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Permitting of emissions to water under the IED

Current practices in Europe

Report for European Commission

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Abbreviations

AOX	Absorbable organically bound halogens
BAT	Best available techniques
BAT-AEL	Best available techniques associated emission level
BATC	Best available techniques conclusions
BOD	Biochemical oxygen demand
BPT	Best possible techniques
BREF	Best available techniques reference document
CAK	Production of chlor-alkali
COD	Chemical oxygen demand
CWW	Common waste water and waste gas treatment
DTPA	Diethylenetriamine pentaacetate
DOC	Dissolved organic carbon
EDTA	Ethylenediaminetetraacetic acid
EEA	European Environment Agency
ELV	Emission limit values
E-PRTR	European pollutant release and transfer register
EQS	Environmental quality standard(s)
EU	European Union
FDM	Food, drink and milk industries
GBRs	General binding rules
GLS	Manufacture of glass
IMPEL	EU Network for the Implementation and Enforcement of Environmental Law
IOWWTP	Independently operated waste water treatment plant
IED	Industrial Emission Directive
IPPC	Integrated Pollution Prevention and Control (IPPC) (Directive)
IRPP	Intensive rearing of poultry or pigs
IS	Production of pig iron or steel
LCP	Large combustion plant
LVOC	Production of large volume organic chemicals
LOQ	Limit of quantification
N	(total) Nitrogen
NFM	Non-ferrous metals industries
P	(total) Phosphorus
PP	Production of pulp, paper and cardboard
REF	Refining of mineral oil and gas
TAN	Tanning of hides and skins
TOC	Total organic carbon
TSS	Total suspended solids
UWWTD	Urban Waste Water Treatment Directive
UWWTP	Urban waste water treatment plant
WFD	Water Framework Directive
WBP	Production of wood-based panels
WI	Waste incineration

WT	Waste treatment
WWTP	Waste water treatment plant

1 Introduction

1.1 This report

This is a technical report on the setting of emission limit values (ELVs) for emissions to water in permits prepared under the project "Implementation support for the Industrial Emissions Directive", which is Service Request 12 under framework contract ENV.C.4/FRA/2015/0042. The specific contract number is 070201/2018/785947/SFRA/ENV.C.4. The Terms of Reference for the study can be accessed here.

The report has been developed as part of a wider study which aims to support Member States with more effective implementation of the Industrial Emissions Directive (IED) (2010/75/EU). It is targeted at permitting emissions to water under the IED in response to the following implementation issues which were raised by Member State authorities as part of the consultation undertaken for this report and at a workshop organised as part of the wider study[1]:

- Setting ELVs for indirect releases and establishing where the ELV should apply if waste water treatment is outsourced to an urban waste water treatment plant (UWWTP) or an independently operated waste water treatment plant (IOWWTP).
- Setting ELVs for sources with multiple emission streams mixed together.
- Applicability of emission levels associated with the best available techniques (BAT-AELs) for direct and indirect discharges to water and determining the point where BAT-AELs shall apply.
- Choosing the upper or lower end of BAT-AEL range for permit setting and how the final ELV (including indirect) within a range of BAT-AELs is arrived at.
- Interaction between the IED and the Water Framework Directive (WFD), and the use of IED Article 18 in case of breaching of water environmental quality standards (EQS).

In response to these issues, this report provides key principles of managing water releases based on Member State practices.

The report was prepared by Ricardo in collaboration with Ramboll and involved consultation with Member States and a desk-based literature review. An overview of this technical report establishing principles for setting ELVs in permits was also presented at a webinar and participants were invited to provide feedback which has been integrated to the final draft.

Consultation with Member States covered the processes and practices used to translate BAT-AELs into ELVs in permits and the associated challenges for managing emissions to water. The consultation involved a questionnaire (Appendix A1) and written responses were received from 18 Member States (including the United Kingdom)[2], one Member State region (Flanders) and Norway[3]. This information is referred to throughout the report, referencing the Member State, region or Norway.

[1] Workshop: BAT-AELs, AE(P)Ls and setting ELVs in permits. Brussels, Thursday 6 June.

[2] A combined response from the devolved administrations was received for the UK. The consultation and drafting of this technical report were undertaken prior to the UK's departure from the EU (31 January 2020). As such, for the purposes of this report, the UK is referred to as a Member State within the EU-28.

[3] Responses were received from: Austria, Belgium (Flanders), Croatia, Bulgaria, Denmark, Estonia, Finland, France, Germany, Lithuania, Luxembourg, Latvia, Malta, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the UK.

2 Study context

2.1 Industrial Emissions Directive

Under the IED, ELVs are set for individual installations by permit conditions according to BAT-AEL ranges which are adopted in Best Available Techniques Conclusions (BATC).

BATC and the BAT-AEL ranges contained therein are adopted by the European Commission following an exchange of information culminating in Best Available Techniques Reference Documents (BREFs). Among other things, BREFs contain descriptions for applied techniques, emissions and consumption levels, techniques considered for the determination of Best Available Techniques (BAT).

Within four years of adopting BATC relating to the main activity of an installation, Member State competent authorities are required to ensure that all installation permit conditions (including the setting of ELVs) are reconsidered and updated if necessary (Article 21(3)). At the time of preparation of this report (March 2020), BATC have been adopted for 16 industrial sectors and BAT-AEL ranges for emissions to water have been set in 15[4].

BAT-AEL ranges refer to emissions as defined by the IED (Article 3(4)). In this context, emissions mean 'the direct or indirect release of substances, vibrations, heat or noise from individual or diffuse sources in the installation into air, water or land'. 'Direct' and 'indirect' releases to the environment are not defined by the IED and unless stated otherwise, no distinction is made between direct or indirect releases.

In this report, the following definitions are applied:

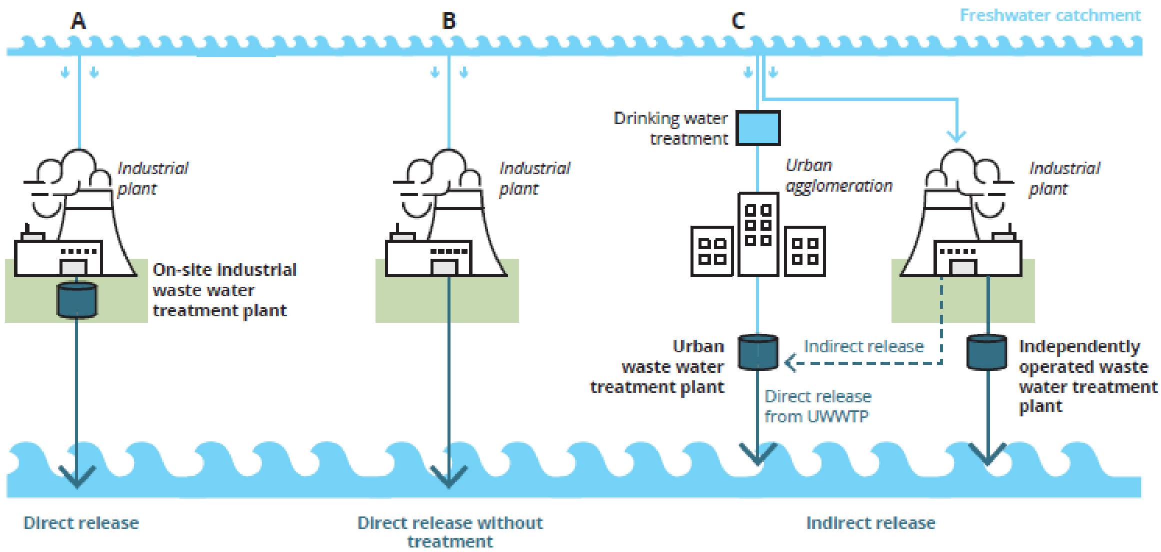
- **Direct releases** are where industrial waste water (treated or untreated) is released directly to a water body (A and B in Figure 1).
- **Indirect releases** are where industrial waste water is transferred offsite for treatment (either by IOWWTP or UWWTP) before being released to a water body (C in Figure 1).

ELVs are set in permits in accordance with Article 15(1) of the IED whereby it is stated that ELVs apply at the point where the emissions leave the installation. Regarding indirect releases, the effect of an offsite waste water treatment plant may be considered when determining the ELVs, provided that an equivalent level of protection can be achieved i.e. the offsite waste water treatment plant can ensure that the same level of protection to water quality is achieved as would otherwise be when the ELV is met at the installation. This may lead to less stringent ELVs being set for installations with indirect releases.

IOWWTPs treating waste water from other industrial installations covered by Annex I of the IED are regulated by the IED and subject to the same requirements with regard to setting ELVs as other IED installations. UWWTPs are not regulated under the IED even if they treat waste water that includes discharges from IED installations; they are however subject to the requirements of the Urban Waste Water Treatment Directive (UWWTD).

[4] BATC for the production of cement, lime and magnesium oxide do not contain BAT-AELs for emissions to water (Commission Implementing Decision 2013/163/EU)

Figure 1 Waste water treatment cycles for direct and indirect releases



Note: For the purposes of this report, freshwater catchment in this figure is synonymous with water use.

Source: EEA (2018)

Article 18 of the IED stipulates that permits can include measures that go beyond BAT where necessary to meet Environmental quality standards (EQS) (see Section 2.2).

2.2 Interaction with the Water Framework Directive and the Urban Waste Water Treatment Directive

Provisions concerning emissions to water under the IED are coherent with the aims of EU water policy EEA (2018). Whereas the IED and UWWTD regulate emissions to water at point source, other EU water policyregulates the quality of water bodies.

The Water Framework Directive (WFD, 2000/60/EC) aims to ensure the good ecological status (the quality of the biological community, hydrological and physicochemical characteristics) and good chemical status of all surface water bodies (freshwater, transitional and coastal), and the good chemical and quantitative status of all groundwater bodies. To achieve this, aspects of the WFD, including provisions under the Groundwater Directive (2006/118/EC) and the Environmental Quality Standards Directive (EQSD, 2008/105/EC) interact with provisions of the IED and industrial waste water management.

The Urban Waste Water Treatment Directive (UWWTD, 91/271/EEC) contains provisions affecting industrial waste water management. It aims to protect the environment from the adverse impacts of waste water discharges from urban areas – and includes discharges from the food processing industry into receiving waters and other industries into urban waste water collecting systems and treatment plants[5]. Industrial influent treated by UWWTP is considered together with the full load treated.

In practical terms, the relevant provisions interact with industrial waste water management in the following ways:

- Article 4(1)(a)(iv) and Article 16(1) of the WFD require the progressive reduction of pollution from priority substances and the cessation or phasing out of discharges, emissions and losses of priority hazardous substances.
- Requirements pertaining to a combined approach for point and diffuse sources are set out under Article 10 of the WFD with explicit reference to the application of BAT and BAT-AELs as set out in the IED.

[5] Articles 13 and 11 of the UWWTD, respectively

- Under the WFD (Article 11), Member States are required to establish programmes of measures for river basin districts to achieve the objectives of the WFD. Of relevance to permitting emissions to water under the IED, where point source discharges are liable to cause pollution, the programme of measures should include a requirement based on General Binding Rules (GBRs) for prior regulation, authorisation or registration laying down emission controls for the pollutants concerned (Article 11 (3)(g)).
- Annex II to the IED includes substances listed in Annex X to WFD. Environmental quality standards (EQS) for these substances are established by the EQSD. However, Annex II of the IED does not systematically list substances identified under the WFD as being of concern at national level (river basin specific pollutants), nor substances of concern under the Groundwater Directive.
- Under the EQSD (Article 4), Member States may designate mixing zones next to points of discharge in which concentrations of one or more substances may exceed the corresponding EQS so long as they do not affect the compliance of the rest of the body of surface water with those standards.
- Article 13 of the UWWTD stipulates that biodegradable industrial waste water from plants belonging to the industrial sectors listed in UWWTD Annex III (relating mostly to the food and drink sector, also known as "agro-food industry")[6] 'shall before discharge respect conditions established in prior regulations and/or specific authorisation by the competent authority or appropriate body in respect of all discharges from plants representing 4000 pe or more'.
- Provisions under the UWWTD relating to the treatment of industrial waste water are set out under point C of Annex I, to ensure that industrial waste water entering collecting systems and UWWTPs is subject to pre-treatment delivering adequate water quality in the water discharged in accordance with Article 11 requirements.

