4. Environmental auditing

SUMMARY

The marine environment, including the oceans, all seas and adjacent coastal areas, forms an integrated whole that is an essential component of the global life-support system and a positive asset that presents opportunities for sustainable development.

Degradation of the marine environment (loss of marine habitat like coral, declining fish stocks, polluted seas, disappearing beaches, mangrove destruction) can result from a wide range of activities on land. Human settlements, land use, construction of coastal infrastructure, agriculture, forestry, urban development, tourism and industry can all affect the marine environment. Coastal erosion and siltation are of particular concern. Hence, rational use and development of coastal areas as well as conservation of the marine environment require the ability to determine the present state of these ecological systems and to predict future conditions.

Thus, systematic collection of data on marine environmental parameters is needed for an integrated management approach to sustainable development and to predict the effects of the construction of a port on the marine environment.

This chapter reviews the marine environmental parameters utilized by environmentalists to predict the effects of the construction of a port or fishing vessel landing site on the surrounding marine environment.

Within the decision-making process, regarding where to construct a port or fishing vessel landing site, the objective is to have ensured that there would be minimum adverse effects on the surrounding marine environment.

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4.1 ENVIRONMENTAL STUDIES

4.1.1 Introduction

In developed countries, environmental audits in support of all applications for the construction, upgrading or re-engineering of fishing ports are mandatory and planning permission only granted for successful outcomes.

In developing countries, especially those with less stringent regulations, the sense in carrying out environmental audits is sometimes not fully understood when planning a new port or remodelling an existing facility, thus the audit may be considered to be superfluous or a costly obstacle to development. On the other hand, in some instances, planning permission may be granted at the highest level of government with the understanding that environmental studies would be carried out by the developer. This may seem to be acceptable if it is conditional as to what type of outcome would be acceptable, but this may not always be the case.

Therefore, in general, an environmental audit should be drawn up in support of all applications for the construction or improvement of harbours or landing places for fishing vessels, whether in coastal zones or inland waters. For both small and large projects alike, the port planner should first seek advice and/or guidelines from the relevant ministries (environment, fisheries, etc.) before embarking on an environmental audit. In most day-to-day cases, projects are usually small and by themselves cause little environmental damage. However, the problems start with multiple small projects mushrooming along a stretch of coastline without forward planning, which together may have the same combined destructive power as a large project and may be more difficult to control.

4.1.2 Standard procedures for environmental studies

Due to their relatively high cost, environmental studies are normally carried out in steps in increasing detail as a project moves from formulation to final design. Figure 1 illustrates the steps in the procedures required when a project moves from the formulation stage to the final design stage. Briefly, the stages comprise:

- the initial environmental examination (IEE), where a number of candidate sites are examined and graded for suitability and potential environmental impact;
- the environmental impact studies (EIS), consisting of detailed studies of the prime candidate site. At the end of these studies, the findings are normally presented at a public hearing as part of the consultation process and the final design refined further; and
- at the end of the second stage, the national agency responsible for the environment then prepares an assessment of the impacts and recommendations known collectively as the environmental impact assessment (EIA), which is then forwarded to the government for a final decision.

Briefly, the Environmental Impact Studies (EIS) leading to the environmental impact assessment (EIA) consist of the following stages:

- An assessment of the existing environment prior to construction of the port facility, including the land-use characteristics (recreation areas, dwelling areas, forested zones, commercial zones, etc.) and socio-cultural activities (population dynamics, migration, cultural and ethnic preferences, etc.) at the proposed site.
- A list of the planned changes to be made to the environment by the proposed project, globally referred to as the project's footprint (land requirement, size of harbour basin, including breakwater foundations, dredging of access channels and turning areas, reclamation for factories, new access roads, power stations, etc.).
- An estimate of the anticipated impact of the planned project on the existing environment (deeper water, loss of beach, increased road traffic, high water consumption by factories, smoke and odour emissions from chimneys, etc.).

