B in the vicinity of the cable. This peak is many times lower in the Voordelta (max. 20 mg/l) because the tops of sand waves do not have to be removed there. As a result of these peaks, visibility in the North Sea decreases by 80% in places in the case of Northern Sea Route B and by 90% in the case of Southern Sea Route B. This figure is 25% and 45% respectively in coastal waters and the Voordelta. A few hectares are involved. After 1 tidal period, visibility will have increased again by a factor of 13. After 2 to 3 tidal periods the effect will have disappeared completely.

The effects on the seawater of the reasonable alternative techniques do not differ significantly from the basic design. If we assume a different burial scenario in which more dredging operations are required, the effects on the seawater will increase as a result of the seabed being churned up. The “40 years no maintenance” scenario gives an extreme value of 520 mg/l in places in the area of the North Sea alongside the southern route(s). This value will have dropped to 18 mg/l within 1 tide. Even these values are negligible compared with the natural dynamics of the North Sea. After a short time, this purely localised effect will have disappeared completely, even assuming the maximum dredging scenario.

Effects on groundwater and surface water
The installation operations on land will have no effect at all on the groundwater and surface water at the site of the cable route and the converter station on the Maasvlakte.

5.2.4 Energy effects

Magnetic fields at sea
The unit of measurement for magnetic fields is µT, or micro Tesla. The magnetic background field of the earth in the area of the BritNed interconnector is estimated at 50 µT. The magnetic field magnitudes around the BritNed cable are in the order of magnitude of the natural background values and do not vary between the alternative routes. Moreover, the field magnitudes decline rapidly the greater the distance from the cable, from 72 µT at 1 metre from the cable to 2.2 µT at 5 metres from the cable. The prerequisite for this is that the two cables are bundled together and the distance between the cables does not exceed 20 centimetres because the magnetic field of one cable largely neutralises the field of the other cable. The effects of the "monopolar operation" alternative are the same as the effects of the basic design for "bipolar operation".

The magnetic fields of the "cable distance 0.5 to 2 metres" alternative are to some extent bigger than in the case of the basic design. At 5 metres' distance from the cable the field magnitude in this situation is 21 µT, whereas at 1 metre it is 310 µT. However, this does not lead to a different conclusion in terms of the alternative routes.

On land, the cables will be laid in a trench about 50 centimetres apart. The magnetic field magnitudes will then be somewhat greater than in the case of the submarine cable, i.e. 5 µT at 5 metres from the cable and 74 µT at 1 metre from the cable. By way of comparison, the limit for continuous exposure recommended by the Health Council of the Netherlands is 40,000 µT.

Induced electrical fields
The unit of measurement used for electrical fields is µV/m, or microvolts per metre. Induced electrical fields are created when seawater flows through the cable's magnetic field. This effect does not therefore occur on land. The magnitude of the natural electrical field in the vicinity of the BritNed interconnector is approximately 39 to 42 µV/m. However, the natural electrical field magnitude is variable and can reach values of 2,500 – 3,500 µV/m in areas with strong tidal currents. At 5 metres from the cable the induced electrical field magnitudes are smaller than the background value by more than a factor of 10. Where two cables are bundled together the induced electrical field is 1.9 µV/m, whereas at a distance of 1 metre from two cables laid 2 metres apart it is 260 µV/m. The electrical fields of the converter station will remain within the boundaries of the site.

Transport losses and heat development
Small energy losses occur when electricity is transported. With the chosen design, the transport losses of the BritNed interconnector in both the basic design and the technical option alternatives are very small: about 2%. By way of comparison, for an AC voltage interconnector of the same capacity and length over land it would be about 4%. The

longer the cable interconnector becomes, the greater the increase in transport losses. The total length of Northern Sea Route B, from coast to coast, is longer than that of the southern sea routes. The energy loss on the northern sea route is therefore somewhat greater, i.e. 10% to 15% more than the southern sea routes.

The limited amount of energy lost is converted to heat. The effects of this heat development on the seabed have been estimated in the EIS, based on the assumption that the cable has been laid under a 1-metre thick layer of sand. Most bottom-dwelling animals are found in the top layer of the seabed. The presence of the cable will increase the local temperature around the cable by an average of $5{,}5^0$ in the top 30 centimetres of the seabed. The temperature of the seabed directly on the surface will remain the same as the temperature of the seawater, as the seawater quickly dissipates the heat.

The impact on the temperature of the seabed will be small, very localised and not be used as a factor in deciding on alternative routes. The effects of the alternative technical options (monopolar operation, cables 0.5m to 2m apart) will be similar. Although the potential heat development is generally greater in the case of bundled cables, the cable design takes this into account.

The heat loss in the terrestrial cable will be similar to the submarine cable. In a worst-case scenario, the temperature of the soil directly round the cable may be about 32.5^0 at a depth of 1 metre. The heating of the soil will be barely perceptible by the time it reaches the surface. If necessary, special filling sand will be used in the cable trench to improve thermal conduction.

5.3 Sound

The sound of the installation work

The sound contours of the installation work are indicated in Maps 10.14 to 10.20 in the map appendix. The contours indicate the area within which temporary sound disturbance may occur. Three contours have been indicated in each case. The 40 dB(A) contour is the strictest contour and only relevant to quiet nature reserves. The 50 dB(A) contour is relevant to areas affected by human activities, such as the immediate vicinity of the Maasvlakte. The 60 dB(A) contour is mainly relevant to areas in which the sound level is naturally very high, such as the beach close to the breakers. The extent to which birds and seals will be disturbed by the sound and visible presence of people and equipment is described in section 5.4.

The sound of maintenance work, any repairs and the removal of the cable will be similar to the sound of the installation work. The alternatives to the design, the configuration and the installation technique will have little bearing, if any, on the sound level. An exception to this is the work involved in some of the alternative land routes, which may require additional drilling.

The sound of the installation work at sea

The sound of the work to be carried out at sea and in the Voordelta will be caused by the ships and will be temporary and very localised. Because the North Sea and the Voordelta are subjected to wind and waves and daily shipping traffic, this sound is unlikely to cause additional disturbance. In the Voordelta, sufficient distance will be maintained from seal colonies to be able to rule out any disturbance.

The process of determining the sound and the sound pressure under water is more complicated than above water. A special “transitional model” has been developed for the EIS to allow the impact under water to be determined as accurately as possible. Section 5.4 provides an indication of what the ecological impact will be.

There will be only minor differences between the alternative routes at sea in terms of the sound both above and under water as the installation equipment will not vary from route to route. It can however be assumed that the protected Voordelta, which will be transected by the southern sea routes, is a quieter area of the sea than the part of the coastal waters traversed by Northern Sea Route B.

The sound of installation work during landfall and on land
The sound of the installation work during landfall will, depending on the route, cause temporary and localised disturbance of a number of small nature reserves in the area around the Maasvlakte, some of which also have a recreational function. The target value for the sound level in nature reserves and wildlife sanctuaries is 40 dB(A). However, it is known that the background level in the nature reserves south of the Maasvlakte is significantly higher than this 40 dB(A) level. Sound measurements specially conducted for BritNed show that only the areas in the lee of the dunes have a sound level of about 40 dB(A). For the Voordelta it can also be assumed that the background level, under the effect of wind and waves, is somewhat higher than 40 dB(A). Nevertheless the EIS contains calculations of the area of the nature reserves at sea and on land within the 40 dB(A) contour – as a worst case scenario and as a measure for comparing the alternatives.

A few kilometres from the landfall site of Northern Sea Route B is the Kapitelduinen dune conservation area. The sound of the installation work, i.e. the dredging in the Meuse estuary, will not extend so far that it will disturb the peace in the dunes of the Kapitelduinen area. There is a strip of dunes known as Zuidwal on the north side of the Maasvlakte. However, in this small strip of dunes on the Maasvlakte there will be temporary disturbance caused by the sound of the installation work for the northern route.

An area of a few kilometres round the landfall site for the southern routes contains the Voordelta, the Voornes Duin habitats directive conservation area and the Voornes Duin wildlife sanctuary. In the area surrounding De Slufter contains smaller nature reserves such as De Kleine Slufter, Westplaat, Vogelvallei and a lake in the Hartel corridor (see Map 9.6 in the map appendix). The sound calculations show that the Voornes Duin area will not suffer any noise disturbance due to the installation work for the landfall. However, a small part of the Voordelta and the other small nature reserves will have to cope with a temporary increase in the sound level.

Most of the sound emitted by the installation work on land will come from the excavation of the cable trench. The disturbance caused to the surrounding nature reserves by this work for both the northern and the southern land route(s) will remain within the area which will also be temporarily disturbed by the landfall operations.

However, in the case of a southern land route, additional work will be required in some places which could result in additional sound production, such as the crossing of wide areas of infrastructure. Maps 5.5 to 5.8 in the map appendix show the alternative land routes that require this drilling operation and the site concerned. As far as the basic design is concerned, the “southern land route cable/pipeline corridor east” is not expected to require drilling operations.

The temporary disturbance of surrounding small nature reserves will have least impact in the event of a northern landfall and a northern land route. This is mainly because, irrespective of landfall technique, the landfall of the southern sea routes will require sheet piling to be driven in and there are more nature reserves in the area around the southern landfall location and land routes. However, the disturbance will be temporary and very localised and will not affect any wildlife sanctuaries or nature conservation areas.

The sound from the converter station and any cooling station
The Maasvlakte is zoned as an industrial estate. A maximum permissible value of 50 dB(A) per 24-hour period for all the activities combined is applicable at the boundaries of the sound zone. This sound zone only applies to permanent sound-emitting installations. The only permanent sound-emitting installations to be constructed for BritNed will be the converter station and, if necessary, a cooling station. The sound emitted by these installations will not exceed the permissible 24-hour value at the established zone boundary. This means that the operation of the BritNed interconnector will not result in any impacts in terms of sound, irrespective of the route.

5.4 Ecological effects

5.4.1 General

The physical effects of the planned activity have been described above. They are minor effects that occur in an area of sea or land which is constantly under the influence of natural processes and human activities. The ecological effects are found lower down the effect chains. The impact prediction shows that, despite worst case assumptions, these ecological effects also fall within the natural dynamics of these processes and, for this reason, are barely perceptible, if at all. There are therefore no major differences between the alternative routes.

Tables 5.3 and 5.4 provide a summary of the ecological impacts of the basic design of the BritNed interconnector. The alternative techniques that could reasonably be considered for the design and configuration of the interconnector have a limited effect, if any, on the ecological impacts. Even the differences between the alternative Southern Sea Routes (A2, B and C) are minimal. Alternative installation techniques, particularly on land, could however have different impacts. Where relevant, this will be briefly stated.

Effects due to installation and operation of the cable at sea and on landfall
Provided they are carried out in the right seasons, the installation operations at sea and on landfall will have negligible effects on the natural values of the North Sea, Voordelta (including the marine reserve exploration zone) and coastal zone. This is mainly because the effects only occur on a very localised scale, are temporary (days to weeks) and have little impact on areas with specific natural values or protected species. A comparison of the alternatives does however show that the effects of the Southern Sea Routes (A2, B and C) will be similar to the effects of the northern sea route, provided that mitigation measures are taken to avoid disturbing breeding birds. The operation of

the BritNed interconnector is not expected to have any effects either. The electrical and magnetic fields around the cable will be limited and are generally within or in the region of local background values.

Ecological effects	**The effects have been established on the basis of**		**Northern Sea Route B**	**Southern sea routes**
Death of bottom fauna	Ecological function	Groups of species	Negligible	Negligible
Food supply for birds	Species diversity	Foraging birds	Negligible	Negligible
Primary production	Ecological function	Relative change	Negligible	Negligible
Disturbance of fish, birds and marine mammals	Species diversity	Fish	Negligible	Negligible
		Foraging birds	Negligible	Negligible
		Breeding birds	Negligible	To be mitigated
	Protected species	Thwaite, sea lamprey	Negligible	Negligible
		Marine mammals	Negligible	effect mitigatable
Orientation of fish and marine mammals	Species diversity	Fish	Negligible	Negligible
	Protected species	Thwaite, sea lamprey	Negligible	Negligible
		Marine mammals	Negligible	Negligible
Prey detection and orientation of fish	Species diversity	Cartilaginous/bony fish	Negligible	Negligible
	Protected species	Thwaite, sea lamprey	Negligible	Negligible

Figure 5.3 Summary of ecological effects of basic design on sea and on landfall.

