Environmental Impact Assessment Ordinance, Cap.499
Guidance Note

Methodologies for Marine Ecological Baseline Surveys

(This guidance note supersedes EIAO Guidance Note No. 11/2010 with immediate effect)

Important Note :

The guidance note is intended for general reference only. You are advised to refer to and follow the requirements in the Environmental Impact Assessment Ordinance (Cap 499) and the Technical Memorandum on Environmental Impact Assessment (EIA) Process. Each case has to be considered on individual merits. This guidance note serves to provide some good practices on EIA and was developed in consultation with the EIA Ordinance Users Liaison Groups and the Advisory Council on the Environment. This guidance note may be subject to revision without prior notice. You are advised to make reference to the guidance note current to the date. Any enquiry on this guidance note should be directed to the EIA Ordinance Register Office of EPD on 27th Floor, Southorn Centre, 130 Hennessy Road, Wan Chai, Hong Kong. (Telephone: 2835-1835, Faxline: 2147-0894), or through the EIA Ordinance web site (www.epd.gov.hk /eia/)

1. Purpose

Further to the *EIAO Guidance Note No. 10/2023: Methodologies for Terrestrial and Freshwater Ecological Baseline Surveys*, this guidance note (GN) aims at introducing some general methodologies for marine ecological baseline surveys. It should be noted that the purpose of this GN is not intended to provide detailed prescriptions of recommended methods. Instead, it provides the general concepts and considerations for various standard survey methods normally applied in ecological impact assessments studies and the methods described below are by no means exhaustive. It is acknowledged that each method has its own merits and limitations and the environmental consultant responsible for the surveys should choose the most suitable one on a case-by-case basis using his/her professional judgement. Typical methods of marine ecological baseline survey and adopted by some previous EIA examples are presented in Section 2 to Section 4 below, and summarized in the Appendix. This GN should be read in conjunction with EIAO Guidance Note No. 7/2023: *Ecological Baseline Survey for Ecological Assessment*, which provides general guidelines for conducting an ecological baseline survey.

2. Intertidal Habitats

The distribution and abundance of intertidal shore communities (i.e., rocky, sandy and muddy shores) are commonly surveyed using the transect method. Quantitative information such as species richness and diversity, abundance and density can be obtained from the transect method. The number of transects and replicates of quadrat and core sampling will depend on the objectives of the survey study. Reference should be made to previous studies on the number of samples to be taken as the number of samples can be site-specific.

In addition to the above-mentioned, suitable qualitative surveys are useful to facilitate the smooth implementation of the quantitative surveys and help to audit the survey findings. For example, undertaking an initial observation along the shore could find out the species present and their occurrence and hence facilitate the determination of representative sites for conducting the

quantitative surveys. Also, a walk-through / active-search survey along the transect during or after a quantitative sampling could help to assess whether the sampling exercise has collected representative data (e.g. the number and type of species encountered) and whether the sampling effort is deemed adequate.

Factors, such as the weather, season and exposure of the shore will affect the distribution and abundance of intertidal organisms and hence timing of the survey is important. In general, it is desirable to carry out the survey during suitable ebbing tides. For assessing rocky shores it is important to also assess the profile (e.g. presence of rock pools) of the shore and other important abiotic factors (e.g., exposure, season etc). When comparisons are required between the same type of shores, standard reference tidal levels should also be recorded (e.g. metre (m) above Chart Datum).

2.1 Line Transect

The line transect is one method to assess the distribution and abundance of flora and fauna along the shore. Transect lines are set up seaward and perpendicular to the shore (on a representative site). At regular intervals along the line transect, quadrats are placed on the shore. All flora and fauna found within the quadrat are identified and counted. For sessile organisms, the percentage cover within the quadrat can be estimated.

For sandy and muddy shores, animals living within the sediment are also collected and the core sampling method is used. Cores are pushed into the sediment and then lifted out. Fauna within the sediment are assessed for species diversity, abundance and density, after screening with sieves of suitable size.

2.2 Belt Transect

The belt transect method involves surveying a contiguous area along a line transect. It may be considered as a widening of the line transect or a continuous line of quadrats. As with the line transect, information of fauna and flora identified within the belt is recorded. Core sampling on soft shores can also be conducted along the belt transect.

3. Sub-tidal Habitats

Suitable methodology is required for assessing the nature of the seabed substrate, the species composition, their percentage cover and abundance in the surveyed area.

3.1 Soft-bottom Benthos

Grab Sampling

Sampling for benthos is undertaken from boats, and equipment such as grabs are commonly used. The choice and design of the grab contribute to its efficiency in collecting benthic samples at different excavated depths and, in minimising disturbance of the sediment surface which would result in a loss of surface fauna. Benthic samples are sieved, generally onboard the boat, to separate the fauna from the sediment for subsequent sorting and analysis in the laboratory. The number of replicate samples to be taken at each sampling station is a

compromise between the best possible representation of species and the time required to collect and process the samples within the availability of sea time and study duration.

