

LIFE SURE

– Layman's report



Swedish Agency
for Marine and
Water Management

The problem

Urban water bodies constitute an important part of many modern cities. They provide residents and visitors a well-used recreational area and are often iconic to many cities urban landscape. However, these lakes, rivers and estuaries are often prone to contamination. Snow and rainwater collect contaminants from roads, houses, industries and old landfills and transport them to these water bodies. These water bodies then become eutrophicated, i.e., receive too many plant-nutrients, or show high levels of toxins such as heavy metals. This in turn affects the aquatic ecosystem negatively as well as giving negative aesthetic values.

To combat this eutrophication, it is important to prevent new pollutants to enter the water body. For example, by redirecting the water run-off pipes or installing sedimentation-dams. However, in many cases, this is not enough. An additional measure can be removing sediments. By removing

the sediments, the top-layer of the bottom of the waterbody, large quantities of nutrients and other contaminants can be removed and subsequently remedy the waterbody. Conventional sediment removal methods, or dredging, although efficient, are prone to causing other effects that negatively affects the aquatic environment. Municipalities therefore face the challenge of ever-growing contamination and eutrophication levels in their urban water environments, rendering them unattractive and potentially dangerous, whilst being limited in the ways to deal with these issues. Fortunately, there are solutions.

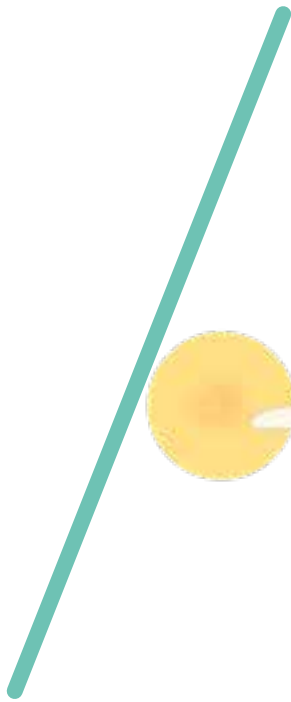




The LIFE programme

LIFE, short for "L'Instrument Financier pour l'Environnement" (Financial Instrument for the Environment) of the European Union, is the programme that enables and finances projects related to environmental issues all across the European Union. LIFE also enables conservation and climate actions, and has since its inception in 1992 co-finance over 4500 projects, making considerable change possible.





