

Environmental control on dredging projects

Lessons learned from 15 years of turbidity monitoring

Marine and inland water-based infrastructure is a prerequisite for the sustainable development of economic benefits and public welfare. Dredging works are needed to realise and maintain such infrastructure. It is widely recognised that such projects create an impact on the environment and in recent years awareness of these impacts has grown – on the client side as well as among contractors.

The purpose of this paper is to share recent experience gained from the development of marine infrastructure projects in environmentally sensitive areas, with a particular focus on the realisation phase. The main emphasis is on lessons learned from 15 years of turbidity monitoring (see *Figure 1*) during dredging and sediment placement operations.

Dredging projects and the environment

Environmental aspects play an important role during the full cycle of project initiation, development, realisation and operation. While detailing the project at hand, legal frameworks such as the *London Convention* and the *EU Water Framework Directive* pose strict environmental controls. Any environmental effects – both adverse impacts and benefits – are evaluated as part of the environmental impact assessment, often in consultation with the legal commissioner. This evaluation may result in revision of the project design or the implementation of nature compensation measures.

Contractors are responsible for minimising environmental impacts during project realisation (process impacts). Sometimes, the use of environment-friendly work methods and robust environment management plans proves a decisive factor in project tendering. Once contracted, environmental monitoring schemes should be in place before construction works begin. Given the costs associated with these schemes and their strategic importance for environmental control,

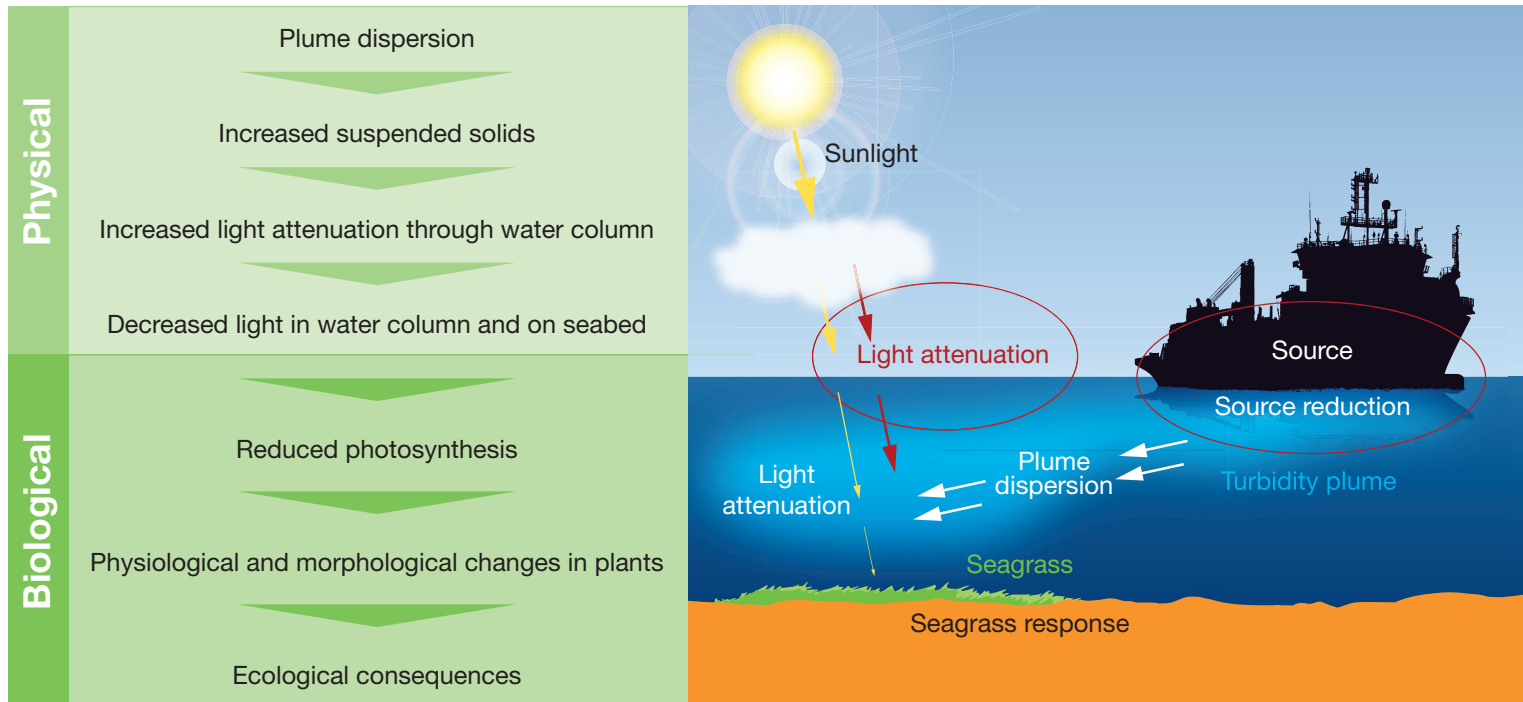


Figure 1: Monitoring during dredging

development of these programmes should be integral to project preparation.

