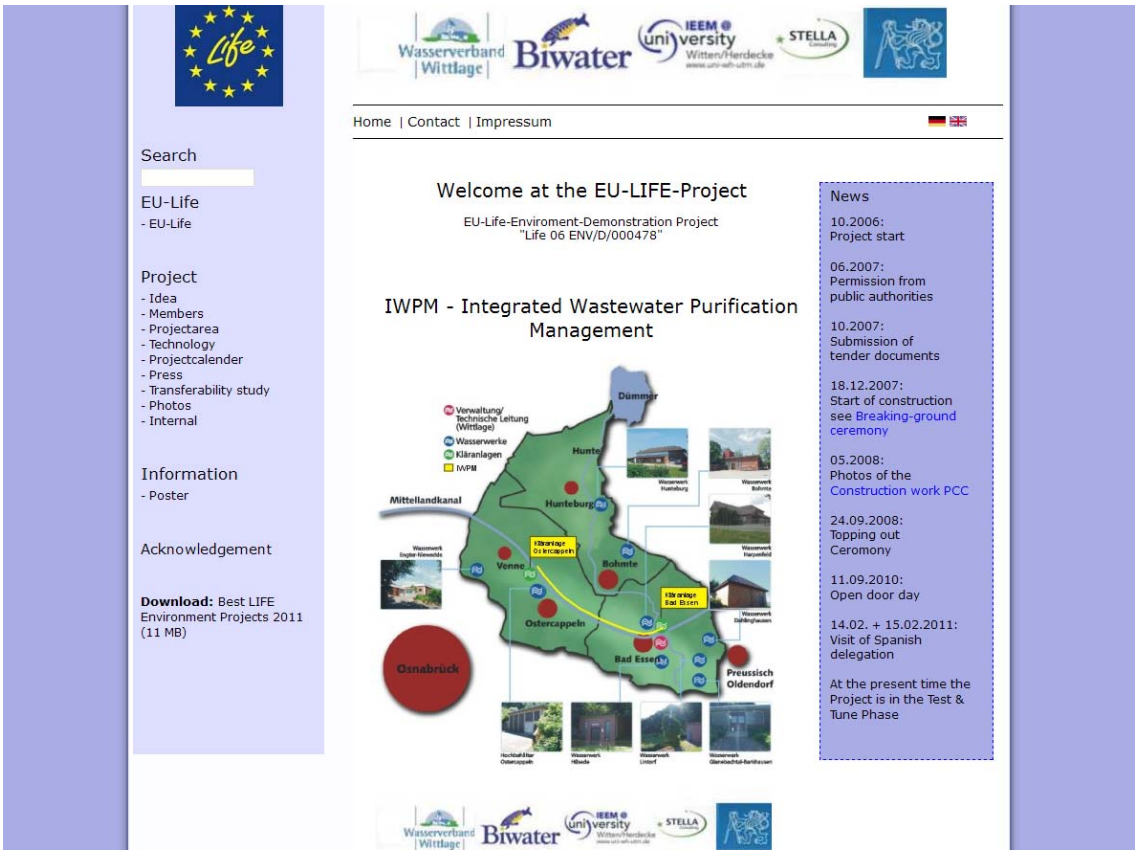
ANNEX 2: LAYMAN'S REPORT

IWPM
- Integrated Wastewater Purification Management -
(LIFE06 ENV/D/000478 - IWPM)



Background and objectives

The future is always hard to predict, and especially in infrastructure and environment it is impossible to deliver a reliable forecast, how much wastewater and how much contamination will be generated from industry, from settlements, from agriculture within a defined region. Therefore, wastewater treatment plants designed years ago, are quite often underloaded or overloaded. Furthermore, it might well happen that one plant receives peak flow from a hotel during weekend, whereas another wastewater treatment plant in the neighbourhood is overloaded during midweek, when the factory is working at full capacity.

Why not connect these two plants, and equalise the loads, and make much better use of existing capacities. And, even more important, it is easy to understand that sewage treatment plants operating under equal loading, without being overloaded or underloaded, produce better results and discharge less contamination to the natural water bodies.

