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The potential of the EU Water Framework Directive for reducing emissions of pollutants is limited: a case study on river basin specific pollutants in Swedish environmental permitting processes

Emma Undeman^{1*}, Henrik Josefsson², Marlene Ågerstrand³, Anna Sobek³ and Annika Nilsson⁴

Abstract

River basin specific pollutants (RBSPs) are supposedly a key tool to fulfil the EU's Water Framework Directive (WFD) goal of good ecological status in all European waterbodies. The RBSPs provide a tool to manage chemical pollution identified as a national priority. An important question is if the costly management related to RBSPs leads to reduced emissions, an issue we investigated here using Sweden as a case. Swedish measures implemented under the WFD mainly rely on environmental permitting and supervision. We, therefore, specifically assessed how RBSPs have influenced permit proceedings in the Land and Environment Court of Appeal, where precedents for judgements in lower courts and authorities is established, during the 2010s. Despite permit-review being an important measure highlighted in the WFD and in Swedish programs of measures, all cases appealed to higher court were initiated by the operators/permit holders. The permissibility of environmentally hazardous activities was not impacted by RBSPs in any instance. Permit conditions addressing RBSPs were discussed in ~1% of all environmental cases, mainly resulting in conditions demanding further inquiries regarding emissions and concentrations of a limited number of RBSPs (i.e., metals and nitrogen in the forms of nitrate and ammonia). Open-ended conditions and delegation allowing for updating permit conditions if additional RBSPs are identified were suggested but rejected by court as these conflict with fundamental principles of precision and predictability of permit conditions stated in Swedish and European law. We conclude that RBSPs as management tool has little impact on emissions from activities requiring environmental permits and thereby water quality.

Keywords: Chemical contaminants, Court cases, Ecological status, Efficiency of measures, Environmentally hazardous activities, Organic pollutants, Micropollutants

Background

Several environmental stressors threaten aquatic life and water quality. In Europe, the Water Framework Directive (WFD) is one of the most important legislations in place to protect the aquatic environment and it has been described as the most important and ambitious legal document in this field in the European Union's (EU) history [5]. The WFD has the overarching aim to protect and restore water bodies to good *chemical and ecological*

*Correspondence: emma.undeman@su.se;
emma.undeman@naturvardsverket.se

¹ Baltic Sea Centre, Stockholm University, Stockholm, Sweden
Full list of author information is available at the end of the article

status, as defined by a number of chemical, biological, physical–chemical and hydromorphological quality factors. It is a framework directive partly in the sense that it relies largely on member states implementing relevant controls and regulations, including other community law and mechanisms. Examples are directives, such as the Environmental Impact Assessment Directive, the Urban Wastewater Treatment Directive and the Industrial Emissions Directive, or mechanisms including environmental supervision and permitting. The WFD thus aims to steer the implementation of existing environmental legislation to ensure that water resources are protected and restored, and thereby achieve the overarching objective of good status for all waterbodies in the EU.

Substantial public funds are invested in Member States' WFD related administration, including mandatory monitoring, reporting and development of River Basin District Management Plans and Programs of Measures. In this way, the WFD influences the use of common resources available for water management in the Member States, motivating the question what added value comes with this directive. One key aspect is whether the implemented measures are effective, and thus whether they lead to improved water quality in practice. The effectiveness of the WFD has been questioned from several perspectives by the scientific community. The studies have focused on various aspects of the implementation of Programs of Measures, including studies of measures related to nutrients [12] and stormwater discharges [14], or other issues, such as learning/knowledge practices [8], impact on municipal physical planning [2], impact on stakeholder participation in planning processes [13], or a general review of the WFD implementation [4, 7, 32, 35]. Giakoumis and Voulvoulis reported a tendency of water management to follow previous mechanisms, despite the implementation of the WFD, meaning that the added value of the WFD can be questioned [10, 25]. Yet, the WFD fitness check by the European Commission in 2019 found it was fit for purpose [9]. Chemical contamination, one of the major pressures targeted in the WFD, was, however, identified as an area lacking efficient measures.

Chemical contamination is considered in the evaluation of both chemical and ecological status, which together defines the overall status of each waterbody. Chemical status is assessed by calculating the ratio between the monitored concentrations of selected substances with their respective environmental quality standard (EQS). A ratio above one thus implies poor chemical or ecological status of the particular waterbody. Deviations from good status, or risk of deterioration of the status, discovered during the status assessment trigger the development of appropriate measures to include in the Programs of Measures that each Member State must establish during

the management cycle. A list of 45 priority substances/substance groups comprises the basis for the evaluation of *chemical status* in all waterbodies in the EU Member States. In addition, the WFD provides a mechanism enabling other than the prioritised substances to impact the assessment of overall waterbody status. Such 'river basin specific pollutants' (RBSPs) and associated EQS are to be defined nationally. These regional/national RBSPs are substances identified as exerting significant biological/ecological pressure on a specific waterbody (WFD Annex V). Monitoring of their concentrations in impacted waterbodies is required as part of the evaluation of the *ecological status*.

