Maintenance regulation of small wastewater treatment facilities

Case studies in Germany, Poland and Sweden,

OPTITREAT
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Summary

Small wastewater treatment plants are of great concern due to the load of phosphorous and nitrogen, contributing to the eutrophication of the Baltic Sea. An important part of the functioning and effectiveness of small wastewater treatment plants is governance structures for supporting replacement of ill functional facilities and maintenance of existing plants. The aim with this report is to map out and highlight policy lessons learnt regarding regulations applied today in Germany, Poland and Sweden for maintenance, as well as identified problems, for small wastewater treatment facilities.

Germany, Poland and Sweden have implemented the EU legislation concerning wastewater. The three most important regulations for sanitation and wastewater treatment in the EU are the Water Framework Directive (WFD), the Urban Wastewater Treatment Directive and the Drinking Water Directive. From an EU perspective, one of the biggest challenges lays in the fact that EU-wide regulation does not enforce stringent policies for small agglomerations, less than 2 000 PE, without sewage network. Ensuring that rural areas in EU have access to treatment plants will be a great future challenge. Still many Europeans live in areas where the EU Urban wastewater treatment directive does not apply, which puts pressure on national authorities to set out laws and regulations in line with the WFD intentions.

Germany

Germany has a high connection ratio to the sewer system. More than 96% of private households and public facilities are connected to the public sewage system. A large share of the population not connected to the public sewage system have decentralised wastewater treatment. A mapping from the German Federal Statistics Office from 2010 showed that only 0.03% of the German population lacks decentralised wastewater treatment. An estimated number of decentralised wastewater treatment systems for up to 50 PE operated in Germany is around 1.5 million.

Germany has a well-developed regulation system for supervision and maintenance activities, compared to the cases of Poland and Sweden. The German legislation specifies that, for example, data regarding performance of small wastewater treatment plants must be stored and available for inspection from relevant authorities when asked. This has laid the foundation for a number of technical approvals and norms regarding supervision and maintenance, including economic incentives for the property owner, in order to have facilities in place that achieve specified requirements.

Due to a recent EU verdict the German system with standards and technical approvals are, however, now questioned, and it is unclear how this system will evolve. The German case could still serve as an inspiring example on how supervision and maintenance activities could be carried out. This system also comes with administrative costs, at least initially, which may put pressure on local authorities that are already having problems with prioritizing supervision activities. A great challenge for Germany is to find technical and competent personnel with the right education and knowledge to...
assess the facilities. The same can be said for both Poland and Sweden. Educating personnel to handle and assess small plants is a common future challenge.

**Poland**

In Poland, approximately 70% of the population is connected to public wastewater treatment. There is, however, a large disparity between the country’s urban and rural areas. Over a third (39%) of the Polish population lives in rural areas, and the connection ratio in rural areas is around 30%. This share is, although, constantly increasing with more and more people connected to the public sewage system. Regarding small wastewater treatment plants, recent regulations have led to improvements.

Capacity building is a great future challenge. This includes ensuring funding for public sewage system, especially in rural areas. It also includes replacing septic tanks in rural areas and providing knowledge transfer and education and training for local authorities.

**Sweden**

Approximately 82% of the population in Sweden is connected to the public sewage system. Almost one million households in Sweden are connected to small wastewater treatment plants for less than 200 people, whereof 700 000 have a water toilet connected. Since 1995, emissions of nutrients from small wastewater treatment plants in Sweden have increased. According to the Swedish Agency for Marine and Water Management (SwAM) (2013a) one reason for this is insufficient maintenance regulation and inadequate incentives for house owners to perform maintenance activities.

Sweden serves an example of a country with vague rules regarding maintenance and supervision, which has led to criticism and requests for clearer and binding rules on how regulating authorities should carry out supervision activities. The main challenges for Sweden lay in finding policy solutions for more efficient replacement of miss-functioning plants and in the unclear legal status of the requirements that plants must achieve. A new legislation is now being developed and more binding rules, both regarding maintenance and supervision and for reduction requirements, would be a welcomed improvement by many. Economic policies are also being discussed as a way to create incentives for property owners to replace their old plants that are in need of upgrading.
1. Introduction

Small wastewater treatment plants are of great concern due to the load of phosphorous and nitrogen, contributing to the eutrophication of the Baltic Sea. Scattered dwellings have been estimated to contribute to about 15% of the anthropogenic phosphorous and nitrogen load on the Baltic proper, and for inland waters the contributions may locally be even larger. The load of hazardous substances is a further concern. In rural areas, small wastewater treatment plants, is the only alternative for cost-effective wastewater treatment. The Optitreat project aims to develop and optimize the efficiency of small wastewater treatment plants, with focus on the Baltic region.

An important part of the functioning and effectiveness of small wastewater treatment plants is governance structures for supporting replacement of ill functional facilities and maintenance of existing plants. Around 80 % of EU population is connected to wastewater treatment in Northern and Southern European countries (EEA, 2013). The corresponding numbers in central Europe is even higher, around 90%. The lowest connection rate can be found in Eastern Europe where around 67% of the population is connected. In this report three EU countries, Germany, Poland and Sweden are compared, regarding regulations for small wastewater treatment plants. These countries have different challenges and preconditions when it comes to regulation.

In Germany, a high share of the population (96%) is connected to the public sewage system. For those households that are not connected almost all have small wastewater treatment plants in place. Germany has a well-developed system for maintenance. In Poland, the situation is somewhat different with approximately 70% of the population connected to the public sewage system. The main challenges can be found in the country’s rural parts where a high share of the population lacks a well-functioning wastewater treatment system. In Sweden, approximately 82% of the population are connected to the public sewage system. A large share of the small wastewater treatment plants in place is in need of upgrading. There is an ongoing discussion on to improve Swedish regulations to speed up this process.

The aim with this report is to map out and highlight policy lessons learnt regarding regulations applied today in Germany, Poland and Sweden for maintenance, as well as identified problems, for small wastewater treatment facilities. All these countries are also affected by EU legislation concerning wastewater. In the following section an introduction to EU policies for small wastewater treatment plants is given. This is followed by a mapping of policies in Germany, Poland and Sweden. The report ends with a discussion on policy lessons learnt and future challenges.
2. EU wastewater treatment policies

2.1. Main EU policies

Several regulations concerning wastewater management have been signed into EU law over the past few decades. The three most important regulations for sanitation and wastewater treatment in the EU are the Water Framework Directive (WFD), the Urban Wastewater Treatment Directive and the Drinking Water Directive. These are described briefly below.

The Water Framework Directive (WFD) was adopted in 2000 to establish a legal framework to protect and restore clean water across Europe and to ensure its long-term sustainable use. The framework requires the achievement of “good status” for all Europe’s surface waters and groundwater. The WDF has a river basin approach that goes beyond administrative and political boundaries. How to reach good status is flexible but is set in river basin management plans and measures by member states, including participation from the public society. The Framework also introduced economic principles and methods for water management. While agglomerations up to 2000 PE are covered by the Urban Wastewater Treatment Directive, agglomerations below 2 000 PE fall under the WFD. Appropriate sanitation and wastewater treatment to reach good water status is required. The requirements of the WFD regarding wastewater collection and treatment are however not specified in detail.

The Drinking water directive (DWD) sets health-oriented quality standards to ensure safe drinking water in supplies for more than 50 people, or more than 10m$^3$ per day. The objective is to protect human health from contamination of water intended for human consumption.

The Urban Wastewater Treatment Directive, (UWWTD), is emission-oriented and oblige member states to collect wastewater and install treatment plants in agglomerations with more than 2 000 PE. The Directive requires secondary treatments of all agglomerations of more than 2 000 PE and more advanced treatment for agglomerations of more than 10 000 in designated sensitive areas. In addition, agglomerations with less than 2 000 PE, which already have a collecting system, must set up appropriate treatment (Article, 7). For agglomerations with less than 2 000 PE that do not have any sewerage network, there are no standards to meet and regulation and management is left to the member states.

Agglomerations in the EU

The definition of an agglomeration is given in the UWWTD:

“Agglomeration’ means: an area where the population and/or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban waste water treatment plant or to a final discharge point”

In the EU there are about 25 000 agglomerations with more than 2 000 PE, corresponding to a generated load of 621 million PE (EEA, 2013)

Table 1 describes how the UWWTD and WFD cover different agglomerations in the EU.

