

JRC TECHNICAL REPORT

Guidance on potential exclusion of certain WFD priority substances from MSFD monitoring beyond coastal and territorial waters

A pragmatic and qualitative approach for the open sea

MSFD Expert Network on Contaminants

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Foreword

The Marine Directors of the European Union and all EU Member States have jointly developed a common strategy for supporting the implementation of Directive 2008/56/EC, the “Marine Strategy Framework Directive” (MSFD). The focus of the strategy is on methodological questions relating to a common understanding of the technical and scientific implications of the MSFD. In particular, one of the objectives of the strategy is the development of non-legally binding and technical guidance, such as this report, on various technical issues under the Directive.

The MSFD Expert Network on Contaminants led by the Joint Research Centre, is delivering thematic technical reports such as “Marine chemical contaminants – support to harmonized MSFD reporting” and “Marine chemical contaminants – support to the harmonization of MSFD D8 methodological standards”. These thematic reports are targeted at those experts who are directly or indirectly implementing the MSFD in the marine regions.

This Technical Report should further support EU Member States in their implementation of monitoring programmes concerning chemical contaminants.

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Abstract

According to Commission Decision (EU) 2017/848 under the Marine Strategy Framework Directive (MSFD), EU Member States (MS) shall consider, in their Descriptor 8 primary criterion (D8C1) assessments, the WFD Priority Substances (PS) and River Basin Specific Pollutants (RBSP) within coastal and territorial waters and also beyond territorial waters if these still may give rise to pollution effects. Some WFD PS might not be relevant for the marine environment in the open sea and, consequently, might be excluded from MSFD monitoring beyond the territorial waters. MS have expressed the need for a framework for the deselection of WFD PS from monitoring under the MSFD, in order to save resources. The European Commission's Joint Research Centre (JRC), collaborating within the MSFD Expert Network on Contaminants, has developed a pragmatic approach to identify the WFD PS that can be excluded from MSFD monitoring in the open sea beyond territorial waters without reducing protection of European Seas. This should preempt the need for individual MS to provide rationales for such exclusions, support comparable monitoring and assessments across national boundaries, and enable MS to focus their monitoring efforts on other (including emerging) substances that require attention.

1 Introduction

The open sea, beyond 12 nautical miles from the coastal baseline, is a particular compartment of the marine environment. While being distant from the coast and land-based industrial installations, it can still be affected by river plumes and currents arising from proximity to land, as well as by emissions from marine industrial installations and shipping. Furthermore, it receives input from atmospheric depositions, including also harmful substances. It is a vast, often unexplored, area and while dilution by the enormous water masses is enormous, two main processes enhance the spread of contamination in marine seas: i) biological processes: bioaccumulation and biomagnification processes re-concentrate even low concentrations of some contaminants in the water column and sediments through marine trophic webs, back to high concentrations in top predators, ii) physical processes: water masses themselves are driven by currents, they connect countries and continents, they can re-suspend sediments and thus contribute to the long-range transport of contaminants.

Because of the specificity of the off-shore inputs to and the processes in the open seas (currents, dilution effects, long-range transport, marine food chains ...), the harmful substances selected for monitoring and assessment in that compartment can deviate from those in freshwater environments. Cost-effective approaches should consider substance properties to ensure that the most relevant substances are monitored.

Commission Decision (EU) 2017/848¹ (the so-called “Good Environmental Status (GES) Decision) under the Marine Strategy Framework Directive (MSFD)² requires the consideration by Member States (MS) of the Priority Substances (PS) established under the Water Framework Directive (WFD)³ within coastal and territorial waters and also beyond territorial waters if these may still give rise to pollution effects. MS have agreed that some WFD PS might be excluded from MSFD monitoring beyond territorial waters if there is clear evidence that they do not pose a risk and there is no harm to the marine environment. While MS can exclude substances if they provide valid reasoning for doing so, jointly identifying a list of substances at EU level which are not relevant beyond territorial waters but still fall under the MSFD would save efforts and provide a harmonised set-up. Following the MS request and a mandate from Working Group GES (WG GES mandate GES_22-2019-08), and focusing on the specific issue of avoiding unnecessary and costly monitoring in areas not covered by the WFD, the JRC and the MSFD Expert Network on Contaminants have developed this guidance on potential exclusion of certain WFD PS from MSFD monitoring.

It is relevant to highlight that there is ongoing work under the WFD to review the PS list and identify substances that can be taken out of the list on the basis of a draft set of possible “de-selection criteria” (Marinov and Lettieri, 2016). While keeping the link between the WFD and the MSFD is crucial (and marine data should be taken into account in the substance’s review process), this is a separate process and with different objectives. This guidance focuses on the particular situation of the open sea and is not intended to be a substance prioritisation process, nor a WFD priority list review. The main aim is to provide a pragmatic approach to identifying which WFD PS can be excluded from MSFD monitoring beyond territorial waters, i.e. to understand (without monitoring) which PS would not be expected to pose a risk in the open sea. This would save resources and help focus monitoring efforts on other (emerging) substances that are not currently on the priority list. Potential exclusion of certain substances from open sea monitoring will be proposed only if there is a large-scale consensus among experts, i.e. if there is an EU-level agreement that monitoring is “*not reasonable*” in open seas. This doesn’t mean these compounds should not be monitored at all since they could still need to be monitored at locations nearer to sources (land, rivers, etc.). It is also important to note that additional risk evaluations to further exclude PS could be needed and applied at regional/subregional/MS level in order to account for the specific conditions in particular areas.

⁽¹⁾ Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017D0848&from=EN>

⁽²⁾ Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)

⁽³⁾ Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

2 Criteria to potentially exclude WFD PS from MSFD monitoring in areas not covered by the WFD

A harmonized approach to the consideration of WFD PS when monitoring and reporting under the MSFD on areas not covered by the WFD has not yet been identified. Evidence that a substance does not pose a risk in the open sea is needed to exclude it from MSFD monitoring. Guidance should therefore take a substance-by-substance approach, identifying which substances are not expected to be relevant beyond coastal/territorial waters. Possible criteria for potential exclusion include:

- Substance properties
- Current production/ban state
- Potential sea-based sources
- Inclusion in relevant lists of chemicals
- Evidence from monitoring data

2.1 Substance properties

In general, the key properties that control a substance's transport and fate in the marine environment, and that should be considered when evaluating the relevance of PS beyond territorial waters, and thus for MSFD monitoring in the open sea, include:

1. Solubility in water
2. Volatility
3. Hydrophobicity
4. Long-range-transport potential
5. Persistence
6. Bioaccumulation potential
7. Toxicity

2.1.1 Solubility in water

Water solubility (usually expressed in mg/L) is one of the most important properties controlling the fate and transport of chemicals in aquatic environments. Highly soluble substances will more readily transfer to water and thus be subject to transport to the sea, leading to potential environmental problems. Such substances are also readily diluted in marine water masses and are usually less likely to bioaccumulate. Different criteria can be used to describe different degrees of solubility. This guidance refers to the criteria used by the National Pesticide Information Center (NPIC)⁴ (as last updated 2016).

2.1.2 Volatility

Volatility is a measure of the movement of a substance from water or sediments to the gas or vapour phase. The vapour pressure, Henry's Law constant (HLC), and solubility of a chemical are relevant factors for volatilization from surface waters. The tendency to volatilize from water can be determined using HLC, which is the ratio of a compound's partial pressure in air to its concentration in water at a given temperature. Chemicals with high vapour pressure and high HLC will volatilize from water, thus becoming subject to atmospheric transport, subsequent dispersion and eventual deposition (United States Environmental Protection Agency, 2015).

2.1.3 Hydrophobicity

The distribution of organic contaminants between the dissolved fraction of seawater and suspended particulate matter (SPM) (i.e. the partition coefficient) depends on the hydrophobicity of the contaminant. Greater hydrophobicity favours partitioning to SPM, particularly if the SPM is fine and has a high organic carbon content. Consequently hydrophobic contaminants are concentrated in SPM (biotic and abiotic), as well as in sediments

⁽⁴⁾ npic.orst.edu/envir/watersol.html, as last updated 5 February 2016

and larger biota in the marine environment. The octanol–water partition coefficient (Kow) (usually given as log Kow) is used as an indicator of the hydrophobicity of a contaminant. Hydrophobic contaminants with higher log Kow values accumulate significantly in SPM etc.

2.1.4 Long-range transport potential (LRTP)

Certain chemicals can be subject to long-range atmospheric transport and can therefore be found in remote areas far away from the initial emission sources. LRTP (usually measured by atmospheric half-life) is one of the screening criteria for determining whether a substance should be classified as a Persistent Organic Pollutant (POP) under the Stockholm Convention⁵. According to Annex D of this Convention, compounds are assumed to have a high LRTP if their atmospheric half-life is >2 days.

2.1.5 Persistence

Persistence concerns the degradation of chemical substances. Persistent substances are particularly likely to bioaccumulate and remain for extended periods in marine trophic webs, and to accumulate in sediments according to their adsorption properties. Section 1 of Annex XIII to the REACH Regulation⁶ defines the criteria for a substance to be classified as “persistent” (P) or “very persistent” (vP), as shown in Table 1. The half-lives correspond to harmonized test conditions (temperature, pH etc.).

Table 1. Persistence criteria according to the REACH Regulation

A substance fulfils the “persistent” (P) criterion in any of the following situations:	A substance fulfils the “very persistent” (vP) criterion in any of the following situations:
Degradation half-life in marine water is higher than 60 days	Degradation half-life in marine, fresh or estuarine water is higher than 60 days
Degradation half-life in fresh or estuarine water is higher than 40 days	Degradation half-life in marine, fresh or estuarine water sediment is higher than 180 days
Degradation half-life in marine sediment is higher than 180 days	Degradation half-life in soil is higher than 180 days
Degradation half-life in fresh or estuarine water sediment is higher than 120 days	
Degradation half-life in soil is higher than 120 days	

2.1.6 Bioaccumulation potential

The ability of some PS to accumulate in biota may increase their toxic effect and transfer in the trophic web. According to REACH, a substance fulfils the “bioaccumulative” (B) criterion when the bioconcentration factor (BCF) in aquatic species is higher than 2000. According to REACH, a substance fulfils the “very bioaccumulative” (vB) criterion when the BCF in aquatic species is higher than 5000.

2.1.7 Toxicity

Some contaminants can be toxic to marine organisms at very low concentrations (e.g. dioxins). According to REACH, a substance fulfils the “toxic” (T) criterion in any of the following situations:

- (a) the long-term no-observed effect concentration (NOEC) or EC10 for marine or freshwater organisms is less than 0.01 mg/L;
- (b) the substance meets the criteria for classification as carcinogenic (category 1A or 1B), germ cell mutagenic (category 1A or 1B), or toxic for reproduction (category 1A, 1B or 2) according to Regulation EC No 1272/2008;
- (c) there is other evidence of chronic toxicity, as identified by the substance meeting the criteria for classification: specific target organ toxicity after repeated exposure (STOT RE category 1 or 2) according to Regulation EC No 1272/2008.