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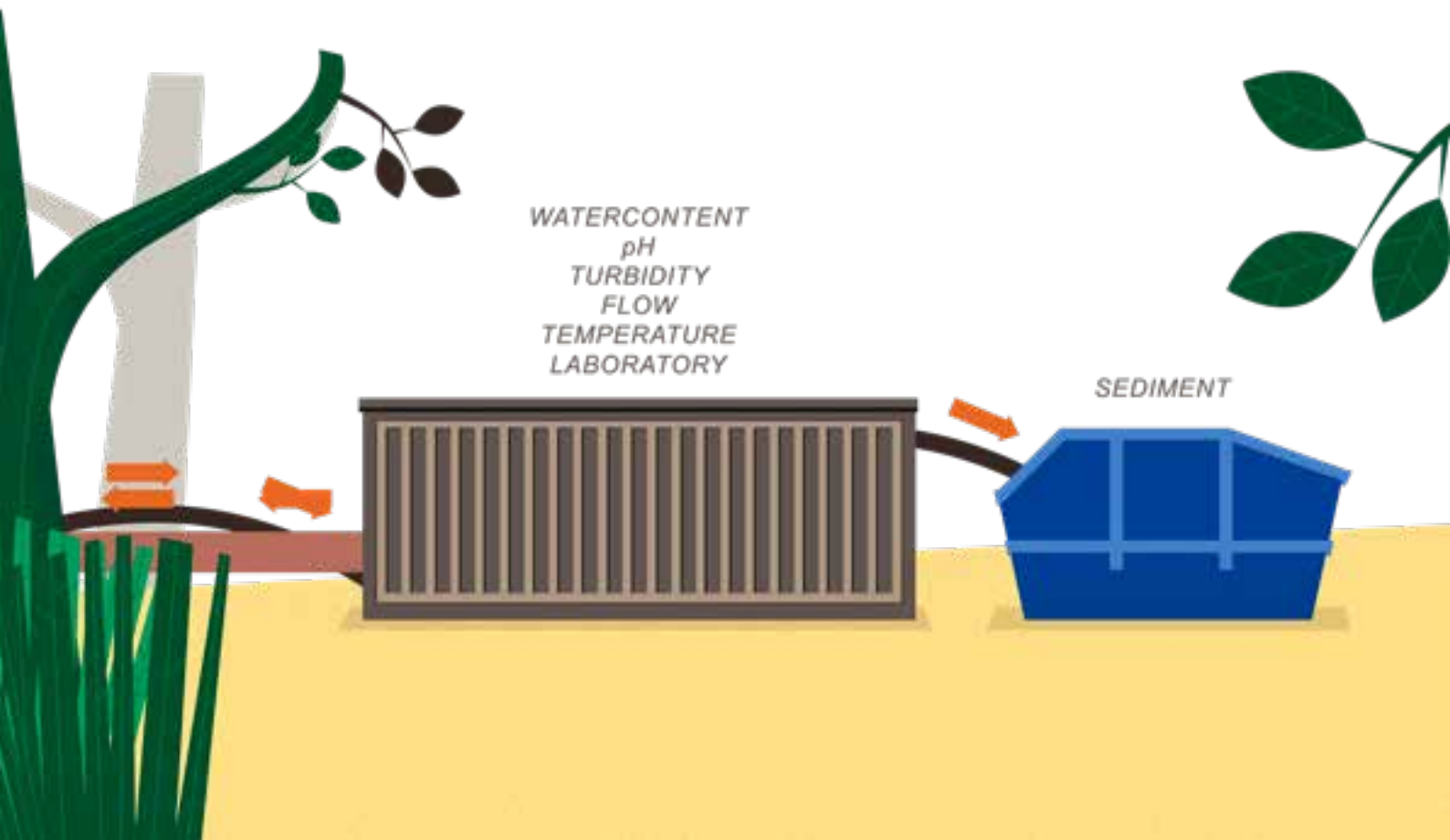
The solution

LIFE SURE has developed and demonstrated a sediment uptake solution that can remove sediment without negative effects on the fragile shallow water body. The LIFE SURE's solution is a low-flow eco-dredging robot that carefully removes sediments from the bottom of the bay while slowly and autonomously moving through a designated area. As conventional dredging solutions focus on removing sediments within a short period of time, putting pressure on both the marine environment and the dewatering capacity, LIFE SURE has looked in the opposite direction. By using a low-flow sediment uptake solution to remove soft sediments from shallow waters, the turbulence is kept to a minimum and fish and birds are not affected by the operation. The low-flow of incoming sediments also allows for a semi-passive dewatering of the sediments, thus saving on energy and investments. The dewatering process in LIFE SURE is done using geotextiles and an automated polymer feed. All processes are continuously being monitored and evaluated by the project's researchers at Linnaeus University, giving the project important feedback.

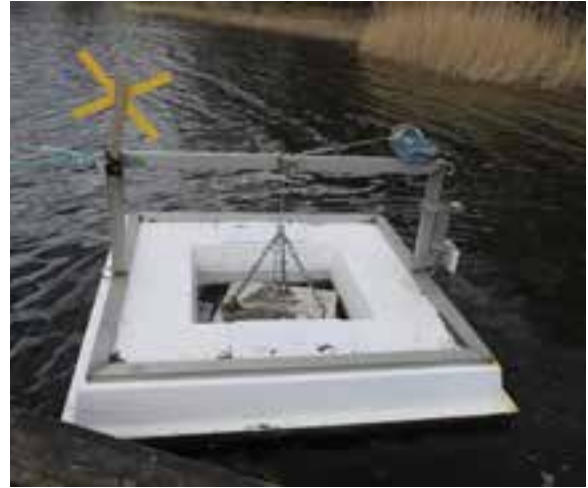
The sediment removal and dewatering can be done continuously, day and night, and most of the year (except wintertime here in Sweden). The system, once set up, runs automatically, and can be operated both from the land site and remote, by computer and phone. Also, the components of the LIFE SURE solution are easy movable, using trucks. The solutions tested in LIFE SURE give perspective for other sediment removal projects with requirements for low-impact on the aquatic ecosystem and waterfronts, sound levels, energy use or carbon footprint.

