THE EMSCHER RIVER - A MODEL OF INTEGRATED WATER MANAGEMENT IN AN URBANIZED AREA: PROBLEMS AND CHALLENGES

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ABSTRACT

In the industrial centre of West Germany (the so-called Ruhrdistrict) difficult water problems arose with the fast growth of industry and population in the second part of the last century. Structures of an integrated water management had been established in those years which proved worthwhile up to now. But new influences and developments require further progress to keep the system in an efficient and acceptable state.

THE EMSCHER RIVER AREA

The Emscher is not a big river. But it drains a densely populated (2.4 million people) and industrialized area in the western part of Germany. Coal mines, steel and chemical factories characterize the economic structure of this district. Some of the largest German cities are situated in the Emscher catchment area in a very tight mutual neighbourhood, similar to just on big city. And this city needs a main sewer for waste water and storm flow; the Emscher river.

Usually the Emscher is looked upon as a river deliberately sacrificed to urbanization by transforming it from a natural watercourse into a sewage canal. But that was an almost inevitable fate, when within a few decades in the second half of the last century the former rural area grew into the main industrial district of Germany. The same happens to many tributaries of the Emscher river.

In consequence of this system the main (biological) waste water treatment takes place at the mouth of the Emscher river before running into the Rhine river. With a capacity of 5 million people (and people equivalent) the Emscher Mouth Treatment Plant ranks among the biggest plants in the world. Within the district a few pretreatment plants exist for sedimentation only (Figure 1).

It is not unusual to include small natural watercourses in a municipal sewage network. But in most cases they are flowing in pipes like sewers. On the contrary in the Emscher area they normally have remained in an open state. What is the reason?

- Flow from the edges of the catchment area to the main treatment plant takes more than ten hours. Decay of the organic components of the waste water can be assisted by sufficient oxygen access to the water body in an open atmosphere.
- Due to the extensive sealed surface very large amounts of storm water have to be coped with. Reasonably this can only be done with open watercourses.
Underground coal mining created and still creates subsidences up to 25 metres. So the Emscher river and its tributaries often have to be regulated. The subsided land must be protected by high dams against flood damages and many pumping stations care for the drainage. This constant regulation work can be done best in a system of open watercourses.

INTEGRATED WATER MANAGEMENT

The coincidence of the nearly explosive development of the Emscher area and the damages caused by the coal mines created severe water and waste water problems in most parts of the area. Experiences proved that it was almost useless to take remedial actions on a local basis. Only coordinated measures in accordance with a uniform plan could result in a successful solution to the difficulties. So the leading and responsible persons from municipalities and industry of the Emscher area came together in 1899 and postulated two principles:

- water management had to include the whole Emscher area and to work along a comprehensive plan;
The Emscher River - a model of integrated water management

- water management had to integrate drainage and regulation of flow conditions, flood protection, waste water transport and waste water treatment - all this under the conditions of subsidences and damages caused by coal mining. (Water supply could not be part of the integrated water management, because potable water in sufficient quantity is not available in the Emscher area, and is therefore supplied by waterworks along the Ruhr river running to the south of the area. - Local sewerage remained the responsibility of the municipalities.)

Thus the Emschergenossenschaft (Emscher River Association) was founded in 1904 by a special law (Emscher Act) of the former Prussian state.

The joint effort of all association members resulted in a significant improvement of water conditions in the Emscher area within a few years, forming a starting point for further steps according to continued development of the area and growing environmental demands.

EMSCHERGENOSSENSCHAFT - STRUCTURE AND ORGANIZATION

The Emschergenossenschaft (EG) can be looked upon as a democratically organized association with the right of self-administration conceded by law. Members include all the municipalities within the Emscher area and the industrial enterprises, the latter only if reaching 1/10 000 of the total charge. The members are represented in the General Assembly, the supreme body of the EG, which is responsible for the most important decisions regarding the construction programme and budget affairs. It elects the Board members out of its midst. There are no members appointed by the state. Governmental supervision is restricted to control that EG works in accordance with the Emscher Act. Nevertheless EG has to act within the scope of governmental water policy and to comply with governmental laws and regulations.

The association members have to pay charges to finance construction, operation and maintenance. The charging takes in to account quantity and quality of waste water, paved surfaces (for management of storm flow) and damages through coal mining. The costs of the watercourses and the waste water treatment plants are totalled and distributed among all producers of waste water and storm flow regardless of what facilities they are connected to. So the association is able to use the financial means in the most effective way to the benefit of the whole river system.