<table>
<thead>
<tr>
<th>Agglomerations with &lt;2 000 PE not having collecting system</th>
<th>Urban Waste Water Treatment Directive</th>
<th>Water Framework Directive</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>-</td>
<td>Yes</td>
</tr>
</tbody>
</table>

| Agglomerations with <2 000 PE having a wastewater collecting system discharging to freshwaters or estuaries | Yes | Appropriate treatment* | Yes |

| Agglomerations with <10 000 PE discharging to coastal waters | Yes | Appropriate treatment* | Yes |

| Agglomerations with >2 000 PE discharging to freshwaters or estuaries | Yes | Secondary treatment** | Yes |

| Agglomerations with >10 000 PE discharging to coastal waters | Yes | Secondary treatment** | Yes |

| Agglomerations with 2 000-10 000 PE discharging to freshwater and estuaries in sensitive areas | Yes | Secondary treatment** | Yes |

| Agglomerations with 10 000 – 100 000 PE discharging to freshwater or estuaries or coastal waters in sensitive areas | Yes | More stringent than secondary treatment. Nutrient reduction*** | Yes |

| Agglomerations with >100 000 PE discharging to freshwater or estuaries or coastal waters in sensitive areas | Yes | More stringent than secondary treatment. Nutrient reduction**** | Yes |

*Appropriate treatment means treatment by any process and/or disposal system which after discharge allows the receiving waters to meet relevant quality objectives and relevant provisions of European Directives.

** Secondary treatment means treatment of urban wastewater by a process generally involving biological treatment with a secondary settlement or other process in which the requirements BOD5 = 25 mg/l O2 (70-90 % percentage of reduction), COD = 125 mg/l O2 (75 % percentage of reduction), and (optional) SS = 35 mg/l (90 % percentage of reduction) are achieved.

*** More stringent treatment than secondary treatment (i.e. tertiary treatment) require Total phosphorus = 2 mg/l (80% percentage of reduction), Total nitrogen = 15 mg/l (70-80% percentage of reduction).

**** More stringent treatment than secondary treatment (i.e. tertiary treatment) require Total phosphorus = 1 mg/l (80% percentage of reduction), Total nitrogen = 10 mg/l (70-80% percentage of reduction).

Urban wastewater discharges to waters situated in high mountain regions (over 1 500 m above sea level) where it is difficult to apply an effective biological treatment due to low temperatures may be subjected to treatment less stringent than that prescribed above, provided that detailed studies indicate that such discharges do not adversely affect the environment.

An important exception from the UWWTD can be found in Article 3. Exemption from collection obligation in the UWWTD is possible through “individual and other appropriate systems” (IAS), for example when establishment of a collection system is not justified from an environmental or economic perspective. The IAS must still, however, achieve the same level of environmental protection as other specified treatments in the UWWTD. Compliance with the UWWTD could mean 100% with IAS, which often means small wastewater treatment plants. As an example, in the latest Implementation report of the UWWTD, Greece reported several agglomerations which are to 100% treated with IAS (European Commission, 2012). When a threshold value of 2% is exceeded more detailed data on the type of treatment should be provided by member states. For the whole EU,
around 2.1% of the population have collecting systems addressed through IAS while 3.1% neither have collecting systems or IAS (European Commission, 2015).

Another important regulation concerning small wastewater treatment plants in EU is the Construction Products Regulations (CPR). It lays down harmonized rules for marketing of construction products in EU. The purpose with the CPR is to facilitate trade between EU member states. All manufactures use the same methodology for assessing and describing product features, through a harmonised European standard. Harmonised standards are used to define requirements, declare a product’s performance or to verify compliance with requirements and demands. These standards are developed by involvement of many stakeholders, through one of the three European Standards Organisations: the European Committee for Standardisation (CEN), the European Committee for Electro technical Standardisation (CENELEC) and the European Telecommunications Standards Institute (ETSI).

The CE marking indicates that a construction product has been assessed according to a harmonised European standard and therefore enables construction products to move across all EU countries. The Declaration of Performance (DoP) is a key part of the CPR, and provides information on the performance of a product. Since, July 1st 2013 all construction products that are covered by a European harmonised standard (or for which a European Technical Assessment has been issued) needs the DoP and has to be CE marked. There are several construction products for small sewage plants affected by the CPR (see Text box 1).

The DoP and the CE-marking will give reliable information on relevant features of the products. This information will guide authorities to decide if the products can achieve national requirements or if they need to be complemented with more measures. National authorities cannot promote competing voluntary certifications for construction products that are covered by harmonised standards, since these can constitute trade barriers. Moreover, authorities cannot demand further testing or marking than what is stated in the harmonised standards, according to the CPR.

### EU harmonized standards for small wastewater treatment plants

The harmonised standards that concern small wastewater treatment plants are EN 12566 – Small wastewater treatment systems for up to 50 PT. The standards consist of the following parts:

- EN 12566-1: Part 1 – Prefabricated septic tanks
- EN 12566-2: Part 2 – Soil infiltration systems (technical report)
- EN 12566-3: Part 3 – Packaged and/or site assembled domestic wastewater treatment plants
- EN 12566-4: Part 4 – Septic tanks assembled in situ from prefabricated kits
- EN 12566-5: Part 5 – Pretreated Effluent Filtration systems (technical report)
- EN 12566-6: Part 6 – Prefabricated treatment units for septic tank effluent
- EN 12566-7: Part 7 – Prefabricated tertiary treatment units

Text box 1 Harmonized standards concerning small wastewater treatment plants in the EU.

**2.2. The Baltic Sea Action Plan**

The Baltic Sea Action Plan (BSAP) is a joint action programme in the countries bordering the Baltic Sea and the European Commission, to attain good environmental status in the Baltic proper by 2021
(HELCOM, 2007). The Plan was adopted in 2007 and HELCOM 2013 Copenhagen Ministerial Meeting adopted the revised HELCOM nutrient reduction scheme. The programme consists of four segments: eutrophication, hazardous substances, biodiversity including fisheries, and maritime issues.

Regarding eutrophication, the signatory countries have agreed to, among other things, reduce the nutrient inputs and share the needed nutrients by all Baltic Sea countries. As an example, the countries agreed that the maximum allowable nutrient input to the Baltic Sea that can be allowed to achieve a good environmental status with regards to eutrophication is 21,716 tonnes of phosphorus and 792,209 tonnes of nitrogen. The agreed country allocated nutrient reduction targets (CART) to achieve the maximum allowable input are specified in Table 2.

Table 2 Country Allocated Reduction Targets (CARTs) for pollution from both land and air, in tonnes, revised 2013 HELCOM according to the Baltic Sea Action Plan. Source: (HELCOM)

<table>
<thead>
<tr>
<th></th>
<th>Nitrogen</th>
<th>Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>2,890</td>
<td>38</td>
</tr>
<tr>
<td>Estonia</td>
<td>1,800</td>
<td>320</td>
</tr>
<tr>
<td>Finland</td>
<td>2,430 +600*</td>
<td>330 +26*</td>
</tr>
<tr>
<td>Germany</td>
<td>7,170 +500*</td>
<td>110 +60*</td>
</tr>
<tr>
<td>Latvia</td>
<td>1,670</td>
<td>220</td>
</tr>
<tr>
<td>Lithuania</td>
<td>8,970</td>
<td>1,470</td>
</tr>
<tr>
<td>Poland</td>
<td>43,610</td>
<td>7,480</td>
</tr>
<tr>
<td>Russia</td>
<td>10,380*</td>
<td>3,790*</td>
</tr>
<tr>
<td>Sweden</td>
<td>9,240</td>
<td>530</td>
</tr>
</tbody>
</table>

The figures are rounded 

1. At this point in time Poland accepts the Polish Country Allocated Reduction Targets as indicative due to the ongoing national consultations, and confirms their efforts to finalize these consultations as soon as possible.

* Reduction requirements stemming from
  - German contribution to the river Odra inputs, based on ongoing modeling approaches with MONERIS;
  - Finnish contribution to inputs from river Neva catchment (via Vuoksi river);
  - these figures include Russian contribution to inputs through Daugava, Nemunas and Pregolya rivers

The figures for transboundary inputs originating in the Contracting Parties and discharged to the Baltic Sea through other Contracting Parties are preliminary and require further discussion within relevant transboundary water management bodies.

3. Germany

3.1. Background

Germany has a high connection ratio to the sewer system. More than 96% of private households and public facilities are connected to the public sewage system (see Figure 1). A large share of the population not connected to the public sewage system have decentralised wastewater treatment A mapping from the German Federal Statistics Office from 2010 showed that only 0.03% of the German population lacks decentralised wastewater treatment (see Figure 1). An estimated number of decentralised wastewater treatment systems for up to 50 PE operated in Germany is around 1.5 million.
Figure 1 wastewater disposal in Germany in 2010, degree of connection. Source: German Federal Statistical Office, 2013.

The environmental impact from small wastewater treatment plants in Germany is not considered to be a pressing issue, given that the total amount of people that are connected to the public sewage system. The treatment efficiency of small wastewater treatment plants is also considered to be very high with well-developed technology and maintenance.

The responsibility for the protection of water and public water supply is shared between federal, regional and local authorities.