⁽⁵⁾ Stockholm Convention on POPs (Convention on Persistent Organic Pollutants). <http://www.pops.int/>

⁽⁶⁾ https://echa.europa.eu/documents/10162/13632/information_requirements_r11_en.pdf

The key properties relating to the PS have been compiled (in Table 3) as far as possible according to the criteria summarized in Table 2.

Table 2. Properties and criteria relevant to assessing WFD PS

Property	Criteria
Solubility (mg/L)	Classification used by the National Pesticide Information Center: Low (< 10 mg/L) Moderate (10-1000 mg/L) High (> 1000 mg/L)
Volatility (measured by HLC and vapour pressure)	According to the EPA, as a general rule, a chemical can be considered as "volatile" when: HLC > 10 ⁻⁵ atm.m ³ .mol ⁻¹ (50 Pa.m ³ .mol ⁻¹) Vapour pressure > 1 mm Hg (130 Pa)
Hydrophobicity (measured by log Kow)	Low (log kow < 3) Medium-high (3 < log kow < 5) Very high (log kow > 5)
Persistence (usually measured by degradation half-life)	According to REACH: Yes (DT ₅₀ marine water > 60 days; DT ₅₀ fresh or estuarine water > 40 days; DT ₅₀ marine sediments > 180 days; DT ₅₀ fresh or estuarine water sediment > 120 days; DT ₅₀ soil > 120 days) No (if the DT ₅₀ is less than or equal to those above)
Bioaccumulation potential (measured by BCF)	According to REACH: Yes (BCF > 2000) No (BCF < 2000) vB (BCF > 5000)
Toxicity (measured by e.g. EC50 and NOEC from different toxicity tests, evidence of carcinogenic, mutagenic and reprotoxic mode of actions)	Yes (if the substance meets the T criterion according to REACH). When the toxicity assessment of a PS has not been performed under REACH or other relevant chemical legislation, toxicity data are gathered from other relevant sources
LRTP (usually measured by atmospheric half-life)	According to the POPs Convention: Yes (atmospheric half-life > 2 days) No (atmospheric half-life < 2 days)

The information in Table 3 has been compiled based mainly on the substance dossiers prepared under the Work Programme of the WFD Common Implementation Strategy (<https://circabc.europa.eu>: WFD CIRCA: "Implementing the Water Framework Directive and the Floods Directive"), the European Chemicals Agency (ECHA) (<https://echa.europa.eu/es/search-for-chemicals>), PubChem (PubChempubchem.ncbi.nlm.nih.gov), and the Toxic Substance Portal of the Agency for Toxic Substances and Disease Registry (ATSDR) (www.atsdr.cdc.gov/ToxProfiles). In some cases, when the information is not specified in those sources or appears inconclusive, data from other literature sources have been included.

It should be noted that a review of data in the literature might reveal widely ranging values for the properties of each substance or group of substances. Table 3 provides an overview, as a point of reference, but is not intended to be definitive, not least because additional knowledge is constantly being generated.

Table 3. Overview of selected properties of the WFD PS

Priority Substance	Solubility in water	Volatility (HLC, Pa.m ³ .mol ⁻¹) (Vapour pressure, Pa)	Hydrophobicity (log Kow)	Persistence in the aquatic environment (DT50 in water)	Bioaccumulation potential	Toxicity	L RTP (atmospheric half-life)	References
1,2-dichloroethane	High (7900-10300 mg/L)	High (1.1 x 10 ² Pa.m ³ .mol ⁻¹) (8530-10247 Pa)	Low (1.48)	No (not readily biodegradable, but unlikely to persist due to its volatility)	No (BCF <10)	Yes (carcinogenic)	Yes (43-111 days)	WFD Substance Data Sheet (2005) ECHA Substance InfoCard PubChem Compound Summary
Aclonifen	Low (1.4 mg/L)	Low (3.03 x 10 ⁻³ Pa.m ³ .mol ⁻¹) (1.6 x 10 ⁻⁵ -3.2 x 10 ⁻⁵ Pa)	Medium-high (4.37)	Yes (although questions still remain, DT ₅₀ expected >120 days)	Yes (BCF >2000)	Yes (NOEC<0.01 mg/L, fish, algae; suspected to be carcinogenic)	No (0.84-1.26 days)	WFD EQS dossier (2011) ECHA/RAC (2011)
Alachlor	Moderate (135.54–247 mg/L)	Low (2.263 x 10 ⁻³ -3.2 x 10 ⁻³ Pa.m ³ .mol ⁻¹) (1.32 x 10 ⁻³ -2.0 x 10 ⁻³ Pa)	Low (2.8)	No (DT ₅₀ 23.7-22.24 days)	No (BCF _{fish} 50)	Slightly toxic to aquatic organisms; suspected to be carcinogenic	No (8.5 hours)	WFD Substance Data Sheet (2005) PubChem Compound Summary
Anthracene*	Low (0.047 mg/L)	Low (4.3 Pa.m ³ .mol ⁻¹) (9.4 x 10 ⁻⁴ Pa)	Medium-high (4.68)	Yes (also vP) (DT ₅₀ up to 210 days in sediment)	Yes (BCF _{fish} 2536; BC _{Fmolluscs} 19000)	Yes (NOEC in the range of 0.0012 mg/L, fish, algae)	No (3.4-9.63 hours)	WFD EQS dossier (2011) ECHA (2008a)
Atrazine	Moderate (31.93 mg/L)	Low (1.5 x 10 ⁻⁴ Pa.m ³ .mol ⁻¹) (0 Pa)	Low (2.68)	Inconclusive. Generally considered non-moderately persistent, but persistence has been suggested recently (DT ₅₀ 28-134 days)	No (BCF _{fish} 7.7-12)	Slightly-moderately toxic (NOEC 29 mg/L, based on visual inspection of the data)	No (14 hours)	WFD EQS dossier (2011) ECHA Substance InfoCard PubChem Compound Summary Jablonowski et al. (2011) Coulombe (2003)
Benzene	High (1800 mg/L)	High (415 Pa.m ³ .mol ⁻¹) (99.7 hPa)	Low (2.13)	No (DT ₅₀ 4.8 hours)	No (BCF 13)	Very toxic (carcinogenic and mutagenic)	Yes (3-10 days)	WFD Substance Data Sheet (2005) ECHA Substance InfoCard PubChem Compound Summary Økland et al. (2005) Rich and Orimoloye, (2016)
BifenoX	Low (<0.1 mg/L)	Low (>1.62 10 ⁻⁴ Pa.m ³ .mol ⁻¹) (4.74 10 ⁻⁸ Pa)	Medium-high (4.48)	No (deselected from OSPAR List of Substances of Potential Concern because it doesn't fulfil the persistence criterion)	No (BCF _{fish} 1500)	Likely to meet criteria for carcinogenicity, mutagenicity, or reproductive toxicity	Yes (approx.. 15 days)	WFD EQS dossier (2011) ECHA Substance InfoCard PubChem Compound Summary
Brominated diphenyl ethers (PBDE)*,#	Very low (<<0.1 mg/L for all congeners)	Low	Very high (6-7)	Yes (long half-lives (years) suggested)	Yes	Very toxic	Yes (29-476 days)	WFD EQS dossier (2011) PubChem Compound Summary ATSDR Toxic Substances Portal

Priority Substance	Solubility in water	Volatility (HLC, Pa.m ³ .mol ⁻¹) (Vapour pressure, Pa)	Hydrophobicity (log Kow)	Persistence in the aquatic environment (DT50 in water)	Bioaccumulation potential	Toxicity	L RTP (atmospheric half-life)	References
					(<10-35100, depending on the congener)			
Cadmium and its compounds*	Insoluble (although some compounds are soluble)	Low (although depends on the compound)	Not applicable	Yes	Considered as non-bioaccumulative	Yes (carcinogenic, suspected to be mutagenic, suspected to be toxic to reproduction)	Yes (days to weeks)	WFD EQS dossier (2011) WHO (2000)
Carbon-tetrachloride*	Moderate (846.1 mg/L)	Very high (2370 Pa.m ³ .mol ⁻¹) (45.236- 14549 Pa)	Low (2.83)	No	No (BCF 40)	Yes (suspected to be carcinogenic)	Yes (34 years)	ECHA Substance InfoCard
Chlorfenvinphos	Moderate (7.3-145 mg/L)	Low (2.8 10 ⁻⁴ Pa.m ³ .mol ⁻¹) (1 10 ⁻³ -3.7 10 ⁻⁴ Pa)	Medium-high (4.15)	Low-moderate (DT ₅₀ 7-70 days)	No (BCF 27-460)	Very toxic	Yes (7-92 hours)	WFD Substance Data Sheet (2005) PubChem Compound Summary ATSDR Toxic Substances Portal
C10-C13 Chloroalkanes*	Low (0.15-0.47 mg/L)	Low (0.021 Pa)	Very high (4.39-8.69, typical value 6)	Yes (also vP) (DT ₅₀ > 180 days)	Yes (also vB) (BCF _{fish} 1173-7816; BCF _{mussel} 24000-40900)	Yes (NOEC 0.005 mg/L). (suspected to be carcinogenic)	Yes (1.9-7.2 days)	WFD Substance Data Sheet (2005) PubChem Compound Summary ECHA (2008b)
Chlorpyrifos	Low (0.39-0.76 mg/L)	Low (0.91 Pa.m ³ .mol ⁻¹) (1.0 10 ⁻³ Pa)	Medium-high (466)	No (DT ₅₀ 3-6 days)	No (BCF _{fish} 1374)	Very toxic	No (< 2 days)	WFD Substance Data Sheet (2005) PubChem Compound Summary Økland et al. (2005) Giesy et al. (2014)
Cybutryne	Low (7 mg/L)	Low (3.15 10 ⁻³ Pa.m ³ .mol ⁻¹) (8.8 10 ⁻⁵ Pa)	Medium-high (3.95)	Yes (DT ₅₀ ca. 146 days)	No (BCF 250)	Yes	Yes (7 days)	WFD EQS dossier (2011) PubChem Compound Summary ECHA (2014)
Cyclodiene pesticides*: Aldrin Endrin Dieldrin Isodrin	Low (< 1 mg/L)	Low-moderate (0.04-50.6 Pa.m ³ .mol ⁻¹) (2.6 10 ⁻⁵ -0.01 Pa)	Very high (> 5)	Yes	Yes (BCF _{fish} > 2000)	(aldrin and dieldrin suspected to be carcinogenic)	No (< 2 days; atmospheric half-life of dieldrin ca. 42 hours)	PubChem Compound Summary ATSDR Toxic Substances Portal
Cypermethrin	Low (0.004 mg/L)	Low (0.024 Pa.m ³ .mol ⁻¹) (2.3 10 ⁻⁷ Pa)	Very high (6.6)	No (DT ₅₀ seawater 7.2-24 days)	No (BCF <2000)	Very toxic	No (3.5-6 hours)	WFD EQS dossier (2011) PubChem Compound Summary ECHA (2017) UNEP (2012)
DDTs*	Low (0.025-0.12 mg/L)	Moderate (0.4-2.13 Pa.m ³ .mol ⁻¹) (2 10 ⁻⁵ -1.7 10 ⁻⁴ Pa)	Very high (>6)	Yes	Yes	Yes	Yes (ca. 1 week)	ECHA Substance InfoCard ATSDR Toxic Substances Portal AMAP (2004)
Diethylhexylphthalate (DEHP)*	Low (0.003 mg/L)	Low (0.0274 Pa.m ³ .mol ⁻¹) (0.034 Pa)	Very high (7.6)	Yes (DT50 up to 300 days in sediment. Regarded as P, but	No (BCF _{fish} 842)	Yes (toxic to reproduction.	No (1 day)	WFD Substance Data Sheet (2005) ECHA Substance InfoCard PubChem Compound Summary

