OSPAR
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Assessment of the impacts of the offshore oil and gas industry on the marine environment

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OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998.

The Contracting Parties are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998.

Les Parties contractantes sont l'Allemagne, la Belgique, le Danemark, l'Espagne, la Finlande, la France, l'Irlande, l'Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d'Irlande du Nord, la Suède, la Suisse et l'Union européenne.

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Executive summary

Offshore oil and gas activities have developed in the OSPAR area over the past 50 years. Environmental impacts can occur throughout the lifecycle of these activities, exploration, production and decommissioning. Impact can arise from discharge of produced water, oil, chemicals, drilling muds and cuttings, physical impact from the placement of installations and pipelines, noise from seismic surveys and drilling, light emitted from the installations and atmospheric emissions.

Pressures from offshore oil and gas activities are greatest in the North Sea and followed by Arctic Waters and the Celtic Seas. In the Bay of Biscay and Iberian Coast and the Wider Atlantic, the number of installations is low, and the pressures in these Regions are considered to be relatively low.

The OSPAR Commission has put in place a significant number of measures aimed at reducing discharges from the oil and gas industry in the OSPAR Maritime Area. The vast majority of these have been made since 2000 and aim to reduce the environmental impacts of the industry on the marine environment. Measures introduced by OSPAR have reduced oil in produced water discharges and the discharge of hazardous chemicals and drilling fluids. OSPAR has with a few exceptions, effectively prohibited the disposal of disused offshore installations at sea.

Studies have been undertaken by OSPAR Contracting Parties looking at a wide range of potential impacts including historical cuttings piles, discharges of produced water, drilling fluids and chemicals. There has been a measurable decrease in emissions and discharges. Activities that were once widespread for example from the discharge of oil-based fluids, have now ceased and the level of contamination has decreased over most of the OSPAR area. Where potential impacts may still occur, these have been reduced, for example by reduction in the amount of dispersed oil discharged in produced water; the phase out and reduction of discharges of hazardous offshore chemicals. A risk-based approach for the management of produced water discharges has also been introduced to complement the OSPAR harmonised mandatory control system for offshore chemicals and promote the shift towards a reduction in the use of more hazardous substances.

Contracting Parties have also fully implemented the ban on the dumping or leaving in place of disused offshore installations. Since OSPAR Decision 98/3 on the disposal of disused offshore installations was adopted, approximately 170 installations have been decommissioned of which 10 were granted derogations.

Evidence from monitoring and reporting indicates that the overall effect of these OSPAR measures and their implementation by Contracting Parties has been to significantly improve the overall quality status of the OSPAR Maritime Area as a whole, particularly in areas of Region II where there are high levels of oil and gas activity.

OSPAR will continue to take all possible steps to prevent and eliminate pollution, and work towards meeting the relevant operational objectives set out in the North-East Atlantic Environment Strategy 2030.

Récapitulatif

Les activités pétrolières et gazières offshore se sont développées dans la zone OSPAR au cours des cinquante dernières années. Des impacts environnementaux peuvent se produire au cours du cycle de vie de ces activités : exploration, production et démantèlement, et peuvent provenir du rejet d'eau de production, d’hydrocarbures, de produits chimiques, de boues de forage et de déblais, de l'impact physique de la mise en place des installations et des pipelines, du bruit des études sismiques et du forage, de la lumière émise par les installations et des émissions atmosphériques.

Les pressions exercées par les activités pétrolières et gazières offshore sont les plus fortes en mer du Nord, suivie des eaux arctiques et des mers celtiques. Dans le golfe de Gascogne, la côte ibérique et l'Atlantique au large, le nombre d'installations est faible et les pressions dans ces Régions sont considérées comme relativement faibles.

La Commission OSPAR a mis en place un nombre important de mesures visant à réduire les rejets de l'industrie pétrolière et gazière dans la zone maritime OSPAR. La grande majorité de ces mesures ont été prises depuis 2000 et visent à réduire les impacts environnementaux de l'industrie sur le milieu marin. Les mesures introduites par OSPAR ont permis de réduire les rejets d’hydrocarbures dans l'eau de production et les rejets de produits chimiques dangereux et de fluides de forage. A quelques exceptions près, OSPAR a effectivement interdit l'élimination en mer des installations offshore désaffectées.

Les Parties contractantes OSPAR ont entrepris des études portant sur un large éventail d'impacts potentiels, notamment les piles de déblais historiques, les rejets de l'eau de production, les fluides de forage et les produits chimiques. Il y a eu une diminution mesurable des émissions et des rejets. Les activités qui étaient autrefois très répandues, par exemple le rejet de fluides à base d’hydrocarbures, ont maintenant cessé et le niveau de contamination a diminué dans la majeure partie de la zone OSPAR. Lorsque des impacts potentiels peuvent encore se produire, ils ont été réduits, par exemple par la réduction de la quantité d'hydrocarbures dispersés rejetés dans l'eau de production ; l'élimination progressive et la réduction des rejets de produits chimiques offshore dangereux. Une approche basée sur le risque pour la gestion des rejets d'eau de production a également été introduite pour compléter le système de contrôle obligatoire harmonisé OSPAR pour les produits chimiques offshore et promouvoir le passage à une réduction de l'utilisation des substances les plus dangereuses.

Les Parties contractantes ont également pleinement mis en œuvre l'interdiction d'immerger ou de laisser en place des installations offshore désaffectées. Depuis l’adoption de la Décision OSPAR 98/3 sur l'élimination des installations offshore désaffectées, environ 170 installations ont été déclassées, dont 10 ont bénéficié de dérogations.

Les preuves issues de la surveillance et de la notification indiquent que l'effet des mesures OSPAR et de leur mise en œuvre par les Parties contractantes a été d'améliorer de manière significative l'état de qualité de la zone maritime OSPAR dans son ensemble, en particulier dans les zones de la Région II où l'activité pétrolière et gazière est importante.

OSPAR continuera à prendre toutes les mesures possibles pour prévenir et éliminer la pollution, et s'efforcera d'atteindre les objectifs opérationnels pertinents définis dans la Stratégie pour le milieu marin de l’Atlantique du Nord-Est 2030.

1. What are the problems? Are they the same in all OSPAR regions?

1.1 Extent and trends of oil and gas activities

Offshore oil and gas activities have developed in the OSPAR area over the past 50 years. Environmental impacts can occur throughout the lifecycle of these activities, exploration, production and decommissioning.

Exploration includes seismic surveys and the drilling of exploratory and appraisal wells. Production includes drilling of production and injection wells, and the construction, placement and operation of infrastructure to produce oil and gas. Decommissioning, the final phase of an oil and gas field when a field production cycle comes to an end, involves activities such as the plugging of wells and removal of infrastructure. Accidents or incidents during the transportation of oil and gas by pipeline or tanker, and accidental spills from installations have the potential to cause impacts outside the area of production. Environmental impact may arise at all these phases including; oil discharges from routine operations, use and discharge of chemicals, atmospheric emissions, noise, light and physical impacts from the placement of pipelines and installations.

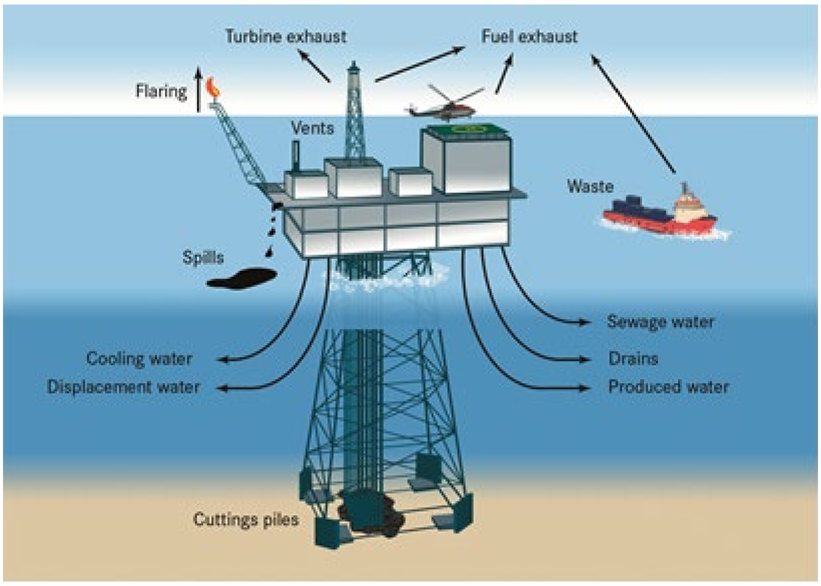


Figure 1: *Pressures to the environment from oil and gas industry*

The production of hydrocarbons decreased by 28% over the ten-year period of 2009 to 2019, though production increased from 2014 to 2016 by approximately 17%, before levelling off. The number of installations with emissions and discharges reported in the OSPAR Maritime Area is the same in 2019 as it was in 2009 (676). Over this period however there was a 14% increase in the number of reported installations up to a maximum of 766 installations in 2015, followed by a 12% decline to 676 installations by 2019. The decline was largely because of increasing cessation of production and decommissioning with the drop in the oil price in 2014.

Drilling activity[1] has, despite the downturn during 2013-2015, increased over the period from 382 wells drilled in 2011 to 443 wells drilled in 2019, with a peak of 490 wells drilled in 2017. While the number of wells drilled has increased over the period, most of the wells drilled are development wells rather than exploration and appraisal wells. There has been a decline in drilling activity in Ireland, the Netherlands and Denmark, while activity in Norway and the UK has remained relatively stable over the period with some annual variation.

Regions	Installations with discharges / emissions	All installations[2]
Region I	18	129
Region II	627	1 371
Region III	28	33
Region IV	2	5
Region V	1	1
Total	676	1 539[3]

Table 1: *Distribution of oil and gas installations in the OSPAR area*

Pressures from offshore oil and gas activities are greatest in the North Sea and followed by Arctic Waters and the Celtic Seas. In the Bay of Biscay and Iberian Coast and the Wider Atlantic, the number of installations is low, and the pressures in these regions are considered to be relatively low.

1.1.1 Region I - Arctic Waters

In Region I, oil and gas are currently produced on the continental shelf of the Barents Sea and the Norwegian Sea. The Barents Sea is one of the widest shelf areas in the world with a mean depth of 230 m. Both Russia and Norway are exploiting the area, which from an ecological point of view, is considered to be very sensitive to oil and gas development. Region I also has areas with a unique bottom fauna of deep sea cold water corals and sponges which are vulnerable to physical disturbance and particle exposure and require many years to re-establish. The Norwegian and Barents Seas have a high biodiversity, high biological production and serve as important spawning and nursing areas for fish. Parts of the Region also hold important numbers of breeding marine mammals and seabirds. In the Arctic, seasonal aggregations of animals, such as marine mammals in open water areas in sea ice, seabirds at breeding colonies, or fish at spawning time, may be particularly vulnerable.

[1] Since 2011, drilling activity is reported to OSPAR as number of wells drilled, including geological sidetracks. Prior to 2011, drilling activity was reported as fractions of a year, e.g. a MODU spending three months drilling would be reported as 0.25 years of activity.

[2] Including subsea infrastructure and derogated installations

[3] Discrepancy with installation co-ordinates is currently being investigated.

Activities in Region I

Iceland

The first licensing round for hydrocarbon exploration and production licences in Iceland, announced in January 2009, was unsuccessful. A second announcement in 2011 led to three applications that were agreed upon, leading to two exclusive exploration and production licences issued in January 2013 and one in January 2014. One of the licences was relinquished in January 2015, the second licence was relinquished in January 2017 and the third licence was relinquished in January 2018. Two areas on the Icelandic continental shelf are thought to have potential for commercial accumulations of oil and gas. The areas are Dreki located east and north-east of Iceland and Gammur on the northern insular shelf of Iceland. However, there are no active licences or oil and gas activity in Icelandic waters.

Denmark

So far five licences have been granted in the waters north-east of Greenland. All licences in Greenland are in ice-covered areas, where both overall and detailed knowledge on sea ice is essential for both authorities and the oil and gas industry. Studies on ice are carried out at authority level, together with regional and local ice studies. Seismic investigations have been carried out. Exploration drilling has been performed in Western Greenland, but these waters are outside the OSPAR area. There are presently no plans for new exploration drillings on the Faroe Islands.

Norway

In the Norwegian part of Region I, there are activities both in the Norwegian Sea and the Barents Sea. New gas infrastructure has been established in the northern part of the Norwegian Sea: the Aasta Hansteen field, which started production in 2018, and the gas pipeline Polarled. There are currently two fields in production in the Barents Sea, Snøhvit and Goliat, and a third, Johan Castberg, is under development and production will start in 2023. In 2021 a programme for impact assessment, for development of the Wisting discovery in the Hoop area in the Barents Sea, 320 km off the mainland, was submitted. The production period is estimated to 31 years.

From the start of offshore oil and gas activities in the southern part of the Barents Sea in 1980 and up to the end of 2020, 162 exploration and appraisal wells had been drilled, 101 of which were begun in 2005 or later. About half of these wells have indicated the presence of hydrocarbon deposits. A number of small and medium-sized discoveries have been made.

In Norwegian waters, the parts of the Barents Sea areas opened for oil and gas activity are on average ice free all year with sea temperatures comparable to the Norwegian Sea.

1.1.2 Region II - Greater North Sea

Region II has more oil and gas development than any other OSPAR Region with exploration and production occurring in Denmark, Germany, the Netherlands, Norway and the United Kingdom. Exploration and production have been carried out in this Region since the early 1960s and there are now a total of 1 371 installations in the Region of which 627 installations are reported to contribute to emissions and discharges. The Greater North Sea is bounded by the shallow mixed water in the south to deeper waters in the north. The major oil developments have been in the northern part of the North Sea in the UK, Norwegian and Danish sectors. Gas deposits are exploited mainly in the southern regions in the UK, Dutch and Danish sectors, as well as in Norwegian waters. There are a limited number of gas and oil production platforms in the Wadden Sea (for example Germany). The seabed of the southern North Sea comprises largely sandy sediments and has relatively strong tidal currents thus the fauna is adapted to changing conditions and the movement of sand along the bottom. In the more northerly areas of the North Sea the sediments are less sandy and less mobile with weaker currents where there are, in places, significant areas of corals and sponges. The Greater North Sea supports a diverse range of cetacean species, represents an important migratory pathway for many Arctic-breeding species supporting vast numbers of breeding seabirds and has some of the commercially important fishing grounds. As Region II has the longest history of oil and gas development and the most mature oil and gas fields, many of the activities that caused impacts during the earlier years of development up until the 1990s have ceased and the main concerns now relate to impacts from historical cuttings piles and the discharge of produced water.

1.1.3 Region III - Celtic Seas

Exploration drilling in Region III has been undertaken in the Celtic Seas since 1969 with oil production starting in 1985.The region where most oil and gas development occurs is dominated by relatively shallow bays in three separated sea areas (Celtic, Irish and Malin seas). Most of the production facilities and pipelines are situated in the Irish Sea in particular around Liverpool and Morecambe Bay off the English coast. The main areas of concern arise from the risk of an oil spill in near shore areas occurring in areas of high seabird numbers, particularly during the winter period. Production of gas from the Kinsale area gas fields, located offshore Cork and the only production facilities in the Celtic Seas, ceased in 2020 and the facilities are currently being decommissioned. The total number of installations in the Region is 33 of which 28 installations are reported to contribute to emissions and discharges.

1.1.4 Region IV – Bay of Biscay and Iberian Coast

Region IV has potential for oil exploitation on the sedimentary basins in the inner south-eastern part of the Bay of Biscay. The coastal plains of Aquitaine (France) and the Northern coast of Spain have historically been exploited and Spain operates a few installations on their shelf. There is also gas production in the Gulf of Cadiz with pipeline to the shore. There are currently five installations in this Region of which 2 installations are reported to contribute to emissions and discharges.

1.1.5 Region V – Wider Atlantic

Exploration and development activities within Region V, the wider Atlantic have been limited with only one installation which is reported to contribute to emissions and discharges. The seabed in these areas comprises largely muds and clays with areas containing cold water corals. Some parts of the Region are important for seabirds and marine mammals.

1.2 Pressures on the marine environment from oil and gas activities

1.2.1 Produced water

Produced water (PW) is a by-product of oil and/or gas production operations and includes formation water, condensation water and re-produced injection water. Hydrocarbons are, as far as possible, removed from the water prior to any discharge. As the volume of hydrocarbons produced from a reservoir decreases over the life of the field the volume of PW generally increases. Consequently, most produced water is from the mature, more developed fields of the North Sea. PW is usually either discharged into the sea after treatment, or is injected back into the reservoir from where it originated.

The continuous discharges of PW are an environmental concern, as they represent the largest source of crude oil contamination to sea from offshore oil and gas operations. In addition to the natural pollutants in the oil, potentially hazardous production chemicals are also discharged.

Naturally occurring hazardous components in PW include substances belonging to the groups of phenols, alkylphenols, and naphthenic acids. The group of alkylphenol substances include individual substances with endocrine disrupting properties in aquatic organisms. Naphthenic acids include substances that are suspected to have endocrine disrupting effects. Other substances of concern are the BTEX-substances (Benzene, Toluene, Ethylbenzene, Xylenes) which, however, are expected to dissipate quickly from the water column due to evaporation. PAHs, including naphthalene, phenanthrene and dibenzothiophene (NPD) may have severe effects in the water column such as carcinogenicity, DNA damage, embryotoxicity, growth, oxidative stress, and narcotic effects. Several of the metals found in PW have a high toxicity to aquatic organisms and some have a potential for bioaccumulation[4]. PW also contains chemicals added during processing or separation of produced oil and gas. A number of different offshore chemicals are applied and are in many cases the main contributors to the overall toxicity of the produced water.

After discharge, PW is largely diluted and dispersed in the water column. However, hydrophobic chemicals may adsorb to sediment, especially in shallow water or by a downward trajectory of the PW plume. The sediments of the seabed may also be exposed indirectly via sedimentation of adsorbed fractions. Sediments near offshore oil and gas platforms contain the hydrophobic components present in PW, although the source can also be drilling mud or drill cuttings. Discharge of produced water can also from time to time lead to the formation of oil sheens at the sea surface, especially in calm weather conditions. A number of factors may contribute to this such as depth of discharge, dispersed oil concentration and metocean conditions. Produced water sheens can in some instances extend some distance from the point of discharge. While the majority comprise thin oil layers which are rapidly dispersed through wave / wind action, in some cases, particularly where there has been a process upset, this may result in thicker oil layers which take longer to break down by natural processes.

