Van Oord Marine Contractors

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Rotterdam, The Netherlands

To Marine Directorate

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From Jesper Elzinga

Subject **Method Statement Sandcapping Ardfern**

Background

A consortium between Seawilding, Van Oord Marine Contractors and University of Groningen intends to execute a seagrass rehabilitation experimental pilot in Ardfern situated in Argyll and Bute, Scotland. The application at hand concerns a scientific project rather than a commercial project. The experiment will be based around a methodology known as sandcapping. Sand capping is a methodology whereby a thin layer of sand is applied upon an unsuitable sediment layer in order to create the abiotic conditions required for seagrass meadows to thrive. Generally, seagrass is introduced by divers placing seagrass shoots into the newly laid sediment layer one by one. All experiments with sandcapping thus far have been executed through mechanical introduction of the sediment. An example of a typical set up has been shown in Figure 1.

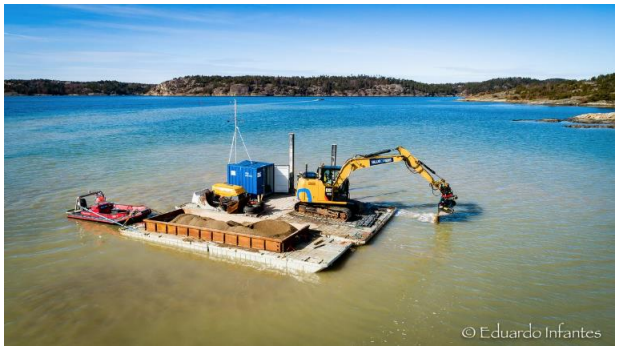


Figure 1: A typical mechanical sandcapping set up with an excavator springing sand into the water column.

The goal of the experiment in Ardfern, is to investigate whether the current sandcapping techniques can be developed in a manner which makes them more suitable for large scale application. In light of this, the sediment introduction will occur hydraulically rather than through mechanical means. This entails that the sediment will be pumped into the water column rather than sprinkled by an excavator on a barge. Rather than applying shoots manually (with divers) after sediment placement, the establishment of seagrass meadows will be attempted by integrating the seeds directly into the sediment deployment process. The aim of doing so is to make the operations more readily upscalable and to eliminate the costs and risks associated with extensive dive works.

Within the current application the aim is to cover an area of seabed of up to 300 m^2 with a sediment mixture. Given that the seagrass seed is not yet available, we aim to include the seeds of domestic terrestrial plants (e.g. Alfalfa, Millet or Clover) as proxy seeds. This first phase of the project is set up to serve as a proof on concept. The aim is to cover a larger area (of up to 1000 m^2) in March next year where we aim to include seagrass seeds and rehabilitate seagrass meadows within this (up to) 1000 m^2 footprint. A temporary works area will also be required for the works. The intended first phase and second phase rehabilitation areas as well as the temporary works area can be seen in Figure 2. The works for both phase 1 and phase 2 are not expected to exceed a time duration of two weeks per phase.

