Thoughts on Sediment Management

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I would like to take the opportunity of this 8th International SedNet conference to draw some general conclusions on sediment management. It will be a personal talk, based on 30 years of work in the dredging department of one of Europe's biggest ports. And I have to say at the very beginning – my perspective is rather contamination related. There are – of course – other valid views on sediments, including those related to ecology, hydro-morphology, use as construction material, etc. To get a complete right picture all of these have to be considered.

To begin with wording. In the 1980's we talked about dredging and about dredged material disposal; today we talk about sediment management. This sounds simple and logical, but it means a total shift in the scope of investigations and solutions.

In 2000 the Water Framework Directive came into force, followed by the Marine Strategy Framework Directive in 2008. Both are based on system thinking. System thinking also became relevant to managing dredged material. Sediments are taken from the aquatic system, and the main objective is for them to remain in the aquatic environment, but at another site where they do not hinder navigation. This requires proper understanding of the systems we are acting in. We have to manage those systems. Managing sediments is Working with Nature.

Nevertheless, whilst in 2013 we know a lot about dredged material management, we still do not have a coherent, overarching concept of river basin sediment management. This is something I want to elaborate a bit in my talk today.

There is a challenge in talking about sediments. They are intrinsic element of aquatic system, as recognised in one of our central SedNet messages. But they are under water; mostly we can't see them. They move in the water, but on a very different time scale. Sediments only move occasionally - at least in significant amount - and often when higher discharges occur. In the meantime, flowing waters continuously connect downstream regions with those upstream. These differences make it difficult to establish a direct relationship between sediment sources and sinks. Those regions are separated not only in space, but also in time. This is why we talk about sediments as being the long term memory of a river. Over the travelling distance sediment not only get spread out, they also get diluted. Out of one primary source of contamination, many smaller, temporary or secondary sources evolve. Contaminants which were discharged decades ago may end up bound to particles in the sea much later, when the original source does not exist anymore, but with in lower concentrations.

This is something scientific people know well, but it is a central challenge in river basin sediment management. Law makers seem to have forgotten sediments when they created

the WFD. There are rarely provisions for sediments in the directive, and the same is true for about 30 European guidance documents for implementation of the WFD. Only the so-called Daughter Directive, published in 2008, formulates a requirement:

> Member States shall arrange for the long-term trend analysis of concentrations of those priority substances that tend to accumulate in sediment … They shall take measures aimed at ensuring, … that such concentrations do not significantly increase in sediment and/or relevant biota.

At first glance this seems fine, but nothing is said about how to ensure this, and who should to take care of this. When you have the results of a long-term analysis it may be too late to take efficient measures against an increase in downstream concentrations. There are no clear provisions in the WFD itself to support this objective

In the 1980s the dredged material problem was recognised in many ports world-wide. However, recognition was not sufficient: solutions had to be developed as there were none at hand. When we talk about dredged material we are often talking about huge amounts, and the mix of contaminants makes treatment difficult

Pretty soon it was realised that there is no one-size-fits-all solution; solutions had to be tailor made to the specific case. Rotterdam built its Slufter disposal site next to the North Sea. Hamburg is further away from the sea: we did not have that possibility. Our concept became more technological. Technically speaking both solutions are confined disposal, as has also proven to be the best solution for large amounts of contaminated sediments elsewhere.

Today many case studies exist, world-wide. It can be concluded that any disposal or treatment of contaminated sediment is very costly – more or less. And also treatment and disposal have environmental impacts, be it space, energy, chemicals etc. For society this handling of dredged material can be a political challenge, as many examples show. People don't like disposal sites, at least not in their own backyard.

Through all this, it becomes apparent that dredged sediment itself is not the source of the problem; it is "only" a sink. This brings me to sediment management. To start with, international developments are relevant. In 1975, the London Convention entered into force as one the first international conventions for the protection of the environment. The convention covers the disposal of waste at sea and is relevant also for placing dredged material at sea.

In Europe some 200 Million m^3 of sediments are dredged annually, mostly in coastal regions. The largest proportion of these sediments remains in the aquatic system having been relocated.

In October this year new Guidelines for Assessment of Dredged Material were adopted. These are a substantial update and modification of the original 2000 London Convention Dredged Material Guidelines. In the guidelines it is stated:

> In general, dredging projects should be considered in the broader context of the watershed and the regional sediment system where they occur. Ideally, dredging and associated sediment management projects should strive to optimize the production of economic benefits, ecosystem services, and social goals, while ensuring the protection of the marine environment. An example of the rationale for this approach can be found in the Working with Nature initiative described in PIANC (2011).