Priority Substance	Solubility in water	Volatility (HLC, Pa.m ³ .mol ⁻¹) (Vapour pressure, Pa)	Hydrophobicity (log Kow)	Persistence in the aquatic environment (DT50 in water)	Bioaccumulation potential	Toxicity	L RTP (atmospheric half-life)	References
				not vP since it has been proven to be readily biodegradable)		Endocrine disrupting)		
Dichloromethane	High (13700-20000 mg/L)	High (270 Pa.m ³ .mol ⁻¹) (58290 Pa)	Low (1.25)	No (DT ₅₀ 10.9 days)	No (BCF _{fish} 6.4-40)	Not acutely toxic towards aquatic organisms (suspected to be carcinogenic)	Yes (107 days)	WFD Substance Data Sheet (2005) ECHA Substance InfoCard PubChem Compound Summary
Dichlorvos	High (18000 mg/L)	High (0.026 Pa.m ³ .mol ⁻¹) (2.1 Pa)	Low (1.43)	No (DT ₅₀ < 1 day)	No (BCF 1.2)	Uncertainties of the genotoxic and carcinogenic properties. Deemed not to be endocrine disrupter	No (< 2 days. Moreover, not expected since it is believed that it is no longer used in open spaces)	WFD EQS dossier (2011) PubChem Compound Summary
Dicofol*	Low (0.89 mg/L)	Low (0.015 Pa.m ³ .mol ⁻¹) (5.3 10-5 Pa)	Very high (5.2)	Yes (DT ₅₀ water/sediment 70-84 days)	Yes (BCF 25000)	Very toxic to aquatic life	Yes (3.1-4.7 days)	WFD EQS dossier (2011) PubChem Compound Summary
Dioxins and dioxin-like compounds*#	Very low (in the order 10 ⁻⁴ -10 ⁻⁸ mg/L depending on the compound)	Overall low (depends on the degree of chlorination: higher-chlorinated congeners usually less volatile than the lower-chlorinated. PCDDs and PCDFs are included among semivolatile organic compounds)	Very high (6-8)	Yes (also vP) (e.g. DT ₅₀ for 2,3,7,8-T4CDD in soil up to 10-12 years)	Yes (BCF 1700-186000)	Highly toxic. Several PCDD, PCDF, and PCB identified as with evidence of endocrine disruption	Yes (depending on the compound; due to their resistance to degradation and semi-volatility, they may be transported over long distances)	WFD EQS dossier (2011)
Diuron	Moderate (35-42 mg/L)	Very low (2 10 ⁻¹¹ Pa.m ³ .mol ⁻¹) (1.1 10 ⁻⁶ Pa)	Low (2.68)	Yes (DT ₅₀ 90 days)	No (BCF _{fish} 2)	Yes (suspected to be carcinogenic. Evidence of potential endocrine disruption)	No (< 2 days)	WFD Substance Data Sheet (2005) ECHA Substance InfoCard PubChem Compound Summary
Endosulfan*	Low (0.23-0.41 mg/L)	Semi-volatile (0.2-1.1 Pa.m ³ .mol ⁻¹) (1.5 10 ⁻³ -1.38 10 ⁻⁴ Pa)	Medium-high (3.62-3.83)	Yes (DT ₅₀ 32-150 days in soil, depending on the isomer)	Yes (BCF _{fish} 5000)	Highly toxic for some aquatic species, particularly fish	Yes (2-4 days)	WFD Substance Data Sheet (2005) PubChem Compound Summary ATSDR Toxic Substances Portal
Fluoranthene	Low (0.2 mg/L)	Low (1.1 Pa.m ³ .mol ⁻¹) (1.2 10 ⁻³ Pa)	Very high (5.2)	Yes (also vP) (DT ₅₀ sediment > 180 days)	Yes (BCF _{crustacean} 4800)	Yes (NOEC <10 µg/L.)	Yes (Although rapidly degraded as a	WFD EQS dossier (2011) PubChem Compound Summary ECHA (2018)

Priority Substance	Solubility in water	Volatility (HLC, Pa.m ³ .mol ⁻¹) (Vapour pressure, Pa)	Hydrophobicity (log Kow)	Persistence in the aquatic environment (DT50 in water)	Bioaccumulation potential	Toxicity	L RTP (atmospheric half-life)	References
							vapour (8 hours), L RTP is likely due to the ability to adsorb to particles)	
Hexabromocyclododecane (HBCDD)*#	Very low (0.066 mg/L)	Low (0.75 Pa.m ³ .mol ⁻¹) (16.3 10 ⁻⁵ Pa)	Very high (5.63)	Yes (DT ₅₀ sediment 21-210 days)	Yes (BCF _{fish} 18100)	Yes (NOEC 3.1 µg/L) (suspected toxic to reproduction)	Yes (3.2 days, found in Arctic wildlife)	WFD EQS dossier (2011) ECHA Substance InfoCard Norden (2008)
Hexachlorobenzene (HCB)*	Very low (0.005-0.006 mg/L)	Moderate (131 Pa.m ³ .mol ⁻¹) (0.0023 Pa)	Very high (5.9)	Yes (DT ₅₀ 5-10 years)	Yes (BCF _{fish} 42000)	Yes (carcinogenic)	Yes (ca. 700 days)	WFD Substance Data Sheet (2005) ECHA Substance InfoCard Økland et al. (2005) AMAP (2004)
Hexachlorobutadiene (HCBD)*	Low (2-4 mg/L)	High (1630 Pa.m ³ .mol ⁻¹) (20-36 Pa)	Medium-high (4.78-4.9)	Yes (vP) (DT ₅₀ 4-52 weeks)	Yes (BCF _{fish} up to 170000)	Very toxic to aquatic life, is very toxic to aquatic life	Yes (60 days-3 years, found in Arctic wildlife)	WFD Substance Data Sheet (2005) ECHA Substance InfoCard Økland et al. (2005)
Hexachlorocyclohexanes (HCH)*	Low (0.32-8.52 mg/L)	Low (1.48 10 ⁻⁶ Pa.m ³ .mol ⁻¹ for lindane) (4.4 10 ⁻³ Pa for lindane)	Medium-high (3.8-4.1)	Yes (DT ₅₀ sediment 135-162 days for lindane)	Yes (BCF _{fish} 1300-2200 for lindane)	Slightly toxic	Yes (ca. 100 days)	WFD Substance Data Sheet (2005) PubChem Compound Summary Økland et al. (2005)
Heptachlor and heptachlor epoxide)*#	Low (0.06-0.3 mg/L)	Moderate (3.2-29.8 Pa.m ³ .mol ⁻¹) (3.5 10 ⁻⁵ -5.3 10 ⁻² Pa)	Very high (5.4-6.1)	Yes (DT ₅₀ 3.5 days for heptachlor; DT ₅₀ up to 4 years for hepta chlor epoxide)	Yes (BCF 14400)	Very toxic to aquatic life (suspected to be carcinogenic)	No (2.1 hours heptachlor; ca. 1 day heptachlor epoxide)	WFD EQS dossier (2011) ECHA Substance InfoCard PubChem Compound Summary ATSDR Toxic Substances Portal
Isoproturon	Moderate (70.2 mg/L)	Low (1.46 10 ⁻⁵ Pa.m ³ .mol ⁻¹) (2.8-8.1 10 ⁻⁶ Pa)	Low (2.87)	Moderate (DT ₅₀ 20-61 days)	No (BCF _{fish} 2.6-3.6)	Very toxic to aquatic life (suspected to be carcinogenic)	No (1.3 days)	WFD Substance Data Sheet (2005) ECHA Substance InfoCard PubChem Compound Summary
Lead	Pure lead is insoluble in water; but lead compounds vary in solubility	Depends on the compound	Not applicable	Yes	Considered as bioaccumulative (factors other than the dissolved concentration in water are likely to be more important in determining the bioaccumulation)	Yes (toxic to reproduction; possible carcinogenic)	Yes (up to several days, depending on the compound)	WFD EQS dossier (2011) ECHA Substance InfoCard ATSDR Toxic Substances Portal Økland et al. (2005)
Mercury)*#	Insoluble to very low (0.02-0.03 mg/L elemental Hg)	High, although depends on the compound (0.25 Pa elemental Hg)	Not applicable	Yes	Yes (MeHg is the most common Hg organic component in the	Very toxic. (toxic to reproduction)	Yes, capable of traveling long distances by both atmosphere and	WFD Substance Data Sheet (2005) OSPAR (2016)

Priority Substance	Solubility in water	Volatility (HLC, Pa.m ³ .mol ⁻¹) (Vapour pressure, Pa)	Hydrophobicity (log Kow)	Persistence in the aquatic environment (DT50 in water)	Bioaccumulation potential	Toxicity	L RTP (atmospheric half-life)	References
					trophic web, with potential for bioaccumulation and biomagnification)		ocean current transport means and is thus truly a global pollutant	
Naphthalene	Moderate (31.9 mg/L)	High (50 Pa.m ³ .mol ⁻¹) (11.2 Pa)	Medium-high (3.3)	Yes (also vP) (DT ₅₀ sediment 230 days)	No (BCF _{fish} 515)	Very toxic to aquatic life (suspected to be carcinogenic)	No (< 1 day)	WFD EQS dossier (2011) ECHA Substance InfoCard Environment Agency UK (2007) ATSDR Toxic Substances Portal
Nickel	Ni metal insoluble (soluble Ni salts like Ni chloride and Ni sulphate)	Depends on the compound	Not applicable	Yes	No (BCF 270)	Various nickel substances are classified as known or suspected carcinogens and reproductive toxicants	Yes (submicron particles may have atmospheric half-lives as long as 30 days)	WFD EQS dossier (2011) Entec UK Limited (2011a) ATSDR Toxic Substances Portal
Nonylphenols*	Low (6 mg/L)	Low (0.3 Pa, it may be lower)	Very high (>5.5)	No (inherently biodegradable and readily biodegradable, it should not be considered as potentially persistent)	Insufficient consistent data (BCF in the range of 1300, so bioaccumulation criterion is not fulfilled)	Yes (NOEC 1-1.27 µg/L) (suspected to be toxic to reproduction; endocrine disrupting)	No (7.5 hours)	WFD Substance Data Sheet (2005) ECHA Substance InfoCard PubChem Compound Summary Økland et al. (2005)
Octylphenols	Low (5-12.6 mg/L)	Low (0.699 Pa.m ³ .mol ⁻¹) (0.064-4.7 Pa)	Very high (5.3)	No (4-tert-octylphenol is inherently biodegradable, with > 60% degradation after 28 days. It is unlikely to persist in freshwater and marine sediments and soils)	No (BCF < 2000; limited measured data from fish suggest low to moderate bioaccumulation potential in aquatic organisms)	Very toxic (p-tert-Octylphenol officially recognised in the EU as endocrine disrupting)	No (0.25 days)	WFD Substance Data Sheet (2005) ECHA Substance InfoCard
Polycyclic aromatic hydrocarbons (PAH)*# Benzo(a)pyrene (BaP) Benzo[b]fluoranthene (BbFA) Benzo[k]fluoranthene Benzo[g,h,i]perylene Indeno[1,2,3-cd] pyrene	Very low (0.0001-0.00154 mg/L)	Low (0.027-0.051 Pa.m ³ .mol ⁻¹) (1.4 10 ⁻⁸ -3.3 10 ⁻⁶ Pa)	Very high (> 6)	Yes (DT ₅₀ in fresh water and marine environments varies from days to years, depending on substance and conditions)	Yes (BCF 135-57981)	Yes (carcinogenic; benzo(a)pyrene, also mutagenic and toxic to reproduction)	Yes (ca. 1 week)	WFD EQS dossier (2011) ECHA Substance InfoCard AMAP (2004)