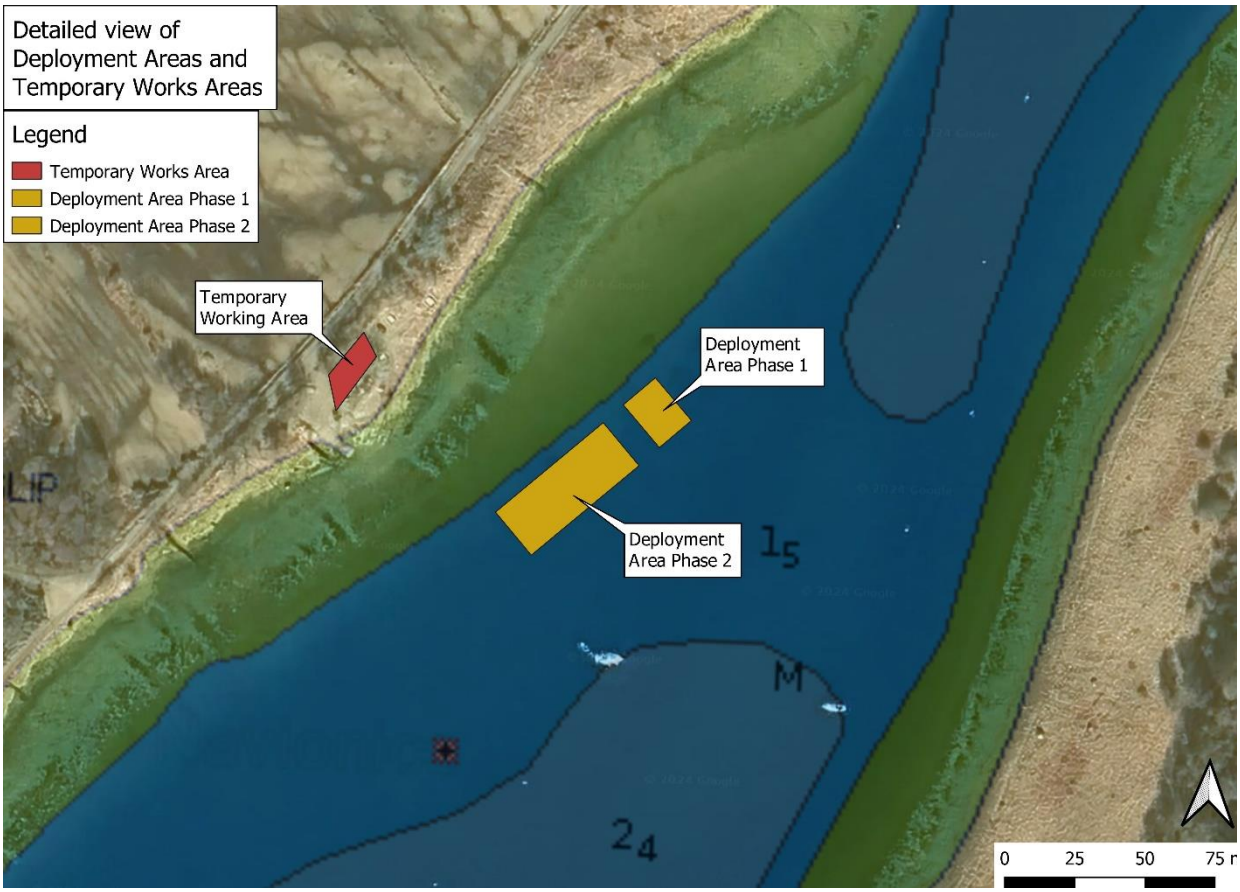


Figure 2: Visualisation of the first phase and second phase rehabilitation areas as well as the temporary works area.

Methodology

The new technology is envisioned to be executed by pumping a thin layer of sand and seagrass seed mixture onto a muddy seafloor with the goal to rehabilitate the seagrass meadows in the local area. In order to do so, we aim to set up a mixing station from which a thin sediment-water mixture will be pumped towards a pontoon and applied to the seafloor via a diffuser. A more detailed overview of this methodology will be described within this section of the method statement.

Mixing Station

Within the temporary works area we will set up a mixing station. The purpose of the mixing station is to mix the stored sand and proxy seeds into a homogeneous mixture prior to pumping the mixture towards the rehabilitation area. This mixing station is conceptually visualised in Figure 3. The mixing station consists of a mixing basin which is pumped at approximately 60 m^3 per hour through a shore based pump which extracts water from near the rehabilitation area through a flexible pipeline with a maximum diameter of 6 inch. Within this mixing basin, the sand will be added at rate of around 10 m^3 per hour by a small excavator.

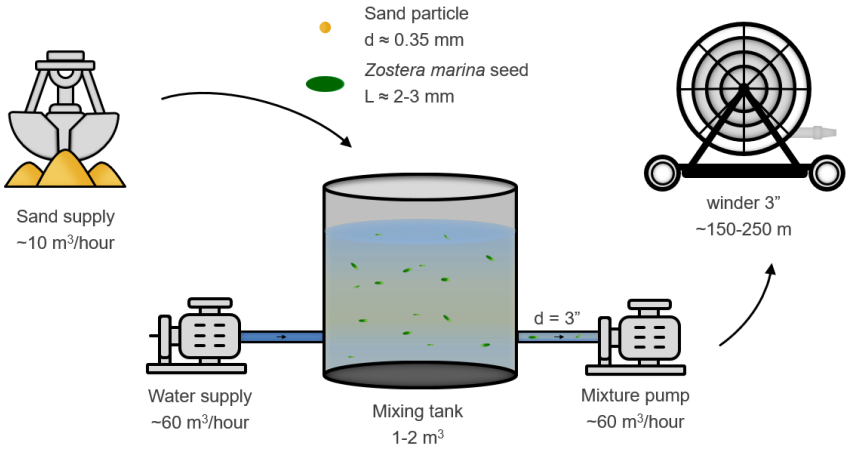


Figure 3: Conceptual overview of the working principles behind the mixing station

The seed will also be supplied into this mixing basin. Due to the vigorous inflow of the pumped water, a homogeneous mixture will be created within the basin. This same homogeneous mixture will be pumped towards the rehabilitation area within a flexible hose by a pump of similar discharge capacity of the supply pump. Due to the unavailability of power on site, both pumps will be petrol or diesel operated. An overview of the envisioned equipment in the temporary works area can be seen in Figure 4.

