# Proposal for a simplified method for the

# quantification of emissions to water

***Draft version 5thMarch 2020***

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### List of abbreviations

AR Activity Rate

CIS Common Implementation Strategy

EC European Commission

EEA European Environmental Agency

EF Emission Factor

E-PRTR European Pollutant, Release and Transfer Regulation

ETC/ICM European Topic Centre for Inland, Coastal and Marine Waters

EU European Union

EQS Environmental Quality Standards

ICPR International Commission for the Protection of the Rhine

IWWTP Industrial Waste Water Treatment Plant

MS EU Member States

OECD Organisation for Economic Cooperation and Development

PAH Polycyclic Aromatic Hydrocarbons

p.e. population equivalent

PHS Priority Hazardous Substances

PS Priority Substances

RBD River Basin District

RBDSU River Basin District Sub-Unit

RBMP River Basin Management Plan

RBSP River Basin Specific Pollutant

TGD Technical Guidance Document

UWWTD Urban Waste Water Treatment Directive

UWWTP Urban Waste Water Treatment Plant

WFD Water Framework Directive

WG Working Group

WISE-SoE Water Information System Europe – State of the Environment

## Summary

Under the Water Framework Directive, Member States are required to report an inventory of emissions, discharges and losses of priority substances. Such information can give information on the success of measures to reduce emissions and indicate whether further efforts may be needed to deliver good chemical status. However, reporting of the inventory under the second river basin management plans was patchy and incomparable between Member States. While there is a Technical Guidance Document on the preparation of the inventory[[1]](#footnote-1), it appears that further information is needed to help Member States report in a consistent and comparable way. This paper aims to provide steps towards that, to enable improved quality of reporting in the third river basin management plans. A simplified method for the quantification of emissions to water is proposed, which will be used as a basis for discussion at the Water Framework Directive[[2]](#footnote-2) (WFD) Working Group Chemicals sub-group meeting on emissions, to be held in April 2020.

This activity is carried out by the European Topic Centre for Inland, Coastal and Marine Waters (ETC/ICM) for the European Environment Agency (EEA).

## Introduction

Several projects related to emissions to water, carried out in recent years for the European Commission[[3]](#footnote-3) (EC) and the EEA[[4]](#footnote-4),[[5]](#footnote-5),[[6]](#footnote-6),[[7]](#footnote-7), show serious problems regarding consistency, completeness and quality of the EU reported emission data. More specific, the EEA reports have shown:

* very little reporting on diffuse sources;
* limited (incomplete) reporting on urban wastewater treatment plant (UWWTP) effluents (not all UWWTPs, not all relevant pollutants);
* unclear quality of emission data of industrial sources (not all facilities, not all relevant pollutants);
* inconsistent reporting in time and space (no comparable and consistent time ranges and not all river basin districts reported);
* some double reporting or reporting gaps between the most important EU emission reporting requirements: WFD, E-PRTR[[8]](#footnote-8), Water Information System Europe – State of the Environment[[9]](#footnote-9) (WISE-SoE) and the Urban Waste Water Treatment Directive[[10]](#footnote-10) (UWWTD).

As a consequence of this, regarding the EU reported emission data (but not limited to the EU: these problems are recognized also on a global scale, see recent OECD[[11]](#footnote-11) and World Bank[[12]](#footnote-12) publications), there is:

* no EU wide overview of relevant emission sources/pollutants;
* no consistent time series, so no idea of trends;
* limited insight in the effects of emission reduction measures carried out in the past;
* no clear relation between emissions and water quality;
* no insight which future measures are needed to meet the water quality targets;
* extra effort for EEA and others in evaluation reports and comparison of different datasets.

### Aim of the work

The aim of the work is to support MS with the WFD reporting on emissions to water for the 3rd cycle of the River Basin Management Plans (RBMPs), to be published by the MS on December 22nd, 2021. Although a Technical Guidance Document was developed for the WFD inventory, reporting in 2016 showed only a few MS succeeded in reporting on diffuse sources and for more than a few pollutants – as summarized in the EEA chemicals report 18/2018. A conclusion might be that more support is needed to improve the emission reporting by the MS. This proposal is intended as supplementary advice, not to replace the existing TGD.

The idea behind the proposal is that available information, data and methods used for emission inventories by some MS or stakeholders can be used by MS with limited data or limited capacity to develop quantification methods. For MS already reporting diffuse emissions, it is intended that the project provides an opportunity to benchmark emission factors and quantification methods used with others. Use of (parts of) the proposed method or the data is intended to be optional.