The complete LIFE SURE report is available at www.lifesure.kalmar.se.

LIFE SURE







LIFE SURE – fact box

- Year 2017-2022
- Project lead by Kalmar Municipality in cooperation with Linnaeus University
- Budget; €3,53 million. Funding: €1,94 million received by LIFE and €650.000 received by the Swedish Environmental Protection Agency
- 2 patents filed

Project partners

Kalmar municipality

Kalmar municipality is a Baltic coastal city in the southeast of Sweden. With a total of 71 000 inhabitants, the city is the capital of Kalmar County and the regional centre for public administration, business, culture and environmentally sustainable innovations.

Kalmar's attraction to both tourists and inhabitants is in many aspects dependent on the quality of the water in the Baltic Sea. Therefore, water management and coastal management are important political priorities. Kalmar is also the home of the "Kalmar Strait Commission" which coordinates coastal municipalities along the east-coast of Sweden.

Kalmar municipality provides the projects project manager, communicator, controller and technical site coordinator.

www.kalmar.se



KALMAR

Linnaeus university

Linnaeus University is located in both Kalmar and Växjö. The university has approximately 34,000 students, of which 1500 full-time, and 2000 employees. Its research areas cover the humanities, social sciences, natural sciences and engineering. In LIFE SURE, two departments of the Faculty of Health and Life sciences are involved. Technicians from the marine research group monitor marine life and water quality in Malmfjärden bay. The Environmental Science & Engineering Group (ESEG) focusses on the recovery of valuables such as metals, nutrients and toxic compounds. A special interest is directed towards the opportunity of performing mining of metals from contaminated sediments. The ESEG group performs a broad range of evaluations in the LIFE SURE project, varying from system evaluation, sediment quality to Life Cycle Analysis and cost-effectiveness evaluations.

www.lnu.se

Linnæus University



Possible beneficial uses of sediment



Agriculture

- Fertilizer,
- Soil improver



Construction

- Sound barriers
- Building blocks
- Landscape architecture
- Restore habitats (wetlands)
- Flood protection

Other partners in LIFE SURE:

Kalmar produktutveckling AB

Inventor and product designer Ulf Rickardsson have played a vital role in the development and production of the dredging robots nicknamed "Mudsters" in the LIFE SURE project. By using a low-flow suction system attached to floating movable, remotely controlled devices, the concept has rendered in a unique solution and the filing of several patents.



Reglertekniskaingenjörbyrån AB

Lead by senior engineer and technical advisor to the project, Erik Andersson, "RIB" has been fundamental to the project's success. By designing an industrial-grade automation system in both the lab, site and one the dredging devices themselves, the dredging process can be operated with ease on-site or remotely.



Sweco

The Swedish consultant agency Sweco has been an active member of the project via former project manager Fabio Kaczala. Providing detailed expertise on environmental issues, this partner has proved invaluable to the project's success. Sweco has also played a role in creating several papers, examining the current legal framework of the re-use of sediments.



Netics

The Dutch company Netics are providing assistance and advice regarding the re-use of sediments in innovative ways. The LIFE SURE project is developing building blocks out of the dredged sediments via a technique developed by Netics.



Other Networking

LIFE SURE is not the only project focusing on new dredging techniques. As it turns out, the interest in new sustainable way to remove sediments from water bodies is high. Therefore, a new low-flow dredging network was created. Consisting of members from several municipalities as well as county administrative boards, the forum aims to share knowledge and experiences from our various trials with low-flow techniques. Together, we work towards a new paradigm in dredging, that is truly sustainable.

Other than the Low-flow Network, LIFE SURE has been networking consistently throughout the project. Visits to other projects in the Netherlands, participant in the worldwide dredging organization PIANC as well as presenting LIFE SURE at over 15 conferences – we want to share our project and its solutions!

9548

The amount in m3 of wet sediment pumped up by our two robots, Mudsters

100

The percentage of the sediments that were re-used.

4800

The LIFE SURE energy consumption in Kwh/month at full production. Which is very energy effective

5

The number of movements of a truck with trailer that is needed to move the LIFE SURE solution to a new location

220

The amount in m3 of dewatered sediment that was finally transported from the land site

22

The number of growing plots at the LIFE sure site, where we tested and evaluated the use of the sediment in agriculture





Actions in the field



Action A

Getting started:

First phase of the project. Here we prepare being gaining permits, analysing potential usages of the dredged masses as well as conducted our first phase studies.