Priority Substance	Solubility in water	Volatility (HLC, Pa.m ³ .mol ⁻¹) (Vapour pressure, Pa)	Hydrophobicity (log Kow)	Persistence in the aquatic environment (DT50 in water)	Bioaccumulation potential	Toxicity	L RTP (atmospheric half-life)	References
Pentachlorobenzene*	Low (0.24-1.33 mg/L)	Semi-volatile (0.027-0.051 Pa.m ³ .mol ⁻¹) (0.86-4.84 Pa)	Very high (5.18)	Yes (DT ₅₀ 200-350 days in soil)	Yes (BCF 135-57981)	Slightly toxic	Yes (277 days)	WFD Substance Data Sheet (2005) PubChem Compound Summary Økland et al. (2005)
Pentachlorophenol	Moderate (14 mg/L)	Low (0.00415-0.0051 Pa)	Very high (5.12)	Yes (DT ₅₀ weeks to months in soil)	No (BCF _{fish} 100-1000)	Toxic (suspected to be carcinogenic)	Yes (29 days)	WFD Substance Data Sheet (2005) PubChem Compound Summary Økland et al. (2005)
Perfluorooctane sulfonic acid and its derivatives (PFOS)*.#	Moderate (12.4 mg/L)	Very low (3.19 10 ⁻⁴ Pa.m ³ .mol ⁻¹) (3.1 10 ⁻¹¹ -0.85 Pa)	Medium-high (4.49)	Yes	Yes (BCF 2796)	Yes (toxic to reproduction; suspected to be carcinogenic)	Yes (115 days)	WFD EQS dossier (2011) ECHA Substance InfoCard PubChem Compound Summary
Quinoxifen*	Low (0.036-0.128 mg/L)	Low (0.0319 Pa.m ³ .mol ⁻¹) (1.2 10 ⁻⁵ Pa)	Medium-high (4.66)	Yes (DT ₅₀ up to 508 days)	Yes (BCF 7450)	Yes (NOEC 6.36 µg/L)	No (1.9 days, to be further assessed)	WFD EQS dossier (2011) PubChem Compound Summary
Simazine	Low (5.29-6.2 mg/L)	Very low (5.6 10 ⁻⁵ Pa.m ³ .mol ⁻¹) (32.94 10 ⁻⁶ -1.5 10 ⁻⁴ Pa)	Low (2.06)	Yes (DT ₅₀ 12->77 days)	No (BCF ~ 1)	Slightly toxic to fish (suspected to be carcinogenic)	No (22 hours)	WFD Substance Data Sheet (2005) PubChem Compound Summary Økland et al. (2005)
Terbutryn	Moderate (22-58 mg/L)	Low (1.5 10 ⁻³ Pa.m ³ .mol ⁻¹) (1.3 10 ⁻⁴ -6.3 10 ⁻⁴ Pa)	Medium-high (3.77)	Regarded as persistent in sediments, but rapidly degraded in the water column	No (BCF 181)	Very toxic to aquatic life	No (36 hours)	WFD EQS dossier (2011) PubChem Compound Summary
Tetrachloro-ethylene*	Moderate (150 mg/L)	High (2110 Pa.m ³ .mol ⁻¹) (2500 Pa)	Low (2.53)	Yes (also vP) (DT ₅₀ > 8 weeks)	No (BCF 49)	Not potentially toxic towards aquatic organisms (NOEC > 0.01 mg/l) (suspected to be carcinogenic)	Yes (3.2 months)	ECHA Substance InfoCard EC (2005)
Tributyltin compounds (TBT)*.#	Low-moderate (0.75-61.4 mg/L)	Low (0.319 Pa)	Medium-high (4.6)	Yes (DT ₅₀ up to several months)	Yes (BCF 500-11400)	Yes (NOEC < 1 µg/L)	No (ca. 9 hours)	WFD Substance Data Sheet (2005) PubChem Compound Summary
Trichlorobenzenes	Moderate (36-48.8 mg/L)	Moderate (101-290 Pa.m ³ .mol ⁻¹) (21.5-80 Pa)	Medium-high (4.05)	Yes (DT ₅₀ 150 days)	Yes (BCF _{fish} 120-3200)	Highly toxic to aquatic organisms (NOEC 0.04 mg/l, the T-criterion is formally not fulfilled)	Yes (ca. 1 month)	WFD Substance Data Sheet (2005) ECHA (2010)
Trichloro-ethylene*	High (1100 mg/L)	High (1030 Pa.m ³ .mol ⁻¹) (9900 Pa)	Low (2.61)	Yes (also VP)	No (BCF 90)	Yes (carcinogenic; suspected to be mutagenic)	Yes (ca. 1 week)	ECHA Substance InfoCard EC (2004)

Priority Substance	Solubility in water	Volatility (HLC, Pa.m ³ .mol ⁻¹) (Vapour pressure, Pa)	Hydrophobicity (log Kow)	Persistence in the aquatic environment (DT50 in water)	Bioaccumulation potential	Toxicity	L RTP (atmospheric half-life)	References
Trichloromethane	High (8700 mg/L)	Very high (275 Pa.m ³ .mol ⁻¹) (20900 Pa)	Low (1.97)	Yes (DT ₅₀ up to 15 months; although it degrades slowly in water, a rapid volatilisation is expected)	No (BCF _{fish} 1.4-13)	(suspected to be carcinogenic; suspected to be toxic to reproduction)	Yes (151 days)	WFD Substance Data Sheet (2005) ECHA Substance InfoCard Økland et al. (2005)
Trifluralin*	Low (< 0.2 mg/L)	Moderate (10.2 Pa.m ³ .mol ⁻¹) (9.5 10 ⁻³ Pa)	Very high (5.27)	Yes (DT _{50water/sediment} 1-2 days) (DT in soil about 170 days) (considered persistent due to the ability to transfer from water (where it has a short half-life) to sediment)	Yes (BCF _{fish} 5674)	Very toxic to aquatic life (suspected to be carcinogenic)	No (0.22 days)	WFD Substance Data Sheet (2005) EU DG ENV (2007)

([†]) Identified as priority hazardous substance (PHS), for which cessation or phasing-out of discharges, emissions and losses are required in accordance with point (a) of Article 4(1) and Article 16(6) of WFD.

([#]) Substances behaving like ubiquitous PBTs.

(^{*}) Certain other pollutants, which are not in the priority substances list, but for which EQS are included in the EQS Directive 2008/105/EC.

2.2 Current production/ban state

Understanding the relevance of a PS in an area in terms of current production, uses and/or regulatory status is necessary to evaluate the possibility of that substance reaching the marine environment. While this information is not always easily accessible, some data are compiled in Table 4. It is important to bear in mind that some substances might be banned in the next few years, which could have implications on their consideration for monitoring under MSFD in future.

Table 4. Information on main uses, production and regulatory status of the WFD PS

Priority Substance	Main uses/production	Relevant EU regulation	Global prohibitions/restrictions under the Stockholm Convention Annex A (elimination); Annex B (restriction); Annex C (unintentional production).
1,2-dichloroethane	Once served as a solvent for processing pharmaceutical products and as a fumigant. Currently mainly used in the production of vinyl chloride. Small use as intermediate for other organic chemical compounds, and as a solvent. Annual volume manufactured in the EU is estimated in the range above 1 000 000 tons (ECHA Substance InfoCard).	REACH ⁷ : Authorisation list.	
Aclonifen	Herbicide.	Plant protection product (PPP) Directive ⁸ : approved in the UE (expiration of approval 31/07/2022) ⁹ . Authorised for use in AT, BE, BG, CY, CZ, DE, DK, EE, EL, ES, FI, FR, HR, IE, IT, LT, LU, LV, NL, PL, PT, SE, SI, SK, UK (EU Pesticides database).	
Alachlor	Herbicide.	PPP Directive: not approved. Banned in the EU since 2006 ¹⁰ (EU Pesticides database).	
Anthracene	Primarily used as an intermediate in the production of dyes, smoke screens, scintillation counter crystals, and in organic semiconductor research. Ubiquitous in the environment as a product of incomplete combustion of fossil fuels (WFD EQS dossier, 2011).	REACH: Authorisation list.	
Atrazine	Herbicide. Used at industrial sites for the manufacture of another substance.	PPP Directive: not approved. Banned in the EU since 2004 ¹¹ (EU Pesticides database).	
Benzene	Mainly used to as an intermediate to make other chemicals (e.g. ethylbenzene and cumene). Ubiquitous in the environment as a natural component of crude oil.	REACH: Restriction list.	
Bifenox	Herbicide.	PPP Directive: approved in the UE (expiration of approval 31/12/2021) ¹² . Authorised for use in AT, BE, BG, CZ, DE,	

⁽⁷⁾ Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC

⁽⁸⁾ Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC

⁽⁹⁾ Commission Implementing Regulation (EU) 2017/195 of 3 February 2017 amending Implementing Regulation (EU) No 540/2011 as regards the extension of the approval periods of several active substances listed in Part B of the Annex to Implementing Regulation (EU) No 686/2012 (AIR IV renewal programme)

⁽¹⁰⁾ Commission Decision of 18 December 2006 concerning the non-inclusion of alachlor in Annex I to Council Directive 91/414/EEC and the withdrawal of authorisations for plant protection products containing this active substance

⁽¹¹⁾ Commission Decision of 10 March 2004 concerning the non-inclusion of atrazine in Annex I to Council Directive 91/414/EEC and the withdrawal of authorisations for plant protection products containing this active substance

⁽¹²⁾ Commission Implementing Regulation (EU) 2020/1511 of 16 October 2020 amending Implementing Regulation (EU) No 540/2011 as regards the extension of the approval periods of the active substances amidosulfuron, bifenox, chlorotoluron, clofentezine, clomazone, cypermethrin, daminozide, deltamethrin, dicamba, difenoconazole, diflufenican, fenoxaprop-P, fenpropidin, fludioxonil, flufenacet, fosthiazate, indoxacarb, lenacil, MCPA, MCPB, nicosulfuron, paraffin oils, picloram, prosulfocarb, sulphur, triflusalufuron and tritosulfuron

