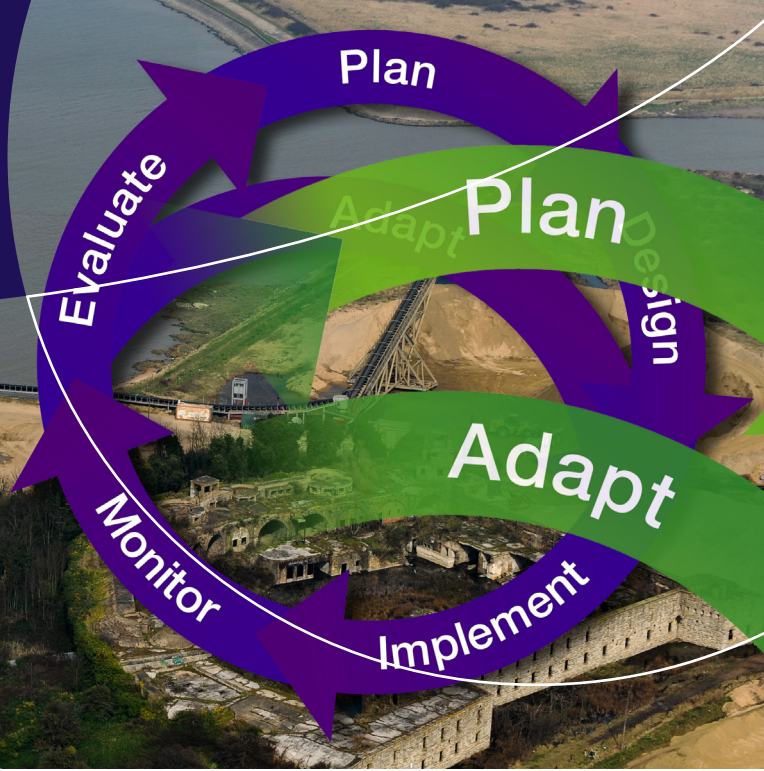


# FACTS ABOUT

An Information Update from the IADC

# ADAPTIVE MANAGEMENT



## WHAT IS ADAPTIVE MANAGEMENT?

Adaptive management is a decision-making framework that can be applied at different stages of a dredging project. Contractors can utilise adaptive management to adapt their operational strategies within different phases of a project, to record the effects of their works and to predict the impacts on the ecosystem and its services. Doing so, both contractor and client or project owner can cater for uncertainties in their decision-making during the project. It should be noted that there is a difference between the client and project owner. In most traditional projects, the client and project owner are the same party. This is not the case in a majority of Engineering, Procurement, Construction and Installation (EPCI) projects. In EPCI operations, the project owner provides investment capital and appoints a project management team to realise the project for it. This project management team is then the client for the EPCI-contractor.

With adaptive management, levels of uncertainty about dredging-related impacts on the environment decrease over the course of the project as more accurate information is collected – project effects are continuously evaluated through various means and especially through monitoring to determine the need for modification.

This framework can be applied at the beginning of the project, where issues such as the scope of work or the project design are to be managed. Further implementation of this management strategy can be scheduled throughout the dredging works, for instance, during the execution of the works or monitoring in the field.

Previously, in a more traditional dredging contract, there was a clear, strict and static description of project targets by the client or project owner and the contractor could go straight to

the technical solution. No or limited interaction was planned during execution. With adaptive management, the client or project owner can formulate project goals on a more strategic level and even on a global scale; engaging the contractor right from the start to realise these integrated targets.

As adaptive management allows for initial project targets to be adapted or reformulated, the contractor can take into account what can be learned along the way. If new information comes up, for instance, during field testing, design, environmental monitoring or execution, the work can be adapted by utilising this new information. Not only can this framework be applied at each stage of a dredging project but it can be combined for the whole project. Currently, many contractors are doing adaptive monitoring or adaptive design but are not (yet) systematically applying adaptive management for a whole project.

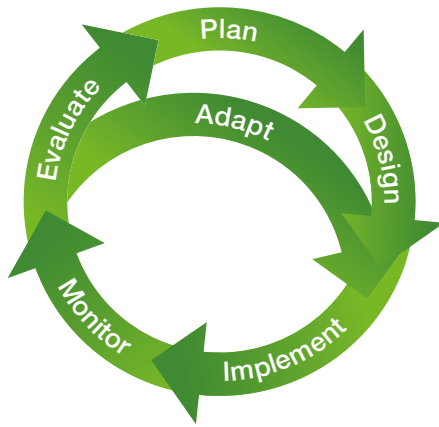
## HOW DOES AN ADAPTIVE MANAGEMENT FRAMEWORK WORK?