### 3.2. Important regulations in Germany concerning small wastewater treatment plants

The main regulations concerning wastewater treatment in Germany can be found in the Federal Water Act (WHG), the Waste Water ordinance and the Waste Water Charges Act. In general the water protection policy is based on the polluter pays principled (PPP), which applies to both property owners and companies, as well as the precautionary principle.

**The Federal Water Act (Wasserhaushaltsgesetz – WHG)**

The Federal Water Act (source) is the most important regulatory law for water management in Germany, and was first adopted in 1957. The last amendment of the Act completed the transposition of the EU WFD into German national law. The new Federal Water Act entered into force on 1 March 2010.

The Federal Water Act takes a coherent and holistic approach to water resource management in Germany. It includes definitions of wastewater, wastewater disposal and discharge of wastewater. It states that waterbodies must be protected and managed to benefit the general public and individuals, and that a high level of protection for the environment must be ensured. The general principle is the precautionary principle. Waterbodies are subject to governmental control and all uses of waters, including discharge, are subject to official authorisation, with a few exceptions. Discharging of water requires an official permission in the form of a so called law permit.

Another important part of the Federal Water Act concerns the construction and operation of wastewater treatment plants. Wastewater pollution must be reduced according to best available technology. Article 57, paragraph 1, states that discharge of wastewater into water bodies is allowed only if the pollutants are kept to the lowest level reachable by means of the best available
technology, i.e. the allowed pollutant load depends on how emissions in the water may be minimised by respective industry by complying with technologically processes.

For small wastewater treatment plants, the Federal Water Act stipulates that infiltration from small wastewater treatment plants requires an official permission and that the operator of wastewater treatment plants must monitor the plant and the wastewater quality. Data must be stored and be available for inspection from relevant authorities when asked.

The Waste Water Charges Act

The Waste Water Charges Act regulates charges for direct discharge of wastewater into a water body. The charges are levied at the federal level and ensure that the polluter pays principle (PPP) is applied in practice. As such the Waste Water Charges Act meets the requirement of the WFD for internalisation of environmental costs. The charge is determined based on quantity and harmfulness of certain components discharged into water, for example COD, P, N, Mercury, Cadmium and Lead. The charge is paid to the Länder and the revenue must be used for water pollution control measures. When a small wastewater treatment plants fulfils the rules of practice, for different treatment classes (see section on Treatment classes) the discharge is free of charge. If the effluent is higher than the specified value, defined for each treatment class, the house owner has to pay a fee.

The Waste Water Ordinance

The Waste Water Ordinance was passed in 1997 and includes guidelines for wastewater for various industries. Minimum requirements for domestic, municipal, commercial and industrial wastewater are defined in special Annexes to the Ordinance. As of today, there are 57 Annexes where Annex I applies to domestic and municipal wastewater, see Table 3. Another purpose with the Waste Water Ordinance is the implementation of technical requirements of EC law on wastewater, such as the Urban Waste Water Directive. Small wastewater treatment plants fall under the first category in Table 3, and the discharge cannot exceed the values of 150 mg/l for COD and 40 mg/l for BOD5. There are, however, different treatment classes for small wastewater treatment plants, described in the next section.

Table 3 Minimum requirements for the discharge of municipal wastewater under Annex I to the Waste Water Ordinance.

<table>
<thead>
<tr>
<th>Size categories of wastewater treatment plants</th>
<th>Chemical oxygen demand</th>
<th>Biocemical oxygen demand over 5 days (BOD₅)</th>
<th>Ammonium nitrogen</th>
<th>Total nitrogen as sum of ammonium, nitrite and nitrate-N</th>
<th>Total phosphorous (P₅)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population equivalent</td>
<td>mg/l*</td>
<td>mg/l*</td>
<td>mg/l*</td>
<td>mg/l*</td>
<td>mg/l*</td>
</tr>
<tr>
<td>Less than 1,000</td>
<td>150</td>
<td>40</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>from to 1,000</td>
<td>110</td>
<td>25</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Greater than to 5,000</td>
<td>90</td>
<td>20</td>
<td>10</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Greater than to 10,000</td>
<td>75</td>
<td>15</td>
<td>10</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>Greater than 100,000</td>
<td>75</td>
<td>15</td>
<td>10</td>
<td>13</td>
<td>1</td>
</tr>
</tbody>
</table>

1 Population equivalent = 60g BOD₅/d in untreated wastewater
* Qualified random example or 2-hour composite sample

The Waste Water Ordinance, Annex I, also specifies that in case of small discharges (as defined in the Waste Water Charges Act):
“...the requirements for size category 1, pursuant to paragraph (1) above, shall be deemed to have been met if a waste water treatment plant authorised by a general building-inspectorate approval, by a European-oriented technical approval pursuant to provisions of the Act on Construction Products (Bauproduktengesetz) or otherwise authorised in accordance with Land law is installed and operated in keeping with the relevant authorisation. The relevant authorisation must also set forth the requirements for proper function of the facility, with respect to installation, operation and maintenance of the facility.”

This means that if a small wastewater treatment plant is produced according to the EN 12566 standard and if it is operated and maintained properly, i.e. operated by the house owner with help of an operation manual and maintained by a trained specialist, the requirements can be considered to be achieved.

3.3. Maintenance and supervision of small wastewater treatment plants

According to the Waste Water Ordinance (AbwV) anyone intending to discharge wastewater is obliged to channel the wastewater through a technical treatment method until a certain level of quality is reached before it can be discharged into a body of water. The intention with the discharging standards is to ensure that whatever is technically feasible is required when discharging pollutants from point sources regardless of the respective body of water’s quality.

Several maintenance and operation norms have been developed in Germany to make sure that minimum performance values are achieved, to ensure environmental protection. Some are only recommendations while others have been legally required. The maintenance and operation norms are:

- DIN¹ 4261-1 Small sewage treatment plants – Part 1: Plants for waste water pretreatment (Oktober 2010)
- DIN 4261-5 Small sewage treatment plants – Part 5: Infiltration of aerobic biologically treated domestic wastewater
- DIBt² Approval Guidelines – Technical approvals for small sewage treatment plants
- DIBt Licensing principles – Small wastewater treatment systems according to DIBt.
- DWA³ Merkblatt DWA-M221 Basic regulations for design, installation and operation of small wastewater treatment plants with aerobic biologically treated wastewater

DIBt (The German Institute for Structural Engineering) develops “National Technical Approvals” (Allgemeine Bauaufsichtliche Zulassung) for construction products, including small sewage treatment plants, that have been legally required. The requirements defined by DIBt concerning small wastewater treatment plants are, however, not valid anymore due to a verdict of the Court of Justice of the European Union (CJEU judgment C-100/13) from 2014.

¹ DIN (Deutsches Institut für Normung).
² DIBTd (Deutsches Institut für Bautechnik).
³ DWA (The German Association for Water, Wastewater and Waste)
In short, the CJEU judgment considered that Germany infringed the EU Construction Products Directive through its Construction Products List⁴, which imposed additional requirements for effective market access and the use of construction products. This concerns “National Technical Approvals” that fall within the scope of harmonized specifications. It is expected that “National Technical Approvals” will lose their function for products bearing CE-marking. Most of the additional rules and standards are now invalid. At the moment, a revision of additional rules and standards is in process so that they are not in contradiction with the EU Construction Products Regulations.

### Treatment classes

In the “National Technical Approval” for small wastewater treatment plant which is under revision according to above, every installation had to be certified according to the standard EN 12566, which allowed the manufacturer to trade the product, but not to install it in Germany. For the installation of the plants, manufacturers needed the “National Technical Approval”. The performance of the plant was established according to five different treatment classes, which require different maintenance frequency. The “National Technical Approval” also defined practice for installation, operation and maintenance for the small wastewater treatment plant. The house owner had to pay a fee if the effluent was higher than the specific value defined in the class. If the treatment efficiency of the small wastewater treatment plant fulfilled the requirements, as defined in the class, no fee was applicable.

The five classes for performance of small wastewater treatment plants are (see also Table 4):

- **Class C** (carbon degradation)
- **Class N** (nitrification)
- **Class D** (denitrification)
- **Class +P** (additional phosphate elimination)
- **Class +H** (additional sanitation)

Table 4 Different treatment classes requirements for small wastewater treatment plants in Germany. Source: DIBt – Allgemeine bauaufsichtliche Zulassungen für Kleinkläranlagen (National technical approval for small sewage treatment plants).