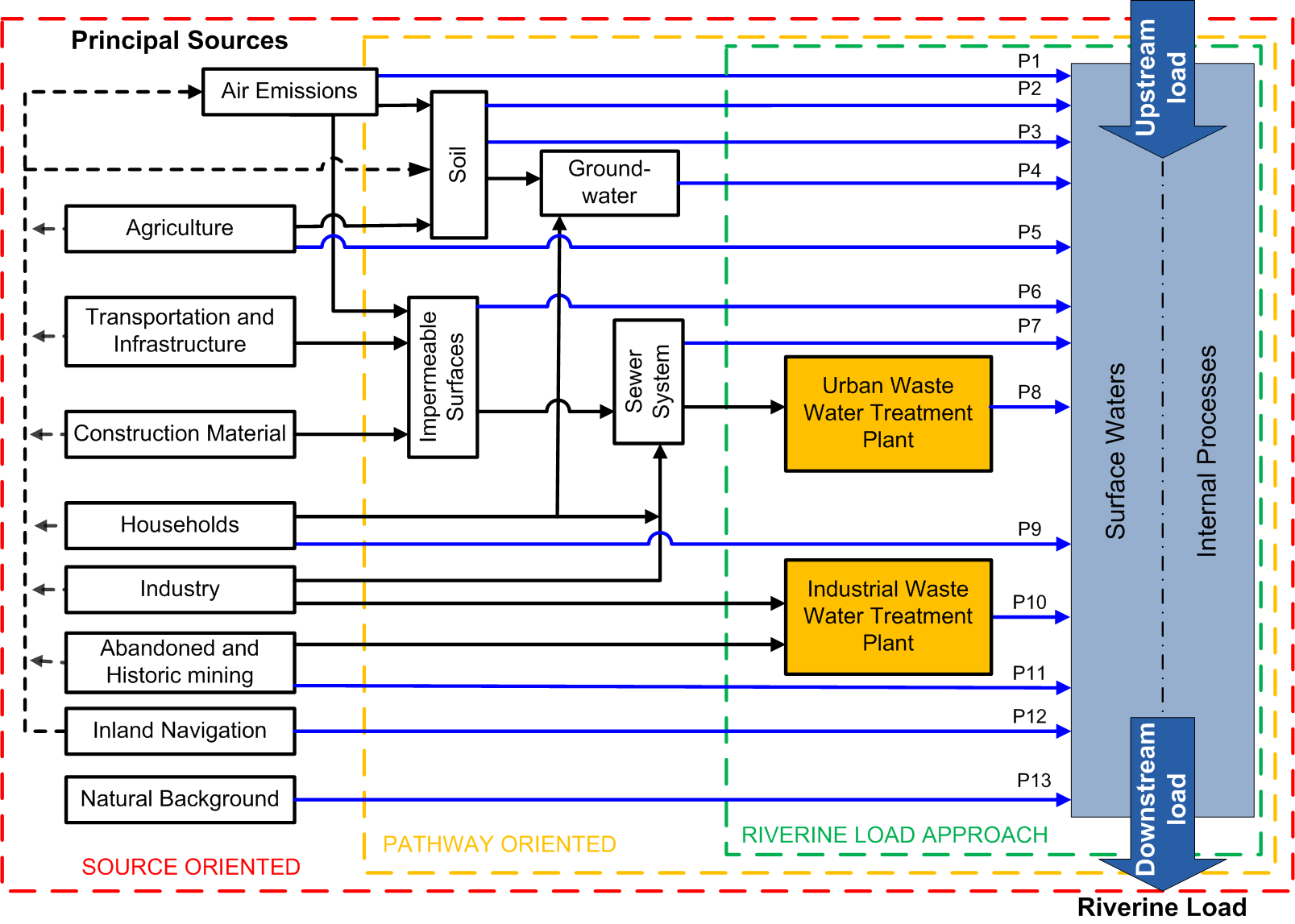
This proposal must be seen as an attempt to make a step forward in the quality i.e. completeness, consistency and transparency, of the WFD reporting of emissions to water. The proposal may also contribute to the harmonization of the methods used for the quantification of emissions to water and in that way improve the EU wide comparability of the reported emission data.

The proposed method has been deliberately designed to be as simple as possible. It is still an incomplete version: not all the details have been fully worked out. A number of discussion points (to add more details to the method, to set other priorities, etc.) is included. It is not intended that simple methods override more detailed approaches already being used by MS: rather, the proposal is targeted towards those MS which currently lack data and or methods.

## Simplified method for the quantification of emissions to water

### General scheme

A general scheme in which the main principal sources, pathways and intermediates of emissions to water are represented was developed under the WFD Common Implementation Strategy[[13]](#footnote-13) (see Figure 1 below).

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|  |  |
| --- | --- |
| P1 Atmospheric Deposition directly to surface water | P8 Urban Waste Water treated |
| P2 Erosion | P9 Individual - treated and untreated- household discharges |
| P3 Surface runoff from unsealed areas | P10 Industrial Waste Water treated |
| P4 Interflow, Tile Drainage and Groundwater | P11 Direct Discharges from Mining |
| P5 Direct discharges and drifting | P12 Direct Discharges from Navigation |
| P6 Surface Runoff from sealed Areas | P13 Natural Background |
| P7 Storm Water Outlets and Combined Sewer overflows + unconnected sewers | |

#### *Figure 1 Relationship between the different surface water compartments and pathways (P1-P13) (EC, 2012)*

On the left in the scheme, the principal sources of the pollutants are shown, representing groups of sources which can be related to economic sectors or activities. The natural background is also represented as a source. Emissions, discharges or loads can follow different pathways, either directly to surface water, or to other compartments of the environment (air, soil, groundwater). A specific place is given to urban areas with the impermeable surfaces, the sewer system and the waste water treatment plants, both urban (UWWTPs) and industrial (IWWTPs).

Although different approaches are shown in the scheme (riverine load approach, source oriented approach and pathway oriented approach), the quantification of the different pathways (P1-P13) can be seen as the core of a complete emission inventory. Most of the existing emission reporting requirements can be related to one or more of these defined pathways. Therefore, this proposal will focus on the quantification of the pathways P1-P13.

**Discussion point 1**: Although the riverine load approach is more simple than the pathway approach (and is, of course, better than no inventory at all), it is not chosen as preferred method in this proposal, mainly because it doesn’t give insight in the different sources behind the pathways. As a result, it would not be easy to make a connection with possible mitigation measures.

**Discussion point 2**: It is interesting to have information on the primary sources (use of products, processes) within households and small and medium enterprises (SME’s) which end up in the sewer and the UWWTP’s, but this rather complicated exercise is something likely to be more appropriate in more advanced stages of emission inventories.