Ecological effects	**The effects have been established on the basis of**		**Land route for northern landfall**	**Land route for southern landfall**
Death of fauna in/on bottom	Protected species	Mammals Natterjack toad Other amphibians	Negligible Negligible Negligible	Negligible To be mitigated Negligible
Change in vegetation	Ecosystem diversity	Types of ecosystem	Negligible	Negligible*
Biotope change for fauna, birds and mammals	Species diversity	Higher plants Sand lizard	Negligible Negligible	Negligible* Negligible*
	Protected species	Sand lizard	Negligible	Negligible*
Disturbance of fauna, birds and mammals	Protected species	Foraging birds Breeding birds Natterjack toad	Negligible Negligible Negligible	Negligible To be mitigated Negligible
	Species diversity	As above	Negligible	Negligible
Death of fauna in/on bottom	Protected species	Mammals	Negligible	Negligible
Disturbance of fauna, birds and mammals	Species diversity	Foraging birds	Negligible	Negligible
Loss of area for types of ecosystem	Ecosystem diversity	Types of ecosystem	Slightly negative	Slightly negative
Loss of biotope for	Protected species	Mammals	Negligible	Negligible

species	Species diversity	Higher plants Breeding birds	Slightly negative Slightly negative	Slightly negative Slightly negative

* Depends on the development and completion of De Slufter

Figure 5.4 Summary of ecological effects of basic design on and near land.

Effects due to installation and operation of the cable on land
The work on land, provided that it is carried out at the right time in the season, will generally have only very minor effects on natural values. Effects on protected species of amphibians and mammals will to a large extent be prevented by taking the correct precautionary measures and will be negligible owing to the limited scale of the work in relation to the available biotopes. The assessment of the effects of the southern land routes on natural values will in any case depend on the development of De Slufter. If it is re-established as a nature reserve as far as the route of the BritNed interconnector, the cable will in fact pass through a future nature reserve. Depending on the planned ecosystem, it could have an effect on certain types of ecosystem and species such as the sand lizard, which will then be able to become established there.

Effects on valuable breeding birds in the study area will be avoided by working outside the breeding season. In the northern land route, any effect on the dotterel can also be avoided by working before mid-August or after September. During construction of the southern land routes, there may be temporary disturbance of foraging coastal birds on the mud flats of the Brielse Gat. When viewed over a year, these effects are negligible in relation to the total number of specimens of the various species in question living on the Brielse Gat as a subregion and the Voordelta as a whole; moreover the effect will generally only occur once or twice (during installation and possibly to some extent during removal). No effects are expected as a result of operating the cable.

5.4.2 Ecological effects due to bottom disturbance at sea

Removal and burial of benthos and fish
Calculations have been made in the EIS of the surface area of seabed that will be disturbed by operations to level sand waves and bury the cable. In places, the result of these operations is that animal species that find it difficult to move away from the seabed are removed. The same applies to fish larvae that live in the seabed. The area of disturbed seabed will be negligible in relation to the total habitat of the benthic communities concerned. The figure is 0.02% for both routes at sea and 0.05% where the southern sea routes cross the Voordelta.

Hindrance to visual predators
A number of fish and bird species that hunt “by sight” are present along the cable routes. Turbidity reduces visibility temporarily and locally in seawater (see Section 5.2). None of the alternatives resulted in any reduction in visibility after a few tidal cycles. The average reduction in visibility for all the alternatives will be so low and localised that no decisive effects on visual predators can be expected. Where these species already suffer disturbance, they may be expected to move their hunting ground for this reason.

Reduction in primary production
Among other things, the primary production of organic material at sea requires sunlight. Any turbidity of the seawater can reduce primary production. Calculations in this regard

have been carried out in the EIS. The reduction in primary production compared with production throughout the study area immediately after the sediment will be, for the southern sea routes, 2.6% in the basic design, 1.2% for the scenario involving minimum dredger deployment and 5.5% in the scenario involving maximum dredger deployment (the 40-year burial scenario). After a single tidal period the effect will have diminished by a factor of 5 to 25. For Northern Sea Route B the reduction will amount to 1.3% in the basic design, 0.7% for the scenario involving the minimum of dredging and 2.9% in the scenario involving the maximum of dredging. After a single tidal period the effect will have diminished by a factor of 7 to 13. Over the total growing season (approx. 400 tidal cycles) the effect will be negligible for both routes.

5.4.3 Ecological effects due to disturbance at sea

Effects on birds and seals
The presence and noise of people, ships and other installation equipment are a potential source of disturbance for susceptible species. Many disturbance-causing human activities already take place along both routes, including shipping, recreation, sand extraction and, within the next few years, the expected construction of Maasvlakte 2. Current and future coastal shipping movements along Northern Sea Route B are more frequent than is the case with the southern sea route(s).

More birds are present near the landfall location for the southern sea routes than is the case with the northern sea route. Seal colonies are also present. Foraging and overwintering birds are mobile and, in view of the short duration and localised nature of the disturbance, they may move temporarily to other sites in the Voordelta. Moreover, the work carried out at sea will not be taking place during the period when foraging and overwintering birds at sea are at their most vulnerable and numerous (autumn and winter) because the weather makes it impossible to work then. Possible negative effects on breeding birds and seals along the southern sea routes will be avoided by having the work take place outside the breeding season for birds and choosing a landfall route as far north as possible, more than 1,200 metres from the seal colonies. Southern Sea Routes A2, B and C have been designed accordingly.

Effects caused by underwater sound
At a distance of 400 metres, the installation work will produce what is known as a broadband sound level which is far below the level at which harm is caused to fish and marine mammals. Harm could be caused in the immediate vicinity of the work. Fish and marine mammals are expected to avoid areas with increased sound levels as they will have an avoidance zone of about 500 metres around the sound source. In the low-frequency range, to which seals in particular are sensitive, the sound level of the work will be somewhat higher than the background sound of shipping. The masking of sounds that the seals themselves make will therefore rarely occur because of the temporary nature of the work.

5.4.4 Ecological effects due to energy effects at sea

Effects of magnetic and electrical fields on fish and other fauna
The magnetic field round the cables will be kept to a minimum because the cables will each generate an opposite field and be laid next to each other. There may be a weak

induced electrical field for a short distance around the cables. Cartilaginous fish (sharks and rays) are able to discern these fields and could, as a result, be hindered locally, close to the cable, when detecting their prey. It is not known whether the sea lamprey or its guidance system (based on an electrical field that it generates itself) can be disturbed. Because of the localised nature of the disturbance, the sporadic occurrence of the species concerned in the study area and their wide range of distribution, no effects on population levels are expected. Likewise, no effects on other fauna, including bottom-dwelling fauna, seabirds and seals are expected.

Effects due to heating of the seabed
The heating of the seabed is so localised and limited that it will have no effect on the species composition and, in the light of the overall ecosystem, can even be disregarded.

5.4.5 Ecological effects due to disturbance on land

Effects on birds
Breeding birds may be disturbed by the installation work on land and near the landfall. The possible effects on breeding birds mainly relate to the land routes situated around the Slufter dykes (see Maps 4.10 and 9.6 in the map appendix). The effects on breeding birds will however be avoided by not carrying out disturbance-causing work outside the breeding season.

The effects on non-breeding birds that stay south of the southern land routes in the coastal zone and on the mudflats have also been determined in the EIS. Divers and ducks are so far away from the routes that no effects are expected on these species. For foraging waders, the mudflats are important all year round. It has been calculated that the maximum effect of disturbance due to sound amounts to about 0.3% of the total (in bird days). This effect is considered negligible.

Near the Northern land route is a stopping place for the rare and strictly protected dotterel, a species which is not very sensitive to disturbance. Effects can be avoided by working before mid-August or after September.

If the proposed mitigation measures are implemented, it is safe to conclude that the differences in disturbance between the alternative locations and techniques for the landfall and the land route will be negligible.

Effects on the Natterjack toad
The southern land routes will pass through a possible overwintering area for the Natterjack toad. Individual specimens may be killed by excavation work. Animals will therefore be trapped and removed elsewhere before work starts and the work sites will be sealed off by barriers to prevent the animals from burrowing in. In view of the very small scale of the work and the high reproduction rate of this pioneer species, any negative effect on its healthy state of preservation can therefore be ruled out.

Effects on vegetation and biotope loss
The vegetation growing alongside the various land routes is similar in terms of type and development. The northern and western land routes are the shortest and therefore more suitable than the southern land routes. Damaged vegetation will recover within a few seasons, except where dry grassland vegetation is replaced by fast-growing species. At the site of the converter station there may be a loss of 4 ha of moderately developed dry

grass lands which function as a biotope for some endangered species and protected mammals in general. This effect is considered slightly negative. The effect of any cooling station will be negligible because the site required for such a station would be many times smaller.

5.5 Effects on other users and land uses

General
The installation and presence of the BritNed interconnector may have minor effects on other users in the study area at sea and on land. These effects will be related to the location of the alternative routes. Table 5.5 shows the land uses for which the effects of the BritNed interconnector are described and the uses for which these effects are to some extent decisive. In all cases, these are very limited and often temporary effects which can also be easily mitigated.

Land use	**Effects, after mitigation**	**Decisive?**	**Preferred route?**
Sand and gravel extraction	Depends on the route	Yes	Southern sea routes
Spoil spreading	None	No	None
Oil and gas extraction	Depends on the route	Yes	Southern sea routes
Cables and pipelines at sea	Depends on the route	Yes	Southern sea routes
Archaeology and cultural history	Very limited	No	None
Shipping and navigation	Limited	Yes	Southern sea routes
Fishing	None	No	None
Harbour development at sea	None	No	None
Military activities	None	No	None
Wind energy	None	No	None
Recreation	Very limited	Yes	Northern Sea Route B
Landscape	No	No	None
Cables and pipelines on land	No	No	None
Harbour development on land	Depends on the route	Yes	Avoid Distripark
Safety and health	No	No	None

Figure 5.5 Effects on other land uses and users

Sand and gravel extraction, spoil spreading sites
Both the northern sea route and the southern sea routes traverse the exploration zone for sand extraction for Maasvlakte 2, but the space required by the cable in this exploration zone is minimal, i.e. not more than 1.25%. However, Northern Sea Route B crosses another possible future sand extraction site to the northwest of the Maasvlakte. In view of the very limited effects – a maximum space requirement of 5% - there is a slight preference for the southern sea routes. Neither route will have any effect on active sand extraction sites as they were avoided when the routes were being developed. The planned activity will have no effect on spoil spreading sites in the North Sea.

Oil and gas industry, cables and pipelines
The BritNed interconnector will have no effect on existing oil and gas platforms in the North Sea. Northern Sea Route B will however have an effect on future development options for (new) oil and gas fields and on cables and pipelines on and to the north of the Maasvlakte. In coastal water, Northern Sea Route B is in a sea area containing

many other functions, including spoil spreading, sand extraction, oil and gas extraction, cables and pipelines. It is therefore impossible to maintain the desired distance of 500 metres from most of these functions, with the exception of oil and gas platforms. If the BritNed cable is laid on Northern Sea Route B, there will be no space left to bring new oil and gas pipelines ashore on the Maasvlakte. The southern sea routes are preferred from the point of view of minimising nuisance and keeping development options open for activities north of the Meuse estuary.

In order to ensure the efficient use of space, Northern Sea Route B will be combined with 2 existing pipelines in coastal waters. There are no cables or pipelines close to the southern sea routes with which they could be combined

Archaeology and cultural history
Both alternative routes have limited impacts on areas in the North Sea in which rich archaeological values could be anticipated. The space that would be occupied by Northern Sea Route B in areas with a potentially rich value is estimated at about 3.5 ha. For the southern sea routes this would range from 5.5 ha (Sea Routes A2 and B) to 7.5 ha (Sea Route C). This is negligible in relation to the total size of the area. Disturbance of archaeological, cultural and historical relics in clay and peat layers in the seabed is not expected to arise since these relics are found at greater depths than the burial depth of the cable (maximum: 3 metres). Moreover, both routes have been adjusted to take account of the location of shipwrecks, which were detected in advance by means of research. The installation of the interconnector in any of the alternative routes will not therefore have any negative effects on shipwrecks. In the unlikely event of a previously undetected shipwreck being encountered, the route will be diverted accordingly, provided that this does not adversely affect the installation procedure. Underwater cameras can also be used, the images from which can, for example, be made available to the Dutch National Service for Archaeological Heritage (*Rijksdienst voor Oudheidkundig Bodemonderzoek,* ROB). Consideration could also be given to working with the ROB on producing an installation protocol.

