8. Waste water treatment

1. Please describe the present situation and development over the last five to ten years in relation to the proportion of total waste water treated in accordance with the Urban Waste Water Directive (max. 1,000 words):

Waste water treatment in Hamburg fulfils the requirements stipulated in the 1991 EU Commission directive on urban waste water treatment to 100%. With a current influent load of 2.7 million population equivalents (p.e.), the combined Köhlbrandhöft/Dradenau treatment plants treat around 150 million m^3 of waste water per year. The average effluent concentrations of 49 mg/l and 4 mg/l in terms of the parameters COD and BOD_5 are significantly lower than the respective reference values of 125 and 25 mg/l. The threshold for total phosphorus of 1 mg/l is being undercut by 30% on average. Annual reduction of the total nitrogen load has been significantly higher than 70% (for example, a constant 78% in the period 2005-2007). The minimum requirements have, therefore, clearly been exceeded.

On top of this, a further catchment area with approximately 80,000 p.e., Buxtehude/Apensen, was connected to the combined waste water treatment plants in 2003. The corresponding increase in the pollution load of around 3% was balanced out by a patented SAT (store and treat) biological centrate treatment plant which reduced nitrification in the main flow, and that had meanwhile been built and put into operation by the “Hamburger Stadtentwässerung” (Hamburg Public Sewage Company) HSE.

Prior to 2000, waste water treated in the Hamburg treatment plants only met around 90% of the EU directive requirements. Problems arose in the area of denitrification due to the fact that, as Hamburg is located in the North Sea catchment area, the city was required to meet the directive’s special requirements pertaining to sensitive areas. These stipulate an average total nitrogen concentration in effluent of maximum 10 mg/l, or at least a 70% reduction of total nitrogen in the treatment plants. While the central combined treatment plants Köhlbrandhöft/Dradenau – then serving 1.85 million p.e. – already met these requirements, the Stellinger Moor plant, which served approximately 250,000 p.e., did not have a large enough biological process to achieve the reference values. As a consequence, in order to comply with German waste water treatment regulations, in 1990 the Senate of the Free and Hanseatic City of Hamburg had already resolved to close the Stellinger Moor treatment plant and connect the west Hamburg catchment area to the central combined treatment plants by 2000. Throughout the

1990s, the conditions were gradually created for the planned change-over, including construction of a new pumping plant for the transfer of raw water, construction of the Altona transport sewer with its capacity of up to 2 m^3 of waste water per second, and the building of the west culvert beneath the Elbe on the inflow to the combined treatment plants Köhlbrandhöft/Dradenau. A variety of capacity increment analyses were carried out within the combined treatment plants. These encompassed an analysis of the treatment capacity according to statistical measuring criteria as well as a dynamic treatment plant simulation including the anticipated inflow loads from the Stellinger Moor catchment area. This included testing various development and optimisation concepts in terms of their impact on effluent quality. As a result of this comprehensive planning, the catchment area change-over was essentially secured by expanding the intermediate storage basin for the centrate produced by dewatering digested sludge, an internal return flow with a high ammonia content. The storage basin allows centrate quantities to be controlled, consequently balancing out the burden on the biological treatment stage.

With the high connection degree (approximately 99%) to the high-capacity central sewage treatment plant Köhlbrandhöft-Dradenau, there are but few decentral sewage treatment plants left in Hamburg, which, in accordance with the „EU Council Directive concerning urban waste-water treatment“, cannot be replaced by a connection to the public sewer system, even in the long run. With an ordinance for Hamburg’s administration (Globalrichtlinie D1/99: Global Directive of 10.05.2005 for steering water rights consent processes on discharging household effluent from waste water treatment plants with connected loads of up to 150 population equivalents), Hamburg has stipulated a markedly higher benchmark as regards the purifying capacity of small waste water treatment plants than the minimum requirements defined in the German Federal Waste Water Ordinance. For the protection of Hamburg’s lakes and waterways, this ordinance puts special emphasis on nitrogen removal (nitrification and denitrification). These requirements developed in Hamburg have meanwhile also been adopted in the technical approval procedures for small sewage treatment plants, which are handled centrally for all Germany by the „Deutsches Institut für Bautechnik“ (German Institute for Building Technology).