<table>
<thead>
<tr>
<th>Klasse</th>
<th>CSB mg/l</th>
<th>BSB₅ mg/l</th>
<th>NH₄-N mg/l</th>
<th>N₅₋₅ mg/l</th>
<th>P mg/l</th>
<th>faecal coliforme Keime je 1000 ml</th>
<th>AFS mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>150* / 100**</td>
<td>40* / 25**</td>
<td></td>
<td></td>
<td></td>
<td>75*</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>90* / 75**</td>
<td>20* / 15**</td>
<td>10**</td>
<td></td>
<td>50**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>90* / 75**</td>
<td>20* / 15**</td>
<td>10**</td>
<td>25**</td>
<td>50*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ P</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ H</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100*</td>
<td></td>
</tr>
</tbody>
</table>

* issued from qualified random sample, in faecal coliforms simple sample

** Determined from the 24-hour composite sample; NH₄ -N And N₅₋₅ at wastewater temperatures T > 12 ° C

The local water authority defines which treatment efficiency class that is required to be reach for the property owners’ wastewater treatment plant. This depends, among other things, on the location of

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⁴ In the German Construction Products Lists (Bauregellisten) technical rules for construction products and types of construction are consolidated by DIBt.
the small wastewater treatment plant. For protected areas or drinking water reserves, stricter requirements apply, since the purified wastewater must be cleaner. Most often, only treatment class C is required for domestic use. Only in specific cases where special measures for the protection of water are required, further purification requirements may be imposed. As an example class +H is mandatory for discharge into water reserves.

**Maintenance according to “National Technical Approval”**

In the no longer valid “National Technical Approval”, the frequency of maintenance, which is carried out by the manufacture or a specialist company, was specified according to Table 5.

**Table 5 Maintenance interval for small sewage treatment plants**

<table>
<thead>
<tr>
<th>Class</th>
<th>Frequency of maintenance per year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Roughly 2 times every 6 months</td>
</tr>
<tr>
<td>Class C</td>
<td>X</td>
</tr>
<tr>
<td>Class N</td>
<td>X</td>
</tr>
<tr>
<td>Class D</td>
<td>X</td>
</tr>
<tr>
<td>Class C / N / D / +P</td>
<td>X</td>
</tr>
<tr>
<td>Class C / N / D / +H</td>
<td>X</td>
</tr>
<tr>
<td>Class C / N / D / +P &amp; +H</td>
<td>X</td>
</tr>
</tbody>
</table>

The maintenance activities also include the following:

- Inspection of log book with identification of regular operation.
- Functional check of essential mechanical, electrical and other components, in particular the air blower and air lift pump (maintenance of these parts of the plant must be carried out according to the manufacturer’s instructions).
- Functional check of control and alarm function.
- Setting optimal operating values such as oxygen supply and settled sludge volume.
- Examination of the sludge height in the primary settling tank. If necessary the sludge removal should be carried out by the operator (owner). The sludge disposal should be carried out at the latest when sludge storage reaches 70% of its capacity.
- General cleaning work, e.g. removal of deposits.
- Review of structural condition of the plant.
- Control of sufficient ventilation.
- The maintenance shall be recorded in the operating manual.

As part of the maintenance activities, an effluent sample should be taken. The following values are checked:

- Temperature
- PH
- Settleable solids

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5 According to Licensing principles for small wastewater treatment system, according to DiBt, the maintenance frequency can be reduced with electronic remote monitoring.
- NH4-N (for systems with nitrification)
- N anorg (for systems with denitrification)
- Ptot (for systems with P-elimination)

The findings from the maintenance activities are recorded in a maintenance report, which is forwarded to the operator (owner). The operator must attach the maintenance report to the log book and submit this to the authority when requested.

**Maintenance contract**

The German Association for Water, Wastewater and Waste (DWA) draws up uniform technical rules for, among other things, wastewater technology. The technical rules are not legally binding but are seen as general basis for planning and operation of plants for wastewater. In the regulation for design, installation and operation of small wastewater treatment plants with aerobic biologically wastewater, the Maintenance Contract is described.

The nature of the maintenance contract for operators of small wastewater treatment plants is designed to set the framing for maintenance activities. The aim with the contract is to unify the scope of maintenance activities to avoid misunderstandings and enable cost comparisons. The maintenance contract should include the following:

- General information of the parties
- Description of the plant
- Number of maintenance dates
- Obligation to draw up maintenance report
- List of maintenance activities with reference to technical approval standards
- Access to the plant
- Ensuring access to the log book for necessary documentation review
- Assumption of costs of electricity and water during maintenance by the operator
- Cost of maintenance
- Cost of repairs
- Entry into force, period of validity, termination, extension of the maintenance contract
- Authorization for disclosure of the maintenance report by the maintenance operation to the community and the responsible water authority
- Notification of the legal validation and the termination of the maintenance contract to the community and the competent water authority.

The scope and the frequency of maintenance must be carried out at least according to the specifications of the “National technical approvals”. If maintenance is not kept up, the approval standard will be rejected. The presence of the operator during the maintenance is recommended, since the maintenance is helpful for giving advice and raise awareness of the operator.

### 3.4. Country situation and good examples according to poll study

Five regions in Germany have answered to the poll study; Aachen, Kreis Coesfeld, Leizig Land, Kreis Nienburg and Lankreis Vechta.

Only one of the regions, Leizig Land, considers small (on-site) wastewater treatment a large problem their region today. Connection to wastewater treatment systems is 100% in the responding regions, except for Leizig Land that report 20% not connected to approved waste water treatment.
The number of inhabitants/facilities connected to small wastewater treatment has decreased due to connection to the public sewage systems. The load of nutrients from small wastewater treatment on water body recipients has also decreased mainly due to better performing and retrofitted plants. Leipzig Land reports that the load of nutrients has decreased but ammonia is still a problem.

Small onsite wastewater treatment systems have improved in the regions. This is mainly due to:

- Enforcement of change – either connect to the public sewage or implement alternative solution
- Financial incentives were provided for small wastewater treatment plants (SWWTP).
- Plants with improved performance are available
- Maintenance and service reporting database interface system “DiWA” and overall control of the systems.
- A system; demonstration centre LvWL which works as an advice centre.

The most successful ways to improve the small wastewater treatment systems are

- Incentives.
- Fixed dates for installations of new plants
- DiWA system
- The region Kreis Nienburg holds a meeting each year to assess what can be done to improve the situation compared to what has been achieved so far. They hold a team of 4 fully and 1 part-time employed people (2 administrative, 1 full time technician and 1 part-time technician) who are employed specifically for this role. The authority decides what needs to be done and improved in terms of SWWTPs. Additional requirements for the maintenance of every single plant may be issued
- Checking if the plant has been installed correctly.
- Digitalization.

There are requirements of continuous service on small wastewater treatment systems in four of the regions which also make it possible to evaluate the functioning of facilities. Service reporting could be improved by using systems like DiWA.

Further steps that are planned to improve small wastewater treatment include:

- A new central planning for water authority for the region Lower Saxony and local water sub - associations will also have their own planning depending on what is important in their region. Sensitive areas will be a priority.

- Enforcing further connection to DiWA system; there are still some small companies which are not connected to DiWA system. If every company is connected to one system of control there is an efficient way to monitor each treatment plant and each maintenance company adheres to the same principle.

- Advise about which plant to install as it saves time later on.

3.5. Summary – main challenges for maintenance and policy lessons learnt

The main identified challenges are

- Availability of skilled and trained staff for monitoring. Present regulations need to be improved regarding this issue -
• The effects of the court decision that Germany lost. It is unclear how this will affect technical approval and future standards?
• Costs for maintenance control

4. Poland

4.1. Background
In Poland, approximately 70% of the population is connected to public wastewater treatment. There is, however, a large disparity between the country’s urban and rural areas. Over a third (39%) of the Polish population lives in rural areas, and the connection ratio in rural areas is around 30% (Polish Central Statistical Office, 2013). This share is, although, constantly increasing with more and more people connected to the public sewage system. Throughout the last few years, significant growth in the sewage network has been observed. In the years 2007-2013, the sewage network was extended by over 43.4 thousand kilometres, including almost 32 thousand kilometres in rural areas. This has been reflected in more than 797 thousands new sewage connections, of which 465 thousand connections in rural areas.

In the areas in Poland where the sewage infrastructure is insufficiently developed some parts of the inhabitants use on-site systems for collection of wastewater. There are around 2 257 000 septic tanks and approximately 155 000 small wastewater treatment systems in Poland (Polish Central Statistical Office, 2013), see Figure 2. Most septic tanks, around 83%, as well as other on-site wastewater systems, around 91%, can be found in the rural parts of Poland.

For several years the number of septic tanks has systematically declined, at the same time as the number of households connected to public sewage has increased. For example, between 2011 and 2013, the number of septic tanks declined with over 100 000. Another explanation for this trend, besides increased sewage network connection, is that the septic tanks have been replaced with other on-site wastewater treatment systems, mainly biological household wastewater treatment systems. For example, the number of on-site wastewater treatment systems, other than septic tanks, increased from approximately 126 thousand in 2012 to 155 thousand in 2013.
4.2. Important regulations in Poland for small wastewater treatment plants

Poland has introduced the standards and requirements of the WFD and the UWWTD, for harmonizing Polish law with European laws. A number of national laws and regulations are also important for small wastewater treatment plants.