Shipping and navigation
Magnetic fields may cause compasses to deviate. The magnetic fields around the cables will – provided that they have been bundled – be so small that compass deviation will for the most part remain below 5^0. It is only where the cables are not bundled and are laid 0.5 to 2 metres apart, that the deviation may be greater in areas of shallow water. However, there is hardly any shipping in these areas. The differences between the two routes are minimal in this respect.

As far as crossing shipping areas is concerned, Northern Sea Route B will cause the most nuisance to shipping. This route crosses 4 shipping areas (see Maps 10.9 to 10.11 in the map appendix). Most nuisance is expected during the crossing of the Meuse estuary because dredging in the Meuse estuary takes four to five months and this is an area of high shipping intensity. The southern sea routes cross 2 shipping areas, of which only 1 has high shipping intensity.

The risk of collision is therefore greater on Northern Sea Route B. The overall risk of collision on Northern Sea Route B is about 0.0017 and for the southern sea routes 0.0011[6].

Fishing
Both the southern sea routes and Northern Sea Route B traverse important areas for commercial fishing. The nuisance to fishing relates to a prohibition zone for other vessels that would be placed around the cable installation site. This nuisance would be very temporary and localised. The area around the southern sea routes is subject to more intensive fishing than the area around Northern Sea Route B. However, the possible nuisance can be easily mitigated, so that compensation is not required. Moreover, plans to keep fishing out of the Voordelta are at an advanced stage. Because the cable will be buried at a sufficient depth, it will still be possible to fish above the cable.

Seaward harbour development
Neither of the alternative routes will have any effect on the options for seaward harbour development. Both Northern Sea Route B and the southern sea routes avoid the exploration zone for Maasvlakte 2 wherever possible. To avoid disturbing seals, the southern sea routes will lie in the extreme south of the exploration zone for Maasvlakte 2. As a result, part of the cable may be laid under the outermost soft sea defences of Maasvlakte 2. The is acceptable to both sides.

South of the exploration zone for the Maasvlakte is an exploration zone for a marine reserve, which is intended as compensation for Maasvlakte 2. The southern sea routes will inevitably cross this area. However, a route has been found within this exploration zone which will have the minimum effect on nature and the environment. The result of this is that no significant effects will arise in the exploration zone for the marine reserve as a result of the installation and presence of the BritNed interconnector. For this reason, there is not expected to be any hindrance to the establishment of the marine reserve.

Military exercise zones
Military exercise zones and areas used for the destruction of explosives will be avoided by both Northern Sea Route B and the southern sea routes.

Wind energy
On land the BritNed cable will not constitute a hindrance to existing or the establishment of future wind farms. At sea, however, allowance has to be made for new initiatives. The rate at which new wind farms are created at sea and the locations of the farms are not yet known. Although it is still by no means certain that all the initiatives will reach the development stage, more account must be taken of the fact that in the decades to come an average of one landfall per year will take place in the coastal area north of the Meuse estuary. Factors such as the totally different nature of the wind farm interconnectors – relatively light, integrated AC cables – preclude the possibility of connecting to the BritNed interconnector.

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[6] This is the risk of a collision during the 268 hours of the installation, which means that about 1 collision can be expected for every 1,000 identical installations.

Recreation and landscape
The presence of the cable will not place any restrictions on holidaymakers. Its installation and any maintenance, repairs and removal may however do so, especially when it makes landfall on the beach at De Slufter. This nuisance would be temporary and partly mitigatable. The routes do not differ either in terms of the landscape. The cables are not a visible part of the landscape and the converter station will be fully in keeping with the surrounding industrial premises and utilities on the site.

Cables and pipelines on land
The installation of the BritNed cable on the Maasvlakte will not cause any problems for existing and future cables and pipelines. The preferred option is to install the BritNed interconnector in the purpose-built cable/pipeline corridor alongside the N15 motorway. The design – and maintaining adequate distances – will prevent any impact on other infrastructure caused by magnetic fields, leakage currents and heat development. These distances have been calculated in advance and agreed in advance with the port authority. Within the cable/pipeline corridor, the preferred option is a cable route on the east side of this corridor, bundled with other electrical infrastructure. In the opinion of the port authority, a cable in the middle of the corridor – where no pipelines have yet been laid – or on the west side of the cable/pipeline corridor – where there are mostly pipelines – would result in an inefficient use of space.

Harbour development on land
To make landfall on the north of the Maasvlakte, only one alternative land route can be considered. This northern land route crosses an area where a new harbour entrance has been planned from the current Maasvlakte to Maasvlakte 2 (extended Yangtze harbour). The possible presence of an installed cable on this site would mean that it would have to be removed again and laid over the new outer contour of Maasvlakte 2 or under the new harbour entrance.

To make landfall on the south of the Maasvlakte a number of land routes can be considered. In the event of a land route along the south of De Slufter and then in or alongside the cable/pipeline corridor to the converter station, there is no question of an effect on the harbour developments. The disadvantage of this western land route is possible interference with the construction of Maasvlakte 2, the need to cross the Hartel corridor where future infrastructure is planned and the possible need to cross the Distripark which is being expanded as part of Maasvlakte 2. The disadvantage of the alternative “zigzag land route” is that this route also crosses the Hartel corridor.

Safety and health
The cable generates magnetic fields. The deeper the cable is buried, the lower the field magnitude at the earth’s surface. On land, the cables will be buried 1 metre deep. Calculations show that even at a burial depth of 0.5 metre the result comes nowhere near the maximum exposure limit set by the Health Council of the Netherlands.

Because the cable is buried at a sufficient depth and protected, it is impossible for people, including holidaymakers to come into contact with the cable. Damage to the cable, e.g. caused by excavation work or heating, is highly unlikely but has been taken into account for safety reasons. Any damage can cause a short circuit, when some of the current will leak away to the earth. This will be recorded immediately by an earth leakage system, which shuts off the power automatically. It is similar to an earth leakage circuit-breaker in someone’s home. The device has been designed so that short circuits last no longer than 150 milliseconds.

The BritNed interconnector including the converter station is not a system that produces toxic substances, chemical reactions, high pressures or high temperature. Moreover, the cables do not run close by installations or infrastructure with a specific external safety risk. The only place where personnel will be present on a regular basis is the site of the converter station. However, the converter is not within the 10^{-6} individual risk contour of the nearest installation with an external safety contour (Lyondell).

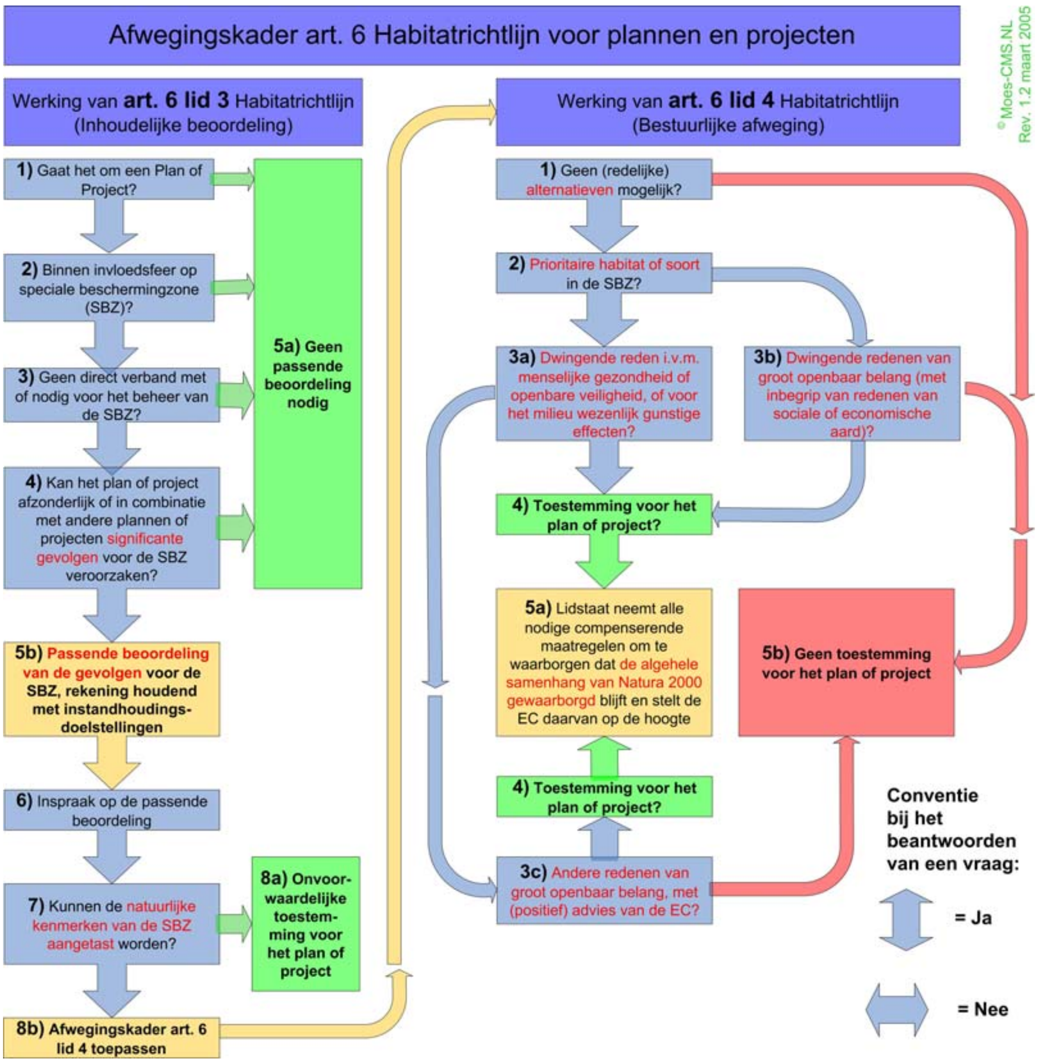
6 ASSESSMENT ACCORDING TO POLICY AND LEGISLATION

6.1 General

The EIS contains a very extensive overview of all regulations and legislation with which the construction and use of the BritNed interconnector must comply. An overview is also included of all policy frameworks that have to be taken into account. This section will demonstrate that the intended activity will comply with all legislation and regulations, as well as all policy frameworks.

6.2 Nature policy and legislation

Bird and Habitat Directives
The European Bird and Habitat Directives arrange the protection of valuable areas and species. In assessing whether a project that encroaches on a Bird and Habitat Directives area is allowed, a number or procedural steps have to be followed. These are indicated in figure 6.1.



Dutch	English
Afwegingskader art. 6 Habitatrichtlijn voor plannen en projecten	Art. 6 of the Habitat Directive framework assessment for plans and projects
Werking van **art. 6 lid 3** Habitatrichtlijn (Inhoudelijke beoordeling)	Operation of **Art. 6, par. 3**, of the Habitat Directive (content assessment)
1) Gaat het om een Plan of Project?	**1)** Is it a plan or a project?
2) Binnen invloedsfeer op speciale beschermingzone (SBZ)?	**2)** Within the sphere of influence of special protection zone (SPZ)?
3) Geen direct verband met of nodig voor het beheer van de SBZ?	**3)** No direct relationship with or necessary for the management of the SPZ?
4) Kan het plan of project afzonderlijk of in combinatie met andere plannen of projecten significante gevolgen voor de SBZ veroorzaken?	**4)** Can the plan or project have significant consequences for the SPZ, either separately or in combination with other plans or project?
5a) Geen passende beoordeling nodig	**5a) No fitting assessment necessary**
5b) Passende beoordeling van de gevolgen voor de SBZ, rekening houdend met instandhoudingsdoelstellingen	**5b) Fitting assessment of the consequences for the SPZ, taking account of conservation objectives**
6) Inspraak op de passende beoordeling	**6)** Participation in the fitting assessment
7) Kunnen de natuurlijke kenmerken van de SBZ aangetast worden?	**7)** Can the natural characteristics of the SPZ be harmed?
8a) Onvoorwaardelijke toestemming voor het plan of project	**8a) Unconditional permission for the plan or project**
8b) Afwegingskader art. 6 lid 4 toepassen	**8b) Apply Art. 6, par. 4, framework assessment**
Werking van **art. 6 lid 4** Habitatrichtlijn (bestuurlijke afweging)	Operation of **Art. 6, par. 4**, of the Habitat Directive (management assessment)
1) Geen (redelijke) alternatieven mogelijk?	**1)** No reasonable alternatives possible?
2) Prioritaire habitat of soort in de SBZ?	**2)** Priority habitat or species in the SPZ?
3a) Dwingende reden i.v.m. menselijke gezondheid of openbare veiligheid, of voor het milieu wezenlijk gunstige effecten?	**3a)** Urgent reason in connection with human health or public safety, or for essentially favourable effects for the environment?
3b) Dwingende redenen van groot openbaar belang (met inbegrip van redenen van sociale of economische aard)?	**3b)** Urgent reasons of great public importance (including reasons of a social or commercial nature)?
4) Toestemming voor het plan of project?	**4) Permission for the plan or project?**
5a) Lidstaat neemt alle nodige compenserende maatregelen om te waarborgen dat de algehele samenhang van Natura 2000 gewaarborgd blijft en stelt de EC daarvan op de hoogte	**5a)** Member state adopts all required compensating measures to ensure that the total cohesion of Natura 2000 remains guaranteed and notifies the EC of such
5b) Geen toestemming voor het plan of project	**5a) No permission for the plan or project**
4) Toestemming voor het plan of project?	**4) Permission for the plan or project?**
3c) Andere redenen van groot openbaar belang, met (positief) advies van de EC?	**3c)** Other reasons of great public important, with positive advice from the EC?
Conventie bij het beantwoorden van een vraag	Convention when answering a question
=Ja	= Yes
=Nee	= No
© Moes-CMS.NL	© Moes-CMS.NL
Rev.1, 2 maart 2005	Rev.1, 2 March 2005

figure 6.1 Assessment framework, Article 6 of the Habitat Directive.