Action B

Removing and dewatering sediments:

Time for business. We designed our dredging robots, called "Mudsters" and sent them into action. By also building our dewatering facilities, LIFE SURE stood ready for the task of removing sediments from the bottom of Malmfjärden and make them available for a beneficial use.



Action C

Monitoring:

As LIFE SURE uses self-operating robots to conduct the dredging, proper monitoring facilities were needed. From our lab, we could evaluate the in- and outflows and the water rejected to the bay. We also analyse the impact on Malmfjärden as well as reviewing turbidity results. We were astonished at how well the results were! The Mudsters cause no turbulence and the rejected water was clean enough to be returned to the bay without extra cleaning. The operating costs, environmental impacts and electricity use turned out to be low as well.

In this phase, we also evaluated different uses for the sediments and as well as evaluating the overall performance of our solution.



Action D

Spreading results:

As we now had a functional technique and results to show it, we wanted to spread the word – and so we did. By participating in over 15 conferences, participating in networks meetings, producing videos of LIFE SURE, writing scientific articles, we spread the results of the project to a wide audience.

Three ways to measure impacts

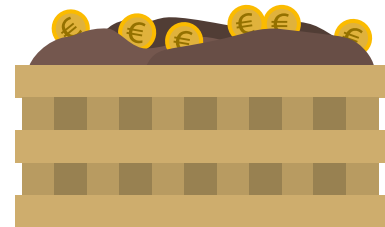
1. Ecological sustainability

The first way to measure the impacts of the LIFE SURE project, is through the lens of an ecological viewpoint. Traditional dredging leads to adverse effects for the local environment. Habitats are destroyed, ecosystems are disrupted and the risk of releasing buried contaminants is high when using high-powered machinery in aquatic environments. But, in LIFE SURE – this is not the case. Our low-flow dredging system gently sweeps the seabed and does not cause any turbidity, i.e., does not cause small particles to dim the water-environment. This is one important factor for measuring the ecological impact of dredging, as the turbidity itself often cause adverse negative effects for fish, birds and can lead to the spread of contaminants. In LIFE SURE, this is non-existent.



2. Economic sustainability

Traditional dredging is expensive. Manpower, large machinery and transportation vehicles quickly increase costs and drive the incentive to finish dredging as quickly as possible. This in-turn leads to increased ecological impacts, but it also affects the local environment in different ways. Costs are vital when selecting methodologies. If we are to achieve true sustainability, it must be economically feasible to select the sustainable option. In regards to dredging, the sustainable option is the LIFE SURE concept and it is cost-efficient.



By conducting a cost-benefit analysis in which we compared the costs of LIFE SURE with the costs of traditional dredging project – we found that the LIFE SURE project is more cost-effective. Despite utilizing low-flow, advanced autonomous dredging systems, LIFE SURE provides an ecological and economic incentive to re-think how we dredge.

3. Social sustainability

Obstruction of narrow water ways and public spaces, noise pollution and generally aesthetic degradation are often common place in dredging projects. As Malmfjärden is situated centrally within Kalmar with a large amount of people passing-by and visiting the surrounding area – social sustainability is important if we wish to create a truly sustainable alternative. If public acceptance is high, it is likely that public actor chooses that alternative in areas which are prone to opposition.



A social impact assessment (SIA) was conducted in the project. By measuring the different impacts of the project, both negative and positive, to a number of social factors – such as recreation, kayaking, property values and visual amenity (amongst others), we have proven that LIFE SURE holds up from a social sustainability point of view.

An aerial photograph of a coastal city, likely Copenhagen, showing a mix of urban buildings, a harbor with ships, and a large island in the background. A large, semi-transparent teal water drop shape is overlaid in the center of the image, containing text.

Conclusion

LIFE SURE has succeed in its mission to bridge the gap between research/development of results and practical application/test of new technology. The project has been implemented on a technical scale that allowed for evaluation if the solutions are functional and cost-effective. Active participation of both public, private and the academic sector and dissemination to national and regional authorities, international networks and international organisations secured that the technique will be applied on a larger scale in similar situations.



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