1.2.2. Chemicals

The use of chemicals is critical for the production of oil and gas. Chemicals are used in a variety of applications during drilling, production and decommissioning operations. They may, for example, be used during drilling and well completions, injected into the process stream, used as pipeline chemicals, gas treatment chemicals, or utility chemicals, as well as those added to export flow and arriving from upstream facilities.

The main discharges of chemicals arise from drilling activities and discharges of produced water. Chemicals are also used to maintain pipelines and ensure pipeline integrity.

Some of the chemicals are hazardous because they contain substances that are either persistent, and/or liable to accumulate in living organisms and/or toxic. Effects on marine organisms from such chemicals discharged into the marine environment can be acute or long term and can ultimately have effects on human health via the food web.

[4] Report on impacts of discharges of oil and chemicals in produced water on the marine environment. OSPAR Commission. London. Publication number 804/2021

1.2.2.1 Plastics and microplastics

The pollution of the marine environment with plastic (macro) litter and microplastic particles, is regarded as a major global environmental problem. Plastic material is a valuable material in our society and is used in a diverse range of applications, both short and long term, before potentially becoming waste. Loss of plastics to the environment may occur at any stage of the lifecycle. (Assessment document of land-based inputs of microplastics in the marine environment, EIHA, 2017)

A limited number of offshore chemicals contain plastic or microplastics substances which are used and discharged during other offshore operations. Given the growing concerns related to marine litter, including plastics and microplastics, it is considered relevant to monitor the amount of plastic or microplastic substances contained in offshore chemicals discharged by the offshore oil and gas industry in the OSPAR Maritime Area, and the extent to which the discharges may be contributing to the wider marine litter issue. In addition, although protection materials such as sand/grout bags and concrete mattress are meant to be removed at end of life of the infrastructure, the plastic materials contained in these materials may deteriorate and eventually disintegrate over the extended periods for which they are deployed on the seabed, and therefore contribute to marine plastic litter and microplastics.

1.2.3 Naturally Occurring Radioactive Materials

Naturally Occurring Radioactive Materials (NORM) arise naturally in the Earth's crust as a result of radioactive elements created through cosmic processes, and radionuclides created through radioactive decay of these elements. NORM wastes arise when these materials are concentrated through industrial activities, for example oil and gas exploration and exploitation. NORM wastes are distinct from anthropogenic radioactive wastes, which arise as a result of activities that deliberately process and use materials for their radioactive, fissile or fertile properties.

Annual data collection by OSPAR on NORM discharges from the non-nuclear sector has been taking place since 2006 (collecting data from 2005). PW discharges from the oil and gas industry is the main source and the radionuclides reported include Ra-226, Ra-228, Pb-210. Norway, the UK and the Netherlands are normally the principal contributors. In 2018 the relative contributions of discharges in PW (using Ra-226 as an indicator), were Norway 50%, United Kingdom 36%, the Netherlands 11%. The discharges reported by Denmark, Germany and Ireland contributed with about 3%[5].

Offshore oil and gas is the main source of total alpha discharges to the OSPAR area, accounting for about 97% of the total from all sectors (non-nuclear and nuclear) and also makes a 13% contribution to the overall total beta discharges from all sectors (nuclear and non-nuclear)[5].

NORM discharges are covered in the Radioactive Substances 5th Periodic Evaluation Report and will not be further discussed in this report.

1.2.4 Drilling fluids and cuttings piles

The drilling process includes use of drilling fluids (or muds), which serve multiple purposes including to carry drill cuttings to the surface, to lubricate and cool the drill bit, and to control well pressures as

[5] https://oap.ospar.org/en/ospar-assessments/committee-assessments/radioactive-substances/discharges-non-nuclear/2018/

part of safe drilling operations. Drilling fluids are categorised into either water-based or organic-phase fluids.

Drilling of both hydrocarbon and injection wells generates drill cuttings, which are particles of crushed rock produced by the action of the drill bit as it penetrates the earth. The chemical and mineral composition of drill cuttings reflects that of the rock layers being penetrated by the drill. Cuttings contain residues of the drilling fluids used in the wells and in some cases also reservoir hydrocarbons. Cuttings piles can arise from drilling operations where the drilled cuttings and associated drilling fluids are discharged at the location of the well and accumulate depending on the water current in the region. It is more than 20 years since the discharge of organic-phase fluid contaminated drill cuttings was prohibited, but historic cuttings piles are still present under some platforms. Historic organic-phase fluid cuttings piles have been identified as possible source of oil release into the marine environment, due to remobilisation of residues of oil still found in the piles and natural leaching into the water column. Studies have shown that the leakage of oil from these cuttings piles is low[6] and their individual footprints are contracting due to natural degradation. However, concerns of possible releases of oil and chemicals from disturbance of historic cuttings piles, either during decommissioning activities or from bottom trawling after decommissioning, were identified.

The discharge of cuttings drilled with water-based fluids (including in some cases cuttings with reservoir hydrocarbons) and treated cuttings drilled with organic-phase fluids are now the only drilling fluids discharged into the marine environment. The main constituents in such fluids are weighting materials such as ilmenite and barite. Dispersion of mud and cuttings is influenced by various factors, including particle size distribution and density, vertical and horizontal turbulence, current flows, and water depth. In deep water, the range of cuttings particle size results in a significant variation in settling velocity, and a consequent gradient in the size distribution of settled cuttings, with coarser material close to the discharge location and finer material very widely dispersed away from the location, generally at undetectable loading.

Discharge of cuttings drilled with water-based fluids and discharge of treated cuttings drilled with organic-phase fluids may cause some smothering in the near vicinity of the well location. The impacts from such discharges are localised and transient but may be of concern in areas with sensitive benthic fauna, for example corals and sponges.

1.2.5 Installations and pipelines

There are approximately 1 539 operational oil and gas installations in the OSPAR Maritime Area, of which 676 contribute to the emissions and discharges in the OSPAR Maritime Area. Approximately 54 000 km of oil and gas related pipelines have been laid in the OSPAR Maritime Area. A large number of pipelines are inter-field lines transporting hydrocarbons from one field to a platform at another where hydrocarbons are usually processed before being transferred to a trunk pipeline.

Environmental impacts from pipelines principally take place during pipeline installation and over time pipeline infrastructure remaining in situ can potentially lead to physical and biological changes on the seabed. The footprint of the pipeline is dependent on the length, diameter and whether or not it is trenched/buried/rock covered. Once laid, the impact on the environment does not extend beyond the area directly beneath the pipeline itself. The water currents near the seabed and the type of sediment

[6] https://oap-cloudfront.ospar.org/media/filer_public/55/76/557644a6-a67f-44c8-802d-564041f07bc6/p00745_disturbance_drill_cuttings_decommissioning.pdf

will affect the accumulation and scouring of the sediment around the pipeline and, if trenched/buried, the frequency of appearance of spans (i.e. areas where pipeline is exposed from the trench). The accumulation and scouring of sediment and the appearance of pans is dependent on local and pipeline specific conditions. Designated protected areas, particularly those containing habitats such as sandbanks and biogenic reefs, are likely to be more sensitive to these changes than the wider maritime area.

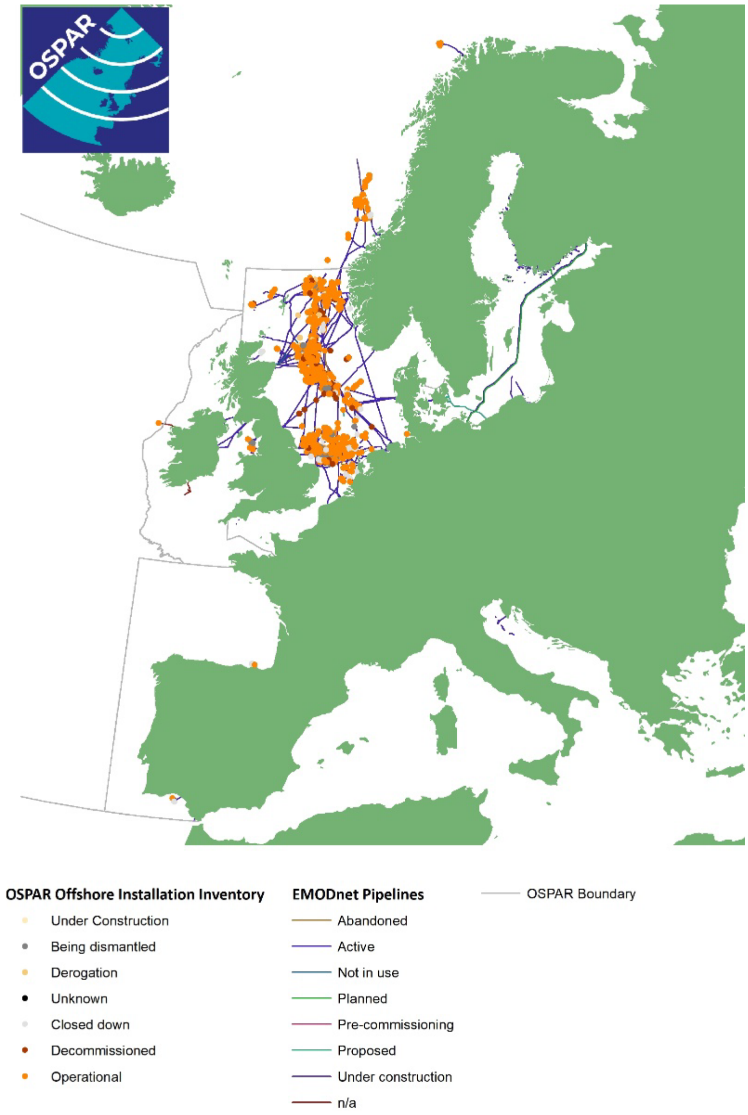


Figure 2: *Offshore oil and gas installations and pipelines in the OSPAR area*

Snagging of fishing nets can occur where surface laid pipelines have been left in situ or where trenched/buried pipelines have been become exposed, particularly where the exposure is significant enough to become a span. No overall statistics are available regarding the number of interactions between fishing gear and pipelines. Most incidents involve loss of fishing gear, however, there has been one fatal accident.

In addition to pipelines, the large number of offshore installations will also cause a physical impact on the seabed and similar to pipelines, the impact is limited to an area affected by the physical presence of the installation. Due to the length of the pipelines placed on or under the seabed overall physical impact of pipelines is considered to be greater than those from offshore installations.

Decommissioning of pipelines and offshore installations will also cause a physical impact on the seabed and leaving structures in situ equally will have an impact on other users of the sea.

1.2.6 Accidental spills

Accidental discharges (spills) of oil and chemicals arise as a result of failures of process, equipment or human error. Spills can range from small drips to large scale ongoing pollution incidents such as well blowouts. The timing and location of a spill are important; a relatively small spill can have a greater impact for example during the spawning season than a much larger spill at a different time. Previous concerns that aging of the offshore oil and gas infrastructure may increase the risk of accidents resulting in spills of oil and chemicals have not been confirmed.

Over the period 2009-2019, the number of accidental spillages of oil to sea varied widely with 2014 having the highest number of spills (572) and 2019 having the lowest (338). While there has been annual variation there seems to be a downwards trend in the number of oil spills being reported since 2014. The total quantity spilled each year is variable with a high of 541 tonnes in 2012 when a single large spill in the UK contributed approximately 400 tonnes to the total and a low of 44 tonnes in 2016 (see Figure 13). In 2019, accidental oil spills contributed with less than 2% (wt) (106 tonnes) of the total amount of oil released to the sea from offshore oil and gas installations, the remaining 98% (wt) (4 096 tonnes) being dispersed oil discharged with produced water.

1.2.7 Atmospheric emissions

Offshore oil and gas installations require substantial power in order to extract, process and export hydrocarbons, consequently the main source of emissions are from power generation. Another source of atmospheric emissions includes flaring and venting of hydrocarbons which is required to ensure safety of operations on the installation as well as during well testing and well clean-up operations. These are the main sources of the majority of the atmospheric emissions. Tanker loading and off-loading also contribute to atmospheric emissions, particularly volatile organic compounds (VOCs).

1.2.8 Light

There are concerns over the impacts on migrating birds from flaring and lighting from offshore installations. A significant number of birds of different species migrate across OSPAR Region II (Greater North Sea) at least twice a year or use the Greater North Sea as a feeding and resting area. The migratory behaviour is an essential part of the birds' natural lifecycle. Some species crossing or using the area may become attracted to offshore light sources, especially in deteriorating weather conditions which result in restricted visibility (e.g. low clouds, mist, drizzle). This attraction can be fatal and may involve large numbers of individuals of many species of birds. OSPAR Region II contains a substantial number of illuminated offshore installations and the attraction can potentially result in mortality. An OSPAR Workshop on research into possible effects of offshore platform lighting on specific bird populations noted that there is evidence that conventional lighting of some offshore installations has an impact on a large number of birds. Evidence is, however, not sufficient to conclude whether or not there is a significant effect at a population level.

1.2.9 Noise

There are a number of distinct phases of oil and gas operations that produce underwater noise, ranging from initial seismic exploration to drilling to production and then to decommissioning. The most significant underwater noise associated with each phase is dependent upon the nature and scale of the specific activities. Geophysical surveys associated with the exploration and management of hydrocarbon reserves are a source of anthropogenic noise. Drilling for hydrocarbons requires the use of mobile drilling units or drilling equipment installed on fixed platforms, and the position keeping propulsion mechanisms of some mobile drilling units are also a notable source of noise. Infrastructure installation activities involving underwater hammer piling, and the occasional use of explosives for well abandonment or the decommissioning of facilities are also a source of underwater noise.

Anthropogenic noise emitted to the marine environment can potentially affect marine organisms in various ways. It can mask biologically relevant signals; it can lead to a variety of behavioural reactions; hearing organs can be affected in the form of hearing loss, and at very high received levels, sound can injure or even kill marine life. Documented effects on marine life vary greatly from very subtle behavioural changes, avoidance reaction, hearing loss, injury and death in extreme cases.

1.2.10 Carbon dioxide storage

Storage of carbon dioxide (CO_2) in geological formations including depleted oil and gas reservoirs and saline aquifers is an emerging offshore activity.

The pressures from CO_2 storage, inter-alia development and decommisioning activities, could be similar to pressures from offshore oil and gas activities. There is the risk of CO_2 leakage from the storage site which may have negative effects on the receptors in the marine environment if CO_2 leakage were to occur. Whilst scientific knowledge of the environmental risks of storage of carbon dioxide in geological formations is developing, the need to improve and refine the reporting to OSPAR on environmental monitoring from CO_2 storage projects has been identified.

There are two large scale CO_2 storage projects currently operating in the OSPAR Maritime Area (*Sleipner* and *Snøhvit* in Norway). A number of new project proposals are being developed and are at various stages of progression including the *Greensand* project in Denmark, the *Porthos* and *Aramis* project in the Netherlands, the *Longship* project in Norway, the *Acorn*, *Northern Endurance* and *HyNet North West* projects in the United Kingdom.

2. What has been done?

The OSPAR Commission has put in place a significant number of measures aimed at reducing emissions and discharges from oil and gas industry with the OSPAR Maritime Area. As of 2020, there are 15[7] OSPAR Decisions and Recommendations relating to offshore oil and gas industry and a further 21[8] other Agreements. The vast majority of these have been made since 2000 (most of which have since been updated) and aim to reduce the environmental impacts of the industry on the marine environment. Measures introduced by OSPAR have reduced oil in PW discharges and the use and discharge of chemicals and drilling fluids. OSPAR has with a few exceptions, effectively prohibited the disposal of disused offshore installations at sea.

[7] The number of Decisions and Recommendations does not include the Decisions and Recommendations amending the original text nor those that have been set aside.

[8] The number of Agreeements does not include those that have been set aside.

2.1 Oil in produced water

2.1.1 Discharges of oil to sea

Dispersed oil is discharged into the OSPAR Maritime Area in accordance with OSPAR Recommendation 2001/1 (as amended), which seeks to limit the concentration of dispersed oil in produced and displacement water discharges to no more than 30 mg/l, calculated as a flow weighted monthly average. The Recommendation also calls for a reduction in the total oil discharged into the sea in 2006 by 15% compared to the equivalent discharge in the year 2000, which has been achieved. The concentration of dispersed oil is determined in accordance with the OSPAR reference method[9].

Discharges of PW, even those meeting the 30 mg/l performance standard, can from time to time lead to the formation of oil sheens at the sea surface, especially in calm weather conditions. The sheens normally evaporate or disperse into the sea by natural processes. The continued application of the above-mentioned measures for limiting the oil content in PW will help reduce the likelihood of the occurrence of such sheens.

2.1.2 Risk based approach

In 2012, OSPAR Recommendation 2012/5 for a risk-based approach to the management of produced water discharges from offshore installations was adopted. Contracting Parties provided OIC with implementation plans in 2013 and the majority commenced assessments in 2014 with the Recommendation due to be fully implemented by 2018.

Through the introduction of the Risk Based Approach (RBA) in OSPAR Recommendation 2012/5, the environmental risk of discharges of PW are calculated for all installations discharging PW to the OSPAR Maritime Area. The purpose of RBA is to assess the environmental risk posed by discharges of oil, naturally occurring hazardous components (like PAH, BTEX) and added chemicals with PW, with the aim of finding appropriate measures to reduce the risk to levels, where the calculations show it is adequately controlled. While RBA cannot be used as basis for an assessment of the actual impact of PW in the marine environment, the results can be used as a tool to target the different investigations of such impacts, like environmental monitoring, in the sea around the offshore installations.

Risk levels of PW discharges in the OSPAR area have been reported through the yearly reporting to OSPAR's Offshore Industry Committee (OIC). Due to differences in the available information on added chemicals, different discharge factors, dilution and dispersion models, the results from installations within, and especially between the Contracting Parties cannot be compared. Nevertheless, a main finding is that some types of offshore chemicals are major contributors to the risk posed by PW discharges. The extent of the contribution may be overestimated due to the scarcity of long term toxicity data and in consequence hereof the use of large assessment factors, but for some production chemicals, their toxicity is inherent to their desired function. For several installations, discharges of corrosion inhibitors and biocides, not surprisingly, are major contributors to risk. Corrosion inhibitors may include a range of inorganic and organic substances.