Flora and Fauna Act (species)

In the Netherlands, the protection of species in accordance with the Bird and Habitat Directives is enshrined in the Dutch Flora and Fauna Act [*Flora- en faunawet*]. The protection consists of a general ban on the destruction of plant species and the killing and disturbance of animal species. The Act makes a distinction between species for which the strictest requirements apply and other protected species. As regards species subject to the strictest protection, the ban provisions may only be lifted for specifically stated purposes, for which, moreover, no alternatives exist. In addition, nothing may be done to upset the 'favourable state of conservation' of the species in question. An exemption cannot be granted for disturbing birds in the breeding season.

Nature Conservation Act (reserves)
The current Dutch Nature Conservation Act [*Natuurbeschermingswet*] arranges the protection of nature reserves. Although other wording is used, this protection is more or less similar to the protection of Bird and Habitat Directives areas. In order to arrange the protection of Bird and Habitat Directives areas in Dutch legislation, too, the Nature Conservation Act has been amended. However, the amended Act will take effect only from 1 October 2005. At the time when the EIS was submitted [August 2005], the Habitat Directive European legal assessment framework applied (see figure 6.1). For that matter, the amended Nature Conservation Act will also have to comply with that assessment framework.

Ecological Main Structure and North Sea Phased Plan
Habitat Directive areas, Bird Directive areas and nature reserves are part of the ecological main structure (EMS) [*ecologische hoofdstructuur in Dutch*], a cohesive network of nature reserves in the Netherlands. Other areas, e.g. large stretches of water like the North Sea, are also included in the EMS. The EMS protection policy is arranged in the Dutch National Policy Document on Spatial Planning [*Nota Ruimte*]. The policy focuses on the conservation, restoration and development of the essential characteristics and values of the protected areas. Projects and plans in or in the vicinity of the EMS are subject to what is termed the 'no, unless' regime. This means that projects in or in the vicinity of the EMS are not permitted unless they meet certain conditions.

With regard to the North Sea, a separate assessment framework has been included in the National Policy Document on Spatial Planning and the Dutch Comprehensive North Sea Management Plan 2015 [*Integraal Beheerplan Noordzee, IBN, 2015*] for granting permits for plans and projects in the North Sea: the North Sea Phased Plan [*Stappenplan Noordzee*]. All alternatives which could be reasonably considered, as well as the manner in which these have been developed, comply with this phased plan.

According to the National Policy Document on Spatial Planning, that part of the North Sea that is shallower than 20 metres, the coastal waters, has exceptional ecological value. The National Policy Document on Spatial Planning therefore includes a separate assessment framework for the coastal waters. Consequently, the assessment and effect forecasts in the EIS take separate account of the coastal waters[7].

6.2.1 Assessment according to a bandwidth of effects

Obligatory European tendering
During the development of route alternatives and the choice of technology for the BritNed interconnector, considerable allowance was made for the policy frameworks for

[7] In the Comprehensive North Sea Management Plan 2015, the area of the coastal waters for which specific planning protection applies is defined in more detail. This shows that the part of the coastal waters through which the Northern Sea Route B runs enjoys no specific protection. At the time when the EIS was drawn up, this was not yet known. For this reason, the Northern Sea Route B, too, was assessed in accordance with the specific assessment framework for the coastal waters.

the North Sea and the forms of land use and values. At the time when this EIS was drawn up, however, the definitive detailed design of the cable interconnector had not yet been determined, because the decision to implement the interconnector can only be taken once the required permits have been obtained. Only then can tendering be initiated. The tendering of a project such as BritNed must comply with European regulations. That means that all companies that are able to perform the work are given the opportunity to make an offer. Every tenderer has its own knowledge, experience and machinery and equipment. As a result, the offers may differ as regards technique and costs.

Space for optimisation within the bandwidth of effects
Without wishing to express a preference in this respect, the most likely alternatives on each part of the BritNed interconnector (system, cable type, configuration and route) are designated as 'basic design'. As it is not the intention to exclude other alternatives in advance, all other alternatives that could be reasonably considered are described in addition to the basic design.

All elements from the basic design phase and the alternatives that could reasonably be considered have been optimised to such an extent, that the effects on nature and the environment will be minimal. However, it may be possible that during the tendering phase, the basic design phase is further optimised for technical and economic or other reasons. For this reason, alternatives and scenarios have been used in the EIS to map out a bandwidth of effects within which the effects of the final design must lie. However, the environmental effects may never exceed those of the alternatives examined within this EIS. For this reason, BritNed has elected to assess the entire bandwidth of effects according to legislation, regulations and policy.

Nevertheless, in order to meet the 'alara principle' (as low as reasonably achievable), the possibilities for limiting environmental effects as far as possible have also been indicated within the bandwidth of effects. For this purpose, an extensive list of mitigating measures has been included in the EIS.

6.2.2 Assessment according to nature policy and legislation

The effects of the intended actives on nature are described in paragraph 5.4. In order to assess whether these effects fit within the framework of nature policy and nature legislation, an investigation has been performed into the consequences of these effects for:

- the diversity of the ecosystem in the sea and on land;
- the diversity of the species in the sea and on land;
- the natural functioning of the ecosystem in the sea.

Important in this respect is the question of whether significant or noticeable consequences may ensue for protected species and nature reserves. If significant effects are involved, a supplementary assessment is required and the project will only be permitted if certain conditions are met.

Assessment of the southern sea and land routes
The Southern Sea Routes (A2, B, C) traverse the North Sea, the Voordelta (the coastal area off the islands of the Dutch provinces of Zeeland and Zuid-Holland) and the marine reserve exploration zone (see map 3.1 in the map appendix). The landfall and the alternative land routes are located along the Voordelta. The vicinity of the southern landfall and part of the southern land routes also contain the Voornes Duin Habitat Directive area. Table 6.1 contains an overview of the protection regimes for the areas along the southern sea routes, landfall location and land routes.

Area	**Protection regime**	**Assessment framework**
North Sea outside 12 mile zone	EMS	North Sea Phased Plan
North Sea within 12 mile zone	EMS Flora and Fauna Act	North Sea Phased Plan Flora and Fauna Act asses. framework
Voordelta	Bird/Habitat Directive EMS Flora and Fauna Act	Art. 6 Habitat Directive North Sea Phased Plan Flora and Fauna Act asses. framework
Marine reservation in the Voordelta	Not yet known	Not yet known
Maasvlakte	Flora and Fauna Act	Flora and Fauna Act asses. framework
External effect on Voornes Duin	Habitat Directive EMS Flora and Fauna Act	Art. 6 Habitat Directive EMS Nat. Policy Doc. on Spatial Planning Flora and Fauna Act asses. framework

table 6.1 Most important protection regimes and corresponding assessment frameworks of the areas along the southern sea and land routes.

An exploration zone has been set up in the Voordelta for the creation of a marine reserve as compensation for the construction of Maasvlakte 2. The southern sea routes traverse the most northern edge of this large exploration zone over a short distance. At present [August 2005], the management regime for the marine reserve is not yet known. When the exploration zone was created, the government indicated that activities resulting in quite substantial harm to the seabed, such as seabed trawling, will be excluded. Cables and pipes were not mentioned in this context.

- Diversity of ecosystems in the sea

The EIS contains quantitative estimates of the percentages of affected surface area of the nature and habitat types in the North Sea, the Voordelta and the marine reserve exploration zone. The maximum percentage of affected surface area is expected in the marine reserve exploration zone and amounts to 0.03% of the protected Habitat type 1110, or sandbanks permanently flooded by shallow seawater. This harm is very slight, temporary and concerns nature and habitat types that occur generally in the North Sea and the Voordelta. There is no significant effect involved. Other protected habitat types that are important for the Voordelta will not be affected or traversed.

Area	Consequences for diversity of ecosystem	Protected habitat types that are traversed	Nature types that are traversed	Max. temporary harm in %
North Sea	Temporary harm	-	Open sea	0.02
	Changing biotope	-	Open sea	<<0.01
Voordelta	Temporary harm	Type 1110	Underwater shore	0.02
Marine reservation exploration zone	Temporary harm	Type 1110	Underwater shore	0.03

table 6.2 Percentage of temporary and local harmed or changed habitat types / nature types with respect to the total surface for the Southern Sea Routes (A2, B and C).

Excavation work on land will result only in temporary harm to and change of vegetation. The construction of the converter station will result in the permanent loss of dry grasslands and brushwood. The vegetations affected are not designated as valuable in the nature policy. The loss of dry grasslands and brushwood is judged to be somewhat negative, but is certainly not significant. It should be noted in this respect that, except for the landfall, almost all affected land is already earmarked for infrastructure or utility companies and not for nature conservation or recreation.

- Diversity of species

The EIS contains lists of all protected animal and plant species that occur in the study area for the BritNed interconnector. These lists do not contain any priority species. Paragraph 5.4 of the summary indicates the influence of the construction work and the use of the BritNed interconnector for the protected species. Possible relevant effects of the construction and the use of the BritNed interconnector on protected animal species are disruption due to visibility, sound above and below water, and electromagnetic fields. Paragraph 5.4 explains that these effects are negligible. Important in this respect is that, on land and at the landfall no disruptive work is carried out during the breeding season for birds, protective measures are taken for the natterjack toad, work in the Voordelta should be at a distance of at least 1,200 metres from the seal colony, and no work should take place in the sea in seasons (autumn and winter) when foraging and overwintering birds are most vulnerable. No work takes place in the sea in any case in these seasons due to bad weather.

- Ecological functioning

Possible relevant effects on the ecological functioning of the North Sea are related to seabed disturbance and turbidity of the seawater, with possible consequences for predators relying on vision for hunting, primary production, local seabed fauna death, and as a result, a reduction in food stocks for fish and birds. The effect calculations show that no significant effects are expected on primary production (see paragraph 5.4), and that the total surface of disturbed seabed is negligible and temporary. Moreover, the nature or habitat types involved occur generally in the areas that traverse the southern sea routes. As the effects are very local and temporary and the foraging fish and birds do not depend entirely on the disturbed area for searching for food, no significant effects are to be expected in this context either; not even for shellfish-eating diving ducks.

Assessment of the Northern Sea Route B and the northern land route
The Northern Sea Route B traverses the North Sea and the coastal waters. On landfall, the Meuse estuary is traversed in the Nieuwe Waterweg. In the vicinity of the landfall and the northern land route lie the Kapittelduinen (sand dunes) and a dune strip on the Maasvlakte (Zuidwal). Table 6.3 contains an overview of the protection regimes applicable here and the corresponding assessment frameworks.