To support competent authorities in their understanding of these interactions, a guidance document on taking an integrated approach to industrial water management has been published by IMPEL (IMPEL, 2018). The guidance document is primarily intended for IED permit writers and concerns the application of BAT for industrial activities recognised as significant sources of emissions to water (e.g. refineries and the production of pulp, paper and cardboard). A description of BAT-AELs and requirements under the WFD is presented together to illustrate how the former can contribute to the objectives of the WFD. A checklist is also included in the guidance to present step-by-step the points at which the objectives of the WFD may be relevant to consider when setting permit conditions for IED installations (relevant to all industrial activities under the IED).

2.3 Environmental pressures from industrial waste water

According to the EEA (2018) report on industrial wastewater treatment in the EU, direct releases of treated industrial waste water (i.e. releases from onsite WWTPs) are mainly associated with the following IED activities: combustion of fuels (IED activity 1.1); production of iron or steel (IED activity 2.2); processing of non-ferrous metals (IED activity 2.5); chemical industry (IED activities 4.1 – 4.6); and production of pulp and paper (IED activity 6.1). Where no onsite waste water treatment plant exists, emissions to water are released indirectly via IOWWTP (IED activity 6.11) or UWWTP. Typical IED sectors with indirect releases to water are food and drink (IED activity 6.4), and to a lesser extent processing of ferrous metals (IED activity 2.3) and tanning of hides (IED activity 6.3). (EEA, 2018)[7].

As described in Section 2.1, direct and indirect industrial waste water releases are regulated via the setting of ELVs for polluting substances. Examples of polluting substances and a summary of their impacts on the environment and human health are reported in the table below alongside key emitting industrial sources.

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[6] Annex III industrial sectors (UWWTD): Milk-processing; Manufacture of fruit and vegetable products; Manufacture and bottling of soft drinks Potato-processing; Meat industry; Breweries; Production of alcohol and alcoholic beverages; Manufacture of animal feed from plant products Manufacture of gelatine and of glue from hides, skin and bones; Malt-houses; and Fish-processing industry

[7] Atmospheric deposition of industrial emissions is a significant source of indirect emissions to water; however, it is difficult to determine the exact contribution of such emissions to pollutant concentrations because the pollution is effectively diffuse.

Table 2-1 Polluting substances to water as listed in IED Annex II

Polluting substances to water listed in IED Annex II	Typical industrial sources	Known impact on environment and human health
Organohalogen compounds	Combustion of fuels, production of iron or steel, chemicals	Generally toxic to humans and affect plant reproduction rates.
Organophosphorus compounds	Combustion of fuels, production of iron or steel, chemicals	Generally toxic to humans and affect plant reproduction rates.
Organotin compounds	Most industrial sectors (including pulp, paper and wood, and food and drink)	Broad range of impacts on human health and environment – some are carcinogenic to humans, some are toxic to plants and some have high bioaccumulation rates.
Substances and mixtures which have been proved to possess carcinogenic or mutagenic properties or properties which may affect reproduction in or via the aquatic environment	Chemicals, pulp and paper and wood	Varied impacts on human health - carcinogenic, damage to kidneys and liver and thyroid. Can affect plant reproduction rates. Can contribute to oxygen depletion and accumulate in aquatic animals.
Persistent hydrocarbons and persistent and bioaccumulable organic toxic substances	Most industrial sectors (including pulp, paper and wood, and food and drink)	Broad range of impacts on human health and environment – some are carcinogenic to humans; some are toxic to plants and some have high bioaccumulation rates.
Cyanides	Combustion of fuels	Toxic to humans and affect plant reproduction rates.
Metals – and their compounds;	Iron and steel, Non-ferrous metals	Generally toxic to humans and affect plant reproduction rates.
Arsenic and its compounds	Iron and steel, Non-ferrous metals	Generally toxic to humans and affect plant reproduction rates.
Substances with carcinogenic or mutagenic properties;	Glass manufacturing, waste treatment, large combustion plants, refineries, tanneries	Carcinogenic impact on human health, damage to kidneys and liver and brain development. Toxic to plants and are persistent.
Biocides and plant protection products materials	Waste water from chemical installations; Pre-treatment of textiles; Production of paper; activities within the Food, Drink and Milk sectors	Often endocrine disruptive and classed as human carcinogens. Toxic to water organisms or carcinogenic.
Materials in suspension	Industrial wastewater; pulp and paper and wood	Reduces plant growth.
Substances which contribute to eutrophication	Industrial wastewater; Intensive rearing of poultry or pigs	High nitrate concentrations can affect infant health and eutrophication.
Substances which have an unfavourable influence on the oxygen balance	Chemicals; pulp and paper and wood	Broad range of impacts on human health and environment – some are carcinogenic to humans; some

Polluting substances to water listed in IED Annex II	Typical industrial sources	Known impact on environment and human health
		are toxic to plants and some have high bioaccumulation rates.
Substances listed in Annex X to Directive 2000/60/EC	Most industrial sectors (including pulp, paper and wood, and food and drink)	Broad range of impacts on human health and environment – some are carcinogenic to humans; some are toxic to plants and some have high bioaccumulation rates.

Source: Own table based on information presented in the EEA report (2018)

The main pressures occurring as a result of industrial waste water discharges regulated by the IED are summarised as follows (detail from EEA, 2018):

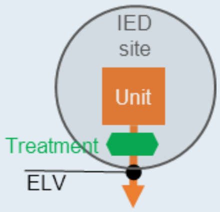
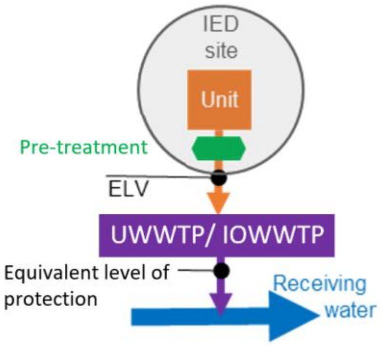
- In terms of eco-toxicity, the largest pressure from IED direct releases occurs where there is large-scale operation or clusters of IED installations in the energy supply (power plant and coke ovens) and chemical sectors.
- 46% of EU28 surface water bodies do not achieve good chemical status. The main reason for this is the widespread presence of a few priority hazardous substances. Some of these are associated with legacy pollution (e.g. tributyltin), some with ongoing emissions from products already on the market (e.g. flame retardants such as the polybrominated diphenylethers (pBDEs)), some from ongoing combustion and long-range transport (e.g. mercury, polycyclic aromatic hydrocarbons (PAHs)). Without these substances, only 3% of EU28 surface water bodies would not be able to achieve good chemical status.
- Other priority hazardous substances putting pressure on the chemical status of water bodies are cadmium and nickel.
- Diffuse emissions of nitrates and pesticides are the main chemical pressures on groundwater (mainly from the agriculture sector, including but not exclusively the IRPP sector[8]).
- Tetrachloroethylene (solvent) and metals (As, Ni and Pb) originating from industrial waste water discharges are another pressure on groundwater.
- Discharges from UWWTP that treat industrial waste water (from both IED and non-IED installations) are reported to place a significant pressure on more than 70% of water bodies in Belgium, Luxembourg and Slovenia, and more than 20% in Bulgaria, Czechia, Spain, France, Latvia and Portugal. It is unclear what the drivers of these pressures are because of the limited available data on plant performance and plant capacity with respect to the status of water bodies. Regardless of the drivers, permit conditions under the IED can play an important role in minimising such pressures on water bodies.

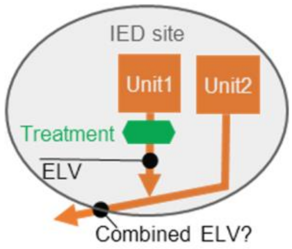
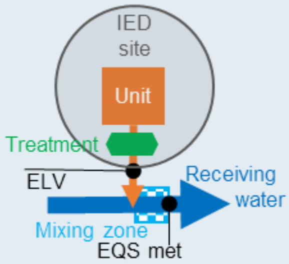
[8] Intensive poultry and pig farms contribute to surface water and groundwater pollution e.g. by NO_3 and NH_4^+

3 Permitting emissions to water under the IED

This section covers Member State good practices according to the different challenges identified in this study for managing emissions to water from installations permitted under the IED, as summarised in Table 3-1.

Table 3-1 Overview of the challenges with managing emissions to water from IED installations

IED reference	Challenges and where they apply
Article 14(1a)	Permits shall include ELVs for polluting substances listed in Annex II, and for other polluting substances. Identifying the other polluting substances, including emerging pollutants, can be challenging.
Article 14(2)	ELVs may be supplemented or replaced by equivalent parameters or technical measures ensuring an equivalent level of environmental protection. A challenge occurs identifying when is it appropriate to supplement ELVs and ensuring that an equivalent level of environmental protection is achieved.
Article 14(3)	BATC shall be the reference for setting the permit conditions. BAT-AEL are typically included in BATC as a range. Choosing the upper or lower end of BAT-AEL range for setting ELVs can be a challenge; in particular, achieving an appropriate balance between flexibility and delivering environmental protection. There has to be recognition of the quality of the receiving water body which for lakes and rivers can be hugely variable due to fluctuations in rainfall. In practice this means that permit conditions are set based on worst case assumptions (i.e. lowest potential dilution due to regular annual hydrological cycle (low flow) drought or other concerns). Typically, ELVs are set at the point they leave the IED installation, as illustrated below. However, another challenge occurs where the BATC does not specify BAT-AELs for indirect emissions. In such cases it can be unclear at which the point ELVs apply. 
Article 15 (1)	ELVs may be set to account for the effect of an offsite water treatment plant, provided that an equivalent level of protection can be achieved. A challenge can be ensuring that an equivalent level of protection can be achieved and identifying when UWWTPs/ IOWTTP may not be efficient in removing industrial pollutants. As illustrated below, the equivalent level of protection that should be achieved relates to the point at which the ELV applies. 

IED reference	Challenges and where they apply
	With respect to managing indirect emissions, establishing when a combined ELV is appropriate for mixed streams and how to determine a combined ELV by applying the mixing rule can be challenging. A combined ELV may be appropriate where mixed streams occur at an IED installation, as illustrated below.  There are risks associated with indirect emissions regarding dilution and synergistic effects. A challenge can be understanding these risks and ensuring that permit conditions are in place to adequately manage them.
Article 18	Industrial releases affect the ecological or chemical status of a waterbody (particularly accumulated releases of heavy metals). Managing the interaction between IED permitting and the WFD objective to stop or phase out discharges of priority hazardous substances can be particularly challenging. As illustrated below, the ELV is set before the emissions reach the water body. It is not clear at what level ELVs should be set where an EQS is already breached and determining the extent that further emissions are permissible to a water body without good status.  An additional challenge is managing emissions of BOD, ammonia, TSS; phosphate/nitrate to nutrient sensitive waters and factoring in the buffering capacity of the receiving water body.

3.1 Setting permit ELVs for direct and indirect emissions to water

ELVs are set in permits in accordance with Article 15(1) of the IED whereby it is stated that ELVs apply at the point where the emissions leave the installation. The effect of an offsite waste water treatment plant may be considered when determining the ELVs, provided that an equivalent level of protection can be achieved which may lead to less stringent ELVs (at IED installations) for indirect releases (Article 15(1)). As described in section 2.1, ELVs are set according to BAT-AEL ranges which are adopted by BATC.

Where BATC may require ELVs to be set for a specific process, the consultation responses received show that in most countries the point at which ELVs are set in permit conditions is determined by the requirements set in the BATC (e.g. Belgium (Flanders), Finland, Poland and the UK). Three Member States (Austria, Finland, and the UK) and Norway reported that ELVs are set at the point where the emissions leave the installation, regardless of whether it is a direct or indirect release. Added to this, Norway reported that in rare cases ELVs are not set where emissions leave the installations and that in these cases the installation must document compliance with the BATCs.

Additional detail was reported as follows:

- Belgium (Flanders) referred to two IED installations where the discharges are treated together in an onsite WWTP and then released to water bodies. In this instance, ELVs for certain pollutants apply prior to the mixing of the two streams to ensure that BAT is applied, and dilution is disregarded. Where the BATCs specify that ELVs should be set at a specific point source (e.g. melting ovens in iron and steel installations), this is followed.
- Guidance is prepared in the Czechia to help set ELVs. Where industrial waste water is discharged via onsite WWTP, the guidance recommends that ELVs for the installation are set lower to account for the treatment.
- Germany stated that where an installation creates a toxic waste water stream that contains for instance cyanides, chromium, or heavy metals, these are kept separate from other waste water streams that do not contain those substances to avoid dilution and contaminating larger volume of water. The justification is that it is easier and cheaper to treat the concentrated stream.
- Poland stated that an alternative solution is used in practice on a case-by-case basis whereby ELVs are expressed as an average weighted by, for example, flows of respective waste water streams, and applied after final treatment at the point where the water leave the installation in question. This approach requires careful consideration of the composition, amount and character of waste waters.
- Spain reported that water quality reports are issued for water bodies and ELVs for direct releases are set to comply with the requirements established by these reports, whereas indirect releases are regulated separately by municipal legislation.
- In Sweden, ELVs are sometimes set at the point of emission where the waste water affects a designated wetland area to either reduce or consume biologically treatable parameters. In such cases, the ELV is set with the use of Best Possible Techniques (BPT) (Swedish Environmental Protection Agency, 2016)[9]. BPT are established in national legislation and facilitate the setting of more stringent ELVs in permit conditions than those that may be required by BATC. The application of BPT has to be environmentally justifiable and financially reasonable.