The list of priority substances comprises substances of EU-wide concern, mainly found in a number of directives superseded by the WFD in the early 2000s. This explains why the list of priority substances largely consists of legacy and well-known pollutants, such as PCBs and atrazine, that are restricted under various EU legislation and global agreements (von [31]). The list of priority substances is supposed to be expanded with a 6-year interval, based on outcomes from environmental monitoring of chemicals of EU-wide emerging concern, called the Watch List (WFD Article 16) [11]. This is, however, a lengthy process that takes several years as the priority list is part of a legal act. In contrast to the list of priority substances, the inclusion of RBSPs contributing to ecological status is faster. It is notable that the adequacy of the RBSPs so far established by EU member states have been questioned due to the extreme variability in EQSs considered safe for the same substances in different nations, as well as the ability of applied risk assessment methodologies to identify all relevant toxicity risk drivers [3, 6, 17, 34]. Yet, RBSPs provide an opportunity to manage substances that are of local concern, yet not prioritized or regulated at EU level. Despite the potential value that management of RBSPs under the WFD might have for surface water quality, its impact has not been quantified or surveyed, an issue we here explore using Sweden as a case.

Measures in the Swedish Programs of Measures are mainly of a general nature and, therefore, not specific to a chemical or location. Instead they are formulated to cover all priority substances and RBSPs [29]. Central in the Swedish Programs of Measures are measures related to guidance, planning and implementation of environmental supervision and, when applicable, permitting of environmentally hazardous activities, urban wastewater treatment plants, contaminated land and water activities (such as dredging) (see Electronic Additional file 1: Fig. S1). It is also notable that WFD Article 11 regarding Programs of Measures, in point 5 specifically states that relevant permits should be "examined and reviewed

as appropriate” if good status is unlikely to be achieved. We, therefore, focus our analysis on permit regulation (licensing). Previous studies on this topic have compared environmental law in Nordic countries implementing the WFD and focussed on the legal status of the WFD objectives in permitting processes, and the possibility of derogation in permit regulation of activities with societal importance [15]. We focus on the potential for permit regulation to reduce chemical emissions to surface waters and specifically investigate 1) to what extent recent permit court proceedings in Sweden consider RBSPs, and 2) how RBSPs are considered in these cases. Furthermore, we discuss the prerequisites for using RBSPs as a tool for water protection, considering the fundamental legal principles of precision and predictability and how these affect permits conditions.

Methods

The Water Framework Directive in Sweden

The water management should, according to the WFD, follow a 6-year cycle comprising environmental monitoring, pressure analysis, status classification of all waterbodies based on the EQS-values, and development of Programs of Measures describing how the EQSs should be reached. In Sweden, five Water Authorities (selected County Administrative Boards) are responsible for the water management in the five Swedish River Basin Districts. Their work related to surface waters is supported by guidance and ordinances from the Swedish Agency for Marine and Water Management, and by all other County Administrative Boards. Further information is provided in the Electronic Additional file 1: 1 Section S1.

Selection of court cases

Environmentally hazardous activities listed in the Swedish Environmental Regulation (2013:251) require a permit (see Electronic Additional file 1: Section S4). There are ~6000 such environmentally hazardous activities in Sweden [28]. Permits are given by the Land and Environment Courts (LECs) or one of the environmental assessment delegations (County Administrative Boards), depending on the environmental impact of the activity. The decisions taken in the latter can be appealed to the LEC. The decisions in the LEC can be appealed to the Land and Environment Court of Appeal (LECA) at the Svea Court of Appeal. Operators that apply for permits in the LEC as first instance may appeal decisions in the LECA to the Supreme Court.

To identify to what extent and how RBSPs influence permits and related supervision, and thereby emissions of these substances, we analysed court cases addressing permits for environmentally hazardous activities, including wastewater treatment plants (WWTPs). We limited

the selection of cases to those granted leave to appeal by the LECA or the Supreme Court between January 2012 and March 2022 as these cases set precedence and guide lower courts’ and authorities’ judgements (e.g., the five LECs, and the twelve environmental assessment delegations organized under the County Administrative Boards). We found no cases addressing RBSPs that were granted leave to appeal in the Supreme Court. During the studied period, 3591 court decisions were taken in the LECA. These are categorized as environmental cases, appeals related to the Planning and Building Act, Real Estate cases or other cases. RBSPs were addressed in environmental cases only ($n=1700$), even if appeals related to the Planning and Building Act cover storm water issues which could include RBSPs. Documentation of the cases is available from the LECA webpage [16].

First, all cases that mention RBSPs ($n=73$) were collected by searching the database with search terms related to RBSPs (*särskilda förorenande ämnen* in Swedish) and ecological status. The cases that only mention RBSPs as part of presenting that the activity has no emissions of RBSPs or that receiving waters have not been classified as having issues with these substances were discarded. This selection resulted in 17 cases which were further analysed.

Qualitative assessment method

The second round of assessment consisted of a close reading of the remaining cases ($n=17$) to identify if and how the establishment of RBSPs affected the court’s ruling. The cases were analysed using content analysis, a method to categorize text-based information in a systematic manner [20, 24]. The content analysis was aided by the use of Microsoft Excel.