Since computerised automation and energy-efficient pumping stations have been developed, it is possible (nowadays) to inter-connect two neighbouring sewage treatment plants through a wastewater pipe (physical connection) and a remote control and monitoring system (electronic connection). With such a connection, the performance of two plants can be much better than two single plants performing independently from each other. So to say: "One plus one is more than two".

The overall objective of the Project is to demonstrate how wastewater management and treatment technologies can be improved through an innovative IWPM-System, increasing the quality of effluent and reducing costs, in support of EU-Directives on Wastewater, on Integrated River Basin Management (IRBM; EU-Directive 2000/60/EC), and on Flora, Fauna, Habitat (FFH).

The specific objective of the Project is to integrate wastewater purification through a new combination of electronic link (→ remote control) and physical connection (→ biologically activated pipe) of selected sewage treatment plants (STPs), in order to integrate their technical capacities and to enhance wastewater purification (as a result of equalised inflow peaks and full utilisation of all existing plant capacities at any time).

Technologies, innovations and modules of the Project

To realise the technology-based IWPM-solution according to its objectives, innovative technologies and methodologies have to be installed. In general, there are three innovative components:

- PCC - the pipe connection combined with an on-line monitoring and remote control system, to connect the two sewage treatment plants.
- MWP - modified wastewater purification, designed and optimised to integrate two (or more) sewage treatment plants.
- EST - enhanced sludge management; one aspect would be centralising sludge treatment at the largest and technologically most convenient plant (making advantage of "economy of scale"). And the other option would be to transport stabilised (still fluid) sludge to a smaller, rural

plant with cheaper options for utilisation as fertiliser, for composting or else.

The **PCC** - pipe connection and control system - includes a 16.5 km pressurised 2 x 300 mm twin pipe with three bi-directional pumping stations (pipe equipment working with wastewater as well as with liquid sludge), operated as biologically activated pipe reactor with ca. 1,000 m³ [the wastewater in the pipe is enriched with activated sewage sludge to drive the biological hydrolisation (for phosphorus removal) and denitrification for N-removal]. Included is an on-line monitoring and remote control system to steer pumps, valves, aerators etc. for optimum IWPM.

As can be seen from the photos, the track and construction technology (including underground piping, "no dig technology") was chosen in a way to protect the environment, especially precious trees and groundwaters. For the pumping stations, automated valves and high-tech equipment had to be installed, to allow sampling, monitoring, computerised operations for wastewater and also for the microorganisms, which can be injected into the pipes, changing them from biologically "dead" reactors to biologically activated pipe (BAP).

The **MWP** - modified wastewater purification - included an activated pre-sedimentation (sludge settlement and sludge pumping controlled to best hydrolysis effect), the multifunctional sequencing batch reactor MSBR [MSBR can be operated with great flexibility, according to different inflow situations: (a) As conventional SBR, in parallel to AST + FS (inflow diverted between SBR and AST; outflow SBR goes to post-filtration); (b) As aerated tank (inflow shared with AST, outflow to final sedimentation); (c) In-line, as first biological stage; (d) As equalising tank, biological function less than maximum, but storage of nutrients provided.] and the waste air collection and treatment.

As can be seen from the photos, the IWPM-plant has been equipped with odour control (biological exhaust air scrubbers and fully covered tanks) and with innovative surface aerators, which turned out to be much more energy-efficient than conventional, non-modified devices.

Very important: The operators in both sewage treatment plants can achieve all data within the monitoring and control system. The same applies to the intermediate pumping station along the track of the connection pipe, where monitors are installed. The plant operator does not only see what is happening on his (or her) facility; it is possible to intervene, if necessary and make sure that an integrated scheme is possible, with operations directed from one plant at another (if decided so, and the software has been programmed that way).