The Water Law Act

The most important legislation in Poland concerning wastewater is the Water Law Act, which entered into force 2002. The Act transposes several directives from the EU, including the Urban Wastewater Treatment Directive. This was done through the National Urban Wastewater Treatment Program, an integral part of the Act on Water Law, for agglomerations with more than 2000 inhabitants. The program also assigned responsibilities for water and wastewater to local authorities (gminas).

Paragraph 42 of the Water Law Act specifies that:

“...in places where the construction of sewage systems would not bring benefits to the environment or would result in excessive costs, use individual systems or the other solutions for the protection of the environment.”

The Polish Water Law defines small wastewater treatment plants as plants for maximum 50 PE and a capacity that does not exceed 5 m³/day.

Law on Maintaining Cleanliness and Order in Municipalities

The Law on Maintaining Cleanliness and Order in Municipalities defines the responsibilities of property owners for maintaining cleanliness and order. It specifies that connection to the public sewage network is not mandatory, if it is technically and economically unjustified. However, the sewage treatment plant must meet the requirements set out in separate regulations (see next
section). This law also specifies requirements for local authorities to keep records on, among other things, the construction of wastewater treatment plants. The local authorities must, among other things, control the frequency of emptying of septic tanks and develop a plan for the development of the sewage system.

**Regulation of Ministry of Environment on conditions of discharges into water and soil (2006)**

In accordance with the Regulation of the Ministry of the Environment from 2006, conditions are set that must be met when discharging wastewater into recipient water or soil, and on substances particularly harmful to the aquatic environment. A property owner is entitled to discharge treated wastewater to the ground if the:

- Amount of wastewater does not exceed 5 m³ per day
- BOD₅ influent wastewater is reduced by at least 20%, and total suspended solids content is reduced with at least 50%

Similar conditions, but with higher requirements, can be found for discharges to water facilities:

- Amount of wastewater does not exceed 5 m³ per day
- Meet the requirements of the UWWTD for 2000 to 9999 pe, set out in Annex I of the regulation

Moreover, the site where the effluent is discharged should be separated with a soil layer of at least 1.5 meters from the highest usable groundwater aquifer groundwater. There are no obligations on removal of nutrients for small wastewater treatment plants.

**Water charges**

Wastewater discharge to municipal WWTP from households is charged monthly with a fee of approximately 2 €/m³ (year 2015 municipal WWTPs). For small WWT systems: the owners pay for transport of sludge from settler (approximately 15 €/m³) (the price depends on the community and municipal WWTPs - differs in various regions of Poland). The owners also pay for the physico-chemical analysis of the wastewaters if they are transported to municipal WWTPs. The price is around 40€ per sample. The owners pay also for maintenance (this depends on the system). The fee system may differ in different communities of Poland.

There are no fees systems for wastewater from small WWT systems or for those who do not have a functioning facility.

**New legislation**

**Regulation of Ministry of Environment on conditions of discharges into water and soil and on substances particularly hazardous to the aquatic environment (2014)**

The Regulation of the Ministry of the Environment from 2014 include regulations specific for the small wastewater treatment plants (§13 5-8). These entered into force on 1th of January 2016.
Effluents from small wastewater treatment plants located outside the urban area may be discharged to soil from the facility if the emissions meet the following conditions:

1. Amount of wastewater does not exceed 5 m$^3$ per day
2. BOD$_5$ influent wastewater is reduced by at least 20%, and total suspended solids content is reduced with at least 50%
3. The site where the effluent is discharged is separated with a soil layer of at least 1.5 meters from the highest usable groundwater aquifer

Effluent from small wastewater treatment plants located in the urban area may be discharged to soil of the facility if the emissions meet the following conditions:

1. Amount of wastewater does not exceed 5 m$^3$ per day
2. Do not exceed the maximum values of pollution specific to agglomeration (in PE) of the area where the holding is situated, as defined in Annex 3 to the regulation
3. The site where the effluent is discharged is separated with a soil layer of at least 1.5 meters from the highest usable groundwater aquifer groundwater

Effluent from small wastewater treatment plants located outside the urban area may be discharged to water facilities if the emissions meet the following conditions:

1. Amount of wastewater does not exceed 5 m$^3$ per day
2. Meet the requirements of the UWWTD for 2000 to 9999 pe, set out in Annex II of the regulation
3. The highest usable groundwater aquifer is at least 1.5 m below the bottom of the discharging equipment

Effluent from small wastewater treatment plants located in the urban area may be discharged to water facilities if the emissions meet the following conditions:

1. Amount of wastewater does not exceed 5 m$^3$ per day
2. Do not exceed the maximum values of pollution specific to agglomeration (in PE) of the area where the holding is situated, as defined in Annex 3 to the regulation
3. The highest usable groundwater aquifer is at least 1.5 m below the bottom of the discharging equipment

4.3. Support programs for small wastewater treatment plants

A number of national priority programs have been introduced the last decade in Poland, concerning small wastewater treatment plants. The programs aim at improving wastewater treatment through funding as well as training activities.

National program: Financial support of on-site wastewater treatment plants and integration of houses to the public sewage system

This program started in 2011 and aimed at improving the quality of surface- and groundwater as well as the living standard in Poland. It also aims at facilitating the fulfilment of the commitment made by Poland towards the UWWTD. The program’s budget was around 48 million euro.
The program was implemented by the National Fund for Environmental Protection and Water Management and is targeted to local authorities and companies. The maximum financing from the program was up to 90% of eligible cost, including 45% in the form of loans and 45% in the form of grants. 10% payment was required. Financing includes small biological wastewater treatment plants up to 50 pe, but only for plants that meet the requirements of the EN 12566-3 standard.

The deadline for applications was in 2013, and 5 800 small wastewater treatment plants were planned to be built that will serve 30 500 people until 2016, see Table 6.

Table 6 Number of small wastewater treatment plants to be built 2011-2013 from priority program “Financial support of onsite wastewater treatment plants and integration of houses to the bulk sewage system”.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of small wastewater treatment plants built</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>362</td>
</tr>
<tr>
<td>2012</td>
<td>2837</td>
</tr>
<tr>
<td>2013</td>
<td>2640</td>
</tr>
</tbody>
</table>

National program: SYSTEM – Support activities of environmental protection and water management

The National Fund approved the SYSTEM program in 2013, which has the aim to support activities of environmental protection and water management, realised by voidships (Polish provinces). The program will continue until 2017 with planned budget of approximately 19 million euro. The beneficiaries of the program are the voidships that can receive loans up to 90% of eligible cost with a low interest rate (1% per year). One of the priorities for financial support is small wastewater treatment plants and building connections to the public sewage system.

European Agriculture Fund for Rural Development

One of the strategic objectives of European Agriculture Fund for Rural Development is rural development. All funded activities are co-funded by the European Agriculture Fund for Rural Development and from national funds. The program for the period 2007-2013 gave the opportunity for receiving grants for construction of small wastewater treatment plants.

Education and training activities

Several educational and training activities regarding small wastewater treatment plants are ongoing in Poland. As example, the national program “Financial support of on-site wastewater treatment plants and integration of houses to the public sewage system” also organized a number of educational meetings with representatives from public administration, together with the Central institute of Mining in 2013-2014. The education targeted representatives of local authorities throughout the country. The aim was to implement the principles of sustainable development for effective treatment of wastewater.

Another example concerns a project from the Polish Ecological Club “Training local government employees in the field of sewage treatment /small wastewater treatment plants”. The project resulted in around 500 representatives from local authorities that participated in training organized all over Poland, which received professional support regarding water protection, construction, operation and economics of small sewage treatment plants.
4.4. Country situation and good examples according to poll study

One community responded to the poll study - the community of Porąbka in the Upper Silesia region. According to Resolution of the Municipal Council no XII/101/2015 (from day 01.12.2015) community Porąbka will implement the program “Building and financing of onsite WWTPs in years 2016-2020”.

Presently, up to 75% of the community housings are not channelized (not connected to municipal WWTP).

The number of inhabitants connected to WWT will be increased because the new program on building onsite WWTPs for 2016-2020 is opened.

Up to now there is no information on parameters of effluents from waste water. More precise data will be available after implementation of the Program. According to the Program, wastewater treatment should result in at least 20% reduction for BOD 5 and at least 50% reduction for total suspended solids.

According to the municipality, it is very important to introduce the mechanisms to obtain (in short time) financial support for buying and construction onsite WWTPs.

In this step – no requirements of continuous service on small waste water treatment systems as the community is in the beginning of the development.

