

LOW-FLOW SEDIMENT REMOVAL AND BENEFICIAL USE OF SEDIMENTS, EXPERIENCES FROM THE LIFE SURE PROJECT

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Introduction

The LIFE SURE project's location is the Malmfjärden bay situated in the city of Kalmar in the South of Sweden. The project has developed an innovative way to remove soft sediments from shallow water bodies without causing resuspension of sediments. The project's solution runs autonomously, has a low, and possible CO₂-neutral, energy consumption and can be implemented in other regions and projects.

The LIFE SURE solutions can inspire those who work on sediment removal in protected areas, storm water basins or in combination with a water body restoration. Besides developing and testing a low impact sediment removal and dewatering solution, LIFE SURE has also tested several beneficial uses of the sediments, once removed from the waterbed.

Background

Stormwater runoff from built-up environments, agriculture and forestry cause leakage of nutrients, heavy metals and other contaminating substances to our water bodies. These substances then accumulate in the sediments of the recipients, lakes, and bays. Malmfjärden bay is an example of such a water body at risk. It is a shallow (max 1-2 meters depth) and semi-enclosed brackish bay, covering an area of circa 1 km². The hydrology of Malmfjärden bay is determined by its connections to the Baltic Sea and stormwater runoff from the surrounding urban area.

A balanced ecosystem in the Baltic Sea is of key importance to Kalmar as a city, as it provides necessary services such as transportation, a tourist destination and attractive living and recreation environments. Unbalances in the ecosystems of the coastal environments cause problems such as oxygen depletion, algae bloom, fish death and bad smells. The deteriorating state of the water quality and ecosystem in the coastal areas have been engaging politicians and inhabitants for many years. Previous mitigating actions in this shallow bay, such as conventional dredging, only made things worse, causing turbulence and disturbing the living conditions for predator fish and plants.

Kalmar Municipality and the Linnaeus University combined their ambitions and applied for a LIFE project that would find a solution for restoring shallow marine environments using a low-flow sediment uptake solution. Meantime, the project also studies and develops new applications for the beneficial use of the sediments once removed from the bay, thus contributing to a more circular economy.

Low-flow sediment uptake and dewatering

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 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, thus 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.

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Beneficial use of sediment

LIFE SURE has tested and evaluated several options for beneficial use that are possible from the perspective of current legislation and local circumstances. The project looked at a range of sediment uses: such as soil amendment, building blocks, landfilling, agriculture and forestry as well as habitat creation.

In 2020 and 2021, Linnaeus University executed a growing experiment for soil remediation with sediments, both on the treatment site and in the laboratory. The experiments succeeded to produce growing substrates by combining different mixtures of sediments, soil, biochar, compost and peat. At the end of LIFE SURE, in June 2022, the University will have produced reports and conclusions about the behaviour and uptake of nutrients and contaminated substances, thus providing information if the sediments from Malmfjärden can be used in horticulture or agriculture.

Additionally, NETICS AB, a Dutch sediment-use specialist company, won the projects procurement in order to find another innovative application of the sediments. Their proposal includes to make a recipe to create compressed construction blocks from the sediments. Applications that are being researched for example, are pavements, sound barriers and water permeable parking tiles. This can be an exciting new use of soft sediments, with a possible big impact in Sweden, as cement shortage is expected to occur in the near future.

Waterbody Restoration

LIFE SURE has focussed on developing, testing and evaluating a new solution. However, the main amount of sediments remain to be removed from Malmfjärden bay in the upcoming years. It is expected that the water quality in the bay will improve once a substantial amount of the sediments is removed. The sediments are high in nutrients and contribute to algae bloom in the summer months. By reducing the amount of sediments in the bay, the internal nutrient load is expected to decrease as well. However, in order to sustain a balanced ecosystem, it is not sufficient that the sediment uptake does not impact the existing ecosystem. The sediment uptake needs to be combined with other measures that will enhance and restore habitats. LIFE SURE will provide recommendations for measures in Malmfjärden bay, such as reducing incoming stormwater run-off, nature friendly maintenance of the shoreline and reeds and restoring lost fish-habitats and spawning areas.



Figure 1. LIFE SUREs project location, Malmfjärden Bay, Kalmar, Sweden

Key words: low-flow, beneficial use, turbidity, energy use, automatic

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