3.2 Hard-bottom Communities: Coral Assemblages and Associated Species

There are several methods available to quantify coral cover and associated species, for example, fishes, invertebrates and macroalgae, and to estimate their abundance and diversity in a systematic and repeatable fashion. Identification of the location and composition of local coral communities should be carried out as the first step to any ecological baseline survey, especially in areas where no prior information has been gathered. Transect lines are employed as a direct measure of coral cover and associated species or as a guide when using quadrats or video techniques. Transects are typically laid parallel to the shore in pre-determined depth zones which correlate with changes in the composition of the hard-bottom community. Sufficient replication is required for both individual transects and identified zones to assess how representative the data are and the natural variation of the community surveyed.

3.2.1 Qualitative Reconnaissance (spot-check) Dives

Prior to conducting a detailed survey of an area, initial 'spot-check' dives are commonly conducted within the identified survey area to identify locations of coral communities (including hard corals, octocorals and black corals) and their composition. In general, it is desirable that spot-check dives should cover the whole project area and its immediate vicinity. Flora and fauna associated with coral communities within the survey area, for example, fishes, invertebrates and macroalgae should also be recorded.

3.2.2 Semi-quantitative Surveys

Rapid Ecological Assessment (REA)

Rapid Ecological Assessment involves 'semi-quantitative' swim-surveys allowing for assessment and classification of survey areas. The field data are collected by divers experienced in the underwater identification of sessile benthic taxa, swimming down-current along coral communities or identified sections of coastline on SCUBA from haphazardly-chosen starting points. The number of transects to be laid and the placement of each transect should be based on site environment and findings from the initial "spot-check" dives. A minimum of two belt transects (1 m wide (on each side of the transect) x 100 m long) should be surveyed at each site. REA surveys provide information on the assessment of relative cover of coral and other major sessile benthic groups, as well as an inventory of sessile benthic taxa used to define community types.

3.2.3 Quantitative Surveys

(a) *Line Intercept Transect Method*

The Line Intercept Transect is one method used to assess the sessile benthic

community of coral reefs. The community is characterized using life form categories, which provide a morphological description of reef community. These categories are recorded on data sheet by divers who swim along lines, which are placed roughly parallel to the reef crest (if present) at depths of 3 ms and 10 m at each site, dependent on the extent of reef development. It is a reliable and efficient sampling method for obtaining quantitative percentage cover data.

(b) *Belt Transects – Quadrat or Photo-quadrat*

Quantitative assessment of coral cover and associated species can be carried out with the use of frame quadrats laid along transects. Survey work can be carried out *in situ* with the surveyor recording percentage cover of coral species and associated species within each quadrat or photographs of each quadrat can be taken and analyzed at a later time. These methods are commonly conducted along permanently marked transects and most useful for assessing demographic questions relating to population dynamics (e.g. growth, mortality) and temporal change. When carrying out photo-quadrat surveys a special quadrat frame with an underwater camera attached at a fixed height is used to take photographs of contiguous quadrats along transect lines. The photographic images provide a permanent record of change in coral cover and associated species of the surveyed sites.

(c) *Underwater Video Transect Method*

Underwater video sampling provides highly precise quantitative estimate of coral cover and abundance of associated species. The video technique in combination with independent sampling, i.e., no need to establish permanent transects, has proven to be a statistically powerful methodology for comparison of univariate and multivariate parameters in repeat surveys of identified sites of moderate – high coral cover (normally >20 %). This method involves the recording of standardized belt transects using a number of replicate transects of pre-determined length and filmed from a standardized height (approx. 40 cm). Video footage is subsequently analyzed to extract quantitative data on coral and other associated species using a point sampling method.

4. Cetaceans

Cetaceans commonly sighted in local waters are the Finless Porpoise and the Indo-Pacific humpback dolphin (locally known as the Chinese White Dolphin). Quantitative estimates of the population size of these marine mammals can be determined based on visual observations however, the sighting efficiency for the animals depends on a number of factors, such as weather and the species being surveyed. The frequently used survey methods for estimating the abundance and distribution of cetaceans are systematic line transect surveys and photo-identification. For study of fine-scale behaviour and movement patterns, a land-based theodolite tracking survey should be carried out at a land location with appropriate height and distance from the sea area of interest. In addition to visual method, acoustic signals and associated activity levels of vocalizing cetaceans

(including dolphins and porpoises) can be investigated using Passive Acoustic Monitoring (PAM). PAM employs suitable underwater acoustic devices which can effectively detect and classify acoustic signals of dolphins and porpoises. The continuous and extended operational time (weeks to months) of PAM devices allow analyses of cetacean activities at various spatiotemporal resolutions (diel, daily, monthly and/or seasonal, etc.)

4.1 Line Transect Survey

The line transect survey requires a minimum of 2 persons (but preferably 3 persons for rotation of duty to minimise fatigue) on a boat following a fixed route (i.e. transects) in a survey area. Along the transect, one observer searches for the animal continuously through binocular, while the other observer searches with unaided eye and records the time, position of the boat and current climate etc. Once cetaceans have been sighted, information such as the time, group size and perpendicular distance between the vessel and the animals are recorded. Data collected from boat surveys are analyzed to estimate the density and abundance of the observed cetaceans in the surveyed area, using specialized computer programme such as DISTANCE.