While reading the court cases, the text was coded into categories to extract and organize content related to:

1. Basic information regarding the type of activity, type of emissions, main actors involved and their claims
2. RBSPs that were explicitly addressed in the cases
3. Content describing RBSP related permit conditions:
 - a. Final and provisional emission limits (maximum or average concentrations in waste streams or total annual emissions)
 - b. Permit conditions regarding further investigations (inquiries), i.e., assessments before final conditions are set
 - c. Control programs (self-control and recipient control)
 - d. Prescribed measures (technical measures, other upstream measures)

4. Content describing the court's and involved parties' reasoning related to the ecological status of the receiving waterbodies
5. Content describing the court's and involved parties' reasoning related to river basin-specific conditions (e.g., flow conditions in rivers, background levels) and the river basin perspective (total pressure in the waterbody, contribution to total burden by various activities in the river basin)
6. Involvement of national-level authorities and their arguments relating to RBSPs

The impact of RBSPs found in the case material was then related to the purpose of establishing RBSPs as part of the WFD. RBSPs and their EQS-values are published in the Swedish Agency for Marine and Water Management ordinance HVMFS 2013:19 and updated in HVMFS 2019:25, see the list of the 32 RBSPs in Table S1 in Electronic Additional file 1.

Results and discussion

The court cases—general overview

Seventeen LECA cases which considered emission limits or measures associated with RBSPs were identified. These court proceedings dealt with new permits or permits for expansion/modification of five waste handling facilities (managing landfills), four mines, three steel industries, one chemical industry, one industrial WWTP, and three municipal WWTPs. The waste streams considered in these cases were landfill leachate or leachate pond water, water overflow from different types of water reservoirs (tailing pond, clarification pond) and leachate from waste rock and tailings in mining areas, locally treated industrial wastewater and scrubber water (gas cleaning), treated municipal wastewater, and emissions to water from contaminated industrial areas (see Electronic Additional file 1: Table S2).

The 32 RBSPs listed in Sweden (Electronic Additional file 1: Table S1 and Section S2) belong to several chemical categories, and occur in different types of waste streams. The RBSPs that are pesticides, pharmaceuticals and personal care products (siloxanes) are generally not relevant for industrial activities, unless they are produced there, nor for mines. These substances are, however, normally present in municipal wastewater and potentially in landfill leachate [1, 30]. The industrial substances are relevant to certain types of industry (chemical industry), municipal wastewater and landfill leachate [18, 30, 33].

Our analysis shows that court negotiations focussed mainly on RBSPs which are metals, namely, zinc (Zn), copper (Cu), uranium (U), arsenic (As), chromium (Cr), and ammonia measured as ammonium nitrogen (NH₃-N) (Table 1 and Fig. 1). Three court proceedings

considered conditions for all RBSPs without further specification. In two other cases, substances belonging to RBSPs having certain properties related to environmental fate and toxicity, were discussed. In addition, nitrate (NO₃-N), bisphenol A (BPA), 17-alpha-ethinylestradiol (EE2) and the sum of eleven poly- and perfluorinated alkyl substances (PFAS11), "micropollutants" (here pharmaceuticals and biocides) were specifically mentioned in some cases (see Table 1). Hence, many RBSPs were not considered in the permit processes. The reason can be partly that information about environmental concentrations and emissions is scarce, and partly that RBSPs such as pesticides are mainly used in activities and sectors that do not require an environmental permit. Another reason for the low occurrence of court cases addressing RBSPs can be that environmental concentrations are low compared to the respective EQS-value, meaning that the selected RBSPs have low environmental relevance in practice. In fact, a consequence analysis, performed by Swedish authorities in 2018, indicated that the environmental concentration of the suggested new RBSPs were in general low and thus that consequences for impacted sectors such as mines, WWTPs and agriculture would be small [27]. Some of the RBSPs that were not considered in the LECA cases were not listed until year 2018 (the siloxanes, some pharmaceuticals and pesticides), whereas Cu and NO₃-N, listed at the same time, were indeed discussed in the LECA, also before this year. The small fraction (~1%) of all environmental cases in the LECA that considered emissions of RBSPs and the narrow range of RBSPs discussed in these cases indicate that the overall impact of this management tool on chemical emissions from permitted activities is low in Sweden. It is conceivable that the establishment of RBSPs impact emissions from activities that need no permit, yet are subject to supervision that ensures, e.g., enforcement of pesticide regulations and guidance, or sales and correct use of products containing regulated substances. However, assessing this was not within the scope of this study.