4.5. Summary – main challenges for maintenance and policy lessons learnt

The main identified challenges in Poland are:

- Ensuring access and funding for public sewage system, especially in rural areas
- Replacing septic tanks, especially in rural areas
- High concentrations of nutrients in wastewater
- Education and training for local authorities

5. Sweden

5.1. Background

Approximately 82% of the population in Sweden is connected to the public sewer system. Almost one million households in Sweden are connected to small wastewater treatment plants for less than 200 people, whereof 700 000 have a water toilet connected. Since 1995, emissions of nutrients from small wastewater treatment plants in Sweden have increased. According to the Swedish Agency for Marine and Water Management (SwAM) (2013a) one reason for this is insufficient maintenance regulation and inadequate incentives for house owners to perform maintenance activities. As of today around 130 000 (or 20%) of the small wastewater treatment plants are estimated to not have better treatment than septic tanks (Swedish EPA, 2014 and SMED, 2009), see Table 7, which is not sufficient according to Swedish legislation.

<table>
<thead>
<tr>
<th>Only sludge</th>
<th>Sand filter beds</th>
<th>Infiltration</th>
<th>P-track</th>
<th>Septic tanks</th>
<th>Miniature treatment</th>
<th>Joint facilities</th>
<th>Total</th>
</tr>
</thead>
</table>

Table 7 Technical use of small wastewater treatment plants that are connected to a toilet. Source: SwAM, 2013b
<table>
<thead>
<tr>
<th>separation</th>
<th>plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of plants</td>
<td>132 501</td>
</tr>
<tr>
<td>Share</td>
<td>20%</td>
</tr>
</tbody>
</table>

Inventories from the municipalities show that approximately half of the soil-based small wastewater treatment plants are older than 15 years and in need of upgrading (SwAM, 2013a). Upgrading of the plants is, however, not happening in desired speed. Estimates show that with today’s replacement rate it will take 70 years to upgrade all the installations in need (SwAM, 2013a). While the replacement rate today is 1-2% per year, a sustainable replacement rate should be approximately 5%.

There are a number of reasons explaining why upgrading of small wastewater treatment plants is not happening today. The most prominent is that property owners, who are responsible for maintenance activities, lack economic incentives to replace and upgrade their facilities. Instead supervising local authorities are responsible for ensuring that maintenance activities are carried out through inventories and injunctions, which is costly and not always at first priority. Since there are over 700 000 small wastewater treatment plants in place in Sweden, this results in a vast societal efficiency loss.

The need for upgrading of small wastewater treatment plants in Sweden has led to a number of analyses and political proposals for new regulations. In 2012-2013 SwAM examined the current regulation and prepared policy suggestions to limit the negative health and environmental effects from small wastewater treatment facilities. A new legislation has been proposed during the autumn 2016 to be implemented in 2017.

There is no existing definition of small wastewater treatment plants in Sweden today. The Swedish Environmental Protection Agency (EPA) (2008) describes that small wastewater treatment plants are plants that are built with such a technique that they are designed for only a few households. There is a new SwAM proposal (2016) that adopts the term small wastewater treatment plant for installation for maximum 200 PE. Small wastewater plants’ common denominator is that the municipality environmental committee is responsible for their administrative management. In short, the municipality is responsible for supervision activities and for giving permissions for the plants, while the property owner is responsible for applying for permission before building and for maintenance activities.

5.2. Important regulations in Sweden for small wastewater treatment plants

There are a number of demands put on small wastewater plants which are applied through several legislations and general advices. Sweden, as other EU member states, has implemented EU legislation including for example the EU WFD and the UWWTD. Below is a description of current legislation in Sweden for small wastewater treatment plants. These legislations can mainly be found in the Swedish Environmental Code, the ordinance concerning activities hazardous to human health and the environment, and in the general advices from the Swedish EPA.
Swedish Environmental Code
The EU water framework directive is implemented in Swedish legislation mainly through the Swedish Environmental Code. The Environmental Code defines wastewater as environmentally hazardous activity (Chapter 9) and regulates that treatment of wastewater should be conducted in a way that it will not cause inconvenience for human health or the environment. Moreover, the Environmental Code includes rules of consideration, among others, demand for knowledge and principles on precaution (Chapter 2) that also comprises small wastewater treatment plants. The Environmental Code defines that the property owner is responsible for recognition of health and environmental risks that the facility may cause, and to carry out safety and caution measures to avoid inconvenience for human health and the environment. The property owner is responsible for the functionality and operation of the small wastewater treatment plant.

This legislation today does, however, not include specific requirements on how the wastewater should be treated or how clean it needs to be. Instead legislation states that it is to be treated to protect human health, the environment and management of resources. There are specific requirements though, based on the Swedish EPA’s general advices, which are the agency’s interpretation of the legislation. The requirements vary from case to case and depend on how sensitive the surroundings areas are (see next section).

The Environmental Code also includes regulations regarding permitting and responsibilities for maintenance and control, implying that responsibility for maintenance activities lies on the municipalities. While it is the property owner’s responsibility to make sure that the small wastewater plants fulfil the legislation, it is the municipality’s responsibility to perform supervision and issue permissions. Permission from the municipality is needed for installation and for operating a small wastewater treatment plant, and without this permission the property owner can get fined.

Ordinance on activities hazardous for human health and the environment
Beside the Environmental Code there are other legislations that concern small wastewater treatment plants. The ordinance on activities that are hazardous to human health and the environment (SFS 1998:899) further defines the general provisions of the Environmental Code. It states, among others, that discharge of wastewater to water that only has passed sludge separation is forbidden. This does, however, not apply if it is obvious that emissions do not harm human health or the environment (12 § SFS 1998:899). Moreover the regulation includes provisions regarding permissions and duty to report small wastewater plants (13§ SFS 1998:889).

The Swedish EPA General Advices (NFS 2006:7)
The General Advices for small wastewater treatment facilities from the Swedish EPA are not legally binding, but can be seen as interpretations of the legislation in the Swedish Environmental Code. The advice demonstrates Swedish EPA’s perception on what requirements ought to be implemented according to chapter 2 in the Swedish Environmental Code, for testing and maintenance of small wastewater treatment plants.

The advices are not founded on technical requirements but on performance requirements, i.e. what level of cleaning the installation should have. There are two levels for this; normal protection level, which applies to most areas and high protection level, which applies to especially sensitive areas. The environmental office at the local authority decides the protection level for each installation. The
municipalities are not entitled to make a judgment for a region or the whole municipality, but must assess each specific case. Table 8 summarises the general advices from the Swedish EPA.

Table 8 General Advices from the Swedish EPA (NFS 2006:7)

<table>
<thead>
<tr>
<th>Protection level</th>
<th>Description</th>
</tr>
</thead>
</table>
| Basic requirements | • Surface- and drainage water cannot be directed to the wastewater treatment plan.  
• The installation should be, with exception for eventual filtration, dense enough to prevent leakage of water.  
• The installation’s functionality should be easy to control.  
• The installations should be designed to facilitate maintenance and service.  
• The installation should be designed in such a way that, and placed, so that its functionality can be maintained during its whole life span.  
• There is an operation and maintenance instruction from the supplier.  
• If needed, there should be an alarm installed that warns for eventual disturbances.  
• It must be possible to test outgoing water, if the wastewater is not directed to a closed tank. |
| Normal protection level | **Health protection**  
• Discharge of wastewater will not lead to essential increased risk for spread of contaminants, smells etc.  
• Remaining products, for example sludge is handled in a hygienic manner.  
**Environmental protection**  
• Water efficient technique.  
• Phosphate free washing detergent and household chemicals should be used.  
• At least 90% reduction of organic material (BOD$_7$).  
• At least 70% reduction of phosphorus (P-total).  
• It should be possible to recycle nutrients from the sewage system.  
• Measures are taken to minimize risk for contamination, or other inconvenience, of animals. |
| High protection level | **Health protection**  
• Additional protection beyond the main treatment in the installation, for example more robust installation, more efficient cleaning of contaminants.  
**Environmental protection**  
• At least 90% reduction of phosphorus (P-total)  
• At least 50% reduction of nitrogen (N-total) |

The General Advices, as specified in Table 8, have been criticised for being vague (SwAM, 2013a). There is a need for binding rules as well as clarifications regarding which protection level applies under which circumstances. Moreover, to align the General Advices with the EU Construction Product Directive, a number of minor changes were discussed (2016), for example including BOD$_5$ (instead of BOD$_7$ which is included today) and explanation of what it means for an application that concerns a harmonised standard (SwAM, 2016).

**Proposed changes to legislation**
In the end of 2014 a number of new recommendations and legislations concerning small wastewater treatment plants were suggested by SwAM (2013a). The main suggestions and recommendations from the investigations can be summarized as follows:

- A new constitution regarding small wastewater treatment plants, including replacement of the general advices from the Swedish EPA with new binding rules.
Further evaluation of the sewage system from the government, including possible policies to increase property owners’ incentives to replace ill functional small wastewater treatment plants (economic policies such as tax or fee system were discussed).