> However, some dredged material is contaminated by human activity to an extent that specific management actions need to be applied when considering disposal or use of these sediments. … An Action List provides a mechanism for evaluating dredged material and its chemical constituents on the basis of their potential effects on human health and the marine environment. In addition to its use to inform permitting decisions, an Action List can also be used as a trigger mechanism to identify the need for source control to prevent sediment contamination.
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> Contamination of aquatic environments, both as a consequence of historical and present day inputs, presents a problem for the management of freshwater, estuarine, and marine sediments. High priority should be given to the identification of sources, as well as the reduction and prevention of further contamination of sediments from both point and non-point sources. Successful implementation of prevention strategies will require collaboration among agencies with responsibility for the control of contaminant sources.

We can see that a step is being made from dredged material management to system wide river basin sediment management, taking into account wider effects, and seeking win-win solutions. Second, and this is not new, the need for source control is underpinned. So where are we with this today? I would like to highlight this with our Elbe case again.

When the river Elbe reaches the port of Hamburg its length is already 1000 km, covering the territories of 2 nations and before 1990 even 3 nations. Mining activities had taken place in the catchment since the medieval ages (the name of the 'Ore Mountains' illustrates this), resulting in discharges of heavy metals. The heavy industries of former East Germany and the Czechoslovakian Socialist Republic were subject to little in the way of effluent control, thus discharging chemicals directly into the river. One example: In the early 1980s mercury concentrations of 80 mg/kg were measured at the German-German border. The situation has improved significantly, and today the corresponding mercury concentration is 1,7 mg/kg.

The same is true with most other contaminants, but we still have several exceedances of German dredged material standards. This is especially the case for some chemicals which have – or had – their origin in chemical industries in the Czech Republic.

These exceedances are not only a problem for dredged material management, but also for many other uses as well as for reaching environmental objectives. More information about the situation on the Elbe can be found in the SedNet Round Table reports. Because of the failures to meet good chemical status in the WFD context and good environmental status in the North Sea in the MSFD, context the International Commission for the Protection of the Elbe River set up a sediment management working group in 2009. Particle-bound contaminant transfer was recognised as being an important supra-regional water management issue for the Elbe.

In the last 4 years the working group has developed a sediment management concept for the Elbe river basin. To assess status, a set of river-specific criteria was derived from guidelines, protocols, etc. The significant task was source identification. Based on existing data (there is loads of data today) patterns in concentrations and fluxes were used to detect underlying processes. On-site measurements were made to gain knowledge about possible remobilisation during flood events.

The result is potentially ground-breaking for other river basins. It became clear that current emissions play only a very minor role in sediment contamination. The situation is as it is mainly due to historic contamination and emissions. We have had to learn a hard lesson:

that while not many years ago there were some hot spots which should have been remediated, these do not exist anymore. Floods have diluted them. The sediments from these hotspots have been moved - downstream and to the sea. There are no longer these few spots with high potential impacts for the entire basin. Historic contamination has become an issue for the entire river basin. We can find contaminated particles everywhere – in the flood plains where cattle graze, in side branches and in groyne fields, behind barrages and in harbour basins. A few primary sources became many secondary sources with lower levels of contamination, but widespread.

What does this mean now, how about a solution? It is not enough to understand the problem, we have to solve it.

Most industries causing today's problems no longer exist. And even if they did, with such widespread contamination, it would be difficult from a legal point of view to clearly identify a specific company as being responsible for remediation. European legislation is not very helpful in this respect. There are examples from the U.S. where a company has to pay; you may remember Todd Bridges' talk at the last SedNet conference. But comparable examples in Europe are rare.

We no longer have many primary sources; only a few of them, for example historic mining activities. Today we have secondary sources which may or may not be near the original source of contamination. Sinks for particle-bound contaminants exist in side branches, groyne fields, impoundments, etc. But who would, or should, be responsible for remediation? Are there binding obligations, or legal tools? And what can an organisation responsible for dredging do to demand upstream source control?

Today we have European laws, we have several environmental guidelines. But managing dredged material and sediments falls between different European laws.

In 2008 the Hamburg Port Authority together with the Federal Waterways Administration published a comprehensive River Engineering and Sediment Management Concept for the Tidal Elbe. Its main objectives are to allow safe navigation for ships calling the port, to comply with requirements of European directives and so on. It covers all the aspects required for proper sediment management; contamination is just one of many more topics. In the estuary our main task is the management of significant quantities of material, some 15 Million m^3 of dredged material is handled every year. An evaluation panel of international experts in 2011 confirmed that the concept is state-of-the-art.