Accordingly, the following legal provisions are important when setting ELVs on the basis of BAT-AELs included in BATC:

- Where BATC do not specify if BAT-AELs are applicable to direct or indirect releases, the BAT-AELs apply to both types of releases.
- Where BATC specify that BAT-AEL applies to direct releases, but alternative BAT-AELs are not specified for indirect releases, BAT-AELs apply to direct emissions only. Nonetheless, BAT-AELs for direct emissions may be considered in such cases so that ELVs can be set in such a way that an equivalent level of protection can be achieved in accordance with Article 15(1) of the IED.

A further consideration is the type of BAT. Some BATC specifically require the onsite pre-treatment[10] of waste water. For example, BATC for the production of pig iron or steel specifies that BAT is to treat effluent water from sinter plants where rinsing water is used or where a wet waste gas treatment system is applied by using a combination of heavy metal precipitation, neutralisation and sand filtration.

Other BATC, such as the Common Waste Water (CWW) and Waste Gas Treatment/ Management Systems in the Chemical sector, establish BAT for onsite waste water treatment techniques to deal with industrial waste water that is much broader in scope. The associated BREFs outline specific techniques that are required to treat waste water. These include:

- Process-integrated techniques – i.e. physical, chemical, biological and engineering techniques designed for the prevention, reduction and recycling of residues/pollutants.

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[9] The Swedish EPA also provide a website on how to set ELVs. URL: http://www.naturvardsverket.se/Stod-i-miljoarbetet/Rattsinformation/Rattsfall/Villkorsskrivning/Sakan-villkor-och-begransningsvarden-utformas

[10] Pre-treatment refers to the partial treatment of wastewater prior to release to UWWTP.

- Pre-treatment – i.e. techniques to abate pollutants before the final waste water treatment, either onsite or transferred to UWWTP or IOWWTP.
- End-of-pipe techniques – i.e. waste water treatment techniques applied to waste water streams at the end of the process where waste water is to be discharged directly to a water body.

Furthermore, BAT 11 of the BATC for CWW stipulates that BAT is to pre-treat waste water that contains pollutants that cannot be dealt with adequately during final waste water treatment by using appropriate techniques, as follows:

- protect the final waste water treatment plant (e.g. protection of a biological treatment plant against inhibitory or toxic compounds);
- remove compounds that are insufficiently abated during final treatment (e.g. toxic compounds, poorly/non-biodegradable organic compounds, organic compounds that are present in high concentrations, or metals during biological treatment);
- remove compounds that are otherwise stripped to air from the collection system or during final treatment (e.g. volatile halogenated organic compounds, benzene);
- remove compounds that have other negative effects (e.g. corrosion of equipment; unwanted reaction with other substances; contamination of waste water sludge).

When setting permit conditions, it is important to consider that BATC may not always cover the full scope of the above waste water treatment phases.

Based on good practices reported by Member States, the following considerations are important when setting ELVs for indirect releases to water:

- Establish which pollutants are removed by the offsite waste water treatment plant to which the IED installation discharges its waste water (see also section 3.6 of this report). If possible, obtain information from the operators on the processes applied and removal efficiencies for pollutants originating from IED installation.
- Require pre-treatment of waste water at IED installation for pollutants which:
    - Are not successfully removed by offsite waste water treatment plant
    - Are known to lead to poor water quality in the water bodies receiving discharge from the offsite waste water treatment plant
    - May damage the equipment at offsite waste water treatment plan
    - May negatively impact the waste water treatment process
    - Would otherwise be stripped to air from the collection system.

  This reduces the pollution load entering the offsite waste water treatment plant and subsequently the water body, ensures that the offsite waste water treatment plant continue to operate efficiently and that cross-media effects are accounted for during permitting.
- Where possible, set ELVs at the point where emissions leave the IED installation (i.e. before waste water enters the offsite waste water treatment plant). This ensures that the pollution is controlled at source, before dilution with other waste water streams entering the offsite waste water treatment plant.
- The ELVs for indirect releases should factor in the removal efficiencies of offsite waste water treatment plant and the extent to which they can deliver an equivalent level of environmental protection. In case of pollutants removed or partially removed through the treatment, this may mean a higher ELV than would have been applied in case the IED installation was discharging directly to a water body. In case of pollutants not removed in the treatment, this means at least the same ELV as would have been applied in case of direct discharge.

3.2 Choosing from the upper or lower end of BAT-AEL ranges

As described in section 2.1, BATC are the reference for setting the permit conditions (Article 14(3)). As such, ELVs are set according to the BAT-AELs prescribed by BATC. See Appendix A2 for a summary of BAT-AELs by key industrial pollutant, IED sector, and whether the BAT-AELs specified in the BATCs relate to pre-treatment, direct discharges or indirect discharges.

BAT-AELs are typically included in BATC as a range. This provides flexibility when setting ELVs to take into account the specific characteristics of the installation and local circumstances. However, information gathered from Member States as part of this as well as other relevant studies on implementation of the IED suggest that most frequently the upper ends of BAT-AEL ranges are used when setting ELVs in permits.

To strengthen pollution controls and reduce pressures on water quality (as described in Section 0), permitting authorities should consider the full BAT-AEL range and determine ELVs on a case-by-case basis when setting ELVs in permits. The following examples demonstrate the different approaches reported by Member State authorities to facilitate the process of setting ELVs in permits according to BAT-AEL ranges:

- In Belgium (Flanders), recommendations have been published online according to a series of regional studies on the application of BAT and the setting of ELVs on a case-by-case basis. The studies were also used to inform the development of regional legislation (transposing the requirements of the IED, VLAREM II).
- Bulgaria has published an ordinance on issuing permits for discharging waste water into water bodies and determining individual emission limits for point sources of (Bulgarian Ministry of Environment and Water, 2011).
- In Finland (Finnish Ministry of the Environment, 2018), the use of daily average values is being considered when setting ELVs to clarify permit controls. The approach would establish a threshold under which the daily average ELV would be compliant (e.g. where over 80% of the daily operating conditions during a calendar year fall below the ELV and where an individual sample does not exceed the limit by more than 100%). The approach may also set a maximum load per installation, e.g. on an annual basis (kg p.a.), to avoid any adverse effects that might result from high cumulative emissions. In keeping with the principles established under the IED, the short-period ELVs are applied on a case-by-case basis and uncertainties in emission measurements are addressed by the approach to monitoring defined by the permit. The frequency of monitoring would then be determined by national legislation (and may differ from BATC while ensuring that the requirements are met) to ensure compliance with permit conditions for emissions.
- In Germany, BATC are implemented via general binding rules establishing the BAT-AEL ranges and approaches to monitoring. The national Waste Water Ordinance (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany, 2004) has sector-specific appendices establishing requirements per sector. The Waste Water Ordinance is responsible for documenting federal-state water legislation and background papers to support the implementation of national or federal-state legal requirements.
- In Sweden, the lower end of BAT-AEL range may be used to set ELVs where an installation is required to comply with BPT.
- In the UK, guidance (England's Environment Agency, 2013) is available to installation operators and permitting authorities to identify where ELVs should be set – including where the lower end of BAT-AEL should be applied. A two-stage process of screening and modelling is described to assess which substances are liable to cause pollution. Screening is undertaken by operators using raw data to identify which substances are having a significant impact. Modelling is then undertaken to determine releases to water bodies; where substances are liable to cause pollution, ELVs are set in permits.

Based on good practices reported by Member States, the following considerations are important when setting ELVs based on the BAT-AEL range:

- Do not default to setting ELV at the upper end of BAT-AEL range. Instead consider the lower end of BAT-AEL range first when setting ELVs.
    - Do not set an ELV at the upper end of BAT-AEL range, if the installation is already performing better than the upper end of the range. In such cases, the ELV should be set at a level equal or lower than current emission levels.
    - Permitting authorities do not need to justify to operators why ELVs have been set at other than upper end of BAT-AEL range. Instead the burden of proof is on the operator to show why lower ELVs cannot be achieved.
- Authorities overseeing the implementation of the IED in a Member State can provide guidance and training to operators and permitting authorities to help with the process of setting ELVs to ensure that the lower-end of a BAT-AEL range or stricter permit conditions are set when necessary to deliver adequate environmental protection.

3.3 Identifying polluting substances for which ELVs should be set

Permit conditions include ELVs for polluting substances listed in Annex II, and for other polluting substances 'which are likely to be emitted from the installation concerned in significant quantities, having regard to their nature and their potential to transfer pollution from one medium to another' (Article 14(1a) IED).

According to the consultation responses gathered, there are very few examples across Member States where ELVs for water discharges are set for other polluting substances than those listed in BATC:

- In Germany, other polluting substances may require ELVs in accordance with the federal Waste water Ordinance (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany, 2004). These substances are determined by sector, e.g. BOD and inorganic pollutants from the pulp and paper industry, or aluminium and COD from the production of non-ferrous metals.
- In Austria, national legislation stipulates which substances are regulated at sector level for both IED and non-IED installations.
- In France, national action for research and reduction of releases of hazardous substances in water from classified installations for environmental protection[11] determines ELVs for the pulp and paper industry for phenols, AOX or EOX, total hydrocarbons, copper and its compounds, zinc and its compounds and a list of micropollutants.
- In the UK, ELVs are occasionally set in permits that are designed to protect aspects of water quality that are not covered by sector-specific BATC. For example, microbiological parameters are used to regulate faecal coliforms in discharges to protect Shellfish and Bathing Water standards. In such cases, the ELVs take into account photo-reactivation and the way in which it increases microbial concentrations.

Member States have reported that the decision on whether to set an ELV for a given pollutant or not is taken either on a case-by-case basis (i.e. at installation level) or at sector level. Case-by-case examples include the following:

- In Luxembourg, the permit for a dairy production installation (currently at the planning stage of development) is expected to have ELVs set for chlorides and sulphates which are needed to achieve the limits set out by the national regulation to achieve good ecological status (see Section 3.5).
- In the UK, it was concluded for the permit of the Overton Paper Mill (Hampshire) that the BAT-AELs set out in the BATC for Production of Paper, Pulp and Board sector (expressed as annual loads in kg/t of product) did not adequately protect the water quality in the adjacent freshwater body. ELVs were therefore also set for total daily waste water volume and total phosphorus (P) concentration in mg/l to ensure that the receiving waters were adequately protected.

In Sweden, ELVs for polluting substances additional to those specified in the BATC can be set with the application of BPT. At sector level, e.g. in the pulp and paper industry, ELVs are set for chlorate (because of the issues with brown algae in the Baltic sea), and complexing agents such as EDTA and DTPA.

To a lesser extent, the setting of ELVs for other polluting substances may occur where emerging polluting substances are apparent (and thus not captured by BATC). Although no examples of this have been reported according to the information gathered, several Member State authorities referred to informal processes which are followed to facilitate the identification of emerging polluting substances from industry. The processes described involve collaboration between technical experts and the dissemination of research and studies on emerging substances to permitting authorities (as reported by Austria, Belgium (Flanders), Bulgaria, France, Germany, Malta, Portugal, Romania and the UK).

In the case of Germany, where Laender-based research projects are underway (e.g. NRW, Baden-Württemberg), this process may lead to the setting of ELVs for emerging pollutants. Investigations at

[11] "RSDE action" (national action for research and reduction of releases of hazardous substances in water from classified installations for environmental protection). URL: https://rsde.ineris.fr/index.php

the federal level are ongoing (stakeholder dialogue organised by the Ministry of Environment). The first results from this process are expected to be obtained in 2020, after which they will be regularly updated.

In Denmark, new substances are evaluated by the permitting authority according to the documentation supplied by the applicant. Depending on the outcome, the Danish Environmental Protection Agency may establish a national EQS for the substance. Danish legislation has a list of approximately 150 substances with a national EQS. Several of these are additionally set in sediment and biota as a number of the substances tend to accumulate. ELVs need to take account of the fact that less can be emitted in cases where little or no degradation takes place in the aquatic environment if the EQS is still to be met.