2. Please describe the measures implemented in the last five to ten years to improve waste water treatment (max. 1,000 words):

2.1. Alster and Elbe relief concept

Hamburg's Public Sewage Company HSE has successfully concluded two large-scale investment programmes in the past ten years. The objective was to significantly reduce within the collecting system the overflow of combined water running into lakes and waterways, by means of the construction of combined water storage basins and sewers. Therefore, now 90% of the separable or biodegradable pollution load transported by rainwater through the sewerage system flows to treatment plants for treating. Together the two programmes (Alster and Elbe relief concept) created more than 135,000 m^3 of combined water storage. The quantity of combined water overflow was reduced by over 90% as compared to the level early in the 1980s, while the quality of the lakes and waterways has since improved considerably.

2.2. Process for the treatment of process waste water with a high ammonia content

In 1999, Hamburg's Public Sewage Company HSE developed an innovative and patented treatment process for return flows with high ammonia content from the sludge dewatering process. This so-called "store and treat" (SAT) process allows quantity management and biological treatment of process waste water to be carried out simultaneously in the same basin. On account of the high concentration levels of ammonia in the influent, nitrification can be stopped after the nitration stage and the nitrite formed in the treatment plant main flow can be directly denitrified. In this way, 25% of the oxygen normally required for nitrification can be saved. The amount of energy required is also reduced accordingly.

The first SAT reactor, with its 4,000 m^3 capacity, was put into operation in 2002 and complimented with a second reactor of similar capacity in 2005. On average, the facility nitrifies around 3,400 kg of ammoniacal nitrogen per day, which correspondingly reduces the burden on the main flow through the treatment plant.

2.3. Energy production from treated sludge

In terms of sludge treatment, for around 10 years the combined treatment plants Köhlbrandhöft/Dradenau have been equipped with a modern and efficient chain of processes encompassing the sewage sludge treatment stages of thickening, digestion, dewatering, drying and

incineration. In addition to the safe disposal of residue, the aim of this chain of processes is to optimally exploit energy resulting from the treated sludge. To this end, the sewage gas formed during the anaerobic digestion of sludge is converted into electricity in a gas turbine and gas motor, whereby the heat and the steam produced through the thermal exploitation of the sewage sludge is also used to generate electricity as well as to heat the digestion plant and plant buildings. As a result, the combined plants are able to self-generate almost 100% of their heating requirements and more than 60% of their electricity.

The treatment plants aim to generate a completely self-sufficient energy supply in the coming years through further optimisation measures. The sewage sludge incineration plant VERA was presented to the public as an official EXPO project in 2000.

2.4. Optimisation of secondary settling tanks

In order to improve filtration performance in the secondary settling tanks in the Dradenau treatment plant, including during periods of extreme hydraulic loads, a variety of optimisation measures were implemented. These measures included, amongst others, the installation of skimming and guide partitions as well as a grid to reduce the power of the inflow current. In a further phase, the tanks will be equipped with an online sludge level measurement system to support the timely recognition of malfunctions.

2.5. Analyses for more comprehensive waste water treatment

The general objective of implementing the EU Water Framework Directive is to achieve good water quality in Hamburg’s lakes and waterways by 2015. As a consequence, Hamburg’s Public Sewage Company HSE is currently investigating which priority substances stipulated in the directive that have a hazardous impact on lakes and waterways but are yet to be treated, are present in the effluent from the Köhlbrandhöft/Dradenau combined waste water treatment plants and in what quantities these substances are emitted. Based on the results, the impact of the treatment plant effluent on pollution in the Elbe can be assessed in terms of individual substances in order to subsequently develop any necessary strategies to remove the substances in question.

2.6. Hamburg initiatives to achieve sustainability in waste water management

2.6.1. Separation of yellow water

Sustainable waste water management has been a top priority in Hamburg for more than a decade.

In addition to the urban concept for public toilets in Hamburg, which are all equipped with energy and water saving technologies, urinals have been installed in critical and overly polluted locations. The urinals are operated without water, and the urine is separately collected and transported.