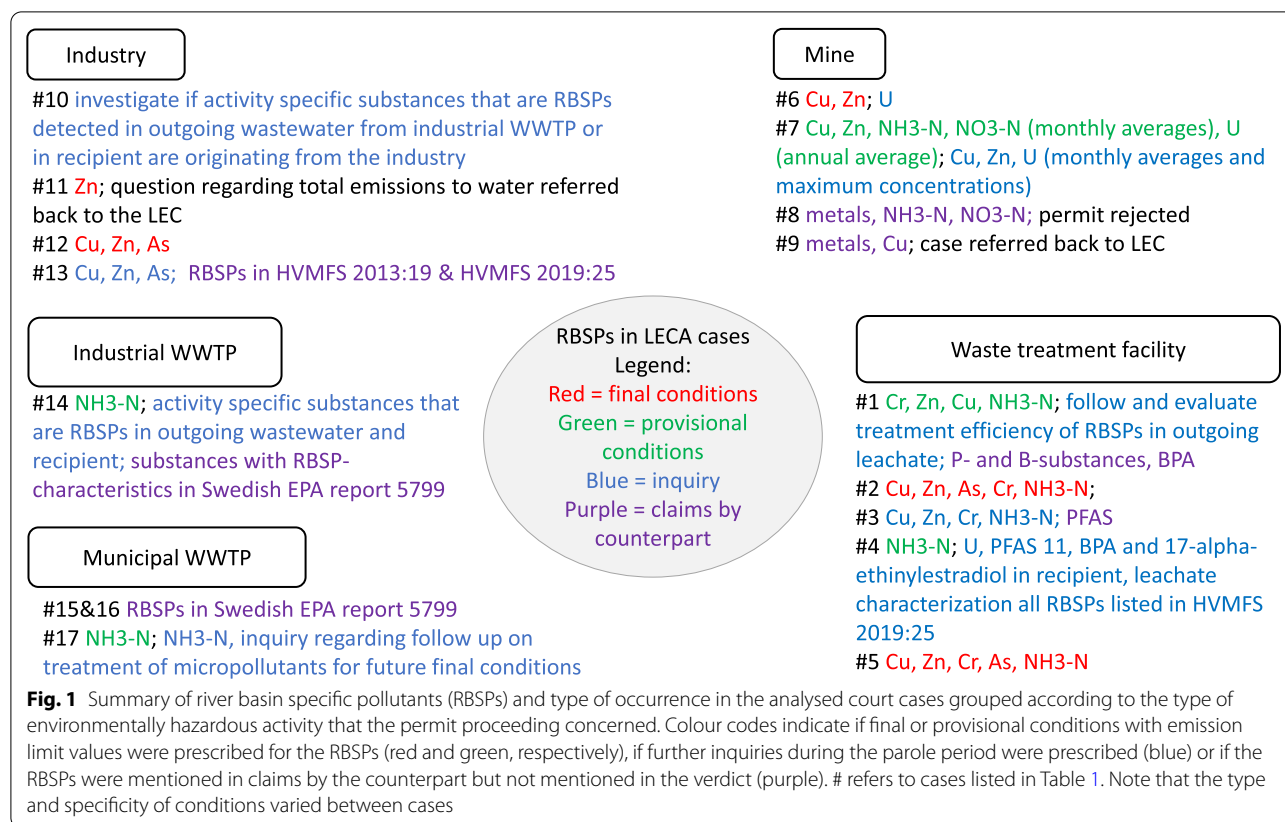
Initiation of the permit review

Certain authorities (the Swedish Environmental Protection Agency (EPA), the Swedish Agency for Marine and Water Management, the Legal, Financial and Administrative Services Agency (Kammarkollegiet), the Swedish Civil Contingencies Agency, County Administrative Boards and in some cases municipalities) can initiate re-examination of a permit, mainly based on 24 Ch. 11 § EC. Permit review is a measure suggested in the Swedish Programs of Measures, as well as explicitly demanded in WFD Article 11 "if objectives set under Article 4 for the body of water are unlikely to be achieved". Our results show that the cases appealed to

Table 1 Summary of activities, type of emissions and RBSPs considered in the analysed court cases

Case #	Year	Activity	Type of emissions	Zn	Cu	U	As	Cr	NH ₃ -N	NO ₃ -N	RBSP	BPA	EE2	PFAS11	pharma/P, B, ecotox, biocides	endocrine
1	2012	waste handling	leachate to municipal WWTP, after parole period to natural recipient	P	P			P	P			C				
2	2018	waste handling	leachate to waterbody	F	F		F	F	F							
3	2021	waste handling	leachate to municipal WWTP	I	I			I	I					C		
4	2021	waste handling	leachate to waterbody			I			P		I	I	I	I		
5	2021	waste handling	leachate to waterbody	F	F		F	F	F							
6	2016	mining	mine water treated in tailing pond and clarification pond	F	F	I										
7	2016	mining	from total activity	P/I	P/I	P/I			P	P						
8	2018	mining	mine water from clarification pond	C	C	C	C	C	C	C						
9	2019	mining	leachate from waste rock and tailings	C	C	C										
10	2016	industry	industrial wastewater to industrial WWTP													I
11	2019	industry	blast furnace scrubber water	F												
12	2019	industry	wastewater from smelter	F	F		F									
13	2021	industry	contaminated land (including storage areas), ground water and sediment	I	I		I				C					
14	2014	industry WWTP	industrial wastewater						P		C					I
15&16	2016	municipal WWTP	municipal wastewater								C					
17	2022	municipal WWTP	municipal wastewater						P							I
Total number of cases				11	10	5	5	5	9	2	4	2	1	2	1	2