According to the CEDA Position Paper, “Integrating Adaptive Environmental Management into Dredging Projects”, adaptive management requires a few essential elements:

- a temporary more intensive monitoring, evaluation and adjustment commitment from a dredging project;
- a higher budget and resource requirements for monitoring, evaluation and adjustment;
- a mechanism to deal with a lower or higher effort due to newly identified requirements;
- a mechanism to deal with differing total costs from the initial calculation;
- strong cross-sectoral project management skills;
- and flexibility for a differing implementation timeframe.

The adaptive management framework is essentially a cycle and the monitoring, evaluation and the adjustment phases of the project form the basis of this framework (see cycle on next page).

*Above: Adaptive management was applied on the London Gateway Project. This included real-time monitoring – a network of monitoring stations was set up to take measurements of various factors such as water quality in real-time. This information was sent to the contractor and stakeholders so the work could be adapted when necessary.*



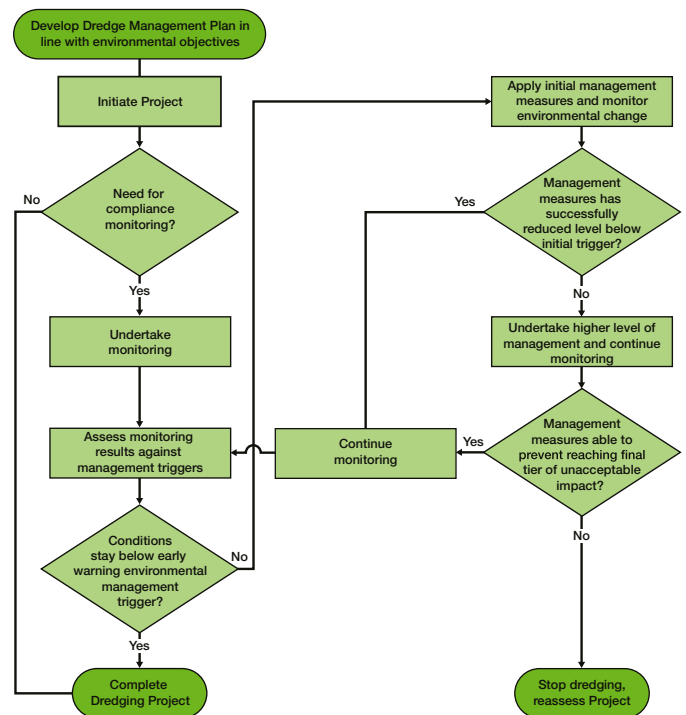
The graph above shows the basic adaptive management cycle that indicates the various stages in a dredging project – planning, designing, implementing, monitoring, evaluating and adapting (original image from CEDA Position Paper, 2015)

The basic steps of adaptive management are as follows:

- **Plan:** The first step during which goals and objectives of the project and its parameters are defined, alternative actions are evaluated and a preferred strategy is selected
- **Design:** The phase when a flexible management action is identified or designed to address project challenges
- **Implement:** The selected action is implemented according to the design
- **Monitor:** The results or outcomes of the operational management action are monitored
- **Evaluate:** The system response is then evaluated in relation to specified goals and objectives
- **Adapt:** The contractor can adapt various integrated actions combining operational-technical-environmental-economic issues in proper monitoring and management to achieve goals and objectives

Contractors can utilise the basic adaptive management framework and integrate it into their dredging project by producing a management plan which defines the types of actions, procedures and compliance measures to be implemented during the execution of the works (see figure on the next column). The plan should be project-specific and tailored to site conditions, environmental sensitivity of the local ecosystem, the socio-economic conditions, regulations and other practical considerations. This is usually referred to as the Adaptive Management Plan (AMP) or Compensation and Monitoring Plan (MCMP) or a section within a Dredged (Material) Management Plan (DMMP).

When adaptive management is properly implemented and though this initially includes slightly higher costs, it should eventually result in overall lower costs and fewer delays. This thereby lowers the risk profile for both contractor and client or project owner alike and can aid in optimally exploring (integrated) opportunities within that project. Issues such as permit approval and operational delays caused by non-compliance or stakeholder's concerns are minimised.