Construction of twin connection pipe


Interconnection pumping station


Pre-sedimentation tanks


Multifunctional sequencing batch reactor

Operational results, demonstration and evaluation

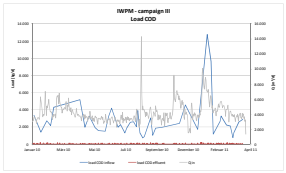
Yes, the IWPM-team (mostly scientists, utility experts and leaders from administration) commenced extended activities for dissemination of the Project, initially driven through obligations in the EU-Life Grant Contract. Sometimes, researchers as well as practitioners, are satisfied with the technical progress already, and forget to transfer know-how and "lessons learnt" to stakeholders and third parties. In the case of IWPM, many workshops, presentations, open-door-days and opening ceremonies have been carried out. This has brought a lot of constructive criticism from third parties, which helped to improve the IWPM-set-up and a lot of additional support - even with the unexpected decision of a third utility and municipality, to join the IWPM-scheme (which had been limited to two parties, two catchment zones, so far).

Cut of the first sod in 2007

Topping-out ceremony in 2008

Anyhow, before this result had been achieved, hard facts and analyses data had to be collected, interpreted and evaluated.

The three slides visualise, what has been the inflow and what the outflow during a measuring campaign ending 2011.



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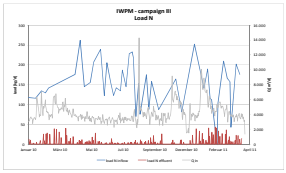

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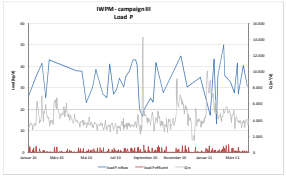

Load P

Without going into details (these can be derived from the report or brochure, available as download from the Project-website *www.eu-life-iwpm.de*), it might be said: All effluent standards have been fulfilled, all targets met - even though unexpected peak loadings and technical problems arose, following the changes in industrial production after the financial crunch and the strong rehabilitation with some companies doubling their production and wastewater generation (especially regarding nitrogen and phosphorus, the critical parameter for the sensitive Flora and Fauna Habitat around the Lake Duemmer, an EU-protected eco-system of high ecological value).

Cost:Benefit

Based on the results of several measurement campaigns undertaken during IWPM, the increased performance of the sewage treatment plant in Bad Essen amounts to 13,000 people equivalents (PE).

According to EUROSTAT [ISSN 1562-3092], the nutrient discharge from German wastewaters in kg/PE/a are 3.7 for N and 1.2 for P before conventional sewage treatment. In the actual effluent Status Quo after installation of

IWPM, the nutrient discharge in kg/PE/a amounts to only 0.224 for N and 0.032 for P. The ecologic advantage through IWPM therefore amounts to 45,188 kg/a for N and 15,184 kg/a for P.

With specific expenses of EUR 19 per kg Nutrient-reduction, reported by WVW to protect the quality of the Lake Duemmer, respectively rehabilitation of the Lake, the ecologic advantage of the application of IWPM can be determined to EUR 1.15 million per annum. With the costs for IWPM of around EUR 12 million and a recovery period of 15 years in average for the IWPM-investments, the cost-benefit-ratio amounts to approx. 2:3, meaning that the benefit exceed the costs by more than 50 %.

Transferability

A transferability study of IWPM with a lot of project options researched has revealed, IWPM can be very positive, but needs favourable geographic and natural site-conditions to be applicable. Various Contacts with interested transferability candidates have been made, a Spanish case has been invited to come to Bad Essen and chosen for in depth studies.

Conclusion and recommendations regarding applicability elsewhere

There is no doubt: The potential advantage of integrating wastewater purification by inter-linking one sewage treatment plant with another or more can be very attractive. Anywhere, where it is necessary to fulfil stringent effluent standards (e. g. to protect sensitive environment or water resources), and where sewage treatment plants are not more distant than (let's say) 40 km, IWPM should be discussed and its advantages in terms of costs and environmental benefits analysed.

To cross administrative borders between neighbouring municipalities and utilities. And it may look complicated to elaborate a master plan, not focused on one plant or one network, but on an overall system integrating more than one catchment zone. Anyhow, as the example of the municipal association "Wasserverband Wittlage" in Germany, with three plant locations in Wittlage, Ostercappeln and Bohmte, has demonstrated: It is worthwhile to invest in "brainwork" - and the savings in construction work and operational effort (power, chemicals etc.) can be quite significant. Even more important in the long-term are the advantages for the environment, better served with an integrated and more reliable, more efficient reduction of contaminants generated everywhere, where people live and industries produce.