Aerial (helicopter) surveys are conducted similar to boat surveys in the area which is difficult to be covered by boat. An additional observer may be required to follow the transect line directly below the helicopter.

4.2 Photo-identification

Photographs are taken on the unique features (such as nicks, scars and distinctive colour patterns) of a sighted cetacean for identification. For Chinese White Dolphin, the animal can be identified from the unique features on its back and dorsal fin, whereas for the finless porpoise, photo-identification may not be practical. Information obtained from such technique provides information on the home range of an individual and contributes to assessing the population size of the species in the area/region.

4.3 Land-based Theodolite Tracking

Land-based theodolite tracking survey obtains fine-scale information on the time of day and movement patterns of dolphins. A digital theodolite with 30-power magnification and 5-s precision was used to obtain the vertical and horizontal angle of each dolphin and vessel position. Angles were converted to geographic coordinates (latitude and longitude). This method delivers precise positions of multiple spatially distant targets in a short period of time. The technique is fully non-invasive, and allows for time and cost-effective descriptions of dolphin habitat use patterns at all times of daylight.

4.4 Underwater Passive Acoustic Monitoring (PAM)

Passive Acoustic Monitoring (PAM) is carried out using suitable static acoustic devices (click detectors/sound recorders) which can effectively detect acoustic signals emitted by the target cetaceans. The deployment locations of the acoustic devices should be carefully planned to collect representative acoustic data of the study area as far as possible. The acoustic devices should be securely attached to firm underwater structures and operate at the recommended height above the seafloor. Operation of the acoustic devices should be

either continuous or in duty cycle without compromising the data resolution. Following retrieval of raw data, processing and verification of acoustic data are performed to screen and confirm positive detections. Quantitative analysis is then carried out to compare positive detections per unit effort among spatial and/or temporal samples.

Agriculture, Fisheries and Conservation Department
in conjunction with Environmental Protection Department

Date of Issue : December 2023

Appendix

Typical methods of marine ecological baseline survey and adopted by some previous EIA examples

Type of habitats	Survey methodology	Reference paragraphs in GN No.7/2023	EIA examples (EIA No.)
Intertidal Habitat	Line Transect	2.1	• Sai O Trunk Sewer Sewage Pumping Station (AEIAR-230/2021) • Hong Kong Offshore LNG Terminal (AEIAR-218/2018)
	Belt Transect	2.2	• Pier Improvement at Tung Ping Chau (AEIAR-226/2020) • Pier Improvement at Lai Chi Wo (AEIAR-225/2020)
Sub-tidal Habitats (Soft-bottom Benthos)	Grab Sampling	3.1	• Sai O Trunk Sewer Sewage Pumping Station (AEIAR-230/2021) • Pier Improvement at Tung Ping Chau (AEIAR-226/2020)
Sub-tidal Habitats (Hard-bottom Communities: Coral Assemblages and Associated Species)	Qualitative Reconnaissance (spot-check) Dives	3.2.1	• Sai O Trunk Sewer Sewage Pumping Station (AEIAR-230/2021) • Pier Improvement at Tung Ping Chau (AEIAR-226/2020)
	Semi-quantitative Surveys (i.e. Rapid Ecological Assessment (REA))	3.2.2	• Sai O Trunk Sewer Sewage Pumping Station (AEIAR-230/2021) • Pier Improvement at Tung Ping Chau (AEIAR-226/2020)
	Quantitative Surveys - Line Intercept Transect Method	3.2.3(a)	• Sai O Trunk Sewer Sewage Pumping Station (AEIAR-230/2021)
	Quantitative Surveys - Belt Transects – Quadrat or Photo-quadrat	3.2.3(b)	• Rarely used
	Quantitative Surveys - Underwater Video Transect Method	3.2.3(c)	• Peng Chau Sewage Treatment Works Upgrade (AEIAR-079/2004)

Type of habitats	Survey methodology	Reference paragraphs in GN No.7/2023	EIA examples (EIA No.)
			• Feasibility Study for Housing Development at Whitehead & Lee On in Ma On Shan, Shan Tin (AEIAR-068/2002)
Cetaceans	Line Transect Survey	4.1	• Hong Kong Offshore LNG Terminal (AEIAR-256/2018) • Expansion of Hong Kong International Airport into a Three-Runway System (AEIAR-223/2014)
	Photo-identification	4.2	• Rarely used
	Land-based Theodolite Tracking	4.3	• Expansion of Hong Kong International Airport into a Three-Runway System (AEIAR-223/2014)
	Underwater Passive Acoustic Monitoring (PAM)	4.4	• Hong Kong Offshore LNG Terminal (AEIAR-256/2018) • Expansion of Hong Kong International Airport into a Three-Runway System (AEIAR-223/2014)