- Proposed mitigation measures to lessen the anticipated impact on the existing environment (increase of water production to compensate for higher consumption, location of chimneys to minimize unpleasant odours or smoke from drifting across the village, noise abatement around new sources of noise such as generators, treatment of all sewage, collection and disposal of spent engine oil, etc.).

4.1.3 Existing environment

The existing environment around a project site may be assessed through:

- onshore topographic and offshore bathymetric maps (down to 20 metre contour) of the site, covering at least 1 kilometre in each direction along the coast;
- aerial imagery of the above-mentioned area with a resolution not smaller than 1:2000 together with any satellite imagery available;
- details of existing or planned coastal structures within 5 kilometres of the proposed site;
- a morphological description of the coastal zone of the site, backed up by a geological description of important local features such as cliffs, sand dunes, beaches, reefs, terraces, rivers, dams on nearby rivers, river mouths;
- wave, tide or lake level statistical characteristics including probability tables for extreme conditions;
- seasonal variations in rainfall, river flows, water density, water temperature, nutrients concentration and microbial pollution levels;
- geological, petrographic and sedimentological characteristics of the coastline and seabed, including source, volume and seasonal changes in littoral transport;
- geotechnical investigation of the project site, including borings and laboratory testing of samples;
- maps of onshore and offshore habitats in and around the project site (coral reefs, lagoon systems, mangroves, sea grass meadows, tidal wetlands, estuaries etc.);
- maps of types of habitat in and around the project site (marine protected areas, areas of refuge, feeding grounds, nursery and spawning);
- lists of the species to be harvested, lists of protected or rare species and biological indicators as well as the methods of fishing;
- layouts of nearby settlements, properties, water wells, flood alleviation canals, cultural places, bathing facilities, archaeological sites, etc.;
- layouts, size and capacity of resource networks, such as water supply networks, power supply and distribution networks, road and other communications networks, sewerage networks, etc.; and
- location maps of any type of activity discharging, directly or indirectly, effluents into the aquatic environment, including distant but connected water courses, such as sewer outfalls, onshore fish farms, slaughter houses, logging/saw mill concessions, wood pulp factories, mines and ore reduction plants and other industries.

4.1.3.1 Planned changes

The planned changes to the environment should include:

- general description of the entire project, including location, type, size and typical cross-sections of the various components that together make up the project together with a description of the proposed stages of construction;
- the additional demands which would be placed on the locally available resources, both during construction and operation of the project;
- all the effluents and emissions arising from the project; and
- the changes in the landscape, including land use characteristics and socio-cultural activities envisaged in the project.

4.1.3.2 Anticipated impact

The estimation of the anticipated impact of the planned project on the existing environment should include:

- topographic, bathymetric and oceanographic changes, including siltation and erosion, during and after construction, until stable conditions are resumed, together with their effect on habitats, flora, fauna and land use, usually achieved through mathematical or physical models;
- changes in water quality (temperature, salinity, turbidity, dissolved oxygen, nutrients concentration and microbial pollution levels) during and after construction and their effect on habitats, flora, fauna and land use;
- sources of pollution discharging effluents, emissions or solid wastes during and after construction until stable conditions are resumed and their effect on habitats, flora, fauna and land use; and
- the visual impact on the seascape and the landscape and general quality of life around the proposed project site.

4.1.3.3 Mitigation measures

The proposed mitigation measures should be:

- technical, i.e. oil reception facilities, waste recycling schemes, sewage treatment systems, chlorofluorocarbon-free refrigeration equipment and bypass dredging where applicable;
- managerial, i.e. a clearly defined harbour board, commensurate with the size of the proposed project and the responsibilities expected of it; and
- legal and administrative, i.e. frameworks formulated in conformity with national laws to provide for sanctions in respect of violations.

4.1.4 Detail required and at what stages in the design

All studies connected with port projects are costly as they require the use of vessels and specialized engineering and diving equipment. It is an established fact that the detail required at each phase of the project increases as the final design stage is approached. Table 1 illustrates the increase in detail and the associated rise in costs as the final design stage is reached for typical hydrographic or bathymetric requirements for a port project.