Priority Substance	Main uses/production	Relevant EU regulation	Global prohibitions/ restrictions under the Stockholm Convention Annex A (elimination); Annex B (restriction); Annex C (unintentional production).
		EE, ES, FI, FR, HU, IT, LT, LV, NL, PL, RO, SE, SK, UK (EU Pesticides database).	
PBDE	Flame-retardants in plastics, textiles and electrical/electronic equipment. Stocks of flame-retarded products may exist and there is a possibility of release to the environment.	POPs Recast Regulation: Annex I, Part A. Use of commercial pentaBDEs and octaBDEs is banned in the EU since 2004 ¹³ , so no industrial point sources are expected. However, due to the persistence and accumulation, decreased emissions do not necessarily mean decreased concentrations in environmental media (WFD EQS dossier, 2011); deca-BDE (still allowed to 0.1% in articles) also degrades to lower-order isomers.	Annex A (tetra-, penta-, hexa-, hepta-, and decabromodiphenyl ethers).
Cadmium	Naturally occurring element. Common component of electric batteries, pigments, coatings, and electroplating.	REACH: Authorisation list; Restriction list (some uses restricted, e.g. in plastics material).	
Carbon-tetrachloride	Mainly used in the production of chlorofluorocarbon refrigerants, and solvents. Also in the manufacture of paints, plastics etc, as a solvent and as pesticide. Production for dispersive uses was banned from 2010 under the Montreal Protocol. All uses declining as production has fallen.		
Chlorfenvinphos	Pesticide.	PPP Directive: not approved in the EU ¹⁴ (EU Pesticides database).	
C10-C13 Chloroalkanes	Manufacture of chemicals (mainly rubber and sealants). Production has decreased globally as jurisdictions have established control measures.	POPs Recast Regulation ¹⁵ : banned with specific exemptions. REACH: Authorisation list.	Annex A.
Chlorpyrifos	Pesticide.	PPP Directive: not approved in the EU ¹⁶ (EU Pesticides database).	
Cybutryne	Biocide. First introduced in Europe in the mid-1980s since the partial regulatory restrictions on TBT. Still widely used in other parts of the world. Widespread pollution found and linked to vessel activity (WFD EQS dossier, 2011).	Biocidal Products Regulation (BPR) ¹⁷ : not approved as an existing active substance for use in biocidal products for product type 21 ¹⁸ .	
Cyclodiene pesticides	Pesticides.	POPs Recast Regulation: banned.	Annex A (aldrin, dieldrin, endrin).
Cypermethrin	Biocide.	BPR: approved as an existing active substance for use in biocidal products for product-type 8 ¹⁹ .	
DDTs	Pesticide. Widespread use in the past, it can be found everywhere (residual DDT even been detected in the Arctic).	POPs Recast Regulation: Annex I, Part A. Banned in the EU since 1991.	Annex B.

¹³ Commission Regulation (EC) No 552/2009 of 22 June 2009 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards Annex XVII

¹⁴ Commission Regulation (EC) No 2076/2002 of 20 November 2002 extending the time period referred to in Article 8(2) of Council Directive 91/414/EEC and concerning the non-inclusion of certain active substances in Annex I to that Directive and the withdrawal of authorisations for plant protection products containing these substances

¹⁵ Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants

¹⁶ Commission Implementing Regulation (EU) 2020/18 of 10 January 2020 concerning the non-renewal of the approval of the active substance chlorpyrifos, in accordance with Regulation (EC) No 1107/2009 of the European Parliament and of the Council concerning the placing of plant protection products on the market, and amending the Annex to Commission Implementing Regulation (EU) No 540/2011

¹⁷ Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products

¹⁸ Commission implementing decision (EU) 2016/107 of 27 January 2016 not approving cybutryne as an existing active substance for use in biocidal products for product type 21

¹⁹ Commission Implementing Regulation (EU) No 945/2013 of 2 October 2013 to approve cypermethrin as an existing active substance for use in biocidal products for product-type 8

Priority Substance	Main uses/production	Relevant EU regulation	Global prohibitions/restrictions under the Stockholm Convention Annex A (elimination); Annex B (restriction); Annex C (unintentional production).
DEHP	Most common phthalate plasticizer.	REACH: Authorisation list; Restriction list (some uses restricted, e.g. in toys or childcare articles).	
Dichloromethane	Used in adhesives and sealants, plant protection products, washing and cleaning products, biocides, coating products and cosmetics and personal care products.	REACH: Restriction list (some uses restricted, e.g. in paints strippers).	
Dichlorvos	Pesticide. Widely used in the past in salmon farms. There is uncertainty in the range of biocidal uses.	PPP Directive: not approved in the EU since 2007 ²⁰ (EU Pesticides database). BPR: not approved as an existing active substance for use in biocidal products for product-type 18 ²¹	
Dicofol	Pesticide. Widely used in the past.	POPs Regulation (as amended) ²² : banned. PPP Directive: not approved in the EU since 2008 ²³ (EU Pesticides database).	Annex A.
Dioxins and dioxin-like compounds	Dioxins and furans are unintentional products resulting from incomplete combustion or chemical reactions. PCBs may also unintentionally form from thermal processes. As mainly unintentional products, long term/continuous releases are more likely than episodic releases, except in accident cases (WFD EQS dossier, 2011). PCBs were extensively used in the past as components in electrical and hydraulic equipment and lubricants, but phased out in the 1970s–1980s.	POPs Recast Regulation: Substances subject to release reduction provisions.	Annex A (PCBs). Annex C (PCBs, PCDD, PCDF).
Diuron	Pesticide. Biocide. Significant contamination is more likely attributable to agricultural run-off rather than antifouling usage (WFD EQS dossier, 2005).	PPP Directive: not approved in the EU ²⁴ . Authorised at national level in IT, SK (EU Pesticides database). Under review for use as a biocide: Initial application in progress for approval in biocidal product-types 7 and 10.	
Endosulfan	Pesticide.	POPs Recast Regulation: banned with specific exemptions. PPP Directive: not approved in the EU ²⁵ (EU Pesticides database).	Annex A.
Fluoranthene	Coal tar pitch mainly used as binding agent. Most important emission sources include coke production, primary aluminium production and creosote and wood preservation. Emissions to surface water directly or indirectly via (industrial) point sources and atmospheric deposition (WFD EQS dossier, 2011).	REACH: Authorisation list.	

⁽²⁰⁾ 2007/387/EC: Commission Decision of 6 June 2007 concerning the non-inclusion of dichlorvos in Annex I to Council Directive 91/414/EEC and the withdrawal of authorisations for plant protection products containing that substance (notified under document number C(2007) 2338)

⁽²¹⁾ Commission Decision of 10 May 2012 concerning the non-inclusion of dichlorvos for product type 18 in Annex I, IA or IB to Directive 98/8/EC of the European Parliament and of the Council concerning the placing of biocidal products on the market

⁽²²⁾ Commission Delegated Regulation (EU) 2020/1204 of 9 June 2020 amending Annex I to Regulation (EU) 2019/1021 of the European Parliament and of the Council as regards the listing of dicofol

⁽²³⁾ 2008/764/EC: Commission Decision of 30 September 2008 concerning the non-inclusion of dicofol in Annex I to Council Directive 91/414/EEC and the withdrawal of authorisations for plant protection products containing that substance (notified under document number C(2008) 5105)

⁽²⁴⁾ Commission Implementing Regulation (EU) 2019/707 of 7 May 2019 amending Implementing Regulation (EU) No 540/2011 as regards the extension of the approval periods of the active substances alpha-cypermethrin, bflubutamid, benalaxyl, benthialicarb, bifenazate, boscalid, bromoxynil, captan, cyazofamid, desmedipham, dimethoate, dimethomorph, diuron, ethephon, etoxazole, famoxadone, fenamiphos, flumioxazine, fluoxastrobin, folpet, foramsulfuron, formetanate, metalaxyl-m, methiocarb, metribuzin, milbemectin, Paecilomyces lilacinus strain 251, phenmedipham, phosmet, pirimiphos-methyl, propamocarb, prothioconazole, s-metolachlor and tebuconazole

⁽²⁵⁾ 2005/864/EC: Commission Decision of 2 December 2005 concerning the non-inclusion of endosulfan in Annex I to Council Directive 91/414/EEC and the withdrawal of authorisations for plant protection products containing this active substance (notified under document number C(2005) 4611)

Priority Substance	Main uses/production	Relevant EU regulation	Global prohibitions/ restrictions under the Stockholm Convention Annex A (elimination); Annex B (restriction); Annex C (unintentional production).
HBCDD	Flame retardant additive, mainly applied in polystyrene foam and as thermal insulation in the building industry. Release is likely to continue for some years to come from installed, landfilled and recycled materials.	POPs Recast Regulation: banned with specific exemptions. REACH: Authorisation list.	Annex A.
HCB	Pesticide. Also used as an industrial chemical. The volume of waste containing HCB is assumed to be very low	POPs Recast Regulation: banned	Annex A. Annex C.
HCBD	Mainly used as an organic solvent. Also as an algicide, hydraulic fluid, laboratory reagent etc. No longer manufactured or used in the EU. It can be unintentionally produced as a by-product in the manufacture of chlorinated solvents (Balmer et al., 2019).	POPs Recast Regulation: banned with specific exemptions.	Annex A. Annex C.
HCH	Pesticide. Production and use assumed to be on a very low level, since it is permitted for use for laboratory scale research only.	POPs Recast Regulation: banned.	Annex A (α -HCH, β -HCH, lindane).
Heptachlor and heptachlor epoxide	Insecticide.	POPs Recast Regulation: banned.	Annex A (heptachlor).
Isoproturon	Herbicide. Biocide for preservation films, preservation for construction materials. It still may be produced in the EU.	PPP Directive: not approved in the EU since 2017 ²⁶ (EU Pesticides database). Under review for use as a biocide: Initial application in progress for approval in biocidal product-types 7 and 10.	
Lead	Mainly used in lead-acid batteries (61%), and in sheet form in the building trade (14%). Also used as shot, for alloying and ammunition, in soldering alloys and cable sheathing, and for the production of oxides, pigments, stabilisers and other lead compounds. Lead oxides mainly used in the EU as PVC stabilising agents and in glass production for televisions and crystal, and other lower tonnage uses include pigments, ceramics and alloys. Greatest emissions to water are from households and sewage treatment plants (WFD EQS dossier, 2011).	REACH: Authorisation list; Restriction list (some uses restricted, e.g. in jewellery articles).	
Mercury	Main sources to the environment are natural atmospheric emissions from volcanoes and anthropogenic emissions from coal-fired power stations, metal production and cement production (OSPAR, 2016).	Minamata Convention (in force since 2017) is the main global instrument on regulating the anthropogenic uses of mercury; is reflected in EU Mercury Regulation ²⁷ . REACH: Restriction list (some uses restricted, e.g. to prevent the fouling by micro-organisms, plants or animals of the hulls of boats or cages for fish farming, in the preservation of wood etc.).	
Naphthalene	Natural component in coal tar and crude oil. Most significant release to the environment from combustion processes, and in particular vehicle exhausts. Also from production and use of naphthalene, during the treatment of wood, from oil refineries and offshore drilling activities (WFD EQS dossier, 2011).		
Nickel	Component of natural ores. High concentrations in igneous rocks, coal and common sulphide minerals such as pyrite. Mined in significant quantities in 21 MS.	REACH: Restriction list (some uses restricted, e.g. in articles intended to come into direct and prolonged contact with the skin such as earrings, necklaces etc.).	