It should be mentioned that EG and Lippeverband (Lippe River Association, founded in 1926 with similar responsibilities for the Lippe river area north of the Emscher area), notwithstanding their legal independence and their own governing bodies, are administered by the same joint staff with a chief executive, three directorates, 19 departments and 1 350 employees.

349
PROBLEMS

Damages by coal mining

Due to the coal sales problems ("coal crisis") coal production has been reduced. So incidences of surface subsidence are on the whole declining, but they are more concentrated and therefore cause even greater difficulties to water management. Always additional dams must be constructed and existing dams heightened to protect subsided land against flood damages. New pumping stations supplement the association’s network of artificial drainage. Almost 40 percent of the Emscher area is already served by 90 pumping stations with capacity for large storm flows (Figure 2).

Figure 2. Parts of the Emscher area drained by pumping stations.

Increase of flood

Although the number of inhabitants in the Emscher area is slowly going down, the extent of paved surface is still increasing (Figure 3). This development simultaneously leads to greater storm flow. In many cases EG has to enlarge the capacity of watercourses and pumping stations. The heightening of bridges, especially for railroads is very expensive, because the maximum slope is strictly limited and large lengths of track on both sides of the bridge also have to be raised.

Of course whenever possible storm water is stored in retention basins. But in the densely populated Emscher district it is difficult to find space to construct basins with the necessary storage capacity.
Nevertheless the number of retention basins has become so great that strategies to operate the system in an optimal manner are to be developed. Radar observation will be part of the system in order to estimate the rainfall still to come. The best way to prevent flood increase is to improve the seepage rate of precipitation.

**Reclamation of natural watercourses**

The conversion of former natural rivers and brooks in the Emscher district at the end of the last century into facilities for waste water transport must not be permanent and irreversible. With the reduction of coal mining and the movement of mining to the north several parts of the Emscher area are no longer influenced from subsidences. The EG endeavors to "renaturate" the watercourses in those parts after separating waste water from clean water.

**Altering conditions of the Emscher river**

The Emscher has until now been a "black river", characterized by the effluents of coal mines. But the continuing black colour covers the fact that the quantity of coal residue is declining. The organic material from domestic sewage and the nutrition industry gains the upper hand with the consequence, that anaerobic decay and occasionally odour nuisance occur during hot weather and low flow periods, giving rise to complaints by citizens in the neighbourhood of the Emscher river. To meet this difficulty, at several points along the Emscher river the EG supplies the river water with oxygen either in gaseous condition or in liquid state as hydrogenperoxide. Thus anaerobic processes and the production of foul-smelling hydrogensulphide are prevented. But the oxygen supply is regarded as a provisional measure only. In the long term the cause of the problem has to be faced, i.e.
the load of organic matter must be reduced. A large new treatment plant in the upper part
of the Emscher river is under design particularly to clean the highly polluted waste water
of the city of Dortmund and its big breweries.

FUTURE PERSPECTIVES

The additional treatment plant in the Dortmund area and perhaps - if necessary - one or
two more pretreatment plants will not substantially change the Emscher system. The
Emscher Mouth Plant will continue to work as the main and final treatment and to be
responsible for a well cleaned effluent to the Rhine river. The Emscher river itself will
continue to be the main sewer of the district. Its pollution will be kept below the limit of
nuisance danger but cannot be reduced to such a degree that the Emscher could be looked
upon as a clean river with fish life and so on. Even if all the waste water in the Emscher
area could be treated near its place of origin the Emscher could not recover to a "healthy"
river due to the bad ratio of 1 : 4 between original water and used water. This poor
dilution of even well cleaned waste water is not able to ensure the requirements of a
biologically sound river.

It may be possible to get the Emscher water "clean" in the sense of transparent instead of
turbid at present and in the foreseeable future. To reach this mere optical effect, however,
a great number of additional treatment plants would have to be erected within the Emscher
district. Apart from the high expense another problem is even more difficult: to find the
numerous places for the plants in an area which is crowded with houses, factories and
traffic facilities. People are always inclined to demand a better environment but don’t like
to have the necessary plants just in front of their door. These considerations result in the
conclusion that from today’s viewpoint the poor effect of scattered waste water treatment
within the Emscher area don’t justify the enormous expense and battle against great
difficulties. But today’s viewpoint must not be the viewpoint of tomorrow. Therefore all
steps and decisions of the EG have to take in to account an "open future" and may not
obstruct the way to further progress. Future generations perhaps will have better or more
technical and financial means to reduce the burden that was laid on the water conditions of
the Emscher area by it’s rapid growth to the big German industrial zone.