Area	**Protection regime**	**Assessment framework**
North Sea outside 12 mile zone	EMS	North Sea Phased Plan
North Sea within 12 mile zone	EMS Flora and Fauna Act	North Sea Phased Plan Flora and Fauna Act assess. framework
Coastal waters	Exceptional ecolog. values area EMS Flora and Fauna Act	Coastal waters assess. framework North Sea Phased Plan Flora and Fauna Act assess. framework
Nieuwe Waterweg	EMS Flora en Faunawet	EMS Nat. Policy Doc. on Spatial Planning Flora and Fauna Act assess. framework
Maasvlakte	Flora and Fauna Act	Flora and Fauna Act assess. framework
External effect on Duinen Zuidwal	EMS Flora and Fauna Act	EMS Nat. Policy Doc. on Spatial Planning Flora and Fauna Act assess. framework
External effect on Kapittelduinen	Nature reserve EMS Nat. Policy Doc. on Spatial Planning Flora and Fauna Act	Nature Conservation Act EMS Nat. Policy Doc. on Spatial Planning Flora and Fauna Act assess. framework

Table 6.3 Most important protection regimes and corresponding assessment frameworks of the areas along the Northern Sea Route B and the northern land route.

- Ecosystem diversity

The EIS contains quantitative estimates of the percentages of affected areas of the nature and habitat types in the North Sea and the coastal waters. The maximum affected surface is expected in the coastal waters and amounts to 0.02%. This harm is very slight and moreover temporary. In comparison with the rest of the study area, these are not areas containing specific important natural values. There is no significant effect involved.

Area	**Consequences for the diversity of the ecosystem**	**Protected habitat type that is traversed**	**Nature type that is traversed**	**Max. temporary harm in %**
North Sea	Temporary harm	-	Open sea	0.01
	Change of biotope	-	Open sea	<<0.01
Coastal waters	Temporary harm	Type 1110	Underwater shore	0.,02

table 6.4 Percentage of harmed or changed habitat type / nature type with respect to the total surface area of the Northern Sea Route B.

The Nieuwe Waterweg is part of the ecological main structure as it is actually a large river that flows out into the North Sea. Large rivers are important for the migration of countless types of animals and the brackish environment around the mouth of the river. The Meuse estuary is the location where the Nieuwe Waterweg flows out into the sea. The dredging work for installing the cable will, in principle, result in negative effects, in addition to the effects resulting from regular channel maintenance. However, given the local character and the limited duration, no significant effects will be involved. The extra sedimentation and turbidity in the Meuse estuary will remain limited due to the rapid flow rate in the mouth of the river. Dredging in the Meuse estuary will result in the risk of collision with vessels sailing in and out. This, too, may have consequences for the environment. However, by imposing limiting conditions on equipment and working times and by adopting shipping traffic measures, these risks are manageable to such an extent that they have become insignificant.

On land, the consequences for the diversity of the ecosystem, depending on the intervention, are fewer or similar to the consequences of the southern land routes and therefore also insignificant.

- Diversity of species

Possible relevant effects of the construction and the use of the BritNed interconnector on protected animal species are disruption due to visibility, sound above and below water, and electromagnetic fields. Paragraph 5.4 explains that these effects may be considered negligible. The northern land route is located close to a resting place for the rare and rigidly protected dotterel, a species that is hardly sensitive to disruption. Negative effects can be avoided by working before mid-August or after September. Breeding birds and seals do not or hardly occur in the area surrounding the Northern Sea Route B and the northern land route. Any negative effects on the protected natterjack toad can be avoided by taking specific measures (see paragraph 5.4.5).

- Ecological functioning

The effects of the Northern Sea Route B on the ecological functioning of the North Sea are similar to those of the southern sea routes, and are therefore insignificant. The very local and temporary consequences, which disappear again after a number of tidal cycles, are even fewer than in the case of the southern sea routes. However, this difference is not of essential importance.

Conclusion

The assessment of the ecological effects on nature policy and nature legislation shows that the activities for the benefit of the BritNed interconnector and the use of the BritNed interconnector will not result in significant effects. This conclusion applies to all alternatives which could be considered reasonable on both sea and land, and to all alternatives which could be considered reasonable for the design, configuration and techniques for the installation of the interconnector.

6.2.3 North Sea Phased Plan

In the EIS, special attention is devoted to the assessment of the intended activity according to the North Sea Phased Plan. This assessment consists of the following steps:

1. defining the spatial claim;
2. precautions;
3. benefit and necessity;
4. choice of location and assessment of spatial use;
5. limiting and compensating effects.

As the BritNed interconnector has no significant effects, the Phased Plan assessment does not need to be run through in full (IBN, 2015 p. 68). For instance, it is not obligatory to substantiate the necessity and no compensation is required. The Phased Plan criteria that *are* relevant for the BritNed interconnector are mainly limiting directly and indirectly the pressure on public space as far as possible, an efficient use of the seabed, exploiting possibilities for the multiple use of space and limiting environmental effects as far as possible (precaution principle).

The EIS – and this summary – indicates at several points the environmental effects of the BritNed interconnector that have been limited as far as possible in advance. A further limitation of the effects is not possible or necessary. In addition, an indication is given of the means by which certain uncertainty margins have been taken into account in the effect forecast. In this way, BritNed has complied with the precaution principle in the Phased Plan.

By laying the cables close to one another, limiting the length of the routes and applying the cluster principle where possible, the principle of the efficient use of public space has been complied with. The Northern Sea Route B, in particular, is clustered with various other functions in the area.

Sinking the cables sufficiently deep ensures that other functions, such as shipping and fishing are possible in the area above the cable. The seabed and the seawater above the cable can therefore still be used for multiple purposes (even though this does not apply to all functions). Another type of multiple use of public space is the combination of protected nature with high-quality infrastructure in the Voordelta. The effect forecast and the assessment in the EIS show that such a combination fits within the nature protection frameworks. The IBN 2015 states that “the laying of cables and pipes may take place anywhere in the North Sea, including areas with exceptional ecological values and Bird and Habitat Directives areas” (IBN, 2015 p. 74) and that “existing EISs show that the effects of cables and pipes are insignificant as a rule” (IBN, 2015 p. 75)

6.2.4 Other legislation and policy

Assessment according to SGR
As the National Policy Document on Spatial Planning has still to be debated by the Upper House of the Dutch parliament, BritNed is assuming that the assessment framework in the 1995 Green Space Structure Plan [*Structuurschema Groene Ruimte – SGR*] is still applicable. Using the criteria ‘ecosystem diversity’, ‘species diversity’ and ‘ecological functioning’, this section has shown that for all EMS areas in the study area, there are no significant effects on nature and natural processes. In addition to the existing natural processes, the SGR and the National Policy Document on Spatial Planning also distinguish the following essential characteristics and values that must be protected: geomorphological and geological values and processes, the water regime, the quality of soil, water and air, tranquillity, quite, darkness and openness, the

landscape structure and the perception value. For these essential characteristics and values, too, the EIS concludes that the temporary and local effects are insignificant.

Electricity supply

The BritNed interconnector is suited to and is a practical extension of European energy policy. The EU supports the project by partly financing the development costs. The interconnector is also suited to Dutch national energy policy, which is currently being adjusted to European policy. Fitting in the planning of the connector requires a partial revision of the Second Electricity Provision Structure Plan. The BritNed EIS was drawn up for the benefit of the decision-making process regarding that revision.

The environment

In addition to nature policy, environmental policy also imposes limiting conditions on the construction activities, the management and removal of the cable. The completion of the converter station, for instance, must take account of regulations relating to sound. The EIS also focuses on specific effects for which there are no standards, statutory or otherwise, such as heat development, magnetic fields and the possible consequences of short-circuiting should there be a break in a cable. A permit on the basis of the Dutch Environmental Protection Act [*Wet milieubeheer*] will be requested for the converter, which will mean that all relevant regulations will have to be complied with.

Space

In the National Policy Document on Spatial Planning, the North Sea Phased Plan indicates the way in which the spatial allocation of activities and projects in the North Sea must take place. This has been used as a basis for the route development (see paragraph 6.2.3). The key planning decision (PKB) concerning the future of the mainport Rotterdam (PMR) includes an exploration zone for Maasvlakte 2 and a marine reservation as compensation for the loss of natural values as a result of Maasvlakte 2. The demarcation line, as it is called, lies on the border between these two areas (see map 3.6 and 3.7 in de map appendix). The southern sea routes, which could reasonably be considered, lie just to the north of this demarcation line, between the expected location of Maasvlakte 2 and the marine reserve, as a result of which both developments are not hindered from a spatial point of view.

Provincial policy

The provincial environmental policy plan and the provincial environmental bye-law contain no defined elements that may influence the BritNed project, except for a reference to the provincial ecological main structure (PEMS) and rules for maintaining quiet in the Voornes Duin sanctuary. The BritNed interconnector activities do not result in the disruption of the Voornes Duin sanctuary. The areas along or in the vicinity of the alternative BritNed routes that are part of the PEMS are the Voordelta, Voornes Duin, Kapittelduinen, Nieuwe Waterweg and a dune strip on the Maasvlakte (Zuidwal). Paragraph 6.2.2 already explained that there are no significant effects on these nature reserves. The BritNed interconnection is not in conflict with the new regional plan of the province of Zuid-Holland for the Rijnmond area.

Municipal policy

Two zoning plans are important for fitting in the local planning of the BritNed interconnector, i.e. the Maasvlakte and West Voorne zoning plans. The alternative land routes, which could reasonably be considered, as well as the location of the converter station, are both suitable for these zoning plans.

7 COMPARISON OF THE ALTERNATIVES

7.1 Comparison of performance alternatives

The BritNed interconnector can be designed and installed in various ways. The development of the alternatives, which could reasonably be considered, has taken place in such a way that the environmental effects are as few as possible. Alternatives with possible significant environmental effects will be disregarded or rejected at an early stage. For instance, no use will be made of sea electrodes, as a result of the negatives effects on the sea environment. Another example is the digging in method. A technique has been selected where the material transport on the seabed is minimal, as a result of which the effects on nature and the environment will be kept to a minimum. In order to keep the magnetic field around the high-tension interconnector to a minimum, the cables are laid close to one another.

The result of these and other effect-limiting measures is that the difference between the environmental effects of the alternatives is minimal. For this reason, a comparison of the alternatives from the viewpoint of nature and the environment does not result in a clear preference. The most important advantages and disadvantages – relatively speaking – of the technical alternatives are summarised again below. A further explanation is provided in section 4.

Bipolar or monopolar system	A bipolar system is the basic design, as such as system has a higher capacity. The environmental effects of a monopolar system are similar, provided that no sea electrodes are used.
2 MI cables or 1 MI + 1 XLPE cable	A bipolar system consists of 2 MI cables; there are no reasonable alternatives. A monopolar system may consist of 2 MI cables or 1 MI and 1 XLPE cable. The environmental effects are similar.
2 cables tied together or separated by 0.5 to 2 metres	Two cables tied together or close to one another is the basic design. This results in smaller magnetic fields and less immediate use of space on the seabed.
Installation procedure with 1 or 2 ships in the sea	Two ships have a logistical advantage and it is safer for the cable. The choice of 1 or 2 ships is not relevant for the environment.
Dredging little, average or a relatively large amount of material from sand waves	The basic design is to level sand waves in such a way that the cable is buried under 1 metre of sand for approximately 15 years. That is the most favourable from the point of view of costs and for the environment. Less dredging has the disadvantage that the risk for the cable is larger and that the cable has to be sunk again more often. More dredging has the disadvantage that during the laying, more disruption, harm to the seabed, turbidity of the seawater and sedimentation occurs.
Removing or returning dredged material	The basic design is to return dredged material to its natural surroundings. The disadvantage of removing is that greater distances need to be covered and that disruption, harm to the seabed, turbidity and sedimentation occur elsewhere. The advantage is that the peak values of turbidity and sedimentation would be lower.

Sinking a cable in the sea with a jet pipe or a plough	The basic design is the use of a jet pipe or a non-displacement plough. The environmental effects are similar. The alternative, a displacement plough, causes slightly more disruption of the seabed and a slightly greater risk of damage to the cable.
Dredging in the Meuse estuary in the case of a northern landfall	Dredging in the Meuse estuary has consequences for the sea environment that are difficult to calculate. The effects in comparison to regular maintenance dredging are expected to be negligible. There are no alternatives which could reasonably be considered.
Drilling under or digging in the dunes in the case of a southern landfall	The basic design is digging in the dunes next to an access road for vehicles to the beach. The environmental effects of drilling are similar as vibrating sheetpile walls into the soil is necessary in both cases. This vibrating is decisive for the sound level. In the case of a drilled solution, a cooling unit may be necessary to cool the cables in tubes placed under the beach and dunes.
Use of existing conduits or sub-drilling to traverse the land infrastructure	The use of existing conduits, where available, is the basic design. Sub-drilling has slightly more environmental consequences as this produces more sound. If drilling is necessary, this will take place outside the breeding season for birds.