### Simplified emission factor method

It is proposed to use a simplified emission factor method as developed in the International Commission for the Protection of the Rhine (ICPR), using a limited number of emission factors and statistical data. This method has been described, including the data used, in Water, Science and Technology, 2001[[14]](#footnote-14). The method has been applied for 7 heavy metals for the Rhine catchment. The estimated loads sufﬁciently agreed with the loads of the river Rhine, as measured at the Dutch-German border.

This emission factor method has also been the basis for the EC project: *Diffuse water emissions in E-PRTR*[[15]](#footnote-15). In this project diffuse emissions to water have been quantified for a selection of 40 key sources – key substance combinations, covering the EU Member States and the EFTA countries on a River Basin District sub-unit scale. The report and maps are available on the E-PRTR website[[16]](#footnote-16). A good explanation of emission factors used in emission inventories can be found in a publication of TNO: *The Art of Emission Inventorying*[[17]](#footnote-17). Although this publication is related to air emission, a lot of the problems and solutions are also recognized in emissions to water inventories.

Emissions of a pollutant for an activity are calculated by multiplying an activity rate (ARa) for a specific activity (or pathway) by an emission factor for this activity and a certain pollutant (EFp,a), expressed in emission per AR unit. An example for an activity is the production of urban waste water. The AR will then be the number of inhabitants producing waste water. The EF for a pollutant, e.g. total-Nitrogen, will then be the yearly load total-Nitrogen in urban waste water per inhabitant.

The calculation method is shown in the formula below:

*Ep,a* = *ARa x EFp,a*

Where:

*Ep,a = Emission of a pollutant for an activity*

*ARa = Activity Rate for an activity*

*EFp,a = Emission factor of a pollutant for an activity*

The emission calculated in in this way is referred to as the total emission. For an activity where all emissions are released directly into surface waters (e.g. P12 Inland Navigation), the total emission equals the net emission to surface waters. When only a part of the calculated emissions ends up in the surface water, and the other part for example in soil, an extra factor needs to be introduced which describes the percentage of the emissions to surface water.

Not all the pathways can be covered with the simplified emission factor method. Some pathways are too complex to be described with only an AR and an EF. For those pathways (e.g. P1 and P3) models are often used. Some models used by MS for the quantification of emissions to water are: MONERIS[[18]](#footnote-18), MoRE[[19]](#footnote-19), WEISS[[20]](#footnote-20) and Pegase[[21]](#footnote-21). Different models may use different definitions of pathways, combine pathways or split up pathways in relevant sub pathways. All these models make use in a way of emission factors. When EU-wide models are known for specific pathways and quantified emissions are available, these models are mentioned in this paper.

### Activity Rates (AR)

It is proposed for the AR’s to make use of freely-available statistical data, which are updated on a regular basis (e.g. the Eurostat Database[[22]](#footnote-22)). This will facilitate the regular updating of the emission inventory and limit the overall burden of emissions reporting. Examples of an activity rate are: inhabitant, population equivalent (p.e.), amount of km driven by cars. In an ideal situation, the chosen AR is as close to the real polluting activity or process as possible (e.g. km driven by cars).

In some cases appropriate data for the ideal AR are not available. In other cases, the available data sets might contain gaps for specific areas or time periods. In such cases application of a so-called proxy variable can help to derive at least a rough estimate of the AR. A proxy variable is a variable that is not directly related to the data that are needed but might have a good correlation with such data. Such proxy data could be the population size or gross domestic product or other high-level indicators of the size and the economic activities in a country. When using a proxy, one has to assume or derive a relationship between the value of the data searched for and the value of the proxy in countries or years where data are available. The estimates for the gaps then follow from the application of this relationship (adapted text from TNO publication: *The Art of Emission Inventorying*).

### Emission Factors (EF)

Emission factors are related to a specific AR (and pathway) and are pollutant-specific.

An EF may vary in time and space, mainly as a result of:

* implementation of new technologies;
* implementation of mitigation measures (like banning or limiting specific products or uses);
* national or regional differences in the use of products or appliance of processes.

One of the big challenges for a simple emission inventory is to find an optimum between using general EFs whenever possible but differentiate if necessary.

### Spatial scale

The easiest way of using the simplified emission factor method is to apply it on a country level. This would already be a good start for the emission inventory. A lot of statistical data is available at a country level. At the other hand, in the TGD is described that certain pollutants do not need to be quantified and reported for the RBDs where no exceedance of the EQS is seen.

**Discussion point 3**: Would it be acceptable to focus as a first attempt the emission quantification on the country level and (for the moment) not detail the calculations to the level of River Basin District (RBD), or even River Basin District Sub-Unit (RBDSU)?

### Temporal scale

Most emission inventories aim to estimate the total mass of one or more emitted pollutants within one specified year. Therefor the quantified emissions will be expressed in mass units per year, corresponding to a specific year (not to be confused with the year in which the inventory is compiled and reported).

### Pollutants

The WFD inventory applies to a long list of priority substances and other pollutants (EQS Directive[[23]](#footnote-23), 2008 Article 5), which means that the inventory will have to address all inputs of those substances into the environment, irrespective of the compartment or pathway involved, that are likely to reach surface waters. Though, as a first step within this proposal, it might be necessary to prioritise the work on a smaller group of priority substances.

A recent overview of reported emission data by EEA[[24]](#footnote-24) (see Table 1 next page) shows the 17 pollutants most frequently causing failure to achieve good chemical status for the WFD. This Table also shows the limited number of MS reporting diffuse sources, with only about one third of MS reporting diffuse sources of metals. For other pollutants, even fewer MS manage to report.