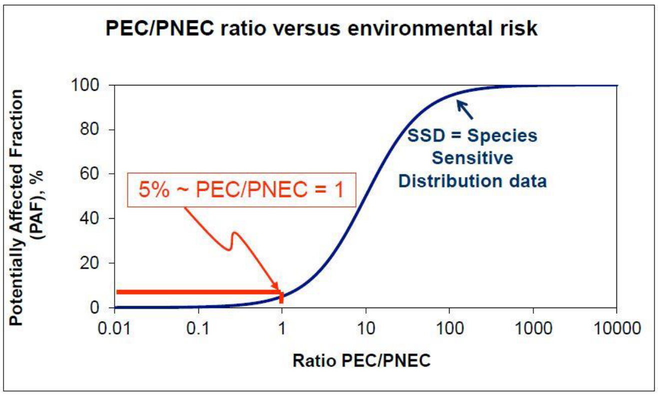
[9] OSPAR Agreement 2005/15 https://www.ospar.org/documents?d=32597

Fact box 1: RBA – example RBA calculation:

The purpose of RBA is to assess the environmental risk (e.g. expressed as PEC/PNEC) posed by discharges of oil, naturally occurring hazardous chemicals and added chemicals with produced water, with the aim of finding appropriate measures to reduce the risk to levels, where the calculations show it is adequately controlled. Risk assessments on a substance level can help to identify substances aiming for risk reduction and for further investigations of possible biological impacts on marine biota. The risk assessment step will not in itself provide information on the actual impacts on marine biota, but the Recommendation includes a step of performing environmental monitoring in order to detect changes in the receiving environment and to verify the impact hypothesis.

The first step in the RBA calculation can be done either by using simple dilution factors or by 3-dimensional fate modelling using a dispersion model that takes into consideration the hydrography, currents, temperature etc. of the sea. The fate modelling also considers the physical properties either provided (for production chemicals) or defined within the model (for the naturally occurring components) such as biodegradation rate and density. This stage of the process calculates the predicted environmental concentration (PEC) of all the components of the release. In this example the simulation runs with a continuous release over a standardised period of 30 days.

This example uses the DREAM-EIF fate modelling, where a concentration field for each release is generated throughout the standardised 30 days modelling period. Following the fate modelling, a risk map is then generated by comparing the PEC with the PNEC for the components in the release.



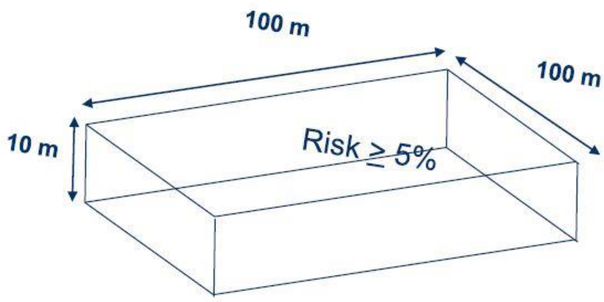


Figure 3: Illustration of the EIF concept (Source: Miljø- og fødevareministeriet, 2018)

The results of the RBA calculation can be expressed as Environmental Impact Factor (EIF) as originally described by Johnsen et al. (2000). The Environmental Impact Factor (EIF) concept is illustrated in Figure 3 . The model calculates EIF, where EIF=1 represents a volume of water 100x100x10m in which PEC/PNEC ratios are ≥ 1.

For each discharge point, risk maps are generated, illustrating the risk of the discharge in terms of PEC/PNEC ratio. An example of a risk map can be seen in Figure 4

The results of these calculations can also be seen on a component-based level, as the risk contribution for each of the components in the discharge can be calculated in the risk modelling. These individual contributions to the total risk can be illustrated in a pie chart generated for each discharge (Figure 5). For each simulation, both a time-averaged EIF and a maximum instantaneous EIF can be generated. The first represents an average over the 30-day period, while the second represents the maximum risk recorded at a single time point during the 30-day simulation period.

If a WET based approach is applied, using WET data, the risk can also be expressed as EIFs, or it can be expressed as the distance to the discharge point where the sum of PEC/PNEC ratios is greater than 1.

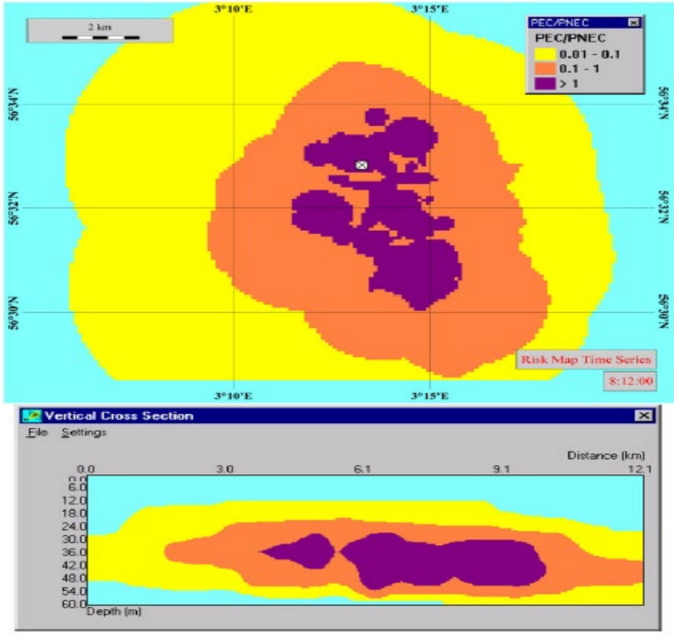


Figure 4: Example of a calculated risk map, coloured after the PEC/PNEC value of the sum of PW constituents. Horizontal view in upper panel and vertical view in lower panel. (Source: Miljø- og fødevareministeriet, 2018)

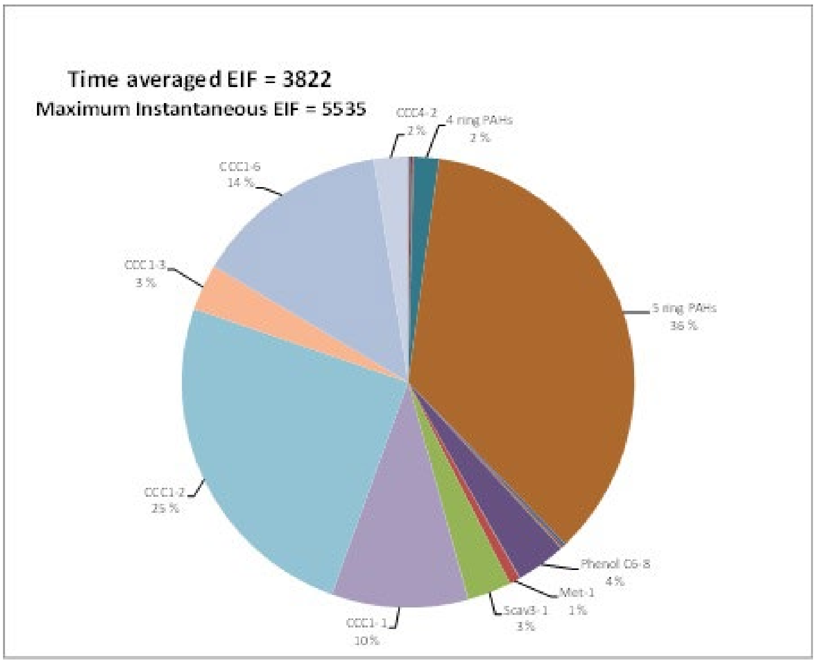


Figure 5: Example of the contribution to risk from the different components of the discharge with indication of both time-averaged risk and maximum instantaneous risk both expressed by EIF (CCC = Corrosion Control Chemical, Scav = H2S Scavenger). (Source: Miljø- og fødevareministeriet, 2018)

2.1.3 Effect studies of PW discharges

Toxicity

Toxicity studies have been conducted at several trophic levels of marine organisms (e.g. bacteria, algae, zooplankton, bivalves, fish). Controlled laboratory studies show that PAH contaminants from oil contamination may induce cardiac defects impacting the fitness of fish fry in several critical ways including reduced swimming performance, prey capture, and prey avoidance, with repercussions for survival and possibly for population recruitment. Haddock is believed to be particularly vulnerable to oil during early life stages because embryo surface (chorion of the egg) is very sticky and haddock eggs were found to adsorb dispersed oil droplets to a much higher degree than eggs from Atlantic cod. It remains to be seen whether cardiac toxicity can be induced in fish, eggs or larvae drifting through an offshore plume of PW. Cod eggs, larvae and fry effectively absorb alkylphenols from PW, and the earliest life stages (eggs and larvae) may be more exposed to toxic effects of the compounds as they have less capacity to metabolise and excrete the short chain alkylphenols compared to juvenile and adult fish.

Water column monitoring

Field based studies have used fish caged in the main pollution plume, which were investigated for chemical content including PAHs and alkylphenols as well as biomarkers such as DNA adducts and histological effects. Findings concluded that the fish had been exposed to PW. However, elevated levels of PAH and biomarkers of exposure have not been identified consistently in wild fish, whether caught outside, or in, production field areas in the North Sea. An explanation could be that some fish species actively avoid plumes containing elevated levels of PAHs, which makes it difficult to assess the impact on wild fish population from observations made on caged fish. The typical modest responses on the possible PW exposure found in wild fish in combination with the environmental risk assessments of PW discharges offshore, points at a low-risk situation for PW discharges in the OSPAR area.

Similar to fish, mussels kept in cages in a PW plume relatively close (some hundred metres to a few kilometres) to the PW discharge point can be confirmed exposed to PW. This is evident from findings of accumulated PAHs and modest responses such as stress indicated by histopathological analyses of mussels' digestive gland. The observed levels and responses decreased with the distance from the platform. Caged blue mussels (*Mytilus edulis*) were found to be compensating for the stress, maintaining reproductive development such as spawning status. The mechanism for compensation is unclear, but could be due to an increase in phytoplankton growth caused by fertilisation (with e.g. ammonia in PW) or a toxicity-related reduction in planktonic grazing pressure, both leading to increased food availability to mussels.

There is no consensus on which biomarkers to use for zooplankton, brine shrimp (*Artemia salina*) being a standard test organism. Neither zooplankton nor phytoplankton (algae) have yet been proven to be particularly sensitive.

It is generally accepted that organism effects are observed at PW concentrations corresponding to a dilution of less than 1000 times. This corresponds roughly to a distance of less than 1000 m from the discharge point depending on the discharge rate, water depth, local currents and other environmental factors. Based on laboratory results and studies with caged animals placed in the PW plume, acute effects can be expected at such concentrations. Effects at lower concentrations are observed, however, after weeks of exposure. Such long exposure times are, however, not relevant under environmental conditions where organisms in the water column move actively, and the direction of the plume may be change over time due to tide, currents, and wind. Sessile organisms are also expected to rarely experience constantly high exposure levels.

Seabed monitoring

Both Danish and Norwegian studies observe that the sediment concentration of petrogenic PAHs increases in areas close to the studied platforms. However, at 70% of the stations, the dominant form of PAH in the sediment surface was pyrogenic, indicating that the main sources are the intensive maritime traffic, industrial activity and coastal cities in the region. The sediment samples around the Danish platforms were scored with biological diversity and evenness descriptors. Although low scores were observed at one platform at a distance up to 1500 m 5 years after drilling operations, the general conclusion was that the environmental status near the Danish platforms is good. A similar conclusion was reached after the latest investigations in 2018. As such, changes to the seabed fauna and quality are local and short-term and the seabed is resilient to disturbances associated with oil and gas operational discharges.

Oil sheens

Investigations of PW discharges to date have not included possible effects of oil sheens originating from discharges of PW. Assessing the extent and possible effects of oil sheens originating from discharges of PW has been identified as a task that needs to be addressed in the coming years.

2.2 Chemicals use and discharge

In 1996, OSPAR's predecessor, the Paris Commission (PARCOM), adopted Decision 1996/3 on a Harmonised Mandatory Control System for the Use and Reduction of Discharge of Offshore Chemicals (HMCS). Following a trial period, its effectiveness was reviewed and a package of new OSPAR measures were established and adopted in 2000 (OSPAR Decision 2000/2 on a Harmonised Mandatory Control System (HMCS) for the Use and Reduction of the Discharge of Offshore Chemicals, as amended). The purpose of the Decision is that by application of the management mechanisms set out, authorities shall ensure and actively promote the continued shift towards the use of less hazardous substances (or preferably non-hazardous substances) and, as a result, the reduction of the overall environmental impact resulting from the use and discharge of offshore chemicals.

The HMCS Decision, along with OSPAR Recommendation 2017/1 on a Harmonised Pre-Screening Scheme for Offshore Chemicals (as amended) and OSPAR Recommendation 2010/3 on a Harmonised Offshore Chemical Notification Format (HOCNF) (as amended) is a key element in OSPAR's control of offshore chemicals. It sets out, inter alia, what kind of data and information must be notified to the competent national authorities of the Contracting Parties. For each chemical, it provides advice that is to be taken into account by the authorities with the aim of harmonising authorisation and permitting procedures for chemicals amongst the Contracting Parties. The measures also include more detailed guidance on the substitution and ranking of chemicals.

Following the introduction of the EU REACH Regulation in 2006, OSPAR has adopted modifications to OSPAR Decisions and Recommendations to harmonise HMCS with the new Regulation where possible. These have included the following changes:

- The molecular weight threshold, above which substances are assumed to be non-bioaccumulative, was increased from 600 to 700 in order to align with the value originally used by REACH (although the latter approach was later superseded);
- The OSPAR List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment (PLONOR) was amended to accommodate all items qualifying as low risk substances under Annex IV of REACH;
- The PLONOR List was amended to accommodate certain items exempted from registration under Annex V of REACH, subject to conditions (described under OSPAR Agreement 2012-05);

- Substances whose hazards cause them to be included in Annex XIV of REACH (The Authorisation List), now qualify as Candidates for Substitution under the OSPAR Pre-Screening Scheme (OSPAR Recommendation 2017/1 as amended);
- Substances whose hazards qualify them for restrictions specified in Annex XVII of REACH now qualify as Candidates for Substitution under the OSPAR Pre-Screening Scheme, if those restrictions are relevant to their offshore use (OSPAR Recommendation 2017/1 as amended);
- The OSPAR Pre-Screening Scheme was amended to allow the use of REACH half-life data when assessing against the 20% biodegradability threshold (OSPAR Recommendation 2017/1 as amended); and
- The data quality requirements for information submitted with the HOCNF form and reflected in the Confirmation Statement are now aligned with those of REACH (OSPAR Recommendation 2010/3 as amended).

The work on measures to increase harmonisation between the HMCS and REACH continues, but initial hopes that the two systems can be completely merged appear unlikely to be realised.

2.2.1 List of Chemicals for Priority Action (LCPA) & Candidates for substitution

OSPAR identifies substances that pose a risk for the marine environment and maintains a List of OSPAR Chemicals for Priority Action of Substances of Possible Concern. These Lists are undergoing substantial review and revision in 2021/22.

OSPAR Recommendation 2005/2 on environmental goals for the discharge by the offshore industry of chemicals that are, or contain added substances, listed in the OSPAR 2004 List of Chemicals for Priority Action (LCPA) set environmental goals for the reduction of substances on the OSPAR LCPA such that discharges were to be phased out by 2010. According to the Recommendation, authorities should not issue new authorisations for the discharge in the OSPAR Maritime Area of offshore chemicals that are, or which contain added substances, listed in the OSPAR 2004 List of Chemicals for Priority Action unless those offshore chemicals have already been notified for offshore use prior to this Recommendation taking effect

OSPAR Recommendation 2006/3 on environmental goals for the discharge by the offshore industry of chemicals that are or which contain substances identified as candidates for substitution sets out environmental goals on the phasing out of discharges of offshore chemicals that are, or which contain substances, identified as candidates for substitution[10] by 2017. The Recommendation was amended in 2019, with a new substitution deadline. The purpose of the amended Recommendation is to set an environmental goal for offshore chemicals that are, or which contain substances identified as candidates for substitution, in order to move towards the cessation of these discharges from offshore installations. As soon as practicable and not later than 2026, Contracting Parties should take appropriate measures to phase out the discharge of chemicals that are, or which contain substances identified as candidates for substitution, except for those chemicals where, despite considerable

10 Except for those chemicals where, despite considerable efforts, it can be demonstrated that this is not feasible due to technical or safety reasons. Demonstration of those reasons should include a description of the efforts.

efforts, it can be demonstrated that this is not feasible due to technical or safety reasons. Contracting Parties should also exchange information on successes and failures in reaching the goal of this recommendation, and report on the implementation.

2.2.2 Drilling fluids

The use of diesel-oil based drilling fluids was prohibited by PARCOM from 1 January 1987 and the discharge of untreated cuttings contaminated with oil-based drilling fluids ceased following PARCOM Decision 92/2 on the use of oil-based muds. Following the adoption of OSPAR Decision 2000/3 on the use of organic-phase drilling fluids and the discharge of organic-phase fluid contaminated cutting, the discharge into the sea of whole organic-phase fluids and of cuttings contaminated with organic-phase drilling fluids at a concentration greater than 1% by weight on dry cuttings has been prohibited since 2001. Cuttings contaminated with organic-phase fluids can only be discharged in exceptional and very rare circumstances of force majeure. The use of organic-phase fluids is not prohibited as it is required in lower sections of most wells. Prior to any usage national authorisation is required.

Drill cuttings contaminated with organic-phase fluids are either injected into subsurface formations or transported to shore where they are treated. Technologies to treat drill cuttings contaminated with organic-phase fluids have now been developed and are used offshore to clean the cuttings down to concentrations below 1% by weight on dry cuttings prior to discharge.

In addition, the use and discharge of chemicals in drilling muds are covered by the HMCS and the vast majority are from the OSPAR List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment (PLONOR).

2.2.3 Plastics and microplastics

Following potential concerns on the discharge of lost circulation materials containing plastics, OIC in 2013 agreed to prohibit discharge of lost circulation material containing plastics and also agreed that if zero discharge of lost circulation material containing plastic materials could not be guaranteed, the lost circulation material should not be permitted for use. In 2019, OSPAR Recommendation 2010/3 on a Harmonised Offshore Chemical Notification Format was amended to include checks on whether a substance is plastic, microplastic or nanomaterial with a view to determining further control measures.

2.3 Cuttings piles

The purpose of OSPAR Recommendation 2006/5 on a management regime for offshore cuttings piles is to reduce the impacts of pollution by oil and/or other substances from cuttings piles to a level that is not significant. In accordance with OSPAR guidelines for the consideration of the best environmental option for the management of organic-phase fluids contaminated cuttings residue, Contracting Parties undertook screening assessments at specific locations. The assessments indicated that immediate action was not required to reduce the environmental impact of any of the cuttings piles and that their management could be addressed as part of the decommissioning activities of the installation.