Table 7.1 Comparison of technical performance alternatives

7.2 Comparison of route alternatives

7.2.1 Comparison of the northern and southern sea routes

Effects of construction
Table 7.2 provides a summarised comparison of the most relevant effects of the construction work for the northern and southern sea routes. The comparison is based on the basic design for the installation of the interconnector including the mitigation measures that are part of that design. The environmental effects of the alternatives which could be reasonably considered for the installation and design of the cable are similar and have no influence on the route and the comparison of the routes.

In the table, the physical effects of the Northern Sea Route B on the seabed and the seawater, as well as the manner in which these influence other natural values, is judged to be slightly more favourable. It should be noted in this respect that these effects and their assessment relate only to the Dutch part of the North Sea. However, the total length of the Northern Sea Route B, from the Dutch to the British coast is 30 kilometres longer than the southern routes. This extra length is located in the British part of the North Sea and is a disadvantage of the Northern Sea Route B that is not quantified in the Dutch EIS.

The effects on the British continental shelf are similar to those on the Dutch continental shelf and are insignificant for both routes. The results of the British environmental investigation have no influence on the assessment and comparison of the reasonable alternatives on the Dutch side of the North Sea.

Consequences during construction	Alternative with the fewest consequences	Explanation
North Sea seabed disturbance	Northern Sea Route B	Difference with southern routes is minor
Voordelta/coastal waters seabed disturbance	Northern Sea Route B	Difference with southern routes is minor
North Sea dredging volume	Northern sea route B	The dredging volume for the southern routes is larger. The consequences for nature and the environment and the difference in those consequences between north and south are insignificant
Voordelta/coastal waters dredging volume	No difference	Do dredging will take place in the Voordelta and coastal waters
Nieuwe Waterweg dredging volume	Southern sea routes	Dredging will only take place in the Meuse estuary for the northern route. The consequences are insignificant
North Sea suspended substances	Northern sea route B	Difference with southern routes is very minor
Voordelta/coastal waters suspended substances	Northern sea route B	Difference with southern routes is very minor
Nieuwe Waterweg suspended substances	Southern sea routes	No dredging needs to take place in the Meuse estuary for the southern routes. The difference with the northern route is negligible as regular dredging work takes place in the Meuse estuary and there is a high flow rate
North Sea sedimentation	Northern sea route B	Difference with southern routes is very minor
Voordelta/coastal waters sedimentation	Northern sea route B	Difference with southern routes is very minor
Nieuwe Waterweg sedimentation	Southern sea routes	See explanation under suspended substances
Primary production	No difference	The effects are negligible
Seabed fauna, food for birds	No difference	The effects are negligible
Disturbance of birds	No difference	The difference between the northern route and the southern routes is negligible if the breeding season is taken into account
Disturbance of the natterjack toad	No difference	The effects are negligible as sufficient mitigating measures will be taken
Disturbance of other fauna	No difference	Seal colony near Hinderplaat will be taken into account by keeping sufficient working distance in the case of the southern route
Change of vegetation, biotopes	No difference	The effect is negligible. Only in the case of the Slufter nature development will there be a slight negative

		effect for the southern route
Hindrance for shipping and risk of collisions	Southern sea routes	The northern route traverses more shipping zones and has a slightly greater risk of collision
Hindrance for those partaking in leisure activities	Northern Sea Route B	Possibly more hindrance in the case of the southern landfall, but no important restrictions
Hindrance for other forms of usage	Southern sea routes	The northern route lies in a busier sea area, keeping a distance of 500 m is not possible everywhere

Table 7.2 Comparison of the Northern Sea Route B and the Southern Sea Route B according to consequences, environmental or otherwise, for the construction (maintenance, repair, removal)

The consequences of the construction of the cable interconnector on the Northern Sea Route B are similar to those on the southern sea routes, and are insignificant in both cases (see section 6). This is because environmentally-friendly construction techniques and designs will be used on both routes. Moreover, in the spatial planning of both route alternatives, limiting the use of space on the seabed and restricting other possible hindrance for other users on the North Sea has been taken into account as far as possible.

The dredging volumes and the consequential effects of the dredging are slightly larger on the southern routes due to the presence of more sand waves on the seabed. In addition, sensitive species such as birds, seals and the natterjack toad are present along the southern sea and land routes in certain seasons. Moreover, the length of the southern routes through the coastal waters (Voordelta) is greater than that of the Northern Sea Route B. Due to the chosen construction techniques, by keeping sufficient distance from sensitive areas such as the Hinderplaat, by not sinking piles, vibrating or drilling during the breeding season for birds and as a result of other mitigating measures, there will be no difference in the final consequential effects of both route alternatives on nature and the environment. Both routes involve very local and very temporary effects that fit easily into the dynamics of the environment. For instance, the effects on the sea will have already disappeared following several tides. The minimal, temporary and local effects that remain, following mitigation, are insignificant for both routes.

Hindrance for other usage, too, will be largely prevented by the chosen performance techniques and the mitigating measures. The remaining hindrance during the construction work will be slightly larger on the Northern Sea Route B, but will be insignificant in this case, too.

Use and presence
Table 7.3 provides a summarised comparison of the effects of the use of the cable for the various route alternatives. In this case, too, the comparison is based on the basic design for the interconnector including the mitigating measures that are part of that design. The environmental effects which could reasonably be considered for the technical construction are similar in outline and have no influence on the route or the comparison of the routes.

The table shows that the environmental effects of the use of the cable interconnector are zero for both route alternatives and almost identical. The consequences of the presence of the interconnector for other users of the North Sea are the fewest on the southern sea routes. The presence of the Northern Sea Route B limits the possibilities to landfall additional cables (wind parks) and pipes (oil and gas industry) to the north of the Maasvlakte. Moreover, the cable lies in a future sand extraction area.

Consequences of use and presence	Alternative with the fewest consequences	Explanation
Magnetic fields	No difference	Effect in order of size of natural background values, preferably clustering cables
Induced electric fields	No difference	Effect in order of size of natural background values, preferably clustering cables
Heating of the seabed or soil	No difference	Effect is negligible on sea and on land
Influence of heating on seabed or soil fauna	No difference	Effect is negligible on sea and on land
Orientation of fish and sea mammals	No difference	Effect is negligible
Pray detection of fish	No difference	Effect is negligible
Loss of area for natural species, biotope loss	No difference	The effect is slightly negative for both route alternatives due to the presence of the converter station. The losses, however, are insignificant and, moreover, the site is already intended for business activity.
Sand and gravel extraction	Southern Sea Route B	The northern sea route traverses a future sand extraction area. Both routes traverse an exploration zone for sand extraction for the benefit of Maasvlakte 2.
Oil and gas extraction	Southern Sea Route B	Future opening up of fields via new pipelines is restricted by the northern route
Cables and pipes	Southern Sea Route B	Landfall of new cables/pipes to the north of the Maasvlakte is restricted by northern route
Harbour development on land	Northern and southern land routes	Western land routes, following a southern landfall, are disadvantageous for harbour development
Other forms of usage	No difference	Other forms of usage suffers no hindrance from the use and presence of the cable

Table 7.3 Comparison of the Northern Sea Route B and the Southern Sea Route B according to consequences, environmental or otherwise, of use and presence

7.2.2 Comparison of the southern sea routes

The southern sea routes traverse the Voordelta and the exploration zone for a marine reserve. Due to the presence of specific natural values, such as seal colonies, several alternative routes have been sought with as few effects as possible on nature and the environment. One of the southern sea routes, the Southern Sea Route A, was disregarded, for instance, because this route was too close to the Hinderplaat, where seals may be present. The remaining alternatives for the southern sea route, which could be reasonably considered, are:

- Southern Sea Route A2
- Southern Sea Route B
- Southern Sea Route C

The environmental consequences of these sea routes are not essentially different. The location and the advantages and disadvantages of these routes are described in section 4. The following section will indicate which of the southern sea routes has preference.

7.3 Comparison on the basis of risks and costs

General
Information about the technical risks and project cost of the alternatives, which could reasonably be considered, is not an obligatory or necessary part of an EIS. As the BritNed interconnector is a technical challenge for which high investment costs with a long-term recovery period are required, this subject played an important role in the design phase and the internal decision-making process of BritNed. Moreover, it is also decisive for the feasibility of the alternatives and the mitigating measures. For this reason, this information, too, is briefly summarised here.

There are many possibilities from the technical point of view, but the costs of technical developments are high and the results uncertain. New techniques may appear attractive, but they may sometimes involve great risks. Even when an entrepreneur wishes to take risks, the financiers are not always willing. Project risks can therefore be divided into technical, commercial and financial risks.

Technical risks
Technical risks may be subdivided into a number of subjects for which BritNed has had various investigations performed:

- risk of poor performance or breakdown of the interconnector;
- application of proven techniques;
- complexity of the construction;
- possible interference with the activities of others;
- accessibility for repairs.

Northern Sea Route B risks
The Northern Sea Route B can be constructed with proven techniques. However, constructing in the Meuse estuary is a large, complex and expensive operation, with dredging having to be carried out transversely in the Meuse channel over a length of 2,000 metres at right angles to shipping traffic and to a depth of 10 metres under the channel bed. The trench must be dredged close to the Noorderdam and Zuiderdam dykes, as a result of which the underwater dyke slopes may become unstable. Moreover, there are risks for a nearby gas pipe. The work would also cause hindrance and result in risks to shipping in one of the busiest shipping lanes in the world.

Even after the cables are installed, they run an increased risk. The route sections along the shores, in particular, have a greater risk of internal failure due to the increased tension on the materials and the reduced discharge of heat. If a breakdown occurs, it is uncertain whether the cables can be pulled out of the channel bed. If they have to be dredged out, this would be a larger and more risky project than the construction. Moreover, the interconnector would then be out of operation for a considerable time.

To the north of the Noorderdam dyke, the cable runs through an area in which many other activities take place. As a result, there is a relatively large risk of damage to the cable at that point due to external influences.

On land, the northern route crosses the future route of the harbour entrance for Maasvlakte 2 (the extended Yangtze harbour, see maps 4.10 and 4.11 in the map appendix). If the cable has to cross this 800 metre wide and more than 20 metre deep harbour entrance, this would be a similar operation to crossing the Meuse estuary as regards size and complexity. Another possibility is that when the time comes, the cable is rerouted over land along the new external contour of Maasvlakte 2. That would mean the cable being out of operation and having to be diverted, which raises very great objections from an economic point of view and for business operations. As Maasvlakte 2 in being constructed in phases, several reroutings may even be required. Crossing the Yangtze harbour or rerouting the cable would have to take place within a few years of the construction, i.e. before the investments are recovered. The uncertainties and costs would mean a huge risk for the project. The choice for a phased construction of the external contour means that until 2020, the Maasvlakte will not be accessible from the northern and western side for infrastructure from the sea.

Southern sea routes risks
The southern sea routes will be constructed with proven techniques. No deep channels need to be crossed and the coast near the landfall will not be drastically altered by the construction of Maasvlakte 2. There is therefore little risk of poor operation of failure of the cable and the cable is easily accessible everywhere.

A short pipe sleeve and cooling unit may be required at the landfall, although this is not assumed in the basic design. The risk of failure of this unit means a somewhat increased risk of poor operation of the cable. However, the risk or failure and the repair time cannot be compared to the risk of a high-tension interconnector under the Meuse estuary.

The costs of the Northern Sea Route B and the southern routes
The absolute costs of the project are still difficult to estimate at this stage of the planning. Nevertheless, in order to provide an understanding of the difference in costs for the various alternatives, the following figures may be used:

- number of kilometres of cable;
- number of cubic metres of sediment to be dredged;
- number of kilometres to be dredged;
- number of kilometres of complex installation work.

The Northern Sea Route B is 30 km longer than the southern sea routes. As the interconnector consists of two cables, this means that 60 km more cable must be purchased and installed. The total number of kilometres to be dredged is larger in the case of the southern route (13 as opposed to 6), but the Northern Sea Route B requires the dredging of three times as much material. This is related to crossing the Meuse estuary. Moreover, the crossing of the Meuse estuary and the Yangtze harbour means that for the Northern Sea Route B, a complex installation is necessary over a distance of approximately 3.5 km. In the case of the southern sea routes, that is 0 km.

Comparison
The Northern Sea Route B is considerably more expensive than the southern sea routes. From the point of view of technique and risks, too, the Northern Sea Route B has very important disadvantages as opposed to the southern routes. An investigation of the technical and commercial risks ordered by BritNed has shown that the although the Northern Sea Route B is not impossible, it is a very difficult alternative for BritNed and the financial backers to fund.

