

# FACTS ABOUT

An Information Update from the IADC

## DREDGING AROUND CORAL REEFS

### WHAT ARE CORAL REEFS?

Corals are tiny polyp-like marine animals with a ring of tentacles around a central mouth by which they filter nutrients from the water. Most corals have a symbiotic relationship with algae (so-called zooxanthellae) to also obtain energy via photosynthesis. Numerous genetically identical polyps constitute a coral colony which functions as a single organism. “Hard” or stony coral species extract calcium carbonate from the seawater to create a durable exoskeleton to protect their polyps. These colonies can develop distinct growth forms including branching to digitate (finger-like), foliose (plate-like), encrusting, massive (boulder-shaped), and mushroom shapes. The different forms have different characteristics and affect where the corals are found, how they react to different stresses, and how fast they grow. So-called “soft” corals don’t build a calciferous exoskeleton, but become flexible organisms that resemble plants.

Coral reefs are marine ridges or mounds formed from the deposition of calcium carbonate by living organisms, predominantly hard coral colonies, but also by other organisms such as coralline algae and shellfish. Most coral reefs grow best in warm, shallow, clear, sunny and agitated water. As the centuries pass, the reef gradually grows until they become extremely rich marine ecosystems hosting 25% of all marine species such as fish and numerous invertebrates.

### WHY ARE CORAL REEFS IMPORTANT?

Healthy coral reefs provide an array of ecosystem services, i.e. benefits to humans, including shoreline protection, food production, carbon fixation, nutrient recycling, and supporting tourism industries. In contrast, unhealthy or degraded coral reef systems may result in a decline in natural resources upon which local communities are dependent, an increased vulnerability in the coastal area to flooding, and a loss of cultural traditions. The economic value of the world’s coral reefs is hard to determine. It has conservatively been estimated at US\$ 30 billion per year, although the tenfold has

also been mentioned. The costs for restoration of coral reefs after being damaged has been estimated to be in the order of US\$ 1,000 per m<sup>2</sup>.

### WHERE ARE CORAL REEFS FOUND?

Coral reefs are most commonly found at shallow depths in warm tropical waters (generally above 21°C), but also on smaller scales in deep water (> 40m) and cold water areas (below 14°C). Warm-water coral reefs form in the shallow, clear seas of the tropics with an essential combination of low nutrient waters and high levels of available sunlight. Although warm-water coral reefs cover just under 0.1% of the ocean floor, their location often overlaps with the coastal areas highly used by mankind.

### WHY STUDY THE INTERACTION OF CORAL REEFS AND DREDGING?

One third of the world’s population lives in coastal areas, where rapid anthropogenic development has led to increased construction of coastal infrastructure such as ports, waterways, coastal defence systems, land reclamation and beach nourishment. This has inevitably resulted in conflicting priorities between coral reef conservation and economic growth. The main concern is that development of waterways, ports and harbours may lead to the direct loss of coral reefs caused by the removal or burial of reefs within the footprint of the works, as well as through stress to corals caused by elevated levels of turbidity and sedimentation in the vicinity of dredging activities. These negative effects to coral reefs by dredging can be immediate or develop over a longer time frame, and be temporarily or permanent.

The effects of dredging projects on the valuable and sensitive coral reefs should always be systematically assessed prior, during and after execution. Careful consideration must be given as to how to monitor and, to avoid or mitigate the impact

*Above: Coral reefs are valuable and sensitive natural assets that require special attention when dredging operations are planned.*

## WHAT CAUSES THE IMPACT OF DREDGING NEAR CORAL REEFS?

Limestone and coral materials tend to break into extremely fine particles when being dredged. This creates milky white “clouds” of suspended sediments and these can stay in suspension for a long time, potentially spreading over a large area. Such an increase in suspended sediments result in significantly reduced light penetration, even in low concentrations, which may cause severe stress to corals over a wide area.