Urine makes up only around 1% of the volume of waste water, but is responsible for the majority of nutrients contained in it. Furthermore, specific pharmaceuticals are introduced into waste water via urine. Without treatment, such undesired residue medication ends up in lakes and waterways. The separate collection of urine is also significant because nutrients and phosphorus can be removed and – as recyclable materials – used for alternative purposes, such as fertilisers.

This technical development was undertaken in cooperation with the urinal operators, JCDecaux and shows that 85% of nitrogen and over 90% of phosphates can be removed from the urine. The elimination of micro-pollutants is also achievable.

On the basis of these positive results, Hamburg is endeavouring to develop the separate collection of urine on a larger scale.

2.6.2. Hamburg Water Cycle

The “Hamburg Water Cycle (HWC)” concept was developed with the objective of improving the sustainability of water management in the future. The concept aims to separate the collection, drainage and treatment of rainwater, grey water and black water material flows in order to avoid the dilution of pollutants. Waste water separation and treatments adapted to individual material flow compositions have the potential to reduce purification costs for the majority of waste water and improve utilisation of the recyclable material and its energy content. This concept is also suitable for application in existing cities.

The HWC will be initially introduced in an urban environment for 720 residential units on an approximately 35 ha large area within the scope of the

Hamburg International Building Exhibition (IBA 2013). The goal is to create a green, water-rich and climate-neutral residential area.

2.6.1. Thermal load scheme for the tidal Elbe river

All over europe, the construction of numerous new power plants is being planned, and at the lower reaches of the river Elbe, too. In order to ensure that the heat loads discharged into this stream remain water-ecologically sound and that the Elbe habitat is protected permanently, the Federal States Hamburg, Niedersachsen and Schleswig-Holstein have conjointly decided to create a new thermal load scheme for the tidal Elbe river. By means of transstate-coordinated requirements, this scheme aims to offer a higher planning security for the power plant operators as well as permanently rule out any harmful water use. The thermal load scheme defines a technical framework which is based on the requirements of the European Fauna, Flora and Habitats Directive, the Water Framework Directive, and the Fish Directive and which shall ensure an effective protection of the Elbe and its creatures. The thermal load scheme is anticipated to enter into effect on 1. January 2009.

4. Please describe how the above issues can be documented should your city be short listed for participation in the second phase of the evaluation (Documentation should not be forwarded in this phase) (max. 600 words):

• Printed papers

Hamburg Parliament document 9/4319 (16.03.1982) “Concept for reducing the overflow from the combined water sewage system into the Alster and its tributaries” (Konzept zur Entlastung der Alster und der Nebengewässer von Überläufen aus dem Mischwassersielnetz), see attachment “9-4319 Alster”

Hamburg Parliament document 15/1775 (06.09.1994) “Elbe relief concept“ (Elbe-Entlastungskonzept), see attachment „15-1775 Elbe Relief Concept“

Hamburg Parliament document 11/6118: “Combined waste water treatment plants Köhlbrandhöft/Dradenau – Bille relief concept” (Klärwerksverbund Köhlbrandhöft/Dradenau), see attachment „11-6118 Bille Relief Concept“

Hamburg Parliament document 16/4843 (26.09.2000) “Report on the waste water disposal plan” (Bericht

Abwasserbeseitigungsplan), see attachment „16-4843 Waste Water Disposal Plan“

Hamburg Parliament document 17/2299 (19.2.2003) “Mid-Bille redevelopment programme” (Sanierung der Mittleren Bille), see attachment „17-2299 Mid-Bille“

Hamburg Senate document 1999/0041 “Determination of the impact of damaged waste water sewers on groundwater” (Ermittlung der Auswirkungen schadhafter Abwassersiele auf Grundwasser), see attachment „99–0041 Waste Water Sewers“

Hamburg Parliament document 16/785 of 13.05.1988: "Determination of the impact of damaged waste water sewers on groundwater" ("Ermittlung der Auswirkungen schadhafter Abwassersiele auf das Grundwasser"), see paper attachment 1