However, concerns have been raised about possible releases of oil, chemicals, and heavy metals from disturbance of cuttings piles, either from decommissioning activities or from bottom trawling after decommissioning. On the basis of an assessment in 2009 of the possible effects of releases of oil and chemicals from any disturbance of cuttings piles[11] OIC concluded that disturbance of cuttings piles and the subsequent release of oil would not result in significant impacts on the marine environment and

[11] https://www.ospar.org/documents?v=7082

no further OSPAR measures should be developed. It was, however, also decided that that this issue should be kept under review.

Only the UK and Norway have had activities in the near vicinity of cuttings piles since 2009. Oil & Gas UK (O&G UK) has focused on current technological capability to map, sample and measure the leaching rate from cuttings piles (OSPAR, 2016). Norway has undertaken environmental monitoring during dredging activities in 2010, 2012 and 2014. The dredging of large amounts of materials in Norway has been necessary in relation to the removal of steel jackets, the installation of new pipelines and re-routing of existing pipelines, and subsea preparatory work to ensure the required geotechnical stability for the safe placement of spud cans[12]. Further, studies have been undertaken by the UK on disturbance of drill cuttings during decommissioning operations in 2014 (OIC 2019). The studies concluded that leaving the piles in situ to degrade naturally is generally the best option. However, disturbance during decommissioning may be unavoidable and there is therefore a need to better understand the options available to manage drill cuttings during decommissioning and how they could impact the environment. In 2017, OSPAR adopted the Guidelines for the Sampling and Analysis of Cuttings Piles, providing guidance on sampling the geotechnical, material properties and chemical determinands of cuttings piles, in order to promote a more consistent approach across OSPAR Contracting Parties (OSPAR Agreement 2017-3).

https://www.ospar.org/documents?v=35692

Fact box 2: Case studies

UK Hutton Field

A total of 47 wells were drilled at the Hutton field generating an estimated pile volume of 24 252 m3 (ERT, 2009) or 18 000 m^3 (Cordah, 2000). The Hutton Tension Leg Platform (TLP) was decommissioned in 2002/2003 (Kerr McGee, 2001). In order to provide access for removal it was necessary to move the cuttings pile; this was undertaken using a high pressure water jet. The cuttings pile was known to contain a combination of water based, diesel based, LTOBM and synthetic muds. The use of a high pressure water jet resulted in the suspension of significant amounts of oil contaminated cuttings in the water column and their subsequent re-deposition on the seabed (OSPAR, 2009b/337).

A post decommissioning sampling survey was carried out in 2003 and the results were compared to the 2001 survey results. The 2003 survey (ERT, 2004) indicated significant quantities of cuttings derived material within 300 m of the TLP. Beyond 1 000 m there was little or no evidence of cuttings derived components. In the 2003 survey, macrobenthic communities were shown to be highly modified up to 500 m from the centre of the Hutton site. This was similar to historical surveys which also show modified macrobenthic communities within about 500 m from the centre of the Hutton site.

The conclusions from the study were that disturbance of the cuttings pile due to decommissioning activities had no major effect on the spatial distribution of cuttings contamination or on the biological communities (OSPAR, 2009b/337).

Albuskjell field

The cuttings pile at Albuskjell 2/4F has an estimated volume of 3 600 m^3 (DNV, 2008) although field measurements indicate a volume of 4 700 m^3 (prior to relocation). The average THC concentration in the cuttings pile was 1 100 mg/kg.

Relocation of cuttings was undertaken in 2010. The majority of solids settled close to the exhaust from the dredger but small particles spread over a greater distance. The water column monitoring undertaken during the cuttings relocation demonstrated that the stations at 150 m and 250 m from the centre of the pile were more influenced than the reference station located at 800 m. Water 2 m above seabed had more particles than 10 m above seabed (DNV, 2017b). However, the level of contaminants in the water was not particularly high and was comparable to results from produced water discharge monitoring (DNV, 2017b).

Seabed monitoring was undertaken in 2011 and 2014. This showed that most of the sedimentation took place within 100 m of the site and elevated concentrations of metals were found at 100 m and 250 m but not at 500 m distance from the centre of the pile, although increased barite levels were detected 2 km away (DNV, 2017b). For THCs an increase in levels was identified following relocation, with concentrations reaching 100 mg/kg at 100 m distance compared to around 10 mg/kg prior to relocation. Beyond 100 m the THC concentration also showed some increase to about 10 mg/kg (DNV, 2017b).

The seabed monitoring undertaken in 2014 (DNV, 2017b) indicated a reduction in THC, barium and other measured parameters compared to the 2011 monitoring. The changes were most obvious in the near stations (100 m and 250 m).

Benthic fauna was also monitored in 2011 and 2014. but were found not to have been significantly influenced by the dredging of drill cuttings. Samples had a comparable number of species and individuals (DNV, 2017b).

2.4 Physical impact

Over the years there has been an improvement in the technology involved in the placement of infrastructure on the seabed and greater awareness of the potential environmental impacts that these may cause. For example, the extensive use of Remotely Operated Vehicles (ROVs) and the use of multibeam and sidescan sonar mapping makes it easier to find the best transects and avoid the disturbance of vulnerable marine communities. Similar, improvements in pile driving techniques and pipeline laying methodologies have contributed to limiting the potential environmental impacts. Assessment of the direct physical impact of placing a structure on the seabed is addressed within the relevant environmental statement and associated environmental impact assessment under relevant national legislation. Environmental monitoring of the physical impacts arising by placing a structure on the seabed is undertaken on a case-by-case basis depending on the particular sensitivities associated in the area. The monitoring of pipelines is routinely undertaken by developers to ensure that the integrity of the pipeline is being maintained. The results from such surveys can also be used to provide useful information on the physical impact that the laying of the line has had and information on the marine fauna that thrive.

Data on pipelines decommissioned in situ has been collected mainly for the UK, with limited data inputs from Denmark, the Netherlands and Norway. As a result, most of the analysis has focused on UK data.

Together, all four countries account for over 400 pipelines decommissioned in situ, with a total length of just under 3 600 km. In the UK 207 pipelines have been left in situ, totalling 1 833 km. This represents approximately half of the pipelines decommissioned to date (data to the end of October 2018). In terms of space occupied on the seabed, total pipelines decommissioned in situ represent a very small proportion of the UKCS (0,002%).

The majority of pipelines decommissioned in situ are buried, with only 127 km surface laid pipelines left on the seabed. To date, the length of pipelines decommissioned in situ, with the potential to interact with fishing gear is relatively small and mostly in areas which are not intensively fished. However, as more pipelines are decommissioned the proportion of pipelines in areas of higher fishing intensity could become more significant.

2.5 Accidental spills

OSPAR does not specifically regulate for accidental spills but national legalisation on the prohibition of spills of oil and chemicals is in place in Contracting Parties jurisdictions. Following the Deepwater Horizon disaster in the Gulf of Mexico in 2010 OSPAR introduced Recommendation 2010/18 on the prevention of significant acute oil pollution from offshore drilling activities which required Contracting Parties to review existing frameworks including permitting of drilling activities in extreme conditions and report back to OIC. In light of the EU introducing Directive 2013/30/EU on Offshore Safety it was agreed there was no need for a further OSPAR measure to cover major accident prevention and there are other established fora which Contracting Parties attend that deal with this topic, e.g. North Sea Offshore Authorities Forum, International Regulators Forum, EU Offshore Authorities Group.

While aging installations may be a factor affecting the risk of accidental spills, the main factors in spill prevention is the effectiveness of barriers through maintenance programmes, development of handling procedures to minimise the potential for spills, and staff training and competence management to ensure management of risks to the environment. Since 2000 there has been a greater awareness by industry for the need to report all spills irrespective of the spill size and such requirements have both resulted in increased reporting as well as increased environmental awareness. All operators are also encouraged to have an environmental management system in accordance with OSPAR Recommendation 2003/5 and such management systems are required to consider how installations are operated to minimise impact on the environment, including the prevention of spills.

2.6 Atmospheric emissions

OSPAR does not specifically regulate atmospheric emissions from the oil and gas industry. However, there are a number of relevant EU Directives and international conventions which apply to OSPAR Contracting Parties. Since 2009 there has been a significant change in the way atmospheric emissions are managed with ongoing strengthening of the European Union Emissions Trading Scheme (EU-ETS), Industrial Emissions Directive (2010/75), Medium Combustion Plant Directive (2015/2193) and Sulphur Content Directive (2012/33). National legislation by some Contracting Parties has also looked to reduce emissions of nitrous oxides.

2.7 Decommissioning

The 1998 OSPAR Ministerial Meeting in Sintra, Portugal, adopted OSPAR Decision 98/3 on the disposal of disused offshore installations which prohibits the dumping, and leaving wholly or partly in place, of disused offshore installations within the maritime area. Only for certain categories and subject to an assessment described in Annex 2 of Decision 98/3, the competent authority of the relevant Contracting Party may issue a permit to leave installations or parts of installations in place (for example for steel installations weighing more than ten thousand tonnes in air or gravity based concrete installations). Before a decision is taken to issue a permit, the relevant Contracting Party shall first consult the other Contracting Parties in accordance with Annex 3 of Decision 98/3.

An informal meeting to discuss comparative evaluation of decommissioning options in support of derogations proposals was held in December 2019[13] following proposals to develop a joint comparative assessment methodology for application across the OSPAR Maritime Area in compliance with OSPAR Decision 98/3. One of the outcomes of the meeting was that in order to improve advancement of technology and to maintain focus, Contracting Parties and Observer Organisations agreed that they would give an annual update on progress made on decommissioning technology developments that would help reduce the number of derogation categories. This was agreed by OIC 2020.

OSPAR monitors the development of offshore installations and maintains an up to date inventory of all offshore oil and gas installations in the OSPAR Maritime Area. The database includes the name, ID number, location, operator, water depth, production start date, current status and function of the installation.

2.8 Light

In OIC 2015, Guidelines to reduce the impact of offshore installations lighting on birds in the OSPAR Maritime Area (OSPAR Agreement 2015-08) was adopted.

[13] https://www.ospar.org/meetings/archive/informal-meeting-to-discuss-comparative-evaluation-of-decommissioning-options-in-support-of-derogation-proposals

These guidelines provide advice for OSPAR Contracting Parties considering the course of action to take to address the potential impact of conventional lighting of offshore installations on birds. The guidelines are not intended to be prescriptive. This document offers guidance based on discussions at the 2012 OSPAR Workshop aimed at reducing potential lighting impacts on migrating birds and seabirds. The guidelines apply to both existing and new offshore installations. Whether a proposal is more practicable on existing or new offshore structures will need to be determined on a case by case basis, and all proposals will need to take account of compliance with national and international regulations on aviation and shipping. Furthermore, proposals must not compromise safe working practices for personnel and processes. On new installations, potential mitigation measures should be considered as part of the design process.

The guidelines also require Contracting Parties to inform each other on developments regarding this issue.

2.9 Noise

Whilst there are difficulties associated with quantifying the occurrence, scale and extent of the potential impacts of underwater noise, as there is great variability in the characterisation of the sound relating to the noise generating activities, the propagation of the sound and the sensitivity of different species to the measured and estimated levels of sound, progress has been made on all these fronts to improve understanding. However, the relatively intense concentrations of anthropogenic activities in some parts of the OSPAR area, especially in Regions II and III, and the probability that the level of these activities will increase, make it important to improve understanding of the potential effects of the most significant sources of underwater noise - seismic surveys, pile driving and the use of explosives.

Wide-ranging studies on noise impacts related to offshore oil and gas activities mainly covering seismic surveys, pipelay noise and piling have been reported by Contracting Parties. Details of these studies were presented at OIC 2015. A summary of impacts on marine mammals, fish and other species was also included in the OIC 2016 report on Inventory of Measures and Techniques to Mitigate the Impact of Seismic Surveys.

Since 2006, the International Association of Oil & Gas Producers (IOGP) has coordinated a Joint Industry Programme (JIP) on Exploration and Production Sound and Marine Life. The JIP has brought together 14 leading, global oil and gas companies. The JIP focuses its activities in five key areas (the number of individual projects commissioned under each heading for the first two research phases is shown in parentheses):

1. Sound source characterisation & propagation (16 projects)
2. Physical, physiological and hearing effects (14 projects)
3. Behavioural responses and Biological significance (39 projects)
4. Mitigation and monitoring (19 projects)
5. Technology development (4 projects).

2.10 Carbon dioxide storage

In order to allow the storage of CO_2 in geological formations, Contracting Parties to the OSPAR Convention adopted amendments to the Annexes to the OSPAR Convention in 2007. In order to ensure environmentally safe storage of CO_2 streams in geological formations, the OSPAR Decision 2007/2 on the Storage of Carbon Dioxide Streams in Geological Formations was adopted in 2007 along with OSPAR Guidelines for Risk Assessment and Management of Storage of CO_2 Streams in Geological Formation. Furthermore, the Contracting Parties also adopted OSPAR Decision 2007/1 to Prohibit the Storage of Carbon Dioxide Streams in the Water Column or on the Sea-bed, because of the potential negative effects.

3. Did it work?

Based on reported data from Contracting Parties, it is possible to follow trends in pressures from the oil and gas industry. Ongoing monitoring undertaken by Contracting Parties and annual assessments of discharges, spills and emissions assists in assessing whether the actions taken have resulted in a measurable reduction in the impacts to the marine environment.

3.1 Produced water

The amount of dispersed oil discharged in 2019 is 16% below that discharged in 2009. While there was not a year on year decrease the total quantity of dispersed[14] oil (aliphatic oil) discharged to the sea from PW and displacement water decreased from 4 890 tonnes in 2009 to 4 096 tonnes in 2019. There had been a notable increase in dispersed oil discharged in 2015 as a result of an increase in the amount of produced water discharged and average dispersed oil concentrations.

Reinjection of produced water has increased by 49% from 2009 to 2019, but the effect of this is counteracted by aging fields with decreasing hydrocarbon production and increasing water production. Continuous improvement in lowering dispersed oil in produced water discharges is also challenging due to a number of factors including older installations (Pre-2001) not designed to meet very low dispersed oil in water concentrations; produced water plant not designed for the produced water volumes being handled; co-mingling of different produced waters from multiple tied back fields; and interactions of chemicals designed to provide corrosion and / or scale inhibition which can negatively impact oil / water separation. While the application of Best Available Techniques (BAT) is expected it is often difficult to retrofit new technologies to older installations due to space limitations, produced water volumes to be handled and / or the cost is prohibitively expensive.

PW and displacement water are the main contributors to the oil discharges from offshore oil and gas activities, representing 95-99% of the total amount of oil discharged to the sea during the 2009-2019 period. The exception was in 2011-2012 where a single large spill event accounted for 11-12% of the total oil to sea.

It should be noted that dispersed oil in displacement water contributes less than 1% to this total. The annual average dispersed oil content in PW ranged from 12,4 mg/l to 14,1 mg/l over the period, well below the current performance standard for dispersed oil of 30 mg/l for PW discharged into the sea.

[14]. “Aliphatics” and “aromatics” are defined by the reference method set in OSPAR Agreement 2005-15 (Solvent extraction, Infra-Red measurement at 3 wavelengths). In that context, “aliphatics” and “dispersed oil” mean the same thing.

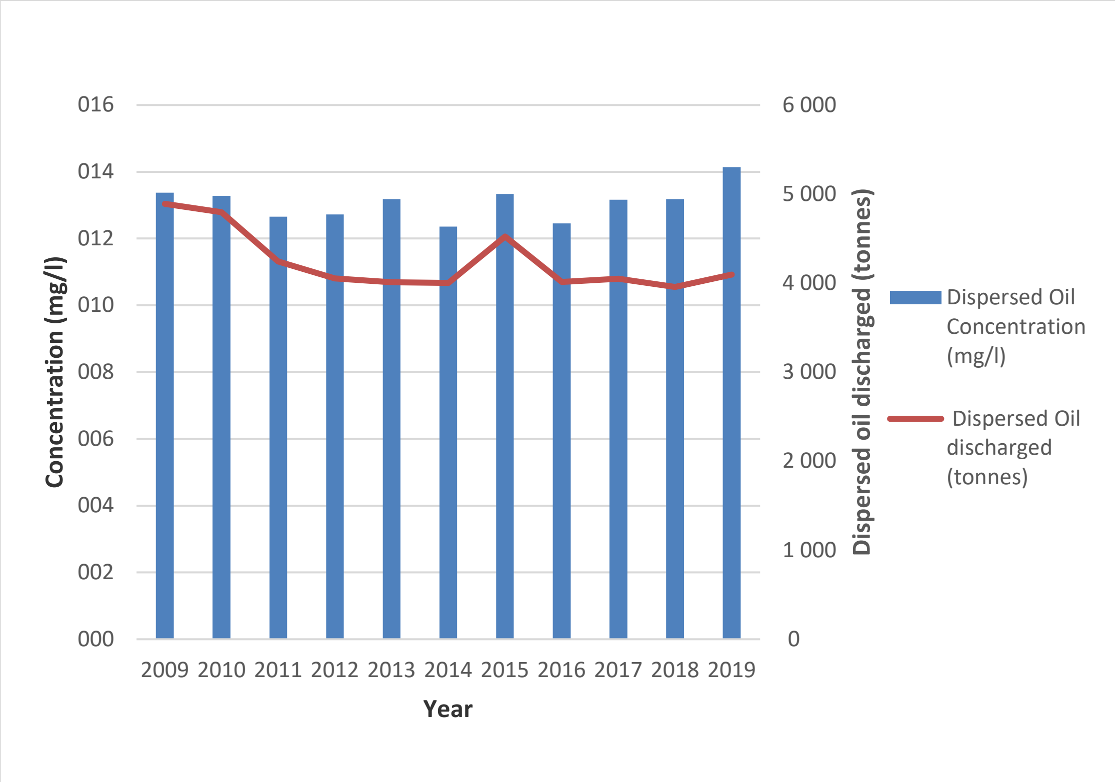


Figure 6: *Dispersed Oil Discharges*

Over the period 2009–2019, the total number of installations exceeding the performance standard has decreased from 31 in 2009 down to 17 in 2019. The amount of oil discharged from six of these installations is less than 2 tonnes annually. In total, the discharge of dispersed oil in excess of the performance standard is less than 2% of the total discharge of dispersed oil in the OSPAR area.