The severity of impacts is directly related to their magnitude, duration and frequency. The effects may be “lethal” to species, causing changes in the reef composition; or they may be “sub-lethal”, that is, causing stress to corals, such as reduced growth rates and reproductive performance, and bleaching (release of zooxanthellae). Therefore, it is critical to avoid or at least to minimise the dredging of coralline rock materials as much as feasible.

## DO ALL CORALS SUFFER WHEN DREDGING IMPACTS THEM?

The response of different hard coral species to the effects of dredging varies widely and may be related to their growth shapes. Branching corals, which usually grow vertically and have low surface area to volume ratios tend to be sensitive to turbidity (reduced light penetration), but relatively tolerant to sedimentation (burial). On the opposite, plate corals, which usually grow horizontally and have high surface area to volume ratio tend to be prone to the burial effects of sedimentation. If sedimentation is only temporarily, some coral species are able to actively remove deposited sediments from their tissue, for instance, by producing mucous or through tentacular ciliary action. If sedimentation rates are long lasting but not too extreme, some coral colonies are able to adapt their growth shape.

The vulnerability of coral reefs to the impact of dredging, and their capability to recover or adapt depends on their health status prior to dredging (degraded or thriving), the type of coral species present, the reef composition as a whole (e.g. algae or coral dominated), and the local environmental conditions.

## CAN CORAL REEFS RECOVER FROM IMPACTS DURING DREDGING?

The main effects from dredging and port construction (i.e. destruction, turbidity and sedimentation) stop once the project is completed. If environmental conditions then return to the pre-impact situation, timescales for natural recovery of coral reefs can be in the order of a few years to several decades, with recovery times depending on the scale of impact, the types of species affected, and the recruitment potential. The risk and severity of impacts from dredging and port construction-related activities on coral reefs are directly related to both the intensity and duration of impacts causing stress. Frequent short-term exposures or chronic long-term exposure to turbidity and sedimentation is likely to result eventually in mortality for many coral species. If moderate levels of impacts on a coral reef persist for particularly long periods of time, the reef may undergo changes in composition,

with the sensitive species gradually being replaced by more tolerant ones. The reef could persist in an altered form, but probably with an overall reduction of its biodiversity.

## CAN CORAL REEFS BE PRESERVED AND PROTECTED DURING DREDGING?

Experts from PIANC and UNEP (United Nations Environment Program) have joined forces to explore the possibilities to preserve and protect coral reefs during dredging activities. Working together, UNEP and the PIANC EnviCom Working Group 15 have developed guidelines for the implementation of best practice methodology in environmental assessment and environmental management for dredging and port construction activities around coral reefs and their associated communities.

Whilst it is recognised that knowledge gaps still exist and that the methods for monitoring and mitigating unwanted impacts on coral reef ecosystems still need improvement, practice has shown that by adopting sound planning, impact assessment, monitoring and management practices, large benefits can be achieved in terms of avoiding or minimising adverse effects on the coral reef environment from dredging and port construction.

## HOW CAN SOUND STRATEGIC PLANNING PROTECT CORAL REEFS?

Impact of dredging can be minimised by strategic planning ahead. An initial risk assessment based on available secondary data, initial field surveys, preliminary numerical modelling, an understanding of local and regional coastal processes, and identification of areas designated for protection under national or international legislation should be conducted. Local stakeholders should be involved to determine the reef services used in the area. This will help to determine the type of impact assessment that will be required and to identify potential effects for early mitigation during the design phase.

A key issue in the planning phase is an assessment of alternative locations, layouts, and methods that can minimise the direct impact of a project’s footprint on coral reefs. In addition, the potential causes of a wide range of indirect effects to the surrounding area should be carefully assessed, such as current patterns, wave conditions, sediment transport, and shoreline stability.

Also in the planning stage, periods of increased risk – such as cyclone/hurricane seasons, periods of high water temperature, and sensitive phases of the life cycles of corals, such as spawning – should be identified. This kind of early consideration during the initial planning phase can prevent or minimise effects to coral reefs, expedite the approval and permitting processes, and optimise the requirement for time-consuming and costly monitoring and management programmes before, during and after the project.