Whereas a project may fail to get past the preliminary stage, once it reaches the final stage it is very likely that it will be constructed; hence, the cost of the bathymetric survey then becomes part of the design cost. The outline and preliminary costs are considered as unreimbursable investigative costs. Likewise for other studies, such as topographic surveys, geological surveys, geotechnical studies, benthic studies, water quality studies, etc.

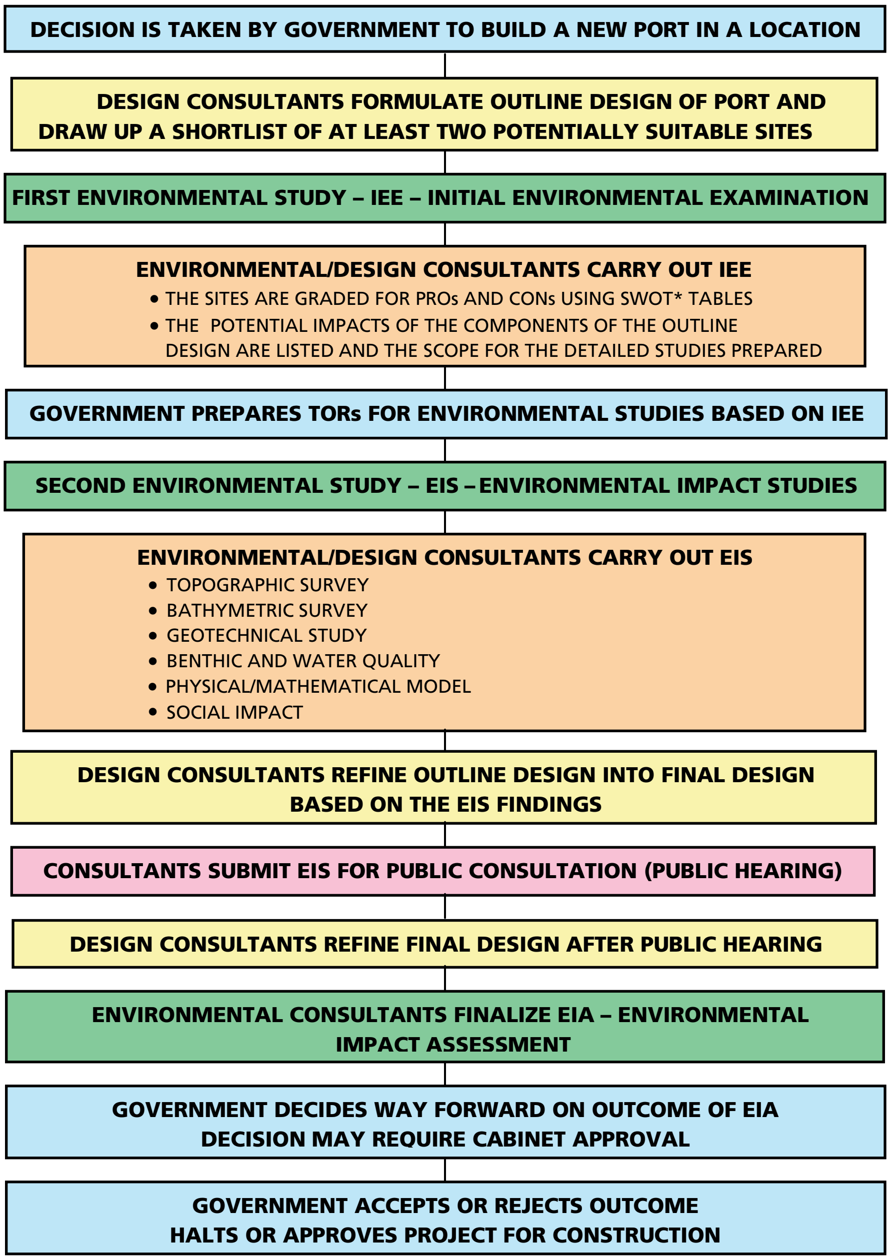
TABLE 1
Typical bathymetric requirements

Phase of project	Outline	Preliminary	Final
Phase of studies	Formulation	IEE	EIS/EIA
Standard required	Navigation chart in largest scale available	Spot soundings by handline from fishing boat	Full wide-area bathymetric survey with echosounder
Typical cost (2009) not including consultant fees	US$100	US$1 000	US$50 000

4.1.5 Procedures for environmental studies

FIGURE 1

Standard procedure for environmental studies



*Stands for strengths, weaknesses, opportunities, threats.