A few years ago we commissioned a German law expert to evaluate the Tidal Elbe Concept in relation to European law. We asked the professor if legal tools exist to foster remediation measures in upstream regions. Our law professor concluded that there is no robust legal instrument to demand upstream sediment remediation. He identified that the WFD objectives have to be realised within a solidary community, which a river community should be. But real-life experience shows that a community has limits when it is about money. And as mentioned already, the WFD is not really clear in demanding sediment related measures. This is also the reason why the Elbe sediment management concept is still under discussion, waiting to be finally approved.

To stimulate remediation measures, we as the Port Authority have provided 10 Million Euros for co-financing remediation measures in the catchment over four years. Until now not a

single cent has been requested for measures… Allow me here one sentence about principles: This is against the polluter pays principle. But it's pragmatic.

It is often well known where contaminated sediments come from and that they end up via the river in the marine environment. Implementation of the MSFD is some way from making its requirements strictly binding in the entire catchment. There are no legal "marine tools" to demand upstream remediation. But when sediments, being transported naturally by the river settle in harbour basins, they have to be dredged to allow safe navigation. Then the legal situation is totally different. The laws tend to be strict in allowing to place sediments. Source control runs the risk of becoming a nice catchphrase but nothing more when it's about sediments becoming dredged material.

Surely the tools the WFD provides can be of great help to develop a river basin sediment management concept: fulfilling quality objectives, reporting, and management plans are all potentially relevant. In the end, measures will need to be undertaken, and this requires funding. A clear strategy for river restoration is needed. There is no sense in doing nice things downstream when still more contamination is coming from upstream. Cleaning the staircase needs to be started at its upper end. Therefore everybody has to agree. But the WFD is a framework directive, which allows exemptions. And it is clear that use is being made of these exemptions.

There is one other option for cleaning the catchment. It's natural and it's efficient. It's flooding. This year, in June, we had of one the highest floods ever recorded in the Elbe. It caused severe damage in the upstream regions. It was one of several 100-year floods we have had since 2002. For us in the port it resulted in a significantly reduced dredging need when compared to other years. Huge quantities of suspended particles from the Elbe were transported directly to the sea, without settling in the harbour. From our intensified monitoring we know that some of the sediment load was contaminated, due to remobilisation in the upstream regions. Much higher sediment loads then normal reached the sea. Maybe with a few more floods we will have an improved situation in the catchment. But the contaminants are not gone, they are only elsewhere. The sea is their final sink. And although such events are highly efficient they do not seem to be the best ecological solution.

So why did I tell you all this? Great progress has been made in recent years and decades with both dredged material and sediment management. This is especially the case for technical options. Options, constraints and costs are known. Use can be made of published experiences, for example the reports of PIANC, SedNet, and others.

Of course, sediment transport modelling needs to be further refined and many more questions need to be answered to support system understanding. System related sediment management concepts should be further elaborated based on science, fulfilling the requirements not only of navigation, but also of other uses and needs.

But from my perspective the most urgent subjects for sediment management are not nature or science related. In the end it is about doing something; doing something to achieve set objectives. Who sets the objectives, and how to achieve them?

To achieve these objectives we need legal tools. As I have tried to show today, the existing tools do not seem to be either strong enough or clear enough. We already have plenty of guidelines, and I'm not asking for an EU sediment framework directive. The WFD provides

the necessary tools. What remains unresolved is the legal question for liability for contaminated sediments in river basins. When contamination is a supra-regional issue it is a matter for the river community. A sea port cannot be the last filter before a river reaches the sea. It's neither its task, nor is this ecologically sound. There should be a fair share between risks, costs, and benefits. The risks of dealing with dredged material need to be considered in a broader context.

This brings me to the other outstanding issue, which is public perception, or communication. This is the basis of political will and decisions.

The public, or should I say the media?, are mostly only interested when there is a notion of a scandal. They want a clean environment, but there is likely to be a scandal when contaminated sediments need to be put somewhere. The matter of risk communication is challenging. There is not only the environmental risk, there is also an economical risk – in our case for the port – and in the end a risk for society. People tend to overestimate the one and to underestimate the other. Our experience with such a communication is not very well developed. It requires a totally different language and approach than is usual in scientific discussions. In the end this responsibility for ensuring effective communication should also be something the river community bears collectively.

So, there are still some significant challenges. I would therefore like to conclude my talk with some suggestions for the different groups dealing with sediments:

- Dredging: Sediments are more than a technological challenge. Although dredging happens underwater, explanation and discussion with the public are necessary;
- Science: Overarching, interdisciplinary and practical approaches for real life questions should be developed;
- Administration: The different agencies responsible for transport, environment, research, etc. need to work together and seek win/win solutions;
- Politics and legislation: Funds are better spent when action can be taken in time to prevent problems and with an overarching view of all issues within the wider river community;
- Media: Sediments can be interesting not only when there is (felt to be) a scandal to be sold.