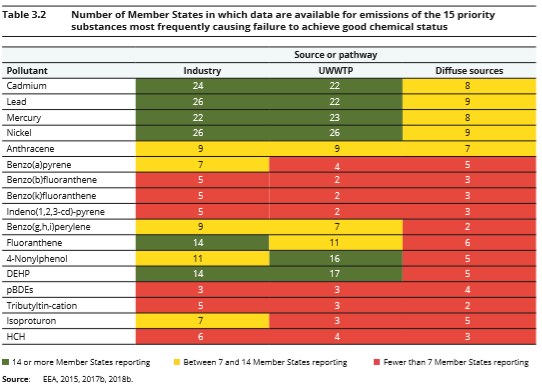


Table 1 From: EEA Report No 18/2018 Chemicals in European Waters: [https://www.eea.europa.eu/publications/chemicals-in-european-waters](https://www.eea.europa.eu/publications/chemicals-in-european-waters%20)

**Discussion point 4**: It will not be possible to achieve a complete overview of all relevant pollutants within this project. If we start trying to complete inventories for pollutants about which we should know a lot, learning from that process can be applied to those pollutants where emissions are less clear. Besides, it can be more encouraging to show a limited number of pollutants for which the inventory of all the (relevant) pathways is more or less complete, than a larger list of pollutants with a lot of missing pathways. We propose to focus on a subset of substances most frequently exceeding the EQS targets, supplemented with the most important (and well reported) ecological parameters total Nitrogen and total Phosphorus. This results in a preliminary list of 11 pollutants (see Table 2).

|  |
| --- |
| **Pollutant** |
| total - Nitrogen |
| total - Phosphorus |
| Cadmium |
| Lead |
| Mercury |
| Nickel |
| Anthracene |
| Benzo(a)pyrene |
| Benzo(g,h,i)perylene |
| Fluoranthene |
| DEHP |

Table 2 Proposed selection of pollutants

### Overview per pathway

In this paragraph, the 13 pathways and the accompanying activity rates and emission factors will be discussed briefly. A general remark is, there seems to be no clear definition of the different pathways in the TGD.

**Discussion point 5**: Would it be helpful to add a clear definition of the pathways in this proposal?

Table 3 (added as a separate spreadsheet) gives an overview of the relevant details and background information of the proposed methods for the different pathways. In the tab “*Formula*” the formulas for the calculation of the emissions are given, definitions of the ARs, the EFs and other factors used and the references to the data. In the tab “*EF*” the EFs are given per pathway for the selection of pollutants (as far as available).

For the selected pollutants, not all pathways seem to be relevant. For those pathways (P5 and P12) no quantification of emissions has been worked out in this proposal. For the other pathways not all the selected pollutants seem to be relevant. For those pathways a proposal is given, which pollutants are relevant and thus needed to be quantified. In Table 3, tab “*EF*” those pollutants are indicated with a green color. Pollutants proposed as not relevant are indicated with blue-grey color. When it is not quite clear in which of these two categories a pollutant fits, a yellow color is given.

**Discussion point 6**: Do MS and stakeholders agree with the deselection of P5 and P12 and for the current work to focus on the selected substances indicated relevant for the individual pathways in Table 3, tab “EF”?

### P1 Atmospheric Deposition directly to surface water

Atmospheric deposition can be described as the load of substances to surface water or soil via the atmosphere. Once emissions to air from sources (e.g. traffic, shipping, industries) have entered the atmosphere, the substances are distributed through the atmosphere and end up in the water and on the soil as a result of deposition in wet (precipitation) and dry form.

For the calculation of emissions EMEP modelling results can be used. For Total – Nitrogen, cadmium, lead, mercury and benzo(a)pyrene modelled fluxes are available for Europe on a 50x50 km level. The average calculated flux (mg/ha/year) per MS can be multiplied with the total area of inland surface water per MS.

For the other PAHs, no EMEP modelling results are available. Instead of these results, the ratio between BaP and the other PAH can be derived from the dry deposition measurements per country. The ratiofactor BaP/PAH could be used for the quantification of the deposition of the other PAHs. For all other substances, it might be checked if deposition measurements have been made by MS. If a flux (mg/ha) is available, it could be multiplied with the area of inland surface water.

**Discussion point 7**: Do MS have recent data on deposition monitoring that could be shared?

### P2 Erosion

Erosion causes a load to water, due to erosion of substances from the rocks in the subsoil or from (heavy) rainfall or wind which removes soil, rock or dissolved material and transports to the surface water.

The load of pollutants to surface water as a result of erosion might be calculated by multiplying the substance content of fine soil by the soil erosion (Eurostat) in tonnes/hectare.

**Discussion point 8**: Is more recent data available for the substance content of fine soil by the soil erosion than used in Table 3 and are there ideas about other quantification methods?

P3 Surface runoff from unsealed areas

The nutrient emissions are calculated by the JRC’s GREEN model. The GREEN (Geospatial Regression Equation for European Nutrient losses) is based on a simplified conceptual approach distinguishing the different pathways in which nutrients reach surface waters. For the surface runoff from unsealed areas diffuse sources, including fertiliser applications (both mineral and organic forms), scattered dwelling and atmospheric deposition could be considered.

For other substances no model is available. It mainly consists of surface runoff from agricultural and natural soils. In Mohaupt et al (2001) a simplified method is described to calculate the surface runoff. For the calculation, the mass of organic and mineral fertilizers (t/year) per country should be identified. The used mass per MS can be multiplied with the metal content of fertilizers (mg/kg). Factors as seepage, spray drift and runoff play a key role in the diffuse emissions to water.