RBA

Contracting Parties provided OIC with implementation plans on OSPAR Recommendation 2012/5 for a risk-based approach to the management of produced water discharges from offshore installations in 2013 and the majority commenced assessments in 2014 with the Recommendation due to be fully implemented by 2018. To date, of the 231 installations still included within the RBA process, 216 have been assessed, with 125 installations (54%) determined to have their discharge adequately controlled, 91 installations (39%) requiring further action to be taken and the remainder still awaiting the outcome of an assessment (Figure 7).

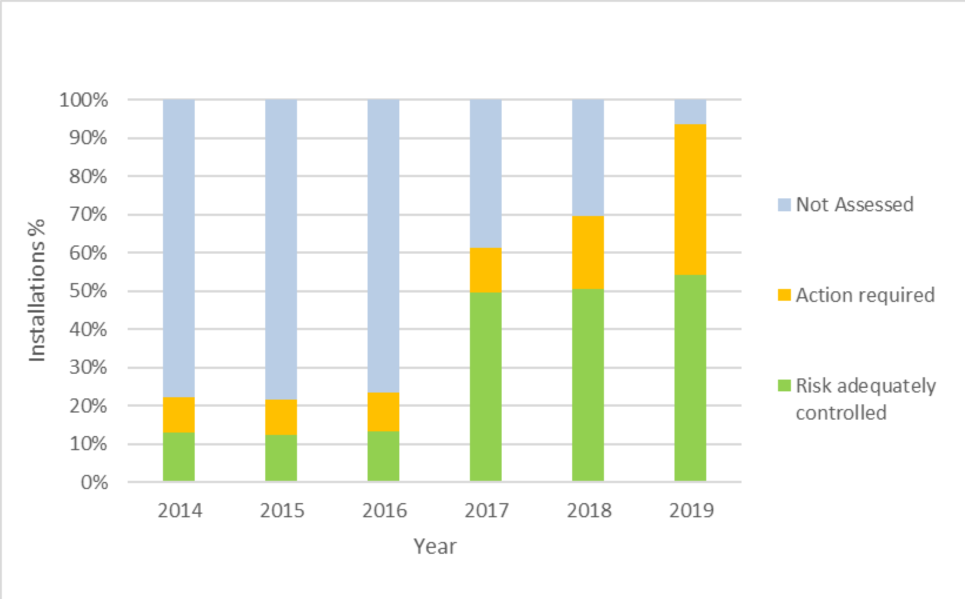


Figure 7: *Progress with RBA*

By 2018 several installations with discharges of PW are considered to have an adequately controlled risk, meaning no increased risk level beyond 500 metres from the installation or an EIF below 10. These acceptance levels are not decided and agreed upon by OSPAR but are used by Contracting Parties according to national guidance.

The RBA work will continue, and further development and refinement of the methods used will be made. Since the OSPAR Recommendation 2012/5 allows for different approaches and methods it is difficult to compare risk levels. The main purpose is however to have risk management tools to identify the right measures for site specific risk reductions.

Linking the estimated risk levels to possible impacts in the receiving environment is a step that has not yet been addressed. As a next stage to RBA, a task has been identified to assess the environmental risk posed by the discharge of naturally occurring substances and added substances in order to identify and adopt measures to reduce the risk to the environment from discharges of PW.

3.2 Chemicals

OSPAR measures such as the harmonised approach to the management of offshore chemicals, harmonised notification format and harmonised pre-screening procedures for offshore chemicals, and efforts to increase harmonisation between the HMCS and REACH continue to ease work of both the national competent authorities and the industry and have made regulatory decisions related to use and discharge of offshore chemicals within the OSPAR Maritime Area more transparent.

The total quantity of chemicals used offshore has decreased from 838 111 tonnes in 2009 to 733 598 tonnes in 2019 of which 69% (wt.) are on the PLONOR[15] list and less than 1% (wt.) contained substances which are candidates for substitution.

https://www.ospar.org/documents?d=32939

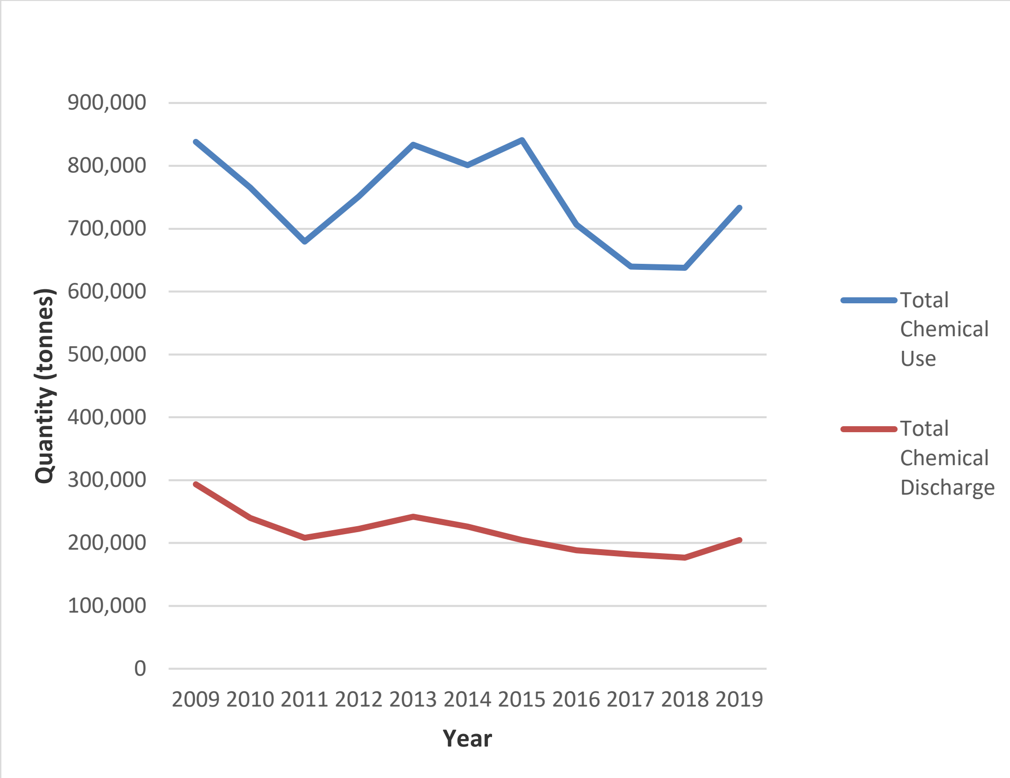


Figure 8: *Total chemical use & discharge*

The total quantity of chemicals discharged into the sea has decreased from a peak of 293 402 tonnes in 2009 to 204 570 tonnes in 2019 of which 84% are on the PLONOR list and less than 0,5% (wt.) contained substances which are candidates for substitution.

The use of Ranking[16] chemicals has increased by 7% while their discharge has decreased by 3% between 2009 and 2019. The use and discharge of PLONOR chemicals has decreased 18% and 34% respectively over the same period. It is not entirely clear if this is mainly due to an overall reduction in use and discharge and/or a change in categorisation of chemicals resulting in removal from the PLONOR List.

3.2.1 LCPA & Candidates for substitution

The amount of LCPA substances used has continued to decrease over the 2009-2019 period from 3 929 kg in 2009 to 111 kg in 2019.

The discharge of added chemicals identified for Priority Action (LCPA) was phased out by 2014, and other than a 3 kg accidental permitting of an LCPA discharge in 2016 in the UK and a 0,5 kg unpermitted discharge in Denmark in 2019 there have been no other discharges of LCPA.

[16] Ranking chemicals being the combination of inorganic chemcials with LC50 or EC50 greater than 1 mg/l and ranking chemicals, which includes substances ranked according to OSPAR Recommendation 2000/2 and don't fall into another category.

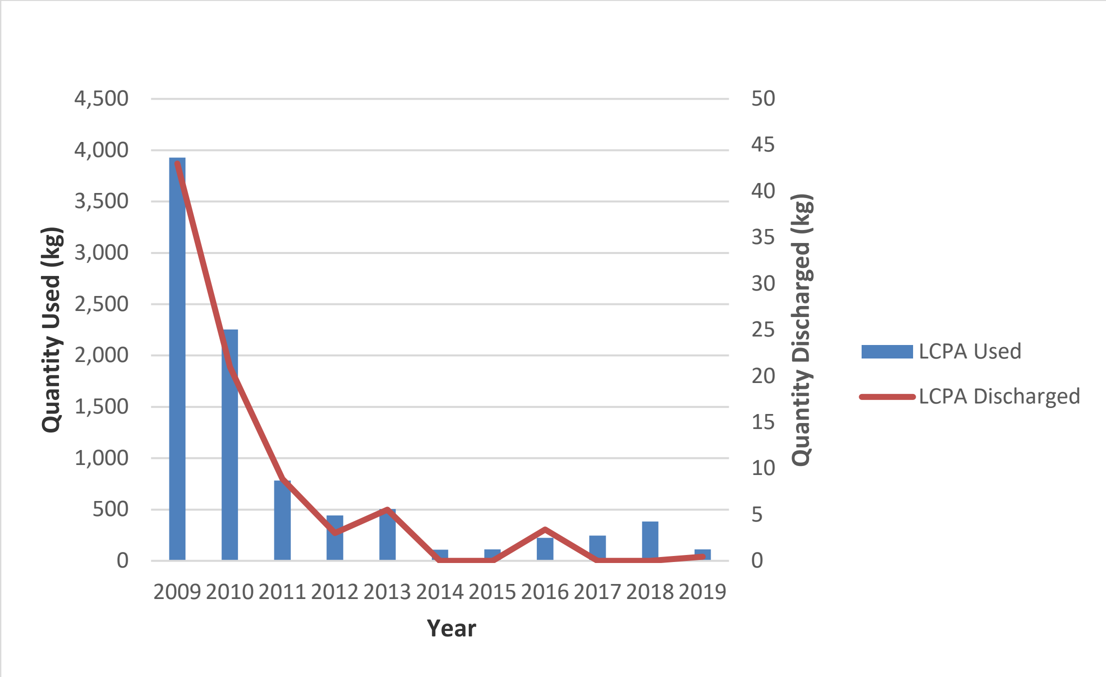


Figure 9. *LCPA chemicals used and discharged*

The discharge of chemicals containing substances that are substitution chemicals decreased from about 1 755 tonnes in 2013 to 1 012 tonnes in 2019, a 42% decrease.

The use of substitution chemicals with a biodegradation of < 20% or that meet 2 of 3 PBT criteria has decreased from 11 959 tonnes in 2009 to 7 739 tonnes in 2018, a 36% reduction. Similarly discharge of these substitution chemicals has decreased from 1 753 tonnes to 1 162 tonnes, a 35% reduction.

Whilst progress has been made in reducing the use and discharge of chemicals identified as candidates for substitution since the introduction of OSPAR Recommendation 2006/3 more needs to be done to reduce discharges of substitution chemicals.

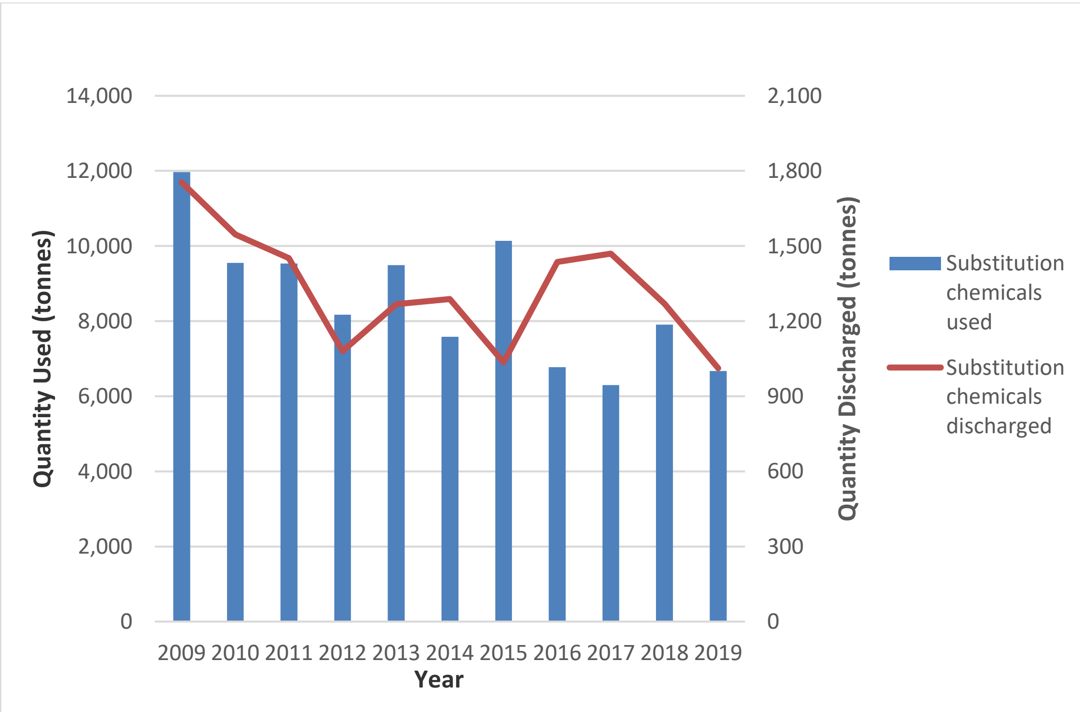


Figure 10: *Substitution chemicals used & discharged*

3.2.2 Drilling fluids

The discharge of organic-phase fluids ceased in 1996 and no organic-phase fluid discharges have been reported since 2004 in the OSPAR area. The aim of Decision 2000/3 on the use of Organic-phase drilling fluids and the discharge of organic-phase fluids contaminated cuttings continues to be fulfilled.

In 2019, a total of 11 wells were drilled with organic-phase fluid with cuttings discharged to sea after treatment to < 1% oil on cuttings. This is the same number as in 2009, and the annual number over the period range from 7 to 20 wells. Other organic-phase drilling fluids have been used in one well in the UK in 2019, and all the cuttings were injected or transported to shore.

With the availability of thermal desorption treatment technologies, which enables the 1% concentration limit to be achieved, there has been an increase in the use of these techniques offshore, particularly in the UK. Through the use of these technologies there has been an increase in the discharge of thermally treated organic-phase drilling contaminated cuttings from 0,3 tonnes in 2009 up to a maximum of 23 tonnes in 2016, however all discharges have been significantly lower than the 1% concentration performance standard (see Figure 11). Less than 0,01% of all the organic-phase drilling fluids used is discharged using this technology.

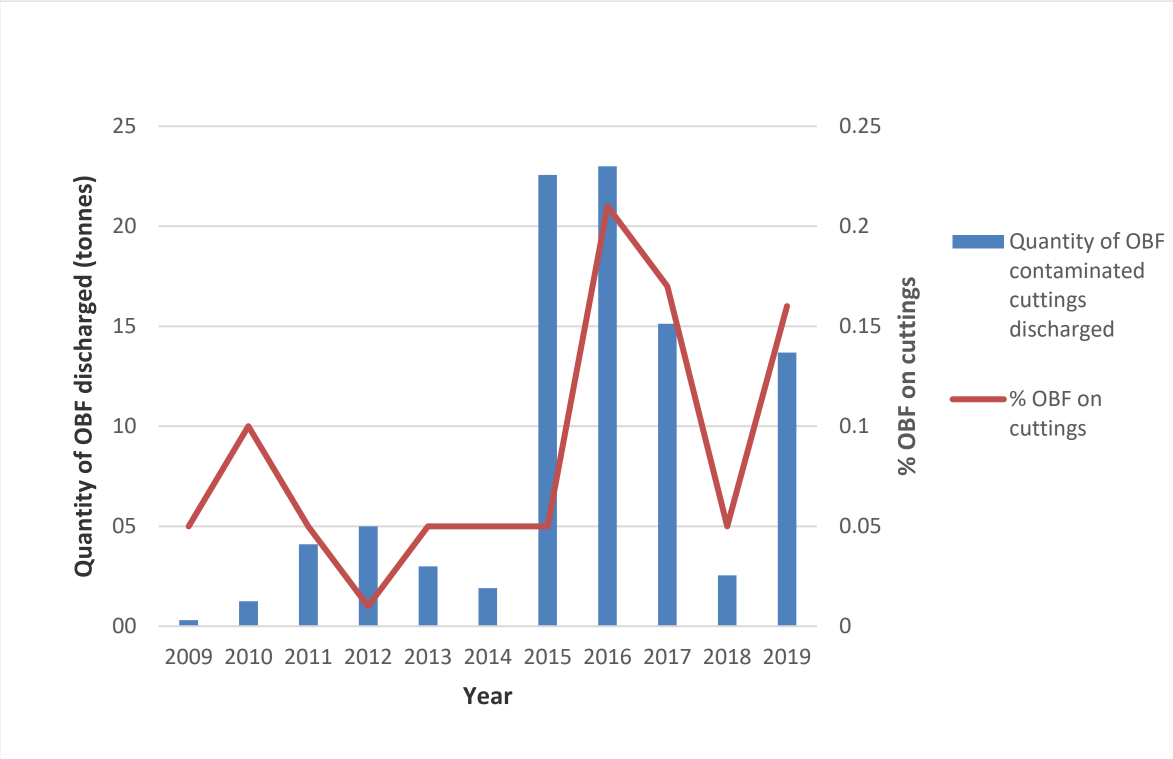


Figure 11: *Quantity of treated organic-phase drilling fluids contaminated cuttings discharged & concentration*

3.2.3 Plastics and microplastics

The amendment of OSPAR Recommendation 2010/3 on a Harmonised Offshore Chemical Notification Format in 2019 to include checks on whether a substance is plastic, microplastic or nanomaterial is expected to provide data in the coming years, which will help determine if additional control measures would be needed.

3.3 Management of cuttings piles

Monitoring undertaken near cuttings piles historically contaminated with organic-phase fluids indicates that concentration and spatial extent of contamination have reduced and leaching rates diminished since the initial discharge.

A spatial and temporal assessment of North Sea benthos using the UK data (OIC 2014) has found that the spatial extent of the impact footprint is greatest within the first one to two years after drilling, but with time the spatial extent of the footprint is reduced and in some cases reduces to ~50 m. The environmental reduction in the extent of impacts and the signs of recovery within the benthic dataset were detectable. The capacity for recovery was notable, supporting the management option of leaving cuttings piles in-situ.