In France, specific actions have been undertaken at the national level to improve the consideration of nanomaterials and endocrine disruptors. For example, a register for nanomaterials[12] was created in 2013 where stakeholders producing or putting nanomaterials on the market have to provide information on the production and the use of these substances. In addition, guidance on BAT is available for inspectors and operators of classified installations to ensure environmental protection where substances in the nanoparticulate state are used (French Ministry of Environment, Energy and the Sea, 2013).

The information gathered in this study suggests that a standardised approach can help to identify emerging polluting substances. Finland reported that an installation is required to report to the authorities if it starts using a new hazardous chemical. The authorities then review the permit conditions to consider whether updates are needed.

Based on good practices reported by Member States, the following considerations are important when setting ELVs for polluting substances other than those listed in Annex II of the IED or BATC:

- Where a BAT-AEL is not provided in BATC for a polluting substance relevant to a specific installation, consider if this other polluting substance may be relevant to the entire sector (at Member State or regional level). For example, it may be that the BAT-AEL is not included in the BATC because there is a lack of representative data at the EU level, but the data are available locally.
- Member State analyses of pressures and impacts in river basins may provide a useful reference for identifying relevant polluting substances (see detail in section 2.2).
- The surface water watch list mechanism under the EQSD and the voluntary watch list mechanism under the Groundwater Directive, which both aim among other things at identifying risks from emerging pollutants, can provide a useful source of information to help identify polluting substances that may require permitting under the IED.
- Collaboration between operators, authorities and researchers can help identify other polluting substances and/ or emerging substances through knowledge dissemination, research papers and guidance on emerging contaminants to competent authorities.

3.4 Setting equivalent parameters or technical measures to ensure an equivalent level of environmental protection

BAT-AELs set for polluting substances in BATC are summarised in Table 2-1. The parameters used are summarised below according to BAT (Table 3-2). The most common parameters to regulate emissions to water are COD, TSS and heavy metals.

[12] URL: https://www.r-nano.fr/

Table 3-2 Pollutants to water most commonly regulated under the IED, and associated source sectors

Parameter	BAT with BAT-AEL adopted by BATC
Arsenic	BAT 13 (GLS); BAT 17 (NFM); BAT 20 (WT); BAT 15 (LCP)
Biological oxygen demand for 5 days (BOD5)	BAT 56 (IS); BAT 10 (TAN)
Cadmium	BAT 13 (GLS); BAT 17 (NFM); BAT 15 (LCP) ; BAT 20 (WT); BAT 12 (REF) ; BAT 80 (LVOC)
Chemical oxygen demand (COD)	BAT 15 (LCP); BAT 20 (WT); BAT 3, 4, 10, 11, 12 (CWW); BAT 13 (GLS); BAT 28, 39, 56 (IS); BAT 19 ,33, 40, 45, 50 (PP); BAT 12 (REF); BAT 10 (TAN); BAT 27 (WBP)
Chromium	BAT 15 (LCP); BAT 20 (WT); BAT 3,4 (CWW); BAT 17 (NFM); BAT 13 (GLS); BAT 81, 92 (IS); BAT 10, 11, 12 (TAN)
Copper	BAT 15 (LCP); BAT 20 (WT); BAT 3, 4 (CWW); BAT 13 (GLS); BAT 80 (LVOC)
Lead	BAT 15 (LCP); BAT 67 (IS); BAT 13 (GLS); BAT 17 (NFM); BAT 20 (WT); BAT12 (REF)
Mercury	BAT 15 (LCP); BAT 17 (NFM); BAT 20 (WT); BAT 12 (REF)
Nickel	BAT 15 (LCP); BAT 20 (WT); BAT 10 (CWW); BAT 17 (NFM); BAT 13 (GLS); BAT 81, 92 (IS); BAT 12 (REF)
Total nitrogen (N)	BAT 10 (CWW); BAT 12 (REF); BAT 19, 33, 40, 45, 50 (PP); BAT 7, 20 (WT), BAT 10 (TAN)
Total organic carbon (TOC)	BAT 15 (LCP); BAT 10 (CWW); BAT 20 (WT)
Total phosphorus (P)	BAT 10 (CWW); BAT 19, 33, 40, 45, 50 (PP); BAT 20 (WT)
Total suspended solids (TSS)	BAT 5, 15 (LCP); BAT 7, 20 (WT); BAT 10 (CWW); BAT 13 (GLS); BAT 19, 33, 40, 45, 50 (PP); BAT 12 (REF); BAT 25, 27 (WBP)
Zinc	BAT 20 (WT); BAT 10 (CWW); BAT 13 (GLS); BAT 67, 81, 92 (IS); BAT 17 (NFM)

Source: EC (2019)

In accordance with Article 14(2), 'ELVs may be supplemented or replaced by equivalent parameters or technical measures ensuring an equivalent level of environmental protection.' In practice, according to the information received from Member State authorities, equivalent parameters are rarely set in permit conditions. The following examples have been reported:

- In Austria, releases to water are regulated by the National Waste Water Ordinance[13] which has sector-specific appendices (as reported for Germany). Equivalent parameters are permitted allowing the option to monitor TOC instead of COD and settleable substances rather than TSS.
- In Belgium (Flanders), equivalent parameters or technical measures are only rarely used as permit conditions. Individual permit conditions can include extra parameters which are adopted by GBRs (in this context, chloride is a commonly used parameter). Toxicity tests can also be included in permits conditions. Where testing identifies a relevant sign of ecotoxicity, the operator is required to determine the cause and take appropriate measures. Total effluent assessment is a possible alternative tool to regulate and control toxicity in waste water.
- In Finland, equivalent parameters may be set in the review of the permit if deemed necessary, but this is not usual (Finnish Ministry of Environment, 2006). Equivalent parameters are identified on a case-by-case basis, taking into account the receiving water body. A typical example is prohibiting the release of a certain substance by demanding, for example, the use of ultrafiltration. Other examples include total N, total P, BOD, conductivity, pH and TSS which are typically controlled with ELVs, even though there is no BAT-AEL for these in the BATC (Kangas, 2018).

[13] URL: https://www.bmnt.gv.at/wasser/wasser-oesterreich/wasserrecht_national/abwasser_emissionsbegrenzung0.html

- In Portugal, additional monitoring of specific pollutants (e.g. mineral oils) has been required to inform the regulation of discharges and determine their impact on water bodies. The requirements are adopted by national regulation and implemented via the permit.
- In Sweden, an ELV for temperature is commonly set for most sectors to account for the way in which elevated temperatures impact flora and or fauna, and to reflect the fact that invasive alien species often thrive in the vicinity of the installation.

In Germany, it is planned to apply 'a properly designed sedimentation basin' as an equivalent technical measure for which emissions can be monitored (Germany finds that the BAT 25 of the wood-based panel BATC does not specify when, how or where to measure TSS for run-off water and therefore the BAT-AEL is not effective)[14]. Adding to this, biotests can be used to monitor emissions from the pulp and paper industry (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany, 2004), for example:

- Biodegradability of cleaning and disinfection agents in the food, drink and milk industries by achieving a Dissolved Organic Carbon (DOC) reduction rate of ≥ 80% after 28 days.
- Biodegradability of complexing agents, blending of partial waste water streams only if a TOC reduction rate of 80% is achieved (chemical industry).
- Toxicity levels (in fish eggs, algae, daphnia, duckweed, luminescent bacteria), and mutagenic potential (bioassays applied on effluents together with limit values using dilution factors).
- The use of a phenol index as a measure of phenol compounds in waters after distillation and colour extraction.

Examples of practices reported by Member States can be used as a reference when setting equivalent parameters in permit conditions. For example:

- Equivalent parameters may be used in addition to existing ones to strengthen environmental protection. E.g. parameters for temperature can be used to regulate impacts on ecosystems.
- Ecotoxicity tests or total effluent assessments can be required in permit conditions to regulate releases of polluting substances more generally.

3.5 Taking into account requirements of the WFD

As described in Section 2.2, requirements of the WFD can have implications for the regulation of industrial waste water where releases affect the ecological or chemical status of a water body. Requirements pertaining to a combined approach for point and diffuse sources are set out under Article 10 of the WFD. Where, discharges from point sources are liable to cause pollution, GBR can be included in the programme of measures (Article 11(3)(g)). Furthermore, Article 18 of the IED stipulates that permits can include measures that go beyond BAT where necessary to meet EQS.

Based on the responses received from Member States, it is not clear at what level ELVs should be set where an EQS is already breached, in particular how to determine the extent to which further emissions are permissible to a water body in less than good status. Other related issues that were not raised by Member States are understanding at what level ELVs should be set where the quality of a water body is deteriorating (but not necessarily in breach of an EQS) and understanding how ELVs should be set to meet EQS set for sediment and biota instead of water.

To achieve good ecological and chemical status, the WFD aims to contribute to the cessation or phase out of discharges, emissions and losses of priority hazardous substances (Article 1). BATC can contribute to this objective where polluting substances are banned (e.g. the use of carbon tetrachloride in degreasing operations or the use of ammonia for denitrification in combustion) (as reported by Slovakia).

It is also not clear if BAT-AELs are well aligned to this objective of the WFD. Specific examples were presented for emissions of heavy metals – in particular mercury emissions from the production of non-ferrous metals (Belgium (Flanders) and Austria) and the chlor-alkali industry (Germany and Spain).

[14] BAT 25 involves a combination of techniques to reduce emissions to water, including technical separation of coarse materials by screens and sieves as preliminary treatment; oil-water separation; and removal of solids by sedimentation in retention basins or settlement tanks.

Industrial activity, especially metal production, is most likely to impact on EQS for heavy metals such as nickel or cadmium.

Where EQS apply, Member States take the following precautions to ensure the standards are not breached:

- Based on the information reported, several permitting authorities (Austria, Belgium (Flanders), Croatia (Croatian Waters, 2018) and Germany) take a combined approach (in accordance with Article 10 of the WFD). ELVs are first set according to BAT-AELs; after which, EQS are assessed. The permit conditions are then defined to ensure BAT-AELs are complied with and that EQS are met, e.g. permit conditions for an installation that produces non-ferrous metals included measures to apply reverse osmosis to reduce the emission of lead because the EQS could not otherwise be met in the receiving waterbody (owing to its small size).
- In Denmark, national legislation (Danish Ministry of Environment and Food, 2019) is in place to ensure and formalise the work required to ensure all water bodies are in a good status according to the WFD. In addition to setting more stringent ELVs for IED Annex II substances, this may involve setting ELVs for other polluting substances where EQS are breached.
- In Estonia, where EQS are breached or where the good status of a water body is not achieved, an action plan is drawn up by national authorities to address the issue. The action plan may refer to permit conditions.
- In Finland, where EQS are breached potential sources of the hazardous polluting substance are identified. Where an installation is identified as being a source, the pollution load and possible impact on the waterbody is then assessed and the permit conditions are reviewed (Kangas, 2018). A similar approach is followed in Slovakia, where stricter ELVs and corrective measures are set in permit conditions when an installation is identified as being responsible for the breach.
- Where applicable, in Spain, ELVs in permits are set according to a mass balance of contaminants to ensure the EQS can be met. The mass balance factors in the volume of water released and the concentration of the substance in the discharge, along with the receiving water mass conditions (circulating water volume and concentration of such substance upstream and downstream). If the EQS are already breached, then the polluting substance, or substances, in the industrial waste water must be reduced to zero or almost.
- Malta applies the precautionary approach by applying the EQS as ELVs. However, no further details of the approach were provided.
- Following the IMPEL guidance (IMPEL, 2010), Portugal is implementing a procedure with the permitting authorities to evaluate, on a case-by-case basis, the need to set stricter ELVs where EQS are breached. If and when considered relevant, the permit for the emissions to water may set stricter ELVs and/ or set ELVs for additional polluting substances. The approach in Portugal considers all aspects of water management, including water use and the effects of fluctuation in rainfall on water quality.
- In Sweden, industrial waste water cannot be emitted to a waterbody if it jeopardises the possibility of achieving good ecological or chemical status or compliance with EQS.

Where Member States have designated a mixing zone (Article 4 of the EQSD), and concentrations of one or more substances may exceed the corresponding EQS in said mixing zone, the permitting of emissions to waste water from IED installations needs to take into account that the rest of the body of surface water must be compliant with the corresponding EQS. Conditions downstream of a mixing zone can also be taken into account (European Commission (CIS-WFD), 2010).

According to the questionnaire responses received, some Member State guidance is available to permitting authorities to facilitate interaction between IED permitting and meeting the requirements of the WFD, as follows:

- In Belgium (Flanders), the second River Basin Management Plan 2016-2021 developed under the WFD contains a programme to reduce hazardous substances and on how to take a combined approach to permitting, available as a background document for the river basin management plan 2016-2021 (Integrated Water Policy Coordination Committee Guidance). Furthermore, guidelines are available to operators on the preparation of an environmental impact assessment report concerning emissions to water (LNE, 2011).