**Discussion point 9**: Are there more recent data for the metal content of fertilisers? Would it be possible to use common factors for seepage, spray drift and runoff?

P4 Interflow, Tile Drainage and Groundwater

This pathway is about the leaching of substances from unsealed areas, whereas pathway P3 describes the runoff of the unsealed areas.

For the nutrients this pathway is covered in the JRC Green model. For the metals a method is described for the drainage in Mohaupt, 2001. The discharge of drained area per MS will be multiplied with the concentration in drainage water. Information about drained areas is available at Eurostat.

P5 Direct discharges and drifting

This pathway is especially important for pesticides. Since that group of pollutants is not enclosed in our selection, no quantification method is described in this proposal.

P6 Surface Runoff from sealed Areas

This pathway describes the loads that end up in the surface water through surface runoff from sealed areas.  The part of the loads that goes to the sewer system (mainly in urban areas) is covered by the pathways P7 and P8. It is not easy to distinguish between these pathways and for now, there is no methodology available to quantify this pathway.

**Discussion point 10**: Is this a pathway with significant contribution to surface water? Do MS use this pathway in their models?

P7 Storm Water Outlets and Combined Sewer overflows + unconnected sewers

Storm water outlets

In this pathway, rainwater will be collected separately. To calculate loads for the storm water outlets information per MS is necessary about the paved urban area, precipitation per year, the percentage of the separate sewer systems and the percentage specific runoff. These factors will be multiplied with the measured concentration in storm sewer outflows.

Combined sewer overflows

If the sewer system can’t handle the large amount of precipitation, the combined sewers may overflow.

Unconnected sewers

Waste water in a collecting system is not connected to any treatment plant. The waste water will be discharged without treatment. Loads to surface water can be calculated by using the load entering an UWWTP for not connected UWWTPs in the Waterstat – UWWTD database. The total load per MS will be calculated with measured concentration in sewer and treatment plants overflows.

P8 Urban Waste Water treated

For UWWTPs with a capacity above 100,000 p.e. this pathway should be covered under E-PRTR reported loads.

**Discussion point 11**: EEA is considering supporting the coming WFD reporting by providing E-PRTR data at RBD level already reported by MS (see also P10). Would that be helpful to the MS?

However, evidence [[25]](#footnote-25),[[26]](#footnote-26) shows that many pollutants are not reported by certain countries or not reported for specific facilities, although releases above the pollutant thresholds would be expected, owing to the size of the UWWTP. In these situations, emission factors (based on reported E-PRTR data) can be used to quantify pollutant releases from UWWTPs not reported under E-PRTR but above the capacity threshold of 100,000 p.e and above the E-PRTR pollutant threshold.

Besides, a recent study[[27]](#footnote-27) shows that the total sum of all UWWTPs below the E-PRTR reporting threshold may contribute in a significant way to the total loads from all UWWTPs. Also, these loads of pollutants from UWWTPs below the capacity threshold of 100,000 p.e. can be quantified using the same EFs as mentioned above.

**Discussion point 12**: The emission factors[[28]](#footnote-28) used in Table 3 can be compared with information from recent UBA publication on UWWTP monitoring. Also, other MS might have useful recent data on this subject.

P9 Individual - treated and untreated- household discharges

This source contains the discharges of domestic wastewater, not connect to a sewer system. The wastewater loads will reach the surface water directly, will infiltrate in the soil or will be collected and treated in e.g. septic tanks.

For the untreated households, the number of ‘untreated’ inhabitants per MS is multiplied with the emission per inhabitant per year. For the treated households the number of ‘treated’ inhabitants is used with a removal efficiency for the septic tank in which the wastewater is collected. The last step is to estimate the load to surface water and to soil, no figures seems to be available. The ratio of surface water to soil may be used in a MS instead.

P10 Industrial Waste Water treated

This pathway is already covered by the E-PRTR reported loads. In theory, all emissions to water are reported on a yearly basis by the MS under 3 conditions:

* they fall under the activities selected for reporting in the E-PRTR;
* they are released from activities with capacities above the capacity thresholds mentioned in the E-PRTR and
* the loads are above the pollutant thresholds mentioned in the E-PRTR.

**Discussion point 13**: EEA is considering supporting the coming WFD reporting by providing E-PRTR data at RBD level already reported by MS (see also P8). Would that be helpful to the MS?

It is very difficult to check if the reported loads are complete. There are indications some pollutants might be under-reported by certain sectors. A comparison has been made between the expected pollutants per activity in the E-PRTR Guidance document and eleven most reported pollutants[[29]](#footnote-29). It shows a number of activity-pollutant combinations for which no loads are reported but might be expected to be reported according the Guidance document. E.g. the PAHs are reported only to a very limited extent, which could be a signal of underreporting. The use of emission factors to quantify these releases instead of, or in combination with, regular monitoring could be considered.

**Discussion point 14**: Would it be useful to carry out an analysis, together with the sector on a selected number of industrial activities for which facilities and/or pollutants seem to be missing? A recent EEA publication on industrial waste water[[30]](#footnote-30) and stakeholder data might be useful in such an action.

P11 Direct Discharges from Mining

Only historical mining sites are part of this pathway. Operational mining sites have to be reported under E-PRTR (P10). At the moment it is not clear yet how to quantify emission from abandoned mining sites.

**Discussion point** **15**: Would it be useful to carry out a literature or stakeholder check for emission data from mining sites. Do MS or stakeholders have data on this pathway or ideas for quantification methods?

P12 Direct Discharges from Navigation

In the general scheme (see Figure 1), only inland navigation is mentioned as primary source. Also, sea shipping should be included here, since this will be an important activity in specific WFD transitional and coastal waterbodies. Navigation might be a relevant source for PAHs.