*One means of mitigating impacts to sensitive Coral Reefs is to relocate the coral prior to commencing dredging operations in the area. This can be costly and should not be seen as a substitute for prevention or mitigation*

## WHY IS THE EIA A KEY ACTIVITY DURING THE PLANNING PROCESS?

Decision-makers need to consider the environmental impact before deciding whether to proceed with a new project. Part of the process of doing this is the use of an Environmental Impact Assessment (EIA), which can identify and assess the potential environmental impacts of a proposed project, evaluate alternatives, and design appropriate mitigation, management and monitoring measures. The EIA supports planners with certainty that they are complying with local and national legislation, and international guidelines or treaties formulated by, for instance, the World Bank and the Equator Principles. Obtaining relevant and accurate baseline data about the location and status of coral reefs in the potential project area is essential to be able to ensure the safety of the reefs.

## HOW CAN IMPACTS TO CORAL REEF BE MITIGATED?

When impacts to a coral reef cannot be prevented, a number of mitigation measures is available. Most of these aim to minimise the release and spread of sediments and thus reduce the levels of turbidity and sedimentation. Best technical mitigation practices include, for instance, the proper type of dredging equipment, control over leakage, sediment spill and propeller wash, the use of an environmental valve, relocating the dredger when necessary, the use of silt barriers and conforming with environmental “windows”.

## HOW CAN IMPACTS TO CORAL REEFS BE COMPENSATED?

If mitigation cannot decrease the impact to an acceptable level, compensation measures may be required to offset the effects. For instance, coral propagation using breeding and/or fragmentation techniques can produce new coral colonies. These can be out planted at affected reefs, thereby supporting and accelerating their recovery. Although these methods offer means for compensation of the impact caused by dredging, they should not be seen as a substitute for prevention or mitigation. They are merely a supplement to best practice prevention and mitigation.

## WHAT IS AN EMP AND HOW CAN IT HELP?

As part of the EIA, a Draft Environmental Management Plan (EMP) should be prepared, and incorporated into the construction tender documents. Once the contractor is appointed and project layout, methodology and timing are

confirmed, a review should be conducted to ensure the project still falls within the “environmental envelope” of the EIA. As there is often a gap between the EIA and the start of work, additional surveys are usually required to establish the EMP baseline. Furthermore, The EMP should continuously be updated during the entire lifecycle of the project.

Common baseline survey components with respect to corals include monitoring of: light attenuation and /or turbidity; sedimentation rates; the status of the coral reef, such as coral cover, growth rates, stress symptoms; the water quality, such as dissolved oxygen, temperature, and nutrients; and the met-ocean (“meteorology and oceanography”) conditions, such as currents and waves.

## CAN MONITORING HELP TO PROTECT CORAL REEFS?

Monitoring before, during and after project execution near coral reefs can help to quantify and reduce risks. Monitoring can determine whether a project is meeting/ has met the agreed levels of impact and that the predictions of impacts during the EIA have been accurate.

When monitoring during project execution indicates that impacts are being exceeded, timely action can be taken. This adaptive management process allows dredging and port construction near coral reefs to be executed with maximum productivity rates whilst meeting environmental protection criteria.

To develop an effective environmental monitoring and management programme, the sensitive receptors in project areas as well as the processes affecting these receptors should be identified. The monitoring programme should be designed such to ensure that the monitoring will be able to isolate and distinguish impacts of the project from other external (natural or human) impacts.

To create a successful dredging project in a sensitive coral reef environment demands that all parties involved will work with transparency, with a clear understanding of the issues, and with a management plan that allocates responsibilities. This way, potential impact can be avoided and, when necessary, the parties involved can respond adequately to significant non-compliance events such as observed impact, unforeseen developments or new stakeholder requirements.

## FOR FURTHER READING AND INFORMATION

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The IADC Knowledge Center: <https://www.iadc-dredging.com/en/knowledge-base>



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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