⁽²⁶⁾ Commission Implementing Regulation (EU) 2016/872 of 1 June 2016 concerning the non-renewal of approval of the active substance isoproturon, in accordance with Regulation (EC) No 1107/2009 of the European Parliament and of the Council concerning the placing of plant protection products on the market, and amending Commission Implementing Regulation (EU) No 540/2011

⁽²⁷⁾ Regulation (EU) 2017/852 of the European Parliament and of the Council of 17 May 2017 on mercury, and repealing Regulation (EC) No 1102/2008

Priority Substance	Main uses/production	Relevant EU regulation	Global prohibitions/restrictions under the Stockholm Convention Annex A (elimination); Annex B (restriction); Annex C (unintentional production).
	Used in over 300 000 products, mainly metal plating, batteries, pigments and other chemicals. Main sources to surface water are losses from historically contaminated sediments and soils, point sources, and emissions to atmosphere (Entec UK Limited, 2011a).		
Nonylphenols	Mainly used as a detergent or an emulsifying agent in the manufacturing of textiles. Main source to the environment from textile articles is by washing in water.	REACH: Authorisation list; Restriction list (some uses restricted, e.g. in concentrations equal to or greater than 0,1 % by weight for industrial and domestic cleaning, textiles and leather processing etc.).	
Octylphenols	Mainly used as an intermediate in the production of phenolic resins (98% of use) and in the manufacture of octylphenol ethoxylates. There is debate about the extent to which these end products can contribute to emissions to water (Entec UK Limited, 2011b)	REACH: Authorisation list.	
PAHs	Unintentional by-products from incomplete combustion of fuels and from manufacture of materials like aluminium and coke. Present incidentally in petrol, creosote, coal tar products, and pitch and tar used for roofing and road construction. Natural sources can also contribute to atmospheric emissions, e.g., from volcanic eruptions and forest fires (WFD EQS dossier, 2011).	REACH: Authorisation list (bezo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene); Restriction list (bezo(a)pyrene, benzo(k)fluoranthene, benzo(b)fluoroanthene).	
Pentachlorobenzene	Fungicide and a chemical intermediate (e.g. for the production of quintozone, a pesticide no longer authorised for use in the EU). Also formed as an unintentional by-product of large-scale combustion processes and industrial processes. Incineration of hazardous and non-hazardous waste is a potential source to the atmosphere (Revised source screening of priority substances under the WFD, 2010).	POPs Recast Regulation: banned.	Annex A. Annex C.
Pentachlorophenol	Multiple uses in the past (e.g. biocide, insecticide, fungicide, wood preservative).	POPs Recast Regulation: banned. REACH: Restriction list.	Annex A.
PFOS	Historic uses include providing grease, oil and water resistance in textiles, carpets, paper and general coatings. Also used as a surfactant, emulsifier, in fire-fighting foams and in pesticide production (WFD EQS dossier, 2011).	POPs Recast Regulation (as amended) ²⁸ ; banned with specific exemptions.	Annex B.
Quinoxifen	Fungicide.	PPP Directive: not approved in the EU since 2018 ²⁹ . Withdrawal authorisations by 27 June 2019, max period of grace: 27 March 2020. Authorised at national level in BE, LU, MT, PL, PT, RO, SK, UK (EU Pesticides database).	
Simazine	Pesticide. Industrial use resulting in the manufacture of another substance (use of intermediates).	PPP Directive: not approved in the EU since 2004 ³⁰ .	
TBT	Biocide. Most widely used active component in antifouling paints.	Biocide use banned on all EU-flagged vessels from 2003 ³¹ and global	

⁽²⁸⁾ Commission Delegated Regulation (EU) 2020/1203 of 9 June 2020 amending Annex I to Regulation (EU) 2019/1021 of the European Parliament and of the Council as regards the entry for perfluorooctane sulfonic acid and its derivatives (PFOS)

⁽²⁹⁾ Commission Implementing Regulation (EU) 2018/1914 of 6 December 2018 concerning the non-renewal of approval of the active substance quinoxifen, in accordance with Regulation (EC) No 1107/2009 of the European Parliament and of the Council concerning the placing of plant protection products on the market, and amending Commission Implementing Regulation (EU) No 540/2011

⁽³⁰⁾ 2004/247/EC: Commission Decision of 10 March 2004 concerning the non-inclusion of simazine in Annex I to Council Directive 91/414/EEC and the withdrawal of authorisations for plant protection products containing this active substance

⁽³¹⁾ Regulation (EC) No 782/2003 of the European parliament and of the council of 14 April 2003 on the prohibition of organotin compounds on ships

Priority Substance	Main uses/production	Relevant EU regulation	Global prohibitions/restrictions under the Stockholm Convention Annex A (elimination); Annex B (restriction); Annex C (unintentional production).
		prohibition on all vessels ratified under the IMO Convention in 2008. REACH: Restriction list.	
Terbutryn	Herbicide. Current use as a biocide still quite extensive, e.g. in surface treatments, preservation etc.	PPP Directive: not approved in the EU ³² (EU Pesticides database). Under review for use as a biocide: Initial application in progress for approval in biocidal product-types 7, 9 and 10.	
Tetrachloro-ethylene	Mainly used as a chemical intermediate and a dry cleaning solvent. Other uses include metal cleaning and extraction processes (EC, 2005).		
Trichlorobenzenes	Manufactured and used as an intermediate for herbicide production, as solvents, dye carrier etc. Despite the extensive restriction on the marketing and use of 1,2,4-TCB in the EU, the substance may enter the EU market via imported articles (e.g. textiles). 1,2,3-TCB and 1,3,5-TCB are not restricted and may be used as substitutes for 1,2,4-TCB (ECHA, 2010).	REACH: Restriction list (1,2,4-trichlorobenzene).	
Trichloro-ethylene	Mainly used for vapour degreasing and cleaning of metal parts, in adhesives, for synthesis in the chemical industry and as a solvent (EC, 2005).	REACH: Authorisation list.	
Trichloromethane	Used in production of other chemicals and as a solvent. Released by both natural and anthropogenic processes (approx. 90% emissions may originate from non-anthropogenic sources) (WFD Substance Data Sheet, 2005).	REACH: Restriction list.	
Trifluralin	Fungicide. The persistence of trifluralin in the environment means that there is potential for emissions of the substance to be released from locations where it has been used in the past (e.g. sediments or soils) (Entec UK Limited, 2011c).	PPP Directive: not approved in the EU since 2009 ³³ .	

2.3 Potential sea-based sources

The existence of offshore sources will also determine the likelihood of certain chemicals appearing in the marine environment, and thus the need to monitor them. Tornero and Hanke (2016a,b) compiled a list of marine-specific contaminants potentially entering the marine environment from sea-based sources. This information is used to identify suspected offshore sources for the WFD PS (Table 5).

Land-based and atmospheric sources are also likely to contribute to the concentrations of some WFD substances in the open sea. Atmospheric inputs into the sea can be considered using the long-range transport potential of the contaminants (see point 2.1.4 above). Additionally, it is assumed that land-based sources are already taken into account by MS when reporting under the MSFD in coastal/territorial waters (which is one of the criteria for potential exclusion considered in this guidance, see point 2.5 below).

⁽³²⁾ Commission Regulation (EC) No 2076/2002 of 20 November 2002 extending the time period referred to in Article 8(2) of Council Directive 91/414/EEC and concerning the non-inclusion of certain active substances in Annex I to that Directive and the withdrawal of authorisations for plant protection products containing these substances

⁽³³⁾ 2010/355/EU: Commission Decision of 25 June 2010 concerning the non-inclusion of trifluralin in Annex I to Council Directive 91/414/EEC

Table 5. Suspected offshore sources of the WFD PS

Priority Substance	Suspected offshore sources
1,2-dichloroethane	No
Aclonifen	No
Alachlor	No
Anthracene	Shipping (discharges from Exhaust Gas Cleaning Systems, accidental oil spills). Produced waters from the offshore gas and oil industry. Dredging and dumping of dredged material.
Atrazine	No
Benzene	Shipping (hazardous noxious substances (HNS) frequently released in European waters. Also released from accidental oil spills and ship operational discharges). Produced waters from the offshore gas and oil industry. Offshore marine renewable energy devices. Historical dumping sites (used as additive in chemical munitions).
Bifenox	No
PBDE	Mariculture (related to feed).
Cadmium	Shipping (frequently detected in operational discharges from different vessels). Drill muds and produced waters from the offshore gas and oil industry. Seabed mining. Dredging and dumping of dredged material. Shipwrecks.
Carbon-tetrachloride	Historical dumping sites (used as additive in chemical warfare).
Chlorfenvinphos	No
C10-C13 Chloroalkanes	No
Chlorpyrifos	No
Cybutryne	Shipping (biocide). Mariculture (biocide). Offshore renewable energy devices.
Cyclodiene pesticides	No
Cypermethrin	Mariculture (frequently used as antiparasitic agent).
DDTs	Mariculture (related to feed). Dredging and dumping of dredged material.
DEHP	Shipping (frequently detected in operational discharges from different vessels).
Dichloromethane	No
Dichlorvos	Mariculture.
Dicofol	No
Dioxins and dioxin-like compounds	Mariculture (related to feed). Dredging and dumping of dredged material.
Diuron	Shipping (biocide). Mariculture (biocide). Offshore renewable energy devices (biocide).
Endosulfan	No
Fluoranthene	Shipping (discharges from Exhaust Gas Cleaning Systems, accidental oil spills). Produced waters from the offshore oil and gas industry. Dredging and dumping of dredged material.
HBCDD	No
HCB	Mariculture (related to feed).
HCBD	No
HCH	No
Heptachlor and heptachlor epoxide	No
Isoproturon	No
Lead	Shipping (frequently detected in operational discharges from different vessels). Drill muds and produced waters from the offshore gas and oil industry. Dredging and dumping of dredged material. Historical dumping sites (component of conventional munitions). Shipwrecks.
Mercury	Shipping (discharges from Exhaust Gas Cleaning Systems). Drill muds and produced waters from the offshore gas and oil industry. Offshore marine renewable energy devices. Dredging and dumping of dredged material. Shipwrecks.
Naphthalene	Shipping (discharges from Exhaust Gas Cleaning Systems, accidental oil spills). Produced waters from the offshore gas and oil industry. Offshore marine renewable energy devices.
Nickel	Shipping (discharges from Exhaust Gas Cleaning Systems, accidental oil spills). Drill muds and produced waters from the offshore gas and oil industry. Dredging and dumping of dredged material. Historical dumping sites (component of conventional munitions).