**Discussion point 16:** Do we have to include inland navigation for PAH emissions and is there any data available?

P13 Natural Background

This will be a relevant pathway, at least in some areas, for metals, total Nitrogen and total Phosphorus. In Mohaupt et al (2001) the loads from natural background are calculated as the difference of the loads in the river discharge of a RBD and the known anthropogenic loads (sum of industrial and communal discharges, drainwater and stormwater overflows).

**Discussion point 17**: Do MS or stakeholders have suggestions for an improved method for quantification?

## Follow-up

This draft paper will be input for the workshop coming April. At the workshop it will be discussed how to proceed with the paper and other possible follow-up activities.

**ANNEX 1**

**Reviewer Comments**

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6 April 2020

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**General Comments**:

The overall framework of describing annual emissions into surface waters in terms of Activity Rates (ARs) that are based on freely available statistics or proxy values, and Emissions Factors (EFs) that are determined from analyses of previously collected data and/or model results is reasonable. The challenges implicit in this approach are defining appropriate EFs and other factors (e.g., percent of manure and fertilizer in surface runoff from unsealed areas) that affect the loading to surface waters. The identification of riverine loadings in 13 categories (Figure 1), the choice of annual loadings and the focus on 11 pollutants seem appropriate for this study. A brief description of the 13 source categories along with a few specific comments on each (where appropriate) is provided below:

P1: Atmospheric Deposition

1. Source loadings = total area of inland waters (km2) × average calculated flux from EMEP model results (mg/ha/yr)
2. Average calculated fluxes are determined on a country-specific basis for TN, Cd, Pb, Hg, B(a)P. Recommendation for other PAHs is to scale their atmospheric fluxes to B(a)P based on country-specific data.
3. **Comment**: On the ‘Formula’ worksheet, the EFs for P1 are given in different units (kg/ha, kg/a, mg/m2/a). The authors should provide EFs for P1 as either mass/area/time or mass/area if the annual time scale is implied.
4. **Comment**: TP and Ni need to be considered.

P2: Erosion

1. Source loadings = Soil erosion from EUROSTAT (tonnes/ha) × substance content in fine soil (mg/kg)
2. **Comment:** Since the substance content of the soil is likely to be a function of the chemical extraction protocol, guidance should be provided on the soil extraction procedure.

P3: Surface Water Runoff from Unsealed Areas

1. For TN and TP, use JRC’s GREEN (Geospatial Regression Equation for European Natural) losses.
2. For metals, Source loadings = Manure application (tonnes/yr?) × Mean metal content (mg/kg) × Farmland seepage and spraydrift (%) × Manure and fertilizer via runoff (%).
3. Values for farmland seepage and spraydrift (%) are taken directly from Mohaupt et al. (2001) based on studies from the early 1990s. I did not see any references in Mohaupt et al. (2001) for the manure and fertilizer via runoff percentages used in their studies.
4. **Comment**: In addition to substance content data (Discussion point 8), the authors should also consider the availability of more recent data on farmland seepage and spraydrift (%) and manure and fertilizer via runoff (%).

P4: Interflow, Tile Drainage and Groundwater

1. This category focuses on leaching of substances from unsealed areas through groundwater.
2. For TN and TP, use JRC’s GREEN (Geospatial Regression Equation for European Natural) losses.
3. For metals, Source loadings = Manure application (tonnes/yr?) × Mean metal content (mg/kg)
4. **Comment**: There is no consideration of retention of any of the substances (TN, TP, metals, PAHs) by soil during groundwater transport. The 2012 ETAP IOC on ‘multi‐compartmental fate of metals’ was focused on this particular issue. The inclusion of a percent removal in the groundwater compartment should be included in the calculation. We should review the 2012 ETAP IOC on ‘multi-compartment fate of metals’ for possible approaches.

P5: Direct Discharges and Drifting

1. No quantification method for TN, TP and metals are provided.

P6: Surface Runoff from Sealed Area

1. No methodology is provided.
2. **Comment**: For Discussion Point 10, you could first collect information to determine if this pathway is important.

P7: Storm Water Outlets and CSOs + unconnected sewers

1. For storm water outlets: Source loadings = Paved urban area (km2) × Mean metal concentration (μg/L) × Precipitation (mm/yr) × area with separate sewers (%) × Specific runoff (%). [I am assuming this last term represents the percentage of the total rainfall that makes it to the storm water collection system.]
2. For CSOs: no method is provided.
3. **Comment**: Combined sewer overflows typically occur when the rainfall intensity exceeds a prescribed threshold (based on a design flow capacity for an UWWTP). One approach for estimating annual CSO flows would be to examine the rainfall data record and identify days or hours when the rainfall intensity exceeded some threshold level. The source loading could then be estimated from an Annual CSO flow (m3/yr) × Mean metal concentration (μg/L).
4. For unconnected sewers: Source loading = Load entering an UWWTPs (population equivalents) × Mean metal concentration in sewer and treatment plant overflows (ug/L).
5. **Comment**: The source loading formula (and units) for unconnected sewers does not make sense. If you are using population equivalents as the Activity Rate (AR), the Emissions rate (EF) should be given in a sewage-specific loading rate (e.g., in g/p.e./yr).