Types of outcomes in court proceeding are indicated with F = final conditions (emission limit values), P = provisional conditions (emission limit values), I = inquiry, C = counterpart mentioned or claimed. Substances addressed were Zn = zinc, Cu = copper, U = uranium, As = arsenic, Cr = chromium, NH₃-N = ammonium nitrogen, NO₃-N = nitrate nitrogen, RBSP = river basin specific pollutants in general, BPA = bisphenol A, EE2 = 17-alpha-ethinylestradiol, PFAS11 = sum of 11 PFAS, pharma/biocides = pharmaceuticals and biocides mentioned without specification, P, B, ecotox, endocrine = persistent, bioaccumulative, toxic to aquatic organisms and endocrine disruptors. Note that permit proceedings #15 and #16 were handled together in court



the LECA were, however, all initiated by the operators/permit holders. This lack of initiative from authorities has previously been explained by limited resources and little support to authorities from the operators of permitted activities, who may have low interest in a permit review [26]. The Programs of Measures also state that the Swedish EPA should prioritise engaging in cases that set precedence/praxis. The agency acted as one of the parties or consultation body in 9 of the 17 cases in the LECA or prior negotiations in a lower court, i.e., one of the Swedish LECs (Electronic Additional file 2: Table S2). The Swedish Agency for Marine and Water Management took part in 8 of the 17 court proceedings. The national agencies engaged in particular in the cases with expected large environmental impact. Principally important decisions were, however, also taken in some of the low-profile cases as further discussed below. We hence conclude, that while the national authorities have the ambition and competence to engage in permit processes, they will rarely initiate permit-review, presumably due to the lack of resources required to pursue the permit-review procedure. The efficiency of permit-review as a measure to reduce emissions of RBSPs is, therefore, questionable.

Impact of RBSPs on permits for environmentally hazardous activities

Permissibility of activities

Our review of the court cases shows that the RBSPs did not impact the permissibility of the activities in any instance. In one mining case (#8), the operator’s permit application for extended activity in a mining area was rejected by the LECA. Although some RBSPs were discussed in the motivations of the involved actors’ claims, the Court’s rejection was motivated by the general lack of information required for a Natura2000-permit. In another case (#10), the counterpart (County Administrative Board) appealed primarily for rejection of the operator’s permit application for extended industrial activity in an industry park, partly because of lacking knowledge regarding emissions of persistent organic pollutants handled in the industrial processes. The claim was refused by the LECA, concluding that sufficient information was available to assess permissibility, that the additional emissions from this long-established industry would be small, and that several of the consulted national authorities did not have any objections.

Permit conditions

The analysis, furthermore, shows that the establishment of RBSPs and related EQS-values does indeed impact how the LECA specifies the permit conditions. The RBSPs were regulated in the permits regarding emission limits (final conditions or parole period provisional conditions), control programs, and inquiries required during a prolonged parole period (Fig. 1). The inquiries required to enable court decisions on final permit conditions concerned either quantification and characterization of emissions, investigation of measures to reduce emissions and their efficiency and costs, development of appropriate emission limit values and measures, identification of sources of observed RBSPs in the environment, and analysis of the pollution situation in the impacted recipient (the latter, e.g., in cases #13, #4, and #14). The different permit requirements come from the WFD related obligation to make sure that the activity does not deteriorate the status or jeopardize the achievement of good status in the impacted waterbodies, but also follow from the general rules of consideration found in Chapter 2 of the EC. The general rules of consideration establish the precautionary principle in Swedish law and as such require that anyone who carries out an activity shall acquire the necessary knowledge and take precautionary measures to protect human health and the environment from damage or inconvenience. They must also provide evidence of their compliance with the Environmental Code (EC 2 Ch. 2–3 §§) as discussed in [21, 23]/98:45).

Final conditions and provisional emission limits Final conditions for any RBSPs were set in five of the cases, addressing Zn, Cu, As, and NH₃-N (Fig. 1). Provisional emission limits during the parole period were set in five cases for NH₃-N, and for Zn, Cu, Cr, and NO₃-N in some of the cases. Only in one case (#1) did the adversary suggest limit values for other RBSPs (in this case BPA); however, this claim was rejected. In case #10, the LECA rejected a condition proposed by the County Administrative Board, implying that substances that within the EU Chemicals Legislation REACH have been classified as being Persistent, Toxic and Bioaccumulative should not be detectable in effluents of an industrial WWTP using commercially available analytical methods.

Parole period inquiries The most common outcome (14 of 17 cases) of the negotiations in court was a prolonged parole period combined with obligations to conduct additional inquiries; sometimes the case was also referred back to the lower court for further assessment. The prescribed parole period inquiries entailed a broader range of RBSPs. In addition to inquiries regarding the RBSP-nutrients and metals with provisional emission

limits shown in Fig. 1, the judgements on mining permits demanded further investigations of recipient concentrations and emissions of uranium (U). In these cases, claims to set final or provisional emission limit values for U were rejected by the LECA due to a lack of data. In a number of other cases, LECA prescribed inquiries for some or all (if relevant) RBSPs in industrial wastewater and landfill leachate as well as in the recipients (Fig. 1). In case #1, a condition set by the LEC, and confirmed in the LECA, was to monitor and evaluate removal efficiency of metals and “organic pollutants” in treated landfill leachate, without any further specification of which substances should be assessed.

Basis for emission limits

Impact of other legislation on RBSPs Our results demonstrate that final or provisional conditions were rarely set for RBSPs in Swedish court cases addressing environmentally hazardous activities, often due to a lack of information on emissions of the relevant substances. Notably, the substances for which provisional or final emission limits were indeed specified in the permits (Zn, Cu, As, NH₃-N, Cr, and NO₃-N) are also covered by other EU-legislation that requires reporting of emissions, for instance to fulfil the Aarhus Convention, the Directive 2003/4/EC on public access to environmental information, the Industrial Emission Directive (IED) and regulation 2019/1010 regarding reporting obligations under environmental law, e.g., to the European Pollutant Release and Transfer Register (E-PRTR). Regulations from the Swedish EPA (NFS 2016:8) also state that NH₃-H, Cu, Zn and Cr should be monitored in WWTPs with a capacity >10,000 population equivalents. For other RBSPs, not covered by such legislations, it was not possible to specify emission limit values with sufficient legal certainty, and the practical outcome in court of listing these substances as RBSPs was hence limited to further investigations.