Priority Substance	Suspected offshore sources
Nonylphenols	Shipping (HNS frequently released in European waters. Also released from ship operational discharges). Produced waters from the offshore gas and oil industry.
Octylphenols	Shipping (released from ship operational discharges). Produced waters from the offshore gas and oil industry.
PAHs	Shipping (discharges from Exhaust Gas Cleaning Systems, accidental oil spills). Mariculture (related to feed). Produced waters from the offshore gas and oil industry. Offshore renewable energy devices (diesel fuel constituent). Dredging and dumping of dredged material. Shipwrecks.
Pentachlorobenzene	No
Pentachlorophenol	No
PFOS	Shipping (marine ship firefighting foam). Dredging and dumping of dredged material.
Quinoxifen	No
Simazine	No
TBT	Shipping (biocide). Dredging and dumping of dredged material. Shipwrecks.
Terbutryn	No
Tetrachloro-ethylene	Shipping (HNS frequently released in European waters).
Trichlorobenzenes	No
Trichloro-ethylene	Shipping (HNS frequently released in European waters).
Trichloromethane	No
Trifluralin	Mariculture (used as fungicide).

2.4 Inclusion in relevant lists of chemicals of European Regional Sea Conventions

In Europe, there are four cooperation structures which aim to protect the marine environment and bring together MS and neighbouring countries that share marine waters: the Regional Sea Conventions (RSC):

- The Convention for the Protection of the Marine Environment in the North-East Atlantic of 1992 (further to earlier versions of 1972 and 1974) – the OSPAR Convention (OSPAR)³⁴.
- The Convention on the Protection of the Marine Environment in the Baltic Sea Area of 1992 (further to the earlier version of 1974) – the Helsinki Convention (HELCOM)³⁵.
- The Convention for the Protection of Marine Environment and the Coastal Region of the Mediterranean of 1995 (further to the earlier version of 1976) – the Barcelona Convention (UNEP-MAP)³⁶.
- The Convention for the Protection of the Black Sea of 1992 – the Bucharest Convention³⁷.

The potential exclusion of WFD substances from MSFD assessments should take into account whether the substance is included in relevant lists of chemicals under the RSC. Information on this matter is presented in Table 6 (as updated in 2020).

⁽³⁴⁾ <https://www.ospar.org/>

⁽³⁵⁾ <https://helcom.fi/>

⁽³⁶⁾ <https://www.unenvironment.org/unepmap/who-we-are/barcelona-convention-and-protocols>

⁽³⁷⁾ http://www.blacksea-commission.org/_convention.asp

Table 6. Inclusion of WFD PS in the relevant lists of chemicals of the European RSC

WFD Priority Substance	Barcelona Convention	Bucharest Convention	HELCOM	OSPAR
1,2-dichloroethane				
Aclonifen				
Alachlor				
Anthracene				LSPC (Section A)
Atrazine				LSPC (Section B)
Benzene				
Bifenox				
PBDE	LBS protocol		Core indicator Priority Hazardous Subst. (pentabromodiphenylether)	Priority Action (Part A) LSPC (Section A) (pentabromodiphenylether)
Cadmium	LBS protocol MEDPOL	BSIMAP (mandatory)	Subst. potential concern Priority Hazardous Subst. Core indicator	Priority Action (Part A)
Carbon-tetrachloride				
Chlorfenvinphos				
C10-C13 Chloroalkanes	LBS protocol		Subst. potential concern Priority Hazardous Subst.	Priority Action (Part A) LSPC (Section A)
Chlorpyrifos				LSPC (Section B)
Cybutryne				
Cyclodiene pesticides	LBS protocol and MEDPOL (endrin, dieldrin) LSB protocol (endrin)		Subst. potential concern	LSPC (Section B)
Cypermethrin				
DDTs	LBS protocol MEDPOL		Subst. potential concern	LSPC (Section B) LSPC (Section A) (o,p'-DDD)
DEHP	Candidate chemical		Subst. potential concern	Priority Action (Part A)
Dichloromethane				
Dichlorvos				
Dicofol	Candidate chemical			Priority Action (Part A)
Dioxins/dioxin-like compounds	LBS protocol		Priority Hazardous Subst. Core indicator	Priority Action (Part A)
Diuron				
Endosulfan	Candidate chemical		Priority Hazardous Subst.	Priority Action (Part A)
Fluoranthene				LSPC (Section A)
HBCDD	Candidate chemical		Priority Hazardous Subst. Core indicator	Priority Action (Part A)
HCB	LBS protocol MEDPOL		Subst. potential concern	LSPC (Section B)
HCBD				LSPC (Section B)
HCH	Candidate chemical (HCHs) LBS protocol and MEDPOL (lindane)	BSIMAP (optional) (lindane)	Subst. potential concern	Priority Action (Part A)
Heptachlor/heptachlor epoxide	LBS protocol (heptachlor)		Subst. potential concern (heptachlor)	LSPC (Section B) (heptachlor) LSPC (Section C) (heptachlor epoxide)
Isoproturon				
Lead	LBS protocol MEDPOL	BSIMAP (mandatory)	Subst. potential concern Core indicator	Priority Action (Part A)
Mercury	LBS protocol MEDPOL	BSIMAP (mandatory)	Subst. potential concern Priority Hazardous Subst. Core indicator	Priority Action (Part A)
Naphthalene				
Nickel	Candidate chemical	BSIMAP (optional)		
Nonylphenols	Candidate chemical		Subst. potential concern Priority Hazardous Subst.	Priority Action (Part A) LSPC (Section B)
Octylphenols	Candidate chemical		Priority Hazardous Subst.	Priority Action (Part A)
PAH	LBS protocol MEDPOL	BSIMAP (optional)	Subst. potential concern Core indicator (BaP)	Priority Action (Part A) LSPC (Section A) (BaP, benzo(g,h,i)perylene, benzo(k)fluoranthene)
Pentachlorobenzene				LSPC (Section B)
Pentachlorophenol	Candidate chemical		Subst. potential concern	Priority Action (Part A)
PFOS	Candidate chemical		Priority Hazardous Subst. Core indicator	Priority Action (Part A)
Quinoxyfen				

WFD Priority Substance	Barcelona Convention	Bucharest Convention	HELCOM	OSPAR
Simazine				
TBT			Priority Hazardous Subst. Core indicator	Priority Action (Part A)
Terbutryn				
Tetrachloro-ethylene				
Trichlorobenzenes				Priority Action (Part A)
Trichloro-ethylene				
Trichloromethane			Subst. potential concern	
Trifluralin	Candidate chemical			Priority Action (Part A)

Barcelona Convention: *LBS Protocol* - Substances of concern under the protocol for the protection of the Med Sea from Land-Based Sources and Activities; *MEDPOL* - Chemicals monitored under MEDPOL monitoring programme; *Candidate chemicals* - Additional chemicals proposed to be included in the Barcelona Convention (UNEP, 2017).

Bucharest Convention: *BSIMAP* - Substances covered by the Black Sea Integrated Monitoring and Assessment Programme.

HELCOM: *Subst. potential concern* - List of substances of potential concern specified in HELCOM Recommendation 19/5 and annex I; *Priority Hazardous Subst.* - HELCOM List of Priority Hazardous Substances (this designation does not correspond exactly to the WFD designation of PHS); *Core indicator* - Indicators for hazardous substances of specific concern to the Baltic Sea (update 2015).

OSPAR: *Priority Action* - Substances which should be given priority (Part A: Chemicals where a background document has been or is being prepared; Part B: Chemicals where no background document is being prepared because they are intermediates in closed systems; Part C: Chemicals where no background document is being prepared because there is no current production or use interest); *LSPC* - OSPAR List of Substances of Possible Concern (Section A: Substances which warrant further work because they do not meet the criteria for Sections B-D and substances for which information is insufficient to group them in Sections B-D; Section B: Substances which are of concern but which are adequately addressed by EC initiatives or other international forums; Section C: Substances which are not produced and/or used in the OSPAR catchment or are used in sufficiently contained systems making a threat to the marine environment unlikely; Section D: Substances which appear not to be "hazardous substances" but where the evidence is not conclusive).

2.5 Evidence from monitoring data

The availability of monitoring data and evidence of occurrence should be regarded as strong screening criteria when discussing the potential exclusion of contaminants from assessments. For instance, a substance which is regularly monitored in rivers and found at very low concentrations (already below WFD Environmental Quality Standards, EQS) is not expected to cause exceedances of EQS in the marine environment unless there are offshore sources. Indeed, under the MSFD, some MS report only on substances that cause bad chemical status under the WFD. Under the latter, it is possible to limit the monitoring of certain PS if they are not discharged into or found in the aquatic environment. However, it is important to take into account that a "not-found" substance might re-appear (or suddenly be detected/quantified with improved analytical techniques), and that trend assessments and long-term studies are necessary to properly understand the potential impact of many substances in the marine environment.

The MSFD reports on Art. 8, 9 and 10 (2018 reporting cycle) submitted by MS have been analysed to check the consideration of chemical substances in the marine environment. Table 7 summarizes the WFD PS reported for MSFD D8C1, including the number of MS reporting exceedance of the threshold value for the substance concerned.

Table 7. WFD PS reported for D8C1 assessments under MSFD Art. 8 in the 2018 reporting exercise.

Information from 21 MS (out of the 22 EU MS with a sea border): Belgium, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Malta, the Netherlands, Poland, Portugal, Romania, Slovenia, Spain, and Sweden. Data extracted from the MSFD e-reporting (xml data) (<https://water.europa.eu/marine>). For Greece, information available from the MSFD "text" report

Priority substance	MSFD 2018 reporting cycle		
	Number of MS reporting on the substance	Number of MS reporting concentrations above threshold values in coastal/territorial waters and/or beyond territorial waters	Proportion of reporting MS finding threshold exceedances (%)
1,2-dichloroethane	9	0	0
Aclonifen	2	0	0
Alachlor	7	0	0
Anthracene	16	7	44
Atrazine	7	0	0
Benzene	7	0	0
Bifenox	2	0	0
Brominated diphenylethers	17	9	53
Cadmium	19	6	32
Carbon-tetrachloride	6	0	0
Chlorfenvinphos	7	0	0
C10-C13 Chloroalkanes	9	0	0
Chlorpyrifos	7	0	0
Cybutryne	3	1	33
Cyclodiene pesticides	9	1	11
Cypermethrin	2	0	0
DDTs	11	1	9
DEHP	6	2	33
Dichloromethane	8	0	0
Dichlorvos	4	0	0
Dicofol	4	0	0
Dioxins/dioxin-like compounds	8	1	12
Diuron	6	0	0
Endosulfan	7	0	0
Fluoranthene	18	3	17
HBCDD	8	0	0
HCB	16	2	12
HCBD	11	0	0
HCH	8	0	0
Heptachlor/heptachlor epoxide	6	3	50
Isoproturon	7	0	0
Lead	19	3	16
Mercury	20	11	55
Naphthalene	13	1	8
Nickel	15	2	13
Nonylphenols	7	0	0
Octylphenols	6	1	17
PAHs	20	6	30
Pentachlorobenzene	9	0	0
Pentachlorophenol	7	0	0
PFOS	9	2	22
Quinoxifen	3	0	0
Simazine	7	0	0
TBT	15	8	53
Terbutryn	3	0	0
Tetrachloro-ethylene	6	0	0
Trichlorobenzenes	7	0	0
Trichloro-ethylene	6	0	0
Trichloromethane	8	0	0
Trifluralin	7	0	0

3 Proposal for excluding certain substances from MSFD monitoring beyond territorial waters

Although the overall picture of chemical properties, emissions, environmental distribution, and removal by environmental processes still has gaps, this guidance identifies a list of criteria upon which to pragmatically ascertain which contaminants can be expected not to pose a significant risk in open seas.