The contaminant content of the top (approximately 10 cm) layer of a cuttings pile is often relatively low, having leached into the water column over time or oil in surface layers is microbially metabolised aerobically, in situ within the pile. This suggests that the release of contaminants into the water column by over-trawling of cuttings pile is unlikely to be significant. The amount of sediment disturbed depends primarily on fishing gear and rigging type, hydrodynamic conditions and sediment type. Studies suggest that scallop dredging gear has the greatest potential for sediment disturbance; the majority of historic cuttings piles are not in scallop dredging areas.

Environmental monitoring conducted during and after the dredging activity in Norway from 2010 to 2014 indicates that dredging contaminated drill cuttings can influence the water and sediment quality near the site. There is also expected to be some dispersion of finer particles that could settle further away from the site (at least 1 km away). In general, the seabed conditions in these areas are poor. This is mainly due to discharges of oil-based drilling muds during the period 1982-1991, and the contaminated cuttings are still present on the seabed. The monitoring data shows that the disposal and settlement of cuttings did not significantly change the conditions on the seabed since they were already poor. However, based on visual and chemical analyses the benthic environment was slightly impacted. The concentration of hydrocarbons in the water during the dredging was particularly high for some oil-derived compounds. This may have temporarily negatively influenced the local organisms. The contamination of the water column was expected to be reduced soon after the dredging stopped, and comparable to the situation prior to the dredging. The water currents will disperse and dilute the contaminants, which are mainly bound to particles that will re-settle, and the local seabed is expected to recover to the condition prior to the dredging within a few years.

Based on the case studies reviewed (OIC 2014) the majority of impacts from cuttings piles are noted within 100 m of the centre of the pile; and, generally, beyond 500 m there is little discernible impact. When cuttings piles are disturbed, the pile is aerated allowing some additional degradation to take place. However, this disturbance results in additional, albeit generally short-term and localised impacts on the water column, and in some (not all) cases could cause contamination of the seabed outwith the areas impacted by the original cuttings discharge.

Fishing may be able to resume over cuttings piles previously contained in a 500 m safety zone where fishing activities would have been excluded. Where cuttings are left in situ or relocated on the seabed there is the potential for trawling activities to disturb the cuttings pile resulting in the release of contaminants contained within the cutting pile into the water column, as well as the potential for the nets and catch to be contaminated.

Fact box 3: UK sediment surveys

Two linked regional sediment and fauna surveys were undertaken December 2015 - January 2016 and covering the Fladen Ground and Mid North Sea High (MNSH) areas marked on Figure 12.

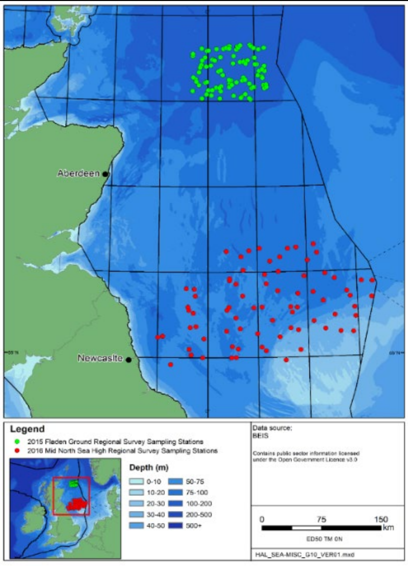


Figure 12: *Map of UK monitoring Area 2015 – 2016. (Source: BEIS, 2016)*

Monitoring programme and method

Sampling points were selected on a stratified random basis, but with no stations closer than 2 km from an exploration or appraisal well, or 5 km from a producing installation.

Sediment samples were analysed in line with OSPAR Agreement 2017-02 for sediment grain size, concentrations of trace and heavy metals (Aluminium, Arsenic, Barium, Cadmium, Copper, Chromium, Iron, Lead, Lithium, Manganese, Mercury, Nickel, Rubidium, Strontium, Vanadium, and Zinc), Total Hydrocarbon Content, Naphthalene (128), Phenanthrene/Anthracene (178), Dibenzothiophene (184), Fluoranthene/Pyrene (202), Benz(a)anthracene/Chrysene (228), Total NPD, Total 2 to 6 ring PAH, and Biota using 0,5 mm & 1,0 mm sieve meshes. The MNSH survey was the first regional survey of the area. Accumulations of biodegradable contaminants were not predicted, given the controls in place for discharges from installations in the area.

Results

Seabed faunal results from the Fladen and Mid North Sea High area indicated healthy, diverse seabed communities, apparently unaffected by discharges in the areas and with no elevations of any opportunistic species typically associated with disturbance or contamination effects.

Concentrations of metals and hydrocarbons present were below OSPAR Background Assessment Criteria (BAC) for almost all samples and determinands, the exceptions were all close to the BAC concentrations and showed no spatial pattern or between determinand correlation within a sample.

Three stratified random sampling surveys have been undertaken in the Fladen Ground (2001, 2005, 2015) and the hydrocarbon concentrations in sediments in samples and strata show a progressive improvement over time, with concentrations now at or below the OSPAR BAC.

3.4 Accidental spills

Oil

Over the period 2009-2019, the number of accidental spillages of oil to sea varied widely with 2014 having the highest number of spills (572) and 2019 having the lowest (338). While there has been annual variation there is a possible downwards trend in the number of oil spills being reported since 2014.

The total quantity spilled each year is variable with a high of 541 tonnes in 2012 when a single large spill in the UK contributed approximately 400 tonnes to the total and a low of 44 tonnes in 2016 (see Figure 13). In 2019, oil spills contributed less than 3% (wt) of the dispersed oil discharged or spilled to the OSPAR Maritime Area.

There is no discernable trend in the quantity of oil being spilled annually. Spills over 1 tonne account for just 2 – 4% of the number of oil spills but account for 68 – 96% of all the oil spilled on an annual basis. Consequently the quantity spilled annually is very much dependant on a small number of larger spills.

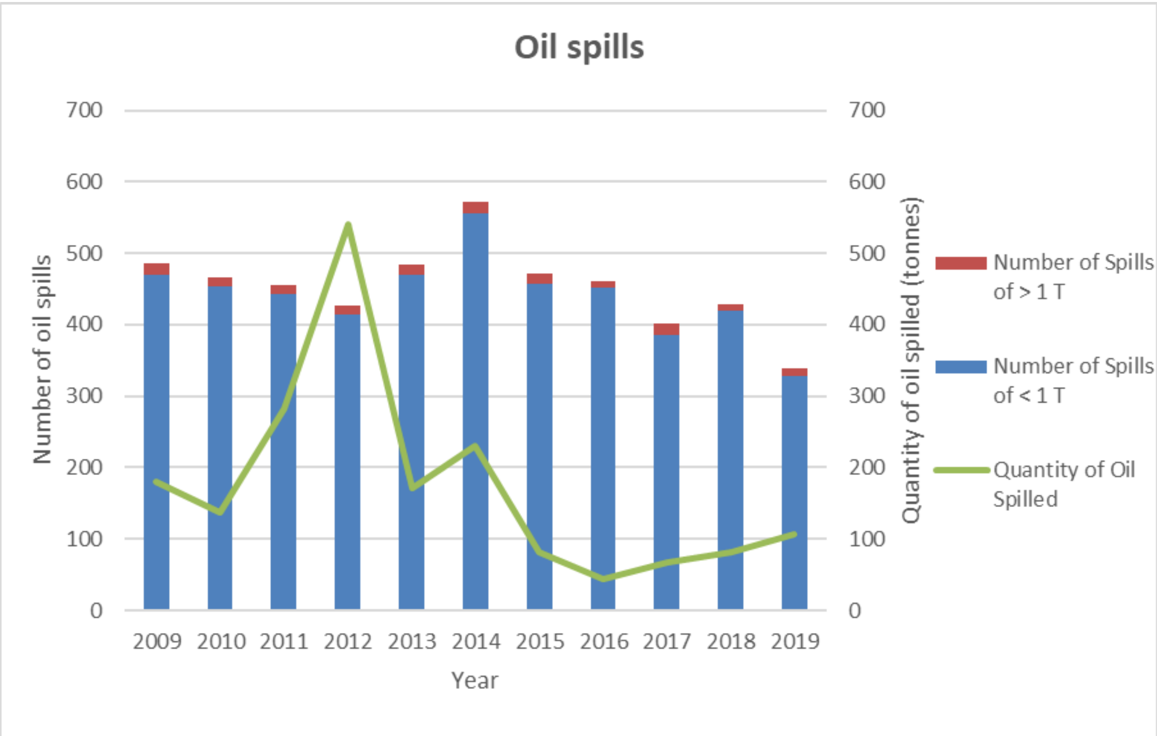


Figure 13: *Oil spills*

Chemicals

Over the period 2009-2019, the number of accidental spillages of chemicals to sea has also varied widely with 2014 having the highest number of spills (488) and 2019 having the lowest (346). While there has been annual variation there is a possible downwards trend in the number of chemical spills being reported since 2014. The number of larger spills (> 1 tonne) has also trended downwards over the period from 99 in 2009 to 55 in 2019.

The total quantity spilled each year is extremely variable with a high of 14 464 tonnes in 2009 and a low of 728 tonnes in 2011 (see Figure 14) and there is no discernible trend in the quantity of chemicals being spilled annually. Of the chemicals spilled in each year the vast majority (97 – 99%) were on the PLONOR List or were Ranking chemicals.

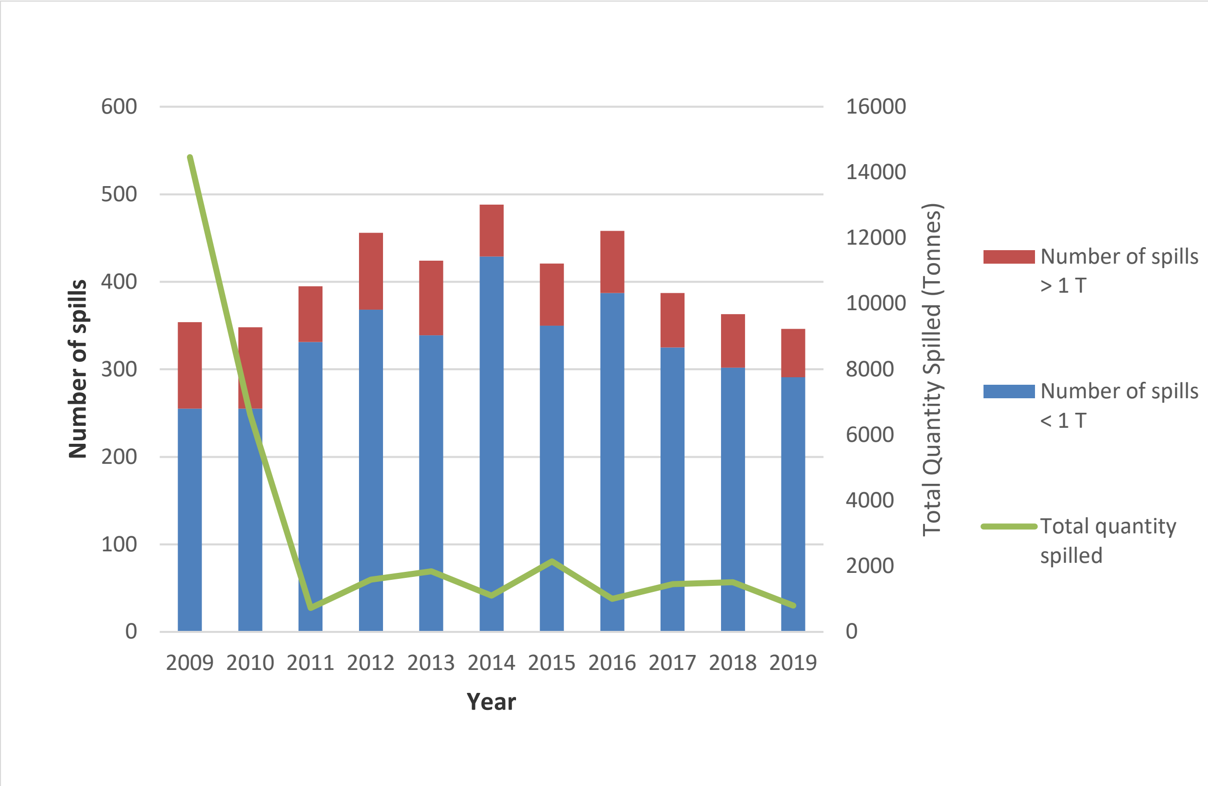


Figure 14: *Chemical spills*

3.5 Atmospheric emissions

While atmospheric emissions are not covered by OSPAR measures there have been overall reductions in all reported atmospheric emissions across the OSPAR area over the last 10 years, most significantly in methane and SO_2 emissions. Over the 2009 – 2019 period:

- CO_2 emissions have decreased 7,5%;
- NOx emissions have decreased 9,2%;
- Methane emissions have decreased 35%;
- nmVOC emissions have decreased 7,2%; and
- SO_2 emissions have decreased 33%.

The contribution to CO_2 emissions by the offshore oil and gas industry as a proportion of Contracting Parties national emissions varies depending on the size of the oil and gas industry in the Contracting Party[17]. For Contracting Parties with a small offshore industry footprint such as Spain, Germany and Ireland the contribution from oil and gas ranges from 0,001 – 0,2% of total national emissions. For Denmark and the Netherlands, it is an average of 4,9% and 1,1% respectively, while in Norway and the United Kingdom it is 35,5% and 3,4% respectively.

As national and EU legislation is introduced to address local, regional and international Net Zero commitments it is expected that emissions from offshore installations will continue to fall.

[17] National CO_2 emission data taken from iea.org

3.6 Decommissioning

OSPAR Decision 98/3 prohibits dumping, and the leaving wholly or partly in place, of disused offshore installations within the maritime area. It is possible to seek derogation to this Decision if it can be demonstrated that there are significant reasons why an alternative disposal option is preferable. The majority of installations are removed at the time of decommissioning. A review of experience and technical developments relating to the decommissioning of platforms was undertaken in 2013 and 2018. The review showed that the number of projects involving concrete structures and substantial steel footings has been very low and there have been no significant developments in the technical capabilities of the industry which would support a reduction in the categories eligible for derogation. However, as older installations reach their end-of-life, it is anticipated that a number of installations will be decommissioned in the coming decade. Therefore, the review in 2018 also agreed that Contracting Parties and Observer organisations should proactively promote areas of research and scientific understanding so as to provide a wider scope for the upcoming review of derogation categories in Annex 1 of Decision 98/3 in 2023.

Since the ban on dumping of disused offshore installations came into force in 1999, 170 offshore installations have been brought ashore for disposal. There are 59 steel installations with a substructure weighing more than 10 000 tonnes and 22 gravity-based concrete installations for which derogations from the dumping ban may be considered. Ten derogations have been issued by Contracting Parties for structures to be left in place (five concrete substructures and the footings of five large steel structure). In addition, the Piper Alpha installation was abandoned in situ following the disaster in 1988. In the light of experience in decommissioning offshore installations, relevant research and exchange of information, OSPAR aims to ensure derogations from the dumping ban remain exceptional.

During 2019-2020 a consultation process under OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations on the UK's intention to issue derogation for leaving in-situ the footings of the Brent Alpha Steel Jacket and Brent Bravo, Brent Charlie and Brent Delta gravity-based concrete installations structures was undertaken. A Special Consultative Meeting[18] to discuss the objections raised to the derogation proposal on comparative assessment methodology, long term risk to the marine environment from the residues in the storage cells and the risk of the gravity based concrete installation legs to shipping and fishing was held in London in October 2019. The meeting agreed that in view of the upcoming decommissioning projects, the process was considered as an opportunity in agreeing on common OSPAR-standards for comparable challenging decommissioning cases.

3.7 Light

Contracting Parties provide an update on a biennial basis to OIC on efforts being made to reduce the impact of offshore installations lighting on birds in the OSPAR Maritime Area. The Netherlands have reported that in the Dutch part of the North Sea an operator is developing a new platform and the following measures are proposed to be implemented:

- Automatic on / off switching on areas on the platform where safety is not compromised.
- Full shutdown during the night on areas of the platform where safety is not compromised.

[18] https://www.ospar.org/meetings/archive/special-consultative-meeting

Germany has reported that in the German part of the North Sea an operator already in 2010 implemented the following measures to reduce the emissions of platform lighting:

- Wherever possible light sources were dismantled.
- Of the remaining lamps, only very few are in non-stop operation. The remaining lamps are only switched on when required via the process control system.
- The light sources were ideally positioned to minimise light being emanated into the surroundings of the platform.

The UK and Norway have reported that the operators of existing offshore installations continue to be encouraged to implement measures to reduce the lighting attraction, and that appropriate measures should be implemented for new installations through the Environmental Impact Assessment process.

3.8 Noise

Some noise generating activities such as seismic surveys are subject to Environmental Impact Assessment including noise assessment under relevant national legislation. In the case of the oil and gas activities, a number of guidance documents have been published to assist developers and regulators in the consenting process. Mitigation measures have been developed and implemented for seismic surveys. They include the avoidance of undertaking work during specific periods, the application of a soft start-procedure (gradually increasing the sound level to provide animals with time to leave the impact area), and the use of observers that scan a safety zone where no marine mammals should be present prior to the commencement of activities. However, the application of these measures is likely to be very varied within the OSPAR area as guidelines to prevent or minimise the impact of noise on marine mammals currently vary and there is international recognition of the need for more consistent, evidence-based, guidance.

3.9 Carbon dioxide storage

There are only two full scale projects with CO_2 storage in the OSPAR area. Due to the very limited number of full-scale projects so far, an evaluation of the effectiveness of OSPAR Decision 2007/2 has not yet been undertaken.

The need to improve the reporting to OSPAR on environmental monitoring from CO_2 storage projects has been identified, and work has been initiated by OSPAR’s Environmental Impact of Human Activities Committee (EIHA) and OIC to analyse the existing reporting obligations stemming from OSPAR and other national and international measures with a view to ensuring adequate monitoring and reporting is undertaken.

4. How does this affect the overall quality status?

4.1 Impact from offshore oil and gas activities

The exploration for and the development of oil and gas within the OSPAR Maritime Area for over 50 years have affected different compartments of the environment in the North-East Atlantic, and this chapter aims to describe how the different pressures have affected the quality status of the seabed and water column.

4.1.1 Sediments

As a result of contamination by organic-phase fluids and the settlement of suspended fine cuttings, benthic fauna become stressed. This results in lower diversity and the dominance of tolerant opportunistic species in several square kilometres around the well location. Since the ban on discharge of diesel oil-based drilling fluids and the restriction in discharge of other organic-phase drilling fluids, and after the substitution of most of the hazardous chemicals with less hazardous substances, the impact has significantly reduced. Studies have shown that at the peak of discharge of oil-contaminated cuttings fauna disturbance was found at more than 5 km from some platforms, but is now seldom detected beyond 500 m.