Emission limit values and relation to the status of the recipient The added value of listing already well-regulated substances as RBSPs can be questioned. However, defining EQSs for these substances provides added value as not all environmentally hazardous activities and/or waste streams are associated with emission limit values or EU-level best available technology (BAT) conclusions. In addition, stricter emission limit values than those stipulated in EU-law or BAT conclusions may be necessary to follow the EQSs in certain waterbodies. This “safety-net mechanism”, however, requires that the conditions in the recipient are indeed considered in the permit proceedings.

The Swedish Programs of Measures stresses that a river basin perspective should be considered in the prioritization of supervision activities, e.g., that total emissions in

the catchment area should be mapped. It is, therefore, reasonable to assume that the numerical value of emission limits (concentrations in outgoing waste streams or total mass emitted) should be related to the current concentrations of the pollutants (status) and expected contribution from the activity to the total load (pressure) in the recipients. However, recipient specific conditions were mainly considered in permit processes for mining activities, where advanced calculations based on measurements, models and water flow in the recipients were presented. Such calculations underpinned arguments also in some cases, where conditions for NH₃-N emissions from landfill leachate and municipal wastewater were discussed (#4, #5, #17). In the other court proceedings, permissible emissions were instead related to other factors including observed emissions from the activity, thresholds that were possible for the operator to manage, if there existed additional measures to be taken and their reasonability, and marginals to limit values associated with sanctions. The LECA reasoning behind prescribed emission limit values or rejection of those suggested by the parties relied on other judicial principles, such as use of best possible technology (#9, #12) or precision and predictability of permit conditions (#10). In some cases, the emission limit values prescribed or suggested were arbitrarily set as a compromise between the parties' suggestions (#11), based on general guidelines for wastewater and sludge quality from the municipality and the Swedish Water Association (#2, #3) or not specifically motivated (#1, #10, #13). The arguments brought up in these cases are discussed in detail in the Electronic Additional file 1: Section S5. As emission limit values were only prescribed or almost exclusively suggested for well-known and regulated substances, the added value of also defining EQSs for these substances in Swedish ordinances was clear only in the mining cases and for NH₃-N.

Consideration of future updates of the RBSP list

Final conditions in permits are the basis for supervision, and violation of the conditions, such as transgression of emission limit values, leads to various types of sanctions against the environmentally hazardous activity. Consequently, steady case law, based in Swedish Supreme Court precedents and fundamental principles of exercise of public authority, requires predictability and precision in permit conditions [22]. This circumstance was reflected in the reluctance of the LECA to prescribe permit conditions that were flexible or addressed a broad range of substances, as they were not considered enforceable if transgressed. In addition, the requirement that conditions should be reasonable, i.e., that costs and benefits should be weighted, does not apply if the ecological (or chemical) status is deteriorated for one quality element

(from one status class to a lower) or if the possibility to reach the EQSs is jeopardized (EC 2 Ch. 7 §), as discussed in several cases.

Open-ended permit conditions In case #10, a County Administrative Board wanted to set concentration conditions for substances with certain properties (Persistent, Bioaccumulative, Toxic) present in landfill leachate and relate these concentrations to the performance of available analytical methods (i.e., detection limits were suggested as concentration limit values). The LECA pointed out that such conditions are unclear and unprecise and that transgressions cannot be ascertained. In case #14, the County Administrative Board claimed that the operator of an industrial WWTP, serving several industries in an industrial park, should be conditioned with measures to phase out substances listed under various directives from their processes. The substances suggested to be phased out included RBSPs under the WFD. The County Administrative Board also stated that their claim was an attempt to compensate for lacking conditions in the connected industries' permits. The operator claimed that this would lead to unreasonable consequences as the connected industries might have to shut down if they could not transfer their wastewater to the industrial WWTP. With reference to the above stated case law, the LECA judged that the suggested conditions were unprecise and unpredictable, and that it is not appropriate to condition the WWTP rather than the connected activities, as this is where emissions can be controlled.

Related to case #14, in cases #15 and #16 (municipal WWTPs in Höganäs and Ystad), the permit condition prescribed by the LEC, to map emissions of RBSPs, priority-substances and substances of specific concern entering the municipal WWTPs to specify quality criteria for incoming industrial wastewater, was reverted by the LECA. The reason was the praxis set in case #14 (the industrial WWTP), discussed above, to not regulate the use of chemicals in the permit of a WWTP. Instead, this should be done in permits of the connected activities. The LECA also argued that the possibility to arrive at environmentally motivated and technically feasible measures as a result of the suggested mapping was small. This was opposite to the LEC conclusion, namely, that operators of any activity should acquire the knowledge necessary to protect human health and the environment (Ch. 2 EC), and that in this case, irrespective of case #14, the environmental benefit exceeded the costs of the mapping.