Improvement of the supervision of small wastewater treatment plants.

The analysis further concluded that a combination of clearer legislation, economic incentives and more effective supervision is needed to achieve a sustainable replacement speed of small wastewater treatment. Below the main outcomes of the investigation are described.

**Clarification in regulations concerning small waste water treatment plants**

In 2016, changes in the ordinance on activities hazardous to human health and the environment have been proposed by SwAM (SwAM 2016). The new constitution will replace general advices from the Swedish EPA with binding rules in a legal context of ordinance status. The ordinance will assemble the present regulations, as compared to today when they are found in different ordinances and regulations. The aim is also to clarify regulations and to improve efficiency in the permitting and compliance monitoring processes and to ensure the safe function of the wastewater treatment plants with accurate technical and environmental requirements. The ordinance will be in practice from January 1, 2017. Some of the provisions, regarding the system with certified construction and control) and the identification of areas vulnerable to toilet sewage) will be subject to a transition period.

In short, the suggested changes includes the following:

- Areas that are vulnerable to toilet sewage will be identified by a national assessment. This will facilitate identification of treatment requirements for the property owner and the local authority
- A national assessment will also provide a good basis for a consensus view on treatment and monitoring requirements
- Requirements of phosphorous separation will be enhanced in areas with adverse eutrophication effects and where the small waste water treatment plants contribute considerably. Accordingly, the requirements will be decreased in areas where risk of adverse effects is small. By this adjustment, the requirements are customized to the risk of environmental effects from the waste water treatment plant.
- Requirements of knowledge (through certification) for those who build waste water treatment plants and requirements of unbiased control of new plants put into use. This will ensure the implementation of requirements from the permitting process
- Higher demands regarding environmental assessment in the permitting process as well as higher demands regarding monitoring for plants dimensioned for 51-200 pe

SwAM also concludes that in addition to the changes in the ordinance, there is also need for an incentive e.g. a tax or fee in order to achieve a sustainable development concerning rate of implementation of measures.

A number of changes to current legislation have been proposed. Some of the most important changes are summarized below:

- There is a presently a lack of a clear definition of small wastewater treatment plants. The new SwAM proposal adopts the term small wastewater treatment plant for installation for maximum 200 PE.
• In areas identified as vulnerable to emissions of toilet wastewater, emissions of treated or untreated wastewater will not be allowed (permitting authorities may however issue exceptions). In other areas, only emissions of treated wastewater will be allowed. Treatment must exceed septic tank (sludge separation or corresponding treatment). These suggested regulations will apply for new plants and new permit applications.

• SwAM has proposed that a permit is required for construction of a plant, or changes in localization or use (e.g. increasing the load). The permit defines the dimension of the plant, the localization and the technology to be used. A permit is not required for the use of the plant. If use of the plant was to be included in the permit, a large number of existing plants would need to apply for a permit, which would result in a substantial work load for the authorities. The use of the plant is to be regulated by direction orders given by the local authorities. This provides for a larger flexibility to adjust to local conditions in a less bureaucratic manner than the permitting process would imply.

• Only professionals that are certified by an accredited organization (according to EU Ordinance (EG) no 765/2008) are allowed to construct a wastewater treatment plant that requires a permit or notification. The aim is to improve the technical performance of the plants and to guarantee that they are constructed in accordance with the permit.

• The ordinance proposal includes a list of minimum critical information to be included in applications for permits. Different check lists have so far been applied by municipalities, and the new proposal will make the demands on applications for permits more transparent and harmonized in Sweden. More transparent demands will further help the branch to develop facilities that meet the demands.

• Technical dimension of a new plant is to be derived from expected load. A plant intended for up to 50 pe is to be dimensioned for at least five year-round residents per household. Variations in load are to be taken in account in dimensioning the plant.

• Emissions from a wastewater treatment plant should not result in more than negligible risk of infectious contamination of drinking water. If needed, local authorities can require at least 50% expected reduction of total nitrogen.

• Certain dimensioning criteria are suggested (e.g. distance between infiltrating parts and ground water level, distance between infiltrating parts and drinking water source, dimensioning to facilitate service and control and to reduce risk of damage)

• Reduction of organic content, as BOD7 or BOD5, is to exceed 90% (or 80% if only bath, dishwashing and laundry water is treated). Reduction of total Phosphor is to exceed 40%. If the treatment plant is in an area identified as vulnerable to emissions of toilet water, reduction must exceed 90%.

• Today, current provisions regarding time limits for the permission may be misinterpreted. Accordingly there is a suggestion to make the time limits clearer regarding permission. The plant must be constructed within two years after the permission has been issued.

• At the earliest 12 months and at the latest 24 months after the plant is brought into operation, it is to be controlled that the function is in accordance with the operational guidelines. The control is to be performed a professional certified by an accredited organ and is to be documented. The plant is to be continuously maintained according to operational and maintenance guidelines. This is to be controlled by a professional certified by and accredited organ (plants dimensioned for 1-50 pe every ten years, plants dimensioned for 51-200 pe every year)
The suggested changes include stricter demands on waste water treatment plants dimensioned for 51-200 pe regarding permitting and control.

**Economic policies**

One of the reasons for why the replacement rate of small wastewater plants is low is that property owners lack incentives to upgrade their plants. A number of economic policies were suggested by SwAM (2013a) to increase these incentives. The largest socioeconomic loss from maintenance of small wastewater treatment plants today derives from the fact that in reality it is the supervising authority, i.e. the municipalities, that must take action for upgrading to take place, even though the property owner is responsible. Estimates have been made that approximately 10 million EUR could be saved yearly if incentives were transferred to the property owner from the public authority.

Two policies suggested for correcting for this market failure are an environmental tax with tax exemption measures and a fee system that bring back subsidies for measures. Regarding incentives both economic policies would have the same effect, and they are comparable from a cost efficiency perspective. However the fee system would have a larger administrative cost to handle the subsidies brought back. A prerequisite for a tax or a fee system is the introduction of a register or status declaration for the treatment plants. This system can be more or less detailed depending on how the tax or fee system is designed.

SwAM (2013a) suggested that the government should decide on a wastewater investigation where the implementation of a tax or fee system for small wastewater treatment plants is further investigated. This investigation is still under discussion.

**Improving supervision**

An important challenge for maintenance and supervision of small wastewater treatment plants is that the interplay between different authorities needs to be strengthened. Another challenge concerns the need for consensus between municipalities regarding supervision activities and examinations.

There are good examples where local authorities have worked with supervision. A number of factors for good supervision have been identified by SwAM (2015). For example communication regarding the property owners’ own treatment plants, instead of general information or when supervision is followed by demands on measures and prohibitions of faulty treatment plants. It should however be mentioned that the cost effectiveness of the supervision activities have not been taken into account when they have been evaluated. It can be very costly for local authorities to perform the supervision activities.

When it comes to supervision of small wastewater treatment plants, research has shown that “hard policies” such as prohibition and supervision charges have led to the highest replacement rate of small treatment facilities (Wallin, Molander & Johansson, 2011). As an example the Swedish EPA’s supervision project “Små avlopp- ingen skitsak – small wastewater treatment plants – no bullshit”, that focused on information to households and had 137 participating municipalities, showed that the project had little effect on the property owners’ behaviour. Harder measures should, however, be complemented with information investments and social planning that facilitate measures for the house owners (SwAM, 2015).
5.3. Maintenance and supervision of small wastewater treatment plants

SwAM is since 2010 the responsible authority for small wastewater treatment plant up to 200 PE in Sweden. The County Administrative Boards (Länsstyrelser) are responsible for supervision guidance for small wastewater treatment plants towards the local authorities, municipalities, which are the regulatory authorities. The increased environmental pressure from small wastewater treatment plants in Sweden have lately put stress on improved supervision and maintenance activities.

In general, the authorities and municipalities that are responsible for supervision, permits and planning have to make sure that environmental quality standards, i.e. good environmental standard, are achieved. The Swedish municipalities should require high protection level when necessary (see The Swedish EPA General Advices).

The Swedish Environmental Code specifies that permits are needed for installing a waste water facility and that the regulatory authorities (municipalities) have the right to request the information needed to assess the functionality of the facility. More binding and clearer rules have been suggested which include control by an external professional, certified by an accredited organ.

5.4. Country situation and good examples according to poll study

Five municipalities in Sweden responded to the poll study _Skövde, Södertälje, Kungsbacka, Kungälv and Falun. The following text is a short summary of their responses,

The respondents consider small (onsite) wastewater treatment as a large problem in the regions, mainly due to eutrophication, WFD compliance and adverse effects in the local environment, such as odour and health risks.