P8: Urban Waste Water Treated

1. For UWWTPS greater than 100 000 p.e.: Use E-PRTR reported loads.
2. For UWWPTs less than 100 000 p.e. and for UWWTPs greater than 100 000 p.e. but missing information: Source loading = Load entering the UWWTPs (p.e.) × Treatment-specific effluent load (g/p.e.). On the ‘EF’ tab, effluent loads are specified separately for primary, secondary and tertiary treatment.
3. **Comment**: For completeness, a row should be added for UWWTPS greater than 100 000 p.e. on the ‘Formula’ tab.
4. **Comment**: It may be appropriate to divided tertiary treatment into ‘Advanced N removal’ and ‘Advanced P removal.
5. **Comment**: We should compare the treatment-specific effluent loads (g/p.e.) on the ‘EF’ tab to values that we derived from information in the 2019 ETAP IOC on ‘metal removal in STPs’.

P9: Individual-treated and Untreated Household Discharges

1. For domestic waste water that is not connected to a sewer system: Source loading = inhabitants connected to IAS (inhabitants) × emissions per inhabitant (g/inhabitant/yr) × % Removal in septic tanks (taken as 50% for pollutants) × % of load to surface water (based on soil characteristics).
2. **Comment**: The emissions per inhabitant is specified as g/inhabitant/yr on the ‘Formula’ tab, but is reported as ‘μg/L’ on the ‘EF’ tab.
3. **Comment**: No references are given to support the % removal of pollutants in septic tanks.
4. **Comment**: Further work is needed on the % of load to surface waters.

P10: Industrial Waste Water Treated

1. Source loading from E-PRTR reported loads.
2. If information is not available through the E-PRTR reports, comparison have been made between expected pollutants per activity in the E-PRRT Guidance Document.
3. **Comment**: Need to make sure that detection limits are appropriately set for all contaminants based on potential accumulation of contaminants (e.g., hydrophobic contaminants) in surface waters, sediments and biota.

P11: Direct Discharges from Mining

1. Direct discharges from operational mining sites are reported under E-PRTR (P10).
2. It is not clear how to quantify emissions from abandoned mining sites.

P12: Direct Discharges from Navigation

1. Both inland and coastal navigation should be considered.

P13: Natural Background

1. Source loading = Yearly mean river discharge (106 m3/a) × Concentration in surface waters (μg/L).
2. **Comment**: The approach suggested for estimating background concentrations is based on Mohaupt et al. (2001); i.e., subtraction of expected concentrations from anthropogenic loads from measured concentrations in surface waters. This approach is likely to result in taking the difference between two large concentrations. Measurement of surface waters concentrations in un-impacted areas should be considered. We should review the 2019 ETAP IOC on ‘ambient background concentrations’.