Delegation to the supervisory authority In several cases, the adversary or the operator suggested that the permit should specify that additional conditions regarding concentrations in outgoing waste streams should be added

after the permit was given in dialogue with the supervisory authorities.

In case #3, the LEC judged that the parameters defining sufficient quality of the leachate treated in the municipal WWTP should be specified by the WWTP operator; however, the LECA reverted this decision as such a condition does not fulfil the requirements of precision and rule of law that enable the operator to follow the regulations and the supervisory authority to control compliance with permit conditions.

In case #2, one of the adversaries claimed that there should be a possibility for the supervisory authority to prescribe additional parameters with limit values to adapt to new knowledge regarding contaminants in leachate. The LECA, however, judged that since decisions regarding which parameters that should be regulated by limit values cannot be considered an issue of minor importance, this task could not be delegated to the supervisory authority. Nevertheless, the conditioned *characterisation* of contaminants in the leachate and the wetland receiving the leachate could, according to both the LEC and the LECA, be specified by the supervisory authority.

The practical impact of a substance being listed as a RBSP was also illustrated in case #4. The County Administrative Board claimed that the parole period should be prolonged and that the operator should assess certain substances, including some RBSPs, in the recipient as well as all RBSPs and priority substances in another leachate characterisation assessment. The operator stated that the assessment already performed was done in dialogue with the supervisory authority (in this case the County Administrative Board). The LECA stated that on one hand, the fairness assessment (reasonability) of the conditions should consider that the operator followed planning decided together with the supervisory authority. On the other hand, this cannot be done to any larger extent when there is a risk that an EQS is impacted in an illegal manner, and this type of pollution can hence not be handled as part of the activity self-control. The LECA, therefore, decided that the operator (the municipality) should further assess the RBSPs found to exceed their EQSs when measured in the recipient, to set emission limit values.

These cases show that it is not possible to leave conditions in permits open-ended to be able to cover a wide range of substances that may or may not be emitted from the activity, or to be able to condition new substances when the RBSPs or other lists of somehow prioritized substances are updated, without initiating a permit review process. The option provided in the EC to impose additional conditions on permitted activities is that the government can establish general regulations for a certain area or activity to protect the environment (9 Ch. 4

§ and 11 Ch. 9 c §§ EC). This type of regulation overrides the conditions specified in the permit and would allow for adaptation, similar to how BAT conclusions are used. This option has never been used by the Swedish government and appears unrealistic in practice, even though the preparatory works specify it as a suitable way to update permits for WWTPs.

As we could see in the analysed cases, all permit review processes were initiated by the operators developing their activities. The requirement that conditions should be precise and predictable conflicts with the cyclic management demanded under the WFD, where priority lists are supposedly continuously updated in the light of new knowledge and when chemical emissions change in our society. At the same time, the strong legal requirement to assure good ecological status prevents delegation of prescribing conditions regarding RBSPs (e.g., setting of limit values) to local authorities. This is a problem as permits are given for infinite time, and supervision is based on the permit conditions. Without conditions in environmental permits that require control/characterisation of emissions of a substance, the supervisory authorities are to rely on the operators' will to voluntarily assess and control new parameters. To circumvent this problem, time-limited permits could be granted or the possibility to establish general regulations for this purpose in practice could be investigated. Such general rules could, for example, entail emission limits or requirements of precautionary measures. A recent governmental investigation proposed regulating a duty for operators of environmentally hazardous installations to initiate full review of permits older than 40 years, as well as duties for the supervisory authorities to review permit conditions periodically [26]. The same study also concludes that many EU member states' legal systems, just like the Swedish case, entail environmental permits that are not time-limited, combined with regulations for repeal and review. Other studies recognising the problem connected to the ever-increasing number of contaminants of emerging concern in wastewater have suggested to develop adaptive wastewater licensing, where a weight of evidence approach is applied and multiple levels of information (e.g., indications of increased use of certain chemicals in society, results of effect-based monitoring) is used to trigger some management action, such as expanded monitoring or better treatment [19].

EU relevance

The selection of RBSPs, and thereby their relevance for activities requiring environmental permits, and the transposition into national law (e.g., legal status of the EQS for RBSPs and measures in the Programs of Measures) are nation specific [4]. The Swedish case, however, illustrates overall obstacles to RBSPs being an efficient tool for

improving surface water quality in waterbodies impacted by permitted activities. Basic principles in the Swedish legislations are also fundamental in the EU law, such as the requirement of legal certainty, meaning that the law must be clear, precise and with foreseeable legal implications, in particular when financial sanctions apply. The difficulties in combining ever-updated priority lists and permit conditions with this principle is an EU-wide complication, and a faster process to update permit conditions in light of new knowledge and additional RBSPs (or EU-wide priority substances) without a full permit review is warranted. Notably, the EU system with BAT conclusions, that ensure a gradual technological update of industrial activities, is an example of a management tool that has been implemented despite its apparent conflict with (long-time) legal certainty, indicating that it is possible to impose additional conditions on an activity without a permit review.

Conclusions

Our analysis of the LECA cases shows that RBSPs were only considered in 17 of 1700 permit processes for environmentally hazardous activities between the years 2012 and 2022. Although the establishment of RBSPs did not impact the permissibility of the activities in any of these cases, it did impact how the LECA specified permit conditions for the environmentally hazardous activities in question. The most common outcome of the court proceedings relating to RBSPs was conditions regarding further investigations of their emissions and presence in the recipient.