8 WHICH ALTERNATIVE IS PREFERABLE?

8.1 General

Preferred alternative
In section 4, the basic design for all elements of the BritNed interconnector were described, as well as the alternatives that could be reasonably considered. The environmental consequences of the basic design and the alternatives were described in section 5. In section 6, these consequences were assessed according to the rules for nature protection. The description and assessment of the environmental consequences showed that there are no reasons to adjust the basic design. For BritNed, the basic design is therefore the preferred alternative. In paragraph 8.3, the preferred alternative is set out once more. BritNed is going to request a permit for this alternative, taking into account the fact that due to developments in the market and during the call for tenders, one of the alternatives which could reasonably be considered will be used. It is therefore important that the environmental consequences of those alternatives, too, have been assessed according to the nature protection rules and other government, provincial and municipal policy.

The preferred alternative contains various measures that ensure that the effects on the environment are as few as possible. A general explanation of these measures is provided in section 8.2.

The most environmentally-friendly alternative (MEFA)
The MEFA is an obligatory part of an EIS from a statutory point of view. The MEFA can best be described as a realistic performable alternative, the consequences of which for the environment are, on balance, the smallest. The MEFA is also a reference for the comparison of the effects with the preferred alternative.

For the BritNed interconnector, the possible alternatives have been built up and optimised step by step. For instance, the most desirable and environmentally-friendly design for the interconnector has been sought as well as the most desirable and environmentally-friendly forms of installation. In addition, the routes of the interconnector have been developed in such a way that the consequences for the surroundings remain as few as possible. This means that all remaining alternatives have been developed as environmentally-friendly as possible.

As all alternatives which could reasonably be considered have already been investigated on the basis of various studies and consultations with competent authorities, it is not possible to formulate other alternatives with less effects for the environment that are also feasible from a technical, economic and planning point of view. This means that in the EIS, the MEFA is based on one of the investigated alternatives supplemented by mitigating measures.

8.2 Effect-limiting measures

Limiting environmental effects is one of the starting points of the project. The possibilities for doing so have therefore been investigated in all phases of the design. Extensive tables have been included in the EIS with mitigating measures. The tables also indicate whether these mitigating measures are part of the basic design for the BritNed interconnector, or whether they may be considered as extra mitigating measures. During the decision-making process and the detailed design phase, the extent to which these measures can be applied will be considered.

The environmental consequences, as described in this summary, are based on the basic design including the mitigating measures that are part of that design. With respect to the choice of route, the basic design has already been optimally mitigated. With respect to the way in which the BritNed interconnector will be constructed, too, the basic design has already been mitigated to a great extent. As regards noise, further mitigation is possible by internally cooling any cooling units and by use of the most modern equipment with the lowest possible noise emission for placing sheetpile walls. The turbidity resulting from redepositing dredged material can be limited by using the extracted material for the construction of Maasvlakte 2. It is also conceivable to relocate or redeposit material dredged up when levelling sand waves, with the aid of a downcomer. On land, in addition to catching and removing natterjack toads in advance, other species and small mammals may conceivably be caught and removed, and holes may be covered to prevent animals from falling in. With respect to the period in which installation work will be carried out, the most important measure is not performing work that will disturb birds during the breeding season. This measure is part of the basic design phase. With regard to archaeology, underwater cameras may be used for the registration of any discoveries and a protocol could be used for the installation work.

8.3 Preferred alternative (PA)

Main principles
The main principle of the preferred alternative is a bipolar high-tension interconnector in the soil/seabed, with a converter station on the Maasvlakte and on the Isle of Grain in England. The converter is located next to the TenneT linking and transformer station on the Maasvlakte, directly adjacent to the E.On electricity power station. The interconnector will be in operation almost continually with a change in the transport direction of electricity transport between the Netherlands and Great Britain several times a day. The maximum capacity of the interconnection is 1,320 MW. Depending on the market demand, a monopolar high-tension interconnector is a possible fallback option. In that case, the maximum transport capacity is 800 MW.

Further detailing of the technical design
The bipolar interconnector consists of two converters per converter station and two high-tension cables. A monopolar interconnector, as a fallback option, is being considered with one high-tension cable and one almost tension-free return electricity cable. In that case, the return electricity cable can be selected in such as way that upscaling from monopolar to bipolar is possible in the course of time. In all cases, the cables have a protective housing and contain no liquid oil.

Both in the case of a bipolar and a monopolar interconnector, the preferred alternative consists of binding cables together in order to eliminate the magnetic field of the cables almost entirely. As a result of the clustering, the cables and the soil/seabed become slightly warmer than if they were separated by a space. The cable design will be adjusted to limit the increase in temperature.

Work on land and at the landfall
On land, the cables are placed in the soil with as little earth moving as possible. A narrow trench is dug of no more than 1.5 metres wide and deep, which is then filled again with excavated sand. The trench is covered with concrete slabs displaying a warning tape. For junctions with other infrastructure on land, use is made in the preferred alternative of facilities already present and intended for that purpose, such as underground conduits. Certainty as to whether these can be used can only be obtained during the detailed design phase, following the call for tenders. Consequently, two supplementary drillings have been taken into account as an alternative. The noise that these drillings cause will not lead to any significant effects on natural values as this work will take place outside the breeding season.

A southern landfall on the Maasvlakte is preferred. This means that vibratory sheetpile driving is probably necessary. The preferred alternative is digging a trench between these sheetpile walls through the beach and the dunes. An alternative landfall method is drilling under the dunes, but in that case, too, vibratory sheetpile wall driving will be necessary for a cofferdam. An alternative location for the southern landfall is a northern landfall by means of a dredging operation in the Meuse estuary.

The preferred alternative has no significant effects on natural values. The breeding season for birds will be avoided and a minimum distance will be kept to seal colonies. Prior to the work, any protected species present in or near the work site will be traced and relocated to a similar biotope and measures will be taken to prevent animals from returning during the work. For tracing, relocating and in the unlikely event of any other disturbance of animals, permits will be applied for on the basis of the Flora and Fauna Act.

In the case of any repairs during and when the cable is removed following the operational life of the cable, work similar to that during the construction will take place.

Choice of route on land
There are a number of route alternatives from the landfall on the south coast. The preferred alternative is a land route to the south of the Slufter followed by an eastern route in the cable and pipeline corridor on the Maasvlakte (see map 4.10 in the map appendix). Agreement has already been reached about this route with the Port of Rotterdam Authority. The route makes efficient use of the current cable and pipeline corridor, no drillings are likely to be necessary, the cable is easily accessible for maintenance and there is no interference with future developments in the harbour area. However, the route is slightly to the south of the demarcation line. Here, the routes lies on land belonging to the Municipality of Westvoorne, which has been earmarked for ‘nature’. Nevertheless, the municipality of Westvoorne has promised to cooperate in the planning of this route, as there are no significant effects on natural values.

There are seven alternative routes to this preferred route (see map 4.10 in the map appendix). Each of these alternatives has important disadvantages as opposed to the preferred route. Most of these relate to harbour development plans. The initiator does not wish to disregard these alternative land routes at this stage, as the government may assess the alternatives differently.

Both the preferred route and the alternative land routes have no significant effects of natural values.

In the case of an alternative landfall location from the north, the only alternative for the land route would be a direct route from the Edison bay in the Meuse estuary, via the cable and pipeline corridor, to the converter station.

Work at sea
The preferred alternative is based on laying the cables on the seabed from a cable-laying ship, after which they are placed in the seabed using a jetting machine or a plough blade. These burying machines are linked to another ship. Initially, the cable is buried to a maximum of about three metres in the seabed. No seabed material is moved during the burying. The coast guard and the harbour master will be informed of the work on time and beacons will be placed.

Sand waves are present in some places. These are types of underwater dunes that shift slowly. Outside the coastal waters / Voordelta, it may be necessary at certain locations to lower (level) the tops over a wide strip of 20 or more metres in order to make them more accessible to the digging machine or in order to reach a greater digging depth. The latter may be necessary in order to prevent the cable being exposed by the moving sand waves. The cables are preferably buried so deep that they are not expected to be exposed during the next 15 years. In the course of time, they are reburied if necessary. An alternative is to remove just a fraction from the tops of the sand waves or to remove them altogether. However, this has disadvantages from the point of view of costs and the environment. In the first case, less dredging takes place but the cable has to be reburied more often and possibly repaired as it is exposed more frequently; in the second case, the reverse is true. Although the disruption is greatest in one case and seabed material relocation is greatest in the other, these alternative burying scenarios are not expected to result in significant effects.

In the case of any repairs during and when the cable is removed following the operational life of the cable, work similar to that during the construction will take place.

Choice of route at sea
The preferred route is the Southern Sea Route B, through the Voordelta, with a landfall on the Maasvlakte at more than 1,200 metres distance from any seals on the Hinderplaat.

Construction and landfall on this route corridor is possible without significant consequences for the Voordelta special protected zone. As a result, an acceptable alternative with respect to policy is involved. The Southern Sea Route B also traverses the exploration zone for a new marine reserve for which the same protection currently applies as for the Voordelta as this exploration zone is located in the Voordelta (see paragraph 8.5). As a result of the Voordelta location and the marine reserve exploration zone, the effects of two other reasonable alternative routes have been investigated: the Southern Sea Route A2 and the Southern Sea Route C. These routes are feasible, but are somewhat longer and enjoy no clear preferences. The differences in the effects on nature and the environment are so small that they can be compared as a group to the Northern Sea Route B.

BritNed considers the Northern Sea Route B as an alternative. The consequences for nature of this sea route are possibly slightly fewer, although the difference with the southern sea routes in terms of nature conservation legislation is not relevant (see below). However, the northern route runs through areas with more shipping, future sand extraction, gas and oil production, and future wind parks. Due to the expected increase in cables and pipes in this area, spatial problem areas will be created. The northern landfall of infrastructure from a southern direction, such as the BritNed cable, will be a further addition to these problem areas. For BritNed, a northern landfall on the Maasvlakte is, moreover, complex, risky and extremely expensive (see 7.3).

8.4 Most environmentally-friendly alternative (MEFA)

The technical implementation of the project
The most environmentally-friendly alternative for the design, configuration and the installation of the BritNed interconnector corresponds to the preferred alternative. After all, the preferred alternative has been mitigated to a large extent. As a result, there is no reasonable technical alternative conceivable with noticeably fewer effects on nature and the environment.

Nevertheless, a number of extra supplementary measures are conceivable which would reduce the effects even further. The measures in question relate to limiting the spread of silt in the seawater and the use of low-noise equipment available at the time when tenders are called for construction. However, these measures are expected to be relatively expensive and unnecessary in order to limit the effects on natural values to an insignificant level. The use of low-noise equipment is only considered meaningful in the unlikely event that there is a need or desire to perform work during the breeding season, because for instance, the construction planning is at risk due to reasons still unknown. In that case, the equipment must produce demonstrably lower noise levels that the usual levels assumed in this EIS.

Measures to limit the spread of silt are only considered meaningful if – again as a result of reasons still unknown – it should prove that the seabed material to be moved in the Voordelta has to be larger than expected. Incidentally, a provision has been included in the monitoring programme for these situations (see section 9.3).

As the BritNed interconnector is being put out to tender as a ‘Design and Construct’ project, the meaningfulness and feasibility of these extra mitigating measures will be determined in consultation with the contractor and the competent authority only as late as the tendering phase and during the granting of the implementation permit.

The route
As regards the consequences for nature in the coastal waters, the effects for the Northern Sea Route B and the southern sea routes are insignificant, but slightly smaller for the northern route. Several less sensitive species are located to the north of the Meuse estuary. Moreover, less seabed material moving is required for the Northern Sea Route B, as this route involves slightly lower and steeper sand waves. If only this difference in the effect on natural values is taken into account, the Northern Sea Route B can then be considered as the most environmentally-friendly alternative.

However, the following comments should be noted in this respect. As a result of the extensive mitigation in design, installation technique and installation period, the environmental effects on both routes are in the end very small to negligible. A second comment is that the traversing of the Meuse estuary demands a relatively large dredging operation. Locally, this results in a relatively major disruption of the soil/seabed and to increased risks of a disaster: collision, stability of the harbour dykes and gas line. Although manageable, the environmental effects of a possible disaster are larger than in the case of the southern sea routes. A third comment concerns the 30 km longer route length of the Northern Sea Route B, although this extra length lies mainly in the British part of the North Sea. From the point of view of nature and the environment, the traversing of the Meuse estuary and the longer route length are not paramount arguments against the Northern Sea Route B, but they do detract from the small difference in nature effects with the southern sea routes.