Although it is more than 20 years since the discharge of organic-phase fluids contaminated cuttings was prohibited, historical cuttings piles are still present under some platforms. The 2009 OSPAR assessment of impacts of offshore oil and gas activities in the North-East Atlantic concluded that disturbance of cuttings piles does not result in significant impacts on the marine environment. Further studies in 2014 (OIC 2014) and 2017 (OIC 2017), and new data supports that conclusion, as no significant effects on the seabed have been observed, although there may be a temporary effect on the water and sediment quality near the site of disturbance. Contamination of the water column is expected to be limited to during and immediately following the disturbance and the local seabed is expected to return to its prior status within a few years.

The discharge of drill cuttings and water-based fluids may cause some smothering in the near vicinity of the well location. Water-based cuttings may affect biomarkers in filter feeding bivalves, and cause elevated sediment oxygen consumption and mortality in benthic fauna. Effects levels occur within 0,5-1 km distance and the stress is mainly physical. The impacts of such discharges are localised and transient but may be of concern in areas with sensitive benthic fauna, for example corals and sponges.

It is generally expected that PW is diluted in the water phase, however, hydrophobic chemicals in it may adsorb to the sediment, especially in shallow water or a downward trajectory of the PW plume.

Sediment monitoring has been performed by several Contracting Parties. Both Danish and Norwegian studies found that the concentration in sediments of petrogenic PAH increases in the areas close to the platforms. Biological diversity and evenness have been studied in samples from the Danish platforms, and changes to the seabed fauna and quality were found to be local and short term and the seabed is resilient to disturbances associated with oil and gas operational discharges. The results of the seabed monitoring do not indicate that discharges of PW in general have an impact on the seabed, as the probability for such impact by nature will be less likely with increasing distance and depth from where the discharges take place.

Fact box 4: Danish sediment monitoring:

In Denmark, chemical and biological monitoring was performed around the following four installations in 2018; the Gorm platform, the Tyra E platform, the Dan F platform and the South Arne platform.

The monitoring (Figure 15) was performed in May-June 2018. Three of the platforms (Gorm, Tyra E and Dan F) are located in the southern part of the Danish sector of the North Sea. The fourth platform (Syd Arne) is located in the northern part of the Danish sector of the North Sea approximately 243 km from the Danish west coast. The seabed was monitored at 18 platform stations located at a distance of 100 m, 250 m, 750 m, and 1500 m in the north, east, west and south direction around the four platforms and at 3000 m to the east and west. In addition, one or two local reference stations and one regional reference station placed at more than 10 km from each of the four platforms were surveyed.

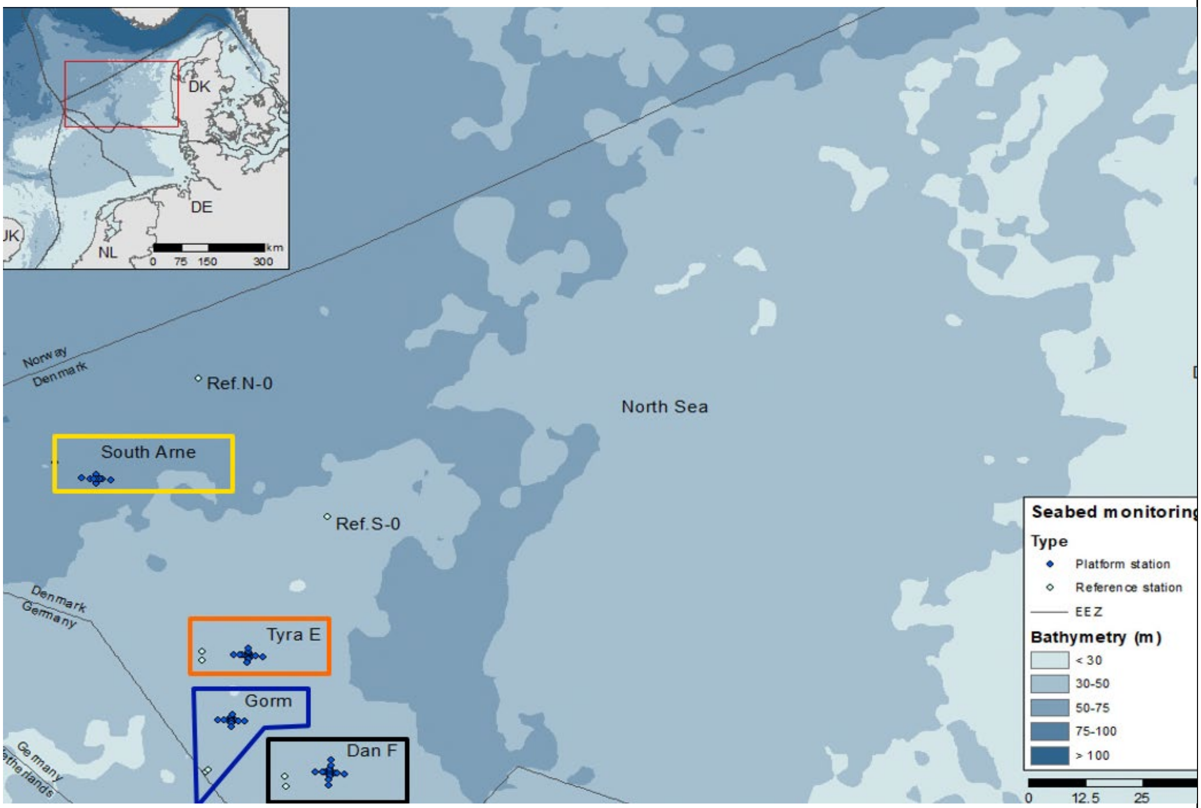


Figure 15. *Map of the 2018 Seabed Monitoring Area on the DCS. (Source: DHI, 2018)*

Two Marine Strategy Framework Directive pressure descriptors and two state descriptors were assessed in the monitoring:

- Descriptor 1: Biological diversity (state)
- Descriptor 2: Non-indigenous species (pressure)
- Descriptor 6: Seafloor integrity (state)
- Descriptor 8: Contaminants (pressure)

Up to 17 individual indicators were compared against specific reference levels and used to calculate individual indicator score (or index). Then, the lowest indicator score was used to define the descriptor index. Subsequently, the stations' Environmental Status (EnS) score was estimated by a weighted average of the four descriptors scores (3 for state descriptors and 1 for pressure descriptors). Index was built to range from 0 (bad state/extreme pressure) to 100 (similar to reference levels). Stations were classified based on their EnS scores: High when score was equal to 100, good (75-100), moderate (50-75), poor (25-50), bad (0-25).

Results

The calculated Environmental Status (averaged over descriptors and over four directions (N, E, S, W from platforms) ranged between 89 and 100. Around Dan F platform, EnS was significantly reduced close to the platform (100 m) primarily due to reduced biodiversity (D1), and to elevated concentration of pollutants (D8). At the South Arne the EnS was reduced 250 m from the platform due to reduced biodiversity (S and E directions), presence of non-indigenous species (D2) and reduced seabed integrity (D6) (N, E and S directions). Around Gorm and Tyra E platforms EnS were rather high, uniform and independent of distance from the platforms (table 2)

The reason for reduced seabed EnS near to Dan F platform is unknown, but potential impact from PW discharge cannot be ruled out, as discharges from Dan F platform is 4 -12 times larger than discharges from the other three platforms. Briefly, the PW is discharged at a depth of 29 m and, having a higher density than the surrounding seawater PW tends to remain near the seabed allowing PW constituents to interact with seabed through adsorption and precipitation.

	100 m	250 m	750 m	1500 m	3000 m	PW discharge
Dan F	89	97	99	96	100	10 726
Gorm	98	98	96	95	99	2 682
Tyra E	100	99	96	98	100	846
South Arne	97	93	100	100	98	2 408

Table 2. *Overview of the Environmental Status of seabed scores at 4 platforms monitored in 2018 separated into distances from the platforms and averaged across distances. Last column shows the accumulated PW discharge in 2017 (in 1000 m^3) (ens.dk).*

In 2017 Oil Gas Denmark produced the report “Descriptor-based review of 25 years of seabed monitoring data collected around Danish offshore oil and gas platforms“. A method based on Marine Strategy Framework Directive descriptors was for the first time used around Danish oil and gas platforms to assess the Environmental Status (EnS); a score that integrates biological and chemical sediment data. Quantitative deviation from reference areas is indicative of some degree of impact on the benthic ecosystem (though not necessarily significant). The following text is extracted from the report:

The majority of stations scored relatively high and above 90. Descriptors scores were significantly lower up to 1500 metres (D1) and 250 metres (D6 and D8) from the platform. There was no indication that NIS presence and abundance is related to the presence of O&G platform. Lower EnS scores were observed up to 1500 metres from the platform 5 years after drilling operations. There were regional differences with lower scored observed around deeper northern platforms. Based on high EnS scores and resistance and resilience of the benthic ecosystem to O&G operational discharges, it is concluded that Environmental Status around platforms in the Danish North Sea is Good. The conclusions are consistent with that drawn from previous benthic fauna analysis in Denmark or results from other monitoring programmes in the North Sea. The findings from 2018 confirm general results from the 1989-2015 review.

4.1.2 Physical impacts on the seabed

Contracting Parties do not undertake extensive monitoring programmes to assess the physical impacts of the placement of structures on the seabed. Historical monitoring has demonstrated that the impacts are largely transient, with re-colonisation of disturbed seabed habitats occurring within relatively short timescales.

The creation of hard bottom substrate can, over time, give an opportunity for new benthic species to colonise the former sandy/muddy areas. Pipelines, platform legs and subsea templates may act as shelter for fish and other mobile marine organisms, and provide a habitat for benthic organisms usually associated with hard substrates.

Physical impacts on the sea bottom will occur in connection with installing pipelines, cables, bottom rigs, templates, skids, and platforms including platform legs and anchoring. Due to the number and length of pipelines placed on or under the seabed the overall physical impact of pipelines is greater than those from the other installations or operations mentioned above. Therefore, this section refers mainly to physical effects from pipelines. However, other installations and associated infrastructure will cause qualitatively similar impacts to those described for pipelines, but at a smaller scale.

Pipelines are either placed on the seabed or buried partly or completely in the sediment. Impacts are caused by the actual placement of the pipelines, particular in areas where the pipelines are to be trenched and buried. Pipelines are buried to ensure that they are not buoyant, and they remain in place; this also reduces the potential hazards for fishermen. The vessels deploying pipelines can also impact the seabed if they are using anchors to maintain position. Compared to the long term direct physical impact of the pipeline itself these impacts are usually short term with the recovery of the seabed over time.

The footprint of the pipeline, or the affected zone around it, is dependent on length, diameter, the degree of burial or build-up of gravel etc. Pipeline burial causes the largest impact during the installation phase because of considerable disturbance of the seabed and mobilisation of sediment. The volume and distance that suspended sediments disperse depends on particle size, weight and current velocity. The area of impact during pipeline burial is considered to be within 10 – 20 m of the line, but once buried, pipelines usually have insignificant impacts. However, once a pipeline is laid there is a risk that upheaval buckling may occur along certain areas of the line. Free-spans may also occur underneath the pipeline when the seabed topography changes due to sediment movement. In these situations, it is critical for the integrity of the lines and safety of fishermen to place gravel or concrete mattresses along those parts of the line. In areas of soft sediment this activity introduces a hard substrate into the environment.

Benthic communities will be impacted for a variable period of time. In areas of soft sediments, where most pipelines are trenched and buried, the soft bottom fauna re-colonises within a year or two. In areas of harder substrates the recovery of benthic communities may take longer, up to 10 years in deeper colder water areas. There are few pipelines that are trenched and buried in these areas. In impacted areas there is a gradual change in the species composition of benthic communities until equilibrium is achieved depending on the new local conditions. During the re-establishment of the area, it is also possible that specific diversity will increase due to the colonisation of hard structures by previously absent benthic species.

Due to differences in bottom topography, geology, water mass movement and other environmental factors such as sensitive benthic species and habitats (particularly cold water corals and sponges), the potential problems in introducing these structures will meet different challenges depending on the natural conditions in the different OSPAR Regions.

Decommissioning of pipelines and removal of installations and associated infrastructure can cause sediment disturbance and subsequent localised impacts. Similarly, if there is a cuttings pile at the base of the platform this may be disturbed and contaminated cuttings re-suspended. On occasions it may not be possible to remove the lower parts of a platform, for example concrete substructures and the footings of the largest steel installations.

4.1.3 Impact and effects in the water column

Water column monitoring (WCM) has been carried out in the OSPAR area to determine the possible effects of discharges of PW. The monitoring of toxic effects in the water column has a focus on biomarkers in fish (especially cod (*Gadhus morhua*) and haddock (*Melanogrammus aeglefinus*) and blue mussels (*Mytilus edulis*) and aim to identify sensitive endpoints that can be linked to the exposure to PW.

Data from Norwegian WCM (Fact box 5) found significantly higher concentrations of PAH and NPD (naphthalene, phenanthrene and dibenzothiophene) in caged mussels located 500 m from an offshore installation compared to reference areas and histopathological analyses indicated a minor stress condition in caged mussels located 500 m and 1000 m from the platform. Thus, the worst-case exposure (500 m from discharge point) mainly confirmed the exposure by observation of minor stress condition in the mussels. Increased levels of PAHs, alkylphenols and measured biological responses also suggest exposure of wild fish. The combined exposure to the constituents in produced water may lead to a toxic effect on organisms in the sea. This is reflected in the OSPAR RBA guideline, which allows for the risk to be estimated by either the whole effluent toxicity or by the (summed) toxicity of each substance.

Controlled laboratory experiments have shown that salmon and herring fry exposed to low PAH levels (ng to µg per L), induced cardiac defects impacted the fish fry in several critical ways, including reduced swimming performance, prey capture, and prey avoidance, with repercussions on survival and a possible impact on population level. Haddock has been observed to be more sensitive than cod when egg/embryo surface (chorion) was exposed to oil droplets.

Generally, however, results obtained with field-realistic concentrations indicate that impacts are expected to be modest. The overall risk of PW discharges inducing adverse impact on populations of wild fish and other pelagic organisms is therefore expected to be low.

It is generally accepted that PW effects are limited to the areas where the PW is diluted less than 1000 times, roughly corresponding to distances less than 1000 m from the discharge point depending on the discharge rate, water depth, local currents and other environmental factors. Based on laboratory results where the test organisms are exposed to constant concentrations over several days as well as studies with caged animals placed in the PW plume, acute effects can be expected at such concentrations.

Fact box 5: Norwegian WCM 2017

Water Column Monitoring was performed in three different regions of the North Sea in 2017: Tampen area, Central North Sea, and Egersund Bank (reference area). Additionally, focus was on studying the water column conditions around the Statfjord A and B platforms (Tampen area).

Monitoring programme and method

The WCM 2017 was carried out in three different regions of the North Sea: Tampen area, Central North Sea, and Egersund Bank (reference area). Additionally, focus was on studying the water column conditions around the Statfjord A and B platforms (Tampen area) – see Figure 16

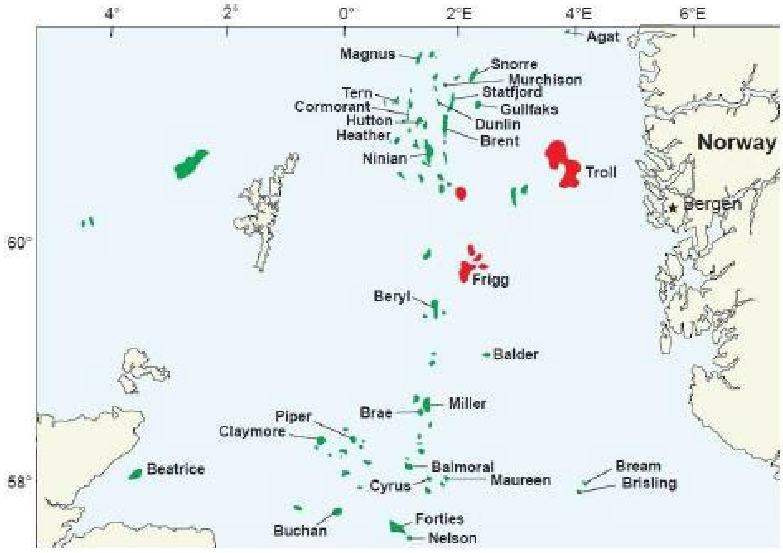


Figure 16. *Statfjord oil field relative location in comparison with Norway and UK coastlines. (Source: Pampanin et al., 2019)*

The WCM monitoring priorities were to determine:

- potential effects of oil and gas related discharges in mussels caged around the Statfjord A and B platforms (WP1)
- potential effects of oil and gas related discharges in wild fish caught around the Statfjord A and B platforms (WP2)
- potential effects of oil and gas related discharges in wild fish caught in three regions of the North Sea (WP3)
- a preliminary study to evaluate the potential use of zooplankton as a monitoring tool for studying the effect of oil and gas related discharges (zooplankton-based monitoring) (WP4)

In addition, priority was given to a research study on method development for DNA adducts in fish (WP5).

Results

Mussels

The sum of PAH concentrations in mussel tissues showed higher concentrations in organisms that were caged closest to both Statfjord A and B platforms. However, these values were lower than those from previous surveys. For PAH accumulation, naphthalenes were the most abundant followed by phenanthrenes and dibenzothiophenes. The source of the PAHs has been identified as petroleum, as in previous surveys at Gullfaks C, Troll C and Ekofisk.

Regarding the biological effect parameters, some highlighted a stress condition present in mussels caged at Statfjord A and B. Mussels appear to be in stress conditions, but compensating, as confirmed by the physiological level measurements and their ability to maintain reproductive development (e.g. spawning status). However, signs of more severe stress conditions were recorded in mussels caged 500 m from Statfjord A, by means of lysosomal membrane stability and micronucleus (MN) frequency in haemocytes. In particular, at 4 stations close to the platform, MN frequency values showed a clear sign of the presence of contaminants with genotoxicity potential.

Fish

Wild caught fish from four areas were analysed: Statfjord, Tampen, Central North Sea and Egersund bank (as a reference).