A simplified process for integrating adaptive management in a dredging project (original image from CEDA Position Paper, 2015)

## WHAT IS MODELLING AND HOW CAN IT AFFECT THE WORKING METHOD?

Once the initial objectives and goals of the project have been planned, the contractor needs to know if the project concept will be able to meet the objectives and does not exceed the limits. Transferring the concept up to real life project levels, brings the contractor to the design phase of the project during which modelling is essential.

Modelling works as a forecasting tool and allows for informed decision-making by management such as how to proceed with the project. It comprises taking various factors into account such as physical parameters of currents, soil characteristics, natural background turbidity, location of the dredging area and adding such relevant information into a 3D modelling software. Depending on the complexity of the project, adding relevant data into the model can take up to several weeks. Also, the contractor can run various scenarios with the model – it will then show various elements such as the area of impact, sedimentation, time, location and an estimate for the project and if a particular area, flora or fauna (sensitive receptors) will be affected or not. After running various scenarios, the contractor can choose one that shows the optimal working level that meets all specific project requirements.

Such detailed information from the model can be shared with the client or project owner, regulators and other stakeholders. This helps with an open discussion with them regarding an integrated project's effects and impacts assessment. Moreover, a working method can be chosen in consultation and in consensus with relevant stakeholders.

Furthermore, talking to the client or project owner on a daily basis and keeping them on board throughout the project development is essential and if the work gets close to the limits or thresholds, the work can be adapted to mitigate possible impacts.

### WHAT IS ADAPTIVE MONITORING?

Adaptive monitoring is an iterative process and is a key part of the adaptive management framework. Monitoring is undertaken for the following reasons:

- To gain a good baseline understanding of the environmental setting of the project through measuring and recording parameters, at both spatial and temporal scales
- To detect and quantify changes in the environment caused by dredging – to assess if the impact is positive or negative
- To assess compliance with permit, licence, legal or contract requirements
- To validate numerical models used to help predict effects of dredging in the design of projects.

Adaptive monitoring is particularly useful for environmental management and can also be applied to address technical, social or economic aspects of a project. Available data and relevant information can be directly used as a visualisation tool in internal and/or external communication. Monitoring can be conducted before and during construction of the project. Depending on the project, monitoring can be carried out after the project during operation of the facility but this is usually done by the client or project owner rather than the contractor.

Data obtained from monitoring can be utilised to compare and evaluate objectives for dredging projects and define goals. Furthermore, the contractor can amend the dredging activity by carrying out adaptive monitoring throughout the dredging work and simultaneously monitoring the ecological health of sensitive receptors in the work area. Receptors are species such as seagrass, mangroves and coral reefs. They can also be resources and activities such as fisheries and tourism that are identified as being important and can be affected by a dredging operation.

In addition, all relevant stakeholders of a project can be involved in this stage of the project – contractors can hold regular dialogues with the client or owner of the project as well as other stakeholders and give updates regarding the dredging works.

Different types of monitoring are carried out during various stages of the project. During the pre-dredging phase, baseline monitoring is carried out. During the dredging phase, surveillance monitoring and compliance monitoring are undertaken. Surveillance monitoring assesses temporal and spatial changes to selected parameters before dredging and during dredging. Compliance monitoring ensures that the dredging process complies with the restrictions that are either legally or contractually stipulated. Compliance monitoring is also carried out post-dredging.

### WHAT IS BASELINE MONITORING?

Baseline monitoring is carried out before dredging activities commence. Baseline conditions are the environmental conditions prior to the start of a dredging project – the existing physical, chemical, biological and human environment. With baseline monitoring, contractors can measure and characterise the initial environmental conditions. This comprises levels of baseline information such as environment and socio-economic aspects that gives the current state of systems and their natural dynamics in which a project is planned. This information serves as reference points for a general assessment framework when comparing effects and impacts from the project or any planned alternatives with the natural variations and/or evolutions in the local ecosystem.

For dredging projects that have long lead-in times, it may be necessary to predict the future state of the baseline when the project has to start. These predictions can be an important consideration for dynamic aspects of the environment that change naturally over time such as ecological temporal trends – seasonal variations and migrations. Anthropogenic factors such as climate change or change due to other nearby projects also have an impact on the environment.