Persistence, bioaccumulation potential and hydrophobicity are the main criteria to consider since these properties determine the transport and fate of the substances. The toxicity of the contaminants in the marine environment, which is also a crucial property, is taken into account in this pragmatic approach by considering the element status reported by MS for MSFD, based on the exceedance of the threshold value used for the substance concerned. If the monitored concentrations exceed the threshold value for a particular substance, the ecotoxicological limit is exceeded, implying a toxicity risk to marine organisms. The higher the number and proportion of MS finding exceedances, the more widespread the risk.

The current production/ban state of the substances and their long-range transport potential (LRTP) provide an indication of the likelihood of their release and of their reaching the open sea. Moreover, some substances might also occur in the marine environment as a result of sea-based human activities. As already indicated, land-based sources are assumed to be already considered by MS when reporting on coastal and territorial waters and atmospheric inputs are taken into account by the LRTP of the contaminants.

The inclusion of a substance in RSC chemical lists indicates not only the existence of grounds for concern in the open sea, but also the “maturity of awareness” regarding that concern. Therefore, such inclusion is also proposed as a screening criterion for this pragmatic approach, although of lower weight.

Taking into account these considerations, and emphasizing again that this is a pragmatic approach with some limitations and not a prioritization process, a semi-qualitative combination of parameters is proposed in order to help estimate the relevance of each WFD PS for MSFD monitoring beyond territorial waters.

Table 8. Values assigned for each criterion

Criterion		Value
Persistence		
Persistent	Red	1
Not persistent	Green	0
Bioaccumulation potential		
Bioaccumulative	Red	1
Not bioaccumulative	Green	0
Hydrophobicity		
High	Red	1
Medium-high	Yellow	0.5
Low	Green	0
Number of MS reporting threshold exceedances		
Exceedance reported by >1 MS	Red	1
Exceedance reported by 1 MS	Yellow	0.5
No exceedance reported	Green	0
Proportion MS finding threshold exceedances		
> 36%	Red	1
18-36 %	Yellow	0.5
< 18%	Green	0
Usage/ban status/LRTP		
Use not banned in EU, and LRTP	Red	1
Use banned in EU, but LRTP	Yellow	0.5
Use not banned in EU, but no LRTP	Yellow	0.5
Use banned or restricted in EU, and no LRTP	Green	0
Potential sea-based sources		
More than one potential sea-based source	Red	1
One potential sea-based source	Yellow	0.5
No potential sea-based sources	Green	0
Inclusion in RSC chemical lists		
Included in more than one RSC chemical list	Red	0.5
Included in one RSC chemical list	Yellow	0.25
Not included in any RSC chemical list	Green	0

The sum of the values attributed to the criteria determines the suggested relevance of the substance in the open sea. Substances found to be of low relevance might be then proposed for exclusion from MSFD monitoring beyond territorial waters.

Table 9. Values assigned to determine the relevance of a substance in the open sea

Total value	Suggested relevance in the open sea
< 2.25	Low
2.25-4.50	Medium
> 4.50	High

The findings, based on the information in Tables 3, 4, 5, 6, and 7 are summarized below in Table 10.

According to the discussed criteria, the following substances are suggested to be of low relevance in the open sea:

1,2-dichloroethane
 Alachlor
 Atrazine
 Benzene
 Bifenox
 Carbon-tetrachloride.
 Chlorfenvinphos
 Chlorpyrifos
 Cypermethrin
 Dichloromethane
 Dichlorvos
 Isoproturon
 Simazine
 Terbutryn

It should be highlighted again that this evaluation process is a pragmatic and supportive approach, and should not be regarded as a single, quantitative decision instrument. As explained above, a substance would be proposed for exclusion only if there is unanimous agreement that monitoring is “not reasonable” in the open sea and the protection of European Seas will not be compromised. In the case where consensus among experts cannot be reached, or scientific opinion remains divided on a particular substance, then that substance, even when fulfilling the discussed criteria, will not be proposed for exclusion.

MS experts have expressed concerns and arguments against the exclusion from monitoring beyond territorial waters of three of the substances listed above: chlorpyrifos, atrazine and simazine.

Chlorpyrifos has been found in some sediment samples from the Spanish continental shelf at several miles from the coast (León et al., 2020). Moreover, water concentrations higher than levels toxic to marine biota obtained in the laboratory have been also measured, indicating a high risk for marine organisms (e.g. Bellas et al., 2005, Campillo et al., 2013; Bellas and Gil, 2020).

The triazine herbicides, in particular atrazine and simazine, are among the most widely used groups of pesticides and have been frequently detected in surface waters and marine biota due to their widespread use in the past and environmental persistence (Reindl et al., 2015; ISPRA, 2018). Simazine and atrazine are structurally similar, share a common mechanism of toxicity, can be determined simultaneously and have been suggested to be used collectively in the assessments to characterize potential ecological risks (Farruggia et al., 2016). While atrazine has been banned in the EU and should not be subject to aerial long-range transport, it may still be applied in some areas and found at high concentrations (Nödler et al., 2013). Atrazine can still be detected in marine waters (Mariani et al., 2018, 2020) and there are indications in the literature on potential existing sources in recent years, related to inappropriate agricultural practices (Sousa et al., 2020).

As no consensus among experts was achieved on chlorpyrifos, atrazine, and the similar compound simazine, the general (and *a priori*) exclusion from monitoring of these substances cannot be proposed, despite they fulfil the exclusion criteria discussed in this guidance. A case-by-case scrutiny (further information/evidence on concentrations in coastal areas, sources, etc.) is instead recommended for these substances.

Table 10. Screening criteria to identify which WFD PS could be potentially excluded from MSFD monitoring beyond territorial waters (filled according to Tables 8 and 9)

Priority Substance	Persistence	Bioaccumulative potential	Hydrophobicity	Number MS reporting threshold exceedances (2018 MSFD reporting cycle)	Proportion MS finding threshold exceedances (2018 MSFD reporting cycle)	Usage/ ban status/ LRTP	Potential sea-based sources	Inclusion in RSC chemical lists	Total value	Suggested relevance for MSFD monitoring beyond territorial waters
1,2-dichloroethane									1	Low
Aclonifen									3	Medium
Alachlor									0	Low
Anthracene									6.25	High
Atrazine									1.75	Low
Benzene									2	Low
Bifenox									1.5	Low
PBDE									6.5	High
Cadmium									5	High
Carbon-tetrachloride									1.5	Low
Chlorfenvinphos									2	Low
C10-C13 Chloroalkanes									4	Medium
Chlorpyrifos									0.75	Low
Cybutryne									4	Medium
Cyclodiene pesticides									4	Medium
Cypermethrin									2	Low
DDTs									5.5	High
DEHP									5	High
Dichloromethane									1	Low
Dichlorvos									0.5	Low
Dicofol									3.75	Medium
Dioxins/dl-compounds									6	High
Diuron									2.5	Medium
Endosulfan									3.5	Medium
Fluoranthene									6.25	High
HBCDD									4	Medium
HCB									5.5	High
HCBD									3.25	Medium
HCH									3.5	Medium
Heptachlor/hept. epox.									5.5	High
Isoproturon									1.5	Low
Lead									5.5	High
Mercury									6.5	High
Naphthalene									3.5	Medium

Priority Substance	Persistence	Bioaccumulative potential	Hydrophobicity	Number MS reporting threshold exceedances (2018 MSFD reporting cycle)	Proportion MS finding threshold exceedances (2018 MSFD reporting cycle)	Usage/ ban status/ LRTP	Potential sea-based sources	Inclusion in RSC chemical lists	Total value	Suggested relevance for MSFD monitoring beyond territorial waters
Nickel									4.25	Medium
Nonyphenols									3	Medium
Octylphenols									3.5	Medium
PAH									7	High
Pentachlorobenzene									3.75	Medium
Pentachlorophenol									3	Medium
PFOS									6	High
Quinoxifen									2.5	Medium
Simazine									1.5	Low
TBT									6	High
Terbutryn									2	Low
Tetrachloro-ethylene									2.5	Medium
Trichlorobenzenes									3.75	Medium
Trichloro-ethylene									2.5	Medium
Trichloromethane									2.25	Medium
Trifluralin									3.75	Medium

4 Conclusions

This guidance provides a pragmatic and qualitative approach to identifying which substances might not be relevant for the open sea and which might, consequently, be excluded from MSFD monitoring beyond territorial waters. This activity is intended to help MS save resources, by avoiding unnecessary costly monitoring in areas not covered by the WFD, as well as to support comparable monitoring and assessments across national boundaries.

Based on the criteria discussed in this report and the evaluation process presented in Table 8, combined with expert judgment, a number of substances have been identified as having low relevance for the open sea and are therefore proposed for exclusion from MSFD monitoring beyond territorial waters:

- 1,2-dichloroethane
- Alachlor
- Benzene
- Bifenox
- Carbon-tetrachloride
- Chlorfenvinphos
- Cypermethrin
- Dichloromethane
- Dichlorvos
- Isoproturon
- Terbutryn

It is important to highlight that, should there be any new evidence that any of the substances listed above, individually or as mixtures, is present or relevant beyond territorial waters, then monitoring for that substance should be taken up again. Likewise, MS might decide to carry out surveillance monitoring at defined times in order to ensure that impacts are not expected (e.g. due to illegal use or transboundary pollution) as well as to perform trend assessments (similarly to WFD provisions).

It is also important to note that this is not mandatory guidance, and MS may select which substances to monitor according to their own circumstances and apply additional risk assessments at national or (sub)regional level to further exclude PS not relevant in specific areas. Furthermore, exclusion from monitoring in open seas does not mean that MS can dismiss the need to monitor the contaminant in relevant areas in coastal and territorial waters, e.g. close to potential sources like river mouths etc.

While the exclusion of certain WFD PS from monitoring in the open sea beyond 12 nautical miles is here proposed, the parallel process of identification of other (including emerging) substances that may be relevant should be pursued, as ongoing within the MSFD Expert Network on Contaminants in close collaboration with RSCs and the scientific community.

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List of abbreviations and definitions

PBDE	Brominated diphenylethers
BCF	Bioconcentration factor
EQS	Environmental Quality Standards
GES	Good Environmental Status
HBCDD	Hexabromocyclododecanes
HCB	Hexachlorobenzene
HCBD	Hexachlorobutadiene
HLC	Henry's Law constant
Kow	Octanol–water partition coefficient
LRTP	Long-range transport potential
MS	Member States
MSFD	Marine Strategy Framework Directive
NOEC	No-observed effect concentration
PAH	Polyaromatic hydrocarbons
PFOS	Perfluorooctane sulfonic acid and its derivatives
PS	Priority Substance
RBSP	River Basin Specific Pollutants
REACH	Registration, Evaluation, Authorisation and restriction of Chemicals
RSC	Regional Sea Convention
SVHC	Substances of very high concern
TBT	Tributyltin compounds
WFD	Water Framework Directive

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