• Publications

“Upgrade of Hamburg’s canalisation” (Ausbau der Entwässerungsanlagen in Hamburg), 1983, see paper attachment 2

Technical Report 3/1998, Hamburg Public Sewage Company HSE: “The river Elbe relief concept” (Hamburger Stadtentwässerung, Fachbericht Heft 3/1998: “Das Elbe-Entlastungskonzept – Durch Gewässerschutz zu gesünderer Umwelt und höherem Freizeitwert”) see paper attachment 3

Technical Report 4/2000, Hamburg Public Sewage Company HSE: “Waste water disposal in Hamburg” (Hamburger Stadtentwässerung, Fachbericht Heft 4/2000: „Abwasserentsorgung in Hamburg – Gesundheitsvorsorge durch Entsorgungssicherheit, Gewässer- und Umweltschutz”), see paper attachment4

Report of the Free and Hanseatic City of Hamburg: “Long-term strategy for reducing pollutant discharge into the river Elbe and the North Sea” (Bericht der FHH: “Langzeitstrategie zur Verminderung der Schadstoffeinträge Hamburgs in die Elbe und Nordsee”), see paper attachment 5

“Waste water disposal plan of the Free and Hanseatic City of Hamburg”(Abwasserbeseitigungsplan der FHH), see paper attachment 6

“Waste water disposal plan of the Free and Hanseatic City of Hamburg”, 2000 (Abwasserbeseitigungsplan der FHH) see paper attachment 7

“The river Bille relief concept” (Das Bille-Entlastungskonzept)

http://www.hamburgwasser.de/cms/website.php?id=/de/index/leistung/abwasserentsorgung/gewaesserschutz/billeentlastungsprogramm.htm

Press report on the Hamburg Senate’s concept for public toilets, 06/2000, see paper attachment 8

Press report of the separation of yellow water, 05/2006, see attachment “Yellow Water”

Certificate 2006 „Green Goal”, see attachment “Green Goal”

Environmetal reports 2007, “Hamburg Wasser” (Hamburg Water), see paper attachment 9

• Statistics

HSE/HW business reports 1995-2007 and flyers, see attached business reports in paper 95-98(paper attachments 10-13), pdf 99-03 and web links:

2007:
http://www.hamburgwasser.de/html/img/pool/gb_2007.pdf
2006:
http://www.hamburgwasser.de/html/img/pool/gb_2006.pdf
2005:
http://www.hamburgwasser.de/html/img/pool/gb_2005_hse.pdf 2004:
http://www.hamburgwasser.de/html/img/pool/gb_2004_hse.pdf

Action Concept “Hamburg Wasser” (Hamburg Water):
http://www.hamburgwasser.de/html/img/pool/broschuere_handlungskonzept.pdf

Environmental Statement 2007 “Hamburg Wasser” (Hamburg Water):
http://www.hamburgwasser.de/html/img/pool/emas_umwelterklaerung_hw_2007.pdf

• Flyers:

http://www.hamburgwasser.de/html/img/pool/broschuere_wasserkompetenz_aus_einer_hand.pdf

http://www.hamburgwasser.de/html/img/pool/broschuere_umweltschutz_fuer_die_hansestadt.pdf

http://www.hamburgwasser.de/html/img/pool/broschuere_schutz_vor_starkregenfolgen.pdf

http://www.hamburgwasser.de/html/img/pool/produktblatt_entsorgung.pdf

http://www.hamburgwasser.de/html/img/pool/produktblatt_kanalnetz.pdf

http://www.hamburgwasser.de/html/img/pool/produktblatt_klaeranlagen.pdf

• Coalition Agreement of Hamburg’s governing parties for the current 19th legislature period, 2008, see attachment “Coalition Agreement”

- Globalrichtlinie D1/99 (Global Directive of 10.05.2005 for steering water rights consent processes on discharging household effluent from waste water treatment plants with connected loads of up to 150 population equivalents), see attachment “global directive 2005”)
- Status report: see attachment “status report”
- Thermal load scheme, see attachment „Wärmelastplan“