If a broader definition of the environment is used and the effects of forms of usage and sustainable spatial organisation of the seabed are taken into account, another picture of the MEFA is created in the opinion of the initiator. As a result of the more intensive use of space to the north of the Meuse estuary and the existing problem areas in that region, the Northern Sea Route B causes more hindrance to other users and more congestion in the spatial use. Eventually, this may mean that energy extraction activities (oil, gas and wind), which take place particularly in the sea area to the north-west of the Maasvlakte, will as yet search for a route to the south side of the Maasvlakte. The final environmental and nature balance will then be negative, as this will lead, on balance, to longer connections and a non-optimal spatial organisation of cables and pipes in the coastal waters. No decisive significance can be attached to this argument either, but it does shed a different light on the Northern Sea Route B as the most environmentally-friendly alternative.

8.5 Assessment and conclusions

From preferred alternative to decisions and permits
Table 8.1 provides a summarised overview of the most important characteristics of the most environmentally-friendly alternative (MEFA), the preferred alternative (PA) and the other alternatives which could reasonably be taken into consideration.

BritNed will request the Dutch Minister of Economic Affairs and the Minister of Housing, Spatial Planning and the Environment for permission for the Southern Sea Route B. The final route must be determined in a key planning decision of the cabinet. The Ministers of Economic Affairs and Housing, Spatial Planning and the Environment will hold consultations for that purpose with other ministries involved such as the Ministry of Transport, Public Works and Water Management and the Ministry of Agriculture, Nature and Food Quality. The preferred alternative is also the starting point for the permit application to the Minister of Transport, Public Works and Water Management. The route corridor for which the permit will be requested is included in map 7.1 in the map appendix.

Depending on the manner of tendering, the consultation with the ministries involved and the ministry's own assessment, the permit application and the granting of the permit may concern one of the alternatives which could reasonably be considered. For the sake of completeness, it should be noted that an environmental permit application will be submitted to the Province of Zuid-Holland in connection with the converter station, an application for exemption will be submitted to the Minister of Agriculture, Nature and Food Quality on the basis of the Flora and Fauna Act, and that the municipalities of Rotterdam and Westvoorne will be asked for planning permission for the converter station and the land cable routes (building and construction permit).

Characteristics	Elements that together make up the MEFA	Elements that together make up the PA	Alternatives that can reasonably be considered
System design	Bipolar system	Bipolar system	Monopolar system without sea electrodes
Cable type	2 MI cables	2 MI cables	1 MI cable, 1 XLPE return cable
Cable configuration	Clustered in 1 trench	Clustered in 1 trench	2 small trenches close to one another
Route at sea	Northern Sea Route B	Southern Sea Route B	Southern sea routes A2 and C
Installation at sea	Plough or jetting machine	Plough or jetting machine	Displacement plough
Burial scenario at sea	Sand cover of 1m for 15 years	Sand cover of 1m for 15 years	Minimum sand cover, maximum sand cover
Landfall location	Meuse estuary	To the south-west of the Slufter	No alternative
Landfall installation	Dredging in the Meuse estuary	Digging on the beach, digging in the dunes	Digging on the beach, drilling in the dunes at the southern landfall
Route on land	Northern land route	Southern land route in combination with eastern cable and pipeline corridor	Several land routes
Installation on land	Digging	Digging	Digging, horizontal drilling under infrastructure
Converter station location	On the E.on site	On the E.on site	No alternative
Construction period	No work in August and September near the dotterel resting place	No work in breeding season near breeding areas	No alternative, unless reliable low-noise equipment is available

Table 8.1 The most important characteristics of the MEFA, PA and alternatives which could reasonably be considered.

Assessment
The competent government authorities will make their own assessment in the BritNed project decision-making process. An indication is given below of how the initiator has assessed the project in its own planning and decision-making process.
This will show that for the initiator, the limited difference in environmental effects between the MEFA and the PA does not compensate for the technical and commercial risks of the MEFA, which, moreover, are not favourable either in the opinion of the initiator from the viewpoint of shared use of space and planning.

Both routes, the PA and the MEFA, unavoidably cross the coastal waters. The entire coastal waters are part of the ecological main structure (EMS), so no preference can be derived from that fact.

There is another important difference: the PA crosses the Voordelta, which is protected on the basis of the Habitat Directive. In the Voordelta, however, not all new activities are excluded. In order to assess the acceptability of a new activity, the protection regime of the Habitat Directive applies (see figure 6.1 of this summary). If an investigation shows that a project has no significant effects, the project is accepted on that basis. For such projects, the planning difference therefore lapses. Incidentally, the EIS also includes an investigation of whether the combination of the BritNed interconnector with other intended and existing projects may possibly result in significant effects. This proved not to be the case. This is achieved by taking the required measures – even as early as in the basic design phase – with respect to design, construction and use to prevent the project from having significant effects in an area that is protected on the basis of the Habitat Directive.

On the basis of the Dutch Comprehensive North Sea Management Plan 2015, another important assessment aspect is the efficient and multiple use of space. One of the starting points in this respect is clustering with existing infrastructure. Although the northern route avoids the Voordelta and clusters with an existing gas line, the use of a northern landfall for an interconnector from a southern direction is not efficient as a matter of course. It results in a longer interconnector and therefore takes up more space. Moreover, the northern route runs through an area where spatial problem areas already exist. These problem areas will increase as a result of future spatial claims: the oil and gas industry, wind parks and sand excavation.

As the interconnector causes no significant effects or hindrance, it is also suitable for the southern routes without clustering. This, too, results in efficient use of space as it involves easily combinable multiple use of space (protected nature and high-quality infrastructure). As a result, the northern route remains available for oil and gas infrastructure that is less suitable for the Voordelta. From the viewpoint of spatial organisation on the North Sea, it would seem wise to landfall infrastructure coming from the south (BritNed) on the southern Maasvlakte and infrastructure coming from the north (wind parks and oil and gas lines) on the northern part.

An objection that may be raised against the southern route is the risk of creating a precedent as a result of the presence of a cable in the Voordelta. Any new cable landfalls from the south could be clustered with the already present BritNed interconnector. In those cases, the significance of the total effects will again have to be assessed against the importance of and the alternatives for the interconnector in question. That does not need to result once again in a choice for the Voordelta, as other landfall possibilities often exists for other infrastructure. For instance, the connection of wind parks imposes less requirements on the connection point. Consequently, there are good possibilities for wind park connections to the north of the Maasvlakte without having to cross the Meuse estuary.

A fourth possible relevant assessment framework is the management plan for the intended marine reserve in the Voordelta, as a compensation for the nature loss as a result of Maasvlakte 2. The southern preferred route crosses the furthest northern point of the marine reserve exploration zone. It is not known when this assessment framework will take effect, for which part of the exploration zone, and what the usage limitations will be. It is, however, clear that an attempt will be made to prevent seabed disturbance. Excluding seabed fishing and sand extraction are mentioned as examples. Cables and pipes are not mentioned. The construction of the BritNed interconnector is in any event a non-recurring, very local disturbance of the seabed, which cannot be compared to the consequences of large-scale interventions such as seabed fishing and sand extraction. Seabed life will recover quickly following the installation of the cable. Reburying the cables after approximately 15 years will only be necessary outside the Voordelta and the marine reserve exploration area in areas with high sand waves. In both areas, there is only a small risk that the cables become exposed and suffer damage, and therefore have to be repaired and reburied. Without seabed fishing or large anchoring ships, the risks of the cables being damaged in the Voordelta and the marine reserve exploration zone is negligible.

Moreover, it should be noted that a management agreement has now been concluded regarding the more precise details of the size and location of Maasvlakte 2. This shows that the gross surface area of Maasvlakte 2 will be smaller. As a result, it is conceivable that in the end, the effects on nature of Maasvlakte 2 will be smaller than were expected. Consequently, the required surface area of the marine reserve may possibly be smaller. That could mean that the already small length over which the Southern Sea Route (B) crosses the marine reserve exploration zone could be smaller or that the route will even lie outside the marine reserve entirely.

9 GAPS IN KNOWLEDGE AND EVALUATION

9.1 Using the best information available

The policy framework for activities in the North Sea requires using the best information available in the decision-making process.

General
A great many studies and field investigations have been carried out for the BritNed interconnector and for the benefit of the EIS. For an extensive overview of these studies, refer to the EIS literature list. This list indicates precisely which studies and field investigations have been carried out and which other studies were used. The EIS publisher's details contains an extensive list of reputable agencies and specialists who have contributed to the EIS and the investigations.

Intended activity and alternatives
For the design and configuration of the cable, the current state of knowledge and technology was listed and evaluated. The available techniques were also listed and evaluated for the installation. The information was obtained from previous projects, cable manufacturers and cable installation companies.

Underwater sound
Little is known at present about the way in which sound moves under water and how marine mammals and fish react to it. The expected underwater sound source levels for the installation equipment have been determined on the basis of the best available scientific knowledge and information. The same applies to the sensitivity limits of marine mammals in the case of different frequencies of underwater sound. For this purpose, a number of representative species have been considered. A transfer model was specifically set up for this EIS for the study of the transfer of sound under water. On the basis of the best available knowledge and information and the transfer model, it can be concluded that a temporary increase in underwater sound resulting from the construction of the BritNed interconnector will not threaten the continued existence of protected animal species.

Physical environment
The data for the physical environment originate from many sources. In the first place, the most up-to-date literature has been used. In addition, field measurements were taken by BritNed. On the basis of these measurements, a number of studies were carried out of dredging volumes, burying scenarios and turbidity of the seawater resulting from suspended substances released during the installation. In this context, dynamic calculation models were used that indicate how the suspended substances move in the seawater. Furthermore, electromagnetic studies were performed, as well as technical and geological studies for the installation of the land cable.

Ecology
The ecological data also originate from many sources. In addition, the most recent and relevant literature has been used. The spread of seabed fauna was summarised by Alterra specifically for the BritNed project based on the most recent databases. The ecology along the cable routes on land was surveyed by Groenteam in Moordrecht. The data relating to sensitivity of species to disturbance originates from reports of institutes

such as the Dutch National Institute for Coastal and Marine Management [*Rijksinstituut voor Kust en Zee*] and the Dutch Institute for Forestry and Nature Research [*Instituut voor Bos- en Natuuronderzoek*], and from other EIS studies. In addition, a number of experts were consulted.

Forms of usage
For the construction of Maasvlakte 2, use was made of the key planning decision (PKB) and the EIS drawn up for that purpose. As the construction of Maasvlakte 2 is currently being prepared, close consultation has taken place with the Port of Rotterdam Authority. Two investigations have been carried out relating to possible effects on shipping. The first relates to effects during the construction phase and the second to effects during the operational phase. With regard to effects during the construction phase, collision risk calculations were made by the MARIN institute. With regard to effects during the operational phase, a specialised Swedish company made calculations that present the consequences for compass error.

9.2 Gaps in knowledge

Extensive, dynamic and complex areas such as the North Sea, including the coastal waters and the Voordelta, unavoidably involve uncertainties and a number of gaps in knowledge. Nevertheless, in order to be able to take responsible decisions, conservative assumptions have been made or bandwidths indicated (within reasonable limits) throughout this EIS. In a number of cases, a 'worst-case' approach has been taken to exclude uncertainties.

The uncertainties relate, in particular, to developments in time. It is possible that the actual situation at the time of construction differs in some ways from descriptions in the EIS. As the descriptions take into account the dynamics of the area, these deviations will probably fall within the bandwidths described within the EIS. If there is cause to do so, the effects actually occurring can be determined with the aid of monitoring.

On the basis of the gaps in knowledge and the uncertainties described, it can be concluded that a responsible decision-making process concerning the construction of the BritNed connection is possible.

9.3 Monitoring and evaluation

An EIS should contain proposals, based on the Dutch Environmental Protection Act, for monitoring and evaluation, in so far as the nature and size of the effects and uncertainties give cause to do so. The gaps in knowledge and information are the starting point in this respect. BritNed sees cause for monitoring in only one case.

- *Soil/seabed material moved and maintenance and recovery frequencies*

The most important parameters for the effects on nature and the environment, both on land and sea, are the amount of soil/seabed material moved and the construction periods. For this reason, a proposal has been made to register the amount of soil/seabed material moved and the construction periods and to report this regularly to the competent authorities during the work. On this basis, decisions can be made as to whether there is cause for additional monitoring and introducing measures.