- Czechia has developed a regulation on indicators and values for permissible pollution of surface waters with waste water from IED Annex I activities (Czechia Government Regulation No. 401/2015 Coll).
- In Denmark, a guidance document is available, specifying which issues have to be taken into account to ensure that permits will support compliance with the WFD. It presents a comprehensive set of requirements including the evaluation of all known sources of each substance emitted to the water body (Danish Environmental Protection Agency, 2017). The Danish EPA has also compiled a large number of FAQs on this and made them available online to support permitting authorities in their job[15].
- Romania has published a decree for approving the rules on the discharge conditions in the aquatic environment (Romanian Ministry of Justice, 2007).

Based on good practices reported by Member States and in accordance with the existing IMPEL guidance (2010), the following considerations are important when setting ELVs for emissions to water:

- A combined approach to setting ELVs in permit conditions and ensuring EQS are not breached in receiving water bodies can preempt any risk to water quality. This can entail:
    - If the EQS are already breached, then the ELV can be set to lower than the lowest range of the BAT-AEL.
    - Avoiding all industrial waste water discharges to a waterbody if it jeopardises the possibility of achieving good ecological or chemical status or compliance with EQS.
    - Applying the EQS as ELVs
    - Evaluating all known sources of input of the substance to the water body. To do this, analysis of the mass balance of contaminants in industrial waste water and the receiving water mass conditions can be used to determine the impact of industrial waste water on water quality.

3.6 Ensuring adequate treatment of indirect discharges through permitting

As described in section 2.1, indirect discharges to water from industry occur where industrial waste water is transferred offsite for treatment either via UWWTP or IOWWTP (EEA, 2018). Conditions are typically set by contracts between the industrial installation and offsite treatment plant.

Under the UWWTD, UWWTPs are required to apply different levels of treatment depending on the size of agglomeration[16]. For agglomerations of more than 2,000 population equivalents (p.e.), secondary treatment is required[17], and more stringent treatment is required in agglomerations of more than 10,000 p.e. and where UWWTP discharge in designated sensitive areas.

The UWWTD also includes provisions to regulate waste water treatment techniques applied at UWWTP when treating industrial waste water. The most common treatment processes currently applied in UWWTP for different levels of treatment are summarised in Table 3-3. Treatment processes are selected according to the characterisation of influent; thus techniques typically address concentrations of TSS, BOD, COD, and biodegradable organic compounds. Nutrients (total N and total P) are also often treated and the techniques required are more complex. Some of the treatment techniques in Table 3-3 can reduce concentrations of heavy metals but they are not easily removed in a standard waste water treatment plant configuration as they require tertiary treatment such as chemical precipitation, oxidation or coagulation techniques.

IOWWTP are normally plants dedicated to the treatment of industrial waste water that serve several installations located in proximity to each other. For certain industrial waste water effluents this can be a

[15] URL: https://mst.dk/natur-vand/vand-i-hverdagen/spildevand/hvad-er-spildevand-og-hvorfor-renser-vi-det/miljoekvalitetskrav-for-overfladevand/spoergsmaal-og-svar-om-miljoekvalitetskrav/
[16] As per the UWWTD, "agglomeration" means an area where the population and/or economic activities are sufficiently concentrated for urban wastewater to be collected and conducted to an urban wastewater treatment plant or to a final discharge point (Article 1;4)
[17] Except for agglomerations between 2,000 and 10,000 p.e. discharging to coastal waters, in which only an appropriate treatment will be required

more efficient option compared with treatment onsite, as economies of scale and synergies between waste water types can be exploited (EEA, 2018). However, according to E-PRTR data from 2017, there are 74 IOWWTP in Europe[18]. The IOWWTP are regulated under the IED. BREFs for certain sectors include IOWWTPs in their scope where the biggest volume of waste water discharges comes from a specific IED sector (e.g. tanning of hides and skins). Nevertheless, the techniques in Table 3-3 are key types of treatment which may be used in industrial waste water plants as well.

Table 3-3 Most unit processes applied in UWWTPs and their pollutant removal efficiencies, across the EU

Type of treatment	Technique	Description	Targeted pollutant	Removal efficiency[19]
Pre-treatment	Screening	Screening is the most common pre-treatment technique. It removes objects such as rags, paper, plastics and metals to prevent damage and clogging of downstream equipment.	Intended to enhance the operation and maintenance of subsequent treatment - not targeted to any one pollutant	N/A
	Grit removal	Removal of grit (sand, gravel, cinder, or other heavy solid materials heavier than the organic biodegradable solids) provides downstream protection of processes, as well as excessive wear of equipment. Grit removal is usually performed after the waste water has been screened.	Intended to enhance the operation and maintenance of subsequent treatment - not targeted to any one pollutant	N/A
Primary treatment	Sedimentation	Separation of suspended solids and floating material by gravitational settling. The settled solids are removed as sludge from the bottom, whereas floated material is skimmed from the water surface. When the particles cannot be separated by simple gravitational means, special chemicals are added to cause the solids to settle.	TSS Settleable solids	60-90 % 90-95 %
	Flotation	Separation of solid or liquid particles from waste water by attaching them to fine gas bubbles, usually air. The buoyant particles accumulate at the water surface and are collected with skimmers.	TSS	90-98 %

[18] URL: https://prtr.eea.europa.eu/#/industrialactivity (E-PRTR activity 5(g) - independently operated industrial waste-water treatment plants)
[19] The removal efficiencies presented in this table relate only to the corresponding technique and do not present cumulative effect from primary, secondary and more stringent treatments. Furthermore, they do not account for any co-benefits of the application of specific techniques together.

Type of treatment	Technique	Description	Targeted pollutant	Removal efficiency[19]
Secondary treatment	Filtration	Separation of solids from waste water by passing them through a porous medium.	TSS	50-99.9 %
	Coagulation and flocculation	Used to separate suspended solids from waste water and carried out in successive steps. Coagulation requires adding coagulants with charges opposite to those of the suspended solids. Flocculation is carried out by adding polymers, so that collisions of micro floc particles cause them to bond to produce larger flocs.	TSS	Unknown
	Activated sludge treatment	This process targets biodegradable organic compounds through the biological oxidation of dissolved organic substances with oxygen using the metabolism of microorganisms. In the presence of dissolved oxygen, the organic components are mineralised into carbon dioxide and water or are transformed into other metabolites and the activated sludge. The microorganisms are maintained in suspension in the waste water and the whole mixture is mechanically aerated. The activated sludge mixture is sent to a separate facility from which the sludge is recycled to the aeration tank.	Biodegradable organic compounds, Heavy metals	90-98 % for BOD and TOC
	Membrane bioreactor	This technique targets biodegradable organic compounds through a combination of activated sludge treatment and membrane filtration.	TSS, COD, BOD, TOC, TP	95-99 % for all
	Biological trickling filters	This technique enables organic material in the waste water to be absorbed by a population of microorganisms attached to the medium as a biological film or slime layer (0.1-0.2 mm thick). As the waste water flows over the medium, microorganisms already in the water gradually attach themselves to the rock, slag, or plastic surface and form a film. The organic material is then degraded by the aerobic	Biodegradable organic compounds	40-90 %

Type of treatment	Technique	Description	Targeted pollutant	Removal efficiency[19]
		microorganisms in the outer part of the slime layer.		
More stringent treatment	Nitrification/ denitrification	A two-step process targeting general nitrates and ammonia that is typically incorporated into biological waste water treatment plants. The first step is the aerobic nitrification where microorganisms oxidise ammonium to the intermediate nitrite, which is then further oxidised to nitrate. In the subsequent anoxic denitrification step, microorganisms chemically reduce nitrate to nitrogen gas.	N, NH_3	60-95%
	Chemical precipitation	This technique is used to remove phosphorus, some organic compounds and some heavy metals from waste waters through the conversion of dissolved pollutants into an insoluble compound by adding chemical precipitants. The solid precipitates formed are subsequently separated by sedimentation, air flotation, or filtration.	P and heavy metals	Unknown
	Disinfection	Disinfection protects from waterborne pathogenic microorganisms. Disinfection normally involves the injection of a chlorine solution. Ozone and ultra violet irradiation are less common methods of disinfection. The bactericidal effects of chlorine and other disinfectants are dependent upon pH, contact time, organic content, and effluent temperature. Disinfection can produce toxic and genotoxic compounds and toxicity tests are needed to mitigate this risk.	Pathogenic organisms and organic contaminants	Unknown

Source: Own compilation based on information presented in EEA (2018) and Commission Implementing Decision (EU) 2016/902

As presented in Table 3-3, many techniques applied in UWWTP are efficient (over 90% emission removal efficiency) in the removal of biodegradable pollutants such as TSS, COD, BOD, TOC, TP and nutrients depending on the level of treatment applied. Section 3.3 further made it clear that heavy metals could represent a challenge to UWWTP as they require specific treatment techniques such as heavy metal precipitation and ion exchange.

Additional pollutants that may represent a challenge during waste water transfers are pollutants for which BATCs do not set BAT-AELs for indirect discharges and are not specifically treated by UWWTP.

According to responses received from Member States, challenging pollutants in addition to heavy metals include hazardous substances such as absorbable organically bound halogens (AOX), halogenates and polyfluorinated compounds.

Table 3-4 summarises pollutants potentially challenging to the common configuration of UWWTPs and IOWWTPs and associated sectors on the basis of the information provided in Table 3-3, Appendix A2 and the stakeholder consultation. The list is non-exhaustive and further pollutants and industries may be relevant depending on the specific industrial installations and activities which take place in it.

Table 3-4 Water pollutants and their industrial sources which are not treated by the most common treatment processes used by UWWTPs

Pollutant	Associated industrial source
Heavy metals	Common Waste Water and Waste Gas Treatment/ Management Systems in the Chemical Sector, Manufacture of Glass, Iron and Steel, Non-ferrous metals, Large Combustion Plants, Refineries, Large Volume Organic Chemicals, Tanning of hides and skins, Waste Treatment
AOX	Common Waste Water and Waste Gas Treatment/ Management Systems in the Chemical Sector, Pulp and Paper
Barium	Manufacture of Glass
Benzene	Refineries
Chlorine	Production of Chlor-alkali
Hydrocarbon oil index	Manufacture of Glass, Iron and Steel, Refineries
Phenols	Waste Treatment, Manufacture of Glass, Iron and Steel

Source: Own compilation based on information presented in Appendix A2 to this report.

In addition to setting ELVs for indirect discharges (see Section 3.1), Member States have taken the following approaches to ensure indirect discharges are adequately regulated by installation permits where industrial waste water is treated via offsite WWTP:

- In Austria and Poland, sector-specific waste water ordinances provide a list of pollutants emitted from the respective industrial activities together with ELVs that need to be included in permits for both direct and indirect discharges.
- In Austria, offsite WWTPs treating industrial effluent are regulated by a permit. The WWTPs are required to share monitoring reports with the competent authority which should indicate the pollutant abatement efficiencies being achieved.
- In Bulgaria, offsite WWTPs have an obligation to monitor incoming waste water loads. Contracts for industrial waste water treatment can only be signed where the WWTPs are equipped with the treatment techniques required to treat the specific loads.
- In Croatia, when issuing and reviewing the discharge permits for waste water from WWTPs, the substances are tested at the outlet of the WWTP according to the *Ordinance on waste water emission limit values* (Croatian Ministry of Environment and Energy, 2010).
- In Estonia, the composition of the industrial effluent is judged on the basis of waste-water stream inventories at facility level, self-monitoring and safety data sheets. However, in practice, there are problems with the quality of data included in the inventories.
- In France, when effluents from industrial installations are treated offsite, a study is required from the operator of the IED installation to prove that the WWTP is able to provide adequate treatment. This study should also determine the characteristics of the effluents that may be released from the installation to the sewer for treatment at the WWTP and specify the pre-treatment required, if necessary, to reduce pollution at the source. The principle laid down in IED Article 15 is followed in France, meaning that when the WWTP is not equipped to abate emissions of a particular pollutant, the ELV set in the permit must be compatible with BAT-AEL for direct releases. Furthermore, under

French law, offsite transfers are only allowed where the waste water collection system is capable of handling industrial effluent.