Small ~2.7 T Excavator

Sediment-Seed Mixing Tank ~2m^3

Two petrol-powered pumps

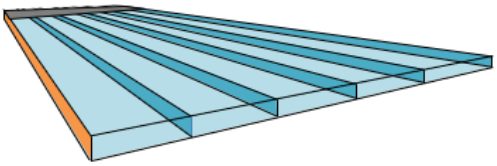
Hose reel to store floating pipeline

Figure 4: Envisioned equipment for the temporary works area

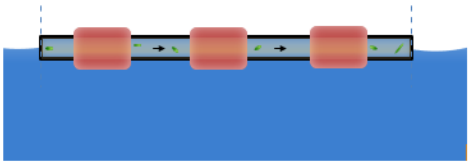
Deployment Station

The deployment hose will be of a maximum length of 300 m and will supply a small custom built pontoon which will nourish the seafloor with a thin layer (approximately 10 cm) of sediment-proxy seed mixture. The pontoon itself will most likely consist of floating jetty (or floater dock) elements which can be readily procured in the local area. An example of such floatation device has been placed in the right bottom of Figure 5. Care will be taken that the pipeline will remain floating between the water’s edge and the pontoon, primarily to ensure it does not drag along the seabed (and works sites) unnecessarily however also to ensure the safety on recreants who may inadvertently find themselves within the works area. The pontoon will remain within the area which is indicated as Rehabilitation Area in Figure 2. The pontoon itself consists of a couple point where the flexible pipeline is attached to the spreader mechanism. The coupling point with the spreader mechamism will be elevated somewhat to ensure there is a downward slope for the sediment-proxyseed-water to travel down. The width of the spreader mechanism where it reaches the water line will be around 5 m in order to ensure some width is provided to the nourishing areas. By moving the pontoon over an area

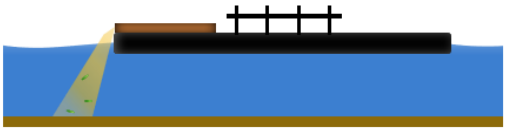
of around 20 metres, the 5 m width allows for 100 m^2 sections (or runs) to be nourished rather easily. The aim is to nourish around 10 m^3 of sediment (laced with proxy-seeds) per run which corresponds to the 100 m^2 section described above. It is not expected for such a run to take longer than 2 hours. Figure 5 provides an overview of the expected equipment pieces which will function as the deployment station.



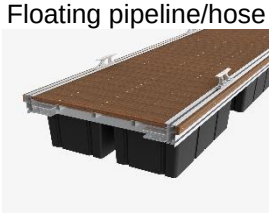
Spreader



Floating pipeline/hose



Deployment pontoon



Floater dock elements

Figure 5: Envisioned equipment for the Deployment Station

According to the bathymetric information available, the pontoon will navigate in waters between 0.5 and 2 metres deep. The pontoon itself will not be machine propelled however rather moved around by tightening or releasing anchor lines. The anchors are envisioned to either be deployed in the muddy seafloor surrounding the deployment or attached to local mooring points if permission is granted by the local mooring association Craignish Lagoon Mooring Association.

After the sediment-proxy-seed mixture has been deployed monitoring will be conducted in order to verify the sediment deployment depth as well as the distribution of the proxy seeds within the nourished profile. This is done as deployment process quality control, however, also to verify whether the mixture pumping densities and proxy seed nourishment depth corresponds to the results in the laboratory.

Sand Storage

The mixing station is supplied with both sand as well as proxy-seeds. The proxy-seeds will be contained in small bags with a total volume not surpassing 5 litres. However, the amount of sand stored will be far more substantial. For the scope of the first phase, we envision to use mix a total of around 20 m^3 of sand for deployment. The foreseen method of supply is by a tipper truck which will place the sand in a heap near the mixing station. The purpose of the small excavator associated with the works is to both supply the mixing station but also to ensure that this sand is moved to a location where it can readily be supplied into the mixing station into a continuous fashion. Figure 6 contains images of the area within which the sand is expected to be temporarily stored.

Figure 6: Two field images of the temporary works area within which the sand will be stored prior to deployment.

Environmental Impact

While the current scope entails an experiment, Van Oord has broad experience in executing large scale marine works. As experienced marine contractor, Van Oord commonly assesses the potential impacts of such works as well as mitigation measures. As stated in the Application Form for this Marine License, the two main expected environmental impacts associated to these works would be introduction of invasive species as well as excessive spreading of suspended sediment induced turbidity. The introduction of invasive species will be managed through our Seagrass Restoration Biosecurity Plan. This plan is based on Seawilding's currently approved Biosecurity Plan and has been altered slightly to reflect the current works. Given the low deployment rates as well as the shallow water depth and low fine content of the deployed sediment, it is expected that the spreading of turbidity will be substantially limited to the direct local area. The sensitive receivers, namely seagrass (*Z. marina* & *Z. noltii*) and [Redacted] , are located more than several hundred metres away from the project site at a distance where turbidity due to the works will not reach and therefore not have an impact. By working with these principles we are confident that environmental impact will be insignificant.