The Port of Southampton Project in the UK is one on which adaptive management was applied. Nine buoys were deployed for three months to measure baseline values before dredging. During the initial monitoring period, background levels such as the suspended sediment concentration (SSC) values due to tide, natural events like storm; the influence of the rivers Hamble, Itchen and Test as well as the effects of passing vessels were measured. This data including the background monitoring that the owner, Associated British Ports (ABP) had executed for the Environmental Impact Assessment (EIA) was valuable for further adaptive management that was seen as critical to the success of the project by client or project owner and regulator. It ensured protection of the sensitive receptors in the work area such as shellfish and Atlantic salmon, compliance to regulations and flexibility to perform the work.

### WHAT IS REAL-TIME MONITORING?

During dredging, surveillance monitoring is carried out. It takes into account baseline environmental measurements during dredging to determine environmental impacts and effects and if they are acceptable. Based on the data obtained from monitoring, the contractor can decide to continue dredging or to modify the work methods, schemes or sequences.

With technology, monitoring during the dredging process can be carried out on a continuous basis or what can be described as real-time. Real-time measurements, data processing and evaluation systems can be used to identify environmental changes online as it happens. Moreover, real time data such as online readings can provide all stakeholders with necessary information during a project that can be utilised to adapt specific targets or dredging activity. The systems can also trigger an alarm – as defined in a tiered level decision-making framework – to inform necessary parties to make alterations before environmental changes become unacceptable. Tiered

level decision-making is when a series of consecutive steps are taken, especially regarding critical thresholds in a project. And during each step, a linked action or decision is taken or activated.

Real-time monitoring can also be part of boundary conditions – not only environmental but also social or juridical limits for a project.

London Gateway Port Project on the banks of the Thames Estuary in the UK is another project for which an adaptive management strategy was utilised. The contractor had to liaise and cooperate with various stakeholders including the Department for Transport, the Environment Agency and Marine Management Organisation. Besides obtaining third party approvals to permit the construction of the port, the contractor had to undertake to a wide range of environmental monitoring operations. These included continuous measurements of the water quality of the estuary in terms of suspended solids and dissolved oxygen (DO) and monitoring of the discharges of fines from the reclamation area into the River via the weir boxes. Sediment plumes created by the dredging activity and measurements of the environmentally designated intertidal areas along the riverbanks were monitored.

In order to clearly define the dynamic nature of the Thames Estuary as an ecologically valuable working environment, the contractor set up a so-called Red Line monitoring which was

the setting and reviewing DO and total suspended solids (TSS) thresholds to control dredge and reclamation works. During dredging and reclamation operations, the water quality of the estuary was monitored in continuous near real-time (every 5 minutes) in terms of TSS and DO. These running values form the dynamic background of the natural estuarine system, as a dynamic threshold framework for environmental compliance. The Red Line was an area 200m beyond the edge of the dredged area across the tidal stream and 3 km up/down stream in the direction of the tidal stream. A network of 11 monitoring stations was set up and data from the Red Line monitors was continuously transmitted to a web based programme available to the contractor, the monitoring subcontractor and the client or project owner. Notifications of threshold exceedances and system issues from a monitor were flagged on the web programme and via SMS so that the issue could be analysed by staff and adaptive action could be taken.



The Port of Southampton project also employed real-time monitoring. Real-time information from the nine deployed buoys was sent to shore by General Packet Radio Service (GPRS) network. Readings were sent every five minutes to the webserver; this data was accessible for the supervisory staff, the client, ABP, and the Environment Agency. In addition, the Environment Agency received an email and ABP received text messages via mobile directly from the monitoring system. If an alarm was triggered, dredging plans were adapted immediately – dredging was halted or vessels moved to another area.

### WILL ADAPTIVE MANAGEMENT BE MORE UTILISED?

Currently, not all dredging contractors are applying the adaptive management framework on their projects as it initially takes more time, effort especially in terms of monitoring as well as costs. However, applying this framework will allow contractors to predict the impacts of dredging on the environment and surrounding areas and adapt their operational strategies accordingly. Moreover, adaptive management ensures that the contractors can keep the client or project owner and stakeholders apprised of the work that ultimately leads to informed decision-making.

### FOR FURTHER INFORMATION AND READING:

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Facts About is presented by the International Association of Dredging Companies whose members offer the highest quality and professionalism in dredging and maritime construction. The information presented here is part of an on-going effort to support clients and others in understanding the fundamental principles of dredging and maritime construction.

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