PAH metabolites were significantly higher in cod collected at Statfjord and in whiting sampled at Tampen area compared to the reference site. The increased levels of PAHs in the water column at Tampen and Statfjord shown in soft tissues of deployed mussel was less evident in fish. Nevertheless, genotoxic effects were clear in fish, as revealed by both DNA adduct and comet assay results. DNA adduct levels were higher at Tampen and Statfjord compared to the reference area. In addition, DNA adduct levels were significantly different between species at Tampen, with higher levels for haddock and saithe, compared to the refence area. DNA adduct levels were also significantly different among fish species collected from Statfjord A, with higher levels for haddock, whiting and ling. DNA adducts were also analysed in the intestines of a subset of samples and higher levels of DNA adducts compared with fish from the reference area were found. Part of the difference could, however, be explained by age differences among the fish.

Levels of DNA adducts from haddock livers at Tampen were higher than those reported in the monitoring programs from 2005-2011.

A significant inhibition in acetylcholine esterase (AChE) activity was observed in ling from Statfjord and cod from Statfjord and Tampen, compared with the Egersund Bank, although not found for whiting and saithe. Inhibition in AChE activity may indicate possible exposure to neurotoxic contaminants.

The monitoring of toxic effects in the water column has a focus on biomarkers in fish (especially cod and haddock) and blue mussels (*Mytilus edulis*) and aims to identify sensitive endpoints that can be linked to the exposure to PW. The Research Council of Norway concluded in 2012 that toxic effects such as cell death, genetic change, DNA damage, a change in fatty acid composition and interference with reproduction is detected at concentrations of produced water at 0.1-1% or higher, i.e. when the PW has been diluted less than 100-1 000 times. Moreover, the focus of testing of effects of PW has recently shifted towards possible effects of chronic, low-concentration exposures to sensitive endpoints and life stages of marine species such as early life and sexual maturation.

However, constant exposure scenario is improbable because an organism is unlikely to be exposed for days to static concentrations. Drifting plankton (including fish eggs) passing the discharge point may be exposed to high PW concentrations, but because of dispersion and dilution the exposure duration is short. For adult fish, effect or accumulation of PW constituents have not been demonstrated in wild animals caught in PW influenced areas, perhaps because they can avoid polluted areas. This does not mean that laboratory results should be disregarded, especially when the exposure concentrations correspond to dilutions of 1 000 times or more. Effects at these low concentrations are observed, however, after weeks of continuous exposure, which are unlikely under environmental conditions.

Also, sessile organisms are expected to rarely experience constantly high pollution levels, as the direction of a pollution plume changes depending on tide, currents, and wind.

Despite the large volumes of PW released, the effects of the constituents appear to be low and mainly seen at biomarker level. However, the causality between the biomarkers and toxic effects and impact at organism and population levels remains to be proven. Other anthropogenic factors are difficult to exclude when assessing the impact of PW in marine ecosystems. Whilst the conclusions from the OSPAR Quality Status Report 2010 are still valid, it should be emphasised that it does not imply that no such causal relationships between impacts at organism level and impacts at population or ecosystem level exist. It should only be seen as an indication that there is a lack of evidence and that further investigations are needed to establish whether such relationships exist.

Accidental spills of oil and chemicals may have an impact on the marine life in the upper water column including mammals and seabirds. The level of impact arising from an oil spill is dependent on the location and size of the spill and when it occurs. Assessment of the environmental effects following the 2012 Elgin incident in the UK which resulted in the release of gas/condensate have shown that dispersion and evaporation of the gas/condensate occurred within hours of its release, with the sheen never travelling further than 60 km from the Elgin location. Environmental surveys following the incident has indicated that there was no evidence of significant effects on the water column, fish or seabed from the condensate or WBM. There was also no evidence of significant mortality of either birds or marine mammals during or after the incident and hydrocarbons did not beach.

There is no evidence that accidental spills of chemicals significantly impact the water column.

Drop out of oil from flaring can occur, particularly when undertaking well clean-up or well testing operations. The majority of well clean-ups and well tests do not have oil drop out and from those that do, the volume of oil discharged into the water column is considered to be negligible. No environmental impacts have been reported from these activities.

4.1.4 Other impacts

Platform lighting and flaring are known to attract birds, and these might cause some mortality in migratory species. The level of impact depends on the location of the platform, the time of year and the prevailing weather conditions at the time with birds being most frequently attracted during the autumn migration and periods of poor weather. According to research into possible effects of offshore platform lighting on specific bird populations (2012 OSPAR Workshop), there is evidence that conventional lighting of some offshore installations has had an impact on a large number of birds. Evidence is, however, not sufficient to conclude whether or not there is a significant effect at a population level (E. van der Zee, 2014) [2].

Impacts from noise due to offshore oil and gas activities are unavoidable. Seismic surveys are required for exploration and to a lesser extent the production phase. All construction activities associated with developing an oil and gas field create noise of some kind. Potential effects from noise vary depending on the sensitivity of the receptor and its proximity to the sound source. There is potential for an increase in mortality of juvenile stages of fish, permanent or temporary hearing impairment and the displacement of fish and marine mammals from their normal range (OSPAR, 2009a).

The most significant source of noise is from seismic surveys, and there is evidence for several species of cetaceans to suggest avoidance over distances most commonly around 2-5 km from a survey vessel;

changes in acoustic communication have been recorded at much greater distances (up to several hundred kilometres) but there is a lot of uncertainty with regard to the biological significance of these observations. Relatively limited evidence is available for harbour porpoises or other species common in the North Sea; as a conservative assessment, it is reasonable to assume that firing of airguns during seismic surveys will affect individuals within 10 km of a survey vessel, resulting in changes in distribution and reduction of foraging activity; although the effect is short-lived.

Impacts on fish from seismic surveys have been shown to occur with an increase in fish mortality less than 5 metres from the sound source and temporary threshold shifts and behavioural responses have also been reported. Evidence from the North Sea indicates potentially large scale avoidance of areas where seismic surveys are being undertaken with fish either moving into deeper water or avoiding the area altogether. Experiments undertaken in the North Sea on sandeels indicated relatively minor responses from seismic surveys with no increases in mortality.

4.2 Effectiveness of OSPAR measures

Studies have been undertaken by OSPAR Contracting Parties looking at a wide range of potential impacts including historical cuttings piles, discharges of produced water, drilling fluids and chemicals. The results of the studies show that the implementation of the OSPAR measures has resulted in a measurable decrease in discharges and associated impacts. Impacts that were once widespread for example from the discharge of oil-based fluids, have now ceased and the level of contamination has decreased over most of the OSPAR area. Where potential impacts may still occur, these have been reduced, for example reduction of over 20% in the amount of dispersed oil discharged in produced water; the phase out of discharges of added offshore chemicals identified for Priority Action (LCPAs); and a nearly 50% reduction in the discharge of chemical substances identified as candidates for substitution (although further reductions in discharges are considered possible).

A risk-based approach for the management of produced water discharges has also been introduced to complement the OSPAR harmonised mandatory control system for offshore chemicals and promote the shift towards a reduction in the use of more hazardous substances.

Contracting Parties have also fully implemented the ban on the dumping or leaving in place of disused offshore installations. Since OSPAR Decision 98/3 on the disposal of disused offshore installations was adopted, approximately 170 installations have been decommissioned of which 10 were granted derogations.

Evidence from monitoring and reporting indicates that the overall effect of these OSPAR measures and their implementation by Contracting Parties has been to significantly improve the overall quality status of the OSPAR Maritime Area as a whole, particularly in areas of Region II where there are high levels of oil and gas activity.

In relation to progress against the North-East Atlantic Environment Strategy 2010 – 2020 thematic objectives:

- *to achieve, by 2020, a reduction of oil in produced water discharged into the sea to a level which will adequately ensure that each of those discharges will present no harm to the marine environment*

There has been reduction in both the concentration of oil in produced water discharges and the volume of oil discharged. Work is ongoing to ensure that oil in produced water discharges does not present harm to the marine environment.

- *to have phased out, by 1 January 2017, the discharge of offshore chemicals that are, or which contain substances, identified as candidates for substitution, except for those chemicals where, despite considerable efforts, it can be demonstrated that this is not feasible due to technical or safety reasons (OSPAR Recommendation 2006/3)*

  Whilst progress has been made in reducing the use and discharge of chemicals identified as candidates for substitution since the introduction of OSPAR Recommendation 2006/3, phase-out has not been achieved. Recognising that more needs to be done to reduce discharges of substitution chemicals a new deadline to phase out by 1 January 2026 has been agreed.

- *The Offshore Oil and Gas Industry Strategy also covers activities to store CO_2 streams in geological formations with the objective to ensure that CO_2 streams are retained permanently in those formations and will not lead to significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area (OSPAR Decision 2007/2).*

  There are only two full scale projects with CO_2 storage in the OSPAR area. Due to the very limited number of full-scale projects so far, an evaluation of the effectiveness of OSPAR Decision 2007/2 has not yet been undertaken.

5. What do we do next?

Since QSR 2010 and because of implementation of OSPAR measures by Contracting Parties and industry, the oil and gas industry has made measurable progress and improvements in reducing the environmental impact. However, there are areas where it may be possible to further reduce the potential impacts.

5.1 What measures have been effective?

The following measures can be seen as effective, based on the progress and improvements:

- 16% reduction from 2009 in dispersed oil discharged in PW has been achieved through the application of standards set out in OSPAR Recommendation 2001/1 for the Management of Produced Water from Offshore Installations, as amended by OSPAR Recommendation 2006/4 Recommendation 2011/8, and Recommendation 2020/2, and also aided by the descriptions of principles, basic elements and operational aspects of techniques in the Background Document concerning Techniques for the Management of Produced Water from Offshore Installations (OSPAR Commission 2013).
- A decrease in the number of installations exceeding 30 mg/l oil for dispersed oil in PW discharged to sea, has been achieved through the application of the performance standard set out in OSPAR Recommendation 2001/1 for the Management of Produced Water from Offshore Installations, as amended by OSPAR Recommendation 2006/4, Recommendation 2011/8 and Recommendation 2020/2.
- The phasing out of added chemicals identified for Priority Action (LCPAs) was achieved through the application of OSPAR Recommendation 2005/2 on Environmental Goals for the Discharge by the Offshore Industry of Chemicals that Are, or Contain Added Substances, Listed in the OSPAR 2004 List of Chemicals for Priority Action.

- Nearly 50% reduction in the use and discharge of substances carrying substitution warnings can be directly attributed to the implementation of OSPAR Recommendation 2006/3 on Environmental Goals for the Discharge by the Offshore Industry of Chemicals that Are, or Which Contain Substances Identified as Candidates for Substitution, as amended by OSPAR Recommendation 2019/2.
- OSPAR measures such as the harmonised approach to the management of offshore chemicals, harmonised notification format and harmonised pre-screening procedures for offshore chemicals, and efforts to increase harmonisation between the HMCS and REACH continues to ease work of both the national competent authorities and the industry and have made regulatory decisions related to use and discharge of offshore chemicals within the OSPAR Maritime Area more transparent.
- Introduction of RBA to assess the environmental risk posed by PW discharges including naturally occurring substances in accordance with OSPAR Recommendation 2012/5 for a risk-based approach to the Management of Produced Water Discharges from Offshore Installations, as amended by OSPAR Recommendation 2020/3. To date, 54% of the installations are determined to have their discharge adequately controlled, 39% require further action to be taken, and the remainder are still under assessment.
- Disused offshore installations are not dumped in the OSPAR Maritime Area in accordance with OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations. Since 2010, four derogations for footings of steel installations have been issued and further derogation for footings of one steel installation and three gravity-based concrete installations were under consideration.

5.2 What measures are still challenging?

- Linking the estimated risk levels calculated through RBA to possible impacts in the receiving environment is a step that has not yet been addressed.
- Whilst progress has been made in reducing the use and discharge of chemicals identified as candidates for substitution since the introduction of OSPAR Recommendation 2006/3, the challenge remains to phase out the discharges of substitution chemicals.
- Continuous improvement remains a challenge with hydrocarbon production at different stages in different regions and new developments continuing in Region I and II.
- Good practice guidelines for geophysical surveys and use of explosives need to be developed.
- On decommissioning, as older installations reach their end-of-life, it is anticipated that a number of installations will be decommissioned in the coming decade. Whilst there has been development in advancing the technical capabilities, such as increase in lift capabilities to remove topsides and steel jacket installations, there have been no technology developments that would support a reduction in the categories eligible for derogation from OSPAR Decision 98/3.
- There are only two full scale projects with CO_2 storage in the OSPAR area. Due to the very limited number of full-scale projects so far, an evaluation of the effectiveness of OSPAR Decision 2007/2 has not yet been undertaken.

5.3 Priorities for action in the future

OSPAR will continue to take all possible steps to prevent and eliminate pollution and adopt the necessary measures to protect the maritime area against the adverse effects of human activities so as to safeguard human health and to conserve marine ecosystems and, when practicable, restore marine areas which have been adversely affected.

The North-East Atlantic Environment Strategy 2030 adopted at the OSPAR Ministerial meeting in Cascais on 1 October 2021 set-out the following Operational Objectives that are relevant for OIC:

Chemicals and Produced Water

S2.O3: By 2027 OSPAR will ensure that measures to eliminate discharges, emissions and losses of hazardous substances are in place to achieve or maintain good environmental status for hazardous substances, including through working regularly with other organisations.

> **Task:** Further reduce discharges of oil in Produced Water to sea to adequately control the risks to the marine environment from those discharges. Assess the possible effects of oil sheens originating from discharges of PW which from time to time and in calm weather conditions forms at the sea surface.
>
> **Task:** Apply a harmonised method of assessing environmental risk (risk based approach) relating to produced water discharges, and to help Contracting Parties in identifying and adopting measures to reduce the risk to the environment from discharges of produced water.
>
> **Task:** By 2026 phase out the discharge of offshore chemicals that are, or which contain substances, identified as candidates for substitution, except for those chemicals where, despite considerable efforts, it can be demonstrated that this is not feasible due to technical or safety reasons.
>
> **Task**. Establish the extent of the use and discharge of nanomaterials contained in offshore chemicals and, where appropriate, develop measures to control or phase out the discharge of nanomaterials contained in offshore chemicals
>
> **Task:** Continue the annual collection of data on use and discharges of offshore chemicals, emissions to air, spills, and discharges of oil and radioactive substances, and the assessment of the effects of discharges and emissions from offshore installations.
>
> **Task:** Review OSPAR Recommendations 2001/1 for the Management of Produced Water from Offshore Installations, 2006/3 on Environmental Goals for the Discharge by the Offshore Industry of Chemicals that Are, or Which Contain Substances Identified as Candidates for Substitution and 2012/5 for a risk-based approach to the Management of Produced Water Discharges from Offshore Installations with a view of developing a holistic approach to the management of produced water.

S2.O4: By 2026 OSPAR will further develop the Harmonised Mandatory Control System for the use and discharge of offshore chemicals to improve coherence with other relevant international requirements such as the EU REACH Regulation and the Biocidal Products Regulation.

> **Task:** Review of OSPAR Decision 2000/2 (as amended by OSPAR Decision 2005/1) and all underpinning Recommendations and Agreements to determine how the OSPAR approach can further harmonise with EU REACH and EU BPR.

Plastics and microplastics

S4.O5: By 2025 OSPAR will adopt programmes and measures to control and, where appropriate, phase out plastic from materials placed at sea for the purposes of marine infrastructure developments.

> **Task:** Establish and report on the source and extent of the use of plastic in materials placed in the marine environment for protecting offshore oil and gas infrastructure and, where appropriate, develop measures to control or phase out plastic from materials placed at sea for the purpose of protecting marine infrastructure.

S4.O6: By 2027 OSPAR will develop measures to control, and where possible, phase out discharges of plastic substances, including microplastics, contained in chemicals from offshore sources.

> **Task:** To determine the extent of use and discharge of plastic substances, including microplastics, contained in offshore chemicals and, where necessary, develop measures to control or phase out their use.

Environmental monitoring

S7.O1: By 2028 OSPAR will further develop methods for the analysis of cumulative effects in the marine ecosystems of the North-East Atlantic, taking into account relevant spatial and temporal information on human activities, pressures, sensitive receptors and habitats, and use the results to inform the establishment of measures and actions to prevent, reduce or otherwise manage impacts.

> **Task**: Develop a monitoring programme for offshore activities, with a view to Contracting Parties carrying out effective, coordinated environmental monitoring to evaluate any regional effects by 2028, including effects on ecosystems.

Noise

S8.O1: By 2025 OSPAR will agree a regional action plan setting out a series of national and collective actions and, as appropriate, OSPAR measures to reduce noise pollution.

> **Task:** Develop good practice guidelines for offshore operations particularly for geophysical surveys and use of explosives.

Decommissioning

S9.O2: By 2023 OSPAR will review and, if appropriate, amend the categories of disused offshore installations where derogations may be considered under OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations, aiming to reduce the scope of possible derogations. The review will be based, inter alia, on the advancement of decommissioning technologies and on the best available scientific knowledge.

> **Task:** In 2023, taking account of advancement of decommissioning technologies and scientific knowledge, review and, if appropriate, amend the categories of disused offshore installations where derogations of OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations may be considered.

S9.O3: By 2023 OSPAR will agree on an approach and on actions to promote and advance decommissioning technologies under the framework of Decision 98/3 with the aim of reducing the scope of possible derogations.

> **Task:** Agree on an approach and develop an action plan to promote and advance the development of decommissioning technologies.

Climate change

S10.O3: In 2023, and every 6 years thereafter, OSPAR will assess the current and projected impacts of climate change and ocean acidification on the OSPAR Maritime Area and its uses, to inform the development of national and international actions.

> **Task:** Undertake a review of OSPAR measures and actions relevant to OIC on pollution prevention and update as appropriate in the context of [additional pressures from] climate change and ocean acidification.

Carbon dioxide storage

S12.03: By 2024 OSPAR will review the results of monitoring that is undertaken in relation to carbon dioxide storage to assess whether the monitoring techniques deployed are adequate to demonstrate that carbon dioxide streams are retained permanently in the storage complex. By 2026 OSPAR will evaluate the effectiveness of OSPAR measures to ensure that carbon dioxide streams are retained permanently in the storage complex and will not lead to any significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area.

> **Task:** Review the monitoring of carbon dioxide stored in geological formations to help evaluate the effectiveness of OSPAR measures in ensuring that carbon dioxide streams are retained permanently in geological formations.

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Our vision is a clean, healthy and biologically diverse North-East Atlantic Ocean, which is productive, used sustainably and resilient to climate change and ocean acidification.

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