**ANNEX 2**



1. *CIS WFD Guidance document No. 28 Preparation of Priority Substances Emission Inventory, EC 2012:* [*https://circabc.europa.eu/sd/a/6a3fb5a0-4dec-4fde-a69d-ac93dfbbadd/Guidance%20document%20n28.pdf*](https://circabc.europa.eu/sd/a/6a3fb5a0-4dec-4fde-a69d-ac93dfbbadd/Guidance%20document%20n28.pdf) [↑](#footnote-ref-1)
2. *Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, OJ, No. L 327, p. 1 ff.* [↑](#footnote-ref-2)
3. *Roovaart, J., et al., 2013a/b, Diffuse water emissions in E-PRTR, Report No 1205118-000-ZWS0016/18, Deltares, Netherlands* <https://circabc.europa.eu/sd/a/dd20cdae-c76a-49b1-bf75-675c15a454d4/Diffuse%20water%20emissions%20in%20E-PRTR%202013%20background%20document.pdf> [↑](#footnote-ref-3)
4. *Roovaart, J. van den et al., 2016, E-PRTR completeness checks – water, ETC/ICM Technical Paper, version November 2016.*  [↑](#footnote-ref-4)
5. *ETC/ICM Technical Report 3/2017 Emissions of pollutants to Europe’s waters:* [*http://icm.eionet.europa.eu/ETC\_Reports/EmissionsOfPollutantsToEuropeanWaters\_SourcesPathwaysAndTrends*](http://icm.eionet.europa.eu/ETC_Reports/EmissionsOfPollutantsToEuropeanWaters_SourcesPathwaysAndTrends) [↑](#footnote-ref-5)
6. *EEA Report No 18/2018 Chemicals in European Waters:* <https://www.eea.europa.eu/publications/chemicals-in-european-waters> [↑](#footnote-ref-6)
7. *EEA Report No 7/2018 European Waters, Assessment of status and pressures 2018:* [*https://www.eea.europa.eu/publications/state-of-water*](https://www.eea.europa.eu/publications/state-of-water) [↑](#footnote-ref-7)
8. *Regulation (EC) No. 166/2006 of the European Parliament and of the Council of 18 January 2006 concerning the establishment of a European Pollutant Release and Transfer Register and amending Council Directives 91/689/EEC and 96/61/EEC (Reg. (EC) No. 166/2006), OJ L 33, p. 1.*  [↑](#footnote-ref-8)
9. [*http://cdr.eionet.europa.eu/help/WISE\_SoE/wise1*](http://cdr.eionet.europa.eu/help/WISE_SoE/wise1) [↑](#footnote-ref-9)
10. [*https://ec.europa.eu/environment/water/water-urbanwaste/index\_en.html*](https://ec.europa.eu/environment/water/water-urbanwaste/index_en.html%20) [↑](#footnote-ref-10)
11. *Diffuse pollution, Degraded Waters, OECD 2017* [*https://www.oecd.org/environment/resources/Diffuse-Pollution-Degraded-Waters-Policy-Highlights.pdf*](https://www.oecd.org/environment/resources/Diffuse-Pollution-Degraded-Waters-Policy-Highlights.pdf) [↑](#footnote-ref-11)
12. *Damania, R. et al., Quality Unknown, The Invisible Water Crises, World Bank 2019* [*https://openknowledge.worldbank.org/handle/10986/32245*](https://openknowledge.worldbank.org/handle/10986/32245) [↑](#footnote-ref-12)
13. *CIS WFD Guidance document No. 28 Preparation of Priority Substances Emission Inventory, EC 2012:* [*https://circabc.europa.eu/sd/a/6a3fb5a0-4dec-4fde-a69d-ac93dfbbadd/Guidance%20document%20n28.pdf*](https://circabc.europa.eu/sd/a/6a3fb5a0-4dec-4fde-a69d-ac93dfbbadd/Guidance%20document%20n28.pdf) [↑](#footnote-ref-13)
14. *V. Mohaupt, U. Sieber, J. van den Roovaart, C.G. Verstappen, F. Langenfeld and M. Braun, Diffuse sources of heavy metals in the Rhine basin, 2001, Water Science and Technology* [↑](#footnote-ref-14)
15. *Roovaart, J., et al., 2013a/b, Diffuse water emissions in E-PRTR, Report No 1205118-000-ZWS0016/18, Deltares, Netherlands,* [*https://circabc.europa.eu/sd/a/dd20cdae-c76a-49b1-bf75-675c15a454d4/Diffuse%20water%20emissions%20in%20E-PRTR%202013%20background%20document.pdf*](https://circabc.europa.eu/sd/a/dd20cdae-c76a-49b1-bf75-675c15a454d4/Diffuse%20water%20emissions%20in%20E-PRTR%202013%20background%20document.pdf) [↑](#footnote-ref-15)
16. [*http://prtr.ec.europa.eu/*](http://prtr.ec.europa.eu/) [↑](#footnote-ref-16)
17. *Pulles, T. and D. Heslinga, The Art of Emission Inventorying, TNO:* [*https://webdosya.csb.gov.tr/db/necen/editordosya/file/NEC/CollectER\_Training/The\_Art\_of\_Emission\_Inventorying.pdf*](https://webdosya.csb.gov.tr/db/necen/editordosya/file/NEC/CollectER_Training/The_Art_of_Emission_Inventorying.pdf) [↑](#footnote-ref-17)
18. [*https://www.igb-berlin.de/en/moneris*](https://www.igb-berlin.de/en/moneris) [↑](#footnote-ref-18)
19. [*https://www.mdpi.com/2073-4441/9/4/239*](https://www.mdpi.com/2073-4441/9/4/239) [↑](#footnote-ref-19)
20. [*https://weiss.vmm.be/*](https://weiss.vmm.be/) [↑](#footnote-ref-20)
21. [*https://orbi.uliege.be/bitstream/2268/35224/1/Towards%20e\_envi\_ULG%20Aquapole%20Pegase%20paper\_2009-03-26\_vf.pdf*](https://orbi.uliege.be/bitstream/2268/35224/1/Towards%20e_envi_ULG%20Aquapole%20Pegase%20paper_2009-03-26_vf.pdf) [↑](#footnote-ref-21)
22. [*https://ec.europa.eu/eurostat/data/database*](https://ec.europa.eu/eurostat/data/database) [↑](#footnote-ref-22)
23. [*https://eur-lex.europa.eu/legal-content/EN/AUTO/?uri=celex:32008L0105*](https://eur-lex.europa.eu/legal-content/EN/AUTO/?uri=celex:32008L0105) [↑](#footnote-ref-23)
24. *EEA Report No 18/2018 Chemicals in European Waters:* [*https://www.eea.europa.eu/publications/chemicals-in-european-waters*](https://www.eea.europa.eu/publications/chemicals-in-european-waters) [↑](#footnote-ref-24)
25. *de Smet et al, E-PRTR data review methodology, 2018. E-PRTR data review methodology - Eionet - Europa* [*https://www.eionet.europa.eu/etcs/etc-atni/products/etc-atni-reports/eionet\_rep\_etcacm\_2018\_3\_e-prtr\_data\_rev\_methodology/@@download/file/EIONET\_Rep\_ETCACM\_2018\_3\_E-PRTR\_data\_rev\_meth.pdf*](https://www.eionet.europa.eu/etcs/etc-atni/products/etc-atni-reports/eionet_rep_etcacm_2018_3_e-prtr_data_rev_methodology/@@download/file/EIONET_Rep_ETCACM_2018_3_E-PRTR_data_rev_meth.pdf) [↑](#footnote-ref-25)
26. *Roovaart, J., et al., 2013a/b, Diffuse water emissions in E-PRTR, Report No 1205118-000-ZWS0016/18, Deltares, Netherlands* [*https://circabc.europa.eu/sd/a/dd20cdae-c76a-49b1-bf75-675c15a454d4/Diffuse%20water%20emissions%20in%20E-PRTR%202013%20background%20document.pdf*](https://circabc.europa.eu/sd/a/dd20cdae-c76a-49b1-bf75-675c15a454d4/Diffuse%20water%20emissions%20in%20E-PRTR%202013%20background%20document.pdf) [↑](#footnote-ref-26)
27. *Roovaart, J. van den et al., 2016, E-PRTR completeness checks – water, ETC/ICM Technical Paper, version November 2016.*  [↑](#footnote-ref-27)
28. *Roovaart, J and N. van Duijnhoven. 2018, Development of quality checks for E-PRTR data on releases to water* [↑](#footnote-ref-28)
29. *Roovaart, J. van den et al., 2016, E-PRTR completeness checks – water, ETC/ICM Technical Paper, version November 2016.*  [↑](#footnote-ref-29)
30. <https://www.eea.europa.eu/publications/industrial-waste-water-treatment-pressures> [↑](#footnote-ref-30)