4.2 BIBLIOGRAPHY AND FURTHER READING

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APPENDIX 1: CASE STUDY

Given situation

At a small fishing village where fishing vessels are presently beached along a stretch of clean coastline and sewage from houses filters into the shoreline at various points ensuring that pollution concentration levels are low, construction of a new timber jetty is proposed and when it is built it is envisaged that a boat-repair slipway will be built together with a wet market and other shops selling food. It is envisaged that the jetty will also attract vessels from neighbouring villages to discharge fish there and service the vessels.

Possible consequences of constructing the jetty

The jetty *per se* is a simple structure and apart from the fact that timber used for its construction should be from plantation sources and not from virgin forests, it has little or no influence on the surrounding environment. The jetty, however, also acts as a magnet for other types of development which, when taken as a whole, can inflict great damage on the environment if not planned and then managed properly. Invariably, workshops, dwellings and businesses start growing up around the jetty and the once tranquil village may start to suffer from:

- increased pollution (oil) from the boat engines in the area of the jetty;
- increased road traffic, parking requirements and accidents near the jetty;
- water shortages if copious amounts of clean freshwater are diverted to the wet market;
- increased activity around the jetty will increase the amount of sewage discharged on the beach;
- a large volume of fuel for the vessels would then be required, requiring road tankers to move the fuel and increasing the risk of spillage;
- increased noise levels from cars trapped in traffic jams and generators running at all times of the day and night;
- increased pollution from works on the slipway;
- overcrowding;
- damage to existing road network from heavy vehicles, trucks, fuel tankers; and
- increased risk of drinking water pollution if supply is from groundwater.

Pretty soon, the once tranquil village would be turned into a chaotic, smelly and noisy environment, with polluted beaches and traffic jams (especially around the wet market area) and polluted air from smoke-belching vehicles, etc. This is exactly the scenario an environmental audit is meant to identify before the damage is done.

In the valuation of coastal resources, the planner should take into account all elements of value, not just those elements for which a ready market happens to exist and to which a financial figure may be attached. The fact that a resource is not traded in a market does not mean it is of no value. The health implications of fresh air cannot be ignored if a once tranquil village is turned into a busy fish marketing centre with fume-belching trucks constantly plying up and down the main street because a bypass was considered too expensive at the design stage.

- Could the market have been placed somewhere else?
- Why is the electric generator so close to houses?
- Why is the smoke-stack so short that smoke and soot engulf inhabited areas?

The social benefits of a clean beach (weekend family walkabout and permanent playing ground for children) should not be ignored if a wet market is proposed to be built nearby; rotten fish and sewage from such places invariably end up on the beach rendering it unfit for human use. Therefore, why:

- are the effluents not treated or removed for disposal; and
- is there no outfall to discharge sewage away from the waterline.

The ecological (and sometimes tourist) importance of intact coral reefs or mangroves (which provide coastal stability against storms and support mangrove fisheries) should be borne in mind when deciding on a location for a new coastal structure thus raising the questions as to:

- was road access to an alternative, less-sensitive site considered first before the mangrove was knocked down;
- could the port have been sited opposite a natural break in the coral reef; and
- could the structure have been designed in piles to save on coral rock fill.

Furthermore, tranquillity (absence of noise) should never be ignored when deciding on the location of new roads, generators or pumps, for example:

- generators can be sound-proofed;
- a water pump can be run on electric power instead of a noisy diesel engine; and
- a generator can be moved away from dwellings.

Invariably, both the design and the construction of a project become more expensive to implement and it is up to the port planner (in conjunction with local authorities) to decide "how green" a project should be.