Final or provisional conditions specifying emission limit values (most commonly concentrations of the RBSPs in waste streams, but sometimes limits on, e.g., total annual emissions), which are associated with sanctions if transgressed, were set only for well-known contaminants, such as heavy metals and ammonia. These substances have been regulated for long at both national and EU level. The added value of listing these substances as RBSPs appears limited. It provides, however, additional arguments in court for demanding control of emissions in cases when no BAT conclusions apply to the activity in question or when the BAT-associated emission limit values are higher than required to comply with the EQS.

For the other RBSPs discussed in the analysed cases, emission limits could not be prescribed by the LECA due to data scarcity and uncertainty, meaning emission data and environmental monitoring data were lacking despite the strong mandate following the WFD to derive this information. However, we can see that claims for further investigations of RBSP emissions and concentrations in the impacted waterbodies can be motivated in court due to the strong legal obligation to not deteriorate or jeopardize the reaching of good status. Although the Swedish EC states that it is

the obligation of any actor to have knowledge regarding their activities' emissions and related impact on the environment (general rules of consideration), it also states that measures taken should be reasonable. The LECA cases, however, show that claims to perform costly investigations cannot be disregarded as unreasonable by the court when there is a risk of deterioration or jeopardizing the ecological status. The establishment of RBSPs hence enables supervisory authorities to demand data on emissions and concentrations in the environment for these substances. This being the major impact of establishing RBSPs, and in addition for a very limited number of environmentally hazardous activities, can be considered unsatisfactory, in particular considering that RBSPs is supposedly the chemical-related mechanism in the WFD that provides most added value. It also shows that the important mechanism of the WFD management cycle stating that pressure and status assessment data should be derived for the RBSPs is not functioning. It remains to investigate the added value of designating RBSP-status to substances that are not relevant for environmentally hazardous activities requiring a permit but are supposedly considered in supervision and guidance, for example, many current use pesticides. It also remains to investigate if designation of RBSPs result in various actors taking pro-active measures to reduce emissions or substitution of substances. In addition, scarcity of monitoring data and reliable pressure analyses hinders assessment of the extent omission of RBSPs in court negotiations is caused by lack of data or lack of EQS-exceedances in the impacted waterbodies.

The cyclic management demanded in the WFD with continuously changing lists of RBSPs as well as EU-wide priority substances present a problem in the permit processes. The analysed cases show that the permits cannot, although suggested in several cases, leave conditions open-ended regarding which substances should be monitored and controlled. The reason is that this conflicts with the fundamental principle that precise and predictable conditions should be specified in the permits, as established in case law. The LECA did also reject suggestions to delegate decisions on limit values for RBSPs as the risk of exceeding RBSP EQSs cannot be considered an issue of minor importance, which is a prerequisite for delegating decisions to supervisory authorities. These circumstances unveil fundamental problems with the Swedish implementation of the WFD, and potentially in other EU countries with similar basic principles stated in their national environmental legislations. An important question for future studies is, therefore, how RBSPs, current and forthcoming, can be considered in *all* permitted activities without a frequent permit review.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12302-022-00705-0>.

Additional file 1: Section S1. Water framework directive and river basin specific pollutants. **Section S2.** River basin specific pollutants in Sweden. **Table S1.** River basin specific pollutants (RBSPs) in Sweden, number of waterbodies (WB) in the Swedish VISS database with moderate status (M), good status (G) and significant pressure (P). The current regulation of the RBSPs at EU-level and in Sweden is indicated. **Section S3.** Swedish Programs of Measures. **Figure S1.** Overview measures in the Swedish Programs of Measures (PoMs). **Section S4.** Swedish Environmental Law and the Role of Permits. (Water) Environmental Quality Standards and permits. **Section S5.** Emission limit values and relation to the status of the recipient—detailed analysis.

Additional file 2: Table S2. Overview and summary of analysed court cases.

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Author contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by EU and HJ. The first draft of the manuscript was written by EU and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Authors' information

EU is an Associate Professor of Environmental science at the Baltic Sea Centre, Stockholm University. Her research interests include environmental chemistry and policy. HJ is an Associate Professor of Environmental law and Senior Lecture in Commercial Law at the Department of Business Studies, Commercial Law Unit, Uppsala University. His research interests include various legal issues, often at the interface with natural scientific research. MÅ is an Assistant Professor at the Department of Environmental Science, Stockholm University. Her research interests include science–policy interactions in regulation of chemicals. AS is Professor of Environmental Chemistry at the Department of Environmental Science, Stockholm University. Her research interests include environmental fate and risk of organic contaminants. AN is an Associate Professor of Public Law at the Faculty of Law, Uppsala University. Her research interests include regulation, administrative control and sanctions, mainly within the area of environmental management.

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Availability of data and materials

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Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Author details

¹Baltic Sea Centre, Stockholm University, Stockholm, Sweden. ²Department of Business Studies, Commercial Law Unit, Uppsala University, Uppsala,

Sweden. ³Department of Environmental Science, Stockholm University, Stockholm, Sweden. ⁴Faculty of Law, Uppsala University, Uppsala, Sweden.

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