- In Germany, the GBRs include specific requirements on substances such as AOX, halogenates and polyfluorinated compounds. Furthermore, WWTPs have to comply with the requirements of the IED. Finally, the German Association for Water, Waste Water and Waste (2018) has developed guidelines on the adequate treatment of waste water, including industrial waste water.
- In Czechia, Spain, Portugal and Luxembourg, waste water pre-treatment may be required onsite to abate emissions of specific substances. In Spain, WWTPs are required to issue declarations which state which pollutants could not be treated.
- Chemical safety data sheets submitted by industrial installations in Finland sometimes require information on how pollutants in indirect discharges are addressed by external WWTPs. Finnish UWWTP generally operate well and have higher efficiency than required by the UWWTD, applying more stringent treatment in all agglomerations of more than 2,000 p.e..
- Latvia reported that competent authorities are responsible for assessing pollutant removal efficiency ranges for WWTPs, testing the pollutant concentrations before and after treatment.
- Malta reported that industrial effluent from different installations is characterised using laboratory testing to establish whether ELVs are complied with or not. It is unclear what actions have to be taken in the event of non-compliance.
- In Sweden, EVLs are set taking in consideration the total environmental impact. Where UWWTPs do not have the relevant treatment techniques, pre-treatment is required by the industrial installation. In general, the preferred approach is to treat pollutants closer to source. Furthermore, Sweden has published guidance on setting ELVs for UWWTPs (Swedish Environmental Protection Agency, 2019). The guidance includes a description of what industrial water is and suggests treatment techniques (e.g. chemical treatment) that can help effectively treat industrial pollutants.
- In the UK, industrial installation operators are required to submit reports on the extent to which pollutants are removed from waste water transferred to WWTPs. The information provided is assessed using the "reduction factors" specified in the *Operational Instruction OI_17_13, Appendix 6* (as submitted by the UK as part of its response to the questionnaire). These factors are used to estimate the additional pollutant removal achieved by WWTPs*.* The factors represent removal rates, pollutant volatilisation rates and pollutant proportions left in the treatment units. If the emitted values adjusted by the reduction factors do not meet the ELVs, lower ELVs would be set to ensure that the required EQS are met at the point where the effluent leaves the WWTP.

Another way in which indirect discharges from industry are controlled is via contractual arrangements between the owner / operator of the installation and the owner / operator of the offsite WWTP, e.g. in Norway, the industrial installation is required to consider the available technologies and removal efficiencies of UWWTP prior to signing agreements. A more detailed example is described in Box 3-1 concerning an UWWTP in Spain and its requirements of industry.

Box 3-1 Case study: Installation of a heavy metals' treatment unit in Galiando UWWTP, Spain

The Galiando UWWTP receives a large influent from households, different industrial sectors and other activities. It collects waste water from 1,600,000 p.e.. Some key treatment techniques onsite include an activated sludge treatment, installed to deal specifically with heavy metals. Activated sludge treatment removes heavy metals as presented in Table 3-3. In cases where the treatment is aerobically activated, it can be regarded as BAT as explained in the Iron and Steel BREF. The UWWTP is in the process of installing a limestone filtration unit to further remove heavy metals.

Challenge: The mixed domestic and industrial streams result in a variety of pollutants that need to be treated in the UWWTP. The UWWTP treats approximately 120,500 m^3 of waste water per day with a high content of metals (28 kg/d of Zn and 7.8 kg/d of Cu). The application of the activated sludge treatment technique leads to a large volume of sewage sludge with high heavy-metal content. This type of waste is difficult to treat or dispose of. The UWWTP incinerates the sludge in a fluidised bed oven to recover energy. This approach is justified by the high content of heavy metals.

Outcome: Besides installing an activated sludge unit, the Galiando UWWTP has improved monitoring of influent to support design decisions and optimise the plant performance.

Further actions have been taken to minimise the heavy-metal content of the waste water influent. Industrial installations which have contracts with the Galiando UWWTP for waste water transfers are requested to install heavy metal pre-treatment units to minimise the challenges for the UWWTP. Monitoring of emerging pollutants has been carried out to track abatement efficiencies for pharmaceuticals including opioids among other substances.

Sources : https://aca-web.gencat.cat/aca/documents/ca/jornadatecnica003/26_villanueva.pdf

http://www.redmeta.es/images/oviedo_2017/5.pdf

Some Member States reported examples where UWWTPs have made changes to their treatment techniques or capacities in response to industrial discharge they receive:

- In Germany (Spremberg), a small WWTP[20] increased its general capacity in response to a contract it held with a paper mill using its services. The WWTP was located in a traditional coal mining area and was treating municipal waste water from a small community and contaminated groundwater. It applied primary treatment and aerobic secondary treatment. After the paper mill started operating and signed a contract with the WWTP, the WWTP installed an anaerobic pre-treatment. Currently, 56% of the influent treated in the WWTP comes from the paper mill, 43 % from other sources (mainly contaminated groundwater) and only 1% of municipal waste water.
- In the UK, an oil refinery is in discussion with a local UWWTP to determine if it can discharge waste water to the plant. If an agreement is reached, the UWWTP will need to install a new process to pre-treat the refinery effluent before it is combined with the domestic effluent.

Additional examples are provided below, where specific treatment units are needed in UWWTP or IOWWTP to ensure that the IED installations responsible for the discharge are compliant with BATC.

Box 3-2 Brewery waste water transfer demanding different treatment in UWWTP

Heineken Brewery in Torreblanca (Seville, ES) had a contractual agreement in which it paid a local UWWTP (La Ranilla) for treating its waste water. The onsite water treatment unit at the brewery was not complete and could not remove some of the pollutants from the waste water, specifically phosphates. The UWWTP is large, processing around 90,000 m^3 of waste water of primarily domestic origin per day (around 4,000,000 p.e.).

Challenge: The UWWTP did not have a suitable treatment to treat phosphates present in the waste water from the brewery. As a result, the treatment of waste water at the UWWTP could not provide a sufficient level of environmental protection. Regulatory implementation issues were raised which resulted in a ruling of the national court to force the industrial facility to invest in new measures on the site.

Outcome: The brewery made changes in their production processes (primary measures), switching from phosphoric acid to sulfuric acid to reduce the phosphate concentrations in the effluent. It also invested in improved onsite treatments. These treatments are not specified in the information that is publicly available.

Source: https://www.diariodesevilla.es/sevilla/factoria-Heineken-residuales-colector-publico_0_201880460.html

[20] Defined a small WTTP because it is treating a waste water load of less than 2,000 p.e. Although plants operating below this threshold are not typically regulated by the UWWTD, the plant may be regulated under the Directive if the discharges are to fresh-water and estuaries (Article 7).

Box 3-3 Innovation and technology cooperation at IOWWTPs serving the slaughterhouse and animal by-products sector

WZI Olen in Antwerp, Belgium is an IOWWT plant that treats waste water from installations in the slaughterhouse and animal by-products sector, specifically from chicken abattoirs.

Challenge: The industrial waste water transferred to the IOWWT is rich in Phosphorus and Cobalt. Other pollutants that are mentioned and monitored include Nickel and Zinc.

Techniques: To minimise the impact from industrial waste water from the installations, the IOWWTP applied techniques to deal with challenging pollutants. In particular the following treatments were included:

- Pre-treatment using rotary screens and water buffer.
- Coagulation/flocculation tanks, adding polymers to the water to form dregs
- Dissolved air flotation (DAF) to filter out the formed waste dregs and buffer for post-DAF water.
- Biological treatment reactors (Sequencing batch reactor) and water buffer
- Phosphorus treatment using iron trichloride.

Outcome: As a result, indirectly discharged industrial waste water was treated to the same or higher standard as directly discharged waste water. The treatment was compliant with BATC for this sector. The operation of the IOWWTP was reflected in the industrial permit for the installations.

However the production of polymers in the coagulation/flocculation step requires large amounts of water which has led to problems with water abstraction in the area.

Source: Stakeholder consultation

Box 3-4 Innovation and technology cooperation at IOWWTPs serving the tanning sector

Consorzio Cuoiodepur SpA and Consorzio Aquarno S.p.A are IOWWTP that treat waste water generated in tannery activities in Italy. These organisations have participated in a research and innovation consortium with other technology stakeholders such as industrial operators, research groups and tanning plant engineering firms to optimise its waste water treatment and sludge management processes. For example, the project Matter and Energy from Tannery Sludges aimed to provide sludge management options which allow for energy and materials recovery.

Challenge: The waste water streams from tanneries which are treated in the IOWWTP contain recalcitrant pollutants and can also cause unpleasant odours.

Techniques: The IOWWTP installed optimised biological treatment (the “Tutto Biologico” process) which does not require large use of chemicals and consists of two optimised biological-oxidation steps followed by a small tertiary treatment which applies Fenton- and Clari-flocculation.

Outcome: The outcome of the approach was a significant reduction in sludge production with respect to the chemical-physical steps.

Source: Consorzio Aquarno SpA at http://www.progettometa.it/en-US/

Based on good practices reported by Member States, the following considerations are important when setting ELVs for indirect discharges:

- Assess whether the external WWTP has the necessary techniques to address the industrial effluent. Reduction factors may be used to calculate the effect of the WWTP when setting ELVs.
- Waste water pre-treatment should be required onsite to abate challenging substances identified in the permitting process on case-to-case basis.
- Where the main pollutant load originates from activities covered by the BAT Conclusions but is transferred to IOWWTP, the IOWWTP could considering implementing BAT.

3.7 Mixed waste water streams

Mixed waste water streams can arise due to different circumstances, for example, if it is technically not feasible to separate the waste water within an installation, when different installations share a WWTP or when different installations discharge to the same receiving water via a shared outlet. These examples are not exhaustive. Article 15(1) of the IED states that the “ELV for polluting substances shall apply at the point where the emissions leave the installation and any dilution prior to that point shall be disregarded when determining those values”. Thus, where mixed streams occur, they must be taken into account when the ELV is set in the permit conditions.

Where mixing of waste water streams occurs, a different approach to setting the ELV may be needed if the point where the emissions leave the installation includes mixing with waste water streams from different processes within one installation (to which different BAT-AELs may apply), from multiple IED installations (to which different BATC may apply), or from industrial installations not regulated under the IED or non-industrial sources. In these cases, the ELVs might be set at an upstream point to avoid incorrectly taking account of dilution with other streams.

Setting ELVs for mixed streams represents a challenge for the permitting authorities. Special conditions such as dilution or synergistic effects need to be considered. When mixed streams occur, a case-by-case approach is necessary to account for the specific circumstances of each installation, still ensuring that criteria defined in the BATC are met. For setting ELVs in permits contextual information needs to be considered such as:

- The flows (stable or not)
- Emission loads (max, average, etc.)
- Process information (all streams are continuously in operation or not)
- Measurement periods of the different BAT-AEL (may differ)
- Activities from which the discharges originate (IED or non-IED)

Belgium (Flanders) uses additional monitoring requirements where necessary (e.g. monitoring of the individual streams) to enable a complete specific assessment of mixed streams.

If there is a risk of dilution, setting the ELV at the point where the waste water leaves the installation would not be representative, since the concentration of the pollutants would be lower (because of the dilution). Thus, the concerned substance might not be detectable anymore because of the limit of quantification (LOQ[21]) of the measurement method.

Another challenge for mixed streams is where WWTPs combine waste water streams from various sources such as private households, health care facilities, commercial enterprises or industrial production. This can lead to unintentional mixtures of anthropogenic chemicals that might cause combination effects, including synergistic effects. Since WWTPs are designed to only partially remove specific substances, waste water is a significant pathway into the environment, especially for human pharmaceuticals and chemicals released from consumer goods and industrial production processes.

The mixture of waste streams or substances can have negative and positive effects, sometimes of synergistic (more than additive) nature. Simple examples of a positive effect (not synergistic) were described by authorities in Belgium (Flanders) and Germany, including neutralisation resulting from the mixing of basic and acidic waste water, and the use of waste water with a high TOC value as a carbon source for biological treatment. Another example is the effect of substances that promote nitrification and thus biological degradation. Synergistic effects can result in aggravated toxic effects through the interaction of two or more substances. Interactions between drugs or pesticides can result in increased toxicity, impaired biodegradability, etc. This has been demonstrated, e.g. for sulfamethoxazole and trimethoprim and for heavy metals and pesticides.

When waste water streams are mixed but it is technically possible to consider them separately, or where at least one waste water stream presents a high risk for humans or the environment (such as from

[21] LOQ means a validated threshold at which quantitative determination of the substance is reliable (i.e. within calibration range, and with acceptable recovery and repeatability).

heavy metals or substances that are not biodegradable, as presented by Austria), a good approach is to establish the ELVs individually for each waste water stream before their confluence, in line with the appropriate BAT-AELs. This approach is followed in Austria, Belgium (Flanders), Norway and Sweden.