Environmental monitoring

To ensure the care and protection of surrounding ecosystems, while enabling the construction of marine infrastructure, environmental monitoring has become common on dredging projects since the Øresund Fixed Link Project between Denmark and Sweden (1996). Major marine infrastructure projects in, for example, Melbourne



(Australia), Rotterdam (Netherlands) or London (UK) have called for extensive environmental monitoring. Such large-scale programmes typically involve several types of monitoring, each with a different objective:

- *Surveillance monitoring or baseline monitoring:* to assess general project conditions and act as a reference for the interpretation of dredging impacts. Monitoring involves flora, fauna, hydrographic conditions, bed sediments and turbidity.
- *Feedback monitoring or adaptive monitoring:* to verify pre-project environmental assessments (model predictions, expert judgement) and to provide a base for possible adaptation of the project design, planning and/or work method.
- *Compliance monitoring:* to ensure compliance with the environmental restrictions endorsed for the project at hand. Each dredging project is unique and impacts vary widely from one project to another, depending on local hydrodynamic conditions (tide, waves), natural turbidity levels, soil characteristics and dredging operations. Environmental monitoring is needed to gain insights into the actual relationship between impacts from dredging and the response of sensitive ecosystems such as coral reefs and sea grass. Such insights help to establish scientifically sound environmental limit levels for dredging operations.

Most present-day monitoring programmes are based on the assessment of turbidity levels, because the greater light attenuation in the water column resulting from the increase in suspended sediment concentrations is known to affect marine life (see diagram above and Figure 2 overleaf). Additional benefits of this parameter are its direct link to dredging and placement operations and its relative ease of measurement. Environmental restrictions typically involve limits on sediment plume size at dredging and disposal sites.

Recently, environmental restrictions have focused on other biological, chemical and/or physical parameters that directly reflect ecosystem health at a particular project site. However, limited capabilities for (operational) monitoring of such complex processes and insufficient understanding of the link to construction activities hamper widespread use of these criteria in present-day dredging practice.

Environmental management

Management of environmental impacts has become a standard component of marine infrastructure projects. To avoid unforeseen delays and costs, environmental monitoring should be integral to project planning. An essential step is the compilation of an environmental management plan (EMP) to provide full details on:



Figure 2: Dredging plume dispersal

- **Monitoring requirements:** what is needed to assure protection of the ecosystem? Includes a summary of environmental restrictions, including specification of monitoring parameters and limit levels.
 - **Monitoring approach:** how to ensure compliance with environmental standards? Includes an overview of work methods, including specification of measurement equipment, data sampling (frequency, location, depth), data processing, data interpretation and dissemination of results.
 - **Mitigating measures:** what operational measures can be taken in case of violation of environmental limits?
 - **Response procedures and responsibilities:** what procedures are in place if environmental warning or limit levels are exceeded, and who is responsible for which action?
- Often, no previous practical experience is available for a specific site. Where this applies, it is recommended to develop adaptive monitoring schemes, so that monitoring efforts can be adjusted (reduced, refined or expanded) if appropriate. It is important to realise that most ecosystems respond to prolonged, rather than instantaneous, turbidity impacts. For such cases, the use of time-averaged turbidity measures (for instance, six- or 12-hour rolling average) to assess impacts is justified. This in itself adds significantly

to the operational manageability of the environmental monitoring programme.

Lessons learned from 15 years of dredging project experience
Environmental monitoring has taught us:

- Each project is unique. Nevertheless, with great care, lessons learned from one project can be used for the next.
- Dredging-induced turbidity impacts should be evaluated as an increase above background level, not as absolute values. Environmental limit levels should be based on the resilience of the local ecosystem, while accounting for natural fluctuations in turbidity level.
- Monitoring programmes should be designed in an adaptive manner, to allow for procedures to be reviewed and, if appropriate, adjusted.
- Environmental monitoring should be an integral part of project preparation and planning, to ensure effective mitigation of possible environmental effects.

When made available to the outside world, environmental monitoring data were also found to encourage stakeholder involvement and to improve public awareness.

In this way, environmental monitoring is directly relevant to the success of marine infrastructure projects and their appreciation by the general public.

This document is presented by the Central Dredging Association (CEDA). an independent, international, easy-to-access platform for the exchange of knowledge and experience on all aspects of dredging and marine construction. CEDA publications are peer-reviewed by internationally acknowledged experts and represent high quality standards. Input for the document is obtained from all professional groups within the CEDA membership which represent a wide range of expertise, disciplines and nations. CEDA publications provide impartial, state-of-the-art information for academics, industry professionals, regulators, decision-makers and stakeholders. This document, or part(s) of it can be used freely by anyone, subject to reference made to CEDA as the author. For more information please refer to www.dredging.org

Central Dredging Association
Radex Building
Rotterdamseweg 183c
2629 HD Delft, The Netherlands
T: +31 (0) 15 268 2575
E: ceda@dredging.org
www.dredging.org