The number of households connected to small wastewater treatment in the regions varies and have decreased or stayed constant. The reason for a decrease is that there has been an increased connection of households to municipal WWTPs.

The percentage of the population not connected to approved WWT (or connected to systems that need improvement) in these municipalities is 30-50%, with exception of Kungsbacka, that reports 2-3%

The municipalities also report decreased load of nutrients from small WWTP in water body recipients. However, Södertälje also mentions a larger share of hard surfaces which may result in a higher nutrient load in the future.

The decreased load is due to
- improvements of the small WWTPs
- larger number of connected facilities to the M-WWTP.
- The supervision and evaluation of the ecological status in the water bodies has improved This serves as a basis for prioritizing supervision and actions concerning small WWTP
- Successful inventories
- Defined areas (so called 6§ areas) where the county is obliged to provide water services according to national legislation to protect human health and the environment. These defined areas are areas with agglomerated housings. The county government is the regulatory authority of the municipality when §6 is applied. Inspection and control can be done in a more systematic manner over a larger area
Increased demands on entrepreneurs. If the entrepreneur is educated according to a certain system, the onsite wastewater treatment system doesn’t have to undergo final inspection.

The municipalities have tried several methods to improve small waste water treatment plants in their regions. Some examples are

- In 2010, Falun started with government founding to facilities that purified 90% P and information meetings.
- Kungälv has performed inventory campaigns with inspections of the facilities and expressed demands on agreements with companies for service and also agreements on sludge removal on soil based solutions.
- Skövde has enforced a procedure where the property owner is informed well in advance of inspections so they have time to enforce improvements etc.
- Falun has started to use the concept of a legally binding order with information regarding the legal requirements. The property owner can supply information to the municipality regarding the emissions and status of the plant but if this is not satisfactory a legally binding order can include requirements of technical improvement actions or an inspection on site.
- Kungälv has started a campaign with information on the municipal website; information includes a time schedule for inventories in specific regions. There has been increased public awareness and a good response from facility owners who spontaneously have contacted the municipality before being visited asking about their facilities.
- Skövde has also held information meetings. That was effective in creating public interest. Facility owners supplied new plant descriptions after the meeting.
- Skövde has held information meetings for plant owners with entrepreneurs, municipality representatives and waste water treatment advisors The advisors can also make visits on site and recommend improvements. The municipality performed inspections at sites that had not submitted plans for improvement of their plants.
- Skövde has also sent letters to plant owners to enhance permit applications or contact. 50% of the recipients have submitted permit applications or contacted the municipality.
- In Kungsbacka, inspections are performed with a more systematic approach than earlier. Letters are sent to all plant owners in a region, stating why and when inspections will be done. If there are problems, a demand of action will be written directly. It is a more fair and transparent way and includes a fee for all plant operators. Occular inspections are done on all types of facilities older than 10 years.
- Södertälje started an information campaign in 2009-2010 with the aim to attract with subsidies to enforce change. This approach didn’t work so well due to high costs. After that the municipality has enforced rules and regulations which has been more successful.
- Södertälje also arranged an exhibition where contractors could show their technical solutions. This was quite popular but did not achieve substantial change.

The most successful ways to improve the small wastewater treatment systems reported by the municipalities were

- Increased municipal supervisions and demands with clarified information to the plant owner.
- Informative time-schedule on the municipal website, about inventories to be done in certain regions, together with an interview of the municipal personnel about what they will check during inventory and pictures of persons coming to do inventories.
- Letters to plant owners to enhance permit applications or contact.
- Transition to mandatory regulations and fixed dates for action.

The effect of the improvement initiatives have however not been evaluated systematically.
There are requirements of continuous service on small wastewater treatment systems. Some municipalities report that it is not possible to assess that the service actually is performed. Service reports are not collected at the municipality. The municipalities do not have enough capacity to assess them.

Several municipalities report that presently, it is not possible to evaluate the functioning of facilities from the service-reports. The functioning control is performed by technically skilled staff but the content in service report varies substantially, as there is no common format. There is not enough information in the service report, to determine if the plant is functioning well or not. Service reporting could be improved by

- introducing simplified clear harmonization of tests, and analysis parameters that can indicate dysfunction (surrogate parameters)
- Digital reports would be good, with yellow or red lights if there are problems
- Quick-tests are good if you choose right test

The next steps planned to improve small wastewater treatment in the regions are

- Supervision plan, 20 areas that optionally can be §6 areas or be handled with small WWT systems and supervision still remains
- Continuous inventories and control, and connections to large WWTP
- New action plans for the water management according to the WFD. Areas that are considered as higher protection. No large problems with the River Dalälven, so the normal protection level is enough.
- Focus is put on groundwater, to increase the protection distance, now 1 m between the bottoms and the groundwater level. In the future 1.5 m distribution pipe to the upper groundwater surface.
- Evaluation of ecological footprint for the onsite WWT systems
- Testing of surrogate (indicator) parameters and discuss demands on standard methods for the parameters to improve service reports.

5.5. Summary – main challenges for maintenance and policy lessons learnt

Since 1995, emissions of nutrients from small wastewater treatment plants in Sweden have increased. According to the Swedish Agency for Marine and Water Management (SwAM) (2013a) one reason for this is insufficient maintenance regulation and inadequate incentives for house owners to perform maintenance activities.

While there are municipalities that have been able achieve effective supervision, most often by combining information campaigns with pressures through penalties, many local authorities do not prioritise these tasks. A new legislation is now being developed and more binding rules, both regarding maintenance and supervision and for reduction requirements, would be a welcomed improvement by many. Economic policies are also being discussed as a way to create incentives for property owners to replace their old plants that are in need of upgrading.
6. Lessons learned and recommendations

The load of phosphorous and nitrogen contributing to eutrophication of the Baltic Sea, as well as emissions from hazardous substances, from small wastewater treatment plants are of great environmental and health concern. This report has mapped out current legislation for small waste water treatment plants in three EU countries, namely Germany, Poland and Sweden, which have different conditions and challenges.

Germany has a well-developed regulation system for supervision and maintenance activities, compared to the cases of Poland and Sweden. The German legislation specifies that, for example, data regarding performance of small waste water treatment plants must be stored and available for inspection from relevant authorities when asked. This has laid the foundation for a number of technical approvals and norms regarding supervision and maintenance, including economic incentives for the property owner, in order to have facilities in place that achieve specified requirements.

Due to a recent EU verdict the German system with standards and technical approvals are, however, now questioned, and it is unclear how this system will evolve. The German case could still serve as an inspiring example on how supervision and maintenance activities could be carried out. However one must take into account that the standards and norms in Germany concern small sewage systems, which for example are not as common in Sweden as in Germany. This system also comes with administrative costs, at least initially, which may put pressure on local authorities that are already having problems with prioritizing supervision activities. A great challenge for Germany is to find technical and competent personnel with the right education and knowledge to assess the facilities. The same can be said for both Poland and Sweden. Recommendation is to support education of personnel to handle and assess small plants.

In comparison, Sweden serves an example of a country with vaguer rules regarding maintenance and supervision, which has led to criticism and requests for clearer and binding rules on how regulating authorities should carry out supervision activities. The main challenges for Sweden lay in finding policy solutions for more efficient replacement of miss-functioning plants and in the unclear legal status of the requirements that plants must achieve. The property owners lack incentives today to replace facilities that are not working properly, instead it is the regulatory authority that after inspections issue orders which plants that must be replaced, which from a cost-effectiveness perspective is an inefficient way of addressing the problem. While there are municipalities that have been able achieve effective supervision, most often by combining information campaigns with pressures through penalties, many local authorities do not prioritise these tasks. A new legislation is now being developed and more binding rules, both regarding maintenance and supervision and for reduction requirements, would be a welcomed improvement by many. Economic policies are also being discussed as a way to create incentives for property owners to replace their old plants that are in need of upgrading. Recommendations are to support and encourage information and control programs in a prioritized order with regard to WFD status to improve the small WWT systems. Recommendation is further to implement economic incentives to increase replacement speed.

Poland is a country with a relatively large share of the population not connected to the public sewage system, especially in its rural parts, although this share has been steadily declining. Regarding small wastewater treatment plants, recent regulations have led to improvements Capacity building is a
great future challenge. Recommendations include ensuring funding for public sewage system, especially in rural areas. It also includes replacing septic tanks in rural areas and providing knowledge transfer and education and training for local authorities.

From an EU perspective, one of the biggest challenges lays in the fact that EU-wide regulation does not enforce stringent policies for small agglomerations, less than 2 000 PE, without sewerage network. Ensuring that rural areas in EU have access to treatment plants will be a great future challenge. Still many Europeans live outside the EU wastewater system, which puts pressure on national authorities to set out laws and regulations.
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