In Austria, exceptions are possible under strict conditions (e.g. when a substance can demonstrably be removed by standard treatment after being mixed with another waste water stream with equivalent effectivity as if treated separately). The combined treatment of multiple waste water streams discharged by several installations can be performed at a central WWTP. A permit containing the combined ELV should be issued to the final discharge to the water body based on the requirements of national legislation. Thus, the combined ELV will apply to the WWTP effluent.

In Austria, Belgium (Flanders), Germany, Poland and Portugal, exceptions are also possible for substances that do not present a high risk. In such cases, the substances can be treated either at a WWTP or, where separate treatment is not possible, a mixing rule can be applied to establish a combined ELVs for emissions after treatment in the WWTP.

Examples of a combined ELV were presented by Austria for COD or biodegradable substances (Box 3-6). The mixing rule applied in these examples is presented below in Box 3-6.

Box 3-5 Mixing rule to determine combined ELV for mixed streams (example provided by Austria)

Installation A contributes 10 % of the combined waste water and has an ELV of 1.0 mg/l for a substance, Installation B contributes 90 % and has an ELV of 0.5 mg/l for the same substance. This results in a “combined ELV” of 0.55 mg/l

With the general formula the required concentration for the individual pollutant parameters can be calculated:

$$S = \frac{S_1 * V_1 + S_2 * V_2}{V_1 + V_2}$$

S: Requirement for mixing for parameter S [mg/l]

$S_{1,2}$: Requirement for the parameter S for waste water stream 1 or 2 [mg/l]

$V_{1,2}$: Amount of waste water [l]

Loadings can be calculated analogously.

France reports an alternative approach in which when waste water from two IED activities is mixed, the operator must identify and justify the activity contributing the main load. The main load defines the ELV set in the permit, corrected by the degree of dilution from the other source. In addition, it should be verified that the concentrations leaving the other IED activity before treatment are less than or equal to the corresponding BAT-AEL.

The following example refers to paper production from mechanical pulp and recycled fibre with de-inking process and is presented as an example for setting combined ELVs for an industrial installation with direct discharge (according to Austrian water legislation for pulp and paper “AEV Zellstoff und Papier”). Two different ELVs are calculated. On the one hand there is the daily ELV, that must not be exceeded on 4 out of 5 measurement occasions during the year and can be calculated in advance by assuming the worst-case paper composition. On the other hand, there is also the annual ELV that needs to be complied with; the annual emissions are calculated at the end of the year, using the actual production data.

Box 3-6 Example of the calculation of the combined ELV applied to permits in Austria

Background information on the affected paper mill and production data

The maximum gross daily production capacity of the paper mill: 1,500 t air-dry. The respective share per paper type on the total paper production is calculated as follows according to the worst scenario in Table 3-5:

- Paper type ratio: 345:570:105
- 33.8%: Type I
- 55.9%: Type III
- 10.3%: Type IV

Table 3-5: Worst case paper composition (in relation to waste water emissions)

Paper type I (mechanical pulp paper)	345 t/day oven-dry
Paper type III (paper made from recycled paper including de-inking)	570 t/day oven-dry
Paper type IV (paper produced from pulp or purchased wood pulp or waste paper, excluding speciality paper)	105 t/day oven-dry

Application of the mixing rule

The share of the paper type is used to calculate the mixed ELV as described above by multiplying the proportion of the paper type with the specific ELV of the paper type. The results from this are then summed up to the mixed ELV (Table 3-6).

Table 3-6: Daily ELV (COD according to Austrian water legislation for pulp and paper "AEV Zellstoff und Papier" Appendix C Table 1)

Paper type I	3.0 kg/t air-dry; gross
Paper type III	5.0 kg/t air-dry; gross
Paper type IV	2.0 kg/t air-dry; gross
ELV COD (daily value) 0.3382 * 3.0 + 0.5588 * 5.0 + 0.1029 * 2.0 =	**4.0 kg/t air-dry; gross**

Using the mixed ELV, the total daily permitted value can be calculated. The value results from the multiplication of the mixed ELV with the maximum production capacity and adding the additional load from other fields (Table 3-7).

Table 3-7: Calculation of the total daily permitted value

Allowed daily amount from paper production: 1'500 * 4.0 kg/t=	6,000 kg/d
additional load from other fields (storage, commune, etc.)	4,000 kg/d
Total **daily** permitted value:	10,000 kg/d

If no further reasons require stricter limit values, the requirement included in the permit could therefore be as follows:

a.) Daily values

In the effluent of the WWTP based on a maximum gross daily production capacity of the paper mill of 1,500 t air dried, four measurements must not exceed the following limits for five consecutive measurements:

CSB: 10,000 kg/d

and maximum one measurement (which can be up to 1.5 times more than the other four measurements):

CSB: 15,000 kg/d (1.5 * 10,000 kg/d)

b.) Annual values

The annual average limit values in Table 3-8 must not be exceeded in the effluent of the WWTP in the year under consideration (1.1.–31.12. of each calendar year).

Note: The annual value in kg/d cannot be defined as a concrete limit value, because the actual ratio of the paper types, in contrast to the installed gross production capacity and the standard recipe, is not known in advance.

Table 3-8: Annual values (production-specific emission limits refer to the actual (net) tonne of paper produced air-dry according to Austrian water legislation for pulp and paper “AEV Zellstoff und Papier” Appendix C Table 2)

Parameter	Dimension	Limit Value Paper type I	Limit Value Paper type III	Limit Value Paper type IV
COD	kg/t air dried, net	2.0	3.0	1.0

Proof of compliance shall be provided in an annual report to the authority on the basis of the annual loads discharged and the actual production data (net tonne of air-dry paper or pulp produced, oven-dry) or, in the case of foreign pulp, on the basis of the quantity of pulp used (oven-dry).

Proof of the annual values

In order to verify if the annual ELV is not exceeded the limit value must be calculated at the end of the year (Table 3-10) with the actual production data (Table 3-9) and be compared with measurement data.

Table 3-9: Actual annual production data

Total paper production:	400,000 t/a, net
Paper type I:	90,000 t/a oven-dry; net
Paper type III:	180,000 t/a oven-dry; net
Paper type IV:	30,000 t/a oven-dry; net

The following relation can be calculated: Type I : III : IV = 30 : 60 : 10. This is used to calculate the mixed ELV (see Table 3-10).

Table 3-10: Annual ELV (COD according to Austrian water legislation for pulp and paper “AEV Zellstoff und Papier” Appendix C Table 2

Paper type I	2.0 kg/t air-dry; net
Paper type III	3.0 kg/t air-dry; net
Paper type IV	1.0 kg/t air-dry; net
ELV COD (annual value) 0.30 * 2.0 + 0.60 * 3.0 + 0.10 * 1.0 =	2.5 kg/t air-dry; net

The maximum permitted annual load is than calculated: (COD) 2.5 * 400,000 = 1,000,000 kg COD

Measurement and control

Table 3-11: Example of measurements within the paper mill and calculation of the maximum permitted load of CSB

Annual waste water from paper production:	6,570,000 m³
Total **annual** waste water (incl. storage, commune, etc.):	8,395,000 m³
Share of waste water from paper production:	78.26 %
Total **annual** COD:	1,259,250 kg
Share of COD from paper production (79.26%):	985,489.05 kg

In this example, the maximum permitted annual load of 1,000,000 kg COD was not exceeded during this production year.

In general, pre-treatment of industrial waste water should be carried out as close as possible to the source in order to avoid dilution, in particular for heavy metals. Sometimes, waste water streams with appropriate characteristics can be segregated and collected in order to undergo a dedicated treatment.

As referred to by several Member States (Austria, Belgium (Flanders), Germany, Norway, Romania and Spain), meeting the ELV by dilution is forbidden by local regulations (e.g. German Waste Water Ordinance § 3 (3), Austrian Water Law §33bZ8) and by the IED itself, and should be monitored. In permits, conditions for monitoring should be defined and operators should take samples of the undiluted waste waters before their treatment.

As reported by Portugal, if the primary discharge point includes mixing with other waste water streams (e.g. domestic, cooling, etc.), the ELVs might be set for a previous point in order to avoid dilution with other streams.

If this is not possible, an alternative (as reported by the Hungarian authorities) is to set ELVs by applying a dilution factor that reflects the share of the respective waste water stream in the total waste water. Several Member States reported that permits include ELVs for both load and concentration (Austria, Finland, Germany, Norway and Sweden). Such approach can be effective in avoiding dilution if both types of ELVs (i.e. load and concentration) need to be complied with at the same time. The concentration ELVs can also be related to a permitted waste water flow, thus combining the ELV [mg/L] with the maximum permitted wastewater discharge volume flow [m³/d]. Adding to this, in Germany, the permitting authorities can ask for flow diagrams of the installation and follow the mass and water balances in order to set appropriate requirements to avoid inappropriate dilution or mixing.

For preventing unintended synergistic effects between chemicals substances, no general approach can be given. The combined effect of all waste water streams should be considered by performing a risk evaluation of the emissions from all installations.

Based on good practices reported by Member States, the following considerations are important when setting ELVs for mixed streams:

- Where mixed streams occur with a low risk to human health or the environment, or where a separate approach is technically not feasible, a mixing rule can be applied to establish a combined ELV.
- Where mixed streams occur, and a combined ELV is set, the permit may include ELVs for both load and concentration.
- To identify the opportunities and the risks of synergistic effects, a risk evaluation of the emissions and their combined effect should be conducted by the discharger.

4 Key principles for managing emissions to water and examples of good practice

Table 4-1 Principles to support the management of emissions to water from IED installations

Principles		Member State good practices	Reference information
Setting permit ELVs for direct and indirect emissions to water			
1	Ensure that, where possible, ELVs are set at the point where emissions leave the IED installation.	In Austria, Denmark, Finland, the UK and Norway, ELVs are always set at the point where emissions leave the IED installation, regardless of whether it is a direct or indirect release. ELVs for hazardous substances are always set at the point of emission (e.g. Austria, Belgium (Flanders), Germany).	A summary of BATs providing BAT-AELs for direct and indirect releases per pollutant and sector is presented in Appendix A2.
2	Consider the lower end of BAT-AEL range first when setting ELVs. The burden of proof is on the operator to show why lower ELVs cannot be achieved.	Belgium (Flanders) provides examples of permits to illustrate how ELVs should be applied on a case-by-case basis and making use of the full range of BAT-AEL. Guidelines are used in the UK to support permitting authorities with identifying when the lower end of a BAT-AEL range is set when necessary to deliver adequate environmental protection. In Sweden, BPT gives legal weight to permitting authorities where ELVs are set in accordance with the lower end of the BAT-AEL range.	More detail on the Member State examples is presented in section 3.2.
3	Where a BAT-AEL is not provided in BATC for a polluting substance relevant to a specific installation, consider if this other polluting substance may be relevant to the entire sector (at Member State or regional level). For example, it may be that the BAT-AEL is not included in the BATC because there is a lack of representative data at the EU level, but the data are available locally.	Federal legislation is used in Austria, Germany and France to establish other polluting substances that require ELVs at sector level.	More detail on the Member State examples is presented in section 3.3.

Principles		Member State good practices	Reference information
4	Collaboration between operators, authorities and researchers can help identify other polluting substances (additional to those referred in Annex II) and/ or emerging substances through knowledge dissemination, research papers and guidance on emerging contaminants to competent authorities.	Collaboration between technical experts and the dissemination of research and studies (as reported by Austria, Belgium (Flanders), Bulgaria, Germany, Malta, Portugal, Romania and the UK). In Finland, installations are required to report to the authorities if they start using a new hazardous chemical.	A summary of water pollutants most commonly regulated under the IED, and associated source sectors is presented in Table 3-2. Member State analyses of pressures and impacts in river basins, the surface water watch list mechanism under the EQSD and the voluntary watch list mechanism under the Groundwater Directive, may also provide useful references for identifying relevant polluting substances.
5	Refer to existing examples to identify relevant additional parameters to supplement ELVs.	Ecotoxicity tests or total effluent assessments can be set in permit conditions to regulate releases of polluting substances more generally (e.g. Germany). Parameters for temperature can be used to regulate impacts on ecosystems (Sweden). In Finland, the use of daily average values can be used when setting ELVs to address uncertainties from emission measurements.	More detail on the Member State examples is presented in section 3.4. See presentation on using daily average values when setting ELVs in Finland.[22]
6	Implement the combined approach to setting ELVs in permit conditions and ensuring EQS are not breached in receiving water bodies can pre-empt any risk to water quality. This can entail:	Austrian, Croatian, German and Portuguese permitting authorities take a combined approach. Analysis of the mass balance of contaminants in industrial waste water and the receiving water mass conditions is used in Spain to determine the impact of industrial waste water on water quality.	More detail on the Member State examples is presented in section 3.5. See presentation of taking a combined approach in Portugal with reference to IMPEL guidance

[22] Forsius, K. (2020) Finnish approach to applying short terms ELVs and requirements on substances harmful to the aquatic environment. Webinar on permitting industrial waste water, Study supporting IED implementation, 15 January 2020.

Principles		Member State good practices	Reference information
	• If the EQS are already breached, then the ELV can be set to lower than the lowest range of the BAT-AEL. • Avoiding all industrial waste water to a waterbody if it jeopardises compliance with EQS. • Applying the EQS as ELVs • Evaluating all known sources of input of the substance to the water body.		to permitting according to both the WFD and IPPCD[23].
Managing indirect discharges via offsite waste water treatment plant			
7	Assess whether the external WWTP has the necessary techniques to address the industrial effluent.	In Bulgaria, WWTPs have an obligation to monitor incoming waste water load and only sign contracts with industries for which suitable technologies are available. Guidance and training to operators and permitting authorities can help with the process of setting ELVs. In France, industrial installations are required to perform a study to establish whether the WWTP can provide adequate treatment, and ELVs are set on the basis of this. In the UK, reduction factors provided by the permitting authority are used to calculate the impact of the WWTP when setting ELVs for indirect discharges.	A summary of the most common techniques applied in UWWTPs and their pollutant removal efficiencies is presented in Table 3-3. A summary of challenging water pollutants by source sector is presented in Table 3-4.
8	On a case-by-case basis, consider whether pre-treatment is needed onsite first to abate those substances that are not specifically treated by the UWWTP/ IOWWTP e.g. heavy metals, AOX, halogenates and polyfluorinated compounds.	In Czechia, France, Spain, Portugal and Luxembourg, waste water pre-treatment may be required onsite to abate specific substances identified in the permitting process.	Refer to BAT 11 of the CWW BATC to identify when pre-treatment is needed. Examples of contracts are included in case studies presented in Box 3-1, Box 3-2, Box 3-3 and Box 3-4.

[23] Rebelo, A. (2020) Emission limit values for emissions to water in IED permits. Webinar on permitting industrial waste water, Study supporting IED implementation, 15 January 2020.

Principles		Member State good practices	Reference information
9	Where the main pollutant load originates from activities covered by the BATC but is transferred to IOWWTP, the permit for IOWWTP could consider implementing BAT.	The WZI Olen in Antwerp, Belgium is an IOWWTP that deals with waste water generated in the slaughterhouses sector, specifically from chicken abattoirs. To minimise the impact from industrial waste water from the installations in question, the UWWTP implemented BAT specified in the sector specific BATC.	
Mixed streams			
10	Where mixed streams occur with a low risk to human health or the environment, or where a separate approach is technically not feasible, a mixing rule can be applied to establish a combined ELV.	Setting the ELV before mixing is general practice in Spain and Norway The methodology for using a mixing rule is defined in the waste water ordinances of Austria, Slovakia and Germany.	A formula for calculating mixed streams is presented in Box 3-5. A worked exampled for this formula is presented in Box 3-6 (as regards the calculation of the combined ELV applied to permits in Austria)
11	Where mixed streams occur, and a combined ELV is set, the permit may include ELVs for both load and concentration .	Both emission loads and concentration are set in permit conditions in Austria, Finland, Norway, Sweden and Germany.	See section 3.7 for list of contextual information needed.
12	To identify the opportunities and the risks of synergistic effects, a risk evaluation of the emissions and their combined effect should be conducted by the discharger.	Companies must perform risk evaluation of the emissions (Norway).	See section 3.7 for example of negative synergistic effects.

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Appendices

A1 Questionnaire: Permitting wastewater discharges from industrial installations

General approach to setting ELVs for water discharges

1. Are ELVs for emissions to water set for any additional polluting substances compared to those listed in Annex II to the IED (in accordance with Article 14(1)(a) of the IED) and included in relevant BATC? If yes, state the substance(s) and related IED activity(ies). If available, provide details for why these substances are regulated, and include references to any supporting documents (e.g. studies, permits).

2. When setting ELVs for emissions to water, are equivalent parameters or technical measures ensuring an equivalent level of environmental protection applied (IED Article 14(2))? If yes, describe the conditions.

3. Have there been any specific examples in your Member State where ELVs for emissions to water were set in a permit in the absence of BATC? Provide details for the approach taken and the circumstances in which the example occurred.

4. Annex II to the IED includes substances listed in Annex X to WFD. Environmental quality standards for these substances are established by Directive (2008/105/EC)24. How are ELVs set if a water EQS is being breached?

5. Is there a process in place to ensure new polluting substances / emerging environmental issues are captured within the permitting process? If yes, please describe.

6. According to Article 15(1) of the IED, 'ELVs for polluting substances shall apply at the point where the emissions leave the installation, and any dilution prior to that point shall be disregarded when determining those values.' Are there cases in your Member State where ELVs are not set at the point where the emissions leave the installation? What is the justification for this approach?

[24] Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:02008L0105-20130913

7. What guidance is available to permitting authorities on how the ELVs should be set for emissions to water? Please provide copies or links to the relevant documents.

8. Under Article 1(c) of the WFD, 'pollution through the discharge, emission or loss of priority hazardous substances must cease or be phased out.'

a. Can you provide examples where application of BATC and setting ELVs in permits has led to a conflict with this ambition?

b. Can you provide examples where application of BATC and setting ELVs in permits has contributed to this ambition?

Permitting in case of mixed waste water streams

9. How are ELVs set in cases where waste water streams from individual processes and/or multiple installations are combined before discharge to the environment?

10. Is there a defined set of rules or specific method to calculate the level at which ELVs should be set with respect to such mixed streams? Please describe and/or provide links to the relevant documents.

11. Can you provide examples of such calculations being performed (either in a permit decision or as a standalone document), that could be then presented in the final study report as part of sharing Member State practices?

12. How is dilution avoided? Is dilution a relevant factor taken into account during permitting and monitoring of emissions (e.g. are emission loads in kg pollutant/day used together with, or instead of concentrations in pollutant/m^3)?

13. Are synergistic effects of substances from individual streams being combined into a single stream considered in permitting (i.e. where a combined effect is larger than would be expected from substances being released to the environment in isolation)? If so, how and for what substances?

Permitting in case of wastewater treatment off-site (indirect discharges)

14. Where discharges to water are treated off-site (e.g. released to sewer and treated in an urban wastewater treatment plant or an independent wastewater treatment plant (WWTP)), what precautions are taken to ensure that wastewater treatment is adequate?

a. How do you identify substances in industrial wastewater which are not removed by external WWTPs?

b. How do you determine the effectiveness of external WWTP removal of a given substance?

c. How do you ensure that the overall load of pollutant to the environment is no greater than if onsite treatment was applied?

15. Are there examples of off-site WWTP adapting their type and/or level of treatment in order to adequately remove substances present in industrial waste water?

A2 BAT-AELs for direct and indirect releases

Summary of BATs providing BAT-AELs for direct and indirect releases per pollutant and sector

Pollutant	BATs	Direct/Indirect
Adsorbable organically bound halogens (AOX)	BAT 20 (WT), BAT 10 (CWW), BAT 19, 45, 50 (PP)	Direct and indirect discharge to receiving water bodies (WT) Direct discharge to receiving water body for all other sectors
Arsenic (expressed as As)	BAT 13 (GLS); BAT 17 (NFM); BAT 20 (WT); BAT 15 (LCP)	Direct and indirect discharge to receiving water bodies (WT) Direct discharge to receiving water body for all other sectors
Ammonia	BAT 13 (GLS)	Direct discharges to receiving water bodies
Barium	BAT 13 (GLS)	Direct discharges to receiving water bodies
Benzene	BAT 12 (REF)	Direct discharges to receiving water bodies
Biological oxygen demand for 5 days (BOD5)	BAT 56 (IS); BAT 10 (TAN)	Pre-treatment (IS) Direct waste water discharges from tanneries or independently operated WWTPs (TAN)
Boron	BAT 13 (GLS)	Direct discharges to receiving surface water bodies
Cadmium	BAT 13 (GLS); BAT 17 (NFM); BAT 15 (LCP) ; BAT 20 (WT); BAT 12 (REF) ; BAT 80 (LVOC)	Direct and indirect discharge to receiving water bodies (WT) Direct discharge to receiving water body for all other sectors
Cobalt	BAT 17 (NFM)	Direct discharges to receiving water bodies
Chemical oxygen demand (COD)	BAT 15 (LCP); BAT 20 (WT); BAT 3, 4, 10, 11, 12 (CWW); BAT 13 (GLS); BAT 28, 39, 56 (IS); BAT 19 ,33, 40, 45, 50 (PP); BAT 12 (REF); BAT 10 (TAN); BAT 27 (WBP)	Pre-treatment and direct discharges (IS) Direct waste water discharges to receiving water body for all other sectors
Chlorine	BAT 13 (CAK)	Direct discharges to receiving water bodies
Chromium (expressed as Cr)	BAT 15 (LCP); BAT 20 (WT); BAT 3,4 (CWW); BAT 17 (NFM); BAT 13 (GLS); BAT 81, 92 (IS); BAT 10, 11, 12 (TAN)	Direct and indirect discharge to receiving water bodies (WT) Direct waste water discharges to receiving water body for all other sectors
Cyanide	BAT 56, 67 (IS), BAT 20 (WT)	Pre-treatment and direct discharge to receiving water bodies (IS) Direct and indirect discharge to receiving water bodies (WT)
Copper (Cu)	BAT 15 (LCP); BAT 20 (WT); BAT 3, 4 (CWW); BAT 13 (GLS); BAT 80 (LVOC)	Direct and indirect discharge to receiving water bodies (WT) Direct discharge to receiving water body for all other sectors
Hydrocarbon oil index	BAT 12 (REF), BAT 20 (WT)	Direct and indirect discharge to receiving water bodies (WT) Direct discharge to receiving water body (REF)
Lead (expressed as Pb)	BAT 15 (LCP); BAT 67 (IS); BAT 13 (GLS); BAT 17 (NFM); BAT 20 (WT); BAT12 (REF)	Direct and indirect discharge to receiving water bodies (WT) Direct discharge to receiving water body for all other sectors
Mercury (expressed as Hg)	BAT 15 (LCP); BAT 17 (NFM); BAT 20 (WT); BAT 12 (REF)	Direct and indirect discharge to receiving water bodies (WT)

Pollutant	BATs	Direct/Indirect
		Direct discharge to receiving water body for all other sectors
Nickel (expressed as Ni)	BAT 15 (LCP); BAT 20 (WT); BAT 10 (CWW); BAT 17 (NFM); BAT 13 (GLS); BAT 81, 92 (IS); BAT 12 (REF)	Direct and indirect discharge to receiving water bodies (WT) Direct discharge to receiving water body for all other sectors
Phenols	BAT 56(IS), BAT 13 (GLS), BAT 20 (WT)	Pre-treated waste water from coking process and coke oven gas cleaning (IS) Direct discharge to receiving water body for all other sectors
Polycyclic aromatic hydrocarbons (PAH)	BAT 56 (IS)	Pre-treatment and discharge to receiving water bodies
Sulphides	BAT 10, 12 (TAN), BAT 15 (LCP), BAT 56 (IS),	Direct and indirect waste water discharges to receiving water bodies (TAN) Direct discharges to receiving water bodies (LCP) Pre-treatment and discharge to receiving water bodies (IS)
Total N (including inorganic nitrogen)	BAT 10 (CWW); BAT 12 (REF); BAT 19, 33, 40, 45, 50 (PP); BAT 7, 20 (WT), BAT 10 (TAN)	Direct discharge to receiving water body for all sectors
Total organic carbon (TOC)	BAT 15 (LCP); BAT 10 (CWW); BAT 20 (WT)	Direct discharge to receiving water body for all sectors
Total P	BAT 10 (CWW); BAT 19, 33, 40, 45, 50 (PP); BAT 20 (WT)	Direct discharge to receiving water body for all sectors
Total suspended solids (TSS)	BAT 5, 15 (LCP); BAT 7, 20 (WT); BAT 10 (CWW); BAT 13 (GLS); BAT 19, 33, 40, 45, 50 (PP); BAT 12 (REF); BAT 25, 27 (WBP)	Direct discharge to receiving water body for all sectors
Zinc (expressed as Zn)	BAT 20 (WT); BAT 10 (CWW); BAT 13 (GLS); BAT 67, 81, 92 (IS); BAT 17 (NFM)	Direct and indirect discharge to receiving water bodies (WT) Direct discharge to receiving water body